Draft Energy White Paper

Strengthening the foundations for Australia's energy future

DECEMBER 2011

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Foreword

The Australian energy sector that underpins our modern economy and way of life is undergoing a fundamental transformation as we move into the second decade of the 21st century. This will bring new opportunities but also some very real challenges.

Much has changed in the seven years since the 2004 release of the last Australian Government Energy White Paper and it is timely to now release this draft Energy White Paper, *Strengthening the foundations for Australia's energy future,* for public consultation. It provides a review of Australia's future energy needs to 2030 and defines a policy framework to guide the further development of Australia's energy sector. It identifies four priority areas for future action and outlines a set of initiatives to progress this agenda.

Resource development is important to meet domestic supply and in our role as a leading energy exporter to our region. Our energy exports have expanded considerably since 2004 and this growth trend looks set to continue with over $140 billion in capital expenditure having been committed since 2007 on major new LNG projects that will quadruple Australia's LNG exports and put us on a par with Qatar as one of the world's largest LNG exporters. This investment reflects Australia's natural resource base, our attractiveness as an investment destination and the importance of gas as a flexible fuel.

Our role as an energy exporter can be further strengthened through the safe and sustainable development of our energy resources, creating jobs and wealth. Yet, we cannot become complacent and we need to maintain our international competitiveness and attractiveness as an investment destination while operating at best practice; this requires community engagement and proper environmental regulation, management of competing pressures that arise from multiple resource use, and investment in education and skills alongside balanced skilled migration.

Alongside growth in energy demand from our trading partners, our domestic energy systems are also expanding and changing. Australia will require significant new investment across the energy supply chain in order to reliably meet the growing demand for energy while also transitioning to cleaner energy sources. Investment of around $240 billion could be required by 2030. While this is achievable, it will test our markets and our policy frameworks. It is therefore important that energy policy is regularly assessed, and revised if necessary, to help ensure that investment outcomes will be delivered.

The magnitude of required investment means that current energy cost pressures are likely to continue for some time. Governments have a responsibility to ensure that energy policy frameworks are as efficient and effective as possible and that markets are operating in the long-term interests of consumers. While good progress has been made in reforming our energy markets over recent years, there is a need for all governments to step up their efforts to address the more challenging energy market reforms that have the potential to unlock further competition and innovation, to the benefit of consumers.

Australia will soon have a carbon pricing mechanism in operation that will help drive the transformation to cleaner energy sources. The draft Energy White Paper recognises the important role of gas as a transition fuel, and the need for a stable and transparent policy framework to support the transition to lower-emissions forms of technology. Ultimately, it is a technology's ability to operate commercially and provide reliable and low-cost energy that will determine its success. A coordinated global effort from government, business and the research community is therefore required to accelerate the commercialisation of new technologies and processes.

I encourage you to engage in the consultation process that will lead to the finalisation of the Energy White Paper next year.

The Hon Martin Ferguson AM MP
Minister for Resources and Energy
Minister for Tourism
December 2011

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Executive summary

1 Overview

Energy is fundamental to our modern economy and society, and access to secure, reliable and competitively priced energy has been a cornerstone of Australia's economic and social development. In this context, it is critical that energy policy continues to strike an appropriate balance in delivering energy security, facilitating economic development and meeting clean energy goals.

Australia is a large continent with a small population and an open economy, and ensuring that our energy markets deliver efficiency to minimise costs for consumers while also providing a commercially attractive environment for investment remains the core challenge. This required investment – much of which will be sourced from foreign capital – is necessary to deliver energy security and provide the technological transformation we expect to see in the energy sector in the decades ahead.

A lot has changed in Australia and globally since the last Energy White Paper was released in 2004 and energy policy and energy supply strategy and management has never been more complicated. Continued strong growth in Asian economies has seen the value of our annual energy exports rise from $24 billion to around $69 billion. We have undertaken further key reforms in our domestic energy markets and have now legislated a carbon pricing mechanism that will drive a long-term transformation to cleaner sources of energy. Technological advances and strong international gas prices have unlocked major new coal seam gas reserves on Australia's east coast and new offshore gas developments in Western Australia – this has broadened our energy possibilities and will significantly alter our east coast gas and electricity markets.

In recent years Australia has entered a new phase of investment in its energy supply sector as we expand and replace our current energy infrastructure – particularly our ageing electricity networks – largely to meet reliability standards and support growing peak demand. This has seen energy prices rise, with retail electricity price increases of 40 per cent in the last three years – and further sustained increases are likely for the rest of this decade.

The outlook for Australia's energy security to 2030 is considered to be generally robust and positive. However, there are possible risks and the energy sector faces an unprecedented set of challenges.

The need for new investment and rising costs of production mean that the era of cheap energy is over, and energy policy must be mindful of the impact that this will have on consumers, both residential and commercial – and particularly vulnerable consumers.

However, governments cannot artificially hold energy costs below costs of supply. If we are to maintain investment and promote the efficient use of energy, then prices must reflect the cost of supply in a competitive market. Interventions to manipulate or suppress efficient pricing outcomes will have detrimental investment and supply consequences that are not in the long-term interests of consumers. Our markets and energy policies must ensure efficiency so that we achieve our investment and transformation requirements at minimal cost to consumers.

Large-scale investment must be delivered to meet the growing demand for energy – particularly peak electricity demand – while at the same time seeking to achieve reductions in our greenhouse gas emissions and improve energy productivity. This must be done in a way that supports continued national competitiveness, economic growth and the aspirations of the Australian people.

Over the next two decades, we expect to see significant growth in gas-fired electricity generation in response to carbon pricing signals along with a continued expansion in wind energy and other renewable energy technologies as they become increasingly commercially viable.

Demand for petroleum fuels will continue to be strong, although this will be increasingly met by a growing level of imported product through well-established and proven supply chains. Australian refineries will face continued pressure from international competitors and there may be further reductions in Australia's domestic refining capacity.

The introduction of a carbon price along with complementary measures to address non-market barriers will also further drive the uptake of economically sensible energy efficiency opportunities. Industry and commercial operations account for 83 per cent of Australia's total energy use and households make up the remaining 17 per cent.[1] This is important when thinking about where the opportunities are to improve energy efficiency. The Australian Government's Energy Efficiency Opportunities program has made significant gains in industrial energy efficiency outcomes.

Achieving our clean energy ambitions will require the global community to successfully develop, adapt, commercialise and deploy new technologies and processes across a range of energy applications. This will include not just energy generation but also transport, energy storage, grid management, building design and more efficient end-use technologies.

For Australia the scale of investment required to deliver these goals is very large – it has been estimated that as much as $240 billion might be needed by 2030 in the domestic electricity and gas sectors alone[2] – and this will place further sustained pressure on energy prices.

The timing of this new investment in energy, combined with the introduction of carbon pricing and the strong demand for energy in rapidly expanding Asia–Pacific markets, presents Australia with a unique window of opportunity to lock in a stronger and more efficient foundation for our long-term energy future.

The Australian Government continues to support the fundamental role of the market in delivering our energy future. In this context, all levels of government must seize the opportunity to set a clearer path for better-functioning energy markets by addressing a set of critical reform issues. These include:

- privatising government-owned energy assets – continued government ownership of energy businesses is impeding greater competition and efficiency, and reduces market confidence by creating uncertainty and risk for private sector investors
- fully deregulating retail energy prices where effective competition exists – this is an important reform that is needed to further stimulate business innovation and improve customer outcomes and empowerment, recognising that social policy frameworks are the most appropriate mechanism to support vulnerable consumers
- implementing an improved energy productivity (demand side) framework (including ensuring that investment incentives are appropriate) to efficiently reduce peak-demand growth and provide an enhanced set of options for consumers to better manage their energy use and costs

[1] Department of Resources, Energy and Tourism, *Continuing opportunities: Energy Efficiency Opportunities (EEO) program – 2010 report,* RET, Canberra, 2011.

[2] Investment Reference Group, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, 2011.

- completing the transition to truly national energy markets – more work can be undertaken to extend the national energy market governance arrangements and principles to cover all Australian electricity and gas markets
- further gas market monitoring to better inform government decision-making, and continued consideration of policy settings to ensure that objectives are being delivered, given the growing importance of gas in our energy future – particularly as a result of the increasing use of gas for electricity generation and the increasing impact that developments in gas and electricity markets can have on each other
- reviewing the current set of non-complementary policy interventions from all levels of government that were made in the absence of a carbon price which are adding unnecessary costs to energy bills and creating investment-distorting complexities in energy markets, and further agreeing not to introduce new measures that are non-complementary.

In addition to addressing market reform issues, governments collectively also need to:

- actively monitor energy policy settings on a predictable timetable and refine them as necessary to ensure that our frameworks are delivering necessary efficient investment and meeting the demands and requirements of the community
- ensure that our energy resources are developed in accordance with best practice, including safe and effective environmental conditions and local community engagement
- actively work with industry and the skills and education sectors to develop the necessary skilled workforce and infrastructure to meet Australia's future energy needs and export opportunities
- continue to actively work with industry and the research community given the critical role technology will have in the transformation of our energy sector – which necessarily involves public and private collaboration domestically and internationally to achieve the technological breakthroughs required to meet our goals. The government, through its publicly funded activities, can play an important role in deepening our understanding around new technologies and in promoting the sharing of non-proprietary knowledge
- promote the deepening of knowledge and understanding of our energy resource base, energy resource sector developments and technology developments to improve policy-making and leverage private sector activity.

Energy policy is never finished or complete and it is necessary to periodically assess and refine policy to ensure that it remains appropriate in changing circumstances. As we further enter a period of transition, we must be prepared to respond if outcomes are not being realised as intended. Ensuring that our markets and settings are resilient and robust to both foreseeable and unforeseeable events is an important role for government, and establishing a predictable timeline for delivering future reviews of national energy policy strategy and national energy security is important in this respect.

If Australia is to cement its role as the leading exporter of energy and energy services in our region, as well as further develop our domestic energy systems, we must also demonstrate that we can safely and sustainably exploit our conventional and unconventional energy resources. There is a growing need to build further community support, understanding and engagement around critical energy sources such as coal seam gas and geothermal as well as build support and understanding of important technologies, including carbon capture and storage.

Finally, Australia must have a mature debate about our energy sector and implications of different decisions. This means there must be a deeper community engagement in energy policy issues and outcomes. This includes ensuring that consumers have appropriate understanding and awareness of energy issues (energy literacy) to empower them to engage and participate in energy markets. Making more information accessible to households and businesses on the nature of energy costs and the options that exist to manage these costs is a critical component in improving energy use productivity. Again, building community support for new technologies and energy sources is fundamental if we are to develop the options we need to meet our climate change and energy security objectives.

2 A policy framework for the future

The draft Energy White Paper provides a review of Australia's future energy needs to 2030 (and in some cases beyond) and defines a comprehensive strategic policy framework to guide the further development of Australia's energy sector.

In doing so it consciously builds on the success of past energy-related policies and forms a key part of the Australian Government's national productivity agenda. It also integrates and complements many of the elements in the government's Clean Energy Future package.

The draft Energy White Paper policy framework is based on the following core energy objective: to build a secure, resilient and efficient energy system[3] that:

- provides accessible, reliable and competitively priced energy for all Australians
- enhances Australia's domestic and export growth potential
- delivers clean and sustainable energy.[4]

This executive summary outlines the major forces shaping Australia's energy future, the current context in which energy policy is developed and the key challenges that can be expected over the coming decades. The final section provides greater detail on the four identified priority areas that the government believes will strengthen Australia's ability to fully realise its future energy potential. These priority areas are:

- strengthening the resilience of Australia's energy policy framework
- reinvigorating the energy market reform agenda (markets and energy productivity)
- developing Australia's critical energy resources – particularly Australia's gas resources
- accelerating clean energy outcomes.

[3] For the purposes of the draft Energy White Paper, the term 'energy system' is defined inclusively to encompass the production, supply and use of energy as well as associated services.

[4] The term 'clean and sustainable energy' refers to sources of energy, technologies or processes that produce lower or zero greenhouse gas emissions relative to conventional counterparts and that meet appropriate social, environmental, health and safety standards.

3 The forces that shape our energy future

It is well recognised that the coming decades present enormous energy opportunities and also very genuine challenges for Australia’s energy sector.

As the world’s ninth-largest energy producer, Australia has abundant renewable and non-renewable energy resources, and both our current energy security situation and our future outlook are robust and positive.

At current rates of depletion, Australia has many decades worth of known gas and uranium reserves, and at least a century of coal. Our remaining oil reserves are more limited but could be supplemented through new discoveries and technological advances including enhanced extraction techniques or coal-to-liquids or gas-to-liquids. In the decades to come we need clean energy technology breakthroughs to allow us to commercially exploit our clean energy resources in the form of wind, solar, ocean and geothermal energy, along with carbon capture and storage technologies.

The Bureau of Resources and Energy Economics projects that Australia’s energy production will more than double – primarily due to strong export demand – over the period to 2035, while primary energy consumption will rise by 30 per cent and electricity generation by almost 42 per cent over the same period.[5]

While Australia’s production of energy and energy resources is booming, the continuing challenges of rising energy prices along with finding cost-effective ways for Australia to reduce its greenhouse gas emissions are confronting consumers, energy providers and governments alike. Society is also placing increasing demands on the energy system through an expanding economy coupled with rising wealth and demand for energy-consuming appliances. These factors combined create a set of policy challenges that will test our markets and energy systems in the coming decades.

Growing energy demand in our region will provide even greater opportunity

The world’s population has now reached seven billion and the energy requirements of larger industrialising and more urbanised populations will continue to drive strong growth in energy demand. By 2035 the International Energy Agency projects that global energy demand will grow by around 40 per cent – and 90 per cent of this growth will occur in developing economies, particularly China and India.[6]

Australia is well placed to export into these markets, given our expanding energy and resources sector and proximity to Asia. Australia is currently the world’s largest coal exporter, third-largest uranium producer and in future years will be the world’s second-largest liquefied natural gas (LNG) exporter, and these exports will continue to support improved living standards for billions of people in our region.

Australian coal production is expected to continue its strong growth over the course of the decade and beyond. This will largely be to meet export opportunities in our region.

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[5] BREE, *Australian energy projections 2034–35*, BREE, Canberra, 2011.

[6] International Energy Agency, *World energy outlook 2011*, IEA, Paris,2011.

The prospects for the Australian uranium industry are also positive, with the Bureau of Resources and Energy Economics forecasting average annual output growth of around 4 per cent to 2035.[7] This reflects the continued expansion of nuclear power in rapidly developing economies. The opening of new markets in Russia, the United Arab Emirates and potentially India will further add to these prospects.

The need to improve long-term energy security in many countries, along with the need to reduce greenhouse gas emissions, is mobilising a major global effort to expand and diversify the energy mix through greater clean energy technology development and deployment – the possibilities of which stand to fundamentally change the way the world generates and uses energy in the future.

In this context, gas will be a growing source of energy both domestically and internationally.

Australia's unconventional gas resources bring the promise of extensive economic opportunities for both regional areas and Australia collectively. To facilitate this development, concerns held in some parts of the community about the industry's development need to be addressed through sound and consistent regulation based on scientific data and community engagement. The development of these resources will have major implications for Australia's east coast gas market, and the east coast gas market outcomes will be an important 'swing factor' in determining electricity generation investment outcomes.

The Australian Government's recent decision to establish a new Independent Expert Scientific Committee (and associated new National Partnership Agreement) to provide scientific advice to governments on coal seam gas and large coal mining projects that have a significant impact on water, are important steps in seeking to address community concerns.

Market-based approaches are critical to future success

The Australian Government is committed to delivering Australia's energy needs and goals through competitive and well-regulated markets. Australia has been well served by two decades of continuous micro-economic reform in key energy markets.

Energy markets, working in tandem with interfacing markets, such as carbon, renewable energy certificates, water and importantly financial markets, are unarguably best placed to produce sustainable, reliable and least-cost energy solutions.

A market-based approach provides a flexible and robust framework that is capable of adjustment in response to rapidly changing market or technology circumstances.

A period of transition

Australia's energy markets are entering a period of major transition. The introduction of carbon pricing reforms, the emergence of new energy sources and technologies, and growing linkages between domestic and international energy markets, particularly in the case of gas and coal, will lead to the emergence of new dynamics and competitive forces. End-use demand patterns are also changing with changes in economic structure and lifestyle.

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[7] BREE, *Australian energy projections to 2034–35*.

Already we are seeing energy prices increase, and new business models will emerge along with new market opportunities. Retailers and industry more generally – along with government – have an important role to play in educating consumers and offering innovative products to help meet consumer needs – particularly if demand-side products can be offered to help reduce peak load. Australia's electricity generation fleet will respond to these changing market conditions and diversify. While conventional coal-fired electricity accounts for 75 per cent of generation today and gas around 15 per cent, by the middle of the century this balance is projected to change significantly and gas could expand to up to 44 per cent. By 2050 – assuming technological breakthroughs – most of Australia's conventional coal-fired power generation could have been replaced.[8] Carbon capture and storage for coal- and gas-fired generation, like other potential baseload technologies such as geothermal and large-scale solar, could play a major role in our long-term energy mix.

The pace and nature of this transformation will be determined through the interaction of carbon and energy prices in the market, with commercial outcomes driven by the ability of emerging technologies to establish reliability and cost-competitiveness. Ultimately, the most commercially reliable and least-cost technologies will succeed.

The need for an informed debate

Australia must have a mature and informed ongoing public dialogue on its energy future.

As a society we face potentially difficult choices in the years to come about the pace of effort we wish to sustain and the price we are willing to pay – particularly in driving the transition to clean energy and reducing our greenhouse gas emissions.

This dialogue should also include a continued and informed consideration of the technology and energy options we use to meet our energy and environmental goals, and the trade-offs and costs involved with each.

Recent analysis by the International Energy Agency (IEA) estimated that around 80 per cent of the world's allowable carbon dioxide emissions budget under a 450 parts per million (or 2°C global warming) scenario is already locked in through existing capital stock (such as power plants, factories and buildings). The IEA emphasises that solutions must be found from a portfolio of technologies and fuels, and that the world cannot afford to limit options if we are to meet increasingly urgent climate goals.[9]

Similarly, much of Australia's energy infrastructure is locked in and will only be transformed over time, but we are fortunate in having gas, carbon capture and storage, and renewable options to aid us in the transition to a cleaner future. All credible analysis supports the need for a portfolio approach drawing on the most effective options across the economy. Suggestions that Australia should aggressively move exclusively to one or two renewable energy technologies to supply its energy are neither feasible nor realistic.

It is a fact that the more we limit our options, the higher will be the cost and the risks of meeting our clean energy and emissions reduction goals.

[8] Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011; ABARES, *Australian energy statistics*, ABARES, Canberra, 2011.
[9] International Energy Agency, *World energy outlook 2011*.

Research, demonstration and deployment of commercial-scale geothermal energy, solar power and carbon capture and storage are being supported by government, and commercialising these technologies will require significant investment from industry – both in Australia and other countries. If these efforts do not prove successful, Australia may need to consider other options that can deliver safe and cost-effective outcomes. Given the lead times for introducing new large-scale technologies, such decision points may be needed by later this decade or in the early 2020s.

Dialogue about Australia's energy future will be informed by science and economic analysis to build a stronger social consensus about the directions we wish to take and tools we adopt to get there. This will underpin longer-lasting outcomes and promote investor and consumer confidence in future social and policy direction.

4 Australian energy policy in context

The context in which energy policy is developed and implemented continues to evolve, and much has happened domestically and internationally since the last Energy White Paper was released in 2004. The energy policy framework outlined in this draft Energy White Paper responds to these changes to ensure that Australia's energy policy can robustly manage future challenges.

Our principal energy markets (liquid fuels, electricity and gas) are different, and the role of government in shaping future developments in each market varies.

Australia's liquid fuel markets are different to other energy markets in that they are part of a globally integrated supply chain with mature and well-functioning structures. In this sense, there is less of a role for government in the further development of these markets. However, the Australian Government still has an important regulatory role in this sector and in responding to policy pressures over time.

In contrast, Australia's electricity and gas markets have historically developed in response to significant government direction. The past two decades have seen major reforms driven by state and territory governments working in cooperation with the Commonwealth. A major outcome of these reforms has been the move away from state-owned vertically integrated energy utilities to the formation of competitive national market structures and institutions with significant private sector participation and investment – including significant foreign investment.

Energy regulation and policy development is very much a shared responsibility between the Commonwealth and states and territories. Building effective national outcomes requires all Australian governments to approach these issues from a collaborative perspective, and our success in building an effective and efficient energy base confirms a substantial track record of achievement in this area.

International factors

As a key part of Australia's modern open economy, our energy sector is increasingly interconnected with global markets and systems. This means that events in another part of the world often have consequences for our energy markets and consumers.

Global economic and financial market uncertainty, an energy resources boom and a commitment to reduce global greenhouse gas emissions are all having a major impact on our energy future.

We are experiencing a period of economic and financial volatility in Europe and other key markets, and it is uncertain how long these conditions will continue. This has resulted in a tightening in investment markets and reduced access to finance – including refinancing – for energy sector investments with exposure to real and perceived risk.

Despite this, growth in rapidly industrialising economies continues to drive a global resources and energy boom. Expectations about Chinese economic growth continue to be the most influential factor in forecasting global energy consumption – for example, China is now the world's largest energy consumer (19 per cent) and represents 47 per cent of global coal consumption.[10]

Australia, as one of only three OECD net energy exporters, is playing a key role in meeting global energy needs – a role that looks set to continue in the period ahead.

Since the last Energy White Paper was released there have been significant increases in energy commodity prices – for instance, oil prices increased from US$45 per barrel in 2004 to US$110 in 2011[11] – and the value of our energy exports has increased dramatically. Australia's coal exports increased from $17 billion in 2004–05 to $43 billion in 2010–11. Similarly, LNG exports have almost trebled from $3.2 billion to $10.5 billion and uranium exports increased from $475 million to $610 million (peaking at $990 million in 2008–09).[12]

While these events unfold, countries continue to look for ways to reduce greenhouse gas emissions. There is international recognition that addressing climate change is a first-order challenge, and reaching a binding and effective international agreement on emissions reduction targets remains a critical goal.

Looking ahead, there will also almost certainly be new international developments that we cannot foresee from today's vantage point. Australia's energy markets and policy frameworks need to be resilient and regularly assessed and refined in order to respond to a broad range of risks.

Domestic factors

Domestically there have also been major changes since 2004. Most significantly from a consumer perspective, energy costs have risen in real terms, particularly for petrol and electricity.

There is now bipartisan support for an unconditional national greenhouse gas emissions target of 5 per cent below 2000 levels by 2020, as well as a continuing bipartisan commitment to a Renewable Energy Target of 20 per cent by 2020. However, Australia's delay in moving to carbon pricing has resulted in numerous ad hoc state, territory and federal climate change initiatives with many (sometimes conflicting) objectives, including emissions abatement, energy efficiency and renewable energy deployment.

Government support, along with significant reductions in production costs, has resulted in an increased deployment of technologies such as solar photovoltaic systems and wind turbines. The development in other less mature clean energy technologies, such as geothermal, ocean and carbon capture and storage, has been more challenging.

[10] International Energy Agency, *World energy outlook 2011*.

[11] International Energy Agency, *World energy outlook 2011*.

[12] BREE, *Resources and energy quarterly: September quarter 2011*, BREE, Canberra, 2011.

Past uncertainty over the introduction of a carbon price and the impact of various climate change interventions has affected investment decisions in a number of energy and downstream industries – including delivery of baseload electricity projects in recent times. The need to manage risk and market exposure has led to a growing trend of vertical integration (the 'gen-tailer' model).

Important institutional reforms have progressed, including through the establishment of the Australian Energy Market Commission, the Australian Energy Regulator and the Australian Energy Market Operator, and the passage of the National Energy Customer Framework legislation.

Australia's energy networks have undergone their first round of determinations with the Australian Energy Regulator. Our supply infrastructure has met reliability and other performance requirements, but increased investment to upgrade and replace ageing assets has seen networks accounting for the biggest share of the increased cost of supplying electricity.

Rising energy costs due to a range of factors is now a critical concern for households and businesses alike. Consumer use of energy-intensive appliances has increased sharply – for example, the number of air conditioners installed in the last five years has grown by 1.7 million or around 36 per cent – and has led to rising peak demand, which is contributing to the increasing cost of electricity.

Price deregulation remains a major unfinished energy market reform – only the state of Victoria has fully deregulated its retail tariffs.

Victoria is also the only state to mandate a statewide roll-out of smart meters. Other jurisdictions will look to lessons learned from Victoria in assessing whether to follow suit.

The supply disruptions at Varanus Island in 2008 and the Montara oil spill in 2009 are also reminders of the importance of continuous improvement with respect to safety and the integrity of facilities. Lessons from these incidents will be important as Australia develops its offshore gas reserves and hosts the world's first floating LNG facility. Steps have also been taken to harmonise state and territory laws, particularly with respect to safety in the energy supply industry, and the expansion of the National Offshore Petroleum Safety Authority to include environmental management and to become the National Offshore Petroleum Safety and Environmental Management Authority from 1 January 2012. Likewise, the National Offshore Petroleum Titles Administrator will be established from 1 January 2012.

Australia's liquid fuel import dependency has increased over recent years. Likewise, Australia has smaller and older refineries compared to regional competitors. In mid-2011 Shell announced a decision to close the Clyde refinery in the years ahead and convert it to an import-receiving facility.

Recent years have also seen a significant expansion in Australia's coal seam gas industry, including sanctioning of three coal seam gas–to-LNG projects – representing collective investment of $45 billion. Sound scientific knowledge to engage and inform the public will be important as this industry delivers its projects.

5 The key challenges in our energy future

Australia's energy sector may face a number of market, capital and technological challenges in the years ahead. Principally, energy prices are rising, and both the scope of the technological transformation sought and the scale of the investment task are unprecedented.

Energy policy is never settled and must be regularly monitored, assessed and refined to ensure that it continues to meet a range of challenges – both existing and emerging.

Scale of investment

A large and sustained level of investment will be required in Australia's energy sector in the period to 2030 and beyond. This investment is necessary to provide reliability of supply to meet our energy security needs while also supporting the transition to clean energy.

There are several credible estimates that illustrate the likely sum of capital that is needed. The Investment Reference Group reported projections from the Australian Energy Market Operator's 2010 National Transmission Network Development Plan which suggested that between $72 billion and $82 billion in new generation and transmission could be needed in the National Electricity Market by 2030. The Investment Reference Group also estimated that an additional $140 billion could be needed in shared electricity transmission ($24 billion), distribution networks ($120 billion) and additional gas production and transmission required to support gas for electricity generation ($18 billion) in the same period – a total of around $240 billion.[13]

Similarly, the Australian Treasury has forecast that in the presence of a carbon price, more than $200 billion will need to be spent in new generation capacity to 2050. This comprises around $50 to $60 billion in gas-fired capacity, $100 billion on renewables and $45 to $65 billion in coal, primarily carbon capture and storage technology.[14]

Australia has already begun to meet this investment task, with a capital expenditure of over $10 billion a year being recorded since 2007.[15] This has been dominated by network capacity replacement and augmentation and has resulted in substantial electricity price rises. Given projected requirements, it is likely that this heightened investment will be maintained through the remainder of the decade.

While aggregate numbers appear (and are) daunting, it should be remembered that this call on capital will be split across a range of different components of the market (generation, networks and gas infrastructure), each with different risk and return profiles, and is within the capabilities of Australian and international capital markets to support if investment settings are appropriate and stable.

[13] Investment Reference Group report.

[14] Treasury, *Strong growth, low pollution.*

[15] P Simshauser and A Catt, *Dividend policy, energy utilities and the investment megacycle*, AGL Applied Economic and Policy Research, working paper 28, June 2011.

Markets will be tested

Nonetheless, the scale of transformation in the energy sector is enormous by historical standards. For example, only around $12 billion has been invested in new electricity generation since 1998, compared to the approximately $80 billion that could be required over the next two decades. Until the 1990s, investment in the electricity generation sector was predominantly delivered by state government–owned vertically integrated utilities. The withdrawal of government from the market means the private sector will be called on to deliver future investment, and the market is largely untested at delivering investment at the scale required in the period ahead.

Our ability to deliver this investment will critically depend on access to finance and capital. Given the relatively small pool of Australian investors with deep experience in delivering greenfield electricity generation investments, it is likely that a significant proportion of this required capital – debt and equity – will need to be sourced from overseas. While network investment has different risk and return characteristics to generation investment, network investment is also likely to be sourced from a mixture of domestic and foreign capital.

The footloose and competitive nature of foreign capital emphasises the need for Australia to maintain attractive and stable investment and policy frameworks. This includes ensuring that energy markets provide the opportunity for commercial returns.

In addition, further investment will also be required in Australia's liquid fuels sector to maintain refinery performance and expand import infrastructure. These will be commercial decisions that take into account Australia's relative competitiveness against projects in Asia and other key markets.

It is also important to note that carbon pricing may pose additional challenges to Australia's energy sector through the significant transformational investment task required, and by changing the economics of different generation technologies. The lack of bipartisanship around carbon pricing policy is also a significant concern to investors in electricity generation and to downstream energy users and emissions-intensive industries.

External factors are impacting the market

The introduction of a range of policies – such as the bipartisan expanded Renewable Energy Target, state-based feed-in tariffs and white certificate or similar energy efficiency schemes – are impacting Australia's energy markets and (by design) affecting decisions about investment in new generation capacity.

Continued government ownership of electricity generation assets, as well as the ongoing potential for further intervention, make attracting investment more difficult than it otherwise would be. Furthermore, retail price regulation can also reduce incentives for new competition and innovation.

The combined effect of external factors is significantly adding to the complexity and risk in investment decisions and distorting market outcomes, both intentionally and unintentionally. While retrospectively changing these measures may not in most instances be practical or even desirable, given that investments have been made on the basis of existing policy, the implementation of carbon pricing is an opportunity to ensure that no further market-distorting non-complementary interventions are made and that current measures are reviewed against the Council of Australian Governments (COAG) complementarity principles for climate change mitigation measures.

In this context, the Australian Government has decided not to proceed with the introduction of an emissions standard or carbon capture and storage standard for future coal-fired generation investment. An emissions standard is unnecessary in the presence of carbon pricing. Similarly, a carbon capture and storage standard would impose unnecessary regulatory and administrative costs and would be difficult to implement until a greater understanding of carbon capture and storage requirements is available. The government also considers such regulatory interventions to be inconsistent with a market-based approach to reducing greenhouse gas emissions.

Managing energy market participant risks

The growing complexities in the dynamics of Australia's energy markets mean that it is important that participants can effectively manage their exposures and risk. This is done through a variety of mechanisms in market design, financial instruments and business strategies.

A properly functioning forward contract market is essential to the smooth functioning of Australia's electricity sector and helps participants manage risk. However, overall levels of exposure and risk resulting from financial transactions are not well understood. Improving understanding of prudential positions and forward contract market positions may help inform government and energy market institutions, including in assessing whether there is a need for additional policies or measures to reduce risks of contagion and the spread of systemic risk.

One mechanism businesses use to reduce risk is vertical integration. Vertical integration is now spreading from the downstream electricity sector – generation and retail – to upstream, with vertical integration of positions in the electricity and upstream gas markets. It is important for all participants that the wholesale and contract markets are deep and liquid, and that new entrants have incentives to enter each of the market sectors – retail, generation, and gas exploration and production.

Bringing new technologies to market

Our ability to commercially deploy clean energy technologies such as solar or carbon capture and storage at scale – and integrate these technologies into our network – will be a significant factor in Australia's success in reducing domestic emissions.

While clean energy outcomes have enormous potential, they are far from predetermined and the success of individual technologies hinges on addressing current technical, social and cost issues. The challenge and scale of the clean energy transformation should not be underestimated. For example, the Australian Treasury has forecast that under carbon pricing, some 260 terawatt hours of clean energy generation could be delivered by 2050.[16] Taking into account current clean energy generation, this would equate to the average annual output of around an additional 43 new 750 megawatt hour coal-fired power stations – a significant investment task.

Australia is a relatively modest and open market by world standards and we will remain largely a technology taker. Given the commercial reality that almost all technology breakthroughs that are likely to be deployed at scale in the future will be at least in part manufactured outside of Australia, we should also seek to leverage other global technological developments so that Australian consumers have access to a larger range of lower-cost outcomes.

[16] Treasury, *Strong growth, low pollution*.

Deepening and broadening the knowledge base around new technologies and new energy sources is critical to efforts to accelerate clean energy outcomes. The Australian Government, through it clean energy programs, will encourage public dissemination of lessons learned and other non-proprietary information to ensure maximum value is obtained from public funds.

Our future success in large part will entail research, development, adaption, demonstration and commercialisation of clean energy technologies. Initiatives such as the Australian Renewable Energy Agency, the Carbon Capture and Storage Flagships Program and the Clean Energy Finance Corporation will be essential to realising this.

Working to accelerate the commercialisation of key technologies – as the Australian Government is doing – is critical so that markets have access to an earlier and wider set of options. This can reduce the potential future cost of technology lock-in. We will also benefit from earlier understanding around key technologies so that policy-makers and business can plan ahead and adjust if required.

Managing the growth in peak demand and improving energy productivity

Australia's electricity demand continues to rise, although overall growth appears to have been slower in recent years. However, this growth is not uniform and changing load profiles and increased use of domestic appliances such as air conditioners have resulted in peak demand rising significantly faster than average demand. Between 1998 and 2010 the number of households in Brisbane rose by 35 per cent, while peak electricity demand increased over the same period by 104 per cent.[17]

This means that capacity is being built and capital spent that may be used only a handful of times each year. It is estimated that 25 per cent of retail electricity costs are derived from peak events that occur over a period of less than 40 hours per year[18]– clearly this is an inefficient utilisation of capital with resulting consequences for energy bills.

This growth is driven by a range of factors, including inefficient uniform pricing structures that do not reflect the true cost of energy choices. This results in some consumers paying more than they should, and effectively cross-subsidising those who are driving the growth in peak demand.

As an example of how significant this can be, it is estimated that the installation of a 2 kilowatt (electrical input) reverse-cycle air conditioner costs a consumer around (on average) $1500 yet imposes costs on the energy system as a whole of up to $7000 when adding to peak demand.[19] The $7000 system-wide cost must then be spread across all other customers.

Efficiently managing and reducing growth in peak demand to increase capital utilisation is an important objective. This can be achieved either through pricing signals or through direct regulation.

If market signals are to be better utilised to reduce growth in peak demand, we must ensure greater consumer engagement with the energy sector. The importance of this was emphasised in the recent deployment of smart meters in Victoria. Proper consumer engagement and community acceptance

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[17] P Simshauser, T Nelson, T and Doan, 'The boomerang paradox, part 1: how a nation's wealth is creating energy poverty', *The Electricity Journal*, vol. 24, no. 1, 2011 p. 72.

[18] R Fraser, 'Demand side management', paper presented at the Australian Institute of Energy symposium, NSW's Electricity Future 2020 (and beyond): What will it look like and how do we get there?, 24 May 2010, Sydney.

[19] Department of Employment, Economic Development and Innovation, *Queensland Energy Management Plan*, Queensland Government, Brisbane, 2011.

is critical if large-scale deployment is to be implemented or if the community is to accept changes in tariff structures.

Smart meters can lead to greater efficiencies in network management and underpin more competitive market outcomes. They are a facilitative tool that can provide information and opportunity for consumers to have a greater say in their energy choices. Finding the right deployment model is essential.

There are also other demand-side opportunities that do not require smart meter deployment that governments can collectively pursue.

Further efforts to address non-market barriers to the uptake of energy efficiency opportunities for businesses and households are also an important complement to carbon and energy price signals. While carbon and energy prices will drive the uptake of these outcomes, other measures such as improving energy information, applying cost-effective minimum performance standards and increasing energy literacy across consumers can all contribute to improving energy efficiency and productivity outcomes.

In the context of consumer engagement, it is important to recognise the varying abilities of different consumers to access programs and information, and understand that communication may need to occur through a range of channels.

Energy costs are rising

Australia's energy costs have increased over recent years and this trend is expected to continue through this decade. Increasing electricity costs are predominantly due to network investment, and hence it is important to ensure that our energy network regulatory regime – the result of earlier reforms – delivers optimal outcomes. There are existing processes to ensure that the network regulatory regime settings are appropriate.

Global oil prices have increased due to strong demand and rising costs of production. Domestic gas prices have also increased for similar reasons.

While energy remains a small to modest proportion of average household income (around 2.6 per cent)[20] and business expenditures (typically less than a few per cent for most non-energy-intensive businesses), future increases will place pressure on the affordability of energy for a range of less well-off consumers and for energy-intensive businesses.

There is no easy or simple fix to this issue. If we are to maintain investment and promote the efficient use of energy, prices must reflect the cost of supply in a competitive market. Interventions to manipulate or suppress efficient pricing outcomes will have detrimental investment and supply consequences that are not in the long-term interests of consumers. While energy prices are a challenge, it should also be recognised that it is energy prices that send signals to investors to ensure that capacity is delivered to maintain reliability.

Energy demand – particularly electricity demand – is driven by the choices consumers make about their energy use. Current regulated electricity pricing structures can encourage inefficient patterns of use and unfairly distribute costs across consumers. They also significantly reduce the incentive for innovative consumer tariffs and technologies that allow for better management of energy use and

[20] Australian Bureau of Statistics, *Household expenditure survey, Australia, 2009–10*, cat no. 6530.0, ABS, Canberra, 2011.

costs. This means that the less well-off, who generally do not run multiple air conditioners and television sets, are cross-subsidising those consumers who do.

While politically challenging, this further stage of market reform must be addressed to reduce inefficient energy use and growth in peak.

Managing risks – a broader government perspective

There are a range of risks that will need to be closely monitored. Specifically, some of the key strategic risks identified in the draft Energy White Paper include:

- the nature and timeframe of the international response to climate change
- unforeseen geopolitical or economic developments that reshape or disrupt international energy or capital markets
- the importance of optimal electricity and gas investment for least-cost energy delivery
- a failure to commercialise key technologies in a timely fashion
- a confluence of these outcomes which interact to produce unanticipated sharp increases in delivered energy costs.

The Australian Government has in place a range of mechanisms to manage the impact of many of these possible events. However, there is a need to continually monitor developments and refine policy as necessary. To manage this, the government recognises that the inherent resilience of Australia's policy framework can be improved. This includes providing for well-signalled and more predictable reviews of key energy policy settings to ensure that Australia remains on track with respect to its energy policy goals, as well as ensure that key policy, market or physical risks have been identified and that there are effective mechanisms and processes that can anticipate or respond to them.

Resource development challenges

Australia must ensure that we are positioned to develop our energy resources – for use both domestically and to meet growing regional demand in Asia.

Bringing on further economic development requires us to remain an attractive destination for foreign capital, and maintain an exploration pipeline to ensure that discoveries of new energy resources are made.

Strong terms of trade and significant growth in Australia's resources and energy sectors – while of overall benefit to our community – will also place strains on our economy. Policies such as the extension of the Petroleum Resource Rent Tax and the introduction of the Minerals Resource Rent Tax are designed to share the benefits of high commodity prices throughout the broader community as well as support investment in necessary infrastructure.

Access to infrastructure such as rail and port facilities as well as housing and other supporting facilities is critical in ensuring that Australia remains a reliable supplier of energy resources into the future. This is a shared responsibility between industry and governments at all levels. Recent investments and reforms are addressing previous infrastructure constraints and it will be important that future emerging issues are identified and addressed in a timely fashion.

The growth and transformation of Australia's energy industries will also create new employment opportunities and demand for skills in a wide range of areas. Meeting these needs will come through a combination of education and training, improving workforce participation and mobility, and utilising skilled migration. The Australian Government is working with the education and training sector and business groups to implement initiatives in these areas to address short-term constraints and improve long-term capacity.

The energy and resources sectors also play a significant role in creating long-lasting opportunities for Indigenous people and communities by creating jobs and providing valuable income. This is particularly important in remote and very remote areas of Australia. Industry, government and Indigenous communities are working successfully together to ensure that these opportunities create deep and long-lasting benefits.

There is also an important role for governments in ensuring that regulatory frameworks provide for transparent, sustainable and safe development, particularly where multi-resource use and co-development exist.

Reflecting the need to ensure best practice, the Australian Government is seeking to achieve harmonisation and best practice of state-based regulatory responsibilities with respect to the coal seam gas industry. Governments are also working through the COAG ministerial-level Standing Council on Energy and Resources to develop a national framework for multiple land use that can promote national consistency and transparency in land access and use.

The importance of gas

Gas will have a critical role to play as the world moves to reduce greenhouse gas emissions. Access to competitively priced gas offers Australia and other countries a lower-emissions alternative that can provide energy security, particularly while other technologies have yet to successfully commercialise.

By 2050, gas could account for 44 per cent of Australia's electricity supply[21] – nearly triple the 15 per cent it accounted for in 2009-10.[22]

To meet demand, there is a need for timely and competitive upstream gas development matched with efficient investment in downstream processing, and in transmission and distribution capacity.

Recent years have seen significant capital committed to Australian LNG projects – around $140 billion to increase our LNG export capacity by 50 million tonnes per annum from our current 20 million tonnes per annum. Of this, $45 billion was committed to coal seam gas–to-LNG projects on Australia's east coast.

The development of an east coast coal seam gas–to-LNG industry will affect the east coast gas market – it will support further domestic gas development and also introduce additional competition for our gas resources. However, these new dynamics have yet to mature and there are market risks. Community concerns about the potential impacts of coal seam gas developments must also be addressed.

[21] Australian Treasury, *Strong growth, low pollution*

[22] ABARES, *Australian energy statistics*, Table O.

It is important that there is better public information and understanding around gas market developments. The Australian Government will closely monitor the development of upstream and downstream markets to ensure that competitive supplies to domestic and export markets are being maintained.

There is an important role for the Australian Government to work with the states and territories to both promote further upstream and downstream market development that can help bring on gas projects, and undertake further work to better understand gas market developments and dynamics – particularly given the increased interrelationship between gas and electricity markets.

The Australian Government strongly encourages further reform to the Western Australian gas market to ensure that it becomes a more mature and competitive market.

Liquid fuels

Australia is heavily dependent on imports of both refined petroleum products and crude oil (which is refined in Australian refineries) to meet our liquid fuel demand. The majority of our current crude oil production is exported due to the higher-value uses it has in other markets.

Australia's liquid fuel import dependency has increased over recent years. Likewise, Australia has smaller and older refineries compared to regional competitors. In mid-2011 Shell announced a decision to close the Clyde refinery in the years ahead and convert it to an import-receiving facility.

Australia is linked into well-established global supply chains to meet our liquid fuel needs and import dependency itself does not imply an energy security threat. At least until the middle of this decade it is forecast that there will be a surplus of refining capacity in the Asian region; however, Australia should continue to monitor market developments.

New alternative transport fuels have future potential to complement conventional fuel stocks, particularly if oil prices continue to rise. While this will be market driven and will emerge over time, it makes sense to examine market or regulatory barriers that might impede commercial outcomes.

Sustainability

The production, supply and end use of energy intersects with the natural and human environment in many ways and it is critical to the ongoing viability of our energy resources and energy supply sectors that they operate in a manner that is safe and sustainable. Key issues in this regard include ensuring that energy production and generation projects efficiently manage their impacts on water resources and the natural environment more broadly.

The regulation of new industries such as coal seam gas should be consistent and based on sound scientific information regarding potential impacts. This includes impacts on human health and safety as well as environmental impacts such as air and water quality. Better understanding of Australia's groundwater resources and the impact of energy-related developments and other human activities is increasingly important.

Environmental regulation must also be effective and efficient in terms of both outcomes and its administration. In this context, the Australian Government has recently announced a set of major reforms to the operation of the *Environment Protection and Biodiversity Conservation Act 1999* to improve its effectiveness and streamline administration. These include developing a more strategic approach through regional planning and approvals as well as developing cooperative national standards and guidelines to harmonise approaches between jurisdictions and foster cooperation with all stakeholders.

The government is working closely with industry to implement these reforms.

Community engagement

As energy-related projects become increasingly prevalent and new technologies and practices are developed, it is critical that proponents of energy infrastructure and energy projects properly engage at an early stage with local communities. Early and effective engagement should ensure that communities are properly informed and that risks and costs are appropriately managed.

The significant expansion of the coal seam gas and wind energy industries has recently shown the growing pains that can occur in our energy sector and highlight the importance of building local and general support with the community.

6 Priority actions for Australia's energy future

Taking the opportunities and challenges discussed above into account, the draft Energy White Paper proposes four priority action areas for national energy policy that the Australian Government believes should be addressed to enhance Australia's ability to realise its energy potential. These are:

- strengthening the resilience of Australia's energy policy framework
- reinvigorating the energy market reform agenda
- developing Australia's critical energy resources – particularly Australia's gas resources
- accelerating clean energy outcomes.

Strengthening the resilience of Australia's energy policy framework

The Australian Government recognises that there are substantial changes underway in Australian and global energy markets. Strengthening the resilience of our energy policy frameworks through regular and predictable strategic assessment of key policy settings will provide policy-makers and business with a better ability to anticipate and respond to emerging risks or changing circumstances, and also ensure that our energy policy frameworks remain appropriate over time.

An improved and more transparent information base on energy resources, technologies and fuels, including their comparative costs and commercial maturity, is an important complement and input into the policy process. It will enhance our ability to evaluate future energy pathways over time and promote a more informed public dialogue.

The Australian Government will strengthen the resilience of Australia's energy policy framework by:

- institutionalising a regular four-yearly review of national energy policy strategy beginning in 2016 – this will provide an opportunity to assess overall progress in meeting our national energy goals and identify emerging risks or changing circumstances and consider appropriate responses
- undertaking biennial National Energy Security Assessments from 2014 with a revised analytical and quantitative methodology to provide for a more systematic and integrated understanding of key relationships between the energy sector and other areas of the economy

- undertaking a National Energy Risk Preparedness Audit across the energy sector as part of the National Energy Security Assessment process, to test the appropriateness and effectiveness of response mechanisms to manage critical risks to the energy sector
- improving Australia's energy information base, including through:
  - biennial publication from 2014 of the Australian Energy Resource Assessment and the Australian Energy Technology Assessment
  - expanding the scope of the Australian Energy Technology Assessment to specifically cover liquid fuel technologies
  - as part of the 2014 National Energy Security Assessment process, assess Australia's liquid fuel vulnerabilities – this will cover the liquid fuel supply chain, including import and refining infrastructure and critical supply linkages
  - lead work, in consultation with industry, to improve the quality of the Australian Petroleum Statistics
  - enhancing the quality and timeliness of public information on Australia's conventional and unconventional gas reserves and projected market developments, which will help inform policy development
  - annual publication of the Australian Energy Market Commission's report on trends in future electricity prices
  - undertaking a road-mapping exercise to improve the scope and alignment of Australian energy data collection.

Reinvigorating the energy market reform agenda

Past energy market reforms have provided a strong foundation in building competitive national energy markets. However, several major areas have yet to be completed and the Australian Government wants to now move to the next stage of energy market reform. Rising cost pressures and the challenge of transforming energy markets mean we need to tackle outstanding issues in addition to those currently underway.

The National Electricity Market has delivered reliability and efficiency to date. Regulatory stability is important and the government is not proposing to pursue change of the current energy-only market design of the National Electricity Market. However, the government recognises that the National Electricity Market's ability to deliver the significant investment challenge ahead will be tested and market settings must be regularly monitored to ensure that objectives are being met. This should also include further analysis by government and market bodies to anticipate emerging technology and market developments.

The next stage of reform should focus on improving the productivity and operation of energy markets, ensuring that appropriate incentives are in place to support efficient network and supply investment outcomes, and providing consumers with a more accessible and comprehensive range of options to manage their energy use.

In a modern and diverse economy such as Australia's, there is no compelling rationale for continuing government ownership of energy assets. Such ownership can create inherent competitive tensions in markets, discourage private investment and reduce incentives for business innovation or more efficient operation.

Similarly, implementing reforms to more efficiently manage the continuing growth in peak demand to increase capital utilisation is important so that we do not generate unnecessary costs. Retail pricing reforms along with appropriate network incentive regimes can not only provide incentives for more efficient energy use, they are also the key to unlocking greater innovation and competition in energy management technologies and consumer products.

The Australian Government will therefore work with the states and territories through established COAG ministerial councils to pursue:

- completion of agreed commitments on retail price deregulation, and with respect to energy prices:
  - ensuring that social safety nets take into account the impact of rising energy costs (including carbon costs) and that institutional and regulatory frameworks maintain consumer protections
  - helping to further empower consumers, recognising that jurisdictions that pursue retail price deregulation should also ensure appropriate support for consumer engagement, in terms of both advocacy and market participation
  - ensuring that the drivers of cost increases are transparently reported and better understood by consumers
  - continuing to review and test regulatory frameworks to ensure they are delivering outcomes for the long-term interests of consumers
- promotion of greater competition and business efficiencies, including through further asset privatisation
- promotion of greater network efficiency and productivity – including looking at whether some services currently provided by networks on a monopoly basis could alternatively be opened up to competition
- development and implementation of better demand-side reforms (including development of a smart meter framework and review of barriers to distributed generation)
- assessment of the lessons from smart meter deployments to inform the role that smart meters may play in our energy system, including consideration of appropriate deployment models
- further exploration of potential measures to reduce growth in peak demand (including possible regulatory measures, market measures and enhanced consumer education)
- development of regulatory settings that support increased innovation by energy retailers in terms of tariff design and consumer engagement
- further development of Australia’s gas markets to improve transparency and trading opportunities, and further Commonwealth-led work to better monitor market dynamics to assess whether policy settings are delivering required outcomes given the growing use of gas for electricity generation

- support for further reforms to the Western Australian gas market to ensure that it becomes a more mature and competitive market
- completion of the transition to truly national energy markets – specifically by undertaking more work to explore extending the national energy market governance arrangements and principles to cover all Australian electricity and gas markets. Ensuring national harmonisation also includes reviewing and removing unnecessary jurisdictional derogations
- consistent with the agreed COAG complementarity principles for climate change mitigation measures, agreement from all Australian governments to a review of existing non-complementary measures, and agreement not to introduce new measures that are inconsistent with these principles.

In taking forward this agenda, the Australian Government remains firmly committed to the energy market development and reform actions and activities currently underway through the COAG Standing Council on Energy and Resources, and related processes.

Developing Australia's critical energy resources – particularly Australia's gas resources

Competition among nations for investment and market share in key energy exports markets is growing, with many new suppliers seeking to take advantage of strong demand. To remain competitive, Australia must maintain and improve its standing as a reliable energy supplier.

There are ongoing tensions between export and domestic demand for key energy resources. Analysis shows that in particular, natural gas is likely to have a critical role to play in our future economic development, both as a source of enormous export income and in our domestic energy system as a proven large-scale lower-emissions source of energy for electricity and other end uses. Gas stands to play a pivotal role as we move to reduce our greenhouse gas emissions.

Recognising that in many cases export opportunities provide an important backbone for domestic market development, the Australian Government will actively work to promote market and policy settings that provide appropriate investment incentives to bring on export and domestic development. This must also continue to balance the needs of commercial development with ensuring an appropriate and fair return to the Australian community.

There is also an important role for government in ensuring that energy resource developments, such as coal seam gas, are safe and sustainable. In this context, the Australian Government is working with states and territories to harmonise the coal seam gas regulatory regime and has already moved to implement as a priority important offshore regulatory reforms – including the establishment of the National Offshore Petroleum Safety and Environmental Management Authority and the National Offshore Petroleum Titles Administrator, and enhanced incident prevention and response capabilities.

Long-lasting and mutually beneficial solutions must also be found to address emerging resource co-development conflicts. This will take a concerted cooperative effort from all governments, and particularly from project developers and relevant industries in developing best-practice approaches and engaging with local communities. This must be supported by the best available science and analysis as well as effective and efficient regulation.

The Australian Government will advance these goals by:

- pursuing an active approach to the development of its offshore gas resources, including through:
  - updating offshore retention lease arrangements to improve transparency; allow third-party comment on the commerciality of developing particular fields; ensure that reserves are not 'warehoused' indefinitely; and provide certainty of gas supply over long timeframes, including for highly capital-intensive LNG projects
  - ensuring, through the application of retention lease and production licence approval arrangements, that offshore gas project design and development are providing the best returns they can for the Australian community within a commercial framework, including through appropriate consideration of domestic gas opportunities
    - specifically, having greater regard to the potential for projects to supply the domestic gas market when considering granting a production licence
  - examining the possible introduction of cash bidding for offshore areas of high prospectivity
- advancing national consistency and transparency with regard to multiple land use resources projects through the development of a national framework for multiple land use under the Standing Council on Energy and Resources
- working with the resources and other industry sectors to deliver announced reforms to the operation and administration of the *Environment Protection and Biodiversity Conservation Act 1999*, including providing for more strategic planning and assessment
- establishing a new Independent Expert Scientific Committee (and associated new National Partnership Agreement) to provide scientific advice to governments on coal seam gas and large coal mining projects that have a significant impact on water
- working with states and territories through the Standing Council on Energy and Resources to cooperatively progress a more harmonised approach to the regulation of the coal seam gas industry
- undertaking, through Geoscience Australia, further work to establish a more rigorous understanding of the aquifers across jurisdictions and across basins, their connectivity, and how groundwater pressures in connected aquifers are likely to be affected by the cumulative impacts of coal seam gas production
- assessing and reporting on infrastructure requirements for bulk resource commodities such as coal, LNG and iron ore, and providing updates at regular intervals.

Accelerating clean energy outcomes

The pace of Australia's clean energy transformation will be determined through the interaction of carbon, renewable energy certificate and energy prices in the market, with commercial outcomes driven by the ability of emerging technologies to establish commercial reliability and competitive cost. The complementary incentives from the carbon price and Renewable Energy Target are intended to bring forward the deployment of renewable energy in Australia – driving around $20 billion of investment in renewable energy in the period to 2020. The introduction of a carbon price can assist in efficiently delivering the Renewable Energy Target.

Beyond the renewable energy technologies that are currently mature, accelerating the pace of commercialisation for new clean energy technologies is critical if the market is to be provided with an earlier set of deployment options that could reduce the longer-term cost of meeting of national greenhouse gas abatement goals.

The Australian Government has committed up to $17 billion in funding to support the development, commercialisation and deployment of clean energy technologies. This includes the establishment of the Australian Renewable Energy Agency and the Clean Energy Finance Corporation, as well as support for large-scale carbon capture and storage demonstration.

Within the government's policy framework and existing funding that has been committed, there remains a need to continue to identify and address potential market gaps or barriers to efficient uptake of clean energy solutions. This might include identifying and addressing issues relating to network connection and integration, as well as ensuring that there are appropriate regulatory standards to support uptake.

In this context, the Australian Government will work to accelerate clean energy outcomes by:

- expediting implementation of its clean energy programs to ensure continued support for innovation and commercialisation, including establishing the Australian Renewable Energy Agency by July 2012 and the Clean Energy Finance Corporation from 2013–14, and continuing to progress carbon capture and storage initiatives
  - progress in achieving energy outcomes, including clean energy outcomes, will be assessed as part of the proposed four-yearly strategic energy policy review process
  - the government has announced that the scheduled review of the Renewable Energy Target scheme by the Climate Change Authority will occur in the second half of 2012 and every two years after that
- monitoring the impacts of increased levels of intermittent generation on network stability, in particular the need for any consequent new requirements on the structure and operation of networks
- working with other jurisdictions to identify opportunities to harmonise micro-generation feed-in tariffs, so that they do not impose an unjustifiable burden on electricity consumers, either through cross-subsidy mechanisms or their impact on the Small-scale Renewable Energy Scheme
- continuing to seek opportunities to develop collaborations with state and territory governments, business and the research community. This will include ensuring that government support is best targeted at technologies that offer Australia the greatest potential benefits, and recognising the need to maintain a long-term and consistent policy approach to support
- continuing to engage in international clean energy processes and partnerships to promote clean energy technology development and deployment through enhanced knowledge sharing, leveraging international effort and building market capability
- identifying the need for nationally consistent and supportive regulatory arrangements for new clean energy technologies and working with states and territories to promote efficient uptake.

7 Engagement and consultation process

The draft Energy White Paper has been developed as a basis for consultation on the future directions and priorities for Australian energy policy. Written public submissions are invited from interested readers by no later than 16 March 2012. This process will be supported by a series of open information sessions to be held in state and territory capital cities.

Further details on the submission and consultation processes are available at www.energywhitepaper.ret.gov.au.

1 Introduction

The draft Energy White Paper sets out a long-term energy policy framework to guide the further development of Australia's energy systems[1] into the next decade and beyond.

Its goal is to provide clear policy directions that improve the productivity and resilience of Australia's energy systems so that all Australians can access clean, secure, reliable and competitively priced energy. In doing so it sets out a series of interconnected policy positions that collectively form the overall policy framework.

Part I of the draft Energy White Paper – *Australia's energy in context* – provides an overview of Australia's current energy situation and identifies key energy trends, priorities and challenges to 2030 and beyond.

Part II – *Australia's energy policy framework* – examines Australia's energy security framework and the opportunities and challenges involved in the sustainable development of our energy resources, improving the operation of our energy markets and energy productivity, and making the transformation in deploying clean energy technologies.

Part III – *Supporting energy policy outcomes* – addresses the energy-related cross-cutting policy issues of sustainability, skills and workforce development and promoting Indigenous opportunities, and concludes on two important enabling activities – international engagement and improving energy analysis.

1.1 The importance of energy

Access to secure, reliable and competitively priced energy underpins almost every facet of life in Australia's modern economy. Without energy, our society cannot function.

The efficient production and generation of energy is integral to business and trade and for creating goods, services and jobs. It underpins our high standard of living as well as our world-class health and education systems and the services we rely and depend on for our daily activities.

Continued reform to our energy markets and networks will ensure that they are well regulated and meet our energy needs efficiently with a secure and dependable supply. Providing Australians with options to respond to increasing energy costs is vital, particularly for the less advantaged. Improving the productivity of Australia's energy system will provide ongoing benefits for everyone.

Energy is also a commodity that is transformed and traded. Energy-intensive industries have prospered in Australia and they make a substantial contribution to the economy and society, particularly in regional Australia. Though sometimes challenging to develop, new and emerging energy sources have the potential to add to our national wealth.

Australia is now a leading supplier of energy to citizens in many countries throughout our region. When the last Energy White Paper was published in 2004, energy exports contributed around $24 billion a year to Australia's economy. By 2010–11, our energy exports had nearly tripled to

[1] For the purposes of the draft Energy White Paper and its associated policy framework, the term 'energy system' is defined inclusively to encompass the production, supply and use of energy as well as associated services.

$69 billion, and there is significant potential for further growth. In a dynamic global environment, it is critical that we continue improving our international competitiveness and productivity.

We also increasingly require more sustainable patterns of energy production, supply and consumption. A major global and national transformation driving investment in clean energy is underway and will continue for many decades, creating opportunities for new industries, technologies and jobs.

Delivering on these needs and ambitions will require sound economic and policy foundations and well-functioning markets that attract and sustain large-scale investment across our energy system. With an estimated $240 billion or more of investment needed in energy generation and networks by 2030 alone, this is a substantial and challenging task. Foreign investment and open trade will be critical to our future growth and prosperity.

Efficient pricing of greenhouse gas emissions is now a legislated reality for Australia's energy investors. Carbon pricing, combined with well-functioning energy markets and targeted support for developing new clean energy technologies, will drive long-term change in our energy system. Securing this change will be a challenging and long-term undertaking.

Australia's economy is increasingly integrated into global markets. The importance of our global engagement is critical, not just for export opportunities but for our ability to finance development and for leveraging new technologies and expertise. If we manage our energy choices efficiently and sustainably this will bring enormous trade and investment benefits. Undeniably, it will also present challenges. A key purpose of energy policy is to manage these challenges and, in doing so, to improve the wellbeing of Australia and its citizens.

1.2 The need for an Energy White Paper

Much has changed in Australia and our region since the 2004 Energy White Paper was published.

Global energy systems are experiencing significant change, including technological advances, growth in demand, and action to reduce greenhouse gas emissions and develop sustainably. Australia has an important position in this global energy transformation.

Despite disagreement over how it will be achieved, there is now a bipartisan commitment to unconditionally reduce greenhouse gas emissions by 5 per cent below 2000 levels by 2020, and this will drive a long-term transformation towards clean energy sources. Implementation of carbon pricing, supported by a comprehensive set of targeted clean energy measures under the Australian Government's Clean Energy Future package,[2] will transform Australia's economy and energy sector over the decades ahead.

Major new gas developments in eastern, western and northern Australia will bring further prosperity and changing dynamics to energy markets. New technologies developed in Australia and overseas are also likely to open up new energy sources and business opportunities.

Australia is experiencing record demand for its energy and energy-intensive resources, driven largely by sustained economic and social expansion in Asia, most notably China and India. This growth is widely expected to continue in the decades ahead. Strong minerals and energy demand and prices are bringing enormous economic rewards to Australia and driving significant change in our economy.

[2] See Appendix A for an overview of the Clean Energy Future package.

While there is no guarantee that we will retain our hard-won market share, providing competitive policy frameworks will greatly enhance our ability to secure investment to further develop our energy resources and help meet the energy needs of countries in our region.

Ongoing geopolitical turmoil continues to be a feature in international oil markets. A general tightening in global supply and demand balances across energy commodities has also increased concerns over long-term energy security, and this is driving important policy and technological responses in many countries. Our liquid fuel markets are inherently linked to international developments.

These trends have implications for the future of Australia's energy systems. The continued development of conventional and unconventional energy sources and the commercialisation of new and emerging clean energy technologies will likely present new business opportunities. Similarly, Australia will likely benefit from continued growth in global demand for energy and energy-intensive resources.

Within this context, it is likely that shocks or other events will occur that cannot be predicted. Responding efficiently and effectively will require forward-looking, robust and resilient energy policy frameworks that support markets in adjusting quickly with minimal disruption and cost. These frameworks must also provide markets and consumers with the necessary direction and choices. Well-targeted government interventions may be necessary in some circumstances.

Rapid and/or large-scale change can also generate uncertainty and risk. While markets are highly flexible and generally efficient at managing risk, high levels of uncertainty can impede or increase the cost of investment and, ultimately, costs for consumers. Clarity over policy frameworks and objectives for business and investors will provide stability and market confidence. The current lack of bipartisan support for the government's carbon pricing mechanism is an area of uncertainty and concern for energy sector investors. Further reforms are also needed to improve the productivity of Australia's energy markets, which in turn will provide deeper benefits to the economy and consumers.

Energy policy increasingly intersects with a wide range of other policy areas. Climate change and environmental goals must be balanced with economic development, industry policy, innovation objectives, and transport, population and development planning. More sophisticated energy management technologies and processes will inevitably integrate energy and communication systems. As an essential service, energy intersects with national security frameworks and social policy outcomes. These considerations and others must be brought together in a coherent and consistent approach.

1.3 Shaping the Energy White Paper

Timeframe

Setting directions for national energy policy requires a short-, medium- and long-term focus that considers anticipated strategic challenges to 2030 and in some cases beyond.

The multi-decade focus of the White Paper reflects the fact that many investments made in the energy sector have lengthy operating lives with consequent long-term policy implications. Transformation driven by incremental investment decisions will take time to flow through the sector. As we have largely locked in our energy base to 2020 through decisions in past decades, similarly the decisions we make in the next decade will progressively shape our energy future in the years beyond 2020. In this sense, we are rapidly approaching a 2030 planning and policy horizon.

That said, this draft Energy White Paper does not apply the same timeframe rigidly across all aspects of energy policy and recognises that the focus in different areas should rightly be context-dependent. For example, some aspects of energy market reform have a more immediate horizon than others.

While the draft Energy White Paper sets out policy positions for the Australian Government, it also acknowledges the national energy policy framework previously agreed by the Council of Australian Governments (COAG) in 2001 to guide future decision-making by jurisdictions. The framework proposed in this draft Energy White Paper is fully consistent with the overall objectives of the COAG framework and provides a renewed Australian Government perspective based on future anticipated policy needs.

Energy policy is always evolving, and hence a framework of monitoring and regular review is necessary.

Scope

Australia has a mature and complex energy system comprising producers, networks, retailers, customers, regulatory bodies and governments, as well as providers of capital and technology.

In addition, Australia's energy system does not operate in isolation. There are many interactions and interdependencies within the national and global socioeconomic fabric which must be properly understood and considered.

The draft Energy White Paper therefore addresses the policy settings the Australian Government considers are appropriate to meet our national energy objectives. This includes energy resource exploration and development, clean technology innovation, the operation of Australia's energy markets, and demand-side and consumer participation frameworks. The proposed policy framework also identifies and considers links between different components of the energy system and how they intersect with other policy goals.

This White Paper does not revisit well-established Australian Government positions on related issues – climate change, water policy, fiscal settings or broader environmental management frameworks. However, it does recognise that these and other policy areas intersect closely with energy policy, and it is important to be clear about what the interrelationships are.

The draft Energy White Paper also considers the different (shared and separate) aspects of responsibility for energy-related issues across government levels. In this context, the White Paper is a statement of Australian Government policy and thus may not always translate into policy in shared decision-making environments. Nonetheless, it will shape the fundamental direction of energy outcomes sought by the Australian Government.

Approach

This White Paper provides a strategic energy policy framework to guide future policy development. This framework is based on the imperative that energy policy must strike an appropriate balance between supply-side and consumer considerations in meeting energy security, economic development and clean energy transformation goals. Providing the most efficiently priced energy to minimise costs for consumers while also providing a commercially attractive environment for investors (including foreign investors) remains at the heart of this equation.

The Australian Government believes that market-based approaches are generally the best means to efficiently deliver policy outcomes, promote competitive efficiencies and provide the flexibility needed to respond to future developments that may affect the Australian energy sector. The government's position has been reaffirmed by its examination of evidence from over 30 years of continuous reform to Australia's energy markets, as well as thorough analysis undertaken when designing its carbon pricing framework.

The government also recognises that markets have natural limitations and require effective and efficient regulation administered through sound institutional arrangements to ensure that they function well. There is also a clear role for government in providing the necessary parameters to guide areas where markets cannot deliver, as required. These interventions should be appropriate to their context as well as justifiable, transparent, efficient and effective.

In this context, the draft Energy White Paper sets out a series of interconnected policy positions based on clear objectives and principles. It identifies the major strategic challenges associated with achieving these objectives and outlines proposed actions where appropriate. In doing so, it does not attempt to prescribe detailed outcomes for Australia's energy sector by mandating new energy technology or fuel targets. Such a framework would be inherently less adaptable in a rapidly changing environment. It would also be inconsistent with a market-based approach, which relies on the sensible interaction of market forces as well as social and consumer choices within set policy frameworks to produce the lowest cost outcomes over time.

Process

The Energy White Paper process began in late 2008 with the development of a draft Green Paper. Work on the Green Paper was suspended in 2010 pending resolution of carbon pricing policy and the outcome of the federal election. In late 2010 the Australian Government decided to proceed directly to the draft Energy White Paper stage that would incorporate the government's announced Clean Energy Future package and resource taxation reforms. In addition, a comprehensive range of analytical materials and policy positions are reflected in this document (see Appendix B).

The Energy White Paper process also involved extensive consultation on the overall document as well as on specific aspects of the energy policy framework. Two high-level reference groups were formed for the Green and White papers, and a series of stakeholder forums were held involving businesses, industry associations, and social and environmental non-government organisations. The government thanks all those individuals and organisations that contributed their time, knowledge and ideas.

1.4 Defining the energy policy framework

Core objective

Taking the set of social, economic and environmental considerations discussed above into account, the high-level or core objective for the draft Energy White Paper policy framework is to build a secure, resilient and efficient energy system that:

- provides accessible, reliable and competitively priced energy for all Australians
- enhances Australia's domestic and export growth potential
- delivers clean and sustainable energy.

This objective encapsulates the key outcomes sought from national energy policy. Providing accessible, secure, reliable and competitively priced energy underpins the economy and society (see Box 1.1 for a discussion of competitively priced energy).

Box 1.1: The importance of competitively priced energy

The objective and principles of the energy policy framework include a commitment to providing consumers (businesses and households) with 'competitively priced' energy.

This term is meant to describe the policy objective of establishing energy prices that reflect competitive (and thus efficient) market outcomes. Ensuring that our energy policy frameworks and markets are focused on delivering competitively priced energy will support our ongoing international competitiveness by driving efficient investment outcomes in the energy system and across the economy. This will contribute to the prosperity of Australian businesses and help minimise household energy costs – an outcome that remains critical to Australia's economic productivity and social wellbeing.

Competitively priced energy should reflect the cost of supply within an overall level of demand, with the price being that which would be generated in a competitive and efficient market.

This commitment recognises the impact of rising energy costs on the affordability of energy for all consumers. The Australian Government acknowledges that a range of cost-of-living and business competitiveness issues arise from higher energy costs and remains committed to maintaining a whole-of-government policy framework that promotes affordable energy for consumers, particularly those on lower incomes.

In this regard, the clear goal is to ensure that unnecessary costs are not imposed through inefficient policies or interventions, that consumers can access a well-balanced range of options to respond to cost increases, that energy market regulatory frameworks include appropriate consumer protections, and that effective social safety nets or other mechanisms are maintained to address social disadvantage, hardship or other social policy objectives. Energy and carbon policies should also take into account distributional and social equity considerations in design and application. These issues are addressed in later chapters of the White Paper.

It is also important to ensure that Australia's energy resources are developed in a way that promotes economic and social development and provides the best return for the community. This includes capturing the benefits of trade with other nations by providing them with expanded reliable and lower-cost energy opportunities. Finally, it is critical that energy is generated and used in ways that are sustainable and that minimise environmental harm.

Core principles

The following set of overarching principles guide the achievement of the core energy objective and support all aspects of energy policy:

1. Australians have the right to clean, secure, reliable and competitively priced energy.
2. Energy is most efficiently delivered through well-functioning markets supported by effective and efficient policy and regulation.
3. Energy policy and associated actions should promote economic efficiency and enhance national wellbeing.
4. Energy frameworks and markets should provide appropriate consumer protection and provide a commercially attractive, stable and predictable investment environment.
5. Government energy policy interventions should be transparent, cost-effective, justifiable against objectives and targeted to address identified market gaps or failures.
6. Energy policy development and application should have regard to the full range of economic, social and environmental considerations.
7. The Australian Government will work cooperatively with other Australian jurisdictions to develop and implement national energy policy and engage internationally with relevant governments and organisations to promote Australia's energy interests.
8. Australia will meet its international commitments.

Core priorities

These objectives and principles lead to key policy outcomes in terms of:

- strengthening the resilience of Australia's energy policy framework
- reinvigorating the energy market reform agenda (markets and energy productivity)
- developing Australia's critical energy resources – particularly Australia's gas resources
- accelerating clean energy outcomes.

These outcomes reflect a policy framework built around the need for energy security and development of our energy resources to enhance national prosperity. These must occur alongside improvements to our energy productivity and the transformation to greater deployment of clean energy technologies.

In maintaining energy security and enhancing national prosperity, we must ensure that we have appropriate policy settings to attract capital and deliver investment, while promoting clean and productive energy outcomes.

Part I: Australia's energy in context

2 Energy in Australia

Highlights

- Australia has an abundant and diverse range of renewable and non-renewable energy resources.
- Australia is the ninth-largest energy producer in the world and one of only three OECD net energy exporting countries. Energy exports account for 68 per cent of Australia's total energy production.
- The Australian energy industry is a significant contributor to the national economy, providing over $68 billion of gross value added and over 100 000 jobs.
- Economically demonstrated energy reserves of thermal coal and uranium can sustain current production levels beyond 2100. Demonstrated gas reserves were estimated to sustain current production levels for around 68 years, and there is good potential for further discoveries of coal seam gas and shale gas to add to Australia's overall economic gas reserves.
- Fossil fuels currently account for around 95 per cent of Australia's primary energy consumption, and 92 per cent of electricity generation.
- The rate of growth in domestic energy consumption has declined steadily since the 1960s due to energy efficiency improvements and larger growth in less energy-intensive economic sectors.
- Regulation of the Australian energy industry is a mixture of Commonwealth and state and territory government responsibilities.
  - The Commonwealth regulates offshore activities beyond the three mile coastal zone and uranium mining in the Northern Territory as well as a range of matters relating to corporations law, export controls, native title, and environmental protection and conservation.
  - State and territory governments regulate within their respective boundaries, generally having responsibility for the development of onshore energy resources.
  - There are a series of shared legislative responsibilities for national electricity, gas and retail energy markets with oversight by the Council of Australian Governments' Standing Council on Energy and Resources.

2.1 Introduction

This chapter provides an overview of the current position of Australia's energy systems and summarises Australia's principal energy governance arrangements.

Table 2.1 highlights the significant contribution of Australia's energy sector to the economy. In 2009–10, more than 100 000 people worked in the sector and it contributed $68.2 billion of gross value added to the economy. In 2010–11, energy exports reached $69 billion or around one-third of total commodity exports.[1] Coal is Australia's largest energy export earner, followed by crude oil and liquefied natural gas (LNG).

Table 2.1: Energy-related industries in Australia, 2009–10

	Gross value added $b	Gross fixed capital formation $b	Employment '000
Coal mining	22.5	5.3	34
Oil and gas extraction	22.6	16.2	14
Petroleum and coal product manufacturing	1.6	0.5	6
Electricity supply	20.5	11.3	50
Gas supply	1.0	0.4	2
Total	**68.2**	**33.8**	**106**
Australia	**1 283.8**	**364.3**	**11 027**

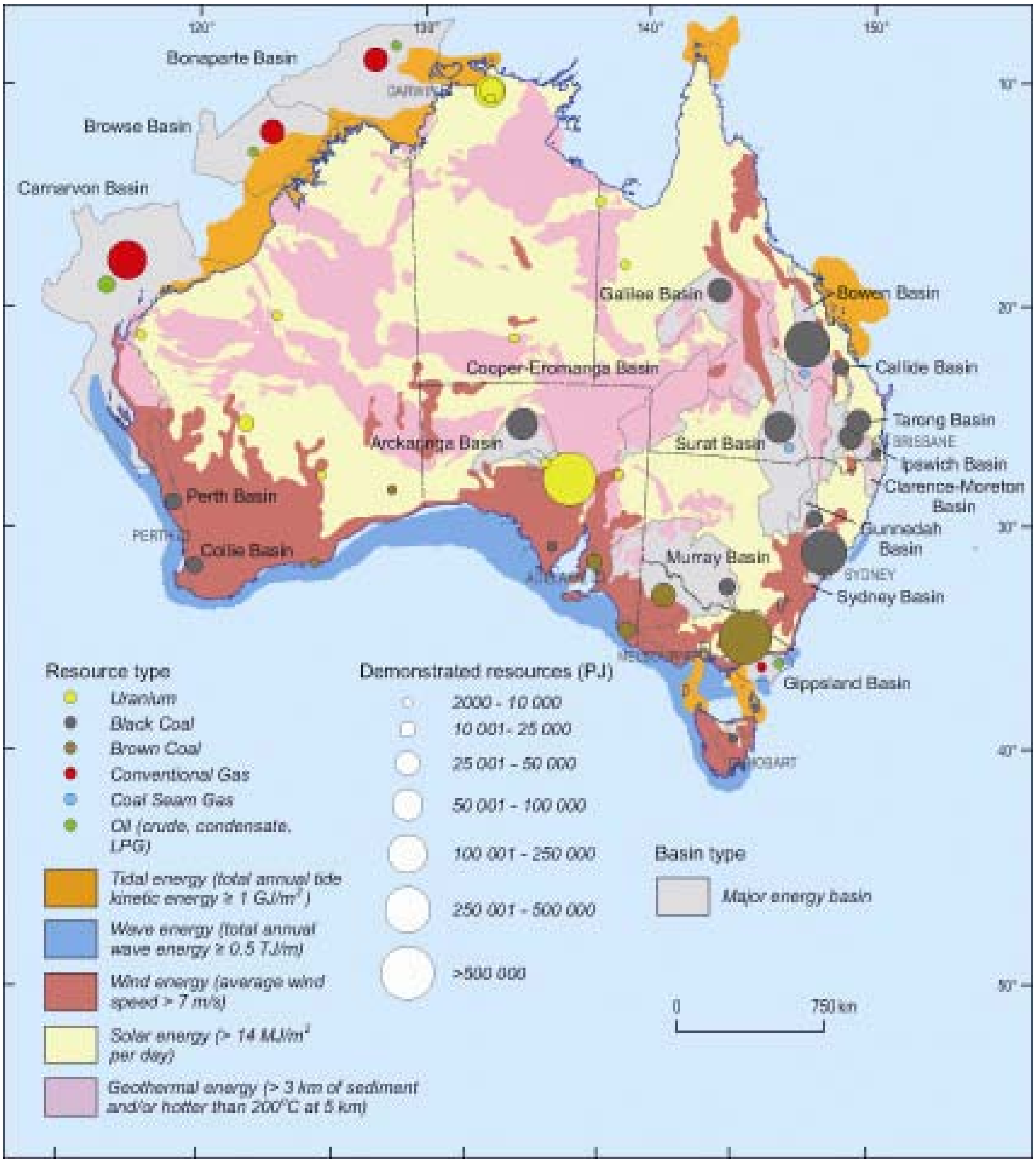
Sources: Australian Bureau of Statistics, *Australian industry 2009–10*, cat. no. 8155.0, *Australian system of national accounts 2010–11*, cat. no. 5204.0, *Australian labour market statistics 2011*, cat. no. 6291.0, ABS, Canberra, 2011.

Energy resource base

Australia has a rich, abundant and diverse range of renewable and non-renewable energy resources (see Figure 2.1). Non-renewable energy resources include fossil fuels (coal, gas and oil) and nuclear energy fuels (uranium and potentially thorium). Australia has world-class wind, solar and geothermal resources and plentiful wave, tidal and biomass sources of energy.

[1] BREE, *Resources and energy quarterly: September quarter 2011*, BREE, Canberra, 2011, p. 12 (includes metallurgical coal).

Figure 2.1: Australia's major energy resources, excluding hydro and bioenergy, 2010



Source: Geoscience Australia and ABARE, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, Canberra, 2010, p. 3.

Non-renewable resources

Most Australian states have black coal deposits, but the largest high-quality reserves are in New South Wales and Queensland. Brown coal deposits exist in all Australian states, although Victoria holds the bulk of commercial brown coal resources.

Australia's identified conventional gas resources have increased threefold over the past 20 years. Around 90 per cent of estimated recoverable reserves of conventional gas are located off the west and north-west coasts of Australia.

Australia also has significant unconventional gas resources, including coal seam gas, shale gas and tight gas. Most of the coal seam gas reserves are in the black coal deposits of Queensland and New South Wales, and shale gas reserves have been discovered in the Cooper Basin. There is also potential for development of tight gas resources, although these are still relatively poorly understood and no reserves of tight gas have yet been booked.

Most of Australia's uranium resources are in South Australia, the Northern Territory and Western Australia. The Olympic Dam deposit in South Australia is the world's largest uranium deposit.

Australia's crude oil reserves are relatively limited. However, Australian crude is typically low in sulphur and of the light variety of liquid fuels, which have greater value than the heavy variety because of their lower wax content.[2] Australia's largest petroleum-producing basins are the Carnarvon Basin in the north-west of Australia and the Gippsland Basin in Bass Strait.

Estimates for 2010 indicated that Australia holds just under half of the world's known economic uranium resources, 10 per cent of world coal resources, almost 2 per cent of world natural gas resources, and about 0.3 per cent of world oil reserves. Australia's economic demonstrated resources of coal and uranium were estimated to last well into the next century, with natural gas lasting 68 years (although this may have changed with planned LNG production capacity coming on line in the middle of the decade). Australia continues to have limited oil reserves – a situation that has existed for the last 15 or so years (see Table 2.2). Since these estimates were published, there have been large new (but yet to be fully demonstrated) discoveries in unconventional gas. There is also considerable potential for further discoveries as these resources become better understood.

Table 2.2: Australia's economic demonstrated resources (petajoules), 2010

	Australia	Share of world %	Reserves to production[e] years
Coal[a]			
Black coal	987 064	10.6	111
Brown coal	359 870	8.9	539
Petroleum			
Oil	6 290	0.3[b]	10
Condensate	12 691	na	45
LPG	4 399	na	42
Gas			
Conventional gas	123 200	1.6	68
Coal seam methane[c]	16 180	na	100
Uranium[d]	685 440	47.5	141

na = not available.

a. Recoverable resources as at December 2009.

b. Crude oil, condensate and LPG combined.

c. As at December 2008,most recent data available at time of publication.

d. Reasonably assured resources recoverable at costs of less thanUS$80/kg U.

e. Estimated economic demonstrated reserves under current production rates.

Source: ABARES, *Energy in Australia 2011*, ABARES, Canberra, 2011, p. 4.

[2] ABARES, *Energy in Australia 2011*, ABARES, Canberra, 2011.

Renewable resources

Australia's current renewable generation facilities include hydro, wind, solar, bagasse (sugarcane) and biogas (landfill and sewage). The distribution of renewable resources across the states and territories reflects the different geographic and climatic characteristics of the regions (see Figure 2.1).

Hydro power is mainly located in New South Wales, Tasmania, Queensland and Victoria. Expansion of hydro has been limited by the availability of suitable sites and some environmental concerns.

Almost all bagasse sources are in the sugarcane production areas in Queensland. Biogas sources are more evenly distributed across Australia, as they are based on gas generated from landfills and sewage treatment.

Australia has some of the best wind resources in the world, primarily located in western, south-western, southern and south-eastern coastal regions but extending hundreds of kilometres inland and including highland areas in south-eastern Australia. Most wind farms are currently located in high-quality resource sites located in South Australia and Victoria.

Solar power is a vast potential source of energy in Australia. The annual solar radiation falling on Australia is approximately 58 million PJ, which is about 10 000 times Australia's annual energy consumption.[3]

Australia has significant potential geothermal resources associated with buried high-heat-producing granites and lower-temperature geothermal resources associated with naturally circulating waters in aquifers deep in sedimentary basins.

Ocean energy, including mechanical energy from the tides and waves, is an underdeveloped but potentially substantial resource. The best tidal energy resources are along the northern margin (especially the north-west coast of Western Australia) and are largely removed from major demand centres. Australia also has significant wave energy resources along its western and southern coastlines.

Energy production

Australia is the world's ninth-largest energy producer, accounting for around 2.4 per cent of the world's energy production.[4] This largely reflects our resource endowments and success as a reliable, competitive supplier. Australian energy production has grown strongly over the past decade, with the majority of this production exported. Figure 2.2 shows the pattern of energy production since 1973–74. In 2009–10, coal dominated energy production (about 60%), followed by uranium (20%), gas (12%), liquid fuels and renewables.

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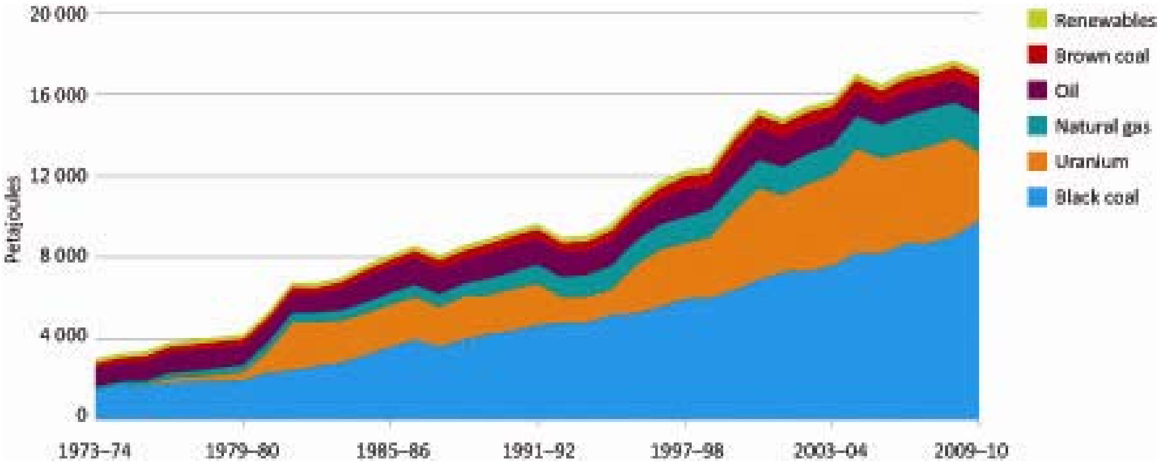
[3] Geoscience Australia and ABARE, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, Canberra, 2010, p. 268.

[4] ABARES, *Energy in Australia 2011.*

Figure 2.2: Australian energy production, 1973–74 to 2009–10



Source: ABARES, *Energy update 2011*, ABARES, Canberra, 2011, p. 6.

Energy trade

Australia is one of only three OECD net energy exporter countries. In 2010–11, the value of energy exports was nearly $69 billion.[5]

Australia is the world's largest coal exporter, making up over a quarter of world coal exports. Coal (including metallurgical and thermal coal) is also Australia's largest energy export by volume and value. In 2010–11, export earnings from Australian thermal coal (used for electricity generation) were around $14 billion, and earnings from metallurgical coal were around $29 billion.[6]

Australia is a major producer of uranium, ranked third in the world. In 2010–11, Australian uranium exports were estimated at 6950 tonnes of U_3O_8 (triuranium octoxide). Earnings from uranium exports were estimated at $610 million, a decline on previous years as a result of both lower export volumes and contract prices in Australian dollar terms. Australian uranium exports are forecast to increase in the next few years driven by higher forecast volumes and contract prices (in Australian dollar terms).[7]

Australian gas production is increasing, associated with new coal seam gas to LNG and conventional LNG projects. Gas production is heavily supported by demand from major export markets – Japan, Republic of Korea and China for LNG – as well as demand in Australia's electricity generation, industrial and residential sectors. In 2010–11, Australia's LNG exports were valued at $10.5 billion, a 34 per cent increase on the previous year, reflecting increased export volumes and higher prices.[8]

Australia is a net importer of crude oil and petroleum products, and its reliance on petroleum imports from South-East Asia and the Middle East is increasing (see Figures 2.3 and 2.4). Over the last decade, Australia's annual crude oil production and domestic refining capacity progressively declined while domestic consumption increased.

[5] BREE, *Resources and energy quarterly*, p. 133.

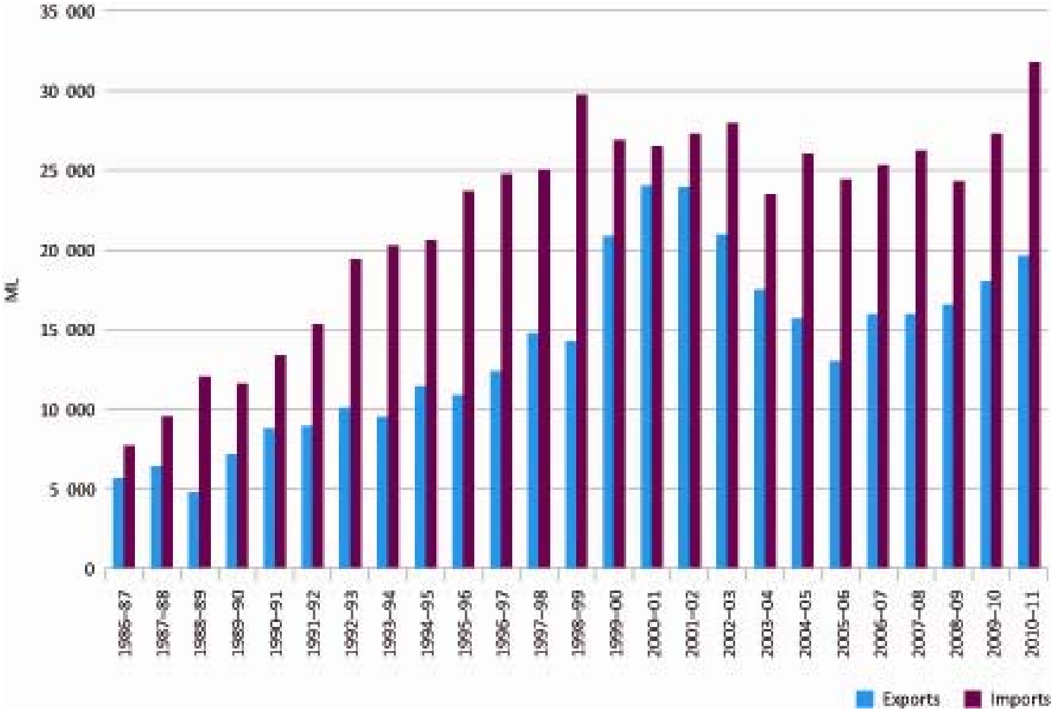
[6] BREE, *Resources and energy quarterly* p. 133.

[7] BREE, *Resources and energy quarterly*, p. 132–3.

[8] BREE, *Resources and energy quarterly*, p. 27.

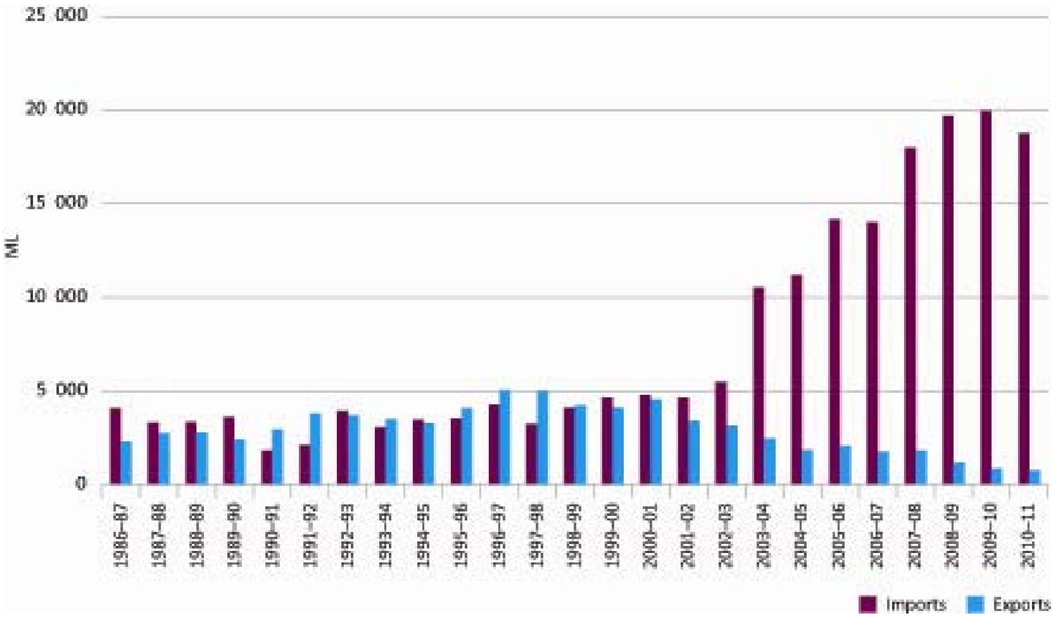
However, Australia also exports significant quantities of oil, particularly liquefied petroleum gas (LPG). This is because of the proximity of oil production in Australia's north-west to Asian refineries relative to domestic refineries on Australia's east coast. In 2010–11, Australian production of crude oil and condensate was 24.8 billion litres, and exports were 19.7 billion litres. The value of Australian oil exports are forecast to rise from $11.8 billion in 2010–11 to $13.3 billion in 2011–12.[9]

Figure 2.3: Australian trade in crude oil and other refinery feedstock, 1986–87 to 2010–11



Source: BREE, *Resources and energy statistics 2011*, BREE, Canberra, November 2011, p. 109.

Figure 2.4: Australian trade in refined petroleum products, 1986–87 to 2010–11



Source: BREE, *Resources and energy statistics 2011*, BREE, Canberra, November 2011, p. 110.

[9] BREE, *Resources and energy quarterly*, pp. 21–2.

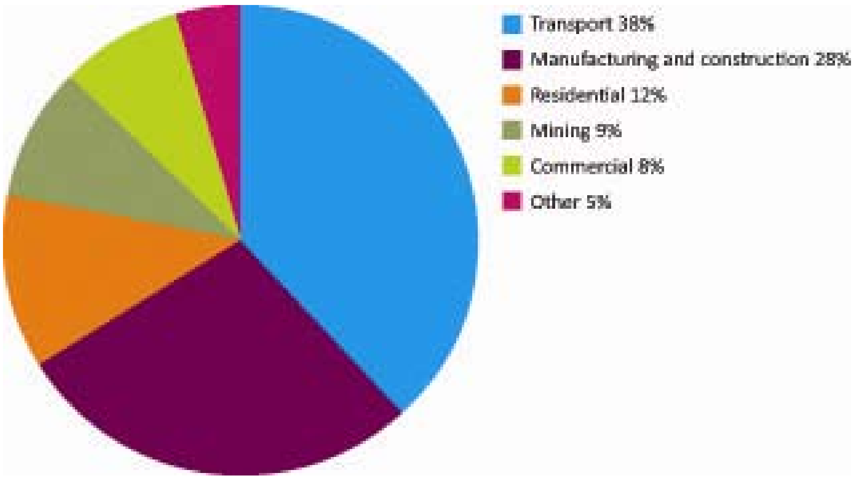
Energy consumption

Australia is the world's 20th-largest primary energy consumer and ranks 15th on a per capita basis. Energy consumption growth has slowed over the past 50 years, from an average of 5 per cent a year in the 1960s to 1.6 per cent a year since 2000.[10] This can be attributed to two main factors. First, greater efficiency has been achieved through technological improvements and fuel switching. Second, less energy-intensive sectors, such as the commercial and services sectors, have grown more rapidly than the energy-intensive manufacturing and processing sectors.[11] Energy productivity trends are discussed further in Chapter 6C.

Energy consumption by sector

The transport sector is the largest end user of energy in Australia, consuming over a third of final energy, followed by the manufacturing and construction sector, then the residential, mining and commercial sectors (see Figure 2.5).

Figure 2.5: Australia's energy consumption profile, 2009–10



Source: ABARES, *Energy update 2011*, ABARES, Canberra, 2011, p. 5.

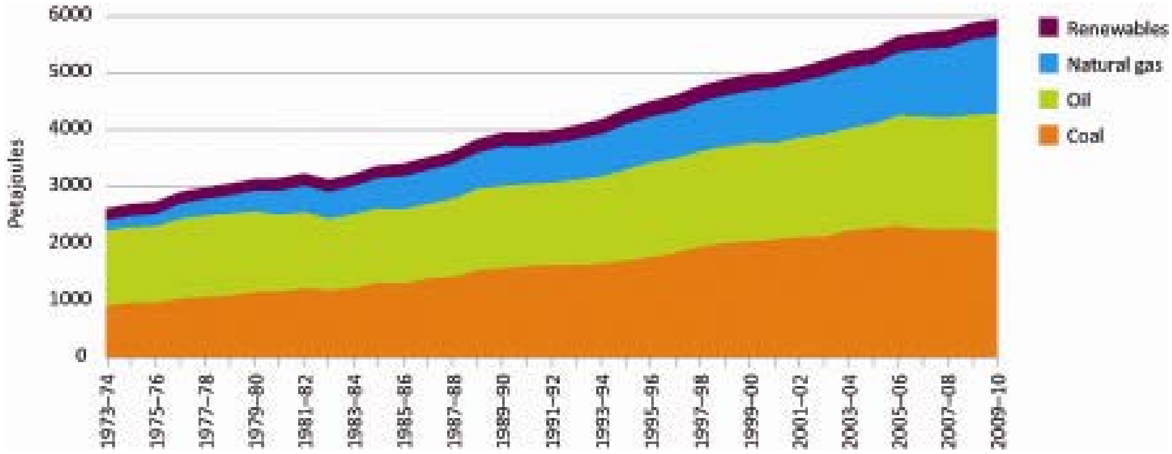
Energy supply by fuel

Total primary energy supply in Australia is dominated by black and brown coal, followed closely by oil (see Figure 2.6). Natural gas has grown strongly in recent years, and currently makes up just under a quarter of total energy supply. Renewable energy sources continue to make up only a small proportion of total energy supply, although the shares of wind and solar energy are growing.

[10] ABARES, *Energy in Australia 2011*.

[11] ABARES, *Energy in Australia 2011*.

Figure 2.6: Total primary energy supply, by fuel, 1973–74 to 2009–10



Source: ABARES, *Energy update 2011*, ABARES, Canberra, 2011, p. 3.

In 2009–10, black and brown coal constituted 37 per cent of Australia's primary energy supply. Since 1960–61, Australia's coal consumption has increased an average of 5 per cent each year, reflecting increased demand for electricity associated with economic and population growth.

Oil comprises 35 per cent of Australia's primary energy supply, although its share has been declining steadily from a high of almost 50 per cent in the late 1970s. Domestic consumption of oil continues to grow, but well below the rates experienced before the 1980s. The transport sector is the largest consumer of oil products in Australia, accounting for around 70 per cent of total use. The industrial sector makes up 20 per cent.

Gas represented 23.1 per cent of total primary energy supply in 2009–10 and overall consumption has grown strongly in the last five years at an annual average rate of 5.6 per cent. The manufacturing and electricity generation sectors are the largest consumers of domestic gas. Industry comprises a few large consumers, including metal product industries (mainly smelting and refining activities), the chemical industry (fertilisers and plastics) and the cement industry. The share of gas-fired electricity has increased in recent years, reflecting market reforms and an increase in gas availability. The strong share of the mining sector is dominated by use of natural gas in the production of LNG.

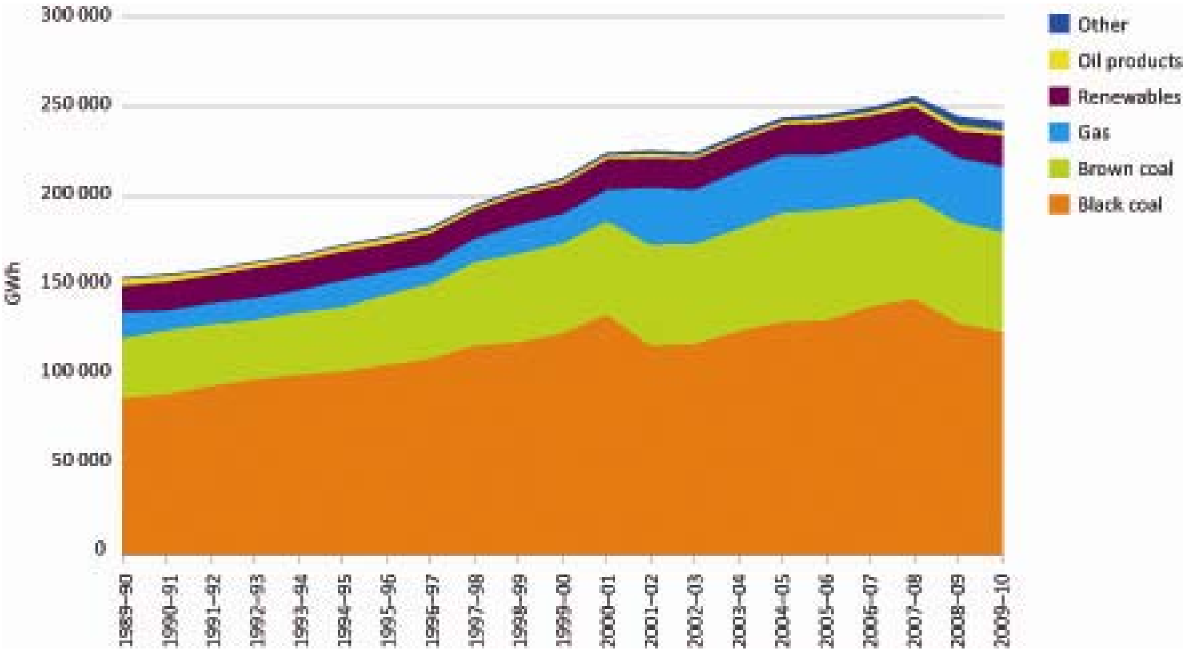
Renewable energy accounted for 5 per cent of Australia's primary energy supply in 2009–10. Around half of Australia's renewable energy is used to generate electricity; a quarter is consumed directly by industry and the remaining quarter by the residential sector.

Electricity

Figure 2.7 shows electricity generation by fuel type. Electricity production continues to be dominated by coal and natural gas, although there has been strong growth in renewables over recent years, albeit from a small base.

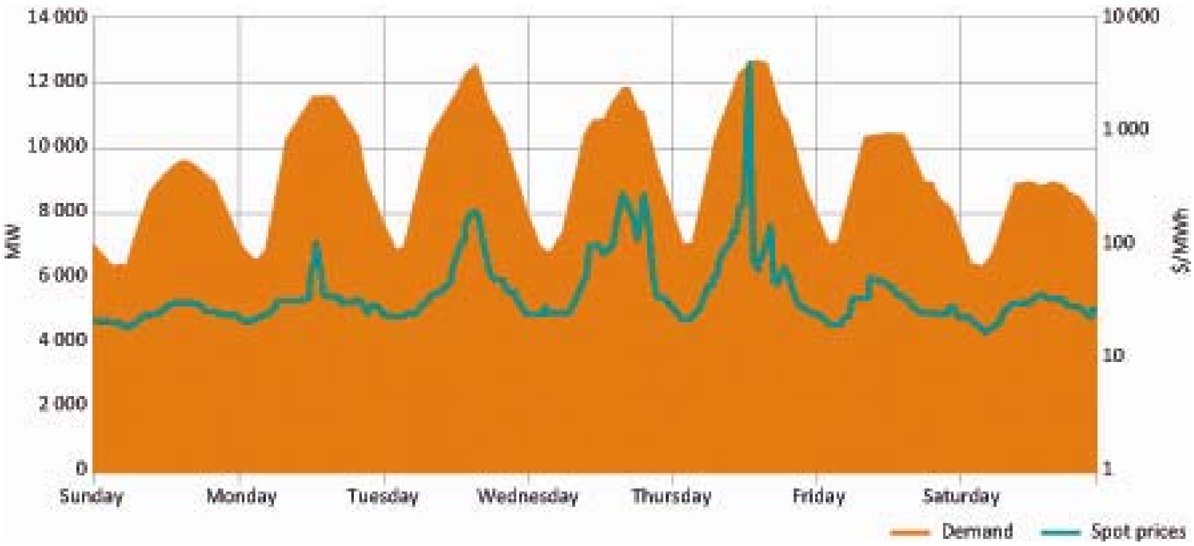
Demand for electricity fluctuates with the time of day, the day of the week and the season. Demand tends to peak in summer (from air-conditioning units) and winter (for heating). Peak demand during the day usually occurs in the early evening. Figure 2.8 illustrates a typical demand profile in New South Wales during summer.

Figure 2.7: Electricity production, by fuel, 1991–92 to 2009–10



Source: ABARES, *Energy update 2011*, ABARES, Canberra, 2011, p. 8.

Figure 2.8: NSW electricity demand profile, a week in January 2011



Source: Energy Supply Association of Australia, *National electricity market report: week 5 ending Saturday 29-Jan-11*, esaa, Melbourne, p. 5.

A reliable power system needs sufficient generation and network capacity to meet demand peaks. In effect, a substantial amount of this capacity may be called on for only brief periods and may remain idle for most of the year. As a result, the need to meet peak demand can drive substantial network costs – even if the network has surplus capacity for most of the time. In recent years, growth in peak demand has increased faster than overall electricity consumption.[12]

[12] Australian Energy Market Operator, *Electricity statement of opportunities*, AEMO, 2011.

Australia's electricity generators are owned by private and government bodies. While government ownership is significant, there has been a trend towards corporatisation and privatisation over recent years, most recently in New South Wales. Currently, most generation capacity in Victoria and South Australia is privately owned, while in Queensland and New South Wales state-owned and -operated generators account for around 67 per cent and about 50 per cent of capacity respectively. Generators in Tasmania, Western Australia and the Northern Territory are predominantly state-owned.

The Productivity Commission has recently undertaken an analysis of multi-factor productivity trends in the electricity, gas and water sectors. The results of this work are summarised in Box 2.1.

Box 2.1: Electricity sector productivity

The Productivity Commission has analysed the productivity of the electricity supply sector in Australia since the mid-1970s.[13] The analysis included changes in the amount of capital (generators, poles and wires) and labour inputs used to produce delivered electricity. The commission found that productivity of the electricity supply industry rose in the period from the mid-1980s until the late 1990s. However, productivity has consistently fallen since the late 1990s, and is now back to the level it was in the late 1980s.

The commission found three main causes for the rise and fall in productivity:

- The excess investment in supply capacity that occurred between the mid-1970s and mid-1980s contributed to productivity improvements in the 1990s, as output of electricity could increase without the need for major new investment. However, strong growth in generation and network capacity that has been underway since the mid-1990s has not yet resulted in significant additions to electricity output, so measured productivity has fallen.
- The investment in electricity generation since the mid-1990s has delivered environmentally cleaner but more expensive generation technologies (open cycle gas and wind power in place of coal-fired power), and this has also acted to reduce measured productivity.
- Over the past 30 years, investment in the wires that deliver electricity to homes has shifted from being dominated by above-ground wires, to the situation since the mid-1990s where about 60 per cent of new wires are placed underground. This has reduced measured productivity because, while underground wires cost up to 10 times more than above-ground wires, the benefits of undergrounding are not accounted for in the measurement of industry output.

Energy prices

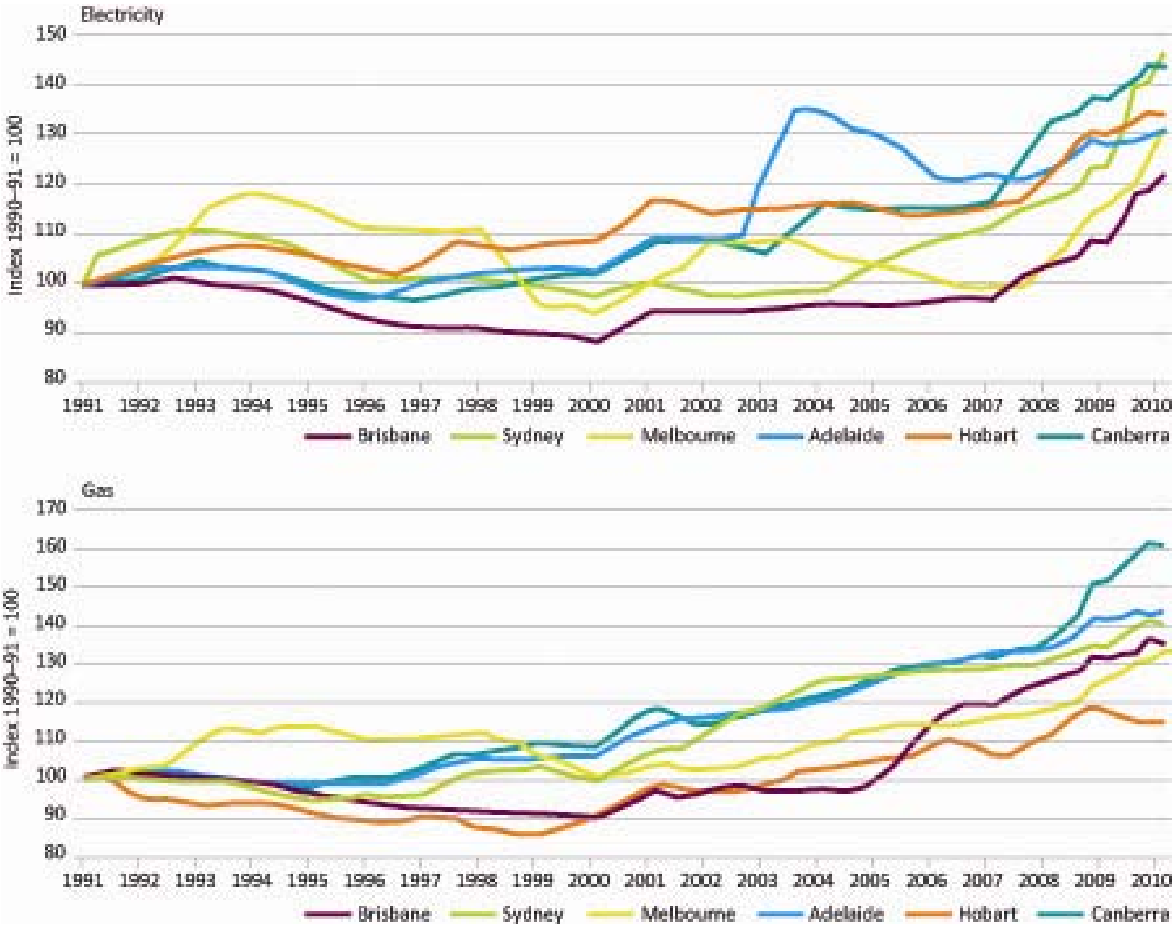
After a period of relatively stable retail electricity and gas prices through the 1990s and the first half of the last decade, significant increases occurred from 2007 (see Figure 2.9). These have been driven predominantly by increased network (mainly distribution) costs as well as a range of government measures to promote clean energy and energy efficiency.[14] A key factor in the increasing network costs is the need to invest in new and ageing network infrastructure to meet rising aggregate and peak demand and associated reliability requirements.

[13] Productivity Commission, *Annual report 2010–11*, Productivity Commission, Canberra, 2011.

[14] Australian Energy Market Commission, *Possible future retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney, 2011.

Overall, retail petrol prices, while displaying significant variations, remain at around the same level as they were in 2007, largely due to the moderating effects of a strong Australian dollar (see Figure 6A.6 in section 6A.1).

Figure 2.9: Electricity and gas retail price index (inflation adjusted), Australian capital cities, 1991 to 2010



Source: Australian Bureau of Statistics, *Consumer price index,* cat. no. 6401.0, ABS, Canberra, various years.

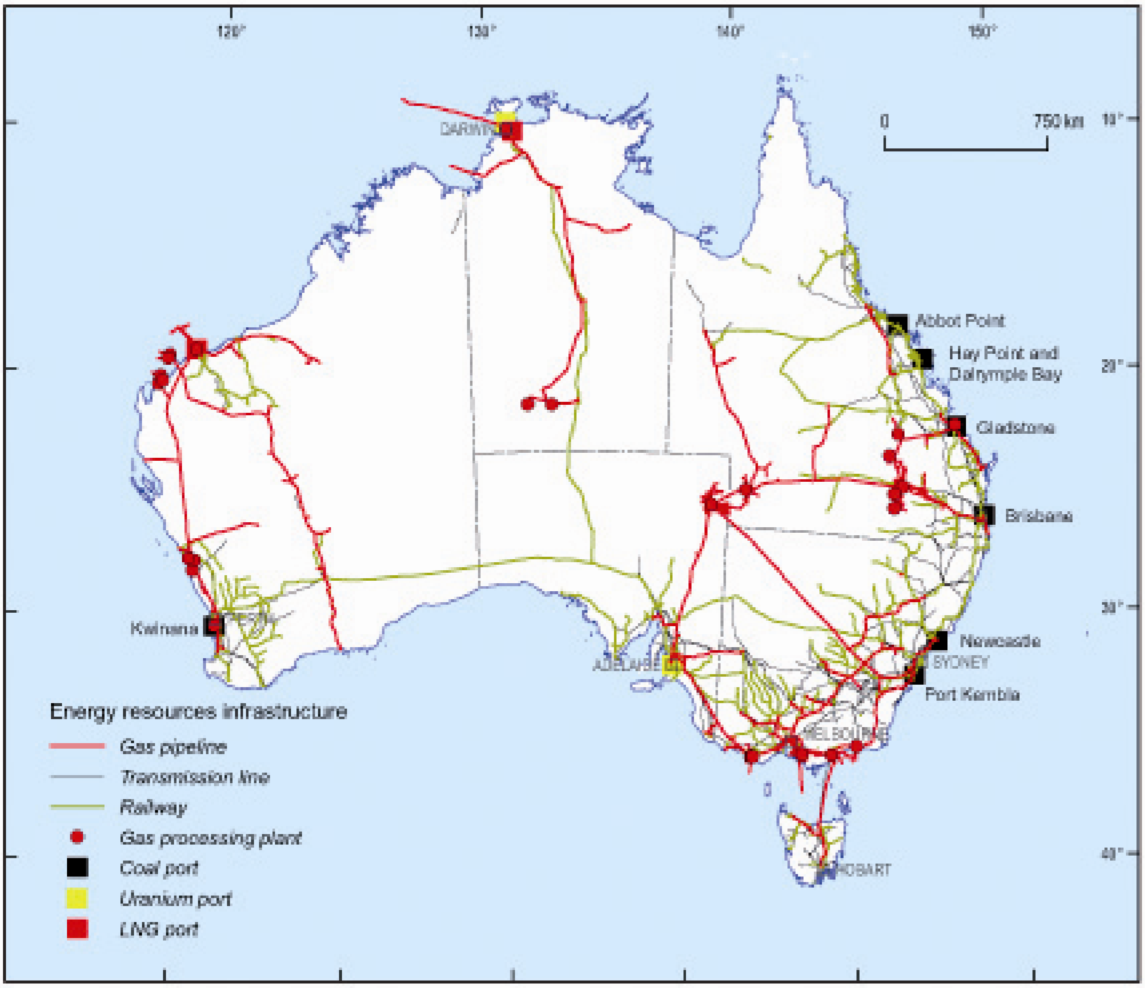
Energy resources infrastructure

The ability to import and export energy in Australia depends heavily on the capacity of major ports. Australia has nine major coal-exporting terminals located in New South Wales and Queensland. In 2009–10, these ports had a combined capacity of almost 350 million tonnes and loaded nearly 300 million tonnes of coal. Australian ports did not operate at capacity in 2009–10 for a number of reasons, including the temporary closure of some capacity for expansion work and weather-related incidents.

Infrastructure capacity constraints (including port and rail) have limited the Australian coal industry's ability to respond to growing global demand over the past few years. However, recent additions to capacity, together with more expansions planned over the short to medium term, are helping alleviate these constraints.

Australia has 11 major deep-water ports with facilities to export petroleum products (see Figure 2.10). The ports at Fremantle and Dampier in Western Australia are Australia's largest exporting centres. Australian exports of crude oil and condensate are increasingly sourced from the west coast, while exports of refined products are largely sourced from the east coast. Australia's refineries and liquid fuel import infrastructure are further discussed in Chapter 6A, and electricity infrastructure is discussed in Chapter 6B.

Figure 2.10: Australian energy resource infrastructure

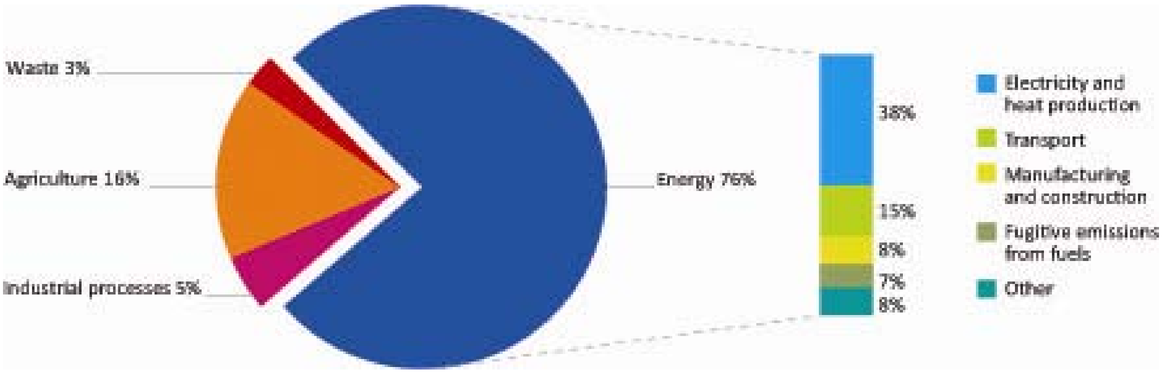


Source: Geoscience Australia and ABARE, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, 2010, p. 25.

Australia's energy greenhouse gas emissions profile

The energy sector accounts for around three-quarters of Australia's greenhouse gas emissions (see Figure 2.11). Public electricity and heat production, comprising Australia's electricity and gas use, is the single largest contributor, making up 38 per cent of our total greenhouse gas emissions. Other major energy-related emissions sources include transport, fuel combustion in manufacturing and construction industries, and fugitive emissions associated with coal mining.

Figure 2.11: Australia's greenhouse gas emissions profile (excluding land-use change)



Source: Department of Climate Change and Energy Efficiency, *National greenhouse gas inventory: December quarter 2010*, DCCEE, Canberra, 2011.

2.2 Energy governance arrangements

Constitutional responsibilities

Under the Australian Constitution, resources onshore and out to three nautical miles from the baseline of the territorial sea are the responsibility of state and territory governments. Within their jurisdictions, states and territories have primary responsibility for energy production, transport, land use, mineral rights and environmental assessments. Responsibility for resources beyond three nautical miles (Australia's offshore jurisdiction) rests with the Australian Government and is administered through a designated authority/joint authority arrangement between the Commonwealth and the state and Northern Territory governments.

Intergovernmental arrangements

At a national level the Council of Australian Governments (COAG) and its predecessors have been the main drivers of change in energy policy, particularly around interconnected markets in the east. COAG comprises the prime minister, state premiers, territory chief ministers and the president of the Australian Local Government Association. The Ministerial Council on Energy was established by COAG in 2001 to deliver the economic and environmental benefits for Australia from implementation of the COAG national energy policy framework.

The new COAG Standing Council on Energy and Resources has taken on the remits of the former COAG Ministerial Council on Energy and Ministerial Council on Mineral and Petroleum Resources. The standing council was established in September 2011, and is responsible for ensuring the safe, prudent and competitive development of the nation's mineral and energy resources and markets to optimise long-term economic, social and environmental benefits to the community.

The uranium industry in Australia is regulated at Commonwealth, state and territory levels. Commonwealth environmental approvals are governed by the *Environment Protection and Biodiversity Conservation Act 1999*, which currently includes uranium mining within the definition of 'nuclear actions'. Nuclear actions that have, will have, or are likely to have a significant impact on the environment are 'controlled actions', and require Commonwealth environmental approval. The use of nuclear power for energy is prohibited under the Act.

At the state and territory level, the approach to uranium mining varies across jurisdictions. Uranium mining is currently allowed in the Northern Territory, South Australia and most recently Western Australia.

Market governance

Over the past 20 years, under COAG-led energy market reforms, state and territory regulatory regimes have adopted a national framework covering electricity transmission and distribution networks and natural gas pipeline services. These reforms are reflected in national energy laws and rules, and the intergovernmental Australian Energy Market Agreement.

Under the national framework, three institutions have responsibility for energy market regulation and operation:

- The Australian Energy Market Operator is responsible for the day-to-day operation and administration of the electricity and gas wholesale and retail markets in all jurisdictions except Western Australia and the Northern Territory.
- The Australian Energy Market Commission is responsible for rule-making and market development in the national electricity and gas markets, reviewing the energy market framework and providing advice to the Standing Council on Energy and Resources.
- The Australian Energy Regulator is responsible for regulating the wholesale electricity market and for the economic regulation of the electricity transmission and distribution networks in the National Electricity Market. It is also responsible for the economic regulation of covered gas transmission and distribution networks and enforcing the national gas law and national gas rules in all jurisdictions except Western Australia.

State and territory governments are responsible for regulating retail energy markets. In 2004, however, they agreed to transfer several non-price regulatory functions to a national framework – the National Energy Customer Framework. The laws and rules underpinning the framework are now in place, and jurisdictions are working towards commencement in July 2012. The framework will be administered by the Australian Energy Market Commission and the Australian Energy Regulator.

Most jurisdictions have introduced full retail contestability, allowing consumers to choose their energy supplier. In the transition to effective competition in retail energy markets, retail price cap regulation continues to apply in several jurisdictions. Australian governments have agreed to review the continued use of retail price caps and to remove them if effective competition can be demonstrated.

In addition, general competition regulation is managed and enforced at a national level by the Australian Competition and Consumer Commission. The commission is also responsible for monitoring the price, costs and profits of unleaded petroleum products.

The liquid fuel market in Australia differs significantly from the more defined electricity and gas markets established under shared Commonwealth – state energy market legislation. The liquid fuel market is regulated through various intersecting frameworks at the Commonwealth, state and territory levels covering competition policy, pricing, environmental, health and safety issues and fuel standards.

Offshore petroleum activities in Australia are regulated by the Commonwealth, state and Northern Territory governments. Operations beyond the designated state and territory coastal waters are governed by the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and related regulations. This area is commonly referred to as 'Commonwealth waters'.

From 1 January 2012, the National Offshore Petroleum Safety and Environmental Management Authority will regulate occupational health and safety, wells and well operations, as well as the structural integrity of facilities and environmental management within Commonwealth waters. The National Offshore Petroleum Titles Administrator will have responsibility for the administration of all offshore petroleum titles.

Australian Government energy arrangements

A range of Australian Government agencies contribute to energy governance, policy development, and research and analysis.

The Department of Resources, Energy and Tourism has primary responsibility for energy policy within the Australian Government. Other agencies that have energy-related roles are the Treasury, the Department of Infrastructure and Transport, the Department of Innovation, Industry, Science and Research, and the Department of Climate Change and Energy Efficiency. The Department of Sustainability, Environment, Water, Population and Communities – through its responsibilities for environmental policy and regulation – has a role in regulating environmental aspects of energy project development and operations.

The Bureau of Resources and Energy Economics is the Australian Government's principal agency for energy and resources economic research. It provides information and independent advice to government, industry and the broader public including through the regular publication of detailed energy and resource information. The Bureau of Infrastructure, Transport and Regional Economics provides economic analysis, research and statistics related to transport and related infrastructure which is of particular relevance to our liquid fuels and transport energy.

Geoscience Australia is the national geoscience and geospatial information agency, providing onshore and offshore geoscientific information and knowledge that enables government and the community to make informed decisions about: the exploitation of resources; the management of the environment; the safety of critical infrastructure; and the resultant wellbeing of all Australians. CSIRO also has a strong energy-related focus through its flagship programs, including the Energy Transformed Flagship, Minerals Down Under Flagship and Future Manufacturing Flagship.

3 Future energy trends, priorities and challenges

Highlights

- Energy markets and systems around the world are entering a period of enormous change that will last for decades.
- Energy security remains a key concern for many countries. Along with the response to climate change, this concern will drive technological advances in many areas, benefiting technology takers such as Australia.
- Global and national demand for energy will continue to grow but higher prices and policies to reduce greenhouse gas emissions and encourage efficiency will moderate demand growth.
- Fossil fuels will still play a major role in meeting global and Australia's energy needs. However, the energy base will become more diverse with a shift towards renewable and alternative technologies such as carbon capture and storage. Nuclear will continue to be a significant contributor of energy in many countries that lack indigenous energy resources. Changes can also be expected in transport fuels and more efficient lower-emissions engine and drive technologies.
- Markets will determine outcomes, and trend analysis is not necessarily predictive. In this sense realising our energy goals at a manageable cost will require us to successfully navigate a range of strategic policy and market challenges. These include:
  - attracting sustained investment in the Australian energy sector. Around $240 billion in new generation and transmission will be required by 2030 in energy generation and supply alone. This is an unprecedented test for our energy markets
  - managing ongoing risk and uncertainty. This includes price and supply risks as well as unforseen shocks that may arise in global or national markets
  - changing market dynamics introduced by new technologies, carbon pricing and growing linkages between national and international markets. New business models will emerge and markets must be allowed to adjust – but with support – to ensure transition pathways are smooth and competition and efficiency is maintained
  - the cost of energy. Meeting society's future energy needs will result in higher energy prices. To ensure efficient long-term investment in the energy sector, prices must reflect cost of supply. It will be important that energy markets are as efficient as possible and that policies do not impose unnecessary costs. Further reforms are needed to improve market efficiency to address peak demand and ensure consumers have better options to manage costs
  - ensuring that energy-related cost-of-living pressures are addressed and consumer protections are maintained for the less advantaged.

3.1 Introduction

This section examines factors that will shape Australia's energy future, our potential development paths, our long-term energy security and the overarching strategic challenges that must be addressed to realise our energy goals.

In doing so, it provides a possible picture of how global and Australian energy sectors may develop from now through to 2030 and beyond. This is necessarily a composite global and national projection based on data analysis and modelling drawn from bodies such as the International Energy Agency, the Australian Treasury, the Australian Energy Market Operator, the Bureau of Resources and Energy Economics, Geoscience Australia and various industry sources.

This is one of many possible futures and it does not represent a prediction or outcome that the Australian Government will mandate through policy settings. That approach would almost certainly position Australia inflexibly in an inherently dynamic future. Rather, it provides a picture of national potential and possible global direction given current policy frameworks and the government's expectation of how major social and economic forces may play out over coming decades.

Markets will determine outcomes, and markets will also make their own assessment about likely trends.

3.2 Global energy trends to 2035

Global energy patterns are expected to change

The global energy system is expected to change over coming decades. While we can expect much of our energy base to remain similar to today's, new fuels and technologies will increasingly capture market share and diversify energy systems. A growing and more affluent population will demand more reliable access to energy while also pursuing improved environmental outcomes, particularly the reduction of greenhouse gas emissions and better air quality.

Many of today's key challenges will remain, including entrenched global energy poverty and energy security concerns, particularly the growing exposure of many countries to the rising costs of energy. These will likely be key drivers in the energy policies that countries adopt and will continue to affect future development decisions.

The International Energy Agency (IEA) *World energy outlook 2011* models three scenarios based on the IEA's assessments of key parameters that will affect global energy trends from now to 2035.[1] These include drivers such as population growth, economic and social development patterns and availability and costs of new technologies. Many of these depend on the success of governments in providing the framework and support to promote technological innovation, and the degree to which greenhouse gas emissions policies are adopted and affect energy supply and demand.

[1] IEA, *World energy outlook 2011*, IEA, Paris, 2011.

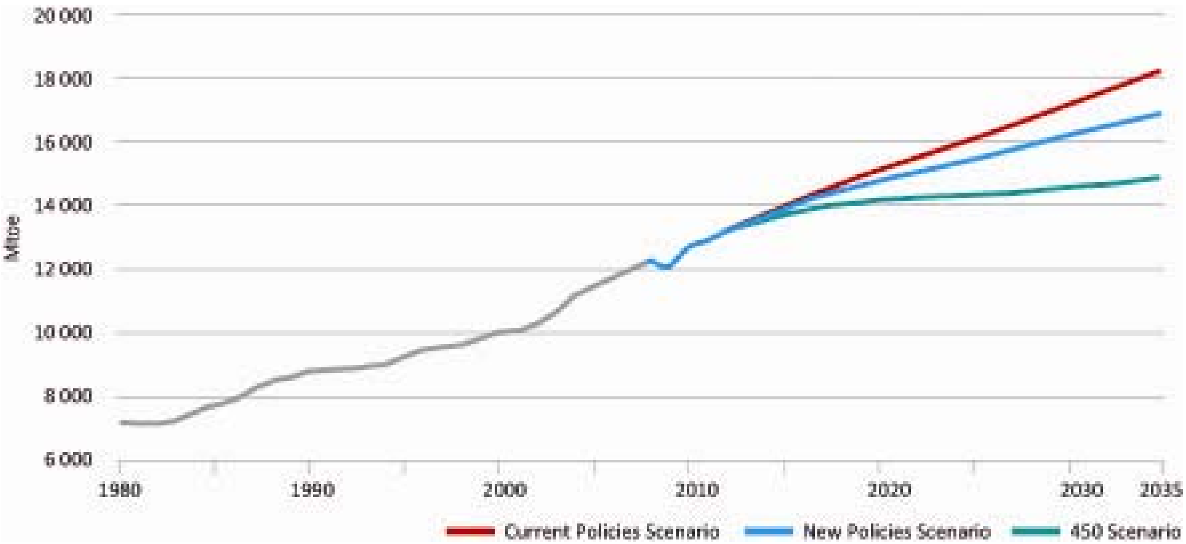
The IEA scenarios are:

- the ‘New Policies Scenario’, which incorporates broad announced country policy commitments and plans on energy and cautious implementation of recently announced plans and commitments. This is used as the IEA central scenario
- the ‘Current Policies Scenario’, which models the future on the basis of perpetuation of government policies and measures enacted or adopted, without change
- the ‘450 Scenario’, which sets out an energy pathway consistent with a limit on the long-term concentration of greenhouse gas emissions in the atmosphere to 450 parts per million (ppm), and a 50 per cent chance of limiting the increase in the average global temperature to 2°C, compared with pre-industrial levels.

Global energy demand will increase

Under all three IEA scenarios, world primary energy demand is expected to increase, although the strength of the global response to climate change will play a major role in determining the rate of growth, particularly after 2020 (see Figure 3.1). In the absence of further greenhouse gas reduction measures, energy demand grows at 1.6 per cent a year, compared to much slower growth if the world were to take concerted action (0.8 per cent a year). This difference reflects the degree to which countries enact energy efficiency measures in each scenario.[2]

Figure 3.1: World primary energy demand, by scenario, 1980 to 2035



Source: IEA 2011, *World energy outlook 2011*, IEA, Paris, p. 70.

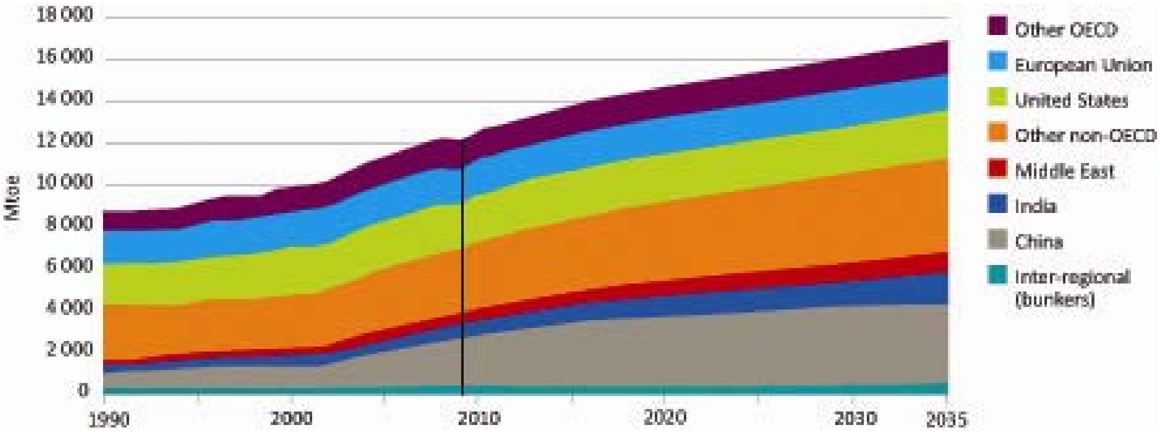
Growth in energy demand is driven by non-OECD countries, particularly China and India

Growth in global energy demand is not distributed evenly, reflecting broader shifts in global economic balances. Under the New Policies Scenario, non-OECD countries account for around 90 per cent of growth in primary energy demand. China accounts for more than 30 per cent of this growth,

[2] IEA, *World energy outlook 2011*, p. 70.

and India adds around 16 per cent. Rapid industrialisation and modernisation in these countries is expected to continue driving growth in demand. Aggregate growth across the OECD is slow at around 8 per cent from 2009 to 2035 (see Figure 3.2).

Figure 3.2: World primary energy demand by region in the New Policies Scenario, 1990 to 2035

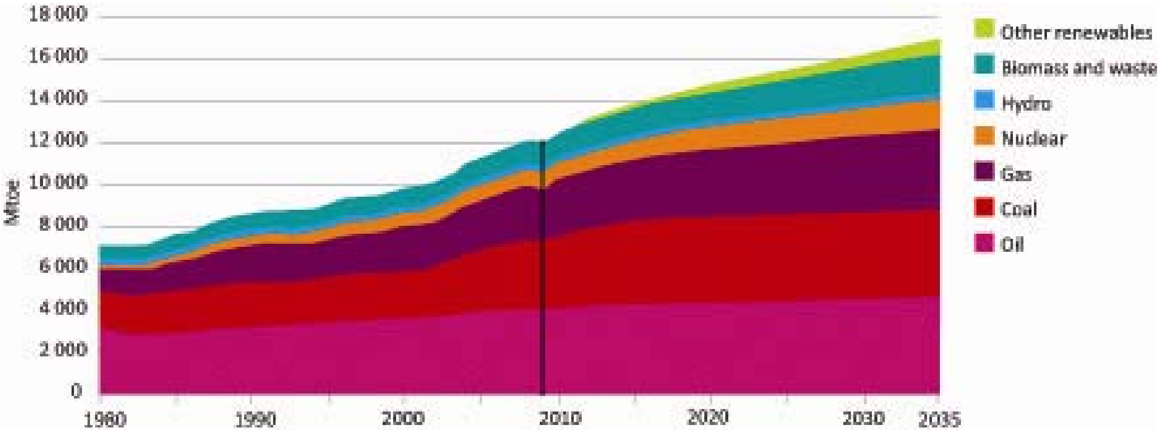


Source: IEA, *World energy outlook 2011*, IEA, Paris, 2011, p. 80.

Demand for all fuel sources increases

The most significant changes over the next 25 years are expected to be in patterns of energy generation and production. Under the New Policies Scenario, the use of all fuel types expands but fossil fuels still account for more than one-half of the overall increase (see Figure 3.3). Renewable energy (traditional and modern) expands its share of total primary energy demand, from 13 per cent in 2009 to 18 per cent in 2035.[3] The share of electricity generation from non-hydro renewable energy sources (wind, biomass, solar, geothermal and ocean) increases more than fivefold, from 3 per cent in 2008 to 15 per cent by 2035 and overall, total renewable energy grows from 19 per cent to around 31 per cent of electricity generation by this time.[4]

Figure 3.3: World primary energy demand by fuel in the New Policies Scenario, 1980 to 2035



Source: IEA, *World energy outlook 2011*, IEA, Paris, 2011, p. 76.

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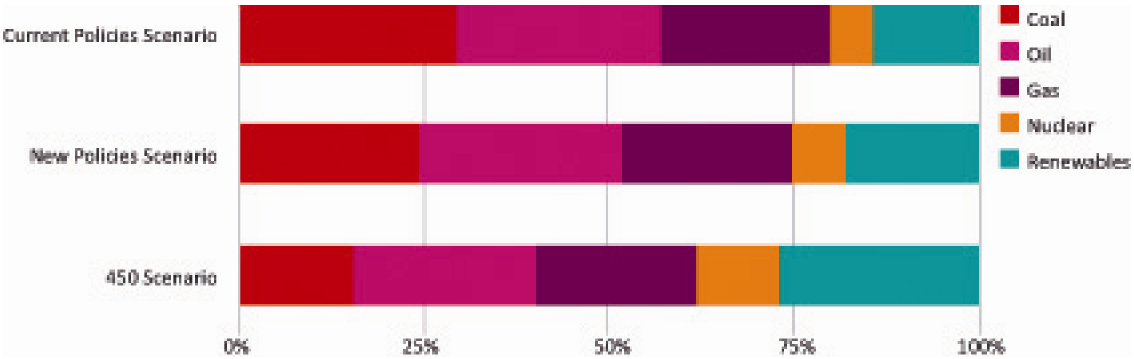
[3] IEA, *World energy outlook 2011*, p. 79.

[4] IEA, *World energy outlook 2011*, p. 175.

Nuclear energy also grows in importance from 6 per cent to 7 per cent of total primary energy demand (largely driven by expansion in China and other developing countries).[5] The Fukushima nuclear incident in Japan in 2011 is not expected to significantly affect nuclear growth in the medium to long term, although some countries may be prompted to diversify their energy base with natural gas, coal and renewables.

These trends will dramatically accelerate if the world takes more substantive action to stabilise greenhouse gas concentrations at 450 ppm (see Figure 3.4). Under the 450 Scenario, global use of fossil fuels (mainly coal) declines markedly with a corresponding expansion in low-emissions sources of renewable and nuclear energy. In this scenario, global coal use declines from around 27 per cent of the global mix to around 16 per cent by 2035.[6]

Figure 3.4: Shares of energy sources in world primary demand by scenario, 2035



Source: IEA, *World energy outlook 2011*, IEA, Paris, 2011, p. 72.

The IEA forecasts that global oil production from conventional and unconventional sources will continue to grow. Physical production limits (so-called 'peak oil') are unlikely to be reached before 2035. However, rising oil prices – from US$78 per barrel (in real terms) in 2010 to US$120 per barrel (in real terms or US$211 in nominal terms) in 2035 – as well as demand-changing policies and technologies could result in a demand-induced peak in global production after 2020, depending on the scope of global climate change action. If oil prices remain high, substantial unconventional oil reserves (such as tar sands) may be unlocked to maintain supply. The risk of major supply disruptions remains an unknown but ever-present factor.

Despite the increased uptake of alternative fuels, oil will remain the primary energy source for the transport sector to 2035.[7] Greater transport activity in rapidly developing countries means that emissions in the sector will grow even with the global electrification of transport and adoption of energy-efficient technologies.[8] International development of these technologies will flow into Australian markets.

Gas is expected to experience a 'Golden Age', with growth increasing by 55 per cent over the period to 2035,[9] and equalling global demand for coal. The growth in gas demand is attributed to its attractiveness in terms of low prices and environmental benefits relative to some other energy sources. Recent developments reinforce the increasing role of gas, including the ambitious gas policy

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[5] IEA, *World energy outlook 2011*, p. 79.

[6] IEA, *World energy outlook 2011*, p. 71.

[7] Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, p. 62.

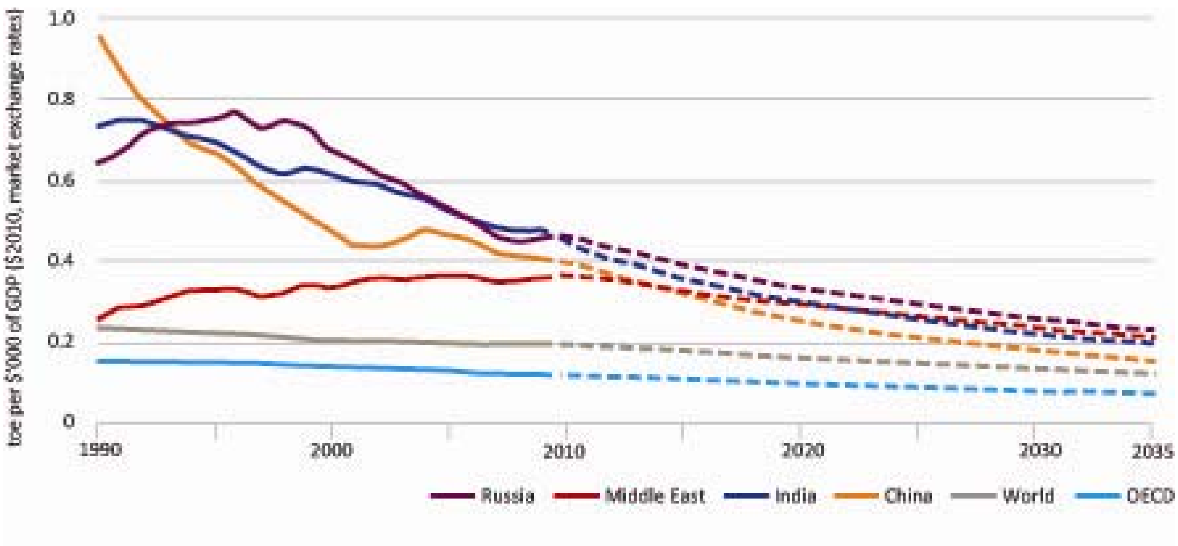
[8] IEA, *World energy outlook 2011*.

[9] IEA, *World energy outlook 2011*, p. 156.

laid out in China's 12th Five-Year Plan, greater global gas supplies, and greater use of gas in transportation. In the next few years the IEA projects that Australia will become the second-largest exporter of LNG and by 2035 we will be the eighth-largest producer of gas.

Rising living standards around the world, along with expansion and replacement of energy-related capital stock over the period to 2035, will lead to continued convergence in the intensity of energy use between major countries and regions (see Figure 3.5). Nonetheless, there will still be a large discontinuity in access and quality of energy between many parts of the world.

Figure 3.5: Energy intensity in selected countries and regions in the New Policies Scenario, 1990 to 2035



Source: IEA, *World energy outlook 2011*, IEA, Paris, 2011, p. 82.

Continued strong demand for low-cost and reliable energy supplies in the Asia–Pacific will offer Australia the opportunity to consolidate its role as a major regional energy supplier over coming decades. Rising living standards across the region are also likely to prompt higher environmental standards, which may provide Australia with innovation opportunities in clean energy products. In turn, the large manufacturing economies of scale in emerging economies may drive innovation and cost reductions in clean energy technologies that benefit Australia and lower the cost of our national emissions abatement task.

Finally, the IEA has estimated that around 80 per cent of the world's allowable carbon dioxide emissions budget under a 450 parts per million (or 2 degree global warming) scenario is already locked in through existing capital stock (such as power plants, factories and buildings).[10] The IEA analysis emphasises that solutions must be found from a portfolio of technologies and fuels, and that the world cannot afford to limit options if we are to meet climate goals. It estimated that a 10-year delay in the development of carbon capture and storage technologies could increase the cost of meeting a 450 parts per million goal by 8 per cent to 2035. Similarly, a major reduction in the use of nuclear energy would make staying within a 450 parts per million emissions budget extremely challenging and impose similar costs.

[10] IEA, *World Energy Outlook 2011*, pp. 209–38.

3.3 Australia's long-term energy future

The Australian energy sector is at the start of a new and dynamic chapter. The introduction of carbon pricing and the possibilities of new technology development will drive fundamental and long-term changes in how we generate and use energy in future decades. Our energy needs will expand at the same time, presenting economic opportunities as well as challenges. It will be a time of large-scale change in Australia's and the world's energy systems.

A complex set of factors will influence the scale and nature of this change. These factors include population and development patterns, structural changes in the economy, movements in domestic and international carbon and energy prices, technology development costs, consumer choices and Australian, state and territory government policies.

Not surprisingly, a range of credible assessments for how these and other factors may impact Australia to 2030 and beyond are available. The three principal modelling exercises that were used to develop the composite projection for this draft Energy White Paper are outlined at Appendix C. The modelling results have many common elements as well as important differences in assumptions, methodologies and scope. For example, some modelling exercises cover the entire economy; others are energy or electricity sector-only. The modelling exercises also extend across different timeframes, i.e. 2030, 2035 and 2050. This diversity makes presenting a projection of the future somewhat challenging while also adding to its robustness.

It also underlines a key theme of this draft Energy White Paper: that Australia stands at the beginning of a new energy era. As it unfolds, we will be presented with enormous opportunities as well as very real challenges, and the ultimate outcomes are far from predetermined.

Overall trends

Modelling by the Australian Treasury, for its 2011 report *Strong growth, low pollution: modelling a carbon price*, projects that by 2050, Australia's population could increase by 62 per cent to reach 36.3 million.[11] Much of this growth is expected to be in capital and major regional cities, through increasing urbanisation.[12] National GDP is expected to increase by an average of 2.6 per cent a year in real terms to 2050. The average gross national income per person is projected to rise 16 per cent or $9000 in real term's by 2020, and by 56 per cent or $30 000 in real terms by 2050.[13]

Appliances and technology will become more efficient, more widespread and cheaper in real terms. Far-reaching advances in information and computing technologies will provide greater interconnectivity and opportunities for many Australians to manage their personal and working lives.

Three principal drivers will intersect and shape Australia's energy future to 2030 and beyond:

- the ongoing expansion of our energy exports to Asia and other growth markets which will underpin a massive development of our energy resources
- the need to replace and expand our electricity generation capacity and networks to meet growing demand for electricity
- the drive to meet our national greenhouse gas reduction targets and develop clean energy systems through carbon pricing and other supporting measures.

[11] Treasury, *Strong growth, low pollution*, p. 56.

[12] Department of Sustainability, Environment, Water, Population and Communities, *Sustainable Australia – Sustainable communities*, DSEWPaC, Canberra, 2011, p. 32.

[13] Treasury, *Strong growth, low pollution,* p. 56.

Australia's resources trade boom is likely to continue for some time, supported by economic and social expansion in Asia. Our high terms of trade will add wealth to our economy as well as result in competitive pressure on some import-competing and export-based industries.

Energy-intensive industries are expected to continue to prosper, supported by transitional assistance under the Clean Energy Future package. Over time, growth is expected to slow as some emissions-intensive, trade-exposed activities that depend heavily on low-cost electricity (such as aluminium production) face competitive pressures from countries that have access to cheaper low-emissions power (such as hydroelectricity). Continued access to competitively priced and reliable sources of feedstock gas will also be important for industries such as plastics and chemicals. The evolution of the economy towards a less energy-intensive structure will continue as activities (such as services and construction) grow faster relative to more energy-intensive industries.[14]

Energy trends

Australia's energy production is expected to grow by 3.4 per cent a year, reaching around 43 000 petajoules in 2034–35.[15] An increasing share of this production will be exported. The combination of rising carbon and underlying energy prices will moderate domestic demand growth and change domestic fuel use patterns, particularly after 2020 as clean energy technology breakthroughs are made and costs decline.

Australia's energy and carbon markets will mature and work to efficiently internalise costs and optimise outcomes, supported by targeted policy interventions and effective regulation. However, energy costs are expected to continue to rise due to the large investments needed to meet Australia's energy goals. This will put pressure on energy affordability for lower-income households and energy-intensive businesses, even as average incomes rise.[16]

Energy production

Australia's rich and diverse energy resource base, its reputation as a reliable supplier and its proximity to growing economies means we are well placed to consolidate our role as a major global supplier of coal, liquefied natural gas (LNG) and uranium.

The Bureau of Resources and Energy Economics (BREE) forecasts an acceleration of energy production to 2034–35 as export demand increases (see Figure 3.6). Energy production and export are projected to rise significantly, while consumption will grow modestly.

Figure 3.7 shows that Australian energy exports are expected to expand rapidly over the next decade. Coal, uranium and gas exports all show growth, while oil shows a decline.

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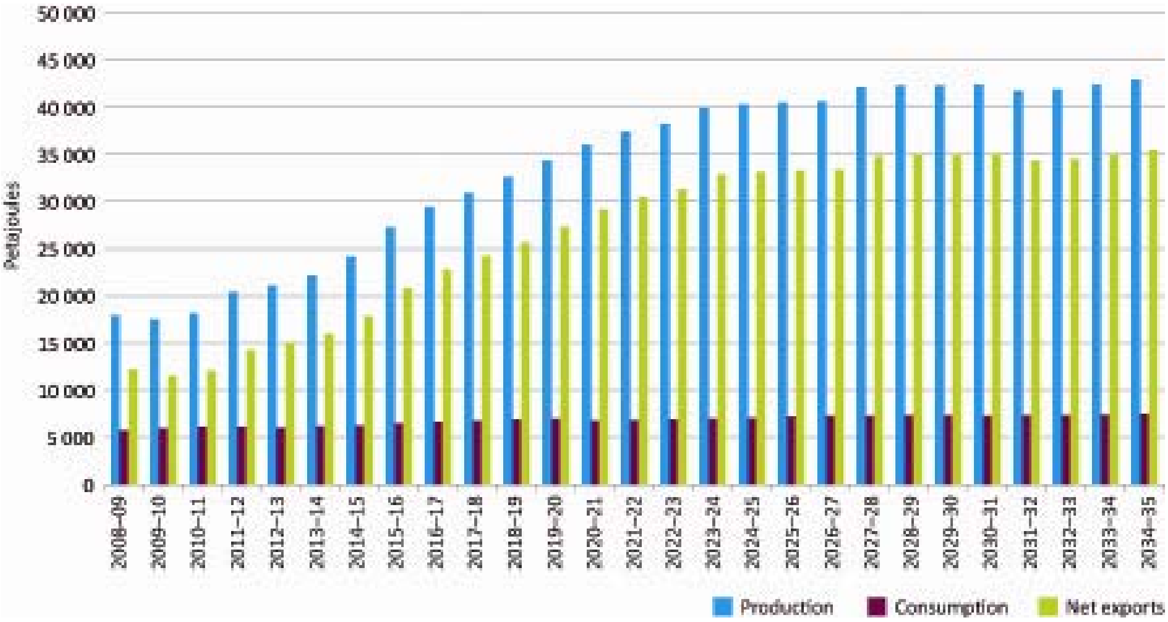
[14] Treasury, *Strong growth, low pollution*, p. 112.

[15] Derived from BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011 (includes uranium production). Measures of energy consumption, production and net trade are expressed in energy content terms (typically petajoules or gigawatt hours for electricity) to allow for comparison across the energy commodities. The significance of a commodity in energy content terms may differ from physical production units (such as tonnes, litres and barrels) and value.

[16] The government is providing assistance to a wide range of households and businesses to assist with carbon price impacts.

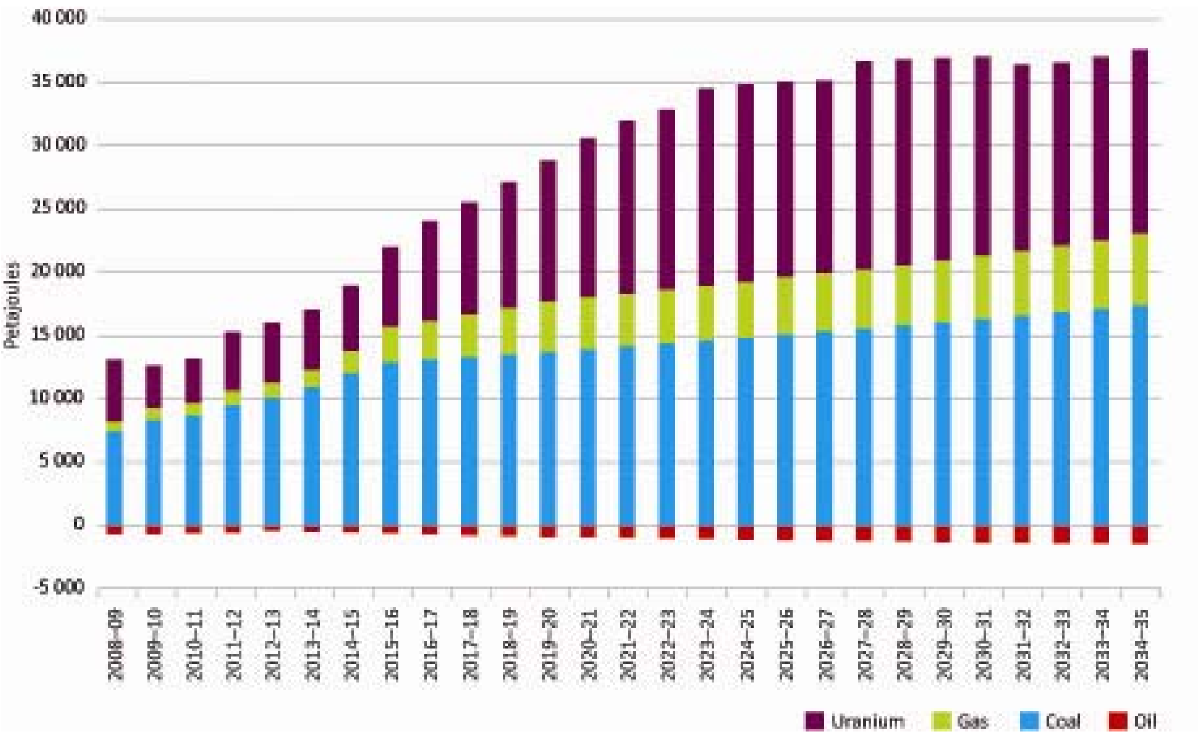
Figure 3.6: Australian energy production, consumption and total exports 2008–09 to 2034–35



Note: Data includes uranium.

Source: Derived from BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

Figure 3.7: Australian energy export projections by fuel, 2008–09 to 2034–35

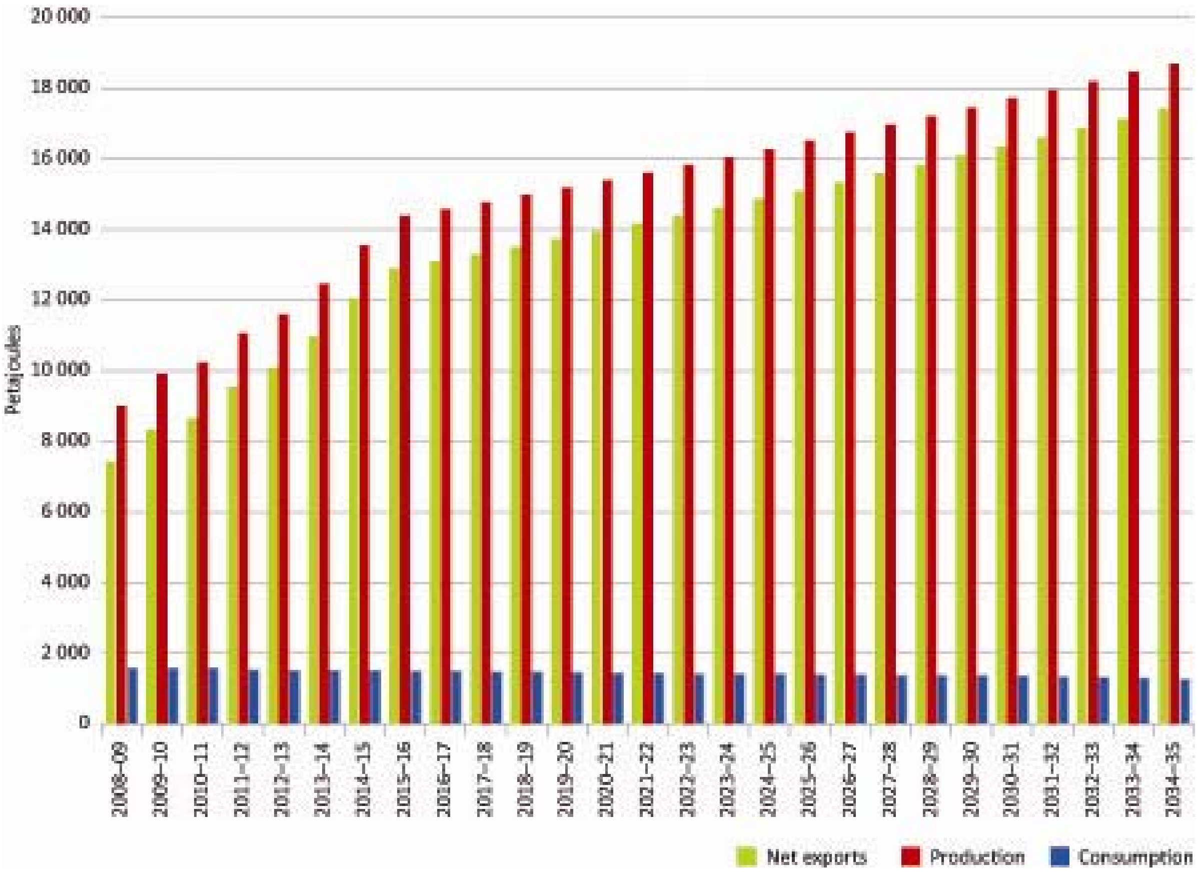


Note: Data includes uranium.

Source: Derived from BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

Figure 3.8 shows Australia's projected coal production, consumption and trade to 2034–35. From 2008–09, black coal production is expected to grow an average of 2.8 per cent a year (more than doubling), with production increasing in New South Wales and Queensland to service the traditional export markets of Japan and Korea and meet growing demand from China and India. Brown coal production is expected to remain steady to 2020 (subject to negotiated power stations closures) and then decline to 2034–35. Coal is expected to remain an important energy source over the long term, particularly if it is supported by the broad-scale roll-out of cost-competitive carbon capture and storage electricity generation technologies.

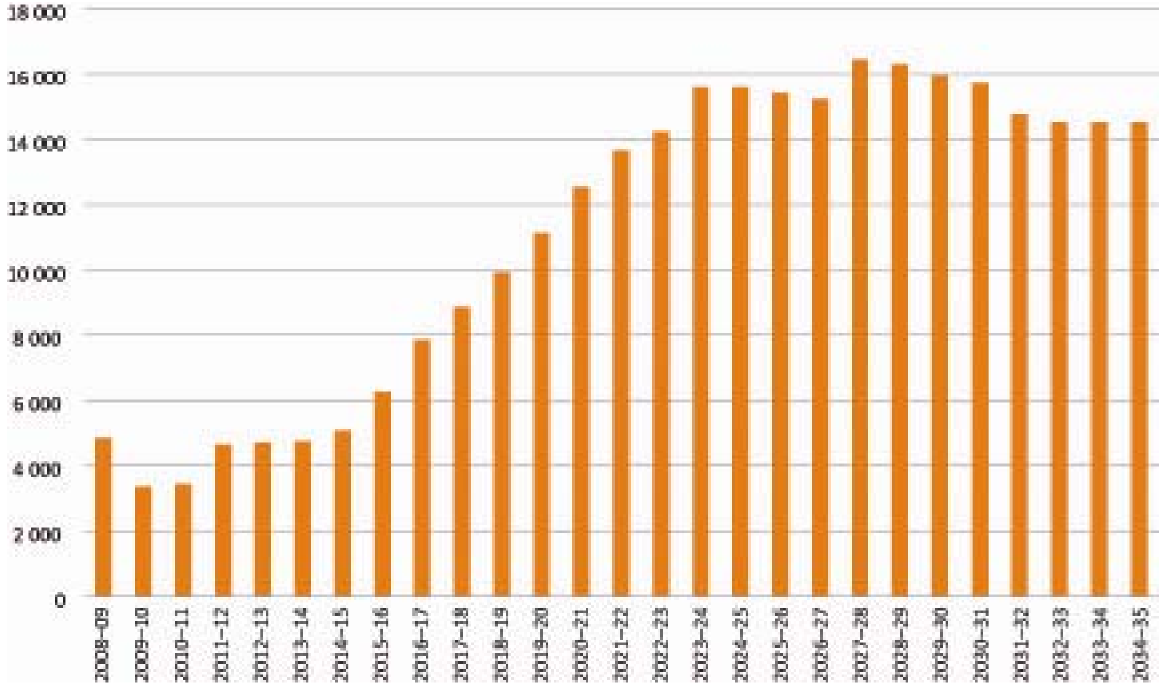
Figure 3.8: Australian coal projections, consumption, production and net exports, 2008–09 to 2034–35



Source: BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

Figure 3.9 shows that uranium production will increase significantly, reflecting Australia's large reserves, new mine developments and growing demand from world markets. Australia's uranium production is projected to increase around 4 per cent a year from 8700 tonnes uranium (4846 petajoules) in 2008–09 to around 26 200 tonnes uranium (14 500 petajoules) in 2034–35.

Figure 3.9: Australian uranium production projections, 2008–09 to 2034–35



Source: BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

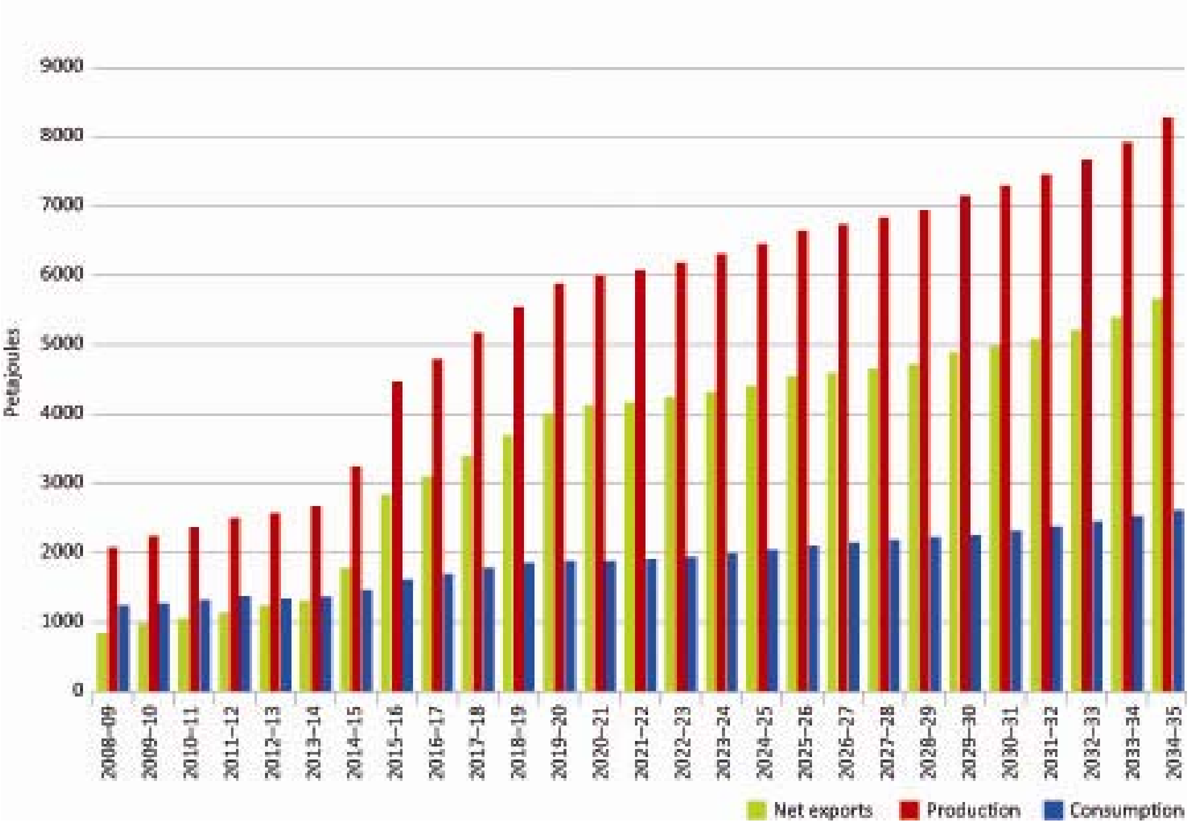
Australia's gas production is expected to increase nearly fourfold, growing at an annual rate of 5 per cent in the eastern market, 5.5 per cent in the western market and 6.5 per cent in the northern market (see Figure 3.10). This will service a growing LNG trade as well as domestic gas markets. Gas reserves are projected to be sufficient to meet future aggregate demand, particularly if additional unconventional resources become commercial.

The growth in energy export opportunities may change the dynamics in domestic gas and coal markets over the medium term. Domestic gas prices in eastern and western markets are expected to rise above historical levels, reflecting higher costs of production and demand–supply dynamics. A growing connection between the domestic electricity and gas markets, particularly on Australia's east coast, will likely see more gas used for electricity generation. There is also expected to be an increase in gas-fired electricity due to carbon pricing.

In the absence of major new discoveries, Australian oil production is expected to decline, with a corresponding increase in imported petroleum products. Refining capacity in Australia is expected to also decline slightly, with an increased substitution of imported refined fuels.

Rising oil prices over the period are expected to spur commercial development of indigenous alternative fuels such as second-generation biofuels from 2020. There is currently insufficient understanding of technology costs to assess whether alternative synthetic fuels such as coal-to-gas or coal-to-liquids could prove viable as an industry in Australia over the longer term. While most analysis does not project this, some prospective projects could feasibly be established using carbon capture and storage technologies to offset longer-term carbon costs. Commercially developing these technologies could potentially unlock otherwise stranded brown and black coal resources.

Figure 3.10: Australian gas projections, 2008–09 to 2034–35



Source: BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

Electricity generation

The electricity sector is perhaps the area of greatest potential change in Australia's energy system. By 2050 the sector will have a more diverse mix of generation technologies than today. This process has already begun with the construction of large-scale wind and small-scale solar systems driven largely by the expanded Renewable Energy Target.

Carbon pricing and other supporting measures will progressively drive deeper change as new technologies evolve and costs reduce. Nonetheless, fossil fuels will continue to underpin our electricity supply over the next few decades. While rising carbon costs will place pressure on these fuels, commercial deployment of carbon capture and storage offers long-term competitiveness while helping Australia to meet its greenhouse gas emissions reduction goals.

Modelling of the effect of carbon pricing within the electricity sector (outlined at Appendix C) indicates that electricity demand is projected to grow steadily, although at a lower than historical rate, due to carbon pricing and the consumer response to higher prices. The Australian Treasury's government policy scenario[17] shows electricity demand growing at 1.1 per cent (ROAM) and 0.9 per cent (SKM MMA) a year to 2030, and BREE modelling shows higher demand growth at 1.5 per cent a year to 2030.[18] All models show that demand growth in the electricity sector progressively decouples from economic and carbon emissions growth over time.

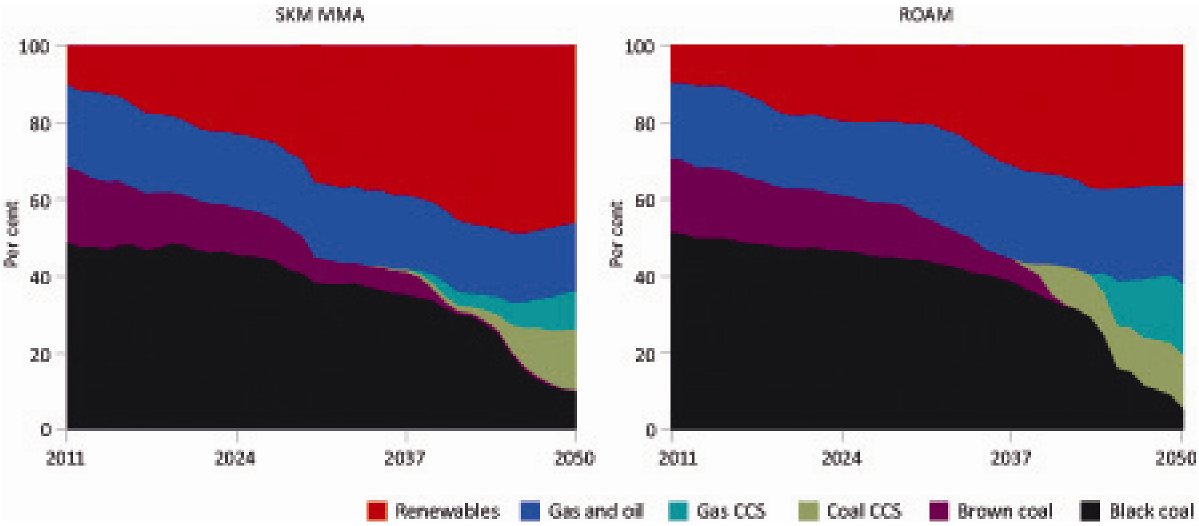
[17] This reflects the price path and structure of the government's announced carbon pricing mechanism within the Clean Energy Future package. BREE also used these parameters in its 2011 *Australian energy projections to 2034–35*.

[18] See Appendix C for further details on the modelling results and access to further detailed information.

Maximum or peak demand is expected to grow faster than total demand. The Australian Energy Market Operator forecasts a 2.4 per cent annual increase in winter maximum demand for the National Electricity Market and a 2.6 per cent annual increase in summer maximum demand over the next decade.[19] Similarly, in the South West Interconnected System, the Independent Market Operator forecasts that maximum demand will increase at an annual compound growth rate of 3.7 per cent over the next 10 years.[20]

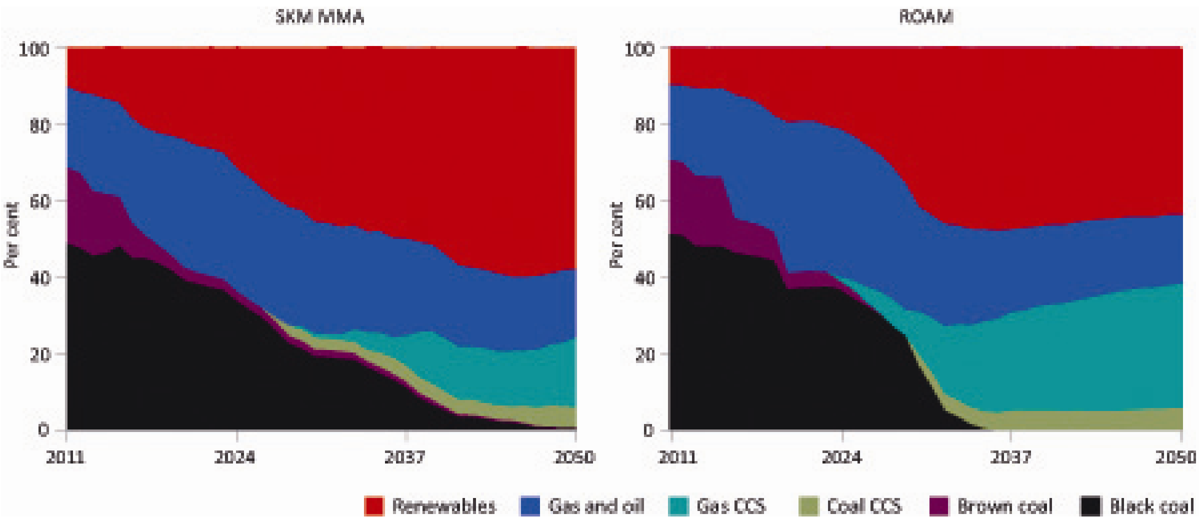
Figures 3.11 and 3.12 show the results of Treasury modelling of the electricity sector under two carbon pricing scenarios and the potential changes to the electricity generation mix to 2050 (further explained at Appendix C). These charts show projected outcomes from two different economic modellers (SKM-MMA and ROAM) under two different carbon price scenarios.

Figure 3.11: Sources of electricity generation – Treasury government policy scenario



Source: Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, Chart 5.19, updated, www.treasury.gov.au/carbonpricemodelling/content/chart_table_data/chapter5.asp.

Figure 3.12: Sources of electricity generation – Treasury high price scenario



Source: Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, p. 116.

[19] Australian Energy Market Operator, *Electricity statement of opportunities*, AEMO, 2010, p. 71.
[20] Independent Market Operator, *Statement of opportunities 2011*, IMO, 2011.

While the figures highlight important differences, they offer an observable consistent story about the possible future development patterns. In many respects it is a story in three parts, covering the roll-out of current policy to 2020, the retirement of ageing and uneconomic generation units as new capacity is constructed through to the early 2030s, followed by a deepening of these changes to 2050.

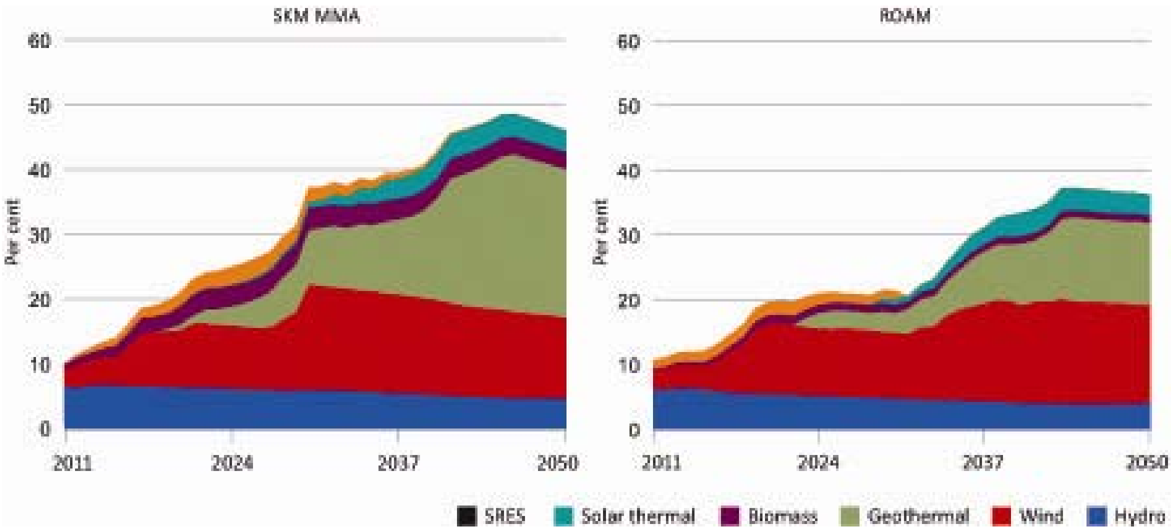
Steady growth in renewable (wind) and gas generation to 2020 is accompanied by a marginal decline in brown coal generation (this may be accelerated by negotiated power station closures). Black coal-based output is likely to remain relatively steady, although a small number of marginal generation units may be retired. It is likely that some new gas-fired baseload capacity will begin operating in the second half of the decade.

Variations in modelling results suggest that changes from 2020 onwards become less predictable, and will depend on the ability of new technologies to overcome technical and cost hurdles as well as carbon price movements. Under a moderate carbon price there is good potential for geothermal energy to expand along with gas (with more efficient combined-cycle gas turbine (CCGT) plants). Wind energy is likely to continue to grow with modest growth in solar thermal. Small-scale solar ceases to grow after the Renewable Energy Target concludes in 2030. Brown coal shows substantial decline in line with its declining competitiveness under higher carbon prices.

By 2035 coal and/or gas carbon capture and storage capacity may progressively enter the mix (see Figure 3.13). The Treasury modelling suggests that by 2050, renewable energy (mostly geothermal and wind) could represent around 40 per cent of total generation. Conventional gas may be around 20 per cent market share and fossil fuel–based carbon capture and storage could make up the remaining market share of 40 per cent.

Overall carbon capture and storage penetration, and the share of gas carbon capture and storage compared to coal carbon capture and storage, will depend on factors such as gas and coal commodity prices, access to gas and coal reserves, operating costs and access to low-cost carbon capture and storage sites.

Figure 3.13: Renewables by technology – share of total generation, government policy scenario



Source: Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, Chart 5.20, updated, www.treasury.gov.au/carbonpricemodelling/content/chart_table_data/chapter5.asp.

These results highlight that under moderate carbon price scenarios, carbon pricing is unlikely to quickly force out many existing generators, although it may hasten planned retirements of marginal units. It will be more likely to influence the choice of new capacity, and the Australian electricity sector will transform as growth brings on new clean energy capacity.

However, these results should not be taken as a fixed set of future outcomes. Sensitivity analysis shows that higher prices and/or lower technology costs can drive deeper and potentially quite different changes. Higher carbon prices will accelerate the phasing out of conventional coal capacity, increase gas use and accelerate the transition to renewable energy and carbon capture and storage. Failure to commercialise new technologies in a timely fashion will lead to a different generation mix and could potentially increase overall costs. Conversely, technological breakthroughs could significantly reduce the cost of some of the new technologies, and overall energy costs.

Lower gas prices would see gas use increase, and gas would most likely replace coal and new geothermal generation. If geothermal and/or carbon capture and storage do not prove commercially viable or are significantly delayed into the market, it is possible that use of CCGT will increase. It is also possible that a more rapid reduction in solar thermal costs and technical leapfrogging (as some anticipate) and advanced energy storage and grid management could provide a larger transformation than described here.

The range of modelling results also suggest that gas is set to play a pivotal role through baseload generation (CCGT and carbon capture and storage), providing important peaking, intermediate or fast-start reserve capacity, or as a replacement source of generation if other technologies do not commercialise as anticipated.

These results project an encouraging picture of our energy future. However, the pace and shape of Australia's clean energy transformation is by no means 'locked in'. The outcome will depend on dynamic factors including international carbon prices (trajectory and predictability), gas prices, improvements in costs and risks associated with new energy technologies, and ongoing investor confidence in the market. Changes in these variables, due to global factors or domestic policy settings, can potentially be game-changing in terms of the outcomes described above. Efforts by governments, the research community and business to accelerate the commercialisation of a broad suite of clean energy technologies in Australia will play an important part in this transition by providing markets with earlier and lower-cost deployment options.

The driving force in determining Australia's clean energy mix will be the interaction between energy and carbon markets, which will work to find the lowest-cost outcomes for emissions and technology constraints. Where technologies or prices move unexpectedly, if the market is functioning well it will adjust. However, if future policies reduce market flexibility by constraining this interaction, the costs to the economy and consumers are likely to be higher. A wide range of technology options will also promote greater competition, and better long-term price outcomes.

Energy networks

Growing and changing energy demands will require significant augmentation and reinforcement of transmission and distribution networks servicing Australia's energy markets.

The 2010 National Transmission Network Development Plan suggests that there will be significant investment in new interconnector capacity between regions in the National Electricity Market (NEM) as new gas and renewable generators emerge.[21] This will more closely connect the NEM regions, providing a greater capacity for sharing energy from renewable and gas-fired generation across borders, and promoting greater integration between gas and electricity markets.

Economic development could drive significant line extension into regional areas in South Australia and northern and western Queensland as well as expansion of the Western Australian grid. The Australian Energy Market Operator has canvassed a major new transmission link in the eastern states (NEMLink) to underpin major grid development. Although the economics of such a proposal are yet to be tested, it is unlikely that cross-continental connection (gas or electricity) will occur in the period ahead, given the poor economics and low need.

There is also likely to be an increased presence of small and micro-generation close to load, which will require greater flexibility in the distribution network. Supply and demand may be more variable, posing challenges for local grid management. As local renewable and other micro-energy generation becomes more widespread, the electricity network will need to become more responsive to demand.

These factors will undoubtedly culminate in a more complex network system, involving challenging network management. Responsive energy supply capabilities, coupled with sophisticated communications and information technology platforms, will create a 'smart' network and could enable real-time load management by electricity distributors, customers, retailers and other energy service providers. This will require technological advancement as well as further development of existing market arrangements.

Existing gas infrastructure will also need to be augmented within the next decade as projected demand growth reaches capacity limits. This will present a number of challenges, particularly the ability of state and territory governments to ensure timely planning approvals and access for pipeline corridors.

Meeting network replacement and expansion needs will place upward pressure on electricity and gas prices. This will be exacerbated if peak demand continues to grow at a faster rate than average demand.

Transport

Given its importance to social interaction and commerce, transport activity is projected to continue growing strongly through the period, albeit with significant changes in fuel mix and technologies. These changes will decouple activity from emissions, with greenhouse gas projections for the sector in 2050 expected to be close to those of today. Higher oil prices are likely to drive these outcomes as much as any other factor, including carbon costs.

Road transport activity is projected to more than double by 2050, water-borne transport activity will triple, and rail and air transport activity will increase fourfold. Growth in light commercial vehicles and heavy truck activity is expected to be faster than in private and passenger vehicles. This will influence the types of fuels used as well as the transport infrastructure required.

The increasing urbanisation of our population presents challenges and opportunities for the transport sector's use of energy. Continued expansion of our major cities is likely to lead to

[21] See Australian Energy Market Operator, *2010 National Transmission Network Development Plan*, AEMO, Melbourne, 2010, sections 3–4.

increasing commute times and distance. However, greater urban densities can also reduce energy requirements through greater viability of public transport and distributed business and commercial centres.

During the remainder of this decade, greater use of petrol blends is likely in heavy and light road vehicles, combined with switching to diesel in light vehicles.

Australia is largely a technology taker in transport. Our vehicle fleet is relatively old and has a low turnover rate. These two factors combined mean that alternative fuels are unlikely to make a significant impact until after 2020. Despite their higher up-front costs, these technologies will become more commercially attractive with rising oil and carbon prices over time.

Similarly, there is likely to be scope for biofuels (B20, pure biodiesel and biomass-to-liquid) to become mainstream fuels in the heavy-duty vehicle sector, with forecasts of an expected use rate of 75 per cent by 2050.[22] However, this depends on the ability to develop advanced biofuels, which generally avoid potential competition to food production and have more competitive cost structures.

There is also scope for development and use of synthetic fuels, but their viability under carbon pricing will likely depend on the commercial viability of carbon capture and storage.

New technologies are also emerging for LNG use in heavy-duty vehicles that are suitable to Australian drive cycles and operating conditions. This could provide opportunities for the light-duty vehicle market to leverage the growth of natural gas use in the heavy-duty sector, with potential to share distribution infrastructure and greater public acceptance of new technologies. These developments, in theory, could pave the way to the future adoption of compressed natural gas vehicles, or create a long-term pathway that incorporates hydrogen as a mainstream transport fuel, although technology and infrastructure costs are expected to remain a major hurdle for some time.

The period to 2050 is also expected to see the significant uptake of hybrid and electric passenger vehicles. This will depend on the availability of cost-effective vehicles suitable to Australian drive cycles, improved battery technologies, timely and effective energy supply options and management of effects on the energy distribution network.

Conventional vehicle efficiencies will also improve, driven by higher fuel prices, tighter emissions standards and the need to remain competitive against electrics and hybrids.

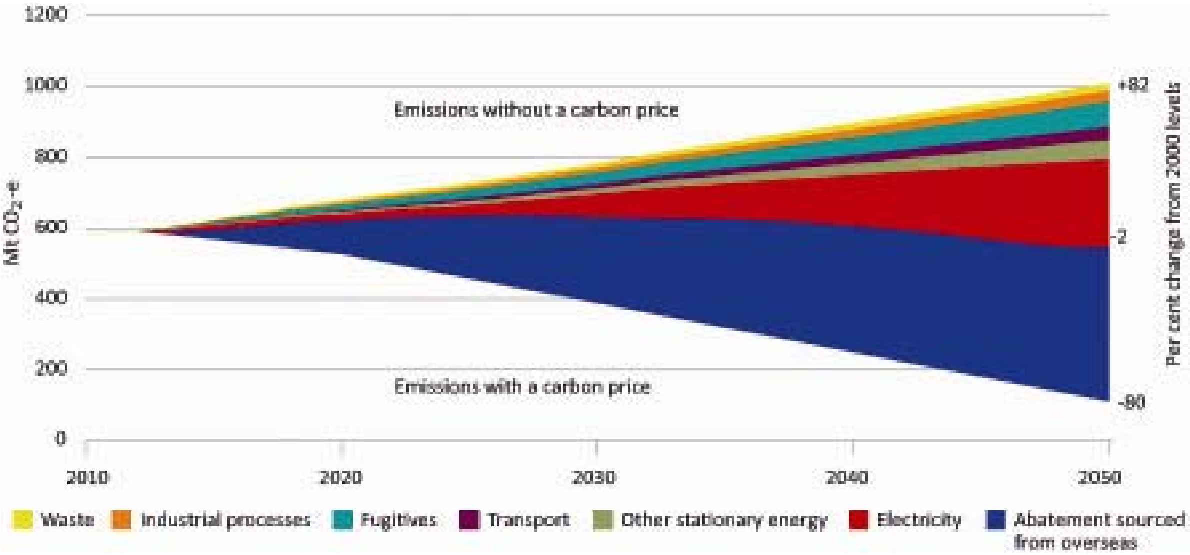
Australia's climate change response

Australia's commitment to reducing our greenhouse gas emissions in line with international goals will play a crucial part in shaping the future direction of Australia's energy sector over the next 30 to 40 years. The Australian Government has set the goals of reducing greenhouse gas emissions from a minimum unconditional 5 per cent reduction from 2000 levels by 2020 and an 80 per cent reduction by 2050.

Many changes will be driven by carbon pricing and other near-term mechanisms such as the Renewable Energy Target. Figure 3.14 illustrates expected sources of abatement for Australia under Treasury's core policy scenario (550 ppm global objective).

[22] Treasury, *Strong growth low pollution*, p. 132.

Figure 3.14: Sources of emissions reductions under the government policy scenario, 2010 to 2050



Source: Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, Chart 3, updated, www.treasury.gov.au/carbonpricemodelling/content/chart_table_data/chapter5.asp.

Around 60 per cent of Australia's greenhouse gas reductions in 2020 could come from purchasing international abatement. The electricity sector is expected to provide the second-largest abatement source, representing some 25 per cent of overall net emissions reductions under this scenario. This highlights the importance of reducing emissions in the electricity sector and also emphasises that achieving our abatement goals will occur across the entire economy and from the deployment of different technologies and policy responses.

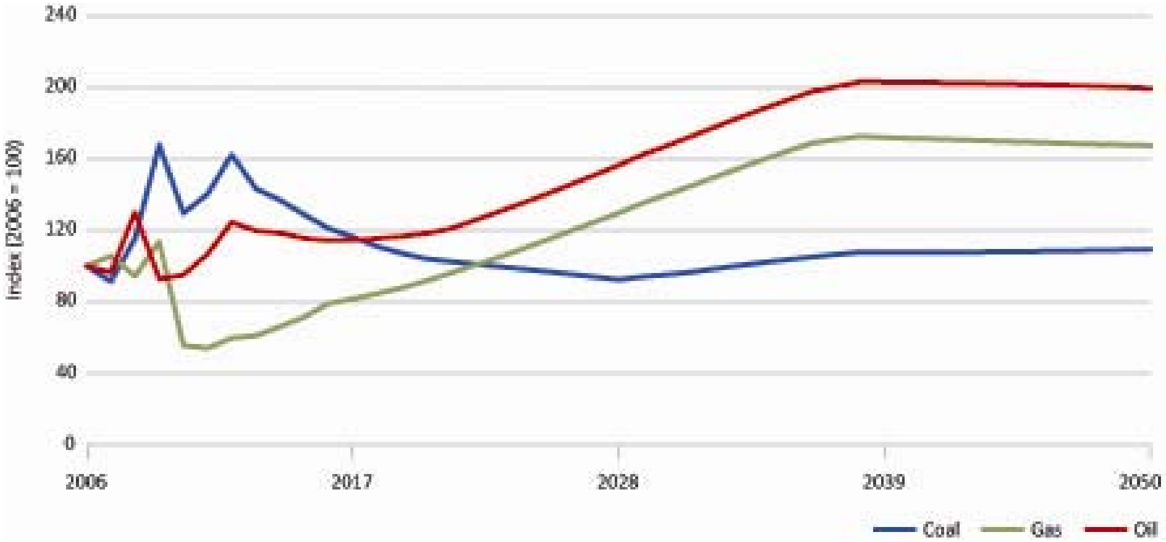
The ability to purchase international sources of abatement has two important effects. First, it effectively links the Australian carbon price to prices in international carbon markets and thus automatically calibrates the pace of change in the Australian energy sector to the international effort. Second, international linking will allow reductions in greenhouse gas emissions to be sourced globally at the lowest cost. Climate change is a global problem and the most efficient response is to ensure that the lowest-cost abatement options are exploited first.

Energy prices

This draft Energy White Paper does not attempt to forecast detailed price movements for energy commodities, which are notoriously difficult to predict. However, it is worth reflecting on general expectations from analysts such as the IEA and the Australian Treasury.

On this basis it is reasonable to suggest that global and Australian energy prices will generally rise in real terms to 2035 and beyond (see Figure 3.15).

Figure 3.15: Energy commodity price index, 2006 to 2050



Source: Derived from Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011, Chart 4.7, updated, www.treasury.gov.au/carbonpricemodelling/content/chart_table_data/chapter4.asp.

The IEA forecasts a rise in oil prices in real terms from US$78 a barrel in 2010 to US$120 (under the New Policies Scenario) in 2035.[23] Traded gas prices will also rise substantially in all regions. Thermal coal prices will rise but by much less as overall demand growth for coal slows by 2030.

These price rises are driven by the need to meet the costs of investment associated with continued growth in energy demand. The IEA predicts global investment requirements of $38 trillion for energy supply infrastructure requirements between 2011 and 2035, reflecting a projected 40 per cent increase in demand for energy over a similar timeframe.[24]

Australia's domestic energy prices (except for oil) have not historically been directly linked to international prices and Australia has maintained relatively low energy prices compared to other OECD countries. However, this separation is expected to change over the coming decade as LNG and coal export market opportunities increase competition in domestic markets.

Nationally, the Australian Energy Market Commission forecasts an increase in residential electricity prices by around 30 per cent in nominal terms in the period 2009–10 to 2012–13 (excluding the impact of a carbon price) (see Figure 3.16). This equates to a 19 per cent increase in real terms, or just under six cents per kilowatt hour.[25] The key factors driving this increase are:

- increased distribution costs (41 per cent)
- wholesale electricity cost increases (19 per cent)
- retail costs (14 per cent)
- meeting the Renewable Energy Target (large- and small-scale), primarily driven by the uptake of small-scale renewable technologies (11 per cent)

[23] IEA, *World energy outlook 2011*, p. 64

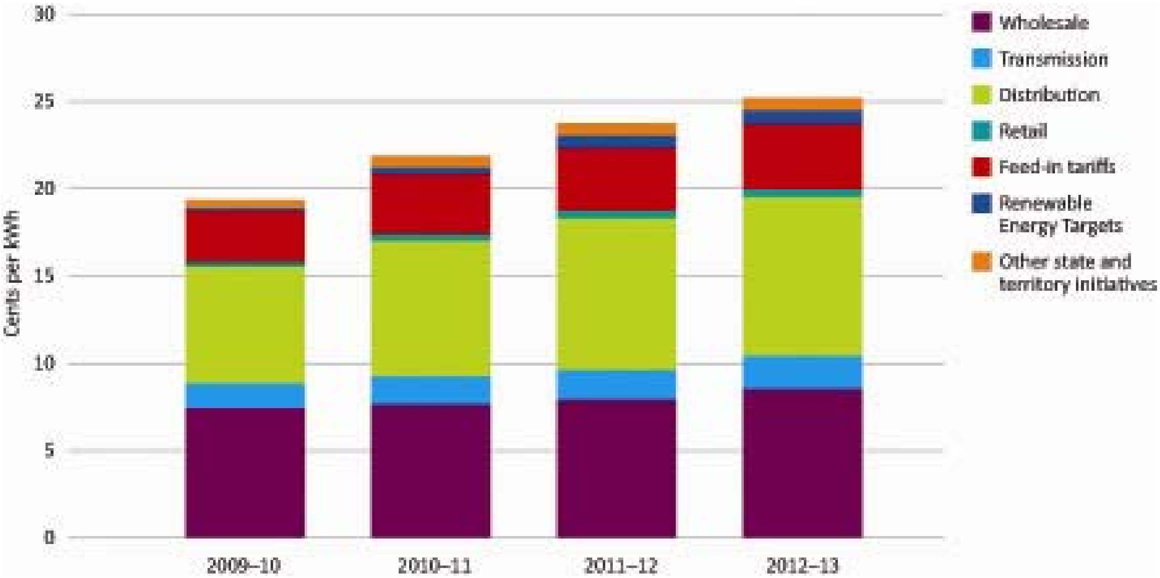
[24] IEA, *World energy outlook 2011*, p. 96.

[25] Australian Energy Market Commission, *Possible future retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney, 2011.

- increased transmission costs (9 per cent)
- costs of delivering feed-in tariffs and other jurisdictional schemes (6 per cent).

Treasury modelling estimates that the effects of the carbon price on electricity prices will add an additional 10 per cent.

Figure 3.16: Contributions to residential electricity price increases, 2009–10 to 2012–13



Source: Australian Energy Market Commission, *Possible future retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney, 2010, p. iv.

Treasury's carbon modelling analysis also projected potential electricity price increases under proposed carbon pricing arrangements. Carbon pricing is expected to have a modest additional impact on residential electricity prices of around 10 per cent over five years from 2012.[26] The Australian Government is providing generous compensation arrangements for many households and emissions-intensive, trade-exposed industries through the Clean Energy Future package (outlined at Appendix A).

3.4 Strategic challenges and policy priorities

The global and national assessments above outline a positive outlook for Australia's energy future over coming decades.

However, it is clear that Australia's energy markets are entering a period of major transition. The introduction of carbon pricing reforms, the emergence of new energy sources and technologies, and growing linkages between domestic and international energy markets, particularly in the case of gas and coal, will lead to the emergence of new dynamics and competitive forces. End-use demand patterns are also changing with changes in economic structure and lifestyle.

This brings a range of core challenges and policy issues that must be addressed if we are to realise this future. These challenges and issues are discussed in the following two subsections.

[26] Treasury, *Strong growth, low pollution*, p. 123.

Strategic challenges in Australia's energy future

Some of the key strategic challenges that can be identified in Australia's energy future include:

- managing key risks and uncertainties
- adapting to evolving market dynamics
- attracting timely investment
- bringing new technologies to market
- addressing the rising cost of energy
- building community engagement and energy awareness.

These challenges are not unrelated and in many respects flow into each other. For example, successfully managing risks and adapting efficiently to new market dynamics are essential to securing new investment and delivering competitively priced energy. Bringing new technologies to market can reduce long-term costs while reducing risk. Community engagement and energy awareness will promote informed public debate and understanding of our energy future and also underpin more efficient decision-making.

Managing key risks and uncertainties

Accelerated and continual change will be a dominant theme in global and Australian energy markets in the coming decades. Australia's energy future will be shaped by interactions containing or generating risks and uncertainties that make predicting ultimate outcomes from today's vantage point extremely challenging. Some of these factors will emerge over time while some may impose themselves abruptly.

Government policy should recognise that markets and businesses are generally well equipped and effective in dealing with a broad range of market and price risks. However, well-targeted policy can also assist in sharing, managing or reducing a number of non-market risks that could result in inefficient market outcomes.

Uncertainty, particularly policy uncertainty, is by its nature considerably more difficult to manage. While sometimes not apparent at the time, left unaddressed it can often impose additional costs through suboptimal decisions or 'wait and see' risk-averse approaches. For example, extended uncertainty over the design and application of carbon policies has imposed higher than necessary costs on the Australian energy sector through a decade or more of inefficient investment outcomes.[27] Continued uncertainty in this area will similarly impair future investment outcomes.

Key strategic risks for the Australian energy sector in coming decades include:

- the nature and timeframe of the international response to climate change
- unforeseen geopolitical or economic developments that reshape or disrupt international energy or capital markets
- a failure to commercialise key technologies in a timely fashion
- a confluence of risks which interact to produce unanticipated increases in delivered energy costs.

[27] Investment Reference Group, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, Canberra, 2011

A strategic issue for Australia's energy future is the nature and timeframe of global and national responses to climate change. These responses will influence the development of Australia's energy sector and economy, through factors such as carbon prices, abatement strategies, the speed and direction of technological development, and even strategic choices in energy sources by our trading partners.

While there is broad agreement among nations to collectively reduce greenhouse gas emissions,[28] the nature of this effort is likely to take some time to emerge. Australia is managing this uncertainty with a robust and flexible national climate change response framework, notably through introducing carbon pricing and legislated long-term emissions goals under the Australian Government's Clean Energy Future package. These frameworks effectively translate much of this policy uncertainty into manageable risk for business. They are deliberately constructed so that changes in international settings or scientific understanding of climate change (which could lead to future changes in Australia's level of effort) can be relatively easily aligned with less risk of sharp adjustment costs.

Chapter 4 outlines the Australian Government's policy framework for responding to geopolitical or other turmoil that may disrupt energy markets or supply chains. The government also has well-tested response frameworks for managing economic and financial crises. While it can be tempting to 'design for the worst', successful management of historical shocks over the past 30 years suggests that this approach could be very costly and largely unnecessary. This does not mean that these events will be overcome without cost or disruption, but they can be managed and minimised as effectively as possible with existing structures and a timely market response.

Real-world timing for commercialising new and emerging energy technologies is another key policy and market risk. We cannot predict with any certainty future cost reductions and technical breakthroughs or even how the market may ultimately deploy technologies. This uncertainty is managed with a flexible market-based approach that allows the energy sector to introduce alternative technology options if a particular class or type proves too costly or cannot be commercialised.

For this reason the Australian Government has chosen not to set specific technology-based deployment targets or construct technology-specific policy frameworks beyond transitional measures currently in place, as this would risk a potentially inefficient and costly lock-in should the future (almost inevitably) move in a different direction or at a different pace.

However, to enhance market responsiveness the government has also established a framework to support and accelerate clean energy technology development. Building an early understanding of potential will assist markets and policy-makers to plan and/or make timely adjustments if required.

A further possible, if less likely, risk is an unanticipated confluence of higher-than-anticipated carbon prices, fuel prices, and disappointing progress in developing new technologies which could produce unanticipated cost outcomes. A wide body of economic analysis suggests that this is extremely unlikely, particularly as energy and carbon markets have a number of in-built adjustment and cost-capping features that mitigate such outcomes.

High energy costs or poor economic conditions would work through the market to moderate demand and/or induce supply-side as well as innovation and substitution responses. These responses will naturally act to reduce price pressures (although there may be some lag effects as markets respond). There is also an in-built safety valve on excessive domestic carbon costs with the

[28] United Nations Framework Convention on Climate Change, *The Cancun Agreements*, http://cancun.unfccc.int.

ability to purchase international carbon offsets. The proposed carbon market and energy security governance and target-setting arrangements also provide government with the ability to calibrate settings to ensure that the economic cost of action remains tolerable. That said, it is important that governments adopt a very cautious and well-considered approach in any response to price movements. These are critical signals that drive market and consumer responses and underpin efficient investment decisions.

Many of the changes that might generate these risks, if they emerge at all, are likely to develop over time. For example, time will be needed for the interaction of energy and carbon markets to mature, and to understand new market dynamics. Ongoing monitoring will be required to assess the efficiency and effectiveness of market and policy outcomes, including the pace of technology development. Rather than implementing prescriptive and potentially costly policies in an attempt to eliminate risk, a more effective and lower cost response is to ensure predictable, resilient policy frameworks, efficient markets and robust institutional arrangements that provide the capability to look ahead and to respond quickly if required. Proposed actions to improve the risk management and resilience of Australia's energy policy framework are discussed in Chapter 4.

Adapting to new energy market dynamics

Possible trends to 2050 explored above highlight the significant changes expected in global and Australia's energy markets. Some are underway and some will emerge over the next decade. They include:

- the growing dominance of the Asia–Pacific region in global energy and financial markets and trade
- shifting patterns in energy generation and trade, driven largely by economic expansion and energy security and climate change responses
- the likely emergence of international or national and regional carbon markets, which may create new linking dynamics to energy and associated financial markets given the close relationship between energy and carbon emissions. In particular, electricity and gas prices may over time form a closer relationship through carbon pricing if carbon markets deepen and tighten.

Australia's domestic liquid fuel market has been fully exposed to international markets for several decades following the move in 1977 to import parity pricing.

Australia's electricity and gas markets, however, have not been historically linked to international markets, as prices have been largely set through supply and demand balances in Australia's east and west coast markets.

Development of new export opportunities for Australia's gas and coal resources and the competition this introduces into domestic markets has already begun to end this historical separation. This is changing the market, in terms of price and in the way these commodities are traded.

This transition has been underway in the western gas market for several more years than in the eastern market, where new coal seam gas and LNG developments are just beginning to take shape. This new competition will also be affected by growth in demand for gas as a fuel for electricity, largely driven by the response to carbon pricing.

The changing dynamics in gas (and electricity) markets have yet to mature and are not yet fully understood. Competition for gas will generally intensify and large users will increasingly look for more sophisticated and flexible ways to manage supply and price risk. At the same time, new gas suppliers may seek to move away from long-term 'foundation' domestic contracts (as many new projects are instead underwritten by long-term LNG contracts). This combination may see a greater demand for short-term capacity trading. It is unclear whether this might occur to such an extent that it erodes the long-term supply certainty required by large industrial or electricity generation customers.

There are concerns that export competition will drive east coast gas prices permanently to international or LNG netback levels,[29] with a consequent increase in electricity prices or loss of international competitiveness for other large users. There is also concern that physical supply and contract availability will erode as producers seek higher returns in international markets. The experience in the western gas market, where domestic supply has tightened and recent prices have increased substantially over long-term averages, is used as evidence to support this conclusion.

This in turn has fed suggestions that LNG developments may be compromising Australia's low-cost energy base and thus not always be in Australia's long-term energy security or economic development interests.

Drawing such a conclusion is not supported by current evidence and caution should be used in extrapolation between east and west coast gas markets given their significant differences, or in projecting future outcomes based on historical patterns or dynamics. The strength of the relationship between domestic and LNG prices relies on a complex and changing set of influences, including factors unique to each market.

Opportunities offered through LNG markets have undoubtedly underpinned a major expansion of Australia's gas production (in both the east and west coast markets), and will continue to do so. They also bring substantial economic benefit to Australia and the regions they are in. Most of the west coast developments are unlikely to have occurred without export opportunities, or would have been significantly delayed until domestic prices rose well above historical levels. East coast developments have arisen due to a more complex set of market pull factors, but again there is little doubt that current developments are heavily supported by export opportunity. Caution should also be used when speculating on future supply on the basis of current supply–demand balances as these will change over time. It is likely that available reserves in both markets will expand in response to rising prices.

It is also not appropriate to benchmark future market prices against historical levels as circumstances have changed and will continue to do so. For example, production costs have increased significantly in recent years (particularly in the west) and the nature of contract drivers has changed. Demand factors are also changing.

There is little doubt that Australia's east and west coast gas markets are increasingly linked to international markets. However, it is unclear what impact in itself this may have on long-term supply or price in domestic markets. A range of credible scenarios can be painted to support different views.

In Western Australia, the cost of producing new gas is high, particularly from fields increasingly located in deeper waters. In addition, many distant fields do not have commercially viable access to the domestic market. A range of historical and prospective factors are contributing to the current

[29] LNG netback pricing is the theoretical price at which the producer is indifferent between domestic and international markets. As LNG prices will invariably be higher (due to high production costs), it will be the international price less the cost of LNG processing.

tightness in the Western Australian gas market. Competition in supply and demand is more limited than in the east and there has been long-term underinvestment in domestic processing capacity due to a prolonged period of relatively low prices underwritten by the initial North West Shelf contracts. This low pricing has now effectively ended for new gas contracts, and there is evidence of an increased supply response. Realistically this will take some time to become available.

LNG export projects are expected to remain the main source of gas supply in Western Australia. Development costs for these projects are therefore likely to have a significant influence on domestic gas prices. There is some potential for new domestic supplies from alternative gas sources and new smaller fields which may not support LNG to introduce additional supply and price competition. The Department of Mines and Petroleum forecast of projected supply and demand for gas in Western Australia to 2030 suggests that sufficient capacity exists to meet domestic demand in the western market to 2030.[30] Gas supply beyond 2030 in the absence of new discovery may become an issue in the longer term.

In contrast, the link to international pricing of LNG in the east coast market may be weaker (and certainly different), partly due to many more gas supply options. In addition, not all gas producers have the capacity to pursue LNG projects due to location or high up-front capital costs, long payback periods and associated risks.

Gas reserves and production capacity of new LNG projects will be committed up-front to ensure project economics. Reserves and production capacity that sit outside these committed requirements will generally not have the option of diversion into LNG once production capacities are fulfilled. For LNG projects, the sale of gas to the domestic market is also an attractive option as the lower capital costs and reduced market risks provide revenue diversity and improve overall returns to investors. Another factor influencing market outcomes will be the ability to develop additional gas pipeline infrastructure in a timely fashion (see Chapter 6B for a discussion of gas transmission issues).

Accordingly, LNG developments on the east coast are expected to increase overall gas supply options and enhance domestic competition.

Other factors are also expected to have an equal or even stronger influence on gas market price outcomes. For example, demand for gas, and therefore gas prices, could rise with the introduction of carbon pricing. This may be counterbalanced by potential competition from coal-fired or low-cost renewable-based electricity, which would act as a moderating influence on gas price increases. Thus, while it is generally expected that prices will rise over the period, the speed and scale of these increases are far from clear.

The Australian Government acknowledges that a range of current transitional pressures exist in the east and west coast energy markets. It is likely that contract arrangements will continue to evolve, reflecting different business needs and risk management approaches by suppliers and customers. In the current transitional period where future carbon and gas prices attract uncertainty, it is also likely that conservative strategies will dominate market behaviour.

Similarly, Australia's electricity markets are entering a period of transition with the introduction of carbon pricing and the roll-out of new technology. Investment in new baseload capacity, which most project to be in the form of new gas-fired plant, has yet to emerge. While it is important to understand historical circumstances and heed the lessons from past market development, caution must be used in projecting future market outcomes on the basis of previous dynamics. There will

[30] Government of Western Australia, *Strategic Energy Initiative directions paper*, Office of Energy, Perth, 2011, p. 21.

clearly need to be a period of readjustment and learning by market participants as well as financiers, regulators and policy-makers, but there is no reason to suggest that markets cannot deliver as needed, particularly with supportive and stable policies.

The government believes that markets should be allowed to adjust with free-forming competitive prices being a natural, necessary and efficient balancing mechanism. While the government recognises the need to monitor market outcomes, interventions designed to force non-commercial domestic supply outcomes or to moderate prices could lead to suboptimal outcomes and should be contemplated only where a clear need has been established. For example, an inflexible national gas reservation policy could reduce incentives for commercial development of gas reserves and reduce long-term competition in the upstream market.

However, this is not to dismiss the risks and pressures that have emerged or are likely to emerge or to argue for the status quo. There is a need for further reform to upstream gas arrangements as well as domestic gas (and electricity) markets to promote greater transparency, access and competition so they provide commercially attractive opportunities for investors and to ensure that households and businesses can access competitively priced energy options. The government will monitor future developments to ensure that markets are performing in an efficient and competitive manner, and that domestic supply is not compromised. The Commonwealth will also ensure that offshore gas project design and development are providing the best returns possible for the Australian community within a commercial framework, including through appropriate consideration of domestic gas opportunities. Instituting regular policy reviews (see Chapter 4) will also provide opportunities for timely response or adjustment where justified against policy objectives. These issues and actions are discussed further in Chapters 5 and 6.

Attracting timely investment

Meeting Australia's future energy needs will require substantial new investment over coming decades across our energy system, including in production, generation, networks and end-use systems.

The Investment Reference Group (IRG), drawing on modelling by the Australian Energy Market Operator, recently suggested that investment in the electricity sector (including generation transmission, distribution networks, pipelines and associated infrastructure) could exceed $240 billion by 2030. Similarly, the Australian Treasury estimates $200 billion of new generation investment, comprising $50–$60 billion in gas, $100 billion in renewables and around $45–$65 billion in carbon capture and storage coal plants by 2050[31]. In addition to this new investment requirement, much of the sector's existing investments will require refinancing. While not strictly comparable, it is worth noting that investment in new generation capacity since the commencement of the National Electricity Market in 1998 has been estimated at around $12 billion.[32]

While the scale of required investment is imposing, it is achievable. The private sector will drive most investment over several decades (although it may be uneven in terms of amounts and timing). It will also come from a mix of foreign and domestic debt and equity markets.

Foreign markets and investors are vital for meeting our energy goals. The IRG report noted that equity in Australia and the energy sector includes a significant proportion of overseas investors: foreign institutional investors hold 40 per cent of the Australian Stock Exchange and up to 20 per

[31] Treasury, *Strong growth, low pollution*, p. 120.
[32] Investment Reference Group report.

cent of AGL Energy and Origin Energy (Australia's two largest listed energy companies).[33] The IRG also reported anecdotal evidence suggesting that, in the wake of the global financial crisis, project financiers are now seeking lower leverage, while capital costs are higher, reflecting a lower risk appetite.

The IRG also observed that the larger deal size of energy projects requires large amounts of debt capital – amounts that are well in excess of the funding capacity and credit appetite of major Australian banks. As a relatively small market, Australia has a structural reliance on foreign capital, with just under half of loan commitments provided by foreign banks. In the energy and utilities sector this is more pronounced, with 42 per cent of bank loan commitments provided by the four major Australian banks and 58 per cent provided by foreign banks.

In general, Australia maintains a highly attractive investment environment[34] with sound macro-economic settings, competitive fiscal regimes and a skilled labour force. Carbon pricing will also reduce long-term policy uncertainty in the energy sector, although transitional or implementation issues may arise that could affect short-term investment in the electricity generation sector.

However, Australia's competitive position cannot be taken for granted. Further efforts are required to maintain or enhance our attractiveness as a destination for investment, particularly given the rapid growth and improvement in the markets in our region.

It is not the role of government to eliminate conventional market risk. However, it should provide sound, predictable and stable policy and investment-friendly economic and regulatory frameworks that offer investors commercially attractive returns. Given the long-lived nature of many energy sector investments, providing practical certainty over future policy is also important. This is critical for Australia to attract the capital needed in highly competitive financial markets.

There is also a need to ensure our energy markets are operating efficiently and competitively. Because of the delay over the last decade in moving to carbon pricing, there are a range of external interventions which have added complexity and risk for energy market investors. Ongoing public ownership in energy markets also creates the potential for uneven competition and can act to discourage new entrants. These issues must be addressed if we are to attract timely and efficient investment into the future.

There is little doubt that, given these conditions, the private sector and financial markets can provide the capital to meet our energy development needs. This means that energy prices will need to provide an adequate return on these outlays and this is likely to entail higher energy prices.

Bringing new technologies to market

The technology development challenge to deliver a clean and sustainable energy future for Australia is substantial. Our ability to commercially deploy clean energy technologies such as solar or carbon capture and storage at scale – and integrate these technologies into our network – will be a significant factor in Australia's success in reducing domestic emissions.

While clean energy outcomes have enormous potential, it must be noted that outcomes are far from predetermined and the success of individual technologies hinges on addressing current technical,

[33] Investment Reference Group report.

[34] Austrade monitors international investment risk ratings and reports that Australia generally ranks in the top 10 for many important indicators. Further information is available at www.austrade.gov.au.

social and cost issues. The challenge and scale of the clean energy transformation should not be underestimated.

For example, achieving an electricity mix similar to that projected by the Australian Treasury carbon price modelling would require deployment of new clean energy technologies including geothermal, large-scale solar and carbon capture and storage. These technologies are either currently unproven at scale or commercially immature with significant technical or economic hurdles to clear.

Challenges in developing and commercialising new technologies are well known and are discussed more in Chapter 7. In summary, they can include:

- reducing costs and demonstrating commerciality
- attracting sufficient support along the innovation and technology demonstration pathway
- addressing policy and regulatory barriers to deployment
- integrating successfully into energy networks
- building consumer and community acceptance.

While sometimes daunting, these challenges are not insurmountable. The prospect of commercial opportunity is a powerful incentive and by establishing the right set of ‘push’ and ‘pull’ policy signals and commercial incentives, the private sector and markets will mobilise to innovate and deploy. This is already underway through the Australian Government’s Clean Energy Future package. For some technologies with large technical or project risks that inhibit efficient private sector investment, it may be appropriate for the public sector to partner and share risks or address market failures.

Australia is also not alone in addressing these challenges – the international clean energy effort is well underway. Energy sector innovation in the public and private sectors is becoming increasingly collaborative and is no longer purely a national affair.

As an open economy that relies heavily on the adoption and adaptation of international technology, Australia will contribute to and benefit from this effort. Given the commercial reality that almost all technology breakthroughs that are likely to be deployed at scale in the future are likely to be at least in part manufactured outside of Australia, we should also seek to leverage other global technological developments so that Australian consumers have access to a larger range of lowest-cost outcomes. Our ability to leverage the processes and outcomes must be considered when allocating limited government resources.

In determining the level of support to provide in this field, it is a truth that more can always be done and one of the major challenges for government is to strike an appropriate balance between technology support measures, other competing policy priorities and the cost to consumers. This is why the Australian Government has developed a clean energy framework structured around addressing market failure and using public funds to leverage private sector activity and outcomes.

Inevitably, there will be pressure from various interests seeking additional support to accelerate development and deployment of particular technologies that have the potential to offer unique advantages. Each should be rigorously assessed on its merit against criteria that draw out the rationale for and benefit of providing support. This assessment needs to consider how the support might affect the efficiency of energy (and carbon) markets, and the additional costs to consumers and taxpayers.

Finally, there is a need for the government and public to accept that there will be failures along the way, and that technology development is a long-term undertaking. Failure is part of the innovation process and provides necessary and valuable learning experiences that underpin successful technology development.

Addressing the rising costs of energy

Access to reliable and low-cost energy has historically been an enduring strength of the Australian economy and a major contributor to our high standard of living. However, for a range of reasons discussed above, the era of cheap energy is over as Australia undertakes a major expansion and reinvestment in its energy systems.

Energy costs have risen significantly over recent years. This has been driven in large part by the need for networks and suppliers to meet increased consumer demand. For example, the average household electricity consumption in New South Wales and Queensland was 2 megawatt hours a year in 1955; by 1970 it had risen to 4 megawatt hours and by 2008 it was 7.9 megawatt hours.[35] Coupled with this has been a large growth in peak demand largely driven by increased consumer use of appliances for heating and cooling.

It is challenging to definitively assess the impact of rising energy costs on overall affordability as it involves the cost of energy, household incomes and business circumstances as well as access to effective options to respond. It is, in this sense, necessarily an individual assessment rather than a useful collective test, although some clear conclusions can be drawn from a policy perspective. For example, it is evident that in recent times energy, particularly electricity and petrol, has become less affordable for many in society and continued rises will place additional pressure on household cost of living and on the competitiveness of business, particularly energy-intensive industries.[36]

Household energy costs

Definitive statistics on household energy use and costs are difficult to identify and this represents a serious gap in our understanding of energy cost impacts. However, the 2009–10 Australian Bureau of Statistics household expenditure survey results indicated that energy represents around 2.6 per cent of average household expenditure.[37] The proportion of household income spent on energy has remained relatively constant over the last decade.

However, this does not adequately describe the level of energy expenditure across income groups. The share of expenditure was nearly 55 per cent higher for the lowest gross income quartile (4 per cent). Energy expenditure data that is reported by housing tenure or income type shows similar differentiation.

All these results underline the fact that increases in household energy costs are generally regressive in their impact (the impact is greater on people on lower incomes and the socially disadvantaged). These groups are also less likely to be able to access options to reduce energy use or manage costs. The distributional impact of energy and related policies or measures should therefore be a material

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[35] P Simshauser, T Nelson and T Doan, 'The boomerang paradox, part 1: how a nation's wealth is creating energy poverty', *The Electricity Journal*, vol. 24, no. 1, 2011, p. 72.

[36] For example, regulated household electricity tariffs in New South Wales, Queensland and Western Australia have increased 50 per cent or more between 2007–08 and 2010–11 (estimate based on published tariff increases for each state regulator).

[37] Australian Bureau of Statistics, *Household expenditure survey, Australia: summary of results, 2009–10*, cat. no. 6530.0, ABS, Canberra, 2011.

consideration when making decisions around the design and cost of government interventions in the energy market. This includes consideration of social disadvantage and differences in the ability to access energy efficiency or demand-reduction measures.

Business energy costs

Businesses are concerned about energy price rises because they compromise or erode business activity and competitiveness. This will occur where higher costs cannot be passed to customers without losing market share or profitability. Energy-intensive businesses are also sensitive to base price, as this can be an important (but not exclusive) determinant of international competitiveness.

For most non-energy-intensive businesses, energy is a smaller component of their overall cost structure (typically less than a few per cent). This is not to downplay cost concerns for businesses on narrow profit margins or in stressed market conditions. Energy costs for intensive operations can also represent 10 to 30 per cent of costs. This makes energy prices a significant concern for businesses currently renegotiating long-term energy contracts and facing significant prices rises relative to historical levels. Ensuring that energy markets are operating in a competitive and efficient manner with minimal distortion and ready access is critical to minimising competitiveness impacts.

Addressing price pressures

There is no easy fix to the likely increase in energy costs that consumers will face through the course of the decade. There will need to be a concerted focus on removing or not imposing unnecessary policies that add to cost pressures and in ensuring issues facing vulnerable customers are adequately addressed. Further effort is also required to reform pricing to ensure that more efficient and equitable outcomes are provided through competitive retail markets.

All Australian governments provide various forms of social safety net support for higher energy costs to low-income households. For example, there are a range of hardship provisions for distressed consumers and energy rebate programs for low-income households. Structures and service obligations are also in place to ensure that consumers in regional areas are not materially disadvantaged. As a component of household costs of living, energy costs are also addressed in part through the Australian Government's social safety net.

For example, the government has recognised that carbon pricing will increase a range of household and business costs (including energy). The government has provided for household compensation and transitional assistance for business in the Clean Energy Future package, including measures to support household energy efficiency. A number of measures are specifically targeted towards the needs of low-income groups.

Reflecting the need to undertake more work to better understand the social and economic implications of energy cost impacts, the Australian Bureau of Statistics and the Department of Climate Change and Energy Efficiency have been allocated $10 million over three years to conduct a survey to gather information on household sector energy consumption.

It is important that unnecessary increases in energy costs are avoided through efficient policy and market design. Greater attention should also be given to improving the range of, and access to, options for households and businesses to respond to rising energy costs by addressing well-recognised non-price barriers to energy efficiency and demand management. This should be complemented by well-targeted and transparent social policy measures that achieve non-energy policy goals.

However, cost concerns should not be used to justify policies that undermine or distort efficient market outcomes, including pricing. Efficient pricing is at the heart of achieving a more productive energy system and one of the keys to unlocking demand-side responses that could reduce future costs. As past approaches in the energy sector have shown, poorly designed interventions can lead to distorted investment or demand outcomes which produce a longer-term building up of market pressures, all of which are likely to impose higher costs on consumers.

For this reason, it is important to:

- recognise that cost increases impact on national competitiveness with unequal distributional effects on households and businesses
- recognise the need for energy costs to be taken into account in social policy frameworks (including regional and rural considerations or community service obligations)
- provide an energy policy framework based on market outcomes and economic efficiency, alongside appropriate consumer protections.

Building community engagement and energy awareness

Deeper and broader community engagement on energy issues is required on several levels.

First is the need to improve understanding and awareness of consumer energy choices at the individual and firm level. Energy demand is derived demand – it is the composite product that arises from undertaking a range of other activities that use energy. Informed decision-making (be it through improved product information or through understanding the environmental or cost impact of energy use choices) is a key part of promoting greater energy efficiency and productivity and reducing the impact of cost increases (see the discussion of these issues and promoting energy literacy in Chapter 6C). This information may need to be communicated through a variety of mechanisms due to the differing abilities of various groups to readily access materials.

It is also important that governments at all levels ensure that public consultation and engagement in decision-making, program design and other aspects of energy policy is improved. Deeper public engagement can help raise understanding of energy issues more generally, in particular the factors that drive energy costs, the importance (and challenge) of developing new technologies and resources and, importantly, the impacts of these choices. Without such understanding and a broad social consensus about our future directions, meeting Australia's long-term energy goals will become more difficult and costly.

Australia faces a continuous challenge in reducing its environmental footprint from energy generation and use while also meeting growing energy needs. Yet there is a risk that concerns about the development of new technologies may progress to a point where we as a community begin to inefficiently limit what are otherwise safe and sensible options to meet this challenge. At the same time, there is also a need for the energy sector to better engage with and understand community needs and concerns and to transparently and proactively work to address them.

It is incumbent not only on governments to explain the future energy task but also on industry and other proponents to explain how it can be achieved safely and sustainably. The Australian Government, through its climate change and energy programs, is committed to working with businesses, state and territory governments, and community stakeholders to improve the transparency of decision-making as well as engagement in developing policy and programs. The government will also work to improve the energy information base and promote a better understanding of Australia's future energy choices (see section 9.3).

Energy policy priorities

The preceding discussions give rise to a robust set of policy conclusions and priorities for national energy policy over the coming decade. These are:

- Australia's energy security outlook appears positive and robust, although change (geopolitical, demographic, technological or in market dynamics) is likely to be a more dominant factor in the policy landscape than in the recent past.
  - Unexpected events – market or geopolitical – will almost certainly happen, possibly more frequently than in the past.
  - Australia's access to well-established and diverse international supply chains suggests that such risks or outcomes are more likely to affect energy prices rather than compromise in a sustained way Australia's physical energy supply.
  - There is a need to ensure that our energy security and policy frameworks are robust and resilient to a range of possible futures – active monitoring and an ability to respond where required will be important.
  - Our ability to manage our long-term energy security and climate change goals crucially depends on our ability to attract required investment and successfully deploy a suite of low-emissions technologies.
- Meeting Australia's growing energy needs, rising global costs of production, and reducing our greenhouse gas emissions will all place pressure on domestic fuel and electricity costs over the coming decade and beyond. Growing links between domestic and international gas and coal markets may also add to price pressures and generate new market dynamics.
  - To ensure efficient and timely investment and energy use decisions, it is essential that energy prices are efficient and reflect the cost of supply.
  - However, it will be important to minimise pressures on household and business costs through efficient policy and regulatory settings that improve the productivity of Australia's energy system and build more competitive and efficient markets.
  - In particular, unfinished reforms should be pursued in electricity and gas markets to improve competition, transparency and access, reduce government ownership and increase consumer choice. Reducing the impact of unnecessary and costly external interventions on energy markets is also important.
  - Reform of regulated pricing structures is politically challenging but fundamentally necessary to provide long-term consumer benefits and improve our energy productivity.
  - Ongoing policy uncertainty in energy, carbon or financial markets will increase costs as investment is postponed or moves into lower-risk (but suboptimal) alternatives.
- Australia will face growing competition from other energy suppliers, particularly in coal, LNG and uranium, and realising our energy development potential, for export and domestic markets, will require a continued focus on improving national productivity and competitiveness.
  - Australia will need to attract investment for new energy resource projects through improved regulatory and business frameworks, building our energy resource knowledge base, promoting exploration and development, enhancing our skills base and developing new infrastructure to provide access to markets.

- Sustainable development of our energy resources and energy system remains critical. Balanced approaches that resolve current and future tensions over multiple land or resource uses will be essential to unlocking our development potential and to meeting future social needs.
- While coal will continue to underpin our baseload energy needs well into the next decade, gas is set to be increasingly important, particularly if commercially viable alternative clean energy baseload technologies fail to emerge in a timely fashion.
- The commercial health of Australia's gas and electricity markets will be important to our energy security, economic development and climate change response.

- Energy markets will interact with carbon pricing frameworks (and markets such as the market for Renewable Energy Certificates) to find least-cost clean energy solutions that help meet our greenhouse gas emissions reduction targets. This will come from a portfolio of technologies developed or adapted in Australia and from overseas.
  - Flexible and well-regulated energy markets will be critical, along with a continued effort by government and business to accelerate development of a range of commercially viable clean energy technologies. Some of these options will be developed in Australia, but most will be developed and/or adapted through international trade and collaboration.
  - Carbon capture and storage and emerging renewable technologies (solar thermal, geothermal and wind) have the potential to be an important set of clean energy technologies for Australia, both domestically and in supporting our energy trade.
  - Global and national efforts to accelerate technology development are critical. Providing markets with a wider and earlier range of commercial clean energy options can lower long-term costs by avoiding technology lock-in. Early understanding of technology potentials will inform future choices and allow smooth market adjustment.

These conclusions form the basis of four clear priority areas which the government believes will strengthen Australia's ability to fully realise its future energy potential. These are:

- strengthening the resilience of Australia's energy policy framework
- reinvigorating the energy market reform agenda (markets and energy productivity)
- developing Australia's critical energy resources, particularly Australia's gas resources
- accelerating clean energy outcomes.

Part II of the draft Energy White Paper – *Australia's energy policy framework* – focuses on the key elements of energy policy (security, markets, productivity and clean energy), and addresses the core aspects of each priority, outlining the main challenges and actions in each.

Part II: Australia’s energy policy framework

4 Australia's energy security

Highlights

- Maintaining Australia's energy security continues to be a paramount goal for the Australian Government.
- Australia's energy systems (electricity, gas and liquid fuels) are currently meeting the economic and social needs of Australians, and are expected to continue to do so into the future. Nonetheless, there are some emerging issues that continue to present challenges in energy markets, including:
  - transitioning to pricing of carbon
  - ability to secure large-scale investment
  - uncertainties surrounding emerging gas market developments (particularly coal seam gas)
  - unrest in global oil markets
  - upward pressures on energy prices
- The efficient exploitation of Australia's energy resources (renewable and non-renewable) makes an important contribution to Australia's energy security. However, fuel self-sufficiency should not be a policy goal in itself as this could impose substantially higher costs on Australia.
- A growing reliance on liquid fuel imports (both refined and crude product) is not considered to impair long-term liquid fuel security due to our ability to access an adequate and reliable supply of liquid fuels through well-established and diverse international supply chains. However, it will place a greater reliance on longer global supply chains and a consequential need for investment in adequate import and storage infrastructure.
- Over the coming decade there are a range of challenges for improving or at least maintaining Australia's energy security, including:
  - long-term policy investment certainty around carbon pricing
  - continuing market (supply- and demand-side) reforms to maximise appropriate investment and improve the flexibility and resilience of energy markets
  - encouraging diversity of supply and infrastructure reliability on supply chain resilience
  - attracting the necessary investment required to meet future energy demand (including attracting capital and having skilled labour to deliver projects)
  - promoting the importance of continuing well-functioning international energy markets.
- Energy security risks are more likely to manifest themselves in higher prices, rather than in restrictions to physical supply.
- There would be benefit in the regular review and refreshment of national energy policy, and in deeper assessment of Australia's energy risk preparedness to better understand critical relationships and test information and decision-making mechanisms. A review process will also enable predictable assessment of opportunities for structured and timely policy adjustments, where required.

4.1 Introduction

Ensuring Australia's energy security is a high priority for the Australian Government. Energy security enables society to function and consumers (both households and businesses) to plan and develop in the knowledge that they have access to adequate, reliable and competitively priced energy.

Maintaining energy security requires careful balancing of many policy objectives: facilitating timely and appropriately sized investment in the energy sector in the context of moving to a lower-carbon economy; providing internationally competitive frameworks for Australian industry; and delivering reliable, adequate and competitively priced energy to Australian households and businesses. It also requires specific emergency response and system security frameworks to enable Australia to prevent or respond quickly to unforeseen developments or threats.

Energy security, like many other aspects of energy policy, is a responsibility that is shared across the Commonwealth and state and territory governments. This joint constitutional responsibility is recognised through the Standing Council on Energy and Resources and other energy-related arrangements under the Council of Australian Governments framework.

4.2 Overview of energy security

Key elements of energy security

From a policy perspective, energy security can be defined as 'the adequate, reliable and competitive supply of energy to support the nation's economic and social development, where:

- **adequacy** is the provision of sufficient energy to support economic and social activity
- **reliability** is the provision of energy with minimal disruptions to supply
- **competitiveness** is the provision of energy at an affordable price that does not adversely impact the competitiveness of the economy and that supports continued investment in the energy sector'.[1]

These three dimensions of energy security are interrelated. For example, in a situation where energy supplies are not adequate to meet the needs of the economy or community, the price of energy will need to rise or intervention in the market will be required to allocate scarce energy resources. Conversely, the interaction of these three dimensions can lead to trade-offs. For instance, assuring or increasing reliability can require sustained higher investments, which may place upward pressure on energy prices. Both of these situations could adversely affect the competitiveness of the economy.

Energy security is also a time-dependent concept, which can change, sometimes unpredictably, and is often more readily appreciated when it is absent than when energy systems appear to be functioning well.

[1] Department of Resources, Energy and Tourism, *National energy security assessment*, RET, Canberra, 2011.

What factors determine energy security?

In modern economies, almost every aspect of energy policy contributes to energy security. It is supported by ready access to energy resources and fuels, infrastructure that transforms and transports energy products, and markets and policies that provide frameworks for the efficient delivery of energy to consumers.

Australia's natural resource endowment, ready and open access to international markets and high-performing economy with the capacity to attract necessary investment in the energy system all contribute towards our energy security.

There are a range of identifiable drivers that can play a critical role in determining Australia's short-, medium- and long-term energy security:

- the ability to efficiently and sustainably develop our energy resources
- domestic and global geopolitical and economic conditions that influence supply and demand for energy as well as key inputs to the development of the energy system such as availability of investment capital (see Box 4.1)
- the efficiency and robustness of our energy markets
- the degree of integration with international energy markets and supply chains
- changes in domestic and global energy prices.

In addition to these general factors, factors such as the policy framework and the supply of skilled labour are important, while the regional nature of our electricity and natural gas markets and the differences between major energy demand centres are also important considerations.

Fundamentally, all these factors interact to determine our ability to ensure physical supply by bringing on adequate and timely investment in future energy infrastructure in the decades ahead.

Over the past 30 years, energy market and policy framework reforms have been central to improving our energy security and efficiency. Energy outcomes are increasingly a product of market forces rather than government direction, allowing Australia to benefit from the greater efficiencies the private sector can provide. Improved regulatory frameworks and market institutions have also contributed to these outcomes.

Box 4.1: International factors that can affect energy security

Global economic conditions

The influence global economic conditions have on energy markets has been starkly demonstrated in recent years by the global financial crisis. Recovery in many developed countries has been fragile, which has slowed growth and weakened the demand for energy, particularly oil.

While overall Australia has weathered the crisis well, some related consequences such as reduced investment risk appetite, higher lending costs and difficulty in obtaining finance for large-scale energy investments due to financial institutions tightening their lending thresholds have continued across the Australian energy sector. This has led to a shift away from debt finance towards a greater requirement for equity.

Geopolitical instability and the oil market

Geopolitical instability and the risk of a supply disruption have long been features of the global oil market. Nevertheless, market mechanisms have historically proven an efficient and effective way of ensuring that Australia continues to have adequate supplies of liquid fuels.

Australia's access to well-functioning global markets has helped create highly diversified supply chains for crude oil and refined petroleum products, with international sources supplementing Australia's domestic production. This diversity of supply prevents over-reliance on any single supply source and helps mitigate risks from potential supply disruptions.

In addition, the history of oil supply shocks over many decades suggests that global crude oil and refined product markets have the capacity to swiftly respond to a supply disruption by eliciting some alternative or additional supply, reallocating supply efficiently among users, and reducing the quantity demanded through temporarily higher prices.[2]

Australia's liquid fuel security does not solely rest on market outcomes. As a member of the International Energy Agency (IEA), Australia also benefits from the IEA's collective emergency response mechanisms. These emergency response arrangements are designed to mitigate the impacts of sudden oil supply shortages by making additional oil available to the global market.[3]

A final component of Australia's liquid fuel security is provided by the regulatory safety net powers contained in the *Liquid Fuel Emergency Act 1984*. The Act gives the Australian Government wide-ranging emergency powers in the event of a major national fuel shortage, whether triggered by domestic or international events. Australia's emergency response framework is discussed in more detail in section 4.3.

[2] ACIL Tasman, *Liquid fuel vulnerability assessment*, report prepared for the Department of Resources, Energy and Tourism, Canberra, 2011.

[3] For an overview of the IEA's emergency response system, see IEA, *IEA response system for oil supply emergencies*, IEA, Paris, 2010.

While Australia meets most of its energy needs through domestic production, this is not the case for liquid fuels: Australia is a growing net importer of crude oil and refined petroleum products. However, liquid fuel security is expected to remain high due to our ready access to open and well-functioning international markets that contribute to a highly flexible and diversified supply chain (further discussed in Chapter 6A). This reinforces the point that a lack of oil self-sufficiency does not in itself compromise or reduce Australia's energy security. Box 4.2 discusses the efficacy of self-sufficiency as a policy goal.

Box 4.2: Should Australia pursue self-sufficiency as a goal of energy policy?

The findings of the Australian Government's 2011 National Energy Security Assessment show that energy security does not depend on energy independence or the ability to be self-sufficient.[4] Ensuring energy security requires consideration of the growing interconnectedness of global energy trade, supply chain vulnerabilities and geopolitics and the ability of domestic markets to attract investment and efficiently allocate resources.

Countries with large endowments of energy resources (like Australia) can supply global markets with adequate energy supplies to benefit countries with higher costs or poorer domestic energy resources. Energy is like other commodities, where benefits of international trade have increased development options and national and global wealth. Australia benefits from selling energy resources to others and buying resources where it is cheaper to do so.

While disruptions can increase short-term liquid fuel costs, global markets have historically demonstrated that they can maintain supply and meet market demand even when the balance is tight.

Pursuing self-sufficiency in energy resources such as liquid fuels can impose unnecessary higher costs on consumers without necessarily providing a material economic or strategic benefit. In addition, removing or reducing international competition or incentives to utilise alternative reliable energy supplies can have the effect of reducing market efficiency and increasing critical dependency and therefore vulnerability. This reduces overall energy security.

This is not to ignore concerns over increasing critical dependencies or vulnerabilities in an economy. These considerations suggest that it is prudent to maintain a diverse energy supply and encourage development of commercially viable alternative liquid fuels and technologies – but this does not justify the pursuit of self-sufficiency as a goal in itself.

For a major global energy exporter like Australia, pursuing a goal of national energy self-sufficiency is counterintuitive.

Maintaining long-term energy security increasingly requires energy policy frameworks to take into account relevant social and environmental objectives, such as the transition to a lower-carbon economy, and to manage growing competition over access to and use of resources. Promoting an effective global response to climate change, particularly global cooperation on technology, may also be an important energy security objective in terms of maximising global investment in clean energy.

[4] Department of Resources, Energy and Tourism, *National energy security assessment*, RET, Canberra, 2009 and 2011.

Australian governments at all levels will not allow energy security to be compromised and, if necessary, will intervene to maintain supply. However, government intervention should always be seen as a last resort, since it can have negative short-term and long-term consequences, such as inefficient operation of energy markets and increased consumer costs.

The key focus should remain on developing mutually reinforcing policy frameworks that deliver on stated objectives and enhance markets while maintaining Australia's economic prosperity and meeting our social needs and environmental goals.

4.3 Energy security policy framework

Australia's international energy security obligations

As a member of the International Energy Agency (IEA), Australia is a signatory to the 1974 Agreement on an International Energy Program.[5]

The agreement contains a commitment for participating countries to 'establish a common emergency self-sufficiency in oil supplies'. To this end, participating countries are obligated to meet an 'emergency reserve commitment', which requires each country to hold oil stocks equivalent to no fewer than 90 days of the previous year's average daily net imports (see Chapter 6A for more on the 90-day requirement).

The agreement also includes coordinated emergency response measures that allow IEA members to act collectively in the event of a major international oil disruption. The response measures include:

- drawdown of oil stocks
- demand restraint measures
- fuel-switching from oil to alternative energy sources
- surge oil production
- sharing available supplies.

Australia does not hold government-controlled or -regulated industry stocks for drawdown in an emergency, and short-term surge production and fuel-switching capacity in Australia are therefore limited. Without activating the *Liquid Fuel Emergency Act 1984*, Australia can only participate in an IEA-coordinated emergency response, or collective action, through a combination of market and industry mechanisms and voluntary demand restraint.

Australia is also a member of several multilateral energy forums that cooperate on energy information, policy and trade. These include the APEC Energy Working Group, the East Asia Summit Energy Cooperation Task Force, the International Energy Forum, the Energy Charter Treaty and the G-20 energy-related work. Australia is also a member of a wide range of plurilateral energy technology groups that cooperate on low-emissions technologies and practices.

[5] Australia joined the IEA in 1979 by becoming a signatory to and ratifying the agreement.

Australia's energy security framework

Objective

Consistent with the core objective of the draft Energy White Paper framework, Australia's energy security framework aims to ensure an adequate, reliable and competitively priced supply of energy to support our ongoing economic and social needs.

Principles

The framework is guided by the following principles:

- Energy security policies should be implemented where they are rigorously assessed as delivering net positive benefits to the economy and consumers.
- Energy security does not equate to energy independence or self-sufficiency in any particular energy source.
- Energy security is generally enhanced through a diverse set of fuel options and multiple points of supply.
- Efficient, transparent and open domestic, regional and global markets that create clear incentives for timely investment and efficient operation and end use are the best means for ensuring energy security at least cost.
- Government intervention to manage disruptions should be as a last resort. Decisions to intervene should be based on an agreed transparent and objective emergency framework that ensures cooperation between industry and government to minimise market distortion.
- In the event of a disruption, energy market participants should be able to make independent decisions in response to price signals and existing or revised contractual arrangements. These decisions are likely to provide the most effective, flexible and timely responses to minimise the impact of disruptions at least cost.
- Australia should continue to promote energy supply chains and market efficiencies, reduce barriers and improve regulatory transparency and consistency across jurisdictions.

What are we doing to promote energy security?

The Australian Government is promoting national energy security outcomes through an integrated energy policy framework aimed at:

- promoting timely and efficient development of Australia's energy resources
- developing robust energy markets that provide reliable and efficient supply-side and demand-side outcomes
- ensuring effective and resilient governance and regulatory institutions with effective and transparent market monitoring arrangements

- ensuring energy and related resource policies are appropriately and efficiently integrated with climate change and other environmental policy frameworks
- developing new generation and end-use technologies to improve performance (including environmental outcomes), diversify the energy system and reduce critical dependencies
- providing a stable, attractive and open economy that facilitates international trade and investment
- undertaking effective international engagement and collaboration with key trading partners and international energy organisations.

Central to the delivery of this framework and energy security outcomes is the provision of stable policy. Without this fundamental underpinning, it will be difficult or more costly to attract the necessary investments to meet our energy needs.

In addition to this general policy framework, Australia has emergency response frameworks covering our major energy markets as well as measures to improve the resilience of critical energy infrastructure.

Assessment and refinement

Regular review and assessment of Australia's energy policy and energy security settings could help provide a more robust energy policy framework to ensure that our energy security is maintained in this period of significant transformation and investment.

Australia's emergency response framework

Energy market reliability depends on robust critical energy infrastructure (physical energy facilities, energy supply chains, information technologies and communication networks).

The emergency management arrangements for Australia's energy market systems have been developed to improve responses to significant supply disruptions (such as the Longford and Varanus Island gas supply incidents in Victoria and Western Australia) or energy disruptions caused by extreme weather.

The emergency response arrangements that are in place for the liquid fuels, gas and electricity sectors are outlined in more detail below. While these arrangements identify supply options, facilitate communication and ensure effective approaches in the event of a major disruption, they largely rely on the market to resolve supply emergencies. Government intervention is reserved as a last resort to protect consumers or to preserve system security.

Energy emergency responses are also reflected in broader national emergency management arrangements through the Department of Resources, Energy and Tourism's involvement in the Australian Government Crisis Management Framework. This also includes engagement with the Australian Government Crisis Committee, or through the National Crisis Committee when a whole-of-government response is necessary and when the states and territories have requested national support.

Liquid fuels

Unlike many other IEA countries, Australia does not hold government-owned strategic stock to manage supply during a short-term shortage, preferring to rely on the flexibilities markets offer to manage liquid fuel supply constraints without government intervention and to allow price increases to dampen or reduce demand.

However, if circumstances are considered outside the capacity of a market-based response, Australia's state and territory governments have constitutional responsibility for planning and coordinating emergency responses within their jurisdictions. These regulatory powers are primarily focused on supply restraint and priority needs for essential users.

The National Oil Supplies Emergency Committee, a committee of the Standing Council on Energy and Resources, is the main executive channel through which the Australian, state and territory governments formulate their overall management response to a national liquid fuel emergency.

In the event of a fuel shortage with national implications or the need for Australia to meet its commitments to the IEA under existing treaty obligations, the Governor-General of Australia may, upon prior consultation with the Commonwealth Resources and Energy Minister, declare a national liquid fuel emergency under the *Liquid Fuel Emergency Act 1984*. This provides the Commonwealth Resources and Energy Minister with wide-ranging powers to control the drawdown, transfer and sale of industry stocks of crude oil and liquid fuels, to control the range of products produced by Australian refineries and to direct bulk and retail sales of fuel across Australia.

Gas

The Commonwealth Department of Resources, Energy and Tourism is currently interim chair of the National Gas Emergency Response Advisory Committee. It has no power to direct market participants, but provides advice to ministers and a communication channel to resolve gas supply disruptions.

Recent market reform developments in the Australian gas markets, such as investments in pipelines to major demand centres, the National Gas Bulletin Board, the publication of the Gas Statement of Opportunities (by the Australian Energy Market Operator), the gas Short-Term Trading Markets and the contingency gas arrangements have added resilience to market arrangements.

Electricity

The Australian Energy Market Operator (AEMO) is the market operator of the National Electricity Market (NEM) and the system operator of the national electricity grid on the east coast.

The AEMO is responsible for ensuring that it can respond in a coordinated and timely way to power system incidents, and fulfil its obligations under the NEM rules and policy framework to return the power system to a secure operating state.

The Northern Territory and Western Australia maintain separate emergency response arrangements under their market operators.

The AEMO also provides leadership and decision-making during a power system emergency to ensure cooperation between industry participants and coordination with jurisdictional authorities.

NEM jurisdictions can also intervene by use of energy emergency powers in response to power system emergencies.

Critical infrastructure resilience

In general, resilience is about being better able to adapt to and manage change, recognising and – where feasible – implementing measures to reduce risk, and being better able to respond to and recover from any type of hazard, including natural disasters, pandemics, accidents, negligence, criminal activity and terrorist attacks. It is also about learning from incidents and building capacity in organisations to better manage all hazards, both expected and unexpected, and using times of adversity to achieve positive outcomes where possible. An important part of creating a more resilient Australia is creating more resilient critical infrastructure.[6]

Critical energy infrastructure can include those physical energy facilities, energy supply chains, information technologies and communication networks that, if destroyed, degraded or rendered unavailable for an extended period, will significantly affect our energy supply and security, as well as our social and economic wellbeing.[7]

Responsibility for enhancing the resilience of critical infrastructure is shared between owners and operators and the Australian, state and territory governments. Collaboration is supported through the Trusted Information Sharing Network for Critical Infrastructure Resilience, managed by the Attorney-General's Department and supported by relevant Australian Government line agencies.

The network provides opportunities for owners and operators of critical infrastructure to share information on security issues and cross-sectoral dependencies. It comprises seven infrastructure groups (sector groups) for different business sectors, and is overseen by the Critical Infrastructure Advisory Council.

The Energy Sector Group is part of the network and shares information on hazards and vulnerabilities and identifies mitigation strategies. It also shares information with other sector groups, such as banking and finance and the communications sectors, on the interdependencies between those sectors and the energy sector.

National Energy Security Assessment

The 2011 National Energy Security Assessment (NESA) builds on the first assessment report (released in 2009) and provides an assessment of energy security in the short, medium and long terms covering the period 2011–35 for the liquid fuels, natural gas and electricity sectors.[8] The report considers the key influences on the supply of energy in Australia over this period.

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[6] Adapted from Australian Government, *Organisational resilience: position paper for critical infrastructure*, Attorney-General's Department, Canberra, 2011. Further information on resilience is available from the website for the Trusted Information Sharing Network, www.tisn.gov.au/www/tisn/content.nsf/Page/Resilience.

[7] Adapted from the Australian Government's definition of critical infrastructure in Australian Government, *Critical infrastructure resilience strategy*, Attorney-General's Department, Canberra, 2011.

[8] Department of Resources, Energy and Tourism, *National energy security assessment*.

The 2011 assessment examined:

- Australia's growing reliance on oil importation
- the gas sector's rapidly evolving unconventional gas resources and LNG markets on the east coast
- the investment environment in the electricity sector, particularly in the context of climate and renewable energy policies.

The report's key finding is that Australia's current level of energy security is meeting the economic and social needs of Australians, albeit with some emerging market and policy uncertainties that could have implications for the future.

The detailed findings have been incorporated in much of the discussion throughout this draft Energy White Paper. Summary findings for each the three energy sectors are outlined below.

Liquid fuels

Liquid fuels energy security is assessed as high, trending to moderate[9] in the long term, as Australia has continued access to highly adequate and reliable supplies of liquid fuels at prices that are manageable within the broader economy. However, the moderate assessment in the long term recognises that the continued rise in Australia's imports of petroleum products will lead to greater reliance on international supply chains and the consequential need for investment in adequate import and storage infrastructure.

The assessment also recognises the likely trend of high crude oil prices driven by increasing global demand and an increased reliance on more expensive sources of supply; the significant global investment challenge required to meet rising demand; and continued risks of geopolitical uncertainty in key oil-producing countries.

Gas

Gas energy security overall remains moderate over the NESA period, reflecting a rapidly developing market with distinct regional differences and challenges.

This assessment recognises the mixed influences on gas security associated with the development of the coal seam gas and LNG export industries on Australia's east coast, due to commence in 2014–15. While the entry of these fuels to the market has increased Australia's gas reserve levels, it has the potential to introduce competitive tension between the domestic and LNG export markets, which could lead to higher domestic gas prices.

As noted in the previous chapter, the supply and demand balance in Western Australia is changing. While recent increases in demand have placed upward pressure on prices, the market is responding with increased supply from a greater diversity of sources planned to come on line in the short to medium term. Despite this, there is a risk that some downstream projects may be challenged in sourcing gas at prices that maintain their viability.

[9] 'High energy security' is defined as meeting Australia's economic and social needs. 'Moderate energy security' is also when needs are being met but with emerging issues that will need to be addressed to maintain this level of security. 'Low energy security' is when needs are not being, or might not be, met.

Electricity

Electricity energy security is rated as moderate over the NESA period. While some factors (such as the drought) have moderated since 2009, the sector faces significant challenges into the future, most notably reliability and price pressures associated with implementing climate change and renewable energy policies, and providing long-term certainty about these policy frameworks. Significant investment is also needed in new and ageing infrastructure. However, ongoing market maturity, delivered through continued market reforms and the assistance mechanisms and energy security measures announced in the Clean Energy Future package, should allow the market to respond to these challenges. This is further discussed in Chapter 6B.

Shock scenarios

The 2011 NESA also examined a limited set of physical infrastructure supply chain ‘shocks’ in the liquid fuel, natural gas and electricity sectors (see Box 4.3). The three shock scenarios are hypothetical and were designed to test the response arrangements and resilience of the energy system. The modelling results indicated that, in general, Australia has resilient liquid fuel, gas and electricity supply arrangements, and highlighted the continuing importance of resilient infrastructure and diversifying gas supply arrangements and transmission infrastructure to avoid and respond to economically damaging supply disruption events. The report also included a cyber security case study to explore the emerging risks to energy security from this evolving threat.

Box 4.3: Shock scenarios – overview and modelling framework

Liquid fuels – a major interruption to Singapore’s ability to trade petroleum products with Australia

This scenario was based on the temporary closure of shipping to and from Singapore and shutdown of Singapore’s three major refineries. The interruption was modelled to last for 30 days, and impacts were assessed under current conditions and then under the slightly tighter global market conditions forecast for 2015–16.

Modelling of the shock scenario was done using an analysis of the response of the oil market to Hurricanes Katrina and Rita to estimate the impact on prices over three months of a 30-day shutdown in Singapore.

Natural gas – a major reduction in the capacity of the Roma to Brisbane natural gas pipeline

This scenario involved a hypothetical reduction in the capacity of the pipeline for 14 days. The event was assessed under current conditions and then under changed conditions for 2015–16 to determine the impact on:

- gas customers of the affected pipeline, including commercial and industrial customers, gas-fired generators and residential customers
- the broader gas markets in eastern Australia
- the electricity market and electricity prices.

Electricity – the sudden exit of the Loy Yang A Power Station from the National Electricity Market

This scenario examined the impact of an unexpected exit from the market by the largest electricity generator in Victoria. Two possibilities were examined: a 14-day temporary outage and a permanent exit. The modelling examined both non-peak and peak seasonal periods under current conditions and then under forecast conditions for 2015–16 to determine:

- the impact on the electricity (generation and transmission) and distribution networks in the National Electricity Market
- the impact on the market itself
- the effectiveness of market mechanisms in dealing with the reductions in electricity supply.

More information on the shock scenarios and the modelling results is available in the 2011 NESA report.

4.4 Energy security challenges

The NESA findings highlight that governments continue to face several key challenges for maintaining or improving Australia's energy security, including:

- implementing a carbon price mechanism to address investment certainty sought by energy market participants
- continuing market (supply- and demand-side) reforms to maximise appropriate investment and improve flexibility and resilience of energy markets in the face of disruptions or structural change
- encouraging diversity of supply and infrastructure reliability on supply chain resilience
- monitoring the competitiveness impacts and costs to consumers of rising energy prices
- monitoring energy market developments and outcomes
- monitoring investment needed to meet future energy demand against global demand for energy infrastructure capital, components and skilled labour
- promoting the importance of continuing well-functioning international energy markets to our oil security.

Improving the resilience of Australia's energy frameworks

Many of the challenges in our energy future will be managed through well-designed policy and regulation along with targeted support from governments that helps mobilise the private sector and markets. This can be facilitated through a robust and resilient energy framework that effectively monitors, anticipates and provides for timely responses to new developments.

The Australian Government, acting in partnership with other Australian jurisdictions and the energy market bodies, maintains a comprehensive suite of mechanisms and processes which, with a wide range of other market and technical inputs, provide a robust energy resilience and risk preparedness framework covering the spectrum of Australia's energy system.

However, the prospect of unprecedented change in national and global energy systems, as well as evolving dynamics and new relationships between the energy sector and other sectors of the economy, suggests that there would be benefit in a deeper assessment of the overall energy risk management framework, to better map critical relationships and test information and decision-making mechanisms in a more systematic and integrated fashion.

The government will therefore undertake a National Energy Risk Preparedness Audit across the energy sector as part of the National Energy Security Assessment process, to test the appropriateness and effectiveness of response mechanisms to manage critical risks to the energy sector. This work will be undertaken as part of the National Energy Security Assessment process.

The government will also institutionalise the biennial release of the National Energy Security Assessment, with the next assessment to be delivered in 2014. This will include a revised analytical and quantitative methodology to provide for a more systematic and integrated understanding of key relationships between the energy sector and other areas of the economy.

The Australian Government also believes there is benefit in establishing an ongoing institutional mechanism that provides for a regular and transparent strategic review and refreshment of national energy policy. Traditionally this has occurred through ad hoc White Paper or other processes. These reviews have at best been infrequent, with a consequential build-up of policy pressures over time resulting in periods of less clarity in overall policy objectives and direction. While such reviews need to be regular, they should not be so frequent as to add uncertainty or instability to markets.

The Australian Government therefore proposes implementing a regular four-year cycle of strategic review and refreshment of national energy policy, starting in 2016. This will allow time for new market and policy arrangements to mature and provide an opportunity for necessary parameter or policy adjustment.

The review would take into account material changes in key markets and policy settings, the progress that is being made in the commercialisation of key energy technologies, and trends or projected developments in key aspects of energy delivery, including investment in generation capacity and progress in energy market reforms and in the development of critical domestic energy resources such as gas.

To further improve public understanding and policy making, the government will work with relevant stakeholders to improve Australia's energy information base through regular analysis and reporting of key developments in resource information, market developments and technologies and fuels. The government will also work to improve the coherence of its principal energy data collections. These issues are further discussed in subsequent chapters.

4.5 Key actions

The Australian Government will pursue improved energy security and address key challenges by implementing the integrated energy policy framework defined in the draft Energy White Paper. This includes ongoing market monitoring, and energy security activities.

In addition, the Australian Government will:

- commit to a regular four-year strategic review of national energy policy (i.e. the Energy White Paper process) from 2016, including the alignment of critical analytical inputs
- review the National Energy Security Assessment framework with a view to improving its analytical and quantitative methodology, and to provide a more systematic and integrated understanding of key relationships with other critical areas of the economy
- commit to a biennial National Energy Security Assessment from 2014
- undertake, as part of the 2014 National Energy Security Assessment, a risk preparedness audit of Australia's energy sector in collaboration with states and territories, industry, and market bodies, with a view to mapping existing response mechanisms, and identifying whether there are any critical gaps.

5 Developing Australia's energy resources

Highlights

- Our energy resources are in record demand and with over $400 billion of mineral and energy resource projects in planning or under development, we are well placed over the coming decade to meet growing domestic demand and service booming global export markets.
- We have abundant world-class renewable energy resources and many decades worth of coal, gas and uranium reserves with good potential for more discoveries. Oil reserves are more limited but could be supplemented through new discoveries and technological advances.
- These resources not only underpin Australia's high level of economic growth and energy security but also improve the quality of life for many communities and families throughout Australia and our region.
- While these opportunities are expected to continue well into this decade, there is no room for complacency, with intense competition for investment and emerging supply from other producers. Indonesia is likely to shortly overtake Australia as a thermal coal exporter and competitors are expected to increase their exports of LNG.
  - Australia is a relatively high-cost destination; however, we must continue to improve our productivity and competitiveness to attract further investment and ensure a pipeline of new energy resource projects.
  - The continued provision of high-quality pre-competitive geoscientific information is critical to attract commercial interests in our energy resources.
- Improving the efficiency and administration of regulatory frameworks and arrangements is also critical. Consistency in regulation across all levels of government, where possible, is important.
- Australia will face some challenges to gain maximum return on our energy resources, maintain international competitiveness as a supplier and continue to be an attractive investment destination. These include:
  - managing and fostering the economic opportunity of energy resource development, particularly in relation to our gas resources, to ensure that wealth continues to be generated for Australia's long-term benefit
  - managing co-development pressures and access to our energy resources and ensuring development is sustainable – economically, socially and environmentally
  - facilitating infrastructure development to ensure that it keeps pace with demand for our energy resources
  - ensuring that there is a skilled and available workforce to support major energy resource projects.

5.1 Introduction

In the past decade, surging economic and social expansion in rapidly industrialising countries such as China and India has fuelled tremendous demand for Australian energy and mineral resources. During this time, urban populations in China and India have grown collectively by over 250 million – a population 10 times greater than Australia's.[1] These cities need to be constructed and powered, including from Australian thermal coal, liquefied natural gas (LNG) and uranium. These markets are in addition to our well-established and valued long-term energy trade with partner countries such as Japan and Korea.

While Australia's energy resources sector is experiencing a boom period, there are emerging pressures and challenges.

Australia faces growing competition as an energy supplier as new regions in the world develop, and comparative advantages can change quickly. Many of these regions have lower costs of production and, as they are relatively underexplored for energy resources, are perceived as more prospective than Australia.

To put this in perspective, Australia is currently the world's largest exporter of coal, yet we hold only 7 per cent of the world's recoverable black coal and rank fifth behind the United States (31 per cent), Russia (22 per cent), China (14 per cent) and India (8 per cent).[2] In the next few years, Indonesia will likely overtake Australia as a thermal coal producer. Similarly, new LNG capacity will emerge in the Middle East and Caribbean.

Ensuring the timely and efficient development of our energy resources is also critical to ensuring a reliable and competitive energy supply for Australians. Major resource developments and associated infrastructure provide export revenue, and in many cases also contribute to the development of our economy, providing opportunities for new activity and supply.

As noted in earlier chapters, the scale of investment required to develop our energy resource base is large and easily exceeds the potential of Australia's domestic capital markets. The Australian Government therefore welcomes foreign investment and understands its fundamental role in the creation and growth of our energy resources sector and in its future success. As an export-oriented nation, Australia also supports the development of liberalised markets to ensure that all countries can reap the benefits of increased trade.

Australian society increasingly demands that economic development, particularly the exploitation of our natural resources, is undertaken sustainably with social, environmental and economic considerations equally in mind. This is a shared responsibility, and government, business and the community all need to make important contributions to lasting solutions. While Australia's mining and petroleum industries have often been at the forefront of global best practice, increasing co-development pressures are heightening the tensions around managing multiple resource use and land access.

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[1] G Stevens, Reserve Bank of Australia, 'The resources boom', remarks at the Victoria University Public Conference on the Resources Boom: Understanding National and Regional Implications, Melbourne, 23 February 2011.

[2] Geoscience Australia, *Australia's identified mineral resources 2010,* Geoscience Australia, Canberra, 2010.

5.2 Overview of Australia's energy resources

A pipeline of projects

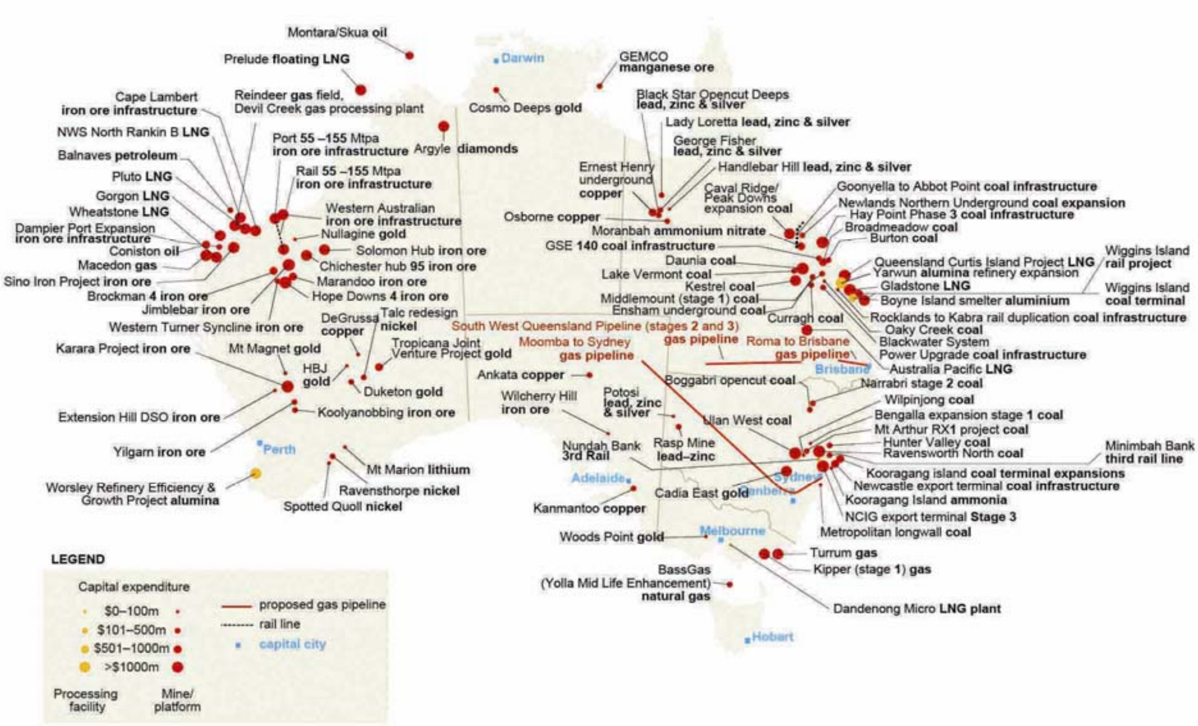
Capitalising on the economic boom throughout Asia, Australian companies have announced a pipeline of energy and mineral resource investment projects worth more than $400 billion due for completion between 2011 and 2020.[3] The scale of these projects is illustrated in Figure 5.1.

LNG is a particular stand-out in the investment pipeline. Australia has sanctioned five new LNG projects since October 2010 and seven since 2007. Included in this is the Prelude project, which is the world's first floating LNG facility, and three projects that will be supplied by coal seam gas. Together, these seven projects represent total capital investment of over $140 billion. They will more than triple our current LNG export capacity, putting Australia on track to be the world's second-largest exporter of LNG in 2015 and potentially the largest exporter by 2021.

But LNG is not alone in experiencing strong growth. There has been a suite of new investments in coal, with existing operations expanded and new developments launched. For instance, there is an entirely new coal precinct opening up in Queensland's Galilee Basin.

This investment will see Australia well placed as a leading regional energy producer in the period ahead. That said, we cannot take our success for granted and we must continue to focus on attracting exploration for new energy resources as well as improving our productivity and competitiveness to attract further investment.

Figure 5.1: Advanced energy and mineral resource projects in Australia, October 2011



Source: BREE, *Mining industry major projects October 2011*, BREE, Canberra, November 2011.

[3] ABARES, *Minerals and energy: major development projects – April 2011 listing*, ABARES, Canberra, May 2011.

Benefits of the boom in energy resources

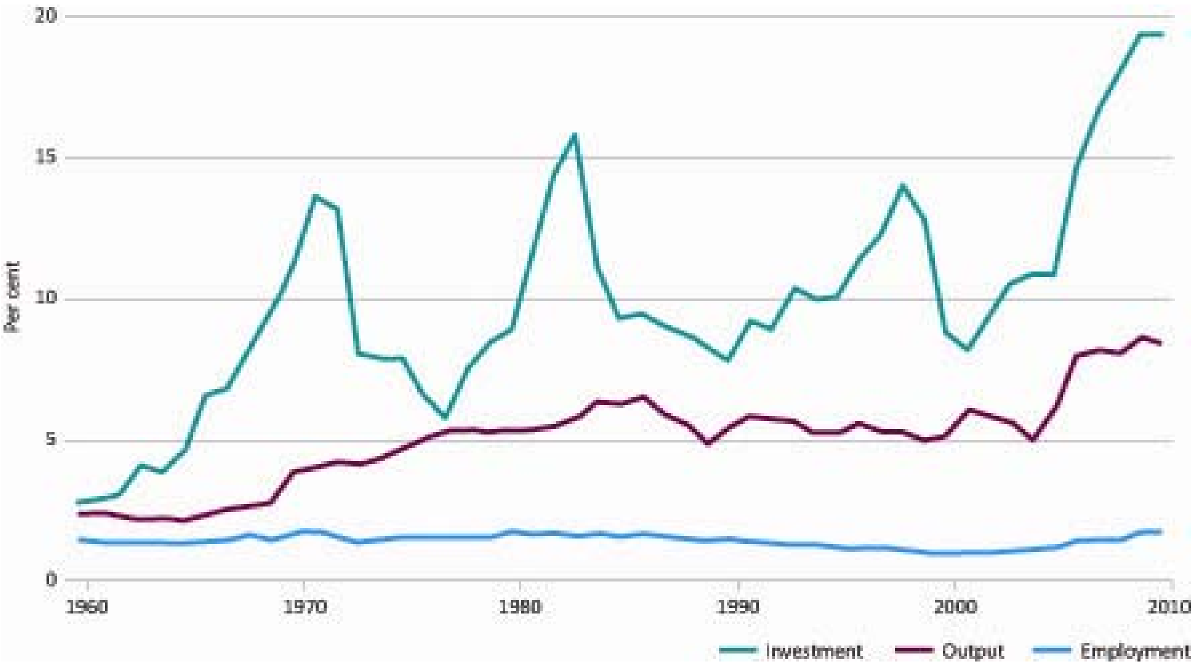
Understanding the magnitude of the current energy and mineral resources boom is difficult. For most Australians its physical manifestations are out of sight in remote locations and, for many, out of mind. Yet, the economic consequences affect us all.

In just 10 years, from 2000–01 to 2010–11:

- Australia's export value of coal has increased almost fourfold, from \$11 billion to \$43 billion[4]
- Australia's export value of LNG has increased more than fourfold, from \$2.6 billion to \$10.5 billion.[5]

It is difficult to estimate the returns to the economy from energy resources alone due to the aggregated nature of statistical reporting, which makes it difficult to fully distinguish between non-energy and energy resource contributions. However, Figure 5.1 shows that Australia's energy and mineral resources sector is an important source of economic wealth that underpins development in many of Australia's regional areas. The energy and mineral resources sector, and mining in general, generates crucial revenue in the economy through investment and wages (see Figure 5.2). In turn this provides important business and job opportunities in many supporting activities.

Figure 5.2: Mining industry share of nominal output, investment and employment, 1960 to 2010



Source: G Stevens, Reserve Bank of Australia, 'The resources boom', remarks at the Victoria University Public Conference on the Resources Boom: Understanding National and Regional Implications, Melbourne, 23 February 2011.

[4] BREE, *Resources and energy statistics: June quarter 2011,* BREE, Canberra, 2011.

[5] BREE, *Resources and energy statistics.*

Total export earnings from Australia's energy resource exports reached a new record in 2010–11 of $68.9 billion – accounting for around one-quarter of our total goods and services exports.[6] In 2011–12, earnings are forecast to reach $84.4 billion – a 20 per cent increase over 2010–11 – and this growth is set to continue.[7]

While the energy and mineral resources sector directly represents a relatively small percentage of employment in the economy (around 200 000 jobs in total, 103 000 of which are in energy and energy resource activities) (see Figure 5.2), many of these jobs are created and maintained in regional Australia. For example, it is estimated that the mining industry accounts for around 12 per cent of employment in Western Australia (outside Perth), the Northern Territory and Queensland (outside the Brisbane region).[8]

This activity also generates revenue for Australia through royalties and taxes. For example, in 2008–09 mining in total provided around $24 billion in royalty and company tax payments to governments – equivalent to 2 per cent of Australia's GDP. Wages also accounted for around 10 per cent of mining revenues at around $18 billion.[9] Energy resource activity accounts for a substantial proportion of these income flows. For example, in 2008–09 the Australian coal industry contributed around $12.9 billion in royalties and taxes[10] and the gas and petroleum industry contributed $8.8 billion,[11] which is comprised of Resource Rent Tax, production excise, royalties, and fees and taxes.

The energy and mineral resources sector also provides an important demand stimulus for intermediate goods and services. In 2008–09, around 25 per cent of total mining revenue was spent on local goods and services (this does not include the amount of total costs from new project investment).[12] The Minerals Council of Australia estimates that the vast bulk of this is sourced locally and supports around an additional 600 000 jobs in the economy.

The continued expansion of the sector has added to pressures elsewhere in the economy, largely through the high terms of trade and strong Australian dollar. There are also pressures on infrastructure and in parts of the workforce as the mining and energy sectors seek to expand and require additional skilled labour, particularly in engineering, geoscience professions and trades.[13] In turn this presents new business and employment opportunities for Australians.

It is undeniable that Australia is much better placed as an economy and a society through the benefits of the resources boom than had we chosen to forgo such development. The question it presents is how best to manage these pressures while sustaining our economic success so the full benefits are realised.

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[6] BREE, *Resource and energy statistics*.

[7] BREE, *Resource and energy statistics*.

[8] E Connolly and D Orsmond, 'The mining industry – from bust to boom', paper presented at the Reserve Bank of Australia Conference, The Australian Economy in the 2000s, Sydney, August 2011.

[9] Connolly and Orsmond, 'The mining industry'.

[10] K Elliot, *The Australian coal industry – creating value for Australia's future*, Australian Coal Association, 2010.

[11] Australian Petroleum Production and Exploration Association, *Financial survey results: 2009–10*, www.appea.com.au.

[12] Connolly and Orsmond, 'The mining industry'.

[13] National Resource Sector Employment Taskforce, *Resourcing the future,* Department of Resources, Energy and Tourism, Canberra, 2010.

Our energy resource potential

Australia's high-quality non-renewable energy resources are widely distributed across the country and, with the exception of oil, are projected to last well into this century on current rates of extraction.

Our renewable energy sources (many of which have yet to have their full potential realised) and emerging unconventional energy resources and technologies also present huge opportunities to further diversify our energy mix and support the transition to a clean energy economy.

Coal

Coal is an integral part of Australia's economy and will remain so for many decades to come.

Coal exports (thermal and metallurgical) are expected to grow strongly over the current decade. However, domestic coal producers face a set of near-term challenges, including increasing development pressures with farmers and local communities, and transitioning to the introduction of a price on carbon.

Domestic black coal production is likely to remain strong into the next decade (although some gassy coal mines will face increased costs). The future of Australia's brown coal industry remains tied to brown coal–fired generation in the Latrobe Valley; it faces long-term decline unless alternative applications can be found. Recognising these pressures, the Australian Government has established transitional assistance arrangements for gassy coal mines as well as for the highest-emitting power generators under the carbon price package.

The long-term sustainability of the coal industry is likely to depend on the successful commercialisation of carbon capture and storage technologies and low-emissions technologies in Australia and elsewhere as the world moves to constrain greenhouse gas emissions. New technologies may also offer the opportunity for unconventional use of stranded coal assets through synthetic fuels such as coal-to-liquids or coal-to-gas.

Uranium

Australia has the potential to be the world's most important uranium supplier due to our extensive uranium resources, mining expertise and leadership role in nuclear non-proliferation. Australia's uranium resources are also important in satisfying the world's need for low-carbon energy resources – 10 000 tonnes of Australian uranium exports replace the generation of 400 million tonnes of carbon dioxide from conventional power sources.[14] However, there are also some challenges to overcome for this to become a reality (see Box 5.1).

[14] Department of Resources, Energy and Tourism, *Australia's uranium industry,* RET, Canberra, 2011.

Box 5.1: Transport infrastructure – uranium

Currently, uranium can be shipped out of the ports of Adelaide and Darwin, to the United States, Europe and China.

Unlike many of Australia's other energy commodity exports, uranium is a high-energy, high-value export. It is exported as containerised cargo. Currently there are around 50 shipments a year. While it is expected to rise in the future, the volume of cargo involved is relatively modest. As such, it is important to encourage carriers to continue servicing Adelaide and Darwin ports.

Governments and industry are working through forums such as the Uranium Council to achieve national consistency in transport regulation for uranium, including opening up additional ports and increasing access to international shipping routes to better meet international demand and improve competitiveness.

Global infrastructure bottlenecks

The International Atomic Energy Agency (IAEA) develops Regulations for the Safe Transport of Radioactive Material. These have been adopted in Australia through the Australian Radiation Protection and Nuclear Safety Agency's Code of Practice for the Safe Transport of Radioactive Material 2008. The code is intended to establish uniform requirements for the safe transport of radioactive material in Australia. As the Commonwealth has no jurisdiction over this matter, the code has to be adopted into legislation by all states and territories, as is the case with other radiation issues. Ongoing streamlining of domestic regulation through the adoption of the code (and future codes as updated) will assist in ensuring uniform requirements across all Australian jurisdictions.

Appropriate and timely access to infrastructure will be an important challenge, both domestically and internationally. The Australian Government continues to work with the IAEA to remove issues of delay and denial of uranium shipments, and with other countries to open ports and increase shipping options for uranium exports.

By working with the IAEA on the delay and denial of shipment, the government aims to help open access to international ports by increasing international understanding of transportation of radioactive material.

Australia can also export its expertise on regulatory and nuclear non-proliferation safeguard regimes. As many Australian exploration companies operate in Africa, there is an opportunity to export Australia's responsible uranium mining culture and expertise to new uranium provinces.

Gas

According to the *World energy outlook 2011*, natural gas is the only fossil fuel expected to have a higher share of the global energy mix in 2035 than it does today.[15] In part, this is due to the role it plays as a transition fuel as the world moves to reduce greenhouse gas emissions. It is a lower-emissions alternative which can also provide energy security, particularly while clean energy technologies move towards commercialisation.

[15] International Energy Agency, *World energy outlook 2011*, IEA, Paris, 2011.

In Australia, gas production is expected to triple to 2020 and to grow an average of 5.5 per cent a year to 2034–35 as gas reserves in north-western Australia develop and coal seam gas in eastern Australia comes on line. This growth will be driven by export (of LNG) as well as increased domestic consumption, and major new developments are expected in Western Australia, the Northern Territory and Queensland. There is also potential for further developing coal seam gas reserves in northern and north-western New South Wales where developments can meet environmental and other regulatory requirements.

As noted in section 3.3, forecasts of future supply–demand balances need to be undertaken with caution as both will respond to changing price and other market factors; demand may shift to alternative supplies or moderate and new supply may emerge under higher prices.

In addition, each of Australia's major gas regions (the western and eastern markets and the Northern Territory) has different characteristics that need to be taken into account when considering future pressures and challenges.

Western market

Gas reserves in Western Australia are considered sufficient to meet long-term needs (export and domestic) to 2035, although maintaining supply at these levels beyond this will require new reserves.[16] It is considered likely that future new gas developments in the west will come from drier (low or no condensate), dirtier (higher levels of carbon dioxide), distant and deeper offshore fields with consequently higher costs of production. Viable commercial delivery to domestic customers will also continue to be limited or not an option for some developments. These factors mean that LNG opportunities are likely to remain critical in underpinning new gas developments. There will be a need to ensure that the development of the Commonwealth Government's gas assets is managed effectively to ensure that they are providing the best return for the Australian community within a commercial framework. This includes ensuring that appropriate consideration is given to domestic gas opportunities.

There is some potential for new tight gas or shale gas supply to augment domestic supply, but this will require sustained high gas prices and improvements in production costs. Supply into the domestic market is likely to be tight in the short term while new processing capacity is being developed.

Eastern market

Gas supply in the east of Australia is also expected to be sufficient to meet demand over the period given the planned and projected developments of new coal seam gas reserves.[17] Bass Strait fields are likely to decline over the period, although the timing of this will depend on the further field enhancement possibilities. The development of LNG projects at Gladstone will result in major new transmission pipelines and offers prospects in the medium term of new domestic supply to feed growing expected demand growth in New South Wales and Brisbane.

There is also speculation that coal seam gas fields in northern and north-western New South Wales could in the medium to longer term supply new power stations or feed into the network and supply major centres. While there is enormous potential in east coast gas, much will depend on price movements and the ability to commercialise and transport coal seam gas reserves. The growing

[16] ABARES, *Energy in Australia 2011*, ABARES, Canberra, 2011.

[17] Australian Energy Market Operator, *Gas statement of opportunities*, AEMO, 2011.

clash over resource uses in these areas must be successfully managed to secure sustainable gas supplies. Similarly, there will be a need for timely provision of gas infrastructure (transmission and distribution networks) if Australia is to optimise the development of its gas resources and transition to a low-carbon economy at manageable cost.

As discussed in section 3.3, the eastern gas market (particularly in Queensland) is projected to tighten as new coal seam gas developers enter production and the impact of carbon pricing begins to emerge. These circumstances may be transitional as market participants adjust to new dynamics and the domestic and international markets move into closer alignment. Market issues are discussed in more detail in Chapter 6B.

Northern market

Although the northern market is the smallest producer and consumer of gas in Australia, the prospects for gas development in the Northern Territory are excellent given its proximity to Asian demand centres. The proposed INPEX/Total gas project will involve developing the Ichthys gas field 850 kilometres south-west of Darwin as well as an offshore central processing facility and a subsea pipeline that will take the gas to Darwin for onshore LNG processing and export.

Gas policy issues

As a result of the emerging and expected changes in market dynamics (particularly increases in domestic prices), there have been calls for a national gas reservation policy to assure adequate supply.

While recognising that current market conditions are particularly challenging for some large gas users, the Australian Government believes that policy intervention at the present time to force domestic gas outcomes is unwarranted. However, there is a need to monitor market dynamics to assess whether policy settings deliver the required outcomes given the growing domestic use of gas. This will inform government decision-making, which will be mindful of domestic gas considerations in granting production licences.

Oil

Australian oil production is expected to decline over the period beyond 2020 in the absence of major new discoveries. As is the case with offshore gas, new finds in the established producing basins are likely to be in deep water, smaller in size and higher cost. Sustained high oil prices and new production technologies such as floating platforms may in the medium term enable development of smaller fields that were previously not commercially viable.

Australia remains relatively unexplored for oil and there is potential for significant new oil resources to be found in deep-water frontier basins (such as in the Great Australian Bight), and the development of onshore shale gas may unlock unconventional liquid hydrocarbons as well.

Renewables

Australia is fortunate to have high-quality renewable energy resources with enormous commercial potential (such as wind, hydro, bioenergy, geothermal, solar and ocean energy).

However, a range of commercial and technical barriers must be addressed before this potential is realised. These include cost and technological development challenges. These are discussed further in Chapter 7.

Unconventional energy resources

Australia's unconventional energy resources (such as shale gas and tight gas) and technologies (such as coal-to-liquids and gas-to-liquids) have significant potential to expand our energy resource base. Energy (and carbon) prices, technological advances and development costs will be key determinants in the future commercialisation of these resources. At present, our unconventional energy resources are not as well understood as our conventional resource base but are attracting increasing attention from prospective developers. They will also receive greater attention in future updates of the Australian Energy Resource Assessment (see Box 5.3).

Effective communication about new and emerging energy resources, including increased community awareness and consultation, will also be required to realise the full potential of our unconventional energy resources. This will help enable the community and policy-makers to make informed decisions about future energy resources in a regional development context and in relation to their role in Australia's energy mix.

Maintaining our investment attractiveness

Few resource-rich countries can compete with Australia's attractiveness as an investment destination. Australia offers energy investors a stable and efficient regulatory environment, a highly skilled and diverse workforce, a culture of innovation, a stable economy with low inflation and world-class industry capabilities – all geographically positioned at the doorstep of the Asia–Pacific region.

The scale of investment required to develop our energy resources for domestic and export is enormous and, as has been the case historically, the capital to support this development will invariably be sourced in large part from foreign sources.

Australia's competitiveness as a location for investment, and thus our ability to promote and develop a stream of new projects into the future, depends on a range of factors including prospectivity (the chance of achieving exploration success and commercial development); political, policy and regulatory settings; access to supporting infrastructure and commercial markets; and supportive fiscal regimes.

Australia is well placed on many resource development indicators, such as the 2011 World Risk Survey, where we were ranked seventh overall. However, in the 2004 survey Australia was ranked first, which shows that investment attractiveness can change quickly due to perceptions about the cost or risks associated with exploration and project development.

As global energy resource demand rises and prices increase, the risk–reward ratio starts to shift and countries once considered less stable – economically, politically and legally – can become attractive investment options. The challenge is for Australia to remain competitive with these new resource provinces without sacrificing the attributes that have helped make Australia so attractive.

5.3 Energy resource development policy framework

Building on the issues and needs raised previously, the Australian Government has developed a policy framework to support the sustainable development of Australia's energy resources. The framework is based on the following objectives, principles and components.

Objectives

The objectives of Australia's energy resource development policy framework are to:

- ensure that Australia's energy resources are sustainably developed for the benefit of all Australians
- provide reliable and competitively priced supplies of energy resources
- enhance Australia's role as a leading global supplier of energy resources.

Principles

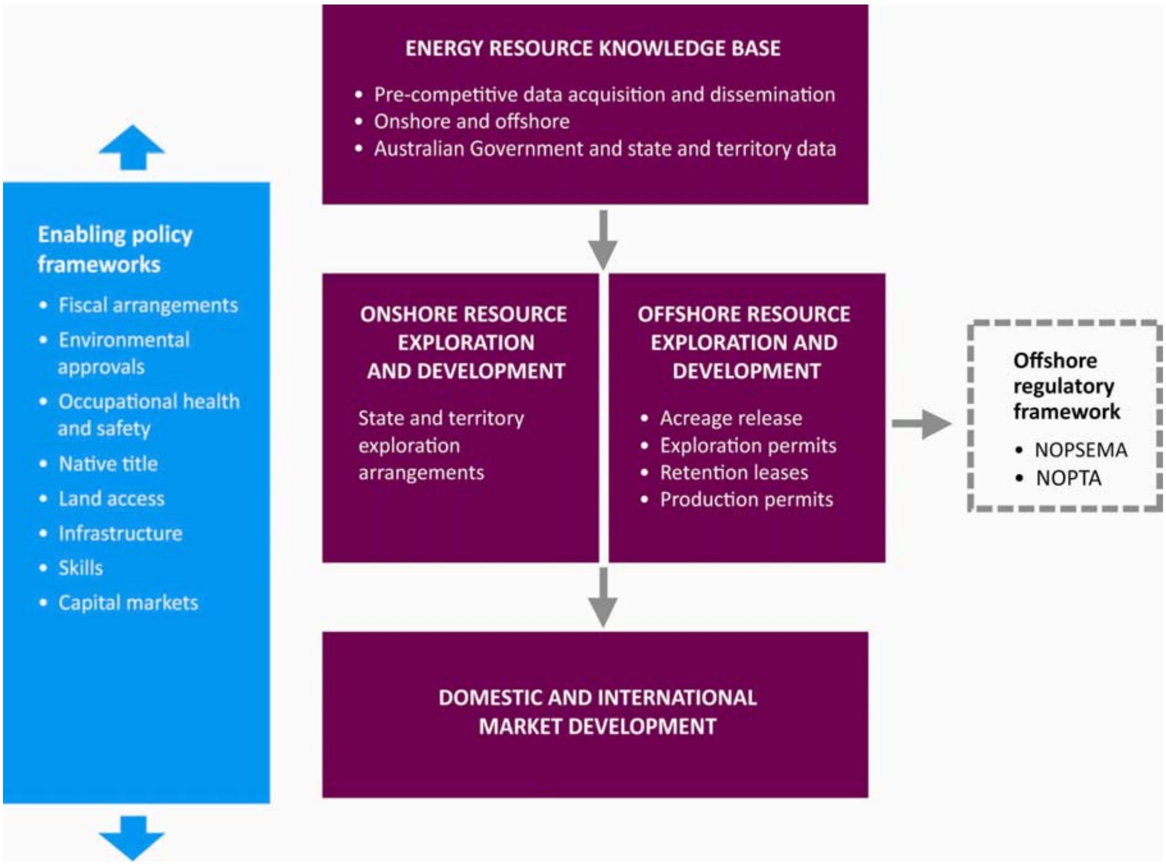
Australia's energy resource development policy framework should:

- promote the efficient commercial development of our energy resources to provide the highest-value return for the community
- ensure safe and sustainable development, consistent with all relevant national environmental and health and safety standards and obligations
- contribute to Australia's ongoing domestic energy security
- enhance Australia's international competitiveness
- interface appropriately and effectively with other relevant markets or regulatory frameworks to support efficient investment in upstream development and downstream supply capacity.

Framework elements

Reflecting Australia's constitutional arrangements, Australia's energy resource development policy framework is, in effect, a complex set of policies at the national, state and territory, and local government levels. There are four specific resource development components, along with a set of intersecting enabling policy frameworks that are critical in shaping the overall business environment. These are shown in Figure 5.3.

Figure 5.3: Australia's energy resource development framework



The resource development components are:

- the energy resource knowledge base, including pre-competitive data acquisition and dissemination
- onshore resource exploration and development policies
- offshore resource exploration and development
- domestic and international market development.

The key enabling policy frameworks include environmental approvals, native title, land access, fiscal arrangements, infrastructure and workforce development.

Onshore resources (energy and otherwise) are owned and managed by the state or territory in which they are located. The Australian Government maintains responsibility for resources located offshore (extending from the limit of the coastal waters to the limit of Australia's legal continental shelf), although these can be cooperatively managed with the relevant state or territory in the case of cross-jurisdictional projects.

The energy resource knowledge base

A comprehensive, well-formed dataset of Australia's energy resources is critical to attracting early commercial interest. The Australian Government, through Geoscience Australia, provides companies and other interested parties with basic pre-competitive geoscientific information (see Box 5.2).

Providing this information can substantially influence perceptions of prospectivity and assists businesses to assess the potential risks and rewards of more detailed exploration and development. Given the high cost and risk of greenfield exploration and development, there is little incentive for exploration companies to acquire their own regional-scale technical data. Because of the 'public good' nature of this information, it is generally collected or acquired by government and made available to interested parties at minimal cost. The information is at a sufficient level to enable companies to assess whether a substantive investment in exploration of specific geographic areas of interest can be justified in terms of technical risk and the prospect of commercial return.

Geoscience Australia consults closely with its state and territory counterpart agencies and with industry to ensure that its annual pre-competitive work program is strategically relevant and to leverage maximum value from limited resources.

Box 5.2: 2011 strategic review of Geoscience Australia

In May 2011, the Australian Government released the *Strategic review of Geoscience Australia*, which examined the alignment of Geoscience Australia's products, services and activities with the Australian Government's priorities for geoscientific information and data capability, and considered options for the most appropriate, efficient and sustainable mechanisms for funding and delivery.

The review concluded that Geoscience Australia's ongoing role in obtaining and disseminating pre-competitive data is fundamental in keeping Australia on the investment radar of the multinational players in the energy sector. It showed that Geoscience Australia's work under the Offshore Energy Security Program from June 2006 to June 2011 delivered a return of $625 million on the government's investment of $75 million in committed frontier exploration expenditure in acreage awarded to date, with an additional $1 billion subsequently attracted for secondary work programs.

Building on the review's findings, the government is undertaking a further review of the efficiency and effectiveness of Australia's offshore exploration policy, focusing on the annual release of acreage for work program bidding. The review will consider whether alternative acreage release models (such as cash bidding) may lead to more efficient outcomes. This will be complemented by targeted industry consultation.

Mapping Australia's renewable energy resources

Future commercialisation of energy resources such as wind, geothermal, solar, tidal and wave energy will also benefit from the provision of pre-competitive information and help create regional development opportunities. There is an important role for government in identifying potential locations with favourable resources and characteristics, such as proximity to the existing transmission grid and energy markets. CSIRO has undertaken valuable work in developing our understanding of many of these resources.

Mapping of our renewable energy resources is a key tool for supporting the efficient and sustainable development of renewable energy. The Australian Government places importance on the pre-competitive mapping work undertaken by Geoscience Australia and CSIRO. The government will also regularly publish detailed energy resource information through the Australian Energy Resource Assessment (see Box 5.3).

Box 5.3: The Australian Energy Resource Assessment

The Australian Energy Resource Assessment is a critical component of Australia's resource knowledge base. It is a comprehensive and integrated scientific and economic assessment of Australia's energy resources, both onshore and offshore.

Geoscience Australia and the Australian Bureau of Agricultural and Resource Economics, in partnership with the Department of Resources, Energy and Tourism and state and territory agencies, released the first Australian Energy Resource Assessment in 2010. The assessment integrates geological and economic information to aid investment decision-making, examines all renewable and non-renewable resources individually, and provides information on the current status of those resources and their potential to 2030.

The Australian Government will update the Australian Energy Resource Assessment every two years, commencing in 2014.

Onshore resource exploration and development

Onshore resources-related activities in Australia are generally the responsibility of state and territory jurisdictions through the Department of Mines, Minerals and Energy, or equivalent. While all states and the Northern Territory maintain separate legal and regulatory frameworks governing onshore exploration and resource development activities, in content and administration they are very similar and are generally based around forms of exploration and production titles.

Another general feature of the administration of exploration and mining titles in Australia is the ready access in the states and the Northern Territory to current tenement information, commonly through online information systems. This enables quick identification of tenement status and titleholders, improved identification of available prospective ground, and immediate registration of applications for new titles. Information is also readily available on previous exploration activity and data availability.

Increasingly, national cooperation is occurring on resource development frameworks and regulatory arrangements. The COAG Standing Council on Energy and Resources has an active role in setting policy and regulatory direction aimed at improving the consistency, efficiency and effectiveness of the governance of Australia's energy resource development in onshore jurisdictions. Recent examples of improved consistency include mine safety regulation and environmental regulation (see Box 5.4).

Box 5.4: National Mine Safety Framework – an example of streamlining regulation

Australia is a world leader in occupational health and safety performance in the mining industry, with a strong risk-based regulatory regime focused on the identification, mitigation and monitoring of hazards at individual mine sites. The Australian Government, in consultation with states and territories and key union and industry stakeholders, is currently working towards the implementation of a more nationally consistent approach to mine health and safety issues through the National Mine Safety Framework.

Strategies under the framework aim to deliver a range of benefits to the mining industry, the first and foremost being better safety and health outcomes through the development and adoption of improved and consistent regulatory regimes. The framework also aims to deliver:

- a greater degree of certainty for duty holders in regard to their legislative duties and responsibilities – both from a day-to-day perspective and when working across multiple jurisdictions
- consistent approaches to mine safety issues between jurisdictions – in terms of both the manner in which potential hazards are addressed, and the application and enforcement of the regulatory regime by regulators in each jurisdiction
- greater mobility of staff between jurisdictions – including by developing consistent competency requirements for safety-critical roles and functions, and by ensuring that competency certificates (where they exist) are automatically accepted in another jurisdiction
- through the development of a national mine safety database, an improved ability to monitor health and safety statistics, identify national and jurisdictional trends, and enable mine sites or companies to benchmark their safety performance against industry aggregates.

In July 2010, the Australian Government established a Policy Transition Group to advise the government on the implementation of the new resource tax arrangements and to consider the best way to promote future exploration and ensure a pipeline of resource projects for future generations. In its report to the Australian Government in December 2010, the Policy Transition Group recommended that a review of regulatory barriers to exploration be undertaken by the Productivity Commission.

The government has accepted the recommendations of the Policy Transition Group and the review will provide the opportunity for Commonwealth, state and territory governments to consider Australia’s framework for resource exploration, such as the various approvals required before exploration can begin, and the opportunities for improving regulatory processes.

It is intended that the Productivity Commission will commence the review in the second half of 2012.

The Policy Transition Group also found that there has been a shift in exploration activity away from greenfield exploration towards brownfield activity as companies seek to exploit near-term high commodity prices. It also found that additional exploration incentives were not justified at that time, but recommended that this finding be reviewed no later than 2015. The government has accepted these recommendations.

Offshore resource exploration and development

Offshore petroleum activities in Australia are regulated by the Commonwealth, state and Northern Territory governments.

Operations beyond the designated state and territory coastal waters are governed by the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and related regulations. This area is commonly referred to as 'Commonwealth waters'.

The legislative framework provides for the orderly exploration and production of petroleum resources (and geological storage of greenhouse gases) and sets out a framework of rights, entitlements and responsibilities of governments and industry. The legislation provides for a system of petroleum exploration, retention and production lease arrangements as well as core environmental and operational safety regulations.[18]

The energy resources in Australia's offshore waters are a significant resource for the Commonwealth. While ultimate responsibility for Australia's offshore areas beyond three nautical miles from the territorial baseline rests with the Commonwealth, the Commonwealth jointly administers the regulatory regime and supervises offshore petroleum industry activities with the state and Northern Territory governments through a joint authority arrangement.

Exploration acreage release

The Australian Government administers the Offshore Petroleum Exploration Acreage Release, which encourages petroleum exploration in Australia's offshore areas. Each year, following consultation with stakeholders, the government (through the Department of Resources, Energy and Tourism) releases offshore exploration acreage for competitive bidding by prospective explorers. The regular release of acreage enables industry to undertake longer-term planning and provides certainty in the release process. As highlighted in the strategic review of Geoscience Australia, the government is considering whether there is benefit in moving to a cash-bidding basis for acreage release.

Offshore petroleum activities that are likely to have significant impacts on matters of national environmental significance, including in Commonwealth marine areas, are regulated under Australia's national environment law, the *Environment Protection and Biodiversity Conservation Act 1999* (see section 8.2).

Offshore retention leases – keeping pace with development

The regulatory framework for retention leases provides a measure of tenure security over resources that are not yet commercial but have commercial potential.

Retention leases were introduced in 1985 to encourage oil and gas explorers to work in deeper water and commercially challenging areas by providing a longer window of tenure security in which to bring discoveries into development.

At that time development was driven by less complex domestic and international energy markets with a limited technological toolkit and very limited infrastructure and services support.

[18] Further information is available from the Department of Resources, Energy and Tourism website at www.ret.gov.au.

Since then, mega-LNG projects have come to dominate the supply and investment landscape. Volatile and rising energy prices and the development of 'game-changing' technologies such as deep-water drilling and floating LNG plant are also enabling the exploration and commercialisation of once-stranded oil and gas fields.

There is also recognition that large, highly capital-intensive and long-term LNG developments require resource certainty. The retention lease framework must balance the need for certainty and legitimate commercial interests with the need to ensure that the national interest is upheld through the timely and most beneficial development of Australia's oil and gas resources.

While the government believes that the retention lease system provides an appropriate framework within which this balance can be reached, it also recognises some improvements can be made.

It is important that the retention lease framework does not provide an opportunity to indefinitely 'warehouse' petroleum resources and provides for the regular review and re-assessment of commercial potential of oil and gas fields.

If changes to the commercial environment, including the option of domestic gas supply or new technology, address the barriers to commercialising petroleum within a retention lease, the government has a firm expectation that a production licence will be applied for and development of the resource will proceed.

The commerciality test remains an essential component of the retention lease system, but there is recognition that transparency for titleholders and for interested third parties should be improved. Changes to facilitate improved transparency would assist third parties to comment on retention lease award or renewal and offer alternative development options. However, commercial data and information would need to remain protected.

In addition, to better reflect the realities of highly capital-intensive LNG projects and the need to provide certainty of gas supply over long project timeframes (30-plus years), further consultation with industry will take place on potential changes around a 'project title' concept, balancing the need for reserve certainty with other pressures, including promoting commercial domestic gas supply.

The Australian Government will continue to review the underpinning policy settings and administration of retention leases to ensure their continuing relevance against likely future energy scenarios out to 2030 (see Box 5.5).

Box 5.5: Review of retention lease policy

A review of retention lease policy was commenced through the release of an options paper in June 2009 titled the *Review of policy relating to the grant and renewal of retention leases*.

The indicative findings arising from the consultation process:

- affirmed the continuation of the retention lease system as part of the overall management process for Commonwealth offshore waters
- supported the commerciality test as an essential component of the retention lease system
- supported a change to the administration of retention leases to improve transparency for titleholders and other interested parties, including the general public
- supported changes to facilitate improved transparency by assisting third-party comment and a capacity to suggest alternative resource development options for retention leases
- affirmed the protection of commercially sensitive information
- supported an opportunity for conditions and work programs of applicants and retention lease titleholders to be reviewed in advance of a formal notification of intent to offer the grant of a retention lease or renewal.

The establishment of the National Offshore Petroleum Titles Administrator from 2012 will provide:

- increased certainty on approval timeframes, parameters for ministerial decisions, commerciality tests and triggers for reviews
- consistent work programs and monitoring to ensure that barriers to commercialising resources are addressed
- enhanced transparency of the retention lease system to better facilitate third-party comments on applications and access to non-confidential information.

To conclude the retention lease policy review, stakeholders are invited to engage in this Energy White Paper consultative process, through which the government will finalise its policy position on these issues and will then work constructively to implement policy outcomes.

Upstream petroleum reforms

The April 2009 Productivity Commission report, *Review of regulatory burden on the upstream petroleum (oil and gas) sector*, identified considerable duplication and inconsistent administration of offshore and onshore petroleum activities. The report found that this was imposing significant and unnecessary burdens on the sector and raised concerns about Australia's continued international competitiveness.

Work is well underway at the Commonwealth and state levels to implement the reforms proposed in the Productivity Commission review. These changes are expected to halve project approval times and improve the present value of petroleum extraction by billions of dollars each year.

The 2008 Varanus Island pipeline explosion and the 2009 Montara incident also highlighted some inadequacies in petroleum regulatory oversight and gaps arising from overlapping safety regulations (see Box 5.6). The government has moved to implement the actions outlined in the government's final response to the Offshore Petroleum Safety Regulation Inquiry and the report of the Montara Commission of Inquiry.

Box 5.6: Responding to the lessons of Montara and Macondo

The 21 August 2009 uncontrolled oil and gas release at the Montara oil and gas field in the Timor Sea was the first well blowout in Australia in over 25 years. Offshore petroleum activities have occurred in Australia for over 40 years, and approximately 3000 wells have been safely drilled.

The importance of offshore resource safety and environmental protection was further highlighted internationally, following the April 2010 incident at the Macondo oil field in the Gulf of Mexico, where 11 lives were lost.

The Australian Government has taken decisive action since the Montara incident and remains committed to making the offshore petroleum industry the best and safest it can be.

In response to the Montara incident, the government has:

- strengthened the principle that the polluter pays – by adding a guarantee in legislation that all costs of responding to a hydrocarbon spill, including scientific monitoring and addressing other damages to the offshore and broader environment, will be met in full by the polluter
- strengthened the regulatory regime – by clarifying the framework for engagement between regulators and the offshore petroleum industry in responding to any future offshore petroleum incident, including ensuring an appropriate cost-sharing arrangement between the shipping and offshore petroleum industries in relation to oil spill preparedness and response capabilities
- enhanced the environmental assessment processes – by applying additional rigour to the approvals process for offshore petroleum activities in Australian waters.

The offshore petroleum industry also recognised that it must be rigorous in its oil field practices and spill prevention and mitigation techniques. Globally, and in Australia, the industry has conducted forensic analyses of processes and practices in well design, integrity and well operations and drilling practices, including the identification and reduction of risk and performance monitoring. The industry has also reviewed its oil spill response capacities and preparedness, and blowout contingency plans.

In August 2011 the Australian Government hosted the International Offshore Petroleum Regulators and Operators Summit. The summit was attended by over 400 delegates comprising government representatives, regulators, operators and industry professionals from across the globe.

A set of key outcomes and an action plan were agreed that will help achieve the goals of protecting human health and safety; and preserving the marine environment in global offshore waters.

The summit reaffirmed:

- the Australian Government’s response to the report of the Montara Commission of Inquiry as representing a good illustration of the developing international consensus on how regulation of the offshore petroleum industry should evolve
- the critical role of an independent well-resourced regulator to challenge industry to be rigorous in its operational practices, prevention and mitigation techniques
- the Australian offshore petroleum industry’s commitment to providing leadership and accountability for the achievement of strategic safety priorities, and the design and building of an Australian capping and containment solution.

In this context, the Australian Parliament has passed legislation providing for the establishment of a single, independent regulator of safety, environment plans and day-to-day operations of petroleum, mining and greenhouse gas storage activities in Commonwealth waters. The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) will be established by expanding the previous National Offshore Petroleum Safety Authority's functions to include the regulation and day-to-day administration of environment plans. The National Offshore Petroleum Titles Administrator (NOPTA), to be established within the Commonwealth Resources and Energy portfolio, will have responsibility for the administration of all offshore petroleum titles.

These reforms retain the joint authority arrangements for key petroleum and mining title decisions. Other reforms include the imposition of statutory timeframes to ensure that unnecessary delays do not occur for decisions. The states and territories will be able to confer their administrative and regulatory powers to both NOPSEMA and NOPTA.

The new arrangements will deliver significant efficiency gains and reduce the regulatory burden on Australia's offshore petroleum industry. Together, NOPSEMA and NOPTA will provide an integrated and consistent approach to the efficient and sustainable exploration and development of Australia's offshore petroleum resources in a manner that protects human health and safety and the marine environment.

Australia's regulatory regime for offshore petroleum is largely objectives based. The operator of an offshore facility is responsible for the safe and effective operation of the petroleum facility, including preventing an oil spill and remediating any impacts to the marine environment that may occur (with the support of key government agencies). Operators are required to pay for the cost of clean-up should a spill or other events occur with environmental impacts. An important feature of objectives-based regulation is that it encourages continuous improvement and allows for flexibility in implementing new technology.

Market development

Australia's energy resource market development framework is underpinned by the active promotion and development of open, transparent and competitive markets. This framework seeks to secure access to key economies and global markets, particularly in Asia, add value to existing markets, participate in emerging markets, and plan beyond the current resources boom.

The Australian Government uses bilateral, multilateral and ministerial engagement mechanisms to promote trade and investment opportunities. This may occur either directly through engaging with governments of existing or prospective markets, or facilitating engagement between governments and Australian industry.

Investment

The openness of Australia's economy to foreign investment and trade has enabled energy resources industries to continue to expand in a sustainable way to meet the growing demand for energy resource commodities, technologies and services.

However, economic, political and commercial factors, as well as natural events, both within and outside Australia, can alter risk profiles and have a dampening effect on the growth outlook for Australia's energy resources industries. By ensuring that effective policy settings and initiatives are in place (including in the areas of investment, taxation, infrastructure, skills and training), the Australian Government is seeking to facilitate the timely and adequate inward investment needed to support the development of Australia's large-scale resources projects.

5.4 Strategic challenges

Australia faces a number of challenges to gain the maximum return on our national energy assets and maintain our international competitiveness as a supplier and attractiveness as an investment destination. These include:

- maintaining economic and social sustainability
- managing land use and access and ensuring environmentally sustainable development
- addressing constraints – facilitating infrastructure development so that it keeps pace with demand for our energy resources and ensuring that there is a skilled workforce to support major resources projects.

The Australian Government, along with the states and territories and the energy and mineral resources sector, is implementing a series of measures to address these issues.

Economic and social sustainability

Managing and fostering the economic opportunity of resources growth is essential – it helps create community support for resource development, and promotes further exploitation and development of our assets. At the same time it is important that all Australians receive a fair return on their non-renewable energy resources and that they are developed in accordance with best practice.

Maintaining an attractive fiscal framework

In response to the challenge of economic sustainability, in 2010 the Australian Government announced the introduction of a Minerals Resource Rent Tax (MRRT) and expansion of the offshore Petroleum Resource Rent Tax (PRRT) to all onshore petroleum projects.

These taxes are designed to capture the economic rents associated with Australia's non-renewable iron ore, coal and petroleum resources, and provide the community as a whole with a better return on their natural resources. The government has also been conscious of the need to structure an overall taxation framework that is internationally competitive in order to continue to attract high levels of investment.

When compared to royalties, rent-based taxes make resource charging arrangements more attuned to the economic cycle, as firms only pay tax when they are profitable. This reduces the distorting effect taxes can have on investment decisions, as is the case with royalties, which require miners to pay tax even when they are unprofitable.

Royalty payments to the state and territories are creditable against the MRRT and PRRT to avoid the risk of double taxation.

Improving Indigenous opportunity

Access to Indigenous land for mining and other resource development activities can provide enormous benefits to Indigenous communities through financial compensation for land access and use and other flow-on effects, such as increased equity participation, employment, and the construction of education and community infrastructure.

An ongoing challenge for governments (particularly state and territory governments), traditional owners and investors will be to maintain access while ensuring that Indigenous communities receive appropriate returns.

Notwithstanding improvements made to the native title process since it was first legislated in 1993, negotiating land access continues to be complex, costly and time-consuming. It is important that both Indigenous communities and resource developers continue to work together to achieve mutually beneficial outcomes.

Efforts to promote better Indigenous opportunities are discussed further in section 8.5.

Promoting Australian industry participation

The expansion of Australia's energy resources sector has created new flow-on business opportunities for Australian firms in industries such as construction, materials and services. As noted in section 5.2, these opportunities have provided huge benefits for the Australian economy. For example, in 2009 around 88 per cent of the mining industry's total demand for goods and services was supplied by local industry.[19]

The extent to which Australian firms can successfully access energy resource development opportunities varies from project to project and depends on a range of commercial factors. The Australian Government does not support mandating levels of local participation as it remains critical to our ongoing competitiveness that developments are able to maximise cost efficiencies.

However, the government is working with the resources and manufacturing industries to help equip Australian businesses to win contracts on a commercial basis through a range of initiatives, such as the $34.4 million Buy Australian at Home and Abroad package, which includes:

- the appointment of supplier advocates to work with Enterprise Connect and Australian firms to increase capability and meet future demand in resources projects
- funding through Supplier Access to Major Projects for the Industry Capability Network to work with resources projects and increase opportunities for Australian industry
- funding to Australian Made Campaign Limited to appoint a supply chain adviser to more effectively link the campaign and the Industry Capability Network
- the establishment of a Resources Sector Supplier Advisory Forum and the appointment of a resources sector supplier envoy to provide leadership in linking Australian suppliers to opportunities in the resources sector.

Environmental sustainability and land access

It is well recognised that to be sustainable, the resources sector must focus not just on economic outcomes or fiscal benefits, but also on environmental impacts and social issues such as land and resource access.

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[19] National Institute of Economic and Industry Research, *Maximising Australia's resources boom*, Australian Steel Institute, 2011.

Resource development and the environment

The Australian Government is committed to ensuring that resource development is environmentally appropriate and sustainable.

The government maintains a comprehensive environmental protection and management framework and engages closely with relevant state and territory governments as well as with business and other stakeholders in the development of energy resource projects that fall within its sphere of responsibilities. These responsibilities and frameworks, including major reforms to streamline their operation and improve effectiveness, are described in more detail in section 8.2.

In addition to these mechanisms, Australia's offshore petroleum regulatory framework (described in section 5.3 under 'Offshore resource exploration and development') provides for the safe and environmentally responsible development and operation of oil and gas projects in Commonwealth waters, including geological storage of carbon dioxide.[20]

Land and resource access

Access to land, under clear and efficient processes that take into account environmental, heritage and cultural values, is fundamental to both the existence and the international competitiveness of the energy and mineral resources sector.

While energy resource developments impact less than 1 per cent of Australia's total landmass, the continued expansion of mining, agricultural and residential land use is causing some tensions between sometimes overlapping or adjoining activities and their communities.[21] In recent times, this has been evident in the proposed development of coal seam gas and coal mining operations in, or near, agricultural and residential areas of New South Wales and Queensland (see Box 5.7).

While in many cases managing these issues is the responsibility of state and territory governments, there is a need to promote nationally consistent and mutually beneficial outcomes that provide for responsible and sensible development and coexistence (where appropriate) based on transparent approaches that safely manage risk and are informed by the best available science.

Traditionally, multiple land use has been commonplace in Australia: agriculture and mining have coexisted for generations. However, the development of new energy sources in regions that have had little involvement with the resources sector can present a challenging new paradigm for people and businesses operating in those locations.

Extractive industries are not alone in generating community tensions. For example, the growing number of wind farms has become an increasing concern in rural communities. Also there a number of emerging technologies such as geothermal and carbon capture and storage that have yet to test community views in practical application.

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[20] Further information is available from the Department of Resources, Energy and Tourism website at www.ret.gov.au.

[21] ABARES, *Land use in Australia at a glance,* ABARES, Canberra, 2010.

Working with communities

Finding lasting solutions means that it will be essential for governments and the resources and energy supply industries to work with communities to develop enduring processes that provide information about the sector's impact, benefits and legacies.

This is not to say that in all instances there must be coexistence – in some cases resource development may not be appropriate in or near residential or culturally and environmentally sensitive areas. Similarly, locking up areas of land for specific purposes to the exclusion of other sensible co-development activity could result in higher costs for Australia in meeting its future needs.

But systemic failure to engage with communities and appropriately manage these conflicts could see valuable resource development opportunities needlessly forgone, and the economic and social benefits may not be fully realised in Australia's underdeveloped areas. It will also limit the earning potential of rural landowners from cooperative access arrangements with resource companies.

Box 5.7: Coal seam gas – managing multiple resource use

In recent years the coal seam gas (CSG) industry has undergone a period of rapid expansion and is expected to grow further as new resources are commercialised.

Although the footprint of each CSG well and its associated infrastructure is small, the need for many wells throughout the life of a project has meant that extraction activities can involve many landowners.

Community concerns about CSG largely centre on the rights of companies to access land for resource exploration and extraction, the effects that extraction might have on agricultural production, and the potential for contaminating or disturbing the flow of water resources, particularly intersecting subterranean aquifers.

Because CSG is an onshore energy resource, the primary responsibility for regulating the industry lies with the state and territory governments. The Australian Government has certain powers under the *Environment Protection and Biodiversity Conservation Act 1999* that require it to regulate mining and other activities that are likely to have significant impacts on matters of national environmental significance such as listed threatened species and migratory species.

CSG has an important role to play in meeting Australia's future energy needs and in supporting continued regional economic growth. Without the additional gas supply offered by CSG, it is likely that conventional east coast gas reserves would struggle to meet long-term demand and the cost of meeting greenhouse gas reduction targets would be higher. Further, given the relatively small amount of productive land that is temporarily utilised in CSG production at any point in time, it is unlikely to present any risk to Australia's food security. In general, there is no foreseeable risk to our food security at this time. The Australian Government is currently developing a national food plan that will set out the strategic direction for the government's food policy over the period to 2030, which will include an analysis of a range of key issues, including the potential risks to food security from competition for land use.

It is therefore vital that approaches be found that support mutually beneficial co-development outcomes and that preserve the integrity of the environment and water supplies and social fabric in which projects operate. These solutions should be informed by sound science and high-quality data and utilise appropriate risk management frameworks. In addition, there may be areas of special significance, cultural or environmental, where such development is not appropriate.

State and territory governments have moved to strengthen their regulation of CSG, significantly enhance community engagement processes and develop strategic land-use policies. In Queensland, for example, the government has developed a policy framework for land access. Resource companies are required to comply with a single land access code, developed in conjunction with the resources and agricultural sectors. Under the code, one of the mandatory conditions for resource companies using private land is that they must minimise disturbance to people, livestock and property.

In addition, to ensure that future decisions about CSG projects and large coal mining developments are based on the most rigorous scientific evidence available, a new science-based framework is being introduced by the Australian Government which will provide certainty for regional communities as well as protection of water resources. The government will:

- provide $150 million to establish a new Independent Expert Scientific Committee that will provide scientific advice to governments about relevant CSG and large coal mining approvals where they have significant impacts on water; oversee research on impacts on water resources from CSG and large coal mining projects; and commission and fund water resource assessments for priority regions
- through the establishment of a National Partnership Agreement, ensure that the advice of the Independent Expert Scientific Committee is taken into account by state and territory governments to inform regulatory decisions
- mandate that the Independent Expert Scientific Committee publicly disclose its advice to ensure that local communities have all the best information available to them.

These new initiatives complement and support the existing research being undertaken by the Australian Government and its agencies on CSG and other resource extraction activities that may affect groundwater. This includes, for example:

- work by the National Water Commission to examine the local and cumulative effects of mining on groundwater
- work by Geoscience Australia to establish a more rigorous understanding of the aquifers across jurisdictions and across basins, their connectivity, how groundwater pressures in connected aquifers are likely to be affected by the cumulative impacts of CSG production and how this is likely to impact on users and environmental values of groundwater resources. The knowledge gained will support regulators in better understanding the capability of groundwater flow models to appropriately simulate these factors
- work by CSIRO, in collaboration with the CSG industry and other parties, to establish the Gas Industry Social and Environmental Network, which will examine the socioeconomic and environmental impacts of the natural gas industry
- work by the Queensland Water Commission to develop a regional groundwater model, relating to areas affected by CSG development.

The Australian Government is also working in collaboration with the states and territories through the Standing Council on Energy and Resources to develop a more harmonised approach to the regulation of the CSG industry.

Multiple land use – working towards a solution

Multiple land use involves using land for different purposes simultaneously within a region or area, and accommodating those different land uses in an efficient and sustainable manner to retain the greatest number of options for future use. Conceptually, the objective is to maximise the net benefits to present and future generations from a combination of land uses.

A national Land Access Working Group, under the auspices of the COAG Standing Council on Energy and Resources, is working to develop a nationally agreed approach to multiple land use, a clear and consistent description of government responsibilities when working with stakeholders on land access, and a framework for more consistent and predictable guidance for all land users to reduce the scope for conflict.

The multiple land use framework will focus on the overall principle that land should not be put to a single use without considering the implications or consequences for other potential land uses.

Addressing constraints

The productivity of our energy resources sector is heavily dependent on access to a skilled workforce to efficiently extract and process resources and on the efficient construction, use and operation of infrastructure to deliver them to markets across the globe.

Issues associated with skills and workforce development are discussed in detail in section 8.4.

Ensuring that infrastructure development keeps pace with demand for energy resources and maintaining a skilled workforce to support major resources projects are critical to avoiding constraints or bottlenecks along the supply chain.

Infrastructure

Australian energy resources are often in remote locations. Developing and getting these commodities to markets requires significant infrastructure – rail networks to carry bulk commodities from mine sites to ports or power stations, roads to transport goods and skilled workers, and ports to send resources to markets around the globe. Efficient infrastructure is the cornerstone of an internationally competitive resources sector.

With a steady stream of new projects in the pipeline, the resources sector is having a dramatic effect on the Australian economy, including creating an extraordinary demand for infrastructure investment. However, competition for this investment is fierce. Energy and mineral resources sector infrastructure projects in remote locations must compete for investment dollars against infrastructure programs in our larger, more densely populated towns and cities.

Infrastructure ‘bottlenecks’ continue to be a key challenge. To address this and assure our trading partners that Australia remains a secure and reliable supplier of mineral and energy commodities, new infrastructure will need to be built and existing infrastructure upgraded.

With the benefit of experience, and more advanced economic modelling based on evidence from the first years of the current resources boom, Australian governments and companies are now better positioned to invest in the infrastructure that will be required to meet the needs of the coming decades.

Oversight of infrastructure development is a shared responsibility across all three levels of government, alongside industry.

Infrastructure Australia

Through Infrastructure Australia (an Australian Government agency), governments are developing and implementing a comprehensive process for assessing the nation-building infrastructure essential to consolidate national earnings from the resources boom.

Infrastructure Australia, in consultation with state, territory and local governments and the private sector, continues to develop a long-term infrastructure 'pipeline' for infrastructure needs. It also advises on investment priorities and policy and regulatory changes to ensure that existing infrastructure is used efficiently and to enable timely and coordinated delivery of national infrastructure investment.

Strategies being developed by Infrastructure Australia, such as the National Ports Strategy and the National Land Freight Strategy, aim to improve infrastructure planning, pricing, funding mechanisms and regulation. They also aim to ensure that infrastructure planning is responsive to future growth and improves productivity.

Major Project Facilitation program

The Major Project Facilitation program is designed to encourage productive and sustainable private sector investment in projects that take advantage of Australia's scientific and technical expertise and natural resources to foster long-term productivity and growth in the economy. The program is administered by the Department of Infrastructure and Transport.

Regional Infrastructure Fund

The Regional Infrastructure Fund was established by the Australia Government to support investment in infrastructure for the resources sector. The fund is worth $5.6 billion over 2010–11 to 2020–21.

The fund aims to address urgent infrastructure needs, support the mining industry, expand export capacity and develop regional economies. The fund is not intended to replace private investment, but invests in projects with potential partner funding from state, territory and local governments as well as private investors to develop crucial infrastructure such as rail, roads and ports.

Export infrastructure

The Department of Resources, Energy and Tourism and the Department of Regional Australia, Regional Development and Local Government have jointly commissioned the Bureau of Resources and Energy Economics to undertake detailed forecasting of Australia's export infrastructure requirements for bulk commodities, including in particular an examination of infrastructure needs for coal and LNG exports. The first report of this project is expected to be delivered in the first quarter of 2012, and updates will be provided regularly thereafter.

5.5 Key actions

To improve the effectiveness of Australia's resource development framework, the Australian Government will:

- support the continued provision of high-quality pre-competitive information through Geoscience Australia
- review the efficiency and effectiveness of Australia's offshore exploration policy and consider whether alternative acreage release models (such as cash bidding) may lead to more efficient outcomes
- continue to implement current offshore regulatory reforms, including the establishment of the National Offshore Petroleum Safety and Environmental Management Authority and the National Offshore Petroleum Titles Administrator, and enhance prevention and response capabilities
- closely monitor development of Australia's gas resources and market dynamics to ensure that both export and domestic supply needs are being adequately addressed
- ensure, through the application of retention lease and production licence approval arrangements, that offshore gas project design and development are providing the best returns possible for the Australian community within a commercial framework, including through appropriate consideration of domestic gas opportunities
  - specifically, having greater regard to the potential for projects to supply the domestic gas market when considering granting a production licence
- update offshore retention lease arrangements to: improve transparency; allow third-party comment on the commerciality of developing particular fields; ensure that reserves are not 'warehoused' indefinitely; and provide certainty of gas supply over long timeframes including for highly capital-intensive LNG projects
- continue to advance national consistency and transparency in regard to multiple land use resources projects through the development of a national multiple land use framework under the COAG Standing Council on Energy and Resources
- work with states and territories, industry and other stakeholders to ensure the safe and sustainable development of Australia's coal seam gas resources, including by:
  - establishing a new Independent Expert Scientific Committee to provide scientific advice to governments about relevant coal seam gas and large coal mining approvals
  - establishing a National Partnership Agreement to ensure that the advice of the Independent Expert Scientific Committee is taken into account by state and territory governments to inform regulatory decisions
  - continuing to work through the Standing Council on Energy and Resources to progress a more harmonised approach to the regulation of the coal seam gas industry
  - undertaking further work through Geoscience Australia to establish a more rigorous understanding of the aquifers across jurisdictions and across basins, their connectivity, and how groundwater pressures in connected aquifers are likely to be affected by the cumulative impacts of coal seam gas production.
- provide regular forecasts for export infrastructure requirements for bulk commodities, including coal and LNG exports in cooperation with the Bureau of Resources and Energy Economics and the Department of Regional Australia, Regional Development and Local Government.

6 Australia’s energy markets and improving energy productivity

6.1 Introduction

In a market-based economy, energy is generated and delivered to consumers through markets that can most effectively allocate resources between their various valued uses and support ongoing investment to meet expanding and changing needs. As highlighted in previous chapters, Australia’s energy markets also increasingly depend on a complex set of relationships with other sectors and markets to function effectively.

Having robust, well-functioning energy markets is therefore fundamental to delivering Australia’s national energy objectives, as well as contributing to broader policy goals such as the response to climate change, at the lowest possible cost.

Australia has three principal energy markets – liquid fuels, electricity and gas – which are, in the case of gas and electricity, composed of a set of geographic and economically separated markets based in the eastern, western and northern regions of Australia.

As highlighted in previous chapters, Australia’s energy markets have generally performed well in delivering safe, reliable and competitively priced energy. The reforms of the past, though incomplete, have been critical to this result. However, Australia’s energy markets are now facing new pressures and challenges in coming decades through massive expansion and in the transformation to clean and sustainable energy. Further reforms are needed to improve energy market and productivity and help reduce expected future cost pressures.

To meet these challenges, markets will need to become more flexible. Accommodating these changes will require policy and regulatory frameworks that can:

- efficiently interface with other key markets and mechanisms, such as the carbon pricing mechanism and financial markets, to ensure that the necessary investment and operational outcomes are achieved at least cost
- smoothly integrate rapidly evolving technologies and robustly adapt to changing dynamics
- more efficiently balance supply and demand and provide consumers with better information and an increased range of options to manage their energy needs.

The imminent prospect of such large-scale change emphasises the need to review market frameworks against future requirements to consider where current reform and development processes might be enhanced or augmented. This should include examining how energy demand decisions can be more efficiently supported within market frameworks and where additional actions can promote more informed energy use decisions by consumers.

The three components of this chapter outline the Australian Government’s objectives and principles for energy market design and operation and energy productivity. The chapter examines the current policy frameworks and governance arrangements in each of the energy markets as well as the principal challenges they face in the coming decades.

For the purposes of this chapter, ‘energy markets’ refers to the production, wholesale, transmission, distribution and retail sale of energy to consumers. This includes networks and other market services.

6.2 Australian Government energy market policy framework

Noting the range of requirements and pressures under which Australia's energy markets are now operating, the Australian Government proposes that the following framework be used to guide its future consideration of energy market design and operation.[1]

Objective

To maintain well-functioning energy markets and services that deliver reliable, safe, secure and competitively priced energy for all Australians, including by:

- ensuring timely and efficient investment in all facets of the energy delivery system
- promoting competitive and accessible energy services
- providing appropriate transparency and protection for consumers.

Principles

The following principles can support the achievement of this objective:

- Energy markets and services should deliver outcomes that are in the long-term interest of consumers.
- Energy market regulation should be nationally consistent to the greatest extent practicable.
- Energy market design should not give preference to particular technologies or fuel types.
- Market regulation should be stable, predictable, efficient, effective, transparent and accountable.
- Energy markets should interface efficiently and effectively with other relevant markets and policy and regulatory frameworks to provide for integrated least-cost decision-making.
- Government participation in energy markets should be minimised; where it does occur it should preserve market integrity and maintain competitive neutrality.

Fundamental to the government's approach is that energy markets should operate in the long-term interests of consumers. This means promoting reliability in meeting Australia's long-term energy needs at a competitive, and ultimately affordable, price. By extension (although sometimes forgotten) is a recognition that market participants must have the opportunity to earn adequate returns to ensure that sufficient and efficient levels of service and investment are maintained over the longer term to ensure reliability and security of supply.

Links to other policy objectives

The framework also recognises that in today's society it is important that energy markets contribute effectively to the broader range of social, environmental and economic goals.

The best way to achieve this is through the creation of well-functioning energy markets that interface efficiently with other policy mechanisms, but do not internalise non-energy objectives in

[1] These principles complement the overall energy policy framework proposed in this draft Energy White Paper.

energy market design. Internalising non-energy objectives in core energy market design or regulation can lead to unnecessary costs caused by potential reductions in efficiency, distortion of market signals, confusion and inconsistency.

For example, concerns over energy affordability for low-income households are most efficiently addressed through mechanisms such as transparent Community Service Obligation payments[2] or through the various social safety nets rather than through market or price regulation. Similarly, environmental outcomes are generally best achieved through appropriate pricing of externalities or direct management of impacts rather than through rules that impose inflexible restrictions or preferences for technologies or fuels in the energy market.

This is not to say that decisions on energy market design and regulation should be made independently of these considerations. Ensuring that energy and other policy goals are achieved harmoniously as well as building necessary community acceptance of reforms means that issues should be tackled holistically and transparently.

For example, new network automation and pricing products that can be delivered using 'smart' or interval meters may change the nature of necessary consumer protections.

This approach also underlies the design of the government's carbon pricing mechanism, which has a range of measures to ensure efficient integration of carbon and energy markets, particularly the electricity market (see Box 6.1).

Box 6.1: Interface between energy markets and carbon policy

Energy is one of the largest contributors to Australia's greenhouse gas emissions. Stationary energy, which includes electricity generation, petroleum refining and gas processing, accounts for around 49 per cent of Australia's total emissions. A key aim of the Australian Government's carbon pricing policy is to reduce the energy sector's emissions profile.

A pricing mechanism lends itself to application through the existing energy market frameworks. The price for emissions will flow on through the energy markets and therefore drive a shift in the emissions intensity of the sector.

A price for carbon will be factored into decisions for businesses operating in the energy sector. In a competitive market, this will drive a change in the cost of different technologies, with higher-emitting technologies becoming more expensive and lower-emitting technologies developing a comparable competitive advantage.

This competitive advantage means that lower-emitting technologies will be used or dispatched preferentially to higher-emitting technologies. The extent to which this will occur depends on the price associated with the emissions and the relative marginal costs of the technologies.

Smoothly managing the transition to mature carbon pricing is a key issue for the government and energy businesses.

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[2] Community Service Obligations apply to situations where government seeks to have commercial businesses deliver certain 'non-commercial' products and services to the community. For instance, state and territory governments often provide Community Service Obligation payments to some energy companies to compensate for the higher cost of delivering services in regional areas.

The Australian Government's Clean Energy Future package includes an energy security component to assist this process and ensure that energy security risks are minimised. This includes:

- the establishment of an Energy Security Fund to provide $5.5 billion in transitional assistance through to 2016–17 and funding under the Contract for Closure initiative to support the negotiated closure of up to 2000 megawatts of highly emissions-intensive generation capacity before 2020.
- the provision of loan support, on the advice of the Energy Security Council, to generators with an emissions intensity greater than 0.8 tonnes CO2-e/MWh on an 'as generated' basis to support the refinancing of existing debt if commercial loans are unavailable on reasonable terms
- the establishment of the Energy Security Council to advise government on possible support measures to address energy security risks during the transition to cleaner energy.

Defining a well-functioning market

Central to the assessment of whether energy delivery goals are being achieved (and therefore whether there is a case for intervention) is the definition of what constitutes a 'well-functioning market'.

While the design of individual energy markets should be tailored to most effectively meet the needs of their specific circumstances, well-functioning energy markets share a number of general characteristics. Primarily these relate to having robust frameworks that maximise competition through:

- transparent and effective market objectives
- transparent, detailed and supportive rules and regulations that do not introduce material barriers to entry or exit
- clear and effective governance arrangements, including independent and accountable institutions to regulate and operate markets
- comprehensive information systems to inform market participants, policy-makers and regulators
- efficient regulation of monopoly network infrastructure
- price signals that reflect the full costs and benefits of producing, supplying and consuming energy
- well-functioning financial markets to provide certainty, improve competitive outcomes and lower potential to entry for new participants
- active consumer participation
- non-integrated and competitive ownership structures throughout the supply chain.

The following three subchapters outline the policy frameworks, core market structures and issues for Australia's liquid fuel and electricity and gas markets, as well as for improving energy productivity.

6A Liquid fuels

Highlights

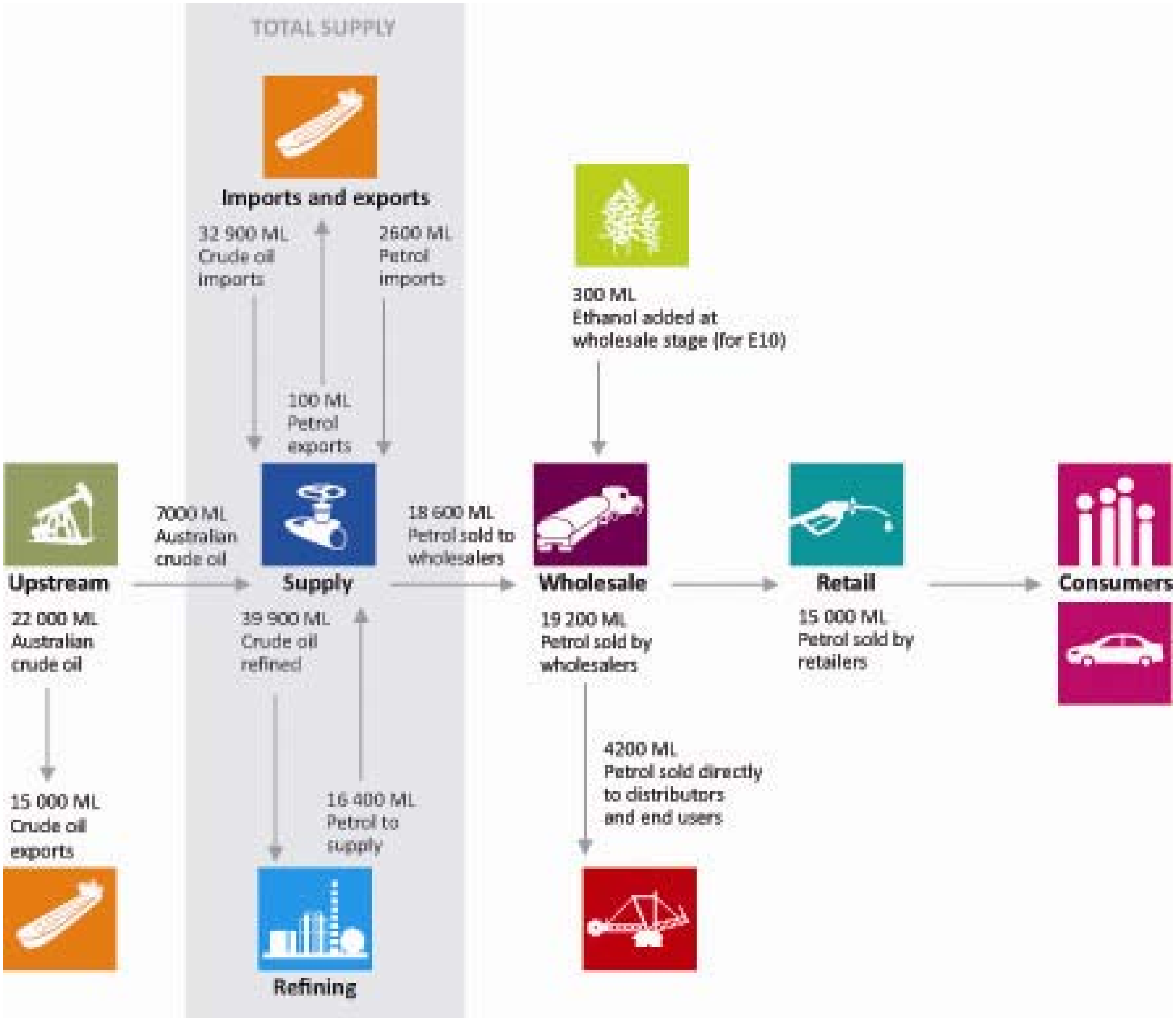
- Australian liquid fuel markets are functioning efficiently and effectively and are well placed to meet Australia's future needs.
  - Wholesale, distribution and retail markets are competitive and supply chains are robust.
  - Pricing is responsive to market conditions.
- Australia's liquid fuel demand will increasingly be met by imports of crude and refined product.
  - The majority of Australia's crude oil production is exported and Australian refineries source around 80 per cent of their crude oil needs from overseas.
  - While Australian refineries currently produce around three-quarters of Australia's petroleum needs, planned reductions in domestic refining capacity will see additional reliance on imports for refined product. This is not considered to impact Australia's overall liquid fuel security due to our access to mature and reliable international supply chains.
  - However, meeting future demand will require timely development of new import terminal capacity and a focus on the ongoing competitiveness of existing refinery operations.
- The prospect of rising oil prices will provide economic incentive for the development of alternative fuels to complement conventional petroleum products.
  - Government and industry will work together to address market failures associated with the development and uptake of alternative transport fuels through the Strategic Framework for Alternative Transport Fuels, guided by the Alternative Transport Fuels Implementation Advisory Group.
- There are a range of measures underway aimed at improving the environmental performance of liquid fuel production and use, including carbon pricing, the implementation of fuel quality standards for petrol, diesel and biodiesel, and the development of carbon dioxide emissions standards for light vehicles from 2015.
- While the liquid fuels sector has few immediate policy challenges, there are a number of developments that may emerge in coming years. These include:
  - increasing domestic production costs and the ongoing costs of upgrading refinery infrastructure, which will place further competitive pressures on Australian refineries from newer regional 'mega-refineries'
  - the need for timely development of additional import infrastructure
  - the promotion of more environmentally sustainable production, supply and use practices, including reducing the sector's greenhouse gas emissions, while maintaining its competitiveness
  - positioning Australia for increased production and use of alternative transport fuels as they become commercially viable and attractive
  - managing Australia's ongoing 90-day stockholding obligation to the International Energy Agency.

6A.1 Overview of the liquid fuel market

Liquid fuels are a significant component of Australia's energy system, representing 48 per cent of final energy consumed. The share and significance of the liquid fuel market are expected to remain at these levels over the long term.[3]

The Australian liquid fuel market encompasses: the supply of Australian-produced and imported crude oil; Australian production and importation of refined petroleum products (including alternative fuels); liquid fuel infrastructure (including storage and import facilities); wholesale, distribution and retail markets; and demand from end users (industrial and individual consumers). These five elements (depicted in Figure 6A.1) function within an integrated market (linked to the global liquid fuel market) to provide competitively priced fuel to Australian industry and household consumers.

Figure 6A.1: Australian liquid fuel market



Source: Adapted from Australian Competition and Consumer Commission, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, December 2011.

[3] BREE, *Australian energy projections to 2034–35,* BREE, Canberra, 2011.

Liquid fuel products include crude oil, condensate, liquefied petroleum gas (LPG), refined petroleum products used as fuels, petroleum-based feedstocks, and alternative transport fuels such as biofuels (ethanol biodiesel and advanced biofuels), compressed and liquefied natural gas, and synthetic fuels such as shale gas and coal-to-liquids.

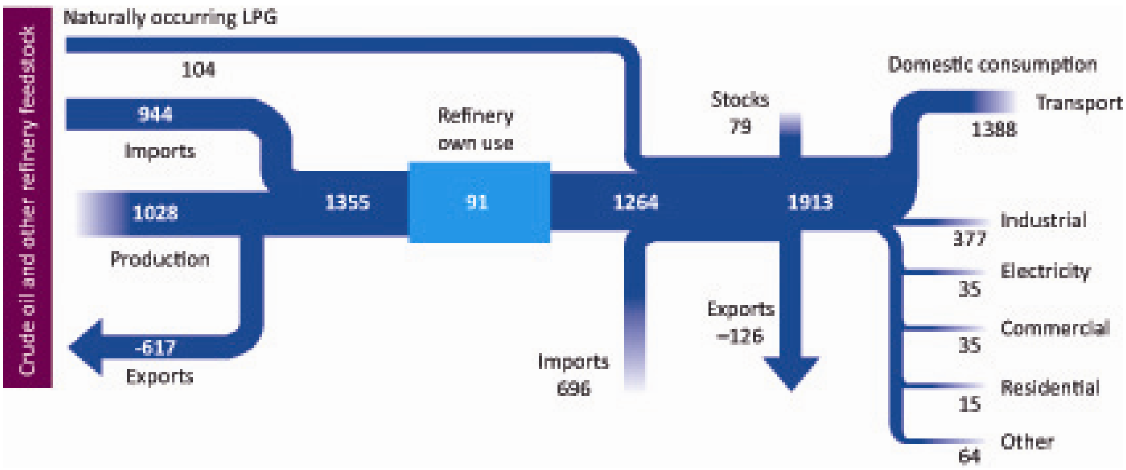
The Australian downstream petroleum industry is a significant contributor to the Australian economy. Economic modelling conducted by KPMG Econtech found that the downstream petroleum industry directly contributed $6.2 billion to Australia's GDP in 2007–08. Around 2500 people are employed at Australia's currently operating refineries, along with a significant number of specialist contractors. Refineries are also technologically advanced, and so employ and train large numbers of highly skilled staff, with significant spillover effects to other industries. The wholesale and retail sector of the market is estimated to have over 42 000 employees and annual revenue of $69 billion.[4]

Liquid fuels demand–supply balance

In Australia, demand for liquid fuels has steadily risen over the past decade and consumption of refined petroleum products is projected to grow 1.2 per cent a year over the long term, reaching just under 2500 petajoules in 2034–35.[5]

The transport sector is the largest final consumer of liquid fuels, accounting for around three-quarters of Australia's final use. The remainder is used in industrial processes, electricity generation and other non-fuel applications (see Figure 6A.2).

Figure 6A.2: Australian oil and LPG flows, 2008–09 (petajoules)



Source: ABARES, *Energy in Australia 2011*, ABARES, Canberra, 2011.

Australia's liquid fuel stocks are supplied through a mix of crude oil imports, domestic crude, imports of refined products and alternative fuel production. A substantial proportion of Australia's crude oil production is exported due to its physical characteristics (which make it more suitable for higher-value products elsewhere) as well as demand from, and proximity to, export markets relative to the domestic market.

[4] IBISWorld, *Petroleum wholesaling market research report (ANZSIC F4521)* and *Automotive fuel retailing market research report (ANZIC G5321)*, IBISWorld, Melbourne, 2010.

[5] BREE, *Australian energy projections to 2034–35*.

Australia currently imports around 80 per cent of crude oil and other refinery feedstock. Key sources of crude oil include Malaysia (5929 million litres (ML) or 14.8 per cent of total refinery input), Indonesia (4802 ML or 12 per cent), United Arab Emirates (4684 ML or 11.7 per cent), New Zealand (2565 ML or 6.4 per cent), Vietnam (2554 ML or 6.4 per cent), Nigeria (2050 ML or 5.1 per cent), Brunei (1830 ML or 4.5 per cent) and Papua New Guinea (1613 ML or 4 per cent). The remaining 20 per cent share is sourced domestically.

There are seven major petroleum refineries operating in Australia which have a combined maximum capacity of 44 210 ML per year.[6] In 2010–11, Australian refineries produced 38 395 ML, or around 74 per cent of the refined petroleum products consumed in Australia in that year.[7] In 2010–11, Australia also imported around 17 030 ML of refined product. Key sources of supply were Singapore, South Korea and Japan, with a wide variety of other countries providing small quantities.

After Shell's Clyde refinery closes in 2013, Australia's maximum refinery capacity will reduce to 39 470 ML a year. The reduction in domestic refining capacity, coupled with the projected increase in consumption, will lead to a greater share of refined petroleum products being sourced from imports.

A finding of the National Energy Security Assessment is that the reduction in maximum refining capacity does not in itself give rise to a fuel security issue, as Australia's access to well-functioning global markets is expected to continue to provide adequate and reliable supplies of refined products to meet Australia's needs.[8] Significant surplus exists in global and regional refinery capacity, particularly in Asia .The excess refining capacity helps provide a range of alternative sources of supply for Australia, while also providing a buffer against unexpected demand or supply shocks.

Surplus regional capacity does, however, place competitive pressures on refineries and there will remain a risk of further rationalisation in the Australian refining industry as Australia's relatively small refineries continue to struggle to compete against mega-refineries in Asia.

In addition to domestically produced products and our imports, alternative transport fuels provides around 5 per cent of the liquid fuel market, with LPG accounting for nearly all of this.

Future trends

In the absence of major new discoveries, domestic crude and condensate production is projected to decline to 2034–35, with a rising share of imports required to meet growing demand (see Figure 6A.3).

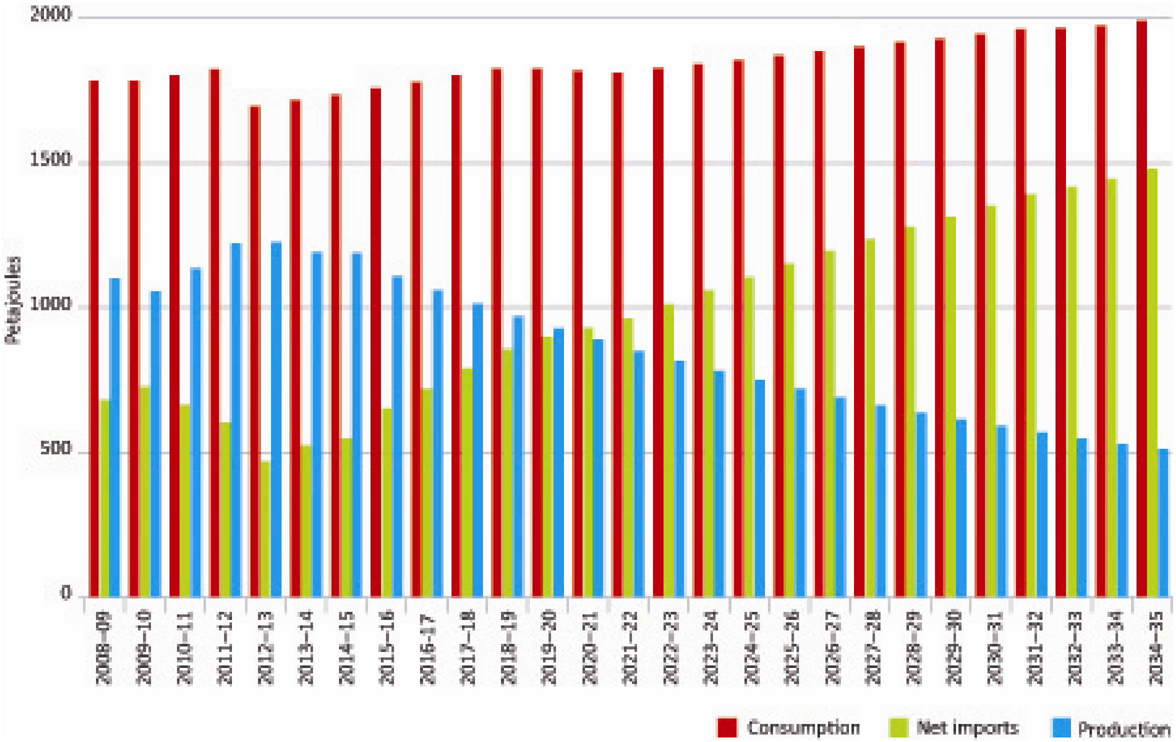
In terms of fuel production and importation, transport scenario modelling conducted for the development of the Strategic Framework for Alternative Transport Fuels indicates that over the period to 2050:

- transport fuel demand is projected to steadily increase, with the freight task and air travel the main drivers of rising consumption
- conventional fuels are expected to continue to be the mainstay of the liquid fuel market

[6] Australian Institute of Petroleum, *Downstream petroleum* 2009, AIP, Canberra, 2010.
[7] Department of Resources Energy and Tourism, *Australian petroleum statistics,* RET, Canberra, 2011.
[8] Department of Resources Energy and Tourism, *National Energy Security Assessment*, RET, Canberra, 2011.

- uptake of alternative transport fuels is likely to be limited in this decade; however, the combined influence of rising oil prices, carbon pricing and technological development is expected to drive growth in alternative fuel consumption from 2020 onwards
- almost all of the alternative transport fuels considered in the modelling are taken up in the road sector during the period to 2030
- the rail sector is expected to adopt some diesel substitutes and increase electrification where feasible
- the aviation sector is expected to have a greater focus on the development of bio-derived jet fuels to contribute a growing share of aviation fuel consumption as supply chains mature
- as oil prices rise, marine transport will transition from fuel oil to diesel, and adopt diesel substitutes where feasible.[9]

Figure 6A.3: Primary oil production, imports and total primary energy consumption, 2008–09 to 2034–35

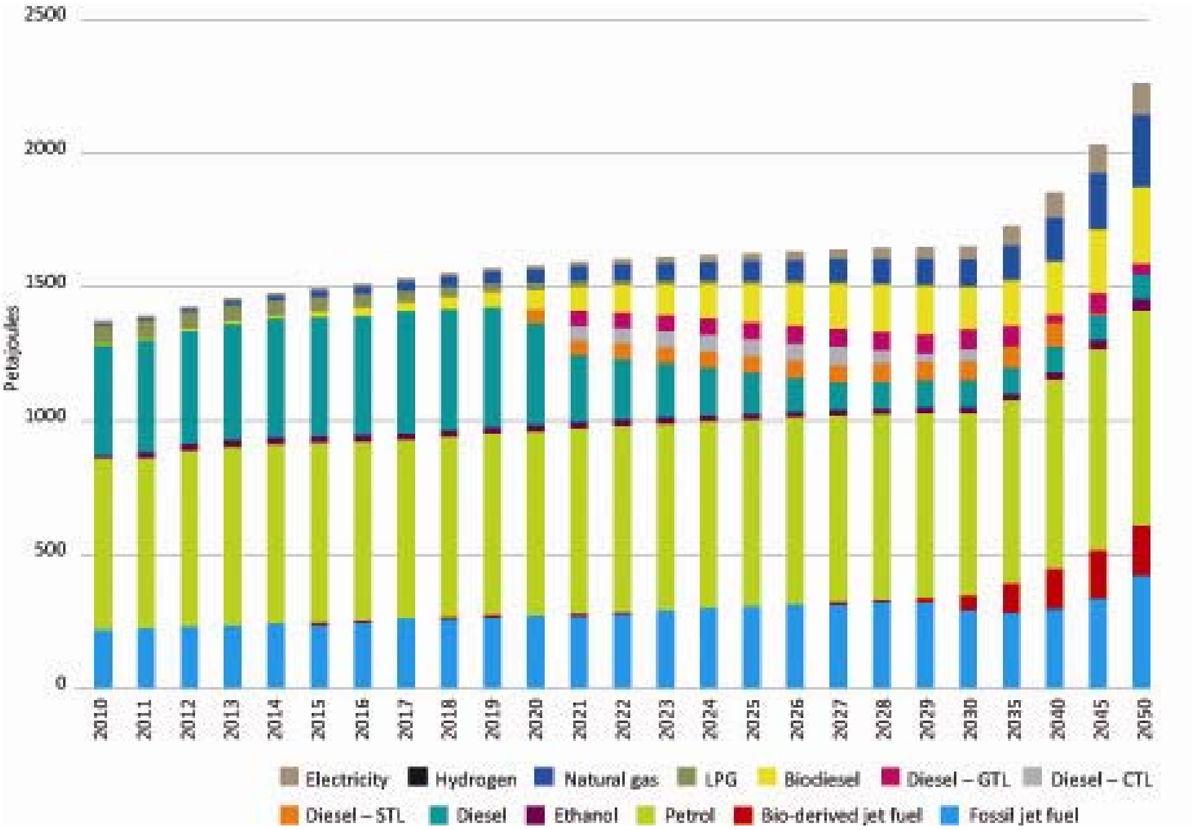


Source: BREE, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

In the modelling, five scenarios were developed with variations in demand, social attitude, fuel price and electric vehicle uptake. The most central of the scenarios (scenario 2) is depicted in Figure 6A.4, indicating a growth in demand for liquid fuels over the period to 2050; petrol remaining steady; an increase in biodiesel, natural gas and electricity from 2020; and a shift from fossil jet fuel to bio-derived jet fuel from 2030. Further information is detailed in the Strategic Framework for Alternative Transport Fuels 2011.

[9] CSIRO, *Possible futures: scenario modelling of Australian alternative transport fuels to 2050*, CSIRO, Canberra, 2011.

Figure 6A.4: Transport fuels modelling to 2050, by fuel type – scenario 2



GTL = gas-to-liquids; CTL = coal-to-liquids; STL = shale-to-liquids.
Source: CSIRO, *Possible futures: scenario modelling of Australian alternative transport fuels to 2050*, CSIRO, Canberra, 2011.

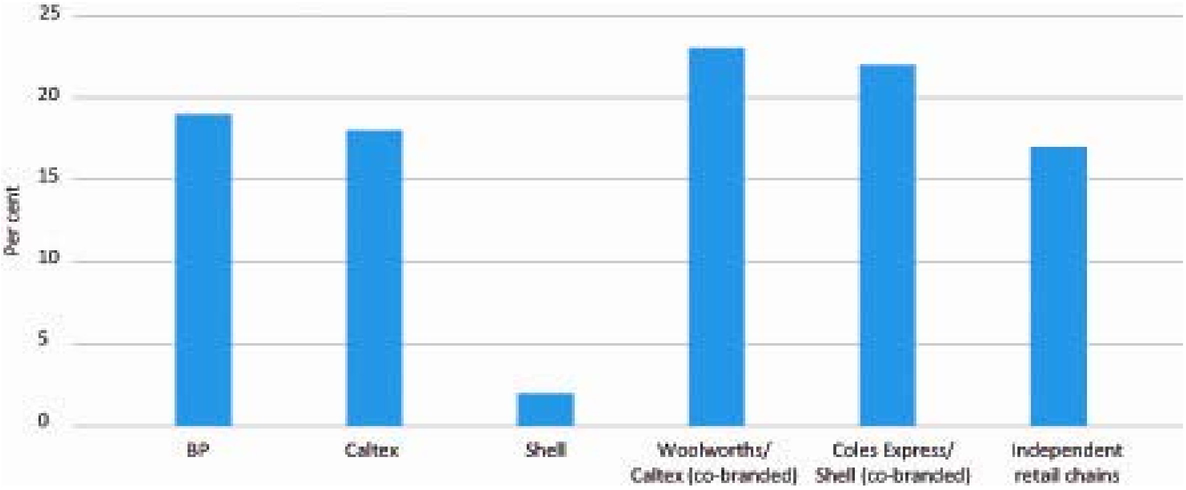
Wholesale, distribution and retail markets

Wholesalers, distributors and retailers sell refined liquid fuel to industrial users and consumers. The four refiner–marketers (BP Australia, Caltex, Mobil and Shell Australia) account for most of the wholesale market in Australia. The most prominent independent wholesalers are United, Neumann, Gull and Liberty. While independent wholesalers account for a small share of the wholesale market, their share has been increasing since 2005–06.[10]

The liquid fuel retail sector has undergone significant structural change, including rationalisation of retail sites, scaling down of retail activities by refiner–marketers and increasing presence of specialist retailers. The refiner–marketers are becoming less prominent in fuel retailing, and the majority of retail sites are now independently owned and/or operated. Two supermarkets operate in the retail fuels market: Woolworths with Caltex, and Coles with Shell, operating co-branded retail fuel outlets. Mobil sold its retail business to 7-Eleven in 2010 and is exiting the retail fuel market in Australia. While the refiner–marketers and the supermarket co-branded chains account for the majority of the retail fuel market, a number of independents with a growing share of sales volumes also operate in this area (see Figure 6A.5).

[10] Australian Competition and Consumer Commission, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, 2010.

Figure 6A.5: Share of retail sales by brand, 2010–11



Note: 2010–11 sales for Mobil sites sold to 7-Eleven and On the Run are included in the 'Independent retail chains' column.

Source: Australian Competition and Consumer Commission, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, December 2011.

Liquid fuel pricing

Australia's participation in the global oil market means that our liquid fuel market and pricing are linked to movements and events internationally. Monitoring and analysis by the Australian Competition and Consumer Commission of the Australian petroleum industry has shown that the major determinants of the price of retail unleaded petrol in Australia are:

- the international price of refined petrol, which is largely driven by the international price of crude oil
- the exchange rate of the Australian dollar against the US dollar
- the established weekly retail price cycles in city areas.

While it is possible for domestic prices to move independently of international crude oil or even refined petrol prices in the short term, Australia's long-term retail prices have generally closely followed international benchmarks. This is demonstrated in Figure 6A.6, which shows the correlation between the average retail regular unleaded petrol price in the five largest Australian cities and the price of Singapore Mogas 95 unleaded (the relevant benchmark price).

Figure 6A.6: Australian average retail and net retail regular unleaded petrol prices and Singapore Mogas 95 price, July 2007 to September 2011

Source: Australian Competition and Consumer Commission, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, December 2011.

Over the medium and long terms, prices for crude oil and refined product are likely to remain relatively high compared to historical levels, driven by growing global demand and increased reliance on more expensive sources of supply. Nevertheless, prices are expected to remain manageable within the broader economy.[11]

6A.2 Liquid fuels policy framework

The liquid fuel markets, while national in character like most Australian markets, are in practice regulated through various intersecting frameworks at the Commonwealth and state and territory levels covering competition policy, pricing, monitoring and enforcement, and environmental, health and safety issues. The main governance mechanisms are briefly discussed below.

Oilcode

The Trade Practices (Industry Codes – Oilcode) Regulations 2006 is a mandatory industry code under section 51AE of the *Competition and Consumer Act 2010*. The Oilcode regulates the conduct of suppliers, distributors and retailers in the downstream petroleum retail industry. It provides:

- standard terms and conditions for fuel reselling agreements for franchise and commission agency arrangements
- a consistent national approach to terminal gate pricing arrangements and improved transparency in wholesale pricing, which allows access for all customers (including small businesses) to petroleum products at the terminal gate price

[11] Department of Resources Energy and Tourism, *National energy security assessment*.

- an independent, downstream petroleum dispute resolution scheme, including the appointment of a dispute resolution adviser to provide the industry with a cost-effective alternative to taking action in the courts.

Monitoring and enforcement

The Australian Competition and Consumer Commission (ACCC) formally monitors prices, costs and profits of unleaded petroleum products following a direction of the minister under the *Competition and Consumer Act 2010.* The ACCC has powers under Part IV of the Act to investigate and take enforcement action where necessary. Part IV of the Act promotes competitive markets through prohibitions on anti-competitive conduct.

Fuel quality standards

Fuel quality in Australia, is regulated under the *Fuel Quality Standards Act 2000*, which is administered by the Department of Sustainability, Environment, Water, Population and Communities. The Act regulates fuel supplied in Australia (with the exception of aviation fuels) to reduce adverse effects of motor vehicle emissions on air quality and human health and to facilitate adoption of new technologies to improve vehicle efficiency. Australian fuel quality standards have been set for petrol, automotive diesel, petrol–ethanol blended fuel up to 10 per cent ethanol, biodiesel and autogas.

The department is currently working with international and national experts and industry to develop fuel quality standards for diesel and biodiesel blends containing more than 5 per cent and up to 20 per cent biodiesel and for E85, a high-ethanol blend with petrol. It is expected that implementation of these new standards will assist with market confidence in these higher-fuel blends.

Vehicle design and emissions standards

The Australian Design Rules are national standards for vehicle safety, anti-theft and emissions. The rules are generally performance-based and cover issues such as occupant protection, structures, lighting, noise, engine exhaust emissions, braking and a range of miscellaneous items.

The rules are administered by the Australian Government under the *Motor Vehicle Standards Act 1989*. The government's policy is to harmonise national vehicle safety standards and emissions with international regulations where possible, and consideration is given to adopting international regulations of the United Nations. Australia is a signatory to the UN 1958 and 1998 agreements relating to vehicle standards harmonisation. The harmonisation policy is also important to fulfil World Trade Organization and Asia–Pacific Economic Cooperation commitments.

On 11 June 2011, the Australian Government announced its decision to update the vehicle emissions design rules to adopt the Euro 5 and Euro 6 air pollution standards for light vehicles. Euro 5 emissions standards will commence for new model vehicles from 1 November 2013 and for existing models from 1 November 2016. Euro 6 emissions standards will commence for new model vehicles from 1 July 2017 and for existing models from 1 July 2018.[12]

[12] Minister for Infrastructure and Transport, *New pollution standards for vehicles*, media release, 11 June 2010.

As part of its Clean Energy Future package, the Australian Government will introduce mandatory carbon dioxide emissions standards on all light vehicles from 2015. This measure is expected to deliver cost savings for motorists by improving fuel efficiency in all categories of new light vehicles.

Fuel taxation

Petrol and diesel are subject to an excise and excise-equivalent customs duty rate of 38.143 cents per litre. The rate for gasoline and kerosene for aircraft fuels is 3.556 cents per litre (this does not include any associated carbon price impacts).[13] Since 1995, excise rates for aviation fuels have been set in accordance with funding requirements of the Civil Aviation Safety Authority and Airservices Australia to enable the provision of services such as air traffic control and air safety regulation.

On 29 June 2011, the package of legislation on the future taxation of alternative transport fuels received royal assent. The new taxation arrangements will apply from 1 December 2011.[14] Table 6A.1 shows the new rates, and reflects the five-year transition of the gaseous fuels into the regime and the government's decision to maintain a 10-year moratorium on current taxation and grant arrangements for ethanol, biodiesel, renewable diesel and methanol.

Under the Ethanol Production Grants Program, grants of 38.143 cents per litre are provided for domestic production of ethanol, making the fuel effectively excise free. The Energy Grants (Cleaner Fuels) Scheme also provides 38.143 cents per litre grants for the domestic production and import of biodiesel and renewable diesel. These arrangements will continue until at least 30 June 2021.[15]

Table 6A.1: Alternative fuels excise and excise-equivalent customs duty rates

Fuel type	**From 1 December 2011**	**From 1 July 2012**	**From 1 July 2013**	**From 1 July 2014**	**From 1 July 2015 (final rate)**
LPG cents per litre (c/pl)	2.5	5.0	7.5	10.0	12.5
LNG cents per kilogram (c/kg)	5.22	10.45	15.67	20.9	26.13
CNG c/kg	5.22	10.45	15.67	20.9	26.13
Ethanol c/pl	38.143	38.143	38.143	38.143	38.143
Biodiesel c/pl	38.143	38.143	38.143	38.143	38.143

Source: Derived from the *Taxation of Alternative Fuels Legislation Amendment Act 2011*, the *Excise Tariff Amendment Act 2011*, the *Customs Tariff Amendment Act 2011* and the *Energy Grants Scheme Amendment Act 2011*.

The taxation and grant arrangements for compressed natural gas (CNG) and liquefied natural gas (LNG) will be reviewed after 12 months of operation. A broader review of arrangements for gaseous fuels will take place after 1 July 2015. A review of the taxation and grant arrangements that apply to biodiesel, ethanol, renewable diesel and methanol will be conducted after 1 July 2021.

[13] *Excise Tariff Act 1921* (as amended), available at www.comlaw.gov.au.

[14] Includes the *Taxation of Alternative Fuels Legislation Amendment Act 2011,* the *Excise Tariff Amendment (Taxation of Alternative Fuels) Act 2011,* the *Customs Tariff Amendment (Taxation of Alternative Fuels) Act 2011* and the *Energy Grants (Cleaner Fuels) Scheme Amendment Act 2011.*

[15] Explanatory memorandum for the Taxation of Alternative Fuels legislation package, page 4.

Carbon pricing and fuel

On 10 July 2011, the Australian Government announced details for its climate change plan, *Securing a clean energy future*. Under the plan, an effective carbon price will apply to business users of liquid and gaseous fuels through a reduction in their fuel tax credit entitlement, rather than through the tradable permit carbon pricing mechanism. However, there will be opportunities for them to opt in to emissions trading.[16] The effective carbon price will not apply to household transport fuel consumption, light commercial vehicles (4.5 tonnes or less), and the agriculture, forestry and fisheries sectors. The government intends that on-road heavy vehicles using diesel will be subject to an effective carbon price from 1 July 2014. Carbon pricing will not apply to the use of biofuels (ethanol, biodiesel and renewable diesel), and gaseous fuels used in heavy on-road vehicles will be effectively exempt as gaseous fuels excise rates are lower than the road user charge.

Transport fuel used in the rail, domestic shipping and domestic aviation sectors will be subject to an effective carbon price from 1 July 2012. International aviation and shipping fuel use will not be subject to the effective carbon price.

International Energy Agency obligations

Under the International Energy Agency Treaty, member countries are committed to hold oil stocks equivalent to no less than 90 days of the previous year's average daily net imports (see section 4.3). These stocks form the basis of the IEA's global emergency response system, which can be activated in the event of a major disruption to the global supply of oil.

Since joining the IEA in 1979, Australia has successfully relied solely on commercial industry stocks to meet its stockholding obligation and does not hold any government-owned or -regulated industry strategic oil stocks. Policy settings rely on the commercial stockholding practices of industry and market flexibility to increase supply during a short-term supply disruption and to meet our stockholding obligation as a member of the IEA.

As a result of increased daily net imports in recent years, the level of oil stocks in Australia has regularly fallen below the 90-day requirement since mid-2010. The National Energy Security Assessment found that this does not indicate an emerging domestic energy security problem. However, Australia's stockholding obligation is an important compliance issue under an international treaty that is intended to be a credible response mechanism to a major global oil supply disruption. The Australian Government is currently considering possible options to respond to this issue.

Alternative transport fuels

The Strategic Framework for Alternative Transport Fuels has been released as a companion document to the Energy White Paper, and examines the outlook for alternative transport fuels in Australia and barriers to their uptake. In doing so it aims to create a more stable policy environment and a pathway to commercial deployment. This framework was developed jointly with industry and other key stakeholders.

[16] Details on the treatment of fuel and opt-in arrangements are available on the Clean Energy Future website, www.cleanenergyfuture.gov.au.

Scenario modelling by CSIRO indicates that by 2030 alternative transport fuels could, under a range of scenarios, make up about 23 to 46 per cent of Australian transport fuels, and this could rise to as much as 30 to 54 per cent by 2050.[17]

While significant uptake and deployment of alternative fuels is not expected until later decades, the framework is designed to ensure that there is a robust policy framework around the possible future market-led diversification of our transport fuel mix. This framework is consistent with the principles of the draft Energy White Paper policy framework and as such does not include the use of government-mandated fuel use targets or production subsidies to support broader uptake of fuels. Such approaches are inherently less flexible than market-driven models in generating optimal outcomes and can impose higher costs on consumers and the economy.

Like all emerging technologies and innovations, the natural commercial development and adoption of alternative transport fuels in Australia can be constrained by a variety of factors including:

- investment uncertainty
- policy, legislative and regulatory barriers
- infrastructure hurdles
- information barriers
- technology constraints (including cost)
- performance uncertainty
- labour force skills constraints
- high adjustment costs.

Consistent with the draft Energy White Paper policy principles, the alternative transport fuels framework adopts a market-based approach, and is intended to remove barriers to the uptake of alternative fuels in order to allow such fuels to enter the market when they are commercially viable. The framework establishes the following principles:

- A stable, predictable domestic policy environment will support the development, production, distribution and deployment of alternative transport fuels.
- Alternative transport policy and measures should recognise the different stages of development of various alternative transport fuels and associated infrastructure and supply chains.
- Measures in support of the development and deployment of alternative transport fuels should:
  - address identified market failures
  - be transparent, efficient and justifiable
  - focus on different stages of maturity including:
  - research and development
  - commercialisation and investment

[17] CSIRO, *Possible futures*.

– distribution and consumption

– be feedstock- and technology-neutral, subject to technical and modal applicability

– be advanced in partnership with industry.

The framework outlines a set of industry–government measures to progressively address market failures and other impediments to commercial uptake, including:

- providing leadership and certainty through the application of alternative transport fuels principles, the development of a coordinated policy approach, the removal of unintended and outdated eligibility criteria definitions within existing programs, and the establishment of relevant advisory mechanisms
- encouraging research, development and demonstration through international collaboration and technology development opportunities utilising existing government programs
- improving understanding of commercialisation, skills and financing issues through collaborative projects and other actions utilising existing government programs
- addressing market failures through the provision of improved information and the creation of sustainability standards and a verification mechanism for assessing the greenhouse gas performance of alternative transport fuels.

The Australian Government, through the Minister for Resources and Energy, will establish and appoint an implementation advisory group (including members with industry understanding and background) to advise the government on the implementation of the actions set out in the Strategic Framework for Alternative Transport Fuels.

Productivity Commission reviews

The Productivity Commission will examine the impact of carbon pricing on the competitiveness of emissions-intensive, trade-exposed industries in 2014–15, and may recommend changes to the assistance rates or the carbon productivity contribution applying to activities.

The Australian Government has also announced that the Productivity Commission will review fuel excise arrangements, including examining the merits of a regime that is based explicitly and precisely on the carbon and energy content of fuels.

Monitoring and assessment

In addition to these governance arrangements, the Australian Government regularly monitors and assesses the state of the liquid fuel market, through its regular National Energy Security Assessment, government analysis of IEA research, ACCC monitoring of the petroleum industry, and the Australian Petroleum Statistics collection and analysis. These assessments are important tools for alerting the government to emerging trends and potential developments, and they enable better consideration of future risks and challenges, as well as the development of appropriate government responses. The government values the input and contribution of industry to the ongoing strength of the liquid fuel market and maintains its commitment to working with industry to rise to future challenges through sound policy development.

6A.3 Strategic challenges

The Australian Government believes that overall the Australian liquid fuel market and systems are functioning efficiently and effectively and are well placed to meet Australia's expected liquid fuel needs. Markets are generally competitive and supply chains robust.[18] Pricing is responsive to market conditions.

To date, the overall strength of the Australian economy and the rise in the Australian dollar have allowed increases in international oil prices over recent years to remain manageable within the broader economy.[19] Australia's access to well-functioning markets for liquid fuels has helped create robust and flexible supply chains for crude oil and other refinery feedstock and refined petroleum products, and has also encouraged a high diversity of supply.

While no immediate major strategic policy challenges for the sector are evident, a number of developments may need to be addressed in coming years. These include:

- further competitive pressures on Australian refineries from newer regional 'mega-refineries', increasing domestic production costs (including carbon costs) and the ongoing costs of upgrading Australia's older refinery infrastructure
- the requirement for additional infrastructure to accommodate the likely growth in fuel imports (both crude oil and refined products)
- the promotion of more environmentally sustainable production, supply and use practices, including reducing the sector's greenhouse gas emissions while maintaining its competitiveness
- positioning Australia for increased use of alternative transport fuels as they become commercially viable and more competitive
- managing Australia's 90-day stockholding obligation to the IEA.

While Australia's refining sector continuously adjusts to market pressures through improved productivity from innovation and technology upgrades, increased competition from new refineries in the Asia–Pacific may lead to further rationalisation of Australian refining capacity, leading to greater volumes of imports of refined petroleum products. Continued access to well-functioning regional markets for refined products and the significant global and regional surplus refining capacity outlined above are expected to provide adequate supply to meet any domestic refinery shortfall over the medium term.[20]

However, it will be important for the government to continue monitoring global and regional refining capacity (as well as the Australian refining sector) as it adjusts to market pressures over time.

Rising imports will require timely investment in capacity and import infrastructure in Australia. Bulk fuel terminals play an important role in the domestic liquid fuel supply chain as the primary distribution point for domestic refineries, and also link the international and domestic fuel markets. Bulk fuel terminals are located throughout Australia, servicing geographic regions where the demand for fuel is concentrated. The terminals are owned and operated by a range of industry

[18] Department of Resources Energy and Tourism, *National energy security assessment*.

[19] Department of Resources Energy and Tourism, *National energy security assessment*.

[20] Department of Resources Energy and Tourism, *National Energy Security Assessment*.

participants, including major oil companies, independent importers, independent operators and major fuel users (such as mining companies).

Currently, the market is delivering adequate terminal and importing infrastructure to meet Australia's liquid fuel needs. This is demonstrated by recent planned investment in new or expanded terminal facilities; a reliable fuel supply that appears to be reasonably competitively priced; a well-functioning wholesale market; negotiation (on commercial terms) of the use of spare capacity; and access to a range of supply options. Commercial barriers to importing fuel to Australia are not prohibitive. However, as demand increases, it will be important for the Australian and state and territory governments to maintain an attractive investment environment through efficient, timely and consistent national planning, approval and regulatory processes to support future investment in import fuel terminals and storage facilities as well as related distribution infrastructure.

Australia's fuel quality standards have improved urban air quality, facilitated the introduction of new engine and fuel-efficient technologies, and reduced greenhouse gas emissions. The introduction of Euro 5 and 6 design rule standards for light vehicles may create flow-on issues for the refining sector, such as potentially significant investment from the refining sector to meet the standards.

Any changes to fuel specification standards will be subject to rigorous economic analysis of the costs and benefits to industry, consumers, and society more broadly, including consideration of domestic refining capacity, environmental and public health outcomes.

While the Australian refining sector is subject to carbon pricing from 1 July 2012, the Clean Energy Future package provides assistance to businesses to address competitiveness impacts on trade-exposed and emissions-intensive activities. This includes the refining sector.

These challenges or pressures, although potentially significant, do not currently present immediate concerns for the sector although this may change over time. In many cases, they will be managed through normal market and policy processes. However, the government will continue to regularly assess Australia's liquid fuel vulnerabilities as part of the National Energy Security Assessment process. This will cover the liquid fuel supply chain, including import and refining infrastructure, and critical supply linkages.

As part of this monitoring and assessment process, there is a need to improve the quality and coverage of the collection and publication of monthly national and state petroleum data through the Australian Petroleum Statistics. This publication provides data on production, sale and trade of petroleum products across the supply chain. The data is collected on a voluntary basis, and requires review to improve completeness, consistency and accuracy and to inform assessment of liquid fuel vulnerability and assist in meeting our international energy obligations.

There is considerable overlap between numerous Australian, state and territory government agencies involved in the collection and use of liquid fuel production statistics. This duplication creates confusion for monitoring, assessment and policy-making purposes, as well as an unnecessary compliance burden for industry. There is a need to streamline current collections and to reduce the reporting burden on the industry, which will require a coordinated government approach if it is to be implemented effectively. This is further discussed in section 9.3.

In addition, the Australian Government recognises the uncertainty surrounding new and alternative fuel and technologies, including:

- the cost-competitiveness of different transport fuel technologies
- the timing of when fuel technologies reach commercialisation and enter the market
- the timing and costs of production methods (such as processing technologies for advanced biofuels and lower-emissions technologies for synthetic fuels)
- advances in internal combustion engine technology, particularly regarding hybrids and dual-fuel systems
- costs and timeframes associated with the distribution and refuelling technology for transport fuels, including electric vehicle recharging and rail energy use improvements.

In this rapidly changing field there is a need for a regular stocktake and consolidation of information on fuel production and vehicle technology developments. This is proposed to be addressed through a regular assessment of fuel technologies, as part of the Australian Energy Technology Assessment, which will encompass all major technology options for conventional and alternative transport fuels for the Australian transport fuel market (also further discussed in Chapter 9).

6A.3 Key actions

To ensure the long-term health of the liquid fuels sector, the Australian Government will:

- reaffirm its commitment to delivering a market framework focused on delivering reliable supply of liquid fuel, priced within open transparent competitive markets
- as part of the 2014 National Energy Security Assessment process, assess Australia's liquid fuel vulnerabilities – this will cover the liquid fuel supply chain, including import and refining infrastructure and critical supply linkages
- lead work, in consultation with industry, to improve the quality of the Australian Petroleum Statistics
- continue to remove impediments to the development and deployment of alternative transport fuels where it is cost-effective through the Strategic Framework for Alternative Transport Fuels, and to address identified market failures, in cooperation with industry and guided by the Alternative Transport Fuels Implementation Advisory Group
- assess Australia's liquid fuels and technology development as part of the biennial Australian Energy Technology Assessment, in 2014
- undertake the scheduled reviews, through the Productivity Commission, into:
  - fuel excise arrangements, including an examination of the merits of a regime based explicitly and precisely on the carbon and energy content of fuels
  - the impact of carbon pricing on the competitiveness of emissions-intensive and trade-exposed industries, including the Australian refining industry
  - promote open, transparent and competitive global and regional oil markets through our international engagement.

6B Electricity and gas markets

Highlights

- Historically, Australia has been well served by its electricity and gas markets in delivering reliable and competitively priced supplies of energy.
- Ongoing microeconomic reforms have provided competitive market structures with clear and accountable governance arrangements that establish separation between regulation, market operation, and policy and rule development. While the pace of reform may be slower than some would like, Australia is moving towards more efficient and integrated national energy markets.
- Australia's electricity and gas markets are facing a period of great change and new challenges, including:
  - rising electricity and gas prices
  - the need for unprecedented investment in new and replacement generation and production capacity and in transmission and distribution networks
  - continued growth in peak demand
  - new dynamics created by carbon pricing, the introduction of new technology and growing links between energy markets and other elements of the economy
  - the need to ensure that market structures remain efficient and competitive.
- While a number of these challenges (particularly the scale of required investment) will test the robustness of market and policy frameworks, the Australian Government believes that the fundamental design of our electricity and gas markets remains sound and that there is no justification for another 'root and branch' review.
  - However, there is a need to follow through on outstanding actions from previous energy market reviews, notably retail price deregulation (while empowering consumers and protecting vulnerable consumers), reducing government ownership in energy markets and furthering the transition to truly national markets by extending market governance arrangements and principles to all electricity and gas markets.
  - Continuing these reforms and development in electricity and gas markets will secure better outcomes for consumers and improve the resilience of our energy markets.
- The process of transitioning markets is not without risk and there is a need for active monitoring of both electricity and gas market developments to ensure that competitive conditions are maintained, and that Australia's energy needs are met in a timely and efficient manner.

Electricity

- Recent price increases will continue into the future. These are driven by a combination of factors, primarily the need to meet ongoing system reliability requirements and transition to cleaner energy. Transmission and distribution network development, the need for new generation capacity, the impact of non-market clean energy measures and carbon pricing will also be key contributors to price outcomes.

- The Council of Australian Governments' Standing Council on Energy and Resources has an active work program to improve market performance in a range of areas to assist in minimising long-term cost pressures.
- However, there are a number of areas where additional attention may be needed:
  - ensuring that our regulation of monopoly networks delivers an appropriate balance between cost to consumers and reliability
  - progressing network and retail pricing reforms to incentivise efficient demand-side participation or other measures to drive energy efficiency and reduce peak-demand growth
  - learning lessons from the deployment of advanced metering (smart meters) and assessing the role advanced metering and related technologies can play in our energy future
  - addressing market or regulatory barriers to the efficient deployment of intermittent and distributed generation.
- In addition, given the importance of timely and efficient network development, it is crucial to assess whether opportunities exist to drive further efficiency in distribution networks through benchmarking, and whether current frameworks are providing optimal investment with regard to regional interconnectors. This work will be undertaken by the Productivity Commission.
- There are a range of largely non-market climate-related interventions that are adding to the complexity of investment decisions for market participants. In addition, the overall incentive framework that will drive investment decisions remains largely untested under carbon pricing.
  - Carbon-related investment risks have been recognised in the design of the Clean Energy Future package, which provides a number of transitional mechanisms to support ongoing energy security.
  - Commitment is needed from all governments to refrain from further market-distorting interventions and to rationalise existing non-complementary climate change measures.

Gas

- Overall, the physical supply available to Australia's domestic gas markets is considered adequate against expected domestic and export demand out to 2035, with good potential for additional reserves from conventional and unconventional sources in the future. Well-functioning markets are the most efficient way to ensure that new gas requirements continue to be delivered.
- The dynamics in the east and west coast gas markets are changing, albeit in different ways. This is largely driven by a mix of increasing production costs, competition from export markets and uncertainty around the impact of carbon pricing on the overall demand for gas, particularly for electricity generation.
- These new dynamics will take time to mature and it is not possible to draw clear conclusions about future market direction. However, there is a strong case for further reforms in eastern and western markets to improve transparency and increase opportunities for more flexible trading.
- While recognising that current market conditions are particularly challenging for some large gas users, the Australian Government believes that policy intervention at the present time to force domestic gas outcomes is unwarranted. However, there is a need to monitor market dynamics to assess whether policy settings deliver the required outcomes given the growing domestic use of gas. This will inform government decision-making, which will be mindful of domestic gas considerations in granting production licences.

6B.1 Introduction

Ensuring that Australia has well-functioning electricity and gas markets that deliver reliable, efficient and competitively priced energy is vital to Australia's future. It is also fundamental to ensuring that consumers are receiving electricity and gas at competitive costs.

Like most markets in Australia, the electricity and gas markets began as state and territory–based arrangements. However, since 1996 the Australian Government – together with the state and territory governments – has implemented progressive reforms to develop a national energy policy framework, including national market legislation and institutions. These arrangements are currently embodied in the Australian Energy Market Agreement.

While energy markets are described as 'national', there is still physical separation between the east, west and northern regions, and electricity and gas markets have yet to be truly integrated under a single regulatory framework.

Australia has two major electricity markets: the National Electricity Market (NEM) and the South West Interconnected System (SWIS). There are also a number of large off-grid systems, although they are not traded systems. Australia's gas market comprises three regional markets – eastern, western and northern.

The connection of the Western Australia and Northern Territory systems or off-grid areas to the national energy markets of south and eastern Australia entails significant geographic and economic barriers that are considered unlikely to change in the period to 2030.

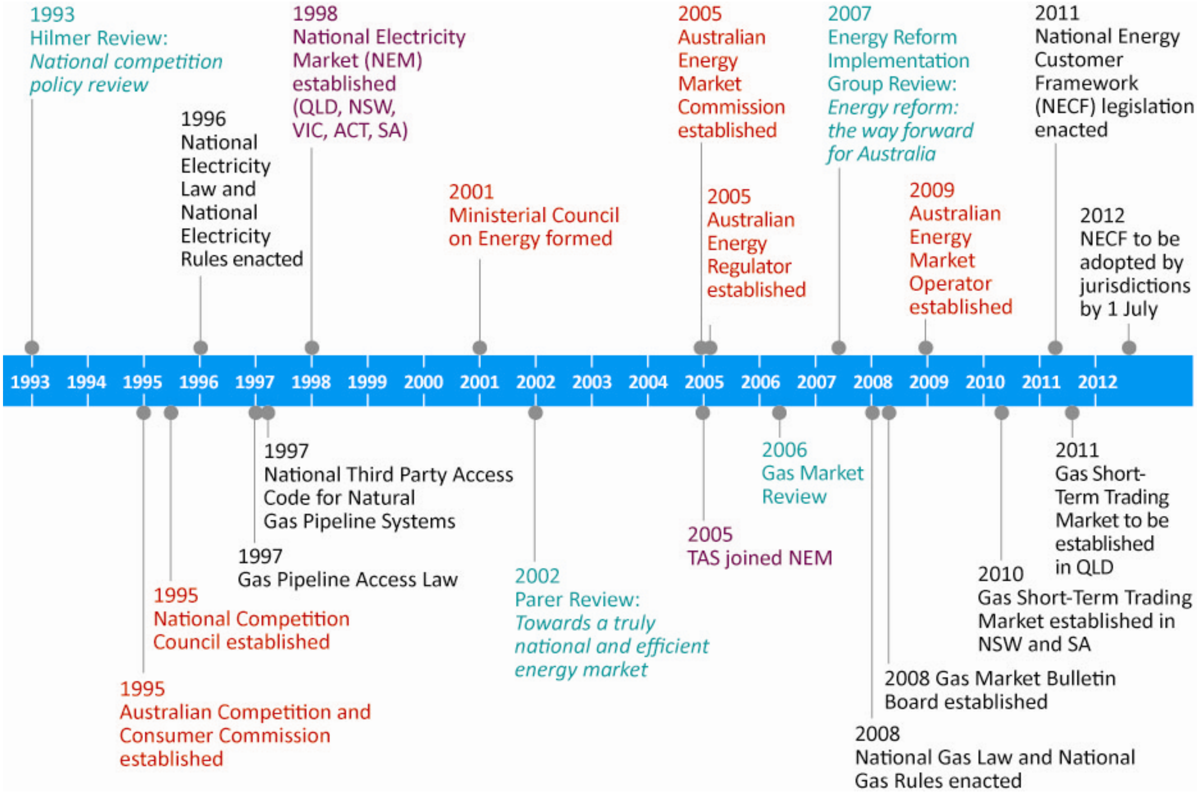
6B.2 Towards a more national approach

The energy market reforms that began in the 1990s have involved the creation of national frameworks for governance, network regulation, planning and pricing, demand-side participation and non-economic regulation (see Figure 6B.1). These developments have been accompanied by structural changes, such as the increasing privatisation of ownership of energy assets. This process has largely been driven by the Council of Australian Governments (COAG) Ministerial Council on Energy, now replaced by the Standing Council on Energy and Resources (SCER).

Two major reviews of electricity and gas market reforms have been conducted under the auspices of COAG to deliver productivity improvements in the energy sector: *Towards a truly national and efficient energy market* in 2002 (the Parer Review) and *Energy reform: the way forward for Australia* in 2007 (the Energy Reform Implementation Group Review).

Broadly, the Parer Review considered governance and market structure, while the Energy Reform Implementation Group Review focused more on improving market performance. Both reviews made recommendations about various aspects of the energy supply chain and noted the importance of developing truly national frameworks. Many of these reforms have been implemented, including the development of more independent and effective market governance arrangements and reforms to network and retail arrangements.

Figure 6B.1: History of Australian energy market reform



However, there are a number of areas that are still to be completed:

- addressing issues created by government ownership, and potential issues from cross-ownership between generation and transmission
- retail price deregulation and promoting greater competition in retail markets
- improving the opportunities for efficient levels of demand response in the market
- determining frameworks for efficient deployment and use of interval meters, smart meters and smart grids
- introduction of full retail contestability
- application of uniform non-economic regulation across jurisdictions
- ongoing review of Community Service Obligations
- further optimisation of network regulation
- review of derogations and differences between jurisdictional arrangements and the national regime
- reform in non-NEM jurisdictions, most notably Western Australia's electricity and gas markets, for which the current Western Australian Strategic Energy Initiative is key.

It is important to note that delivering the energy market reform agenda involves issues that are generally beyond the jurisdiction of any single government, and requires a sustained cooperative commitment over time. Despite differences in views between jurisdictions on a range of matters, the Australian Government considers that the COAG structure remains the most appropriate mechanism to progress these reforms, as demonstrated by its success to date.

COAG, through SCER, is currently addressing a range of issues, including some of those listed above, as part of its current work program which reflects the shared ongoing commitment to COAG-led reform. This includes:

- implementing the National Energy Retail Law and Rules
- looking at improved opportunities for efficient demand response in the market
- developing a national smart metering framework
- improving network frameworks for achieving an efficient level of investment and service
- pursuing greater competition and consumer empowerment in the retail sector and the removal of retail price regulation where effective competition exists
- developing advice to COAG on the need for structural separation of generation and transmission ownership.

Action in a number of these areas is being progressed by the energy market bodies, both in the NEM and the non-NEM jurisdictions (see Table 6B.1 for a summary of the key elements).

The remainder of this section examines overall electricity and gas market design and governance as well as the key elements of each major market.

Table 6B.1: Energy market activities, as at 22 September 2011

Title	**Description**
Australian Energy Market Commission	
Strategic Priorities for Energy Market Development	Explores the most important immediate challenges and opportunities for energy market development in Australia.
Transmission Frameworks Review	Assesses the adequacy of the transmission framework in light of the current significant period of change.
Retail effectiveness reviews (various states)	Assesses the effectiveness of retail competition and the consequential impacts of pricing regulation in NEM regions.
Review of Demand-Side Participation in the NEM	Identifies market conditions and regulatory arrangements needed to facilitate demand-side participation.
Electric and Natural Gas Vehicles	Identifies barriers to the economically efficient uptake of electric and natural gas vehicles.
Australian Energy Regulator	
AER Strategic Priorities and Work Program	Indicates the key focus areas for the AER's immediate work program.
State of the Energy Market	Provides an annual overview of energy market activity in Australia.
AER Networks Information Strategy	Describes the AER's aims for an information collection, analysis and reporting framework.
Electricity market reports	Monitors wholesale electricity market outcomes in the NEM.
Gas market reports	Provides an overview of gas production and flow information.
Retail Pricing Information and Retailer Authorisation Guidelines	Provides guidance on the process and requirements for retailer authorisation and requirements for retailers on the presentation of energy offers, including fact sheets.

Title	Description
Australian Energy Market Operator	
National Transmission Network Development Plan	Provides an independent strategic plan for the NEM transmission network.
Electricity Statement of Opportunities	Provides a broad analysis of opportunities for generation and demand-side investment in the NEM.
Gas Statement of Opportunities	Provides a broad analysis of opportunities for investment in infrastructure or entering into contracts in the gas industry in south-eastern Australia.
Power System Adequacy	Outlines the expected medium-term power system security and reliability.
Energy Adequacy Assessment Projection	Provides information on the impact of drought in eastern and south-eastern Australia on generation capacity in the NEM.
Western Australian Government	
Strategic Energy Initiative	Development of a practical plan that aims to meet Western Australia's energy needs over the next 20 years.
WA Independent Market Operator	
Statement of Opportunities	Provides forecasts of maximum peak demand and energy usage for the South West Interconnected System for the following 10 years.
Market Evolution Program	Focuses on the next steps for development of the Western Australian wholesale electricity market.
WA Economic Regulation Authority	
Inquiry into the Efficiency of Synergy's Costs and Electricity Tariffs	Reports on the efficiency of Synergy's operating and capital expenditure; the efficiency of Synergy's procurement of wholesale electricity; and the efficiency of Synergy's renewable energy certificates.

6B.3 Market design

The Australian Government believes that the design fundamentals of the national electricity and gas markets are sound and that these markets have delivered well against their stated objectives.

That said, there have been a range of significant developments since the last market review (by the Energy Reform Implementation Group in 2007) that are introducing fresh challenges and opportunities for market operation. These include:

- additional clean energy interventions in the form of the expanded Renewable Energy Target, carbon pricing and feed-in tariffs
- accelerating uptake of a range of new technologies, such as intermittent and distributed generation and new metering technologies
- increasing use of gas for electricity generation
- changes in business structures, particularly re-aggregation of energy supply businesses (the rise of the 'gen-tailors', also with investments in both electricity and gas markets – upstream and downstream)
- strong growth in peak electricity demand, which in turn is partly contributing to increases in network and energy costs.

These developments are at various stages – some are well advanced and some have yet to mature. Yet they are all changing the dynamics in electricity and gas markets. As noted by the recent

Investment Reference Group report to the Minister for Resources and Energy, some of these factors, if left unaddressed, may pose challenges to energy markets.[21]

The Australian Government, through its Clean Energy Future package, is working to address a range of carbon-related energy market risks and, in the absence of a compelling rationale, considers that a further review of market design at this point is not justified, particularly as this would likely add to rather than reduce uncertainty for investors. Commitment to a four-yearly review of energy policy will ensure that timely assessment of emerging challenges occurs.

Nonetheless, there is room to improve on current performance, particularly in carrying out actions from previous reviews and in implementing the SCER work program. There are also a number of areas where ongoing monitoring and further analysis is required to improve the understanding of emerging pressures or trends.

6B.4 Market objectives

A cornerstone of effective market design and operation is having clearly defined objectives and principles that guide regulation and rule-making through a statement of policy intent. The objectives and principles that underpin Australia's electricity and gas markets are set out in the Australian Energy Market Agreement, signed by first ministers, and in the three national energy laws (the National Electricity Law, the National Gas Law and the National Energy Retail Law). These are focused on meeting the long-term interests of consumers including by ensuring safe, reliable and secure supplies of energy (see Box 6B.1).

Box 6B.1: The Australian Energy Market Agreement

On 30 June 2004, the Australian, state and territory governments entered into the Australian Energy Market Agreement (AEMA), on the understanding that 'effective operation of an open and competitive national energy market [would] contribute to improved economic and environmental performance and deliver benefits to households, small business and industry'.

The AEMA (which has been periodically updated since 2004, most recently in October 2011) establishes a national energy policy framework intended to guide future decision-making and provide increased policy certainty. In particular, the AEMA:

- established the Ministerial Council on Energy (now the Standing Council on Energy and Resources) to oversee implementation and further development of the policy framework
- established and set out working arrangements for the energy market institutions (the Australian Energy Market Commission, the Australian Energy Regulator and the Australian Energy Market Operator) that oversee the respective energy markets
- established a national framework for distribution, retail and other such detailed arrangements requiring specific reference.

The AEMA is supported by the *Australian Energy Market Act 2004*, which sets out the national laws and rules that apply to electricity, gas and energy retail. These laws and rules (the National Electricity Law, National Gas Law, National Energy Retail Law, National Electricity Rules, National Gas Rules, National Energy Retail Rules) are agreed and applied by each Australian state and territory

[21] Investment Reference Group, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, Canberra, 2011.

and the Commonwealth, with some jurisdictional variations – such as accommodating the geographic separation of the electricity grids in Western Australia and the Northern Territory from the eastern states.

The overarching objective of the AEMA is the promotion of the long-term interests of energy consumers, with regard to price, quality and reliability of electricity and gas services. This objective is supported by the subordinate objectives of the National Electricity, Gas and Energy Retail Laws. The AEMA also sets out a framework for further energy market reform, which includes:

- promoting the long-term interests of consumers
- strengthening the various aspects of the energy market to improve the climate for investment
- streamlining and improving economic regulation, including lowering the costs and complexity of existing regulation and lowering barriers to competition
- improving the planning and development of electricity transmission networks
- enhancing the participation of energy users in the markets, including through demand-side management
- increasing the penetration of natural gas as a way to lower energy costs, improve services and reduce greenhouse gas emissions
- further addressing greenhouse gas emissions from the energy sector.

There has been some debate as to whether the objectives should be amended to explicitly reference other policy goals such as environmental or social policy objectives.

The Australian Government believes that the objectives and principles, as currently defined, remain appropriate to current and future energy policy needs. They provide a robust basis for market regulation and development and provide for effective interface between energy markets and other policy frameworks.

To change or expand these now risks distorting the market by introducing unnecessary confusion for market participants. It is also far from clear how non-energy policy goals could be coherently reflected in a single set of market rules. These issues are best dealt with outside the market settings, as this allows for more targeted, and therefore more effective action.

6B.5 Market governance

The creation of the three independent energy market bodies, the Australian Energy Market Commission (AEMC), the Australian Energy Regulator (AER) and the Australian Energy Market Operator (AEMO) represented a milestone reform of Australia's electricity and gas markets by ensuring day-to-day operation of the market is at arm's length to governments. This has provided greater transparency and confidence in the regulation of electricity and gas markets.

The Australian Government strongly supports these arrangements along with the regular review of market bodies to ensure appropriate accountability and performance. COAG has previously noted that the performance of the new energy market governance arrangements should be examined five years after their commencement. It will be important that it is conducted in a timely and transparent fashion.

When these new institutions were created, it was recognised that their roles and responsibilities would likely need to evolve to meet changing policy and market circumstances.

For example, AEMO has varying roles across electricity and gas between jurisdictions, and the AER's role will change as it takes on more functions from jurisdictions. In response to the governance recommendations from the Prime Minister's Task Group on Energy Efficiency, the Australian Government has made a commitment that the Minister for Resources and Energy and the Minister for Climate Change and Energy Efficiency will undertake further work on national energy efficiency governance arrangements, for consideration by the end of 2012.

The establishment of the AER, AEMC and AEMO are significant achievements and have contributed substantially to the effective functioning of the market. The Australian Government supports, in principle, the continued sensible evolution of the role and functions of market institutions on the basis that independence and accountability are maintained, and that they have the capacity and resources to effectively carry out their required functions.

In the longer term, national governance arrangements should also be extended to cover all Australian electricity and gas markets to provide greater consistency and efficiency to market oversight and development. Such an outcome would not preclude the continuance of different market structures where appropriate.

6B.6 Electricity market issues

A number of the key challenges facing Australia's electricity markets have been well documented in Chapter 3. Attracting the investment required for expansion to meet new growth, transforming to clean energy, and meeting the changing needs of consumers will test the established market frameworks.

As noted above, there are a range of activities currently underway through SCER and the market bodies aimed at further improving market operation or resilience. This draft Energy White Paper does not wish to pre-empt the detailed outcomes of these processes. It does, however, seek to provide a clear indication of the Australian Government's position on key aspects of the market framework.

This section considers the key components of the two major Australian electricity markets, the NEM and the SWIS.

National Electricity Market

The NEM is the world's longest interconnected power system. It extends from Port Douglas in Queensland to Port Lincoln in South Australia, including an interconnector to Tasmania – a distance of around 5000 kilometres. Due to low population density and the vast geographic distances, the NEM faces challenges unlike any other interconnected system in the world.

The NEM was established in 1998 and covers six jurisdictions physically linked by an interconnected transmission network. It has around 200 large generators, five state-based transmission networks and 13 major distribution networks. It supplies electricity to over 10 million customers, with around

230 terawatt hours being supplied in 2009–10.[22] Seasonal peak demand has risen from around 26 gigawatts in 1999 to 34 gigawatts in 2010.[23]

The market is regulated by the National Electricity Law and the associated Rules and from 1 July 2012 will be governed by a third set of legislation, the National Energy Retail Law and the associated Rules, which will give effect to the National Energy Customer Framework.

The NEM is structured around a real-time energy-only wholesale pool market that is physically linked to customers through the transmission and distribution networks and financially linked through the retail market or, in the case of large users, through direct contracts with generators. A well-established financial contracts market is used to manage price volatility and risk between wholesale and retail market participants, in addition to over-the-counter bilateral contracts.

The wholesale market

The Australian Government believes that the energy-only gross pool basis of the wholesale market provides a robust basis for the future efficient supply and dispatch of electricity in the NEM.

There have been concerns expressed that the impact of ongoing uncertainty around carbon pricing and other factors may impede the ability of the market to deliver timely investment in new generation capacity. However, evidence to date suggests that the energy-only market can provide appropriate signals to build new capacity, and hence the government is not suggesting change from the energy-only market design. Prices in the wholesale market generally reflect the supply–demand balance, which provides market signals for the need for new investment. That said, there is a need to address unintended distortions arising from the impact of external policy interventions where these are no longer complimentary to carbon pricing.

The possible role of a capacity market in the NEM has been canvassed; however, the Australian Government is not proposing to revisit this question at this time. Through its four-yearly review of energy policy, the government will actively monitor investment to ensure that our energy goals are being met.

Market reliability standards

The NEM has a number of market settings to deliver a reliable supply of electricity through the integrated system. These include the reliability standard, which currently requires that no more than 0.002 per cent of annual energy consumption for any region in the NEM is unmet. This is a very high reliability requirement which the market, through a combination of generation and network, usually meets.

Since the commencement of the NEM, the security and reliability of electricity supply have been provided at a high level. Technical performance has been maintained and market signals have promoted acceptable performance against the reliability standard. On average, all NEM regions have remained within the reliability standard since the market commenced in 1998. The average NEM customer experiences around three to four hours of outages a year, though the duration and frequency of events varies.[24] This is a very high standard of reliability.

[22] Energy Supply Association of Australia, *Electricity gas Australia*, esaa, Melbourne, 2011.

[23] Australian Energy Regulator, *State of the energy market 2010*, AER, Melbourne, 2010.

[24] Australian Energy Regulator, *State of the energy market 2010*.

Australian data shows that there have been few instances of outages caused by generation or transmission capability; rather, outages are generally caused by issues in the local distribution network.[25] However, a tightening supply–demand balance highlights the need to ensure that the NEM signals are adequate for the market to deliver increasing investment in generation capacity necessary to meet reliability. The NEM signals investment opportunities through the price payable for electricity in the wholesale spot and associated contracts markets and one of the few tools government has to affect these outcomes is the Market Price Cap.

The Market Price Cap was raised to $12 500 on 1 July 2010. On 1 July 2011, the AEMC introduced a new rule to apply an annual increase to the cap, to take effect from 1 July 2012, based on movements in the consumer price index.

The purpose of this change, as with the recent increase, is to encourage investment in new generation capacity. As the supply–demand balance tightens and the number of price cap events increases, this will provide a financial incentive, in the first instance for new peaking plant. In the longer term, the higher average pool and contract prices influenced by price cap events will attract investment in baseload and intermediate plant. However, higher price caps can also lead to increased price volatility.

The Market Price Cap is currently set at around the estimated value of reliability for customers in the residential sector. In general, this value is lower for residential than for business consumers.

Attempts to influence market outcomes by significantly increasing the price cap must be treated with caution as this could affect the financial position of the participants in the wholesale market. In particular, retail businesses would face the risks of more volatile and significant increases in the price of electricity delivered through the pool. Generators would also face substantial financial exposure risks if, during periods of high spot prices, they were unable to meet contracted levels of generation.

NEM prudential framework and contracts market

The NEM prudential framework is designed to maintain confidence in the settlements process by minimising the risk of payment shortfalls to generators. A liquid and healthy contracts market is also essential to efficiently manage price volatility and risk in the wholesale market.

The NEM is generally characterised by high prudential thresholds for participants. The past dominance of over-the-counter traded risk-management products in financial markets has in recent years been reversed as more counter-parties contract through the Australian Securities Exchange.[26] There is currently limited transparency about these arrangements, so it is difficult to determine whether requirements are set as efficiently as they could be. The growing prudential requirements, along with changes in financial management practices in response to the global financial crisis and the impact of carbon pricing, may be increasing price volatility and the risks of financial exposure for market participants in ways that could potentially compromise market stability or lead to financial contagion.

The probability of market stability being materially compromised through price volatility and financial exposure is low, because of the existing mechanisms for managing risk. However, should such an event occur, associated outcomes could be highly detrimental to the Australian economy.

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[25] Australian Energy Market Commission, *Annual market performance review: draft report*, AEMC, Sydney, 2011.

[26] Australian Financial Markets Association, *Australian financial markets report*, AFMA, Sydney, 2011.

For this reason there is merit in SCER examining ways to more actively monitor the health of these financial markets. This should also include further work to review prudential standards and thresholds to ensure that they are supporting efficient market operation.

Retail market

Retail electricity market arrangements, particularly price regulation and transparency, continue to be an area in need of further action to meet previously agreed reforms and objectives.

In an environment of rising energy costs, the continued development of efficient and competitive retail energy markets will be increasingly important. While energy price rises have clear implications for consumers, both in terms of household affordability and business competitiveness, prices must continue to reflect the costs of supply if they are to support the long-term viability of the industry and provide appropriate signals for improvement in the productivity of energy use.

Rising aggregate energy costs and the unwinding of cross-subsidies have uneven distributional impacts on households, with lower-income households facing proportionally greater impacts than high-income households. Hence, retail price deregulation and enhanced consumer empowerment must be accompanied by appropriate protections for vulnerable customers.

Ensuring that consumers, particularly those who are most vulnerable, are able to manage rising energy costs effectively will be increasingly important. In 2009–10, well over $1 billion was allocated to Community Service Obligation payments nationally.[27] The continued provision of adequate assistance to vulnerable consumers through well-targeted jurisdictional concession regimes and appropriate community service obligations will be critical. Such assistance should be transparent and not undermine competitive pricing structures, which reflect, as far as possible, the underlying costs of supply. As such, it is appropriate for assistance to be provided through social policy settings, rather than energy policy settings, to ensure that energy market signals are preserved.

Moving towards national retail regulation

Recognising the benefits associated with a single national retail framework, the South Australian Parliament, as lead legislator, passed the National Energy Retail Law (NERL) in early 2011 to give effect to the National Energy Customer Framework. The NERL creates consistent and enhanced consumer protections in the energy sector and harmonises state-based regulatory frameworks for the retail energy market and energy distribution sector into a single national law and set of rules.

This will involve a shift from six jurisdictional regimes for both electricity and gas to a national regime (excluding Western Australia and the Northern Territory). It will not, however, transfer retail price regulatory and Community Service Obligation functions, which are retained by jurisdictions. The Australian Government recognises that retaining regulatory control over retail prices remains a sensitive issue for jurisdictions, but believes that this continues to be an area of unfinished and necessary reform.

The NERL works in a complementary way with general consumer protection laws which apply at both the state and territory and national levels, including privacy laws and the new Australian Consumer Law.

[27] Department of Resources, Energy and Tourism, unpublished data, 2011.

Participating jurisdictions, through SCER, are currently working to apply the NERL by 1 July 2012.

While the implementation of the NERL is a significant achievement, the Australian Government does not see the implementation of the law as an end point in itself. The framework and associated consumer protections will require ongoing monitoring and attention and may need revision in the future to provide necessary flexibility and adaptability to deal with the dynamic nature of energy markets and prices.

Retail price regulation

Jurisdictions have also committed under the Australian Energy Market Agreement, and the COAG National Partnership Agreement to Deliver a Seamless National Economy, to the removal of retail energy price regulation where effective competition can be demonstrated. This process is being progressed through reviews by the AEMC of retail energy market competition in each jurisdiction.

Reviews have so far occurred in Victoria, South Australia and the Australian Capital Territory, with all reviews containing recommendations to deregulate prices. However, Victoria is the only state that has implemented the AEMC's recommendation and the overall slow pace of progress in this area has been the subject of criticism from a range of market participants and other stakeholders. Further retail market reviews are scheduled for 2012–13.

The Australian Government recognises that progress towards achieving effective competition in retail energy markets is likely to be uneven, due largely to the inherent differences in market characteristics and regulatory and operating environments across jurisdictions.

It is also likely that concerns over the possible impact that deregulation may have on prices, in particular price impacts for low-income households, may be preventing further progress. In some cases such concerns may be driven by a misunderstanding of what is meant by deregulation and a fear that consumer protections or safety nets might be eroded or lost.

Maintaining retail price regulation at a level that does not reflect efficient market outcomes is likely to stifle competition in the market, thus reducing consumer choice and empowerment.

The Australian Government is conscious that the deregulation of prices should not be undertaken unless a robust set of consumer protections is in place to ensure that energy customers can participate in the market with confidence. The Victorian Government deregulated retail energy prices in 2009 – in parallel with adopting stronger consumer protections – and is now one of the most competitive markets in the world. To support the development of an appropriate, and robust, set of protections, the Australian Government supports the continued development of strong consumer advocacy in the energy sector through mechanisms such as the Consumer Advocacy Panel.

Improving price information and transparency

Recent electricity price rises have raised genuine public concern over the causes and likely duration of further increases. The AEMC has previously released a report on possible future trends in electricity prices, including related drivers. SCER intends that the AEMC will release this report annually. The Australian Government strongly supports this work. The government has also allocated $10 million in its Clean Energy Future package to gain a better understanding of how households use energy. Information from this work will be used to inform development of innovative solutions to improve energy use productivity (see Chapter 6C).

In addition, the Australian Government will conduct a scoping study for the establishment of an energy information hub to provide consumers with easy access to energy information currently held by retailers and distributors. Ready access to this information will assist customers to better understand their electricity use. Coupled with innovative analytical tools and retail models, over time this will assist consumers to better manage their electricity use.

'Smart' metering

Advanced metering technologies that use two-way data communication and support enhanced consumer functionalities (so-called 'smart' meters) offer the potential for more control and choice in managing energy use and bills.

In April 2007, COAG committed to a national mandated roll-out of electricity smart meters to areas where benefits outweigh costs, as indicated by the results of supporting cost-benefit analysis. So far only Victoria has commenced a roll-out under this model, and it has experienced mixed support from consumers and other stakeholders.

It is important that lessons are learned from deployment experiences, to help assess the role that smart meters may play in our energy system into the future. Developing an appropriate deployment model is important if smart meters are to be broadly deployed in the future.

A key, and at times contentious, issue in the public debate on smart meters has been the basis on which costs and benefits of their roll-out can be shared between consumers, distributors and retailers, and the relative timing of costs and benefits. In addition, there are community concerns that smart meters could reduce consumer control over energy use, result in increased prices, compromise privacy and security, or create particular risks for vulnerable customers. Consumer education and engagement will be essential to counter any misperceptions and help people identify and take advantage of new opportunities – with possible roles for government, consumer groups and industry. The Australian Government is further addressing these issues through the development of a robust consumer protection framework.

Of benefit in this context will be the work undertaken through the Smart Grid, Smart City project, which has developed a community and industry engagement strategy. The strategy aims to connect and communicate with consumers around key activities such as smart meters. One of the intentions of the strategy is to raise awareness, promote the benefits and build knowledge of smart meters among residential and business customers, schools and local councils. Learning from the use of this strategy will assist in future communications activities.

To help inform future deployment of smart meters, the Australian Government is undertaking further work to develop a framework that:

- promotes a minimum level of national consistency (to avoid the potential for 'rail gauge' standards)
- provides a basic level of functionality but does not stifle innovation in more advanced options, products and services
- sets out required market structures that support deployment in ways that are in the best interests of consumers, including by promoting competition for service and maintaining appropriate consumer safeguards.

There are several possibilities for the deployment of smart meters and similar technology. Individual state governments have the option of mandating a roll-out where the benefits outweigh the costs. This option is not intended to preclude market participants deploying smart meters in the absence of such decisions – for example, retailers may see smart meters as a point of differentiation with customers.

Electricity networks

Recent increases in electricity prices have focused attention on the regulation of Australia's electricity transmission and distribution networks, which are expected to account for around 8 per cent and 41 per cent respectively of price rises in future years.[28] These cost pressures are expected to continue into the future, with an estimated $24 billion in transmission network investment and up to $120 billion in distribution network investment required by 2030.[29]

In the future, investment is likely to be required to extend the grid to incorporate new and possibly remote generation, maintain network reliability with changing supply patterns due to an increased uptake of gas-fired generation and a greater proportion of intermittent generation, and build new system capabilities to better manage supply and demand fluctuations.

It is important to recognise that the majority of cost increases in the electricity sector are ultimately driven by the need to meet growing consumer demand while maintaining reliability. While it is difficult to determine what specifically drives network expenditure, as this can vary significantly between jurisdictions and from business to business, the most recent round of regulatory determinations noted that expenditure had increased due to a number of factors, such as reliability standards, increases in forecast peak demand, increases in the number of connections, and the need to replace ageing infrastructure.[30]

Future challenges could be posed by the need to manage changing flow patterns resulting from increases in demand-side response measures, increasing penetration of embedded generation, and changing load profiles with the uptake of new technologies such as electric vehicles.

There are currently a range of activities underway in this area. The AEMC is currently undertaking its Transmission Frameworks Review, which is examining arrangements for the provision and utilisation of electricity transmission services in the NEM, with a view to ensuring that the incentives for generation and network investment and operating decisions are effectively aligned to deliver efficient overall outcomes.

Regulatory model

Transmission and distribution networks are natural monopolies. It is therefore appropriate that they remain under a regulated business model and that appropriate structural separation is maintained between monopoly and contestable elements of the market.

The Australian Government recognises the need for the regulatory environment to bring on necessary investment, attract capital and balance reliability requirements with cost to the consumer.

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[28] Australian Energy Market Commission, *Future possible retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney, 2010

[29] Investment Reference Group report.

[30] Australian Energy Regulator, *State of the energy market*.

In this context, the government is not proposing significant changes to the network regulatory regime.

However, there are areas where the provision of network services could be contestable. This would assist in delivering the most efficient outcomes for both the direct users of those services and consumers more generally. Mostly, these relate to the connection to networks (both transmission and distribution), and services such as street lighting and metering.

The government notes that SCER, through its working groups, is currently looking into developing a national framework for the provision of contestable distribution connections.

As network costs represent a major and growing component of end-user prices, it is important that networks are operating as efficiently as possible and in the long-term interests of consumers. This means that regulatory frameworks must strike a balance between minimising cost increases without inhibiting efficient and necessary expenditure and providing for a fair return on investment for network business.

Policy-makers must also ensure that reliability standards and other requirements are appropriate to the circumstances.

In this context the Australian Government announced two additional review initiatives as part of the Clean Energy Future package:

- The independent review of the limited merits review appeal process of network cost determinations (required in law to start by 2015) will be brought forward, with the aim of assessing the effectiveness of the merits review regime in light of the original policy intention. This will be managed through SCER.
- An independent review by the Productivity Commission into productivity benchmarking of distribution network service providers, to assess whether (and how) benchmarking might assist in improving the efficiency of network investment and service provision.

The government notes that the AER has recently proposed rule changes relating to the framework for the economic regulation of network businesses. This is currently being progressed through the AEMC. The AER is also investigating ways to improve its information-gathering powers, to better equip it to make more informed regulatory decisions.

In addition, SCER is pursuing reforms to improve the transparency of transmission reliability standards and has asked the AEMC to undertake a detailed study of distribution reliability standards.

Network planning

New network planning functions and rules have been in place for a relatively short time with the first publication of AEMO's National Transmission Network Development Plan in 2010 and the requirement for businesses to undertake the regulatory investment test for transmission (known as the RIT-T) since 1 August 2010. These arrangements are based on an approach that adequately reflects the market benefits (and costs) associated with investment.

As noted above, the transmission planning arrangements have only been in place for a short time, and there remains a separation between planning and investment events. While transmission investment has been generally effective in terms of reliability, there is currently only limited evidence with which to assess the efficiency of this framework, particularly across regional boundaries.

The Commonwealth has commissioned the Productivity Commission to undertake a review of transmission interconnection to assess whether optimal levels of investment are being delivered.

In relation to distribution planning, SCER is implementing the development of a national framework for distribution planning and expansion through rule changes proposed to the AEMC. This aims to deliver a clear and efficient planning process, support the efficient development of distribution networks, encourage demand-side engagement, and provide appropriate levels of transparency and information regarding distribution network service provider planning and investment activities.
Smart grid development

In the future, a broader suite of grid management systems (technologies and processes) could have the potential to deliver improved outcomes, such as better integration of intermittent and distributed generation and electric vehicles, including the associated support systems such as back office systems, back-up storage and recharging facilities.

Much of this potential will be realised through ongoing market and technical development independent of government. However, it will be important that network and market frameworks remain responsive to the pace of development while ensuring that network services are delivered reliably and safely.

The Australian Government is currently assessing the capability of smart grids through its Smart Grid, Smart City project. This project will provide an opportunity to assess market barriers and issues and make key recommendations on future policy and regulatory requirements. The project is developing critical technology standards needed for any broader adoption of smart grid applications, and also developing specific roadmaps to address and possibly close the gaps on technical barriers, and to assess the maturity level of key technologies in this area.

Network connection and integrating new technologies

Over the next several decades, Australia's electricity system will be required to integrate a broader range of power generation and management technologies than it was originally designed for. In particular, wider deployment of intermittent and distributed generation is expected by 2020, as well as an increasing uptake of electric and hybrid vehicles.

The AEMC Stage Two Review of Demand-Side Participation identified that the flexibility afforded distribution companies in determining minimum technical standards for small generators is causing delays and increasing costs for embedded generators. This issue should be addressed by the adoption of appropriate minimum technical standards for embedded generators, and by resolving how to appropriately allocate any network augmentation and connection costs between the distribution company and the installer of the small generator.

Some of these technologies are already posing a range of connection and grid management issues. For example, large wind developments can present or exacerbate localised congestion issues, and increasing penetration of photovoltaic and other distributed generation can place stress and costs on distribution networks which have not been developed to handle large two-way power flows. These latter issues are currently being managed on a case-by-case basis by distribution businesses and this approach is currently maintaining the integrity of the power system.

Understanding the operation of these technologies has improved greatly and work is underway to address barriers to the integration of distributed generation, new energy storage technologies and electric vehicles into the energy system. The AEMC's reviews of demand-side participation and of energy market frameworks in light of electric and natural gas vehicles are investigating such matters.

Noting the importance of increasing the efficiency of the connections process, SCER has been working on an improved framework for new connections to electricity (and gas) networks. This is being introduced as part of the National Energy Customer Framework.

Larger levels of intermittent generation may have implications for maintaining system security. Through SCER, the Australian Government will continue to monitor the integration of new technologies into the grid and may consider undertaking an assessment of the effects on the security and operational safety of the system should these issues become increasingly problematic for networks to manage.

Connecting remote generation

There are a number of challenges already facing new entrants in the generation sector, particularly for remotely located generators, which tend to be smaller in capacity and more capital-intensive per megawatt hour delivered than traditional thermal generators. The challenges include an investment challenge that involves striking a balance between access to suitable fuel (or renewable energy) sources and the cost of connecting to the network where the location of the sources is remote from the grid. This has at times been represented as a particular barrier for new renewable energy generators.

It is important for the efficient development of the electricity network and market that investment in generation is based on market and locational signals. These are provided in part by the costs of connection, which can be an important aspect of delivering generation investment at least cost to consumers. In this regard, it is important that connection frameworks remain technology neutral and that the costs of connection are appropriately allocated to beneficiaries.

The AEMC is currently considering issues relating to connection as part of its Transmission Frameworks Review.

The AEMC has indicated that there may be a barrier to efficient connection in areas where a number of generators connect to the electricity network over time (nodal development). In this circumstance, the first connection must assume all costs and risks of connection. This could result in suboptimal network development (a line without spare capacity) or, when an over-capacity line is built, the first generator having to bear larger up-front costs with the risk of having to reclaim costs from subsequent connectors.

A rule change was proposed to introduce a framework that would allow the sizing of connections to meet future expected generation capacity. The AEMC subsequently amended the rule to bring it into accordance with the National Energy Market objective which ensured that any risks and costs of stranded assets would not be borne by consumers. The AEMC's final rule seeks to facilitate greater transparency to assist market participants to capture opportunities through scale efficiencies.

The Australian Government supports this rule change and will continue to actively monitor this issue through the four-yearly policy review process, to ensure that efficient network connection and development is occurring as new generation technologies and locations expand the reach of the network.

Network pricing

The approach to pricing the augmentation of, or connection to, networks varies across network businesses. This reflects historical differences in the regulatory approaches of jurisdictions as well as differing physical characteristics of local networks. While a general national framework now applies to most businesses, it remains subject to differences in interpretation and application. Increased consistency in the approach to network pricing (in the case of connection to the network or augmentation of the network) could be of benefit.

Consistent access to reliable and robust information on network business costs is also necessary to support improved productivity. The current rule change proposal to establish a consistent distribution network planning framework will assist in delivering more transparent and robust information. In addition, the work currently being undertaken by SCER (on developing a national transmission reliability standard framework) and the AEMC (in determining if a national approach to delivering distribution reliability outcomes) will improve consistency and transparency across jurisdictions.

Non-NEM regions

Western Australia and the Northern Territory are not connected to the NEM and the physical location and size of their networks means that they take different approaches to market management. Additionally, there are a number of smaller regional networks around Australia – the so-called 'non-market' and 'off-grid' installations.

The Northern Territory's electricity industry is small and consists of three regulated systems: the Alice Springs regulated system, the Darwin-Katherine regulated system and the Tennant Creek regulated system.

Isolated networks and stand-alone systems servicing remote communities also exist in all states and territories, with the majority located in Western Australia and the Northern Territory.

Western Australia's networks consist of the South West Interconnected System (SWIS) including Perth, and the North West Interconnected System (NWIS) for the mining areas in the north of Western Australia. While not connected electrically, the SWIS and NWIS are connected through gas pipelines. The SWIS accounts for the majority of installed generation capacity in Western Australia and is the primary network referred to in this section in the Western Australian context.[31]

The Western Australian Government is currently undertaking a Strategic Energy Initiative, which will set out how it intends to meet its energy requirements over the next 20 years. To date, this process has identified four strategic goals: cleaner, competitive, secure and reliable energy.

The discussion in this section is broken down into the SWIS, as the largest non-NEM system, and non-market and off-grid electricity.

[31].Energy Supply Association of Australia, *Western Australian Energy Market Study: a pathway to an efficient energy market in Western Australia*, esaa, Melbourne, 2009.

Western Australian South West Interconnected System

In 2006, Western Australia established a wholesale electricity market to service the SWIS. In contrast to the NEM, the market for the SWIS has two components: a wholesale electricity trading market and a capacity component. As part of this arrangement, a Reserve Capacity Mechanism is used to ensure that there is adequate installed capacity available in the SWIS to cover expected system peak demand, even in the event of a failure of the largest single generating unit, while maintaining the capability to respond to frequency variations. The Reserve Capacity Mechanism creates a market for capacity, including demand-side management, alongside the market for energy.

Some market participants have noted that the Reserve Capacity Mechanism provides a guarantee of payment to investors who build and secure capacity credits in the SWIS. It is argued that this is useful in mitigating market risk, which makes it more attractive for financiers to fund capacity development projects in the SWIS. However, having separate markets for capacity and energy means that there are separate price signals for each. This could lead to a lack of coordination between price signals, and consequently could result in generation being built to obtain capacity credits, irrespective of the price of any electricity traded, and whether or not these assets actually provide electricity.

This delinking of market outcomes and price signals for investment in generation has the potential to deliver inefficient levels of investment. More than 2500 megawatts (MW) of new generation or demand-side management has been added to the market for the SWIS since 2005, resulting in a projected over-supply of 684 MW for 2013–14.[32] The Independent Market Operator for the SWIS has commenced a review of the Reserve Capacity Mechanism to identify potential changes to improve the economic efficiency of these investment signals. The Australian Government is supportive of this review. A related review of the price-setting methodology for the Reserve Capacity Mechanism is almost complete, and is expected to recommend changes with a potential to reduce prices associated with the Reserve Capacity Mechanism by 10 to 15 per cent.

These reviews are part of an ongoing program of reform by the Western Australian Government to ensure that the market for the SWIS continues to meet its stated purpose of promoting economic efficiency, encouraging competition, minimising long-term costs, avoiding discrimination against particular energy types, and managing the amount and timing of energy use.

Market institutions

The SWIS is serviced by three market institutions: the Independent Market Operator, the Economic Regulation Authority and System Management. The Independent Market Operator serves in the roles of both market operator and rule maker (through the Market Advisory Committee). The board of the Independent Market Operator is appointed by the Western Australian Minister for Energy.

In line with the approach under the national energy market arrangements, there would be merit in considering further separation between the rule maker and market operator roles to ensure that optimal outcomes for consumers are being achieved.

In contrast, the Economic Regulation Authority is independent of direction or control by the government in performing its functions. However, under the *Economic Regulation Authority Act 2003*, the relevant minister may give directions in writing to the authority on administration and

[32] Independent Market Operator, *Statement of opportunities 2011*, IMO, Perth, 2011.

financial matters. This separation of regulatory function and governance arrangements is appropriate, particularly in light of the Western Australian Government owning the networks assets that the Economic Regulation Authority regulates.

System Management is a segregated business unit within Western Power, established under the Wholesale Electricity Market Rules. System Management is responsible for the operation and control of generator facilities, transmission and distribution networks, and large customer retailer supply management including demand-side management. It has a central role in the scheduling of generator and transmission outages, and manages the real-time operation of the power system.

As noted previously, in the long run it would be desirable for all Australian electricity and gas markets to be brought under a set of truly national governance arrangements.

Competition

The SWIS retains a relatively concentrated ownership structure, with Verve Energy, a state-owned utility, accounting for more than half of generation capacity. The rapid entry of new, privately owned generators since market start is expected to continue. As of June 2011, there were 12 active retail licences in the SWIS; however, the majority of generation plants are contracted to the state-owned retailer, Synergy.[33]

The Australian Government notes that government ownership of energy assets may act as a barrier to effective competition, particularly where new entrants may not have sufficient certainty around their ability to compete with public businesses in the energy markets. This can arise from private investors not being certain that the decision-making by government businesses is fully commercial and that the projected returns are in line with the risks they are bearing, or from the potential for governments to intervene to deliver particular budget or reliability outcomes. An appropriate focus should be given to ensuring competitive neutrality in the interim, with continued privatisation remaining the preferred policy goal.

Retail prices

Smaller consumers are all supplied by Synergy. Synergy currently receives income from a variety of sources, including:

- uniform or regulated tariff revenue
- revenue from large commercial electricity contracts
- other energy revenue (for example, from gas sales)
- other income (for example, interest received).

The uniform tariffs listed above generate the majority of Synergy's income. However, as these uniform tariffs are not yet at cost-reflective levels, there is a shortfall between the income received and the cost of supplying electricity. This shortfall has been funded, since 2009–10, by a Community Service Obligation payment.[34]

[33] Global-ROAM, *Power trading schematic – Australian electricity market*, 2011.

[34] Economic Regulation Authority, *Inquiry into the efficiency of Synergy's costs and electricity tariffs: issues paper*, Economic Regulation Authority, Perth, 2011.

Electricity networks

In its *Review of energy market frameworks in light of climate change policies*, the AEMC identified a number of inefficiencies in the electricity network frameworks in the SWIS. Specifically, these referred to the connections process and transmission network planning. The AEMC also noted that the 'unconstrained planning' approach does not link the costs of congestion with the costs of augmentation, which could result in over-investment, and it recommended introducing a formal regime for transmission connection and augmentation and reviewing the workability and clarity of the regulatory approval processes and the network augmentation charging regime.

The Australian Government notes that issues around networks are currently being considered by the Western Australian Government in its Strategic Energy Initiative. The discussion paper for the Strategic Energy Initiative proposed the development of a constrained access model[35] to maximise the potential for delivery of efficient combined expenditure in generation and network assets. This transition would be complex and require substantial investment, but may deliver long-term benefits that outweigh the short- to medium-term costs.

Non-market and off-grid electricity

Australia has a number of regional electricity networks supplying electricity to the population that are not connected to the NEM or SWIS. These are typically operated by government-owned utilities or by private businesses with varying degrees of vertical integration and are too small for the operation of any form of tradable market.

While these systems are the responsibility of state and territory governments, the Australian Government recognises their importance to the growth of regional economies and supports their ongoing development to provide access to energy that is competitively priced and is delivered safely, reliably and securely.

The increase in mining operations in Australia has led to an increase in off-grid generation to facilitate these businesses. The introduction of a carbon price may improve the economics of renewable or hybrid technology options in such off-grid areas. Decisions on operation and technology should remain the responsibility of the owners, although they are subject to relevant health, safety and environmental regulations.

The Australian Government, as part of the Clean Energy Future package, has provided $40 million to support the installation of renewable energy systems to 55 remote Indigenous communities. This includes training in basic system maintenance and information on energy efficiency. In addition, the Australian Centre for Renewable Energy has undertaken a case study into the viability of renewable energy systems in remote regions, notably the mid-west and Pilbara regions of Western Australia.

[35] The SWIS operates on an unconstrained network design. This means that network access is offered to the full capacity of a generator. This is a simple system that ensures generators can dispatch into the grid without constraint, but may result in unused capacity in the network and delays in new generators accessing the network while additional network capacity is being built. Under a constrained access model, generators assume the risk of access to the network and mechanisms are required to resolve network constraints, which can be extremely complex, and to allocate generation capacity to plant. A constrained access model, such as that used in the NEM, optimises investment in both generation and network assets and provides additional information on network limitations to guide planning and assist with system management. Independent Market Operator, *Statement of opportunities*.

6B.7 Gas market issues

Australia's gas industry is a significant contributor to the Australian economy. As an energy source gas has a wide range of uses including: electricity generation; as a fuel and feedstock for industry; and by households for heating, cooling and cooking. It is also used as a fuel in a range of transport applications. Australia's liquefied natural gas (LNG) industry generates substantial export income; it is forecast to exceed $10 billion in 2011. The gas industry also provides significant employment opportunities for Australians.

As noted in earlier discussions, Australia's gas markets are projected to undergo major changes in the period to 2030. These changes will introduce new market dynamics and new ways of doing business for suppliers, distributors and a range of end users. Some of the key drivers include:

- expected strong growth in domestic demand for gas, and the expected tripling of domestic gas production to 2030 (largely serving an export market)
- the development of new conventional and unconventional sources of gas
- difficulty in securing long-term contracts in the east coast market, as buyers and sellers wait to see how LNG exports affect market dynamics from 2014–15
- the impact of growing competition between domestic and international markets (through LNG)
- changes in price and technology due to carbon pricing
- changes in contracting behaviour with increasing use of shorter contracts
- greater linkage between key regional gas and electricity markets.

As noted in Chapter 3, there have been some concerns expressed that growing export developments may result in supply being diverted from domestic markets, with a consequent move in domestic gas prices to international parity.

As outlined in Chapter 5, a range of analysis, including the 2011 AEMO Gas Statement of Opportunities, suggests that there is adequate overall supply for Australian domestic and export markets through to 2030. While caution must be used in projecting demand-supply balances given the range of dynamic factors involved, current reserves are likely to be augmented in this period through additional supply in both eastern and western markets, although the characteristics of supply in each market are significantly different – a factor that should be considered in determining future policy responses.

From a policy perspective, efficient domestic gas markets supported by robust regulatory frameworks are critical to delivering the required investment to meet gas demand growth. In this context, the Australian Government believes that it is essential to allow domestic gas markets to adjust to new dynamics rather than trying to constrain domestic prices through intervention.

However, governments at all levels must monitor developments and be mindful of domestic gas supply needs in managing gas resources and approving production. Market adjustments should be closely monitored to ensure that sufficient and competitive supply conditions are maintained, given the potential impact these risks may have for a range of end users.

There are also areas (discussed below) where further reform in the east and west coast markets could enhance transparency, efficiency and market operation. Finally, and as noted in earlier chapters, governments at all levels consider the security of domestic energy supply to be a priority, and will therefore continue to give close attention to this issue as markets and projects are developed.

Market development

Australia's gas markets are generally categorised into three distinct regional markets: the eastern market (comprising Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania); the western market (Western Australia); and the northern market (the Northern Territory). Due to the vast distances between regions, the construction of pipeline infrastructure to connect these markets would be uneconomical. This section primarily considers the western and eastern markets.

The wholesale gas markets have historically been underpinned by long-term bilateral contracts between producers, major users and retailers. Short-Term Trading Market hubs have been developed in Sydney, Adelaide and Brisbane to provide greater transparency and competition in the market. Retail gas markets operate to fulfil contractual arrangements between retailers and distributors based on metered flows at supply inputs and retail outlets.

The market is regulated by the market institutions under the National Gas Law and National Gas Rules, except for in Western Australia where the Economic Regulation Authority performs this role. In Western Australia the Retail Energy Market Company is responsible for the retail market operation and settlement, while the Western Australian Economic Regulation Authority is responsible for regulating the Dampier to Bunbury, Goldfields, and Kalgoorlie to Kambalda gas pipelines.

Eastern market

The eastern market is the most mature, competitive and interconnected gas market in Australia. There are around 16 different producers operating across the Cooper, Gippsland, Otway and Surat–Bowen basins, serving eight major demand centres that are linked by an interconnected pipeline network. Coal seam gas from Queensland supplies around 30 per cent of eastern states' gas production, with the balance coming from the Cooper Basin and offshore Victorian basins.

Domestic gas consumption grew by 8.8 per cent in the eastern market in 2010, largely driven by gas-fired generation in Queensland; Queensland's gas consumption is now almost equal to that of Victoria, or 2.5 times what it was a decade ago.[36] Contributing to this increased consumption is the Queensland Gas Scheme, which was introduced in 2005 and requires electricity retailers to purchase a prescribed amount of electricity from gas-fired generation (currently 15 per cent).

LNG production and gas-fired generation are set to dramatically increase the demand for gas in the eastern market from current levels of around 660 petajoules to a potential high of 6500 petajoules by 2031.[37] However, supply is expected to meet aggregate domestic and LNG export demand out to 2031 in all scenarios modelled by AEMO in the 2011 Gas Statement of Opportunities.

Along with LNG, gas-fired generation is expected to be a major driver of gas demand in Australia. In 2009–10, gas-fired generation accounted for around 15 per cent of electricity generation.[38] This

[36] EnergyQuest, *Energy quarterly – February 2010*, EnergyQuest, Adelaide, 2010.

[37] Australian Energy Market Operator, *Gas statement of opportunities*, AEMO, 2011.

[38] ABARES, *Australian energy statistics*, ABARES, Canberra, 2011, Table O.

disconnect reflects its use as the current preferred fuel for peaking and intermediate generation. By 2050, gas-fired generation could, in some circumstances, make up around 44 per cent of generated electricity, driven by the implementation of a carbon price.[39]

The trend towards increasing use of natural gas as a fuel for electricity generation is encouraging energy sector investors to manage price and supply risk by having equity investments through the production chain from gas production, gas-fired electricity generation through to retail exposure. Examples of this are Origin Energy and AGL Energy – which have coal seam gas interests – and TRUenergy, which has entered into arrangements to access coal seam gas in New South Wales.

Proposed LNG export projects could impact domestic gas prices, and a better indication of long-term contract price paths will emerge over time.

Interconnection in the eastern market has occurred through connections between Victoria and Tasmania (Tasmanian Gas Pipeline), between Victoria and South Australia (SEA Gas Pipeline) and between Queensland, South Australia and New South Wales (QSN Link). Rising coal seam gas production in Queensland and improved pipeline interconnection among the eastern gas basins have enhanced the flexibility of the market to respond to customer demand.

Over the past decade a number of reforms were implemented to improve the reliability, competitiveness and transparency of the eastern market, such as the successful implementation of the National Gas Bulletin Board, the Gas Statement of Opportunities and the eastern Short-Term Trading Markets, supported by governance and regulatory reforms including the establishment of AEMO and passage of the National Gas Law and Rules.

Although these reform initiatives have only been recently implemented, they have thus far proven to be a significant and successful step towards greater levels of market transparency and efficiency. However, as the gas industry continues to evolve at a rapid pace, competition, price and market information and transparency remain limited.

A key focus of future gas market development should be improved transparency – through the provision of market information and trading opportunities. This information transparency should encompass ongoing monitoring of gas market supply, demand and investment trends, such as is contained in the Gas Statement of Opportunities, which is of value to industry, regulators and policy-makers. This will assist industry in its decision-making, contribute to risk management and support efficient outcomes.

The Australian Government considers that increased trading opportunities beyond the current market frameworks will also become important for market participants to manage gas portfolios and contract obligations efficiently, especially in the face of variable supply and demand.

SCER is currently exploring the concept of upstream gas market trading. The existing Short-Term Trading Markets are based on a demand hub model, delivering daily trading flexibility for users and shippers of gas. However, further upstream buying and selling of pipeline capacity and gas still consists primarily of bilateral contracts. As such, there may be an opportunity to expand short-term trading through the establishment of a supply hub that would allow gas and capacity to be traded separately. A supply hub model would be further upstream than the current demand hub model, and could therefore increase overall participation in gas markets by attracting large users such as

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[39] Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011; ABARES, *Australian energy statistics*.

LNG plants and gas-fired generators. This has the potential to provide a mechanism to balance gas supplies at least cost.

In time this could also encourage the development of a secondary trading market, which could allow market participants to better manage the financial risk associated with exposure to variable gas prices. A supply hub would also provide an opportunity for bilateral trading of location and time swaps across the Short-Term Trading Markets in different states, allowing producers to manage their inter-basin portfolio gas more efficiently.

Western market

The western gas market is a large, self-contained market. Of Australia’s 200 000 petajoules of conventional gas resources, 92 per cent is located in the Carnarvon and Browse basins, off Western Australia’s north-west coast, and in the Bonaparte Basin, off the north Kimberley coast.[40]

The western gas market has undergone a significant change in circumstances since 2007 as gas supply tightened and more recent contract prices have risen above long-term North West Shelf establishment levels, reflecting the tight supply and higher costs of production. While these conditions are likely to remain for the short term, planned new supply and processing capacity is expected to ease domestic supply constraints.

The initial development of the western gas market was enabled by the state government utility (State Energy Commission of Western Australia) entering into a long-term contract from the North West Shelf, with the price set by an indexation formula. This provided significant benefit both to the North West Shelf producers (supporting its development) and end users (low gas prices). However, the contracted price was not well aligned with the increasing cost of new supply. This therefore reduced incentives for development of additional new gas supply or increased supplier competition.

Existing upstream gas supply infrastructure is at or near production capacity. Future supply in the western gas market will be mostly characterised by high-cost new offshore gas field developments, many of which are geographically remote, in deep water and often require new offshore and onshore pipelines to access domestic markets. There are some opportunities for unconventional supply but these are less developed than those in Queensland, and likely to be comparatively limited and high-cost.

The number of buyers and sellers in the western market is also relatively small with limited competition in supply and demand and a less developed gas market structure than eastern Australia.

These conditions have led the Western Australian Government to announce that it will implement similar reforms to those in the eastern market, including a Bulletin Board and Gas Statement of Opportunities to improve market transparency. The Western Australian Minister for Energy has announced that the Bulletin Board will commence in July 2012. The Australian Government supports this initiative.

Joint marketing arrangements for domestic gas are currently in place for the North West Shelf and Gorgon gas projects. These arrangements were authorised by the Australian Competition and Consumer Commission (ACCC) for Gorgon in 2009 and the North West Shelf in 2010; both arrangements expire in 2015. The basis of the ACCC’s decision to authorise the joint marketing was

[40] Geoscience Australia and ABARE, *Australian energy resources assessment*, Department of Resources, Energy and Tourism, Canberra, 2010

that the Western Australian market is not sufficiently developed to support separate marketing. The ACCC had specific concerns about the small number of customers comprising the bulk of demand, the preference of market participants to sign long-term contracts, little short-term trading of gas, and limited storage facilities. The ACCC's findings on the state of the Western Australian domestic gas market reinforce the importance of further reforms to the Western Australian gas market to ensure that it becomes a more mature and competitive market.

Gas infrastructure framework

Adequate access to supply is fundamental to the development of an efficient gas market as well as to end-use industries and electricity generation. Realising the potential of Australia's gas resources means that it will be important that gas transmission and distribution developments occur in a timely and efficient fashion in order to support further market development.

Investment in Australia's gas transmission and distribution networks has been predominantly demand driven. As a result, new pipeline investments have historically been underpinned by long-term pre-investment contracts with large foundation customers. Current evidence suggests that this structure appears to deliver on-time investment.

However, there is a risk of poorly timed investment where market signals are dampened by a lack of price transparency and forward price discovery. While major capacity expansions are being made in a timely manner, there are cases where smaller volumes required to underpin small to medium business expansions are not as readily undertaken. These customers must then wait to 'piggyback' off a future large capacity expansion, denying access to the pipeline in a timely manner. Further consideration of the issues associated with incremental pipeline capacity expansion may be warranted and could form part of the Australian Government's ongoing market monitoring and assessment.

As discussed above, several initiatives, including the Gas Statement of Opportunities and the National Gas Bulletin Board, aim to improve the level of market information (including projected demand growth) for investors.

The National Gas Law and National Gas Rules establish the rights and obligations of pipeline owners and users in relation to 'covered' (i.e. regulated) pipelines and provide a mechanism for third parties to obtain access to covered pipelines within an independent regulatory framework. A greenfield no-coverage determination provides a greenfield pipeline with a 15-year 'regulatory holiday' from its tariffs and third-party access being regulated by the AER. Some industry participants have suggested that the no-coverage provisions could be improved to provide greater certainty, and the Commonwealth welcomes feedback from industry on this.

This regulatory certainty can add additional incentives to greenfields pipeline investment decisions. The wider economic benefits include additional investment in new transmission pipelines within a competitive market framework, which is critical for the development of Australia's gas industry. However, to date, the National Competition Council has received one application for a no-coverage determination, which came from BG Group's Queensland Curtis LNG project in January 2010. In June 2010 the application was approved by the Commonwealth Minister for Resources and Energy, thereby granting the no-coverage determination.

Other infrastructure factors

Timely construction of gas pipelines requires the alignment of significant planning and approval processes, mostly at the state and territory and local government levels. These can vary substantially between jurisdictions and are often not well coordinated between various government agencies. There would be merit in a more consistent approach to the development of gas easements and treating of gas infrastructure, including ensuring that consistent treatment is afforded to public and private developments.

Community understanding and acceptance of the need for gas development and infrastructure is also an important issue. Given the key role gas will play in meeting Australia's future energy and climate change needs, it is essential that potentially critical energy resources, such as coal seam gas and new transmission pipelines, are developed safely and efficiently. The industry and governments must ensure appropriate engagement with local communities to ensure community support.

Links between domestic and export markets

The Australian Government recognises the importance of the dual role of developing gas reserves for export and the domestic market, and that at times those markets are complementary, and at other times in competition. Given that both markets are driving a rapid move to develop gas resources, it is critical that domestic gas market frameworks support the continued development of an efficient, reliable and competitive natural gas market. Failure to do so may result in long-term under- or over-investment in supply capacity with higher attendant costs to consumers.

It is important to recognise that higher commercial returns from LNG export opportunities provide significant benefits to the community through additional taxes and royalties. In 2011 the Australian LNG industry is projected to earn export income of around $10 billion. Export earnings are expected to grow significantly in future years.

In addition, the development of the domestic gas markets has been influenced by the expansion and diversification of competitively priced supplies of gas, particularly the offshore resources in the Carnarvon and Otway basins, and more recently the successful exploitation of coal seam gas in Queensland.

The discovery and commercialisation of these resources have strong links to the evolving international gas market through LNG export, which has underpinned industry investment. As these developments proceed they will bring positive flow-on effects to the domestic market in terms of diversity of supply, industry innovation, infrastructure investment and skills and training. They are also changing the nature of these markets.

Although the first LNG exports from Queensland are not expected to commence until around the middle of the decade, the export projects have already started to transform the dynamics of the interconnected eastern market. The historical separation of international and domestic markets is changing, with international demand putting pressure on domestic prices and contract terms. This has resulted in a period of uncertainty for all market participants, especially major buyers of domestic gas, although it is unclear the extent to which current market tightness is transitional or may ease in the future.

While prices in the eastern markets are expected to rise over time (reflecting higher production costs and demand competition), it is far from clear how the various supply and demand drivers may evolve and there are a range of plausible price outcomes. It is important that investment incentives are efficiently maintained.

Compared to the east coast, there has historically been a different relationship between international and domestic markets in the west, where the higher returns offered by LNG are necessary to support the development of more offshore gas fields. Opportunities for domestic supply are also more restricted due to geographic or economic barriers that prevent a range of gas fields from being able to practically supply the domestic market.

While recognising that current market conditions are particularly challenging for some large gas users, the Australian Government believes that policy intervention at the present time to force domestic gas outcomes is unwarranted. However, there is a need to monitor market dynamics to assess whether policy settings deliver the required outcomes given the growing domestic use of gas. This will inform government decision-making, which will be mindful of domestic gas considerations in granting production licences.

Finally, and as noted earlier, governments at all levels consider the security of domestic energy supply to be a priority, and will therefore continue to give close attention to this issue as markets are developed.

Links between gas and electricity markets

A wide range of modelling suggests that demand for gas-fired electricity may increase significantly through to 2030 and beyond, particularly if carbon capture and storage technologies are successfully commercialised. This is likely to be through a combination of combined-cycle baseload and open-cycle peaking plant.

Potential change in the demand for gas use in electricity generation, driven by the introduction of a price on carbon, will result in closer linkages between the electricity and gas markets, particularly in eastern Australia. The nature of electricity generation, particularly peaking generation, may drive a greater need for short-term gas trading or improved storage options. It is also likely to influence both electricity and gas infrastructure development. Given that electricity and gas transmission investment frameworks are currently fundamentally different, this could give rise to inefficient development decisions through mismatched locational drivers.

These issues are not currently well understood and there is a strong need for further analysis of the potential interactions and key drivers to underpin a considered policy and operational response (if required).

6B.8 Strategic challenges

The previous section focused on important electricity and gas market development issues. There are, however, a set of broader challenges that arise due to these and other related reforms, such as carbon pricing and clean energy technology innovation. These include:

- maintaining the momentum for energy market reform
- attracting timely investment in energy markets
- promoting market competition.

These issues are in many ways related and, together with efforts to improve our energy productivity and transform to a clean energy economy, are the key factors that will contribute to successfully delivering energy to Australians over the coming decades.

Maintaining the momentum for reform

It is widely accepted that the economic policy reforms of the 1980s and 1990s transformed the dynamics of the Australian economy, helping drive a surge in productivity growth. More recently, Australia's productivity growth – measured in terms of both labour productivity and multi-factor productivity – has slowed.[41]

The Australian Government considers that there is a need to continue with reforms that increase the flexibility of the economy and its productive capacity in order for people and business to embrace change, adapt and innovate.

In the face of what is likely to be a period of sustained price increases for electricity and gas, it is perhaps more important than ever that attention and momentum are given to promoting greater efficiency and resilience in market structures to minimise any attendant cost-of-living and business pressures.

Australians have generally been served well by the cooperative effort across jurisdictions to promote ongoing reform and development of Australia's principal energy markets. However, there are some important reforms that remain to be completed, particularly on retail price deregulation and winding back government ownership.

While these and other reforms discussed in this draft Energy White Paper will not avoid price increases for consumers, they can contribute to ensuring that energy is delivered efficiently. While some may be politically challenging, they are in the long term important and necessary if we are to provide consumers with the best possible outcomes.

The Australian Government remains committed to working with all Australian jurisdictions through COAG and its standing councils to advance energy market reform as a key element of the productivity agenda.

While the energy market reform process has delivered positive benefits to date, there may be merit in considering how reform processes could be improved. Possible improvements may involve more inclusive use of experts, including from business and consumer groups, at the working level in market design and development issues to ensure that proposed approaches are robust and best practice. This can be done in ways that appropriately address potential conflicts of interest and preserve appropriate policy and decision-making responsibilities.

Finally, the key to a sustained reform agenda is ensuring that the reforms are targeted and are supported by a community consensus. In this context, there is a need for improved communication and community engagement in the energy reform process. To achieve this, it is critical that proponents of energy infrastructure and energy projects properly engage at an early stage with local communities. There is also an important role for governments in ensuring that regulatory frameworks provide for transparent, sustainable and safe development. This should ensure that

[41] M Parkinson, 'Sustaining growth in living standards in the Asian century', speech delivered at the Melbourne Institute Economic and Social Outlook Conference, 30 June 2011.

communities are properly informed through transparent and timely consultation processes, and that risks and costs are appropriately managed and community concerns are addressed.

Attracting timely investment

Chapter 3 highlighted the magnitude of the future investment required in the electricity and gas sectors, with the Investment Reference Group reporting on modelling by the Australian Energy Market Operator that investment in the electricity sector (including generation transmission, distribution networks, pipelines and associated infrastructure) could exceed $240 billion by 2030.[42] The 2010 AEMO National Transmission Network Development Plan estimated that within this range around $72–82 billion would be needed in generation and transmission. The Australian Treasury has projected that, in the presence of a carbon price, more than $200 billion in new electricity generation investment will be required between now and 2050.[43] Like most sector-wide aggregate investment projections, these are daunting figures.

However, this somewhat overemphasises the immediacy of the task. Outcomes will be achieved through a rolling (albeit uneven) series of investments across the period, and across a range of different activities and businesses. Nonetheless, it is still a significant challenge when compared to around $12 billion in new generation since the commencement of the NEM in 1998.[44]

The 2011 Electricity Statement of Opportunities provides an assessment of when the first set of investments in new generation plant may be required to ensure that the market continues to meet the minimum reliability standard (the Low Reserve Condition or LRC point).[45] If new investment is not forthcoming, most jurisdictions will reach an LRC point within the next two to eight years (see Table 6B.2).

Table 6B.2: NEM regions Low Reserve Condition (LRC) points

	Low economic growth		**Medium economic growth**		**High economic growth**	
Region	**LRC point**	**Reserve deficit (MW)**	**LRC point**	**Reserve deficit (MW)**	**LRC point**	**Reserve deficit (MW)**
Queensland[a]	2014–15	544	2013–14	341	2013–14	779
New South Wales[a]	2018–19	222	2018–19	190	2018–19	367
Victoria[a]	2016–17	218	2014–15	96	2013–14	96
South Australia[a]	2016–17	9	2014–15	46	2013–14	5
Tasmania (summer)	>2020–21	na	>2020–21	na	>2020–21	na
Tasmania (winter)	>2021	na	>2021	na	>2021	na

a. Summer peak demand, first occurring LRC point.

Source: Australian Energy Market Operator, *Electricity statement of opportunities*, AEMO, 2011.

The analysis takes account of existing and committed generation and shows that new plant in Queensland, New South Wales and Victoria could be required by the mid-to-latter half of this decade – possibly sooner in Queensland if demand grows strongly. Given construction lead times of

[42] Investment Reference Group report.

[43] Treausry, *Strong growth, low pollution*, p. 120.

[44] Investment Reference Group report.

[45] LRC points do not signify a shortfall in generation capacity or that load shedding will occur, but rather indicate when the power system adequacy is falling below long-term system reliability standards.

between three and five years for such plant, this means that firm investment decisions in these regions, either in new capacity or to expand existing plant, will need to occur soon.

The common expectation is that future investment in the energy (particularly electricity) sector will be undertaken by the private sector. Given the long-lived and capital-intensive nature of these investments, there must be a high level of confidence in the various frameworks that support such decisions. Key factors in this equation are:

- confidence in the ability to generate sufficient revenue over the expected operating life of the plant
- sufficient certainty about key future cost exposures, including carbon, capital and fuel costs
- confidence in future market and policy frameworks
- the extent of project or technical risk
- the availability and cost of project finance (debt and equity)
- the availability of risk-management options such as liquid futures, options or other contracts markets
- expectations about general business and market conditions.

Investment decisions are often heavily weighted around project-specific factors, although general market and policy conditions also play a major role across the sector. Not all factors are weighted equally and will vary between businesses. Project financiers may also apply different weightings to factors than project proponents.

In the course of developing the draft Energy White Paper, there have been suggestions from a range of stakeholders that electricity markets may face difficulty in attracting investment in new or replacement baseload capacity. Reasons given for this include:

- A combination of carbon and fuel price risks may discourage new coal investment in the NEM due to the risk of stranding, but the coal-gas price differential may not be sufficient in early years to change project economics in favour of gas.
- The impact of interventions such as the Renewable Energy Target along with ramp gas from coal seam gas developments is suppressing wholesale market prices below what may be required for new investors.
- Further political debate over carbon pricing may prolong policy and market uncertainty with a consequential negative effect on contract and financial markets.

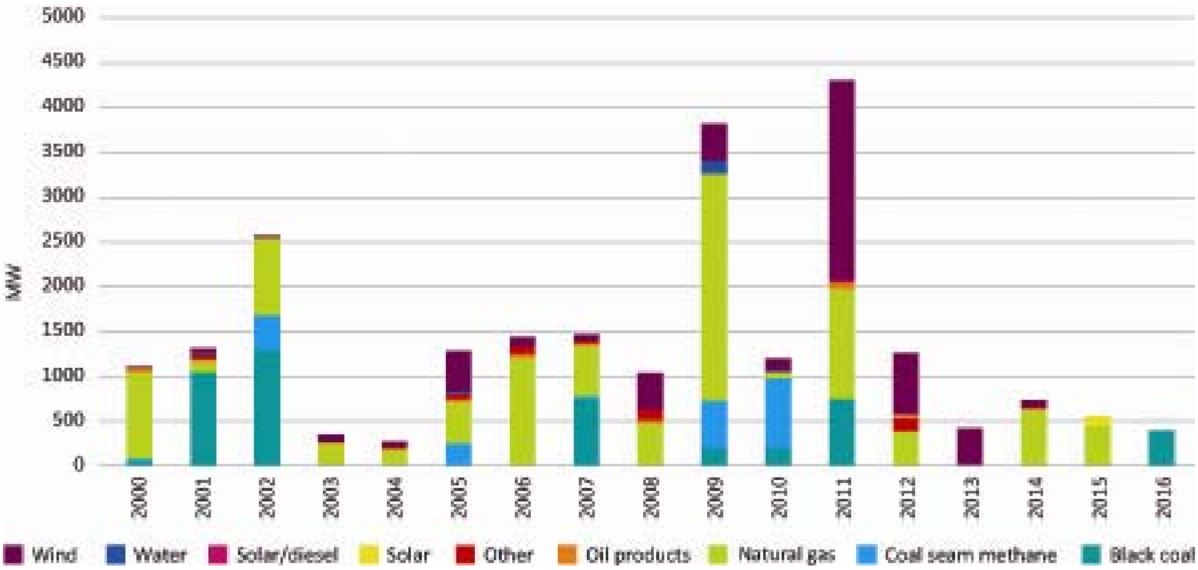
It has been suggested that these issues will make it challenging for private sector investors to bear the risks associated with large, capital-intensive projects. The comparatively lower capital cost and easy-to-build (and convert in the future) nature of open-cycle peaking plant may be the preferred ‘safe bet’ for new capacity. Given the higher operating costs of open-cycle plant, this could have the effect of increasing wholesale prices above what they might otherwise be in the absence of such market risks. These issues were also identified in the Investment Reference Group report provided to the Australian Government in April 2011.

Lessons from past investment patterns in the NEM

The views outlined above are supported by reference to investment patterns in the NEM over the last decade or so, which show that the last major baseload coal investment was supported by the Queensland Government in 2007 (Kogan Creek), while in 2009 three combined-cycle gas turbine plants were commissioned (two in Queensland and one in Tasmania). The main types of committed generation investment are wind and open-cycle gas turbine plant (see Figure 6B.2).

While this pattern is certainly in evidence, the explanation may be due to a more complex range of factors than carbon uncertainty alone. Wind investment in the last decade has been driven by the cross-subsidy offered through the Renewable Energy Target. The lack of committed baseload investment, in particular coal, since 2007 most likely reflects a lack of need either due to an oversupplied market in some NEM regions or an insufficient demand build-up in others. The outcome for open-cycle gas may in part be attributed to risk-averse investment, but it was most likely driven by the strong growth in peak demand and a just-in-time approach to building fast-start, short run-time plant.

Figure 6B.2: Investment in electricity capacity since 2000



Note: Data comprises capacity installed, under construction or advanced planning since 2000, all Australia (year of commissioning or expected start-up year, as of June 2011). At the end of June 2011, 15 projects were under construction with a total capacity of 2760 MW. Some 5700 MW of capacity was at an advance planning stage. An additional 174 projects with a total potential capacity of over 43 GW are proposed.

Source: Energy Supply Association of Australia, *Electricity gas Australia*, esaa, Melbourne, various years.

Because of the lag created by the time required for planning and construction, it is also necessary to consider the range of projects currently under advanced planning. There are no active coal baseload proposals in train (apart from an expansion at the Eraring station in New South Wales), although there are a range of large gas plants under active development or consideration – the most advanced of which is the 550 MW open-cycle plant under construction in the Mortlake project in Victoria.[46]

[46] ABARE–BRS, *Electricity generation: major development projects – October 2010 listing*, ABARE–BRS, Canberra, November 2010.

It is likely that at least one or several of the advanced open-cycle gas projects could be cost-effectively converted to combined-cycle plant relatively quickly if market conditions were strong enough to justify such a decision.

This suggests that some caution should be used in relying on past trends to predict future patterns, particularly where market dynamics have changed significantly over the period. Also, the generation market is effectively segmented between baseload, intermediate and peaking. Each of these 'segments' has different investment and price drivers. For example, peaking providers respond to growth in peak demand and provide cover for relatively rare high-price events, while baseload plant is more focused on dependable load and average pool price. The advent of carbon pricing may also encourage a shift in new investment over time from large-scale baseload plant to more intermediate plant. There is also a small but growing segment of customer-owned generation, including domestic solar photovoltaic and commercial embedded generation, where investment is driven by opportunities to reduce energy bills or provide secure supply.

That said, the lack of advanced baseload coal proposals despite the build-up of capacity pressures, does support the view that ongoing uncertainty has affected investment patterns. The increased investment in open-cycle gas turbine plant suggests a trend towards less capital-intensive investments until either greater certainty for generation is regained or the NEM signals that it is warranted. It is expected that the implementation of carbon pricing and the outcomes from the contract-for-closure initiative will in the near future provide a clearer and more stable investment environment for generation assets; however, bipartisanship in climate policy is important to energy sector investors.

Impact of carbon pricing on investment

In this context, the introduction of carbon pricing will fundamentally change operational and investment dynamics in electricity and gas markets. This is a deliberate policy intent aimed at promoting a more certain and efficient transition to clean energy technologies. As the Investment Reference Group report noted, a clear transition path to mature carbon pricing along with effective transitional support and energy security measures is essential to providing the market with sufficient stability to adjust smoothly. These findings have been reflected in the design of the government's Clean Energy Future package, particularly through the energy security component.

The lack of bipartisan support for carbon pricing will, however, contribute to ongoing uncertainty for investors.

Changing financial market dynamics

The Investment Reference Group report noted that conditions and lending practices in domestic and international financial markets had changed in the wake of the global financial crisis, with a generally reduced appetite for risk. This tightened the global market for capital, regulating in higher costs and larger equity requirements for projects to address the risk concerns of lenders.

While this is not strictly a matter for energy policy, if these conditions were to be sustained it could have implications for the nature of future investments and business structures in the energy sector (see the discussion in the following section on competition) and costs that are passed through to consumers.

Impact of other non-market interventions

A further and growing issue is the potential impact of other policy interventions on Australia's energy markets. The Investment Reference Group report noted that in particular, the Renewable Energy Target acts to suppress NEM wholesale pool prices through its support of renewable generation, much of which is intermittent. When originally introduced, intermittent generation was preferentially dispatched. Now, intermittent generation plant of 30 MW capacity or greater is either semi-scheduled or required to bid alongside other generation. The effect of the cross-subsidy under the scheme is to allow renewable energy generators to bid into the market at lower marginal rates than would otherwise be sustained, and thus drive the uptake of renewable energy. While the Renewable Energy Target is a temporary transitional measure, inefficient subsidy levels can distort efficient market outcomes and result in some discontinuity between price and investment signals.

This is a complex issue as it is difficult to attribute movements in pool prices to individual factors. The extent to which market prices can be regarded as 'suppressed' depends on the degree to which external subsidies are, in effect, driving inefficient outcomes.

More broadly, the impact of large volumes of generation capacity that can bid into the market at a near-zero marginal cost of operation on bidding stacks and prices in competitive energy markets has been the subject of ongoing debate among a range of analysts, including the International Energy Agency, where it has been referred to as the 'merit order effect'.[47] Analysis suggests that this effect does impact pool prices and reduces the economic return earned by conventional generators. For example, in South Australia, average wholesale electricity prices are at their lowest since market start, while there is a divergence between the average wholesale price received by renewable and fossil fuel plant.[48]

In some cases, transmission network constraints mean that, when significant wind generation is available, the wholesale price in a particular NEM region falls rapidly, as other generators bid at low or even negative prices to avoid shutting down. Repeated instances of negative spot prices could discourage market entry by new generators. While the amount of wind generation installed as a result of the Renewable Energy Target (particularly in South Australia) can suppress wholesale pool prices during particular periods (for example, when wind strength is significant), consumers also bear the costs of the requirement of liable parties to acquit renewable energy certificates. Therefore, the overall impact of the bipartisan expanded Renewable Energy Target has been to increase prices to consumers, but it has also delivered its aim of bringing forward investment in renewable energy technologies.

At this point there does not appear to be a clear-cut consensus about whether the merit order effect has a material long-term impact on investment outcomes, and there may be other factors at play; however, the potential impact of the merit order effect is worth monitoring.

In addition, historical wholesale market prices are one among a range of factors that determine investment viability. Forward contract prices can be an equally as important factor. Governments should avoid interventions that distort both wholesale and contract prices.

[47] International Energy Agency, *Interactions of policies for renewable energy and climate*, working paper, IEA, Paris, 2011.

[48] Australian Energy Market Operator, *South Australian supply demand outlook*, AEMO, 2011.

Again, there should be some caution used in extrapolating from market prices directly to investment outcomes. However, the extent to which there is a current or future 'merit order effect' and the implications for Australian energy markets is an area where further analysis is clearly required, particularly given the expected increase in renewable energy.

The Productivity Commission identified more than 230 climate-related measures in operation at the national and subnational levels.[49] While these measures are clearly not all energy related, and while the extent to which they have a material effect on market prices is not known with certainty, they are generally not transparent and add to market complexity. Given that the carbon price has been legislated, the range of measures should be reviewed against the COAG principles of complementarity to ensure that inefficiencies leading to unnecessary costs are avoided. Governments at all levels should review existing measures, consistent with COAG's agreed complementarity principles for climate change mitigation measures and agree not to introduce any new non-complementary measures.[50]

In this context, and in light of the passage of legislation to introduce a carbon price from 1 July 2012, the Australian Government has taken a decision not to proceed with the introduction of an emissions standard or carbon capture and storage standard for future coal-fired generation investment.

Addressing future risks

The introduction of carbon pricing with a clear policy framework under the Clean Energy Future package provides greater certainty to the market to plan necessary investment in new electricity and gas assets. It has also changed the nature of energy markets and the new dynamics should be given time to consolidate.[51] This will involve a period of transition, and may lead to a period of conservative investment and market behaviour, including a tendency towards vertical integration as a strategy for managing risk and market exposure.

It is important that the current lack of bipartisanship around carbon policy be resolved to provide certainty for investors.

Given the price and investment risks in any market transition, the Australian Government recognises the need to monitor market outcomes. However, there is no reason to suggest at this time that an energy-only wholesale market such as the NEM or our gas markets, along with well-functioning contract and financial markets, cannot provide appropriate signals to bring on efficient new investment.

However, this is not to ignore risks. Investment in the NEM under carbon pricing has yet to be tested and international financial markets, which will be critical sources of capital, may be subject to difficult global conditions for some time. The energy security component within the government's Clean Energy Future package will provide an important safety net in this regard.

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[49] Productivity Commission, *Carbon emissions policies in key economies*, research report, Productivity Commission, Canberra, 2011.

[50] Council of Australian Governments, *Principles for jurisdictions to review and streamline their existing climate change mitigation measures*, COAG, 2008, www.coag.gov.au.

[51] Investment Reference Group report.

In addition, the Australian Government will commit to:

- continuing to progress a comprehensive reform agenda during the transition period, with clear objectives relating to improving investment, productivity and competition, and subject to regular monitoring and comprehensive reporting
- undertaking the National Energy Security Assessment biennially, and also undertaking a regular four-yearly strategic review of energy policy
- managing the growing importance of gas in our energy future through further monitoring and consideration of policy settings to help ensure a stable future, given the increasing use of gas for electricity generation and the increasing impact that developments in each market can have on the other
- consistent with COAG's agreed complementarity principles for climate change mitigation measures, seek agreement from all Australian governments to a review of existing measures and not to introduce new non-complementary measures.

Promoting market competition

Competition is the foundation of a well-functioning energy market; it can provide for the delivery of least-cost investment to meet energy requirements through the introduction of effective incentives for higher efficiency and innovation. The competitiveness of energy markets depends on a number of factors, such as:

- unbundling the natural monopoly network activities from all other activities
- provision of equal access rights to the network for all generators and producers and equal ability for all consumers to extract energy
- coordination between the various parties in the supply chain to ensure that investment is both timely and efficient
- the rules, design and regulation of energy markets being competitively neutral
- provision of regular and transparent information to inform decision-makers
- all businesses operating on a level playing field to encourage new entrants.

Through the ACCC and the AER, there exist mechanisms to monitor and regulate competition outcomes.

Market structure

A key aspect of the formation of the national energy market and competition policy in the 1990s was the separation of competitive markets (wholesale and retail) and monopoly markets (transmission and distribution). Another key feature was the disaggregation of state-owned vertically integrated energy businesses.

Since that time there have been a range of business pressures that have seen a trend towards re-aggregation in retail and generation businesses and greater cross-ownership in electricity and gas interests. These business responses have (understandably) largely been driven by the need for more secure balance sheets and customer bases, and the opportunities such arrangements provide to internally manage price risks and other market exposure (such as the cost of Renewable Energy Target liabilities or security of supply). This has led to the rise of a number of so-called 'gen-tailors' as dominant business models and a form of risk management. Substantial vertical integration, however, reduces the liquidity of the contracts market, which could pose a potential barrier to the entry of new market participants.

In noting this trend, there is no suggestion that current market structures are uncompetitive or causing economic harm. While this structure may be different from that first envisaged in the establishment of the NEM, it may well be that Australia's optimal market structure for the foreseeable future is one that comprises a healthy balance of integrated energy businesses and merchant operators.

Ownership and operation of generation capacity sold into the wholesale pool market is diverse. The AER's *State of the energy market 2010* reports that there are 299 registered generators in the NEM. There are around 34 companies or groups which own the 200 or so scheduled and semi-scheduled power stations with at least 30 MW capacity in the NEM.[52] After taking the recent New South Wales Gentrader contracts into account, about half the output capacity of NEM generators is controlled by governments.[53]

Ongoing government ownership in electricity markets remains a concern for private sector investors, particularly new entrants. The risk (even if only as a perception) of an uneven playing field or of future government interventions creates additional investment complexity and risk in an already difficult market environment.

The retail market in the NEM is less diverse; there were 21 retail companies with active licences, as of December 2010.[54] The sector is dominated by three major retailers: AGL, Origin Energy and TRUenergy. The retail market is considered to be competitive in Victoria and South Australia.

Concerns have been raised about the implications over the longer term if the trend towards reaggregation continued to the point where competition was unacceptably reduced or where trade between markets was eroded or compromised. This could also present a barrier to entry for merchant operators that do not have well-hedged positions in multiple markets. The issue of market structure and/or market power is appropriately covered by the role of the ACCC in enforcing competition and fair trading provisions in the *Competition and Consumer Act 2010*. In addition, the AEMC is currently progressing further work in relation to market power.

There is a role for energy policy to identify and address areas that may present effective barriers to competition. A number of key reforms have been identified that can assist in promoting competition, including:

- retail price deregulation – this will promote greater competition and innovation. It will also reduce some of the risks between wholesale and retail markets, which is in part driving pressure for re-aggregation

[52] Australian Energy Market Operator, *Existing and committed scheduled and semi scheduled generation – all NEM regions***,** AEMO, 2011; Australian Energy Regulator, *State of the energy market 2010*, AER, Melbourne, 2010; Energy Supply Association of Australia, *Electricity gas Australia*.

[53] Energy Supply Association of Australia, *Electricity gas Australia*.

[54] Australian Energy Regulator, *State of the energy market 2010*.

- addressing government ownership – there is no compelling economic or energy security reason for continuing government ownership in energy markets. Where government ownership remains, there should be measures to isolate government from operational aspects of the business and market governance to provide confidence around competitive neutrality
- pricing and other reforms to support efficient demand-side participation – these issues are discussed further in Chapter 6C.
- identification of areas for contestable services in regulated markets.

6B.9 Key actions

To improve the effectiveness of Australia's gas and electricity energy market frameworks, the Australian Government will:

- reaffirm its commitment to further progress on a comprehensive reform agenda, with clear objectives relating to improving the investment environment with attendant improvements to productivity and competition, and subject to regular monitoring and comprehensive reporting
- support actions to improve market competition and innovation through:
  - continuing price-deregulation – to allow consumer empowerment, alongside appropriate protections for vulnerable consumers
  - further asset privatisation
  - promotion of efficient demand-side participation, including investigating any barriers to distributed generation
  - further explore potential measures to reduce growth in peak demand, including possible regulatory and market measures and enhanced consumer education
  - identification of areas for contestable services in regulated markets
- improve electricity network efficiency and productivity through:
  - supporting completion of the Transmission Frameworks Review, and the creation of a national framework for distribution network planning and expansion and for transmission and distribution reliability standards
  - further assessing the impacts of increased intermittent generation, particularly any consequent new requirements on the structure and operations of networks
- commission an independent review by the Productivity Commission into the use of benchmarking of network businesses to improve efficiency, and assess claims around the interregional transmission investment framework not delivering adequate investment
- develop a robust smart metering framework, based on an assessment of lessons learned from previous roll outs and consideration of appropriate models for deployment. Lessons learned from deployments can help inform the future role that smart meters can play in our energy system

- support the continued development of Australia’s gas markets to improve transparency and trading opportunities, and lead further work to better monitor market dynamics to assess whether policy settings are delivering required outcomes given the growing use of gas for electricity generation
- support further reforms to the Western Australian gas market to ensure that it becomes a more mature and competitive market
- improve public communication and engagement in the energy reform process, including improving availability of energy price information to customers and public understanding of the implications of energy market reforms
- give further consideration as to whether the Standing Council on Energy and Resources can make greater use of experts and other participants to engage in market design and development activities at the working group level
- extend national governance arrangements and principles to cover all Australian gas and electricity markets and transition to a truly national energy market that provides greater efficiency and consistency to market oversight and development. Ensuring national harmonisation also includes reviewing and removing unnecessary jurisdictional derogations
- consistent with COAG’s agreed complementarity principles for climate change mitigation measures, seek agreement from all Australian governments to a review of existing measures.

6C Improving energy productivity

Highlights

- Historically energy policy and market development in Australia have had a strong supply-side focus, suggesting that there could be further potential to realise cost-effective demand-side efficiencies through an integrated market framework.
- Trends in Australian energy use productivity show that the aggregate energy–GDP ratio of the end-use sectors in the Australian economy improved an average of 1.2 per cent a year from 1989–90 to 2007–08.
- Evidence from government energy programs and research suggests that there is potential to improve energy use productivity – i.e. improve end-use energy efficiency.
- There are also opportunities to improve energy production productivity – particularly the utilisation of energy infrastructure (capacity).
- Pursuing cost-effective opportunities to improve energy productivity (both production and use productivity) can yield individual and national economic benefits. These benefits can include:
  - minimising inefficient peak demand which leads to unnecessarily high electricity costs due to the investment in infrastructure that is only used for a small percentage of time
  - providing relatively low-cost greenhouse gas abatement
  - improving Australia's international competitiveness, particularly for energy-intensive industries.
- Energy productivity improvements will be most efficiently underpinned by market frameworks that allow the true costs of the supply of energy to be reflected in prices paid by consumers.
- However, there are a range of recognised market failures that can inhibit efficient energy management and which suggest that a suite of policy options will be needed.
  - This includes market-based and regulatory measures, enhanced technology and services, and empowering consumer participation through better information and product choice.
  - The optimal mix of measures will take time to emerge and there will be a need to test and refine the policy framework on an ongoing basis.
- There is also a need for improved datasets to help identify the drivers behind changes in energy intensity and energy productivity, and for enhancing the availability of information to support consumer decisions.

6C.1 Introduction

A productive and efficient energy system – from generation and supply through to end use – is important to our national productivity and economic growth. For example, the 1990s supply-side reforms of Australia's energy sector (primarily affecting energy markets) generated an estimated 0.77 per cent increase in GDP.[55]

Energy productivity[56] can be defined in two ways:

- Energy use productivity is the ratio of what is produced (economic output) relative to the energy required to produce it.
- Energy production productivity is the ratio of energy production relative to the system capacity required to produce it.

Energy productivity can also have different meanings for different consumers – for example:

- for a business, it is how well energy is consumed (an input) to produce or provide goods and services (an output)
- for a household, it is how efficiently energy is consumed to provide needs and comfort.

Improving energy productivity can benefit individual households and businesses by reducing energy costs. In this context, improving Australia's energy productivity is an important part of the energy market reform agenda.

Traditionally, Australia has had a strong supply-side focus in its design and application of energy policy frameworks. It is therefore likely that further opportunities exist to develop and integrate an effective demand-side framework that better balances investment and energy use decisions across the supply chain. These opportunities can be achieved when energy users and suppliers have the right information and incentives to find the most efficient outcomes.

This subchapter examines the issues and policy frameworks associated with promoting a more effective demand-side response and improving end-use energy efficiency. In particular, it investigates:

- market and pricing barriers to greater energy productivity
- opportunities to better inform energy users about decisions that affect their energy use
- opportunities to provide consumers with more choice and tools to control their energy consumption.

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[55] Productivity Commission, *Review of national competition policy reforms*, Productivity Commission, Canberra, 2005.

[56] It is important to distinguish energy productivity from that of multi-factor productivity assessment, which measures how efficiently key economic inputs (capital and labour) are used to produce and supply energy – rather than how efficiently the energy itself is generated and used.

6C.2 Measuring the productivity of energy consumption

The diversity of ways that energy is consumed in the economy and the factors that impact on energy productivity makes measuring changes in overall energy productivity challenging.

Aggregating trends across different applications and sectors requires the use of a common metric. Energy intensity (or the ratio of energy per unit of GDP) is commonly used as a proxy for energy use productivity, as data is much easier to collect at a sectoral or national level.

Energy intensity measured in this way, however, is not strictly a measure of energy efficiency. Changes or differences in energy intensity between or within economies or sectors can also be due to the impact of geography, other inputs (ore grades), climate, availability and price of energy, structural change and economic growth, as much as to policy or individual efforts to improve energy efficiency, and yet the two are often used interchangeably.

For the purposes of this draft Energy White Paper, and in the absence of a more defined dataset, the discussion of energy use productivity draws on energy intensity data.

6C.3 Energy productivity trends

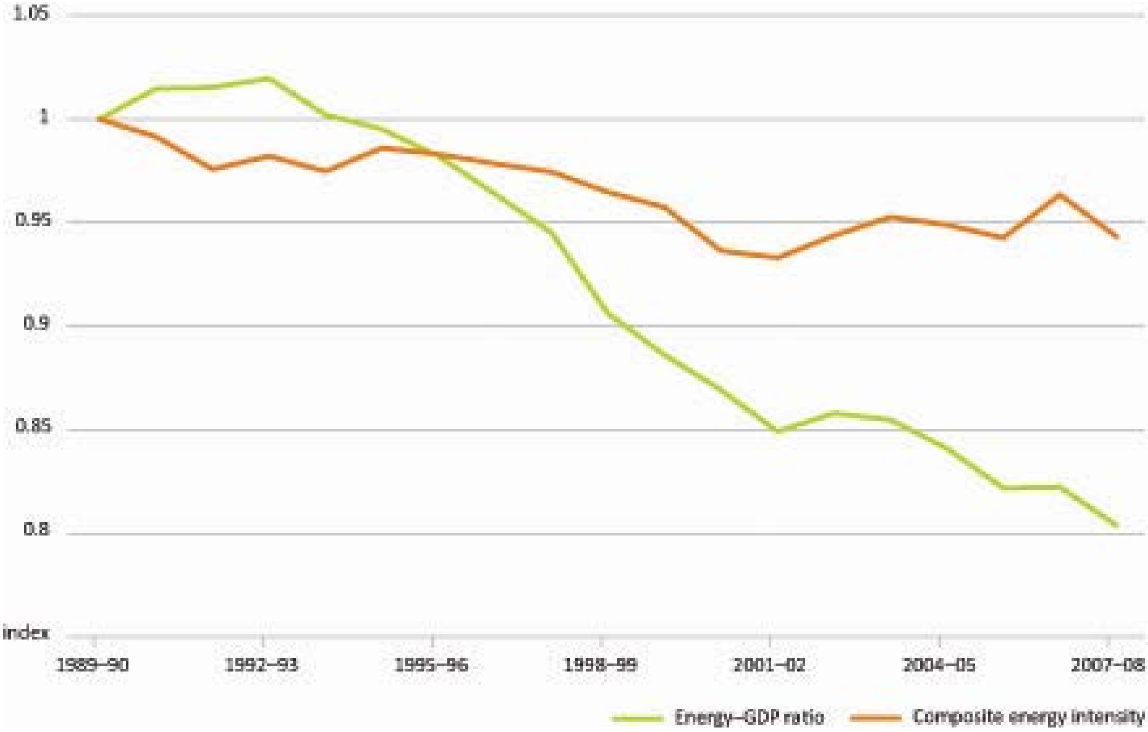
Energy productivity is driven by the collective decisions made by energy users and investors in energy-consuming appliances, technology and buildings, and market participants along the supply chain – as well as a range of interventions from government.

Future energy supply infrastructure requirements are largely driven by the expected cumulative effect of these decisions (reflected in the projected demand for energy), as well as social or regulatory expectations for service quality (such as reliability of supply) or other considerations (such as environmental or renewable energy policies).

Over the previous two decades the Australian economy has tended to become less energy-intensive. As Figure 6C.1 shows, the energy intensity of the Australian economy (shown as the energy to GDP ratio) improved an average of 1.2 per cent a year from 1989–90 to 2007–08.

The composite energy intensity indicator (the red line), which adjusts for the changing structure of the economy, shows the underlying performance of individual sectors of the economy, highlights a lower underlying average rate of improvement of 0.3 per cent a year.

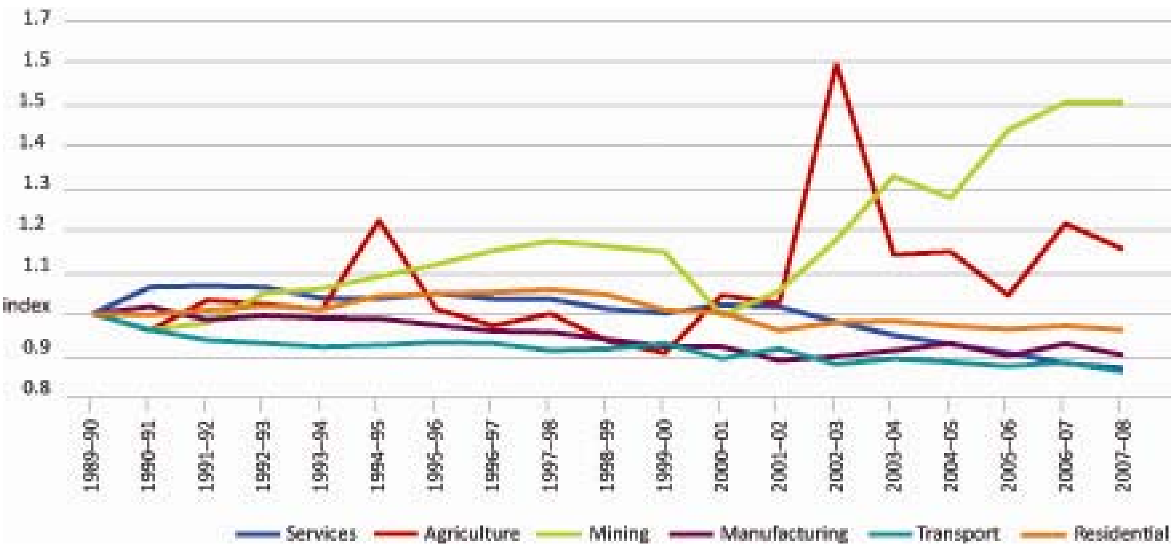
Figure 6C.1: Trends in energy–GDP ratio in Australia, 1989–90 to 2007–08



Source: ABARE–BRS, *End use energy intensity in the Australian economy*, ABARE–BRS, Canberra, 2010, p. 8.

The lower rate of improvement is largely due to the agricultural and mining sectors, which both had increasing levels of sectoral energy intensity from 2001–02, as shown in Figure 6C.2. The services, manufacturing, transport and residential sectors, which had decreasing levels of energy intensity, contributed to the improvement in energy intensity for the economy as a whole.

Figure 6C.2: Trends in composite energy intensity indicators in the Australian economy, 1989–90 to 2007–08



Note: These trends in energy intensity do not imply any weighting of energy consumption by sector.

Source: ABARE–BRS, *End use energy intensity in the Australian economy*, ABARE–BRS, Canberra, 2010, p. 9.

Figure 6C.2 shows an increase in energy intensity in the mining sector due to large increases in energy consumption without a proportional increase in output. According to the Bureau of Resources and Energy Economics, increases in intensity of energy use in mining have resulted from accessing deeper and lower-grade ores, and the sharp rise in production of liquefied natural gas relative to other mining activity. Likewise, the results could be affected by energy use associated with projects under construction that are yet to start producing. In the case of the agricultural sector, factors such as drought and the need for more energy-intensive means to access and use water efficiently could be underlying causes for the increase in energy intensity.

As for productive capacity in the electricity sector, productivity appears to be declining for a number of reasons, including a switch to more expensive generation capacity and growth in network expenditure to service infrequent peak demand.

It is also important to note that government policies can affect energy production productivity. This includes, for example, renewable energy policies that mandate investment in capital-intensive generation that is utilised less frequently than other forms of generation.

6C.4 The rise of peak demand: unproductive utilisation of the energy system

An important factor contributing to declining productivity of the national electricity system and rising prices is the need to build additional capacity in energy infrastructure to meet growth in peak demand, which is growing faster than growth in energy consumption.

Figure 6C.3 illustrates the significant difference in electricity demand that can occur on days with high temperatures compared to days with relatively moderate temperatures. The figure relates to the Albany Creek/Arana Hills area in Brisbane where demand, underpinned by air-conditioning usage, on one hot day in November 2006 (green line) was 65 per cent higher than the preceding day (blue line).

The peak demand curves shown in the figure are illustrative of the energy usage change in the National Electricity Market between hot and cooler summer days. Since 2006, peak demand across the National Electricity Market has continued to grow faster than average energy consumption. It is forecast to continue to grow faster over coming years (2.6 per cent compared to 2.3 per cent), which is a significant factor in rising prices and lower energy productivity in the electricity system.[57]

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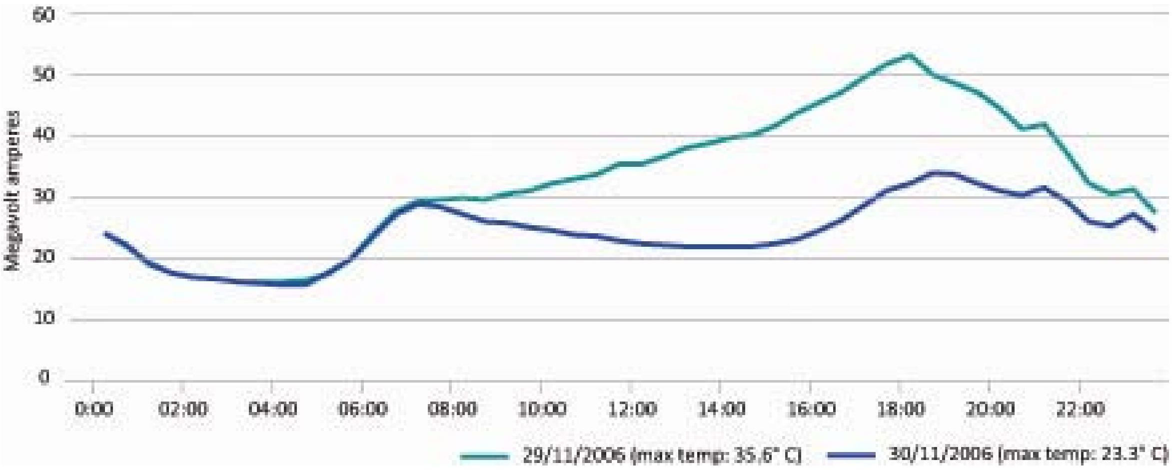
[57] Australian Energy Market Commission, *Strategic priorities for energy market development*, AEMC, Sydney, 2011, p 12.

Figure 6C.3: Albany Creek/Arana Hills peak demand, November 2006



Source: Energex, *Network management plan – part A 2009/10 to 2013/14*, Energex, Brisbane, 2010.

Network and generation capacity is built to provide a very high level of reliability under peak demand, even when this additional capacity may only be used for a fraction of the time. For example, in 2008–09 in Victoria, about 25 per cent of network capacity was used for only 10 days.

Growth in peak demand is leading to a need to augment the electricity network, and is a significant contributor to the expected $38 billion in electricity network augmentation in the current five-year cycle.[58] It is also a contributor to changes in the technology mix of electricity generation, driving recent investment in open-cycle gas turbine peaking plant with higher generation costs per unit of delivered energy. The costs to meet growth in peak demand are reflected in network and generation prices paid by electricity retailers, which feed through to rising retail electricity prices for consumers.

For the majority of electricity users, the time-varying costs of energy supply and delivery cannot be properly allocated between different users because their meters cannot measure the time at which energy is used (instead measuring only a total amount of energy).[59] Even among those with time-of-use metering, the meter may not be configured to allow time-of-use data collection and/or the information may not be presented in such a way as to inform choice and prompt a response by the consumer. This means that peak demand costs are spread across all small users through higher average prices. It also leads to weak incentives for these households and businesses to efficiently manage their consumption. These inefficient price signals and lack of other regulatory measures (such direct load control) contribute to continuing growth in peak demand.

This also means that those consumers who are causing the additional costs are not paying for the full cost of their actions and, conversely, those with a lower proportion of peak usage are paying more than they should. For example, while it may cost around $1500 to purchase and install a 2 kilowatt (electrical input) reverse-cycle air conditioner, such a unit could impose costs on the energy system as a whole of $7000 when adding to peak demand.[60] These capital costs are recovered over time through energy bills, but because of the way energy is priced only some of the costs are paid by the purchaser of the air conditioner while the broader system costs are spread across all customers.

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[58] Investment Reference Group report, pp. 15–16.

[59] Time-varying cost is the cost of peak generation capacity plus the cost of marginal network augmentation required to supply the additional demand.

[60] Department of Employment, Economic Development and Innovation, *Queensland Energy Management Plan*, Queensland Government, Brisbane, 2011, p. 4, provides a figure of $3.5 million per megawatt for incremental network and generation capacity to meet peak demand growth, which is equivalent to $3500 per kilowatt.

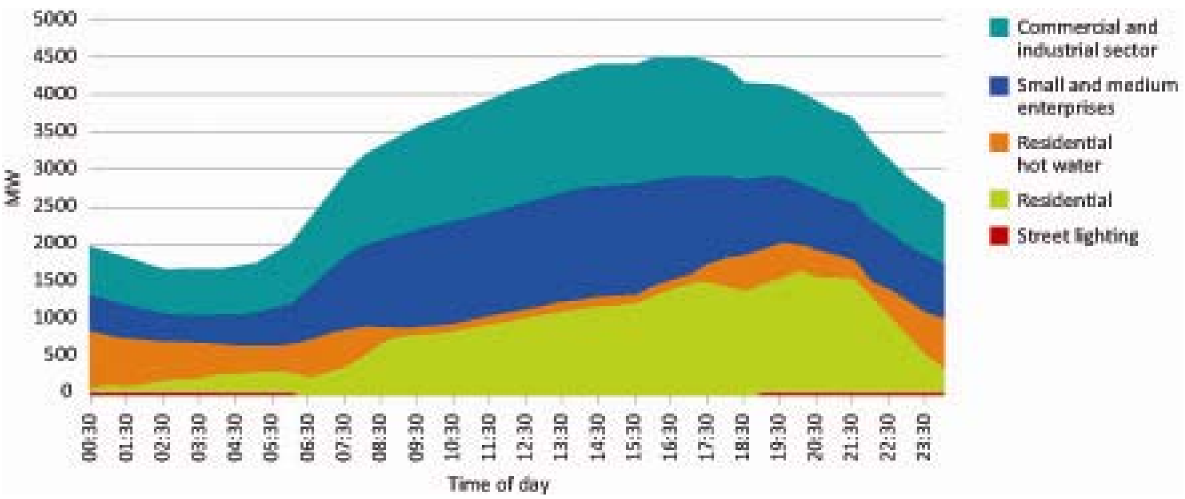
While households consume only 27 per cent of all electricity used in Australia, they are more significant contributors to peak demand.[61] This is because business consumption is generally stable over each day and through the year, while household consumption can vary significantly with weather conditions, even on a daily basis.

A key factor contributing to peak demand is the growing deployment of household air conditioners (and whole-of-house as opposed to room air conditioning), which have significantly fallen in cost in real terms over the past decade. According to the latest data released by the Australian Bureau of Statistics, the number of Australian households with air conditioners has jumped from 4.6 million in 2005 to 6.3 million in 2011, or from 59 per cent of households to 73.1 per cent.[62]

Currently, there is poor national information on the sectoral contribution to peak demand, although analysis is available for some parts of the country. A South Australian study using 2001 data indicates that households, while a small consumer of total energy, contribute around half of peak demand in that state.[63] A more recent analysis by Queensland distributor Energex (illustrated in Figure 6C.4) similarly indicates that households are a significant contributor to system peak demand in south-east Queensland, with similar contributions to each of the small and medium-sized business sector and commercial and industrial sector.

Finally, it should be noted that peak demand in itself is not a sign of inefficiency or a problem that must be addressed. Where inputs such as energy are properly priced through the energy system and consumers are making informed decisions, the use of energy to meet needs (economic or lifestyle) is efficient and sensible. However, it is likely that the current market and consumer frameworks could be improved.

Figure 6C.4: Sectoral contributions to demand on the day of system peak in Energex's network area on Monday 9 February 2009



Source: Energex, *Regulatory proposal for the period July 2010 – June 2015*, Energex, Brisbane, 2009, p. 83.

[61] Calculated from ABARES, *Australian energy statistics*, 'Table A – Australian energy supply and disposal 2008–09', ABARES, Canberra, 2011.

[62] Australian Bureau of Statistics, *Environmental issues: energy use and conservation,* cat. no. 4602.0.55.001, ABS, Canberra, 2011.

[63] Charles River Associates, *Peak demand on the ETSA utilities system*, Essential Services Commission of South Australia, Adelaide, 2004, p. ES2.

6C.5 The importance of improving energy productivity

Improving energy productivity can contribute to raising national economic welfare, through achieving efficiencies at the business and household levels. In businesses, particularly those that spend a large amount on energy, energy productivity gains can reduce costs, and thereby potentially improve profitability and international competitiveness. In households, energy efficiency can also potentially reduce costs and improve standards of living.

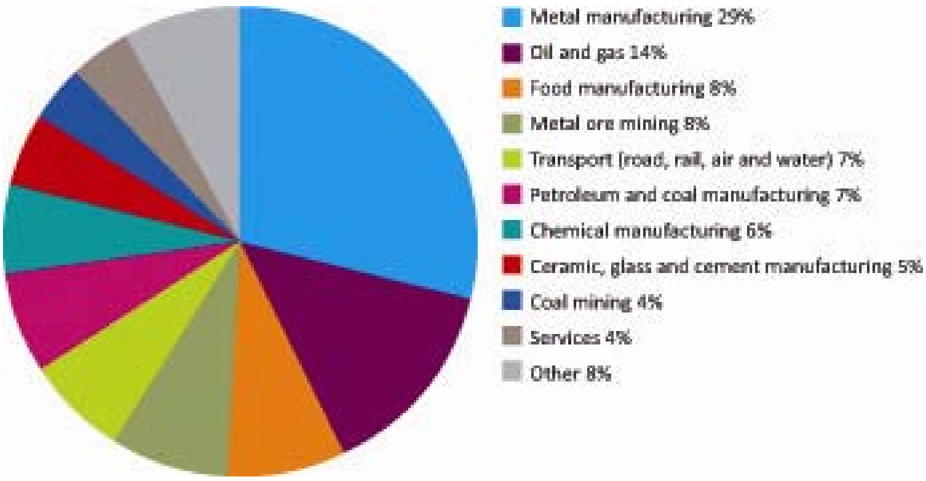
Industry and commercial operations account for 83 per cent of Australia's total energy use and households and their cars make up the remaining 17 per cent. This is important when thinking about where we focus our attention in seeking to improve Australia's energy productivity and reduce associated carbon emissions.

Improving the competitiveness of Australian business

While the majority of Australia's one million plus businesses spend less than 3 per cent of their costs on energy purchased from the electricity and gas sectors, there are around 200 corporations that alone account for around 30 per cent of Australia's total energy use. Most of these corporations are from the mining and manufacturing sectors of our economy and are captured under the government's Energy Efficiency Opportunities (EEO) program, which is discussed in more detail in section 6C.8.

Figure 6C.5 shows the major energy users by sector for the EEO program.

Figure 6C.5: Top EEO energy users by industry subdivision, 2009–10 (total 1701 PJ)



Source: Department of Energy, Resources and Tourism, *Continuing opportunities: Energy Efficiency Opportunities (EEO) program – 2010 report*, RET, Canberra, 2011, p. 7.

Improving energy productivity of these corporations can have significant benefits by reducing energy costs. For example, businesses reporting under the EEO program have identified savings with net financial benefits in excess of $1 billion per annum and a reduction of greenhouse emissions of 10 million tonnes equivalent per annum.

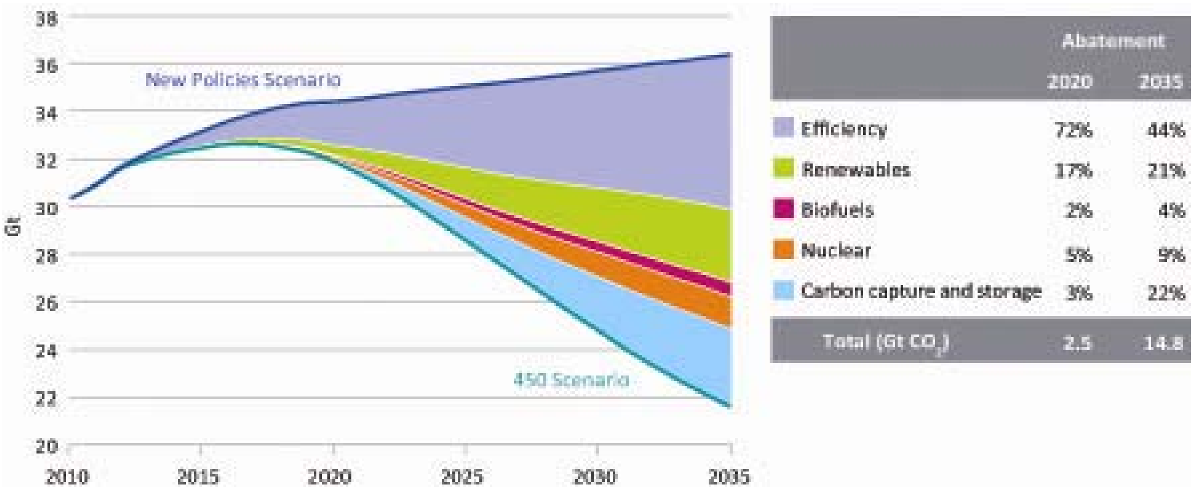
Improving energy productivity is also likely to be motivated by the establishment of a carbon price through the government's Clean Energy Future reforms. Through improving energy productivity, liable businesses are able to reduce their carbon price liability and improve competitiveness when compared to competing businesses that are also liable under the carbon price.

With energy prices expected to continue to rise over the next 10 years, access to more sophisticated information tools, improved processes and new technology will be essential to businesses reducing their energy use and associated emissions to minimise costs.

Reducing greenhouse gas emissions

Improving energy productivity can also support wider policy objectives. It can play a key role in the least-cost transition to a low-carbon economy as energy efficiency is expected to be a significant contributor to reducing global greenhouse gas emissions at least cost. Analysis by the International Energy Agency for the *World energy outlook 2011* (see Figure 6C.6) predicts that energy efficiency technologies will make the largest single contribution to the energy sector's global greenhouse gas abatement, potentially as much as 72 per cent of total abatement by 2020.

Figure 6C.6: World energy-related CO_2 emissions abatement in the 450 Scenario, by policy measure, to 2035



Source: International Energy Agency, *World energy outlook 2011*, IEA, Paris, 2011.

Energy efficiency is often referred to as 'the low-hanging fruit' in terms of a least-cost way to reduce greenhouse gas emissions. The pricing of energy-related greenhouse gas emissions through the carbon pricing mechanism, when combined with efficient energy pricing, will provide an added economic incentive for more productive generation, supply and use of energy.

Empowering consumers to make informed choices

For households and many businesses, energy use can be difficult to measure and consumers may not have access to (and may not seek out) the information needed to understand how their decisions impact their energy use. This is because:

- energy itself is relatively invisible and intangible and is paid for as part of an aggregate energy bill that reflects a broad range of energy-using activities or inputs, providing little information to consumers as to which activities have the highest cost, and consumers do not feel empowered with respect to their energy use

- energy costs for most consumers make up a very small percentage of their income, typically between 2 per cent and 6 per cent, depending on the climate and income[64]
- decisions to purchase appliances and equipment, or to rent or buy buildings, are based on many attributes that are more attractive to the consumer in the short term than the energy costs they will pay in the medium to longer term. These decisions will have ongoing implications for energy consumption that may require specialist equipment or expertise to assess.

Providing transparent, timely and easily accessible information to consumers is essential to empowering more effective decision-making. New technologies can also help consumers access the tools they need to control their energy use.

The biggest gains in energy productivity are likely to be available where information on energy cost implications is easily accessible and can be taken into account in decision-making. Greater consumer choice also needs to be accompanied by transparent information about the energy cost of these choices. Improving understanding around energy choices or 'energy literacy' and enabling greater consumer participation in energy markets are critical to unlocking the benefits of energy productivity.

Ultimately, it is largely consumer and investor choice that will drive improvements in the way energy is used.

6C.6 Barriers to energy productivity

There are a range of well-recognised barriers that can inhibit energy productivity which were comprehensively identified in the Prime Minister's Task Group on Energy Efficiency report. Key barriers include:

- lack of information and skills, and uninformed decision-making
- market failures that distort the prices for energy and the uptake of energy efficiency opportunities, products or services
- regulatory and planning practices.[65]

Lack of information and skills, and uninformed decision-making

Energy users or companies that provide energy efficiency or other auxiliary services such as finance, valuation and legal services can sometimes lack suitable energy or communication skills. This can be a barrier to identifying or implementing efficient energy management options.[66]

Even where parties have access to accurate information, decision-makers may not perceive energy efficiency to be 'material' (for example, energy costs are a relatively small proportion of a business' total costs and profits), meaning they may not investigate potential cost-effective energy efficiency options. Similarly households may not see pursuing energy gains as a priority in allocating their finite time and resources.

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[64] Australian Bureau of Statistics, *Household expenditure survey, Australia, 2009–10*, cat no. 6530.0, ABS, Canberra, 2011.

[65] Prime Minister's Task Group on Energy Efficiency, *Report of the Prime Minister's Task Group on Energy Efficiency*, Department of Climate Change and Energy Efficiency, Canberra, 2010, p. 32.

[66] Prime Minister's Task Group on Energy Efficiency report, p. 33.

Market failures that distort the prices for energy or uptake of energy efficiency products or services

Energy prices, particularly electricity prices, faced by consumers may not reflect the true cost of supply (including the incremental cost of network augmentation and expansion). This will lead to inefficient patterns of demand. Similarly, network regulatory structures may not efficiently value demand reduction which removes or reduces incentives for demand management and technology innovation.

Research, development and demonstration of energy-efficient technologies can face significant first-mover barriers in a market, often face higher costs and generate benefits for those who subsequently use those technologies or services.

The principal–agent barrier (or split incentives) occur where one person (the principal) pays an agent for a service, but the parties face different incentives. For example, landlords (who will seek to reduce capital costs) selecting fixed appliances or building design for their rental property do not face the same incentives as renters (who will pay energy bills) in improving energy efficiency.[67]

Regulatory and planning practices

Existing government programs and regulations can affect the uptake of energy efficiency opportunities. Planning is another area where efficiency gains can be achieved at relatively low cost. However, it is often difficult to balance the large number of competing policy priorities in planning and this can lead to suboptimal energy outcomes.

The nature of and differences in these barriers suggest that policy solutions will not be found in just one area, and that an integrated strategy that effectively targets (in a cost-effective way) a range of key market failures or gaps is needed. Efficient pricing, while a critical foundation, is not in itself sufficient to address many of the above impediments that act to reduce consumers' ability to make informed decisions.

6C.7 Shared energy productivity responsibility

The Australian Government does not have sole responsibility for the energy market and demand-side participation. It works cooperatively with the states and territories through bodies established under the Council of Australian Governments (COAG), principally the ministerial-level Standing Council on Energy and Resources, which has been established to replace the previous Ministerial Council on Energy.

On 2 July 2009 COAG signed the National Partnership Agreement on Energy Efficiency, establishing a 10-year national strategy to coordinate energy efficiency action across jurisdictions – the National Strategy on Energy Efficiency. Through the national strategy, all governments in Australia are working together to improve energy efficiency in all sectors of the economy: industrial, residential, commercial and transport.

The Australian Government works with the states and territories through the Standing Council on Energy and Resources on energy market reforms, including those that support energy productivity.

[67] Prime Minister's Task Group on Energy Efficiency report, p. 163.

The council also has a role in energy efficiency measures that act directly on the generation, distribution, transmission, and retail of energy.

The COAG announcement in February 2011 of a Select Council on Climate Change may have implications for the governance of the national partnership agreement and strategy. Jurisdictions are assessing these implications as part of their consideration of the terms of reference for the select council. The Standing Council on Energy and Resources will continue all its responsibilities for energy efficiency until the Select Council on Climate Change is established.

In addition, the Australian Government has developed and implemented programs to target specific market failures affecting households and businesses. These programs include the EEO program, minimum energy performance standards, the Solar Cities programs and the Green Vehicle Guide. Further Australian Government announcements were also made in the Clean Energy Future package, to assist industry and households to undertake further energy efficiency improvements.[68]

6C.8 Energy use productivity policy framework

The complex and diffuse nature of energy use in society means that improving energy productivity will require a policy framework that addresses the range of interlinked enabling factors that feed into decisions about the supply and use of energy.

It is about ensuring that markets and regulatory frameworks are operating efficiently, including through the pricing of energy, as well as providing consumers (businesses and households) with the tools and information necessary to make informed choices.

This will require a suite of solutions that stimulate market efficiency and business innovation and also address market failures, information gaps or other non-price barriers.

In practical terms, the general intention of the following framework is to guide government policy-making with a view to ultimately empowering consumer participation and decision-making.

Objective

The objective of the framework is to improve the productivity of Australia’s energy use and production, including through:

- developing regulatory and market frameworks that provide the opportunity for efficient demand-side and supply-side responses to the growth in energy demand
- empowering consumers (households and businesses) to efficiently and effectively manage their energy use (and costs).

[68],Australian Government, *Securing a clean energy future – the Australian Government’s climate change plan*, Department of Climate Change and Energy Efficiency, Canberra, 2011, Chapter 8.

Principles

The following principles can support the achievement of this objective:

- Cost-reflective price signals supported by sound market and regulatory frameworks that provide appropriate incentives to consumers to efficiently manage their energy use are the primary enablers of energy productivity.
- Complementary action may be required in some cases to address market failures or other non-price barriers, and to ensure that consumers have accessible and timely information to support choices around energy use.
- Market failures and other non-price barriers should only be addressed directly where this is shown to be cost-effective, and in ways that do not distort efficient operation of markets.
- Governance arrangements should support a consistent national approach to demand-side participation and energy efficiency to minimise consumer costs and overall regulatory burden.

Framework elements

The government's energy productivity policy framework has five central elements:

- market-based price signals – Energy markets are the most effective means of providing price signals so that consumers can respond to maximise the efficient use of their energy and the energy system can operate as efficiently as possible
- balanced regulation and planning – Regulatory frameworks need to ensure demand-side solutions can be realised where more effective than supply-side solutions. Direct regulatory measures such as appliance performance standards may be necessary where market or information failures exist or where individual benefits are highly diffuse and difficult to efficiently capture
- technology and services options – A range of technology and services will be needed to provide the tools to deliver effective demand-side and energy efficiency options to consumers. Governments and businesses will continue to test a variety of options both in terms of specific technological options and in terms of providing policy frameworks that support the uptake of cost-effective options
- informing consumers – Consumers must have access to accurate and timely information to make informed choices regarding their energy use
- empowering choice – By ensuring efficient market signals, and a sound regulatory framework that allows a range of technologies and services to be developed, accompanied by accessible information, consumers will be empowered to make informed choices regarding their energy use. Governments must also ensure that effective consumer protections are in place to protect vulnerable customers.

Market-based price signals

Efficient energy prices (i.e. prices that reflect the costs of supply) are a core element underpinning energy productivity, because they provide a broad signal for cost-effective energy efficiency and demand response. In turn, efficient prices mean that consumer responses should maximise the efficient use of the energy system (recognising that complementary elements of the energy productivity framework also need to be in place). Markets are generally the most effective means of providing efficient energy price signals. In the case of monopoly energy networks, regulation takes the place of the market in setting efficient price signals.

The costs of producing and delivering energy (particularly electricity) vary due to a range of factors, such as time and location. This means that even where prices reflect underlying average costs, there may still be a degree of cross-subsidisation between consumers who use energy at different times or locations. The issue arising from non-cost-reflective prices (such as uniform regulated retail tariffs) is that some consumers, who may use less energy than others (or use it at less costly times), effectively cross-subsidise others.

The Ministerial Council on Energy (now the Standing Council on Energy and Resources) has developed principles intended for application by state and territory governments when redesigning financial support for energy consumption, and these principles recognise that cross-subsidies can 'distort efficient consumption, affect production efficiencies and lead to cost padding'.[69] Ongoing and non-transparent cross-subsidies embedded in retail prices will reduce the opportunity for consumers to realise (capture and achieve) the value of better managing their consumption.

There are expected to be a greater range of energy pricing options in future, from existing flat tariffs to time-of-use tariffs. Key issues include ensuring that this evolution in the market provides benefits across the supply chain and, critically to its success, benefits consumers. A movement towards retail pricing options that appropriately reflect supply costs, while providing a fairer system that helps contain costs for consumers overall, would necessarily involve some people paying more and others less – more in line with the actual costs of their energy consumption. It should be noted that pricing reform in itself should not, on average, increase overall costs; over time it should reduce costs through greater efficiency and demand-side response to price signals.

Some energy pricing options are available that provide lower overall energy costs in return for consumption flexibility or interruptability for a few hours or days a year, particularly in competitive markets for large users who seek out such options. For example, some retailers will respond to consumer requests for customised combinations of spot market exposure and fixed pricing, although only some specialist retailers actively promote such arrangements. Energy retailers or specialist energy service businesses and aggregators provide tools and assistance to energy users to simplify energy management, making it easier for consumers to take advantage of these energy purchase arrangements.

Competition in retail energy markets is an important part of the further development of retail options to support demand response. State-based retail price regulation may act as a barrier to this. The government's work with states and territories towards retail price deregulation is outlined in Chapter 6B.

As natural monopolies, energy networks are subject to revenue and price regulation. Moving towards an appropriate level of cost-reflectivity of network charges will mean retailers, and ultimately consumers are more likely to be paying a fair share of costs for producing and delivering energy at certain times. Better targeted network pricing should lead to more efficient energy management outcomes.

[69] Ministerial Council on Energy, *Community Service Obligations: National Framework*, 2008.

Careful consideration needs to be given to the implications for consumers, and to an appropriate social safety net that provides support for vulnerable groups such as low-income households. Social policy outcomes should be delivered transparently by governments in the first instance, rather than through energy market settings. Pricing reforms must empower consumers and involve appropriate consumer engagement, while existing alongside protections for vulnerable customers.

Furthermore, the Australian Government's Clean Energy Future package has been designed such that the assistance measures to both households and business preserve price signals in a manner that does not reduce the incentive and rewards for energy productivity. Emissions-intensive, trade-exposed industries will be assisted on historic benchmark intensities, rewarding them for energy productivity improvements but protecting their international competitiveness. The Energy Security Fund is not linked to future emissions or energy production, ensuring that market price signals and incentives are preserved. Household assistance through tax reform and transfer payments will mean that households can benefit from improving their energy productivity, without any loss of assistance.

Balanced regulation and planning

Energy market regulation has developed around existing supply infrastructure and further work is needed to ensure that alternatives such as distributed generation, demand-side participation and energy storage do not confront barriers to their efficient adoption. While ultimately it will be for the market participants and energy users to decide whether to adopt these opportunities, energy market regulation needs to ensure balanced incentives for supply-side and demand-side options.

In some cases, market failures mean direct regulation of outcomes can deliver cost-effective energy use productivity, such as through minimum energy performance standards.

Harmonising regulation

More consistent energy network planning, information sets and technical standards across the country could make it easier for energy-using businesses with national reach to evaluate alternatives to using the network. For electricity networks, harmonisation of planning approaches and information publication requirements is underway through amendments to the National Electricity Rules.

Distributed generation connection and registration

Facilitating the efficient uptake of distributed generation can allow supply and demand to be balanced more efficiently in the market, and may support opportunities for cost-effective reduction of network investment. The costs of managing technical requirements could be reduced for both network companies and proponents by standardising some requirements, particularly as a larger number of similar small generators start to seek connection. This, and building on the National Energy Customer Framework to streamline the connection process for additional categories of small generation, should lower the transaction cost of connecting distributed generation.

Given the increased number of distributed generation connections (including some seeking to take advantage of short-term high prices in wholesale markets), some streamlining of wholesale market registration and participation arrangements is likely to lower transaction costs. For example, current wholesale market registration requirements were designed for larger generators, and may contain elements that are not necessary for small and medium-sized generators. The Australian Energy

Market Operator has developed its *Small generator framework design* report to consider options for improvement in this area.[70]

Balanced energy network incentives

While efficient pricing should provide an overall long-run incentive for energy users to manage their own consumption, there are very practical limits to the reflection of underlying cost variations in energy prices. Examples include transaction costs to install appropriate metering and administrative costs to manage price differences. For energy networks, investment can be 'lumpy' meaning costs might be incurred at particular places in one year, and in other places the next. Prices for network use appropriately smear these costs across network users with similar characteristics.

However, this means that network prices do not currently provide signals to energy users to look for cost-effective alternatives to specific network investments. Network regulation seeks to correct this by providing a balanced incentive for network businesses to seek out such demand-side alternatives. Such a balanced incentive should encourage lower costs of network augmentation, including by ensuring that network constraints and reliability requirements can be addressed with the most efficient combination of investment in supply-side infrastructure (generally poles and wires) and demand-side capacity.

While reforms have been made in this area, the extent to which they are effective is unclear. The Australian Government is looking to the Australian Energy Market Commission's *Power of choice* review to consider further actions as part of a broader framework within which opportunities for demand-side response and energy efficiency can be realised. The government strongly supports the objectives of the Australian Energy Market Commission review process.

Direct load control is an example of the type of option that could be offered to energy users. By automating the times that certain appliances are turned on, and providing control to avoid peak times, if widely taken up direct load control could reduce growth in peak demand and help improve the productivity of electricity networks.

Direct load control could also be used to avoid appliance energy use at times of high wholesale market prices, contributing more generally to energy system productivity. Most energy users (particularly small and medium users) would be unlikely to take on wholesale market price variations directly, meaning such targeted use of direct load control would likely be commercially offered by an energy retailer with their own exposure to wholesale costs, or an aggregator or agent acting as intermediary.

To capture the opportunity for the highest-value network and wholesale market cost savings from products such as direct load control, coordination will be required across the supply chain. It is possible, although by no means certain, that commercial arrangements could develop to support this. Again, aggregators may play a role as an intermediary between energy users and market participants.

Direct regulatory outcomes

Even if prices are fully efficient and regulatory incentives are balanced, a range of market failures can mean that direct regulation of outcomes can be a highly cost-effective option for delivering energy productivity improvements.

[70] Australian Energy Market Operator, *Small generator framework design*, AEMO, 2010.

For example, the time, specialist skills and equipment required to work out the likely lifetime energy costs of appliances make it impossible for most consumers to make these assessments themselves. One policy tool used to address this issue is minimum energy performance standards, which remove the most inefficient appliances and equipment from the market and provide additional information to consumers about the energy performance of available products. The standards are complemented by mandatory disclosure of energy performance to drive improvements above the minimum standard. These standards are expected to be superseded by the new Greenhouse and Energy Minimum Standards (see Box 6C.1).

Addressing market failures through equipment energy efficiency regulation is projected to reduce carbon pollution by 19.5 million tonnes CO_2-e over the period to 2020, at a negative cost to the community of $56 per tonne (that is, it saves money).

Box 6C.1: Greenhouse and Energy Minimum Standards

Regulation of standards and labelling is projected to save Australian households and businesses $5.2 billion in 2020 in the form of reduced energy bills.[71]

In 2009, as part of the National Strategy on Energy Efficiency, COAG agreed to develop new national legislation for appliance standards and labelling. The Commonwealth Greenhouse and Energy Minimum Standards are scheduled to commence in 2012.

National Greenhouse and Energy Minimum Standards legislation will streamline regulatory processes, simplify compliance and enforcement responsibilities and ensure consistency of requirements across all Australian jurisdictions. It will also make possible, subject to regulatory impact assessment, regulation of some new areas such as:

- products using energy sources other than electricity
- non-energy-using products that affect the energy performance of other products
- greenhouse gas intensity standards and/or labelling.

A similar approach is being taken to vehicle standards, through the introduction of mandatory CO_2 emissions standards for all new light vehicles sold on the Australian market from 2015 (see Box 6C.2).

[71] George Wilkenfeld and Associates, *Prevention is cheaper than cure – avoiding carbon emissions through energy efficiency: projected impacts of the Equipment Energy Efficiency Program to 2020*, George Wilkenfeld and Associates, Sydney, 2009.

Box 6C.2: Energy productivity and energy transformation in the transport and infrastructure sectors

The Australian Government has put in place a set of complementary measures to the carbon pricing mechanism to promote energy efficiency and reduce emissions in the transport and infrastructure sectors. These include:

- the introduction of mandatory CO_2 emissions standards for all new light vehicles sold on the Australian market from 2015
- changes to the fringe benefit treatment of cars to remove a tax incentive to drive vehicles additional kilometres
- accelerating the use of smart transport technology through the $61.4 million National Smart Managed Motorways Trial
- investing $90 million through the Australian Rail Track Corporation for a trial of the Advanced Train Management System to make our rail system more productive and efficient
- establishment of the New Car Plan for a Greener Future to help Australia's car industry deliver an improved environmental performance.

The efficiency of Australia's transport fleet has also been promoted by past measures to cut tariffs and open up the Australian vehicle market. This has encouraged greater access by consumers to innovative and fuel efficient vehicles at an affordable price.

In other cases, split incentives mean that the party making decisions with significant influence on long-term energy costs will not have to pay those costs themselves. Minimum standards for the energy performance of buildings, as delivered through state regulation and building codes, are an example of direct regulation to address this type of issue.

Governments remain open to using this type of direct regulatory intervention where clear market failures and significant benefits to consumers, and the community more generally, can be clearly demonstrated.

Proactive planning and policy

There are a range of areas where proactive consideration of energy productivity could present very cost-effective savings. These include in transport and infrastructure and urban design.

Major challenges to improving Australia's transport energy productivity will come from population growth if it leads to increased urban sprawl. This expansion could also lead to increasingly congested transport networks, particularly roads.

The energy and environmental performance of our transport sector will obtain long-term benefits from recent Australian Government reforms to infrastructure. These include:

- massive increases in transport infrastructure funding since 2008 with even greater increases in funding to (energy-efficient) public transport – the government has increased annual rail spending more than tenfold
- reforming the assessment of transport infrastructure projects, with greater transparency and publication of cost–benefit analyses to favour those projects offering the greatest net benefits in terms of emissions and fuel savings.

The Australian Government is also committed to working with state and territory governments to improve strategic planning of cities. In May 2011, the government published Australia's first-ever National Urban Policy, which sets out a vision for Australia's cities and provides guidance on how the Australian Government can facilitate better urban design outcomes.

The National Urban Policy builds on the COAG Capital Cities Strategic Planning reforms through which energy efficiency will be an important consideration for infrastructure investment.

Technology and service options

A range of technologies and services are needed to provide the tools to deliver effective demand-side and energy efficiency options to consumers. With the pace of change in technology, there are increasing options that have the potential to deliver greater energy use productivity benefits to consumers. These will also open up a variety of opportunities for retailers, distributors and other parties to offer new services to customers to help manage their energy use.

Governments have a role to ensure that the necessary regulatory and policy frameworks are in place to support broad-scale consumer access to technology and associated new products and services. These, however, must provide cost-effective benefits to consumers. Transitioning from conventional proven technologies and services to those that are new can often involve risks, challenges and in some cases up-front costs. Targeted demonstration and testing can assist in early learning and building consumer confidence.

Consumer engagement with respect to the introduction of any new technology or service will be a key to its success.

Advanced metering infrastructure or 'smart' meters

An existing barrier to efficient allocation of electricity costs to different retailers, and to more dynamic retail pricing for small consumers, is the lack of installed metering that can measure when energy is used.

Advanced metering infrastructure or 'smart' meters offer a technology solution by providing periodic – usually every 30 minutes – data reads of customer energy use. In contrast, the bulk of existing meters for small consumers are manually read accumulation meters, with readings taken four times a year. Facilitating a move towards smart meters may enable pricing structures and retail product options to better reflect supply chain costs.

Smart meters offer the ability to empower consumers to more flexibly and simply interact with the supply side of the energy market where they choose, and the potential to lower their energy costs.

Smart meters may also have communication capabilities to facilitate a wider range of additional energy services, such as operational efficiency improvements including remote reading, automated control of appliances to make it easier to manage energy use, and improvements in the timely availability of energy use information for consumers.

While these meters are available, installing them represents a relatively high transaction cost to offering demand-response products to small consumers. These costs and potential benefits need to be optimised if there is to be a wider deployment of smart meters.

Lessons need to be learned from the earlier deployments of smart meters to better understand the role this changing technology can play in our energy system and what might be the most appropriate technical configurations and deployment models.

Supporting a range of new technologies and services

There are a whole host of technologies that are now becoming available with the advent of improved communications and computerised devices which can support improved energy use productivity. Technology improvements can support more sophisticated information tools, improved processes and simpler energy management services, which could help households and businesses to reduce their energy use and associated emissions to minimise costs.

The Australian Government recognises that transitioning from conventional proven technologies and processes to those that are new involves risks and challenges. The $800 million Clean Technology Investment Program, the $200 million Clean Technology Innovation Program, and the $200 million Clean Technology Food and Foundries Investment Program are designed to support investments in energy-efficient equipment and minimise the risks associated with adopting new technologies to improve the competitiveness of Australian businesses. The government's $10 billion Clean Energy Finance Corporation will also provide support for the commercialisation of higher-productivity energy efficiency technologies.

While not necessarily increasing energy production productivity, the uptake of distributed generation such as solar photovoltaic systems, new energy storage technologies and electric vehicles also has the potential to significantly change household and business energy consumption patterns. If these technologies are able to be deployed commercially, they can potentially change the way energy users participate in the energy market, not only as consumers but also as suppliers of electricity.

Governments have a role in ensuring that these technologies can effectively integrate into existing energy infrastructure and systems. Understanding the operation of these technologies is improving and work is underway to address barriers to the integration of distributed generation, new energy storage technologies and electric vehicles into the energy system through various reviews by the Australian Energy Market Commission.

Technical standards for key technologies can reduce transaction costs for their deployment and commercial use. For example, the Australian Government's work through Standards Australia to establish a standard interface for demand response in appliances such as air conditioners and pool pumps will help lower transaction costs for direct load control and the smart use of appliances more generally.[72]

By ensuring that any barriers to the wider adoption of these technologies are removed, consumers will have greater opportunities to decide how they participate in the energy market.

Trialling new technologies

New technologies and services need to operate in the real world. It is essential that the costs and benefits of deploying these new technologies or services are tested through pilot programs in selected regions or towns. Pilot programs provide governments with the opportunity to trial new technology and services, collect information and data to inform wider-scale adoption and build consumer and industry experience with how to realise potential benefits.

[72] Demand-response standards for electrical appliances are defined in AS/NZS 4755 and its various parts.

The Australian Government has two active pilot programs underway: the Smart Grid, Smart City project and Solar Cities (see Box 6C.3).

Box 6C.3: Smart Grid, Smart City and Solar Cities

Smart Grid, Smart City

The Australian Government, in association with Ausgrid, has established the $100 million Smart Grid, Smart City demonstration project in Newcastle and other trial areas, to deliver a suite of innovative services to give consumers greater transparency about and control over their energy use. The project has the potential to inspire new opportunities to encourage and support end users to respond flexibly to the energy market.

Smart grids combine advanced communication, sensing and metering infrastructure with the existing electricity network. Smart grids can help consumers manage their individual electricity consumption and enable the use of energy-efficient 'smart' appliances that can be programmed to run on off-peak power.

The information and data uncovered as part of the trial will be available for the benefit of the broader industry. The results will inform the business case for any broader adoption of smart technologies and applications. It will also help us understand the economics of these systems, and the opportunities for consumers to manage their own energy bills.

Solar Cities

The Australian Government's $94 million Solar Cities program is designed to showcase sustainable energy models that help consumers and retailers to monitor their energy use and limit peak demand. The program is a partnership between governments, industry, businesses and local communities with trials being conducted in seven Solar Cities around Australia: Adelaide, Blacktown, Townsville, Central Victoria, Alice Springs, Moreland and Perth.

The program has been gathering data and lessons from a mix of solar technologies and energy efficiency initiatives, including solar photovoltaic and solar thermal technologies, cost-reflective pricing, load management, smart meters, in-house displays and energy audits of large, grid-connected urban sites.

The Solar Cities program has begun producing results such as the Townsville Solar City targeting a reduction in peak demand through time-of-use pricing. The trial is testing whether rebates are effective in shifting customers' consumption outside the peak hours of 6 pm to 9 pm. Preliminary results are promising: 87 per cent of participants have reduced their peak demand and there has been a 28 per cent reduction in average peak-time consumption. Peak demand on Magnetic Island has been reduced by 33 per cent from business-as-usual levels in December, the island's busiest time of year. This means that $17 million of investment in an additional power transmission cable can be put off for at least eight years. Innovative air-conditioning cycling in the Blacktown Solar City has also found savings of daily energy consumption on hot days of over 29 per cent for trial participants.

A central feature of the Solar Cities program is a database that will hold valuable information collected by the seven Solar Cities during the trials, including household demographics, types of domestic appliances, the characteristics of rooftop photovoltaic systems, and household energy consumption (at half-hourly intervals). Analysis of the data will help to identify the types of measures that reduce energy consumption and help households save on energy bills.

Informing consumers

Improving the availability and quality of consumer information and awareness of energy – or energy literacy – is fundamental for effective management of energy use and energy costs.

For this reason it is an important component of a number of the government's energy programs, particularly with respect to energy efficiency. This reflects the fact that individual consumers do not necessarily have the time, expertise or resources to fully identify and assess opportunities. Consumers, particularly disadvantaged groups, also vary in their ability to access energy information, particularly web-based or commercial products, and information should be provided in a variety of forms to ensure wider dissemination and effectiveness.

The enabling aspect of technology also means that there will be strong links between technological innovation and the quality of energy information available for decision-makers (consumers or energy providers).

Better information for energy consumers

Energy consumers typically lack detailed information on or understanding of their energy use. While an increasing variety of information is provided to consumers on options to increase energy efficiency, this can sometimes be complex and confusing. Most people do not have the time to read all information sources and can find the process overwhelming, so providing high-quality information from a trusted, centralised source is a good way to help consumers. Trusted methodologies for quantifying the benefits of demand-side participation, including energy efficiency, could assist. Energy bills reflect a wide range of activities and are often delivered long after energy use decisions are made, meaning they generally provide poor transparency around use patterns or the costs of particular appliances and equipment.

Some information (where there is a strong public good element) may be best provided by government or regulatory bodies. However, a well-structured energy productivity framework should also support energy providers or service companies to provide effective consumer information and energy management tools where this could lead to greater uptake of energy efficiency and demand response. It is an open question whether this is currently the case.

Making energy use data available to consumers, providing tools to help consumers understand their own energy use patterns, and improving transparency surrounding the costs and benefits of potential energy management actions and major purchase decisions are all important for consumers to make efficient energy use decisions.

Appliance labelling

A key policy tool to improve appliance and industrial equipment energy efficiency over time is mandatory energy rating labelling, which allows consumers to make informed decisions while providing an incentive for manufacturers to innovate above the minimum standard and gain a marketing advantage. Products currently covered by this regulation in Australia include household and commercial electrical goods such as air conditioners, water heaters, whitegoods, televisions, lights and motors.

Building Disclosure program

Energy use in the commercial building sector accounts for around 10 per cent of Australia's total greenhouse gas emissions, and this figure is rising.

Providing consistent and meaningful information about a building's performance makes it easier for organisations to buy or rent energy-efficient office space. An informed market rewards better-performing buildings. It creates a strong market-based incentive for owners to improve their properties with cost-effective energy efficiency upgrades that will increase their return on investment.

The Commercial Building Disclosure program, established by the *Building Energy Efficiency Disclosure Act 2010*, seeks to address this issue by requiring the disclosure of a building's energy efficiency to potential buyers and tenants. The disclosure obligations apply to office space of 2000 square metres or more and commenced on 1 November 2010.

The Residential Building Disclosure program is currently being developed by the Commonwealth and state and territory governments. Requiring energy efficiency information to be provided at the time of sale or rent for residential properties will allow more informed decisions to be taken and more efficient pricing in the residential building and renting sector and will promote investment in residential building energy efficiency.

Information on energy pricing and demand-response options

Given the potential for a range of energy pricing structures, it is important that consumers are able to assess and choose an appropriate option for their circumstances. The Australian Government will continue working with jurisdictions and market institutions as it implements the National Energy Customer Framework to ensure that trusted information is available on new pricing options and demand-response products (for example, through the Australian Energy Regulator's price comparator website and pricing information factsheets).

LivingGreener

The Australian Government has launched and recently upgraded the LivingGreener website – www.livinggreener.gov.au – to provide comprehensive information on living sustainably. The website will connect to all Commonwealth, state and territory energy efficiency and climate change programs.

The website provides a central resource to households and includes information on how households can improve energy efficiency to reduce energy costs and cut carbon pollution.

A household information and telephone advice line will assist those who cannot access information online. Information will also be provided via social media channels.

Consumer access to their energy information

An energy information hub, for which the government is currently conducting a scoping study, is one way of supporting a range of innovative approaches to providing information and tools to support consumers' engagement with their energy use. Such a hub could comprise a secure and private online data-sharing system that could provide consumers, or third parties authorised by consumers, with easier access to their energy information. The scoping study, which is intended to be complete in mid-2012, is also considering the potential of supporting the use of non-identifiable data for policy-making. Key considerations are security and authorisation arrangements to support consumer privacy and control over their data.

Energy bill benchmarking

Consumer bill benchmarking is a way to inform households of their electricity consumption in relation to similar households. Bill benchmarking aims to motivate consumers that use large amounts of electricity to use less by highlighting their large use compared to an available benchmark. Bill benchmarking is already happening in Victoria and parts of Queensland, and is due to be extended nationally under the National Energy Customer Framework.

Energy efficiency information grants

As part of the Clean Energy Future package, the Australian Government will establish a $40 million program providing grants over four years to industry associations and non-government organisations that work with small to medium-sized enterprises and community organisations. These groups will deliver specific and specialised information about how businesses and community organisations can improve their energy efficiency and, by doing so, mitigate the impacts of a carbon price.

Energy Efficiency Opportunities program

The Australian Government's Energy Efficiency Opportunities (EEO) program requires companies that use more than 0.5 petajoules of energy to undertake a comprehensive energy assessment and publically report on identified opportunities that have payback periods of four years or less. This provides a rich source of comparative data that can assist in identifying common points of saving and provides business-specific information for potential energy efficiency investments. Participation in the EEO program also raises the profile and understanding of energy issues in businesses where organisational barriers may have previously prevented this.

An important part of the EEO program is the capacity-building element, such as information sharing through national workshops and the Energy Efficiency Exchange website that provides a national portal to save businesses time and money in finding best-practice energy efficiency information.

The 2010 report on the program, *Continuing opportunities*, contains the latest EEO results. Businesses participating in the EEO program reported identifying possible savings of 141.9 petajoules of energy (9.8 per cent of their assessed energy use), or 2.5 per cent of Australia's total energy use. Of those identified savings, 75.5 petajoules were nominated as 'adopted' (had been, were being, or were to be implemented), 43.0 petajoules were nominated as 'under investigation', and 23.4 petajoules were nominated as 'not being implemented'. The adopted energy savings (75.5 petajoules) will result in an estimated 6 million tonnes per year of greenhouse gas emissions reductions, equivalent to around 1 per cent of Australia's annual emissions. The adopted energy savings also represent an average net annual financial benefit to industry of approximately $700 million, or $117 saved per tonne of carbon dioxide equivalent reduced (that is, a negative cost of abatement).

As part of the Clean Energy Future Package, the government announced that the coverage of the EEO program would be extended to include energy networks, the design and commissioning stage of new greenfield developments and voluntary participation by medium energy users.

Assisting skills development

Implementing effective energy management strategies requires the right mix of people and skills. It requires the skilling-up of workers and a fully informed board of directors to understand how their business manages its energy use and to identify, evaluate and implement opportunities to improve its energy performance.[73]

Programs such as the EEO program and the National Australian Built Environment Rating System are already requiring businesses to build these skills in Australian industry through their obligation to undertake mandatory energy efficiency assessments. However, gaps still remain, particularly in the mining and commercial retail sectors.[74]

Insights from the EEO program are supporting the development of other information and skills development measures under the National Strategy on Energy Efficiency. In February 2012, the Energy Efficiency Exchange will be launched as a one-stop shop for quality energy efficiency information. The site is designed save companies time when researching information to support the development of energy management strategies.

The Australian Government is working with states and territories through the National Strategy on Energy Efficiency to implement the National Energy Efficiency Skills Initiative. The initiative outlines measures to build the workforce knowledge and skills needed for a low-carbon economy and to achieve sustainability, including collaboration with universities and industry to increase the energy efficiency content in higher education courses.

The government's Clean Energy and Other Skills package will also invest up to $32 million over four years to enable tradespeople and professionals in key industries to develop the skills needed to deliver clean energy services, products and advice to Australian communities and businesses.

Energy skills and workforce development issues are discussed more fully in section 8.4.

Empowering choice

An effective energy productivity framework pulls together all the elements described above to provide consumers with improved choice. With access to information to help easily assess a variety of energy technology and service options, consumers can become empowered to make informed decisions about how they use energy. Competition among retailers and service providers is one of the most effective means of ensuring consumers have access to a variety of cost-effective energy services.

Using energy is different for each consumer. A suite of options and access to accurate information will enable consumers to make the choices that best suit their energy needs. Where choice exists, governments must also ensure that effective consumer protections are in place to protect vulnerable customers.

[73] Skills Australia, *Energy efficiency in commercial and residential buildings: jobs and skills implications*, Skills Australia, Canberra, 2011.

[74] Department of Resources, Energy and Tourism, *Report for long term training strategy for the development of energy efficiency assessment skills*, RET, Canberra, 2010.

Competitive retail services

The further development of competition in retail energy markets is the Australian Government's preferred approach to supporting the emergence of retail options to advance demand response. Such demand-side products are becoming more available for larger users and, as the market develops – and appropriate metering and control infrastructure becomes widespread – these demand-side response opportunities could be increasingly beneficial to smaller users. The deregulation of telecommunications in the 1980s and 1990s illustrates this point – it was a spur for significant innovation in consumer products. Internet access, for example, offers a range of consumer products which often have different prices, terms and conditions at different times of consumption to effectively share infrastructure capacity between different users.

Similar consumer products could be developed by energy utilities to maximise the productive capacity of the energy system. As the retail sector evolves to support more market-led productive energy use outcomes, consumer protections need to be maintained and evaluated for their effectiveness. As part of its ongoing engagement in the energy market reform process, the Australian Government will continue to work with states and territories, energy market bodies and stakeholders to ensure that appropriate and targeted consumer protections are maintained as new risks and issues are identified, including any arising in light of energy pricing or other market reforms to progress energy productivity.

Empowering choice for disadvantaged households

The Australian Government understands the importance of all Australians being able to access appropriate energy efficiency and energy management options. This is particularly important for low-income households that may be unable to afford the up-front investment required for newer, more efficient technologies. The Clean Energy Future package contains two new measures to assist low-income households which both sit under the broader banner of the Low Carbon Communities program:

- the Home Energy Saving Scheme, which will support low-income households to improve their energy and financial sustainability
- the Low Income Energy Efficiency Program, which will trial new energy efficiency approaches to assist low-income households to overcome energy efficiency barriers.

As part of the National Energy Customer Framework, a communication strategy is being developed to help ensure that all consumers, particularly disadvantaged households, have access to clear and consistent public information around changes to existing protection frameworks brought about by the introduction of the new framework. The strategy will ensure energy retailers, consumer groups and energy ombudsmen all have access to consistent information when communicating these changes to consumers.

However, for some, improvements will be difficult unless several barriers are removed simultaneously. For example, a low-income family in a rented home may need access to finance, removal of the split incentive, and information about what their options are before they can make changes to their energy use. Addressing only one of these may not be enough.

Energy savings initiative

One approach to motivating energy consumers to act to improve their energy efficiency has been through energy savings initiatives, or 'white certificate' schemes. There is evidence to suggest that even with the introduction of a carbon price, various market failures may mean that numerous cost-effective opportunities to improve energy efficiency across all sectors of the economy may not be realised. An energy savings initiative may assist in helping to unlock these opportunities. Commonly, an energy savings initiative does this by placing obligations on energy utilities to help their customers find and implement energy savings.

Already South Australia, Victoria and New South Wales have three different types of these schemes operating, and the Australian Capital Territory has announced that it is developing a scheme to start in 2012.[75]

The Australian Government is investigating a national energy savings initiative. Depending on its design and benefits outweighing costs, such a scheme could contribute to one or more elements of an effective energy productivity framework. Work in this area is being informed by advice from stakeholders and state and territory governments, and a final decision on a national energy savings initiative will be subject to removal of jurisdictional schemes, a positive cost-benefit analysis and agreement from COAG.

6C.9 Effective policy and governance

One challenge to improving energy productivity is ensuring that effective governance arrangements are in place with clear divisions of responsibility. In Australia, there are a huge number of energy efficiency programs and measures across all tiers of government. To maximise Australia's energy use productivity while minimising administrative burdens, we must ensure that regulation and programs are effectively targeted, well managed and do not overlap.

Effective governance requires access to accurate data and information about Australia's energy use productivity, how energy is used in different segments of the economy, and consistent methodologies to ensure that the best policy outcomes are achieved.

Effective governance

The International Energy Agency (IEA) states that successful energy efficiency policy outcomes are more likely if an effective system of governance is established. The IEA's definition of energy efficiency governance is the combination of legislative frameworks and funding mechanisms, institutional arrangements and coordination mechanisms, which work together to support implementation of energy efficiency, strategies, policies and programs.[76]

There are currently over 300 separate policy measures in Australia aimed at improving energy efficiency or energy use productivity.[77] These measures have been introduced by all levels of government (local, state and federal) and also include contributions by a range of market bodies and regulators. The derived nature of energy demand and the diverse benefits of energy productivity

[75] Prime Minister's Task Group on Energy Efficiency report, Chapter 4.

[76] International Energy Agency, *Energy efficiency governance: handbook*, IEA, Paris, 2010, p. 7.

[77] Prime Minister's Task Group on Energy Efficiency report, Chapter 5.

have also led to interventions across government, with measures introduced not just by energy portfolios, but also environment, transport, infrastructure, planning and treasury portfolios.

While some measures seek coordinated arrangements (for example, the COAG National Strategy on Energy Efficiency), the aggregate policy approach across all jurisdictions remains diverse and confused, with many inconsistencies and overlapping approaches. These measures are frequently far from least-cost and are driven by a range of political goals. Duplication also leads to increasing administrative costs.

Examples of inefficiencies and inconsistencies include:

- state-based schemes subsidising the replacement of light bulbs, which are already subject to a mandatory phase-out from sale through Commonwealth regulation
- solar water heaters being subsidised through a range of direct rebates from the Commonwealth, state and territory governments, as well as through renewable energy certificates under the Renewable Energy Target
- large energy users being subject to a range of state- and territory-based schemes that duplicate or overlap obligations and reporting requirements under the Commonwealth Energy Efficiency Opportunities program – many of these large energy users are businesses operating in multiple jurisdictions
- energy retailers that operate nationally needing to comply with different regulatory incentive schemes in each state and develop different services and reporting for each.

The Prime Minister's Task Group on Energy Efficiency recommended that significant improvements in energy efficiency over the medium and longer term would require a more coordinated and coherent approach, with clearly and commonly defined goals and less fragmented responsibilities.

The range of experiences of the barriers to improving energy efficiency calls for an integrated strategy to remove multiple barriers so that measures are targeted and complementary. Many of the non-price barriers will continue to exist even with a carbon price, which is why government intervention to improve energy efficiency, in accordance with the principles described earlier in this subchapter, may be complementary to a carbon price.

The Minister for Resources and Energy and the Minister for Climate Change and Energy Efficiency will undertake further work on national energy efficiency governance arrangements, for consideration by the end of 2012.

Evidence-based policy

In order for governments to develop effective policy to enhance the energy use productivity and capacity of the Australian economy, accurate data and information are needed about the way different segments of the economy use energy.

Economy-wide data

Through the energy efficiency data project (an initiative under the National Strategy on Energy Efficiency), the Australian Government, in collaboration with states and territories, has been scoping the additional data needed to construct indicators of energy intensity and energy efficiency that are more disaggregated.

The first set of new energy intensity indicators will be published on the Bureau of Resources and Energy Economics website in 2012.

Business-level data

Better understanding of energy efficiency measures and technologies, including the barriers to their uptake, is needed for the following sectors:

- medium-sized to large energy-using businesses
- large electricity users, particularly at peak load times
- sectors where energy consumption is growing.

From 2012 the Australian Government will undertake work to better understand the energy efficiency potential and barriers to energy efficiency – particularly for large energy users. The work will be conducted through the Department of Resources, Energy and Tourism and will analyse the value of prospective energy efficiency processes and technologies and will assist in the development of a marginal abatement cost curve for industry.

Household data

A better understanding of the distributional impacts of energy price rises on households and their capacity to respond is needed to inform demand-side and energy efficiency policy.

The Australian Bureau of Statistics household expenditure survey is one of the few sources of information available to governments on household energy use and its distributional impacts for varying household incomes. The survey is conducted every five years and access to a more regular dataset could help inform energy and social policy, particularly in light of increasing energy costs.

As part of the Clean Energy Future package, $10 million over three years from 2011–12 will be allocated to the Australian Bureau of Statistics and the Department of Climate Change and Energy Efficiency to conduct a survey on household sector energy consumption and expenditure. Data collected from the survey will support the design of energy efficiency policies (such as an energy savings initiative) and energy efficiency standards for buildings and appliances. It will also inform power pricing options.

The emergence of interval meters and the datasets that sit behind them may also provide an opportunity to better understand household consumption patterns. This is particularly valuable when thinking about policy measures that seek to target the issue of growing peak demand. Privacy of information and security of household data will need to be carefully considered.

6C.10 Key actions

- The Australian Government will lead further work (with states and territories and energy market institutions) to improve energy productivity by undertaking work to:
  - better understand the issue in the context of energy markets and consumer behaviour
  - identify barriers, particularly in seeking to minimise the costs associated with increasing peak demand
  - develop effective and efficient measures to overcome identified barriers.
- Specifically, further work will be undertaken with states, territories and market bodies, focusing on:
  - network incentive structures
  - process improvements for connection of embedded generators
  - frameworks to support delivery of new energy management and pricing products and services to consumers, including those supported by smart metering infrastructure
  - retail competition and pricing deregulation (while ensuring appropriate protections for vulnerable consumers)
  - investigating the possibility of a national energy savings initiative.
- The government will progress work to look at energy efficiency governance structures.
- These initiatives build on existing work, including:
  - the $40 million energy efficiency information grants
  - the $100 million Low Income Energy Efficiency Program
  - the new $10 billion Clean Energy Finance Corporation, which will assist innovation and commercialisation, including to enhance energy use productivity
  - the $800 million Clean Technology Investment Program and the $200 million Clean Technology Food and Foundries Investment Program, which will support investments in energy-efficient equipment
  - the $200 million Clean Technology Innovation Program will support business investment in low-emissions research and development in the areas of renewable energy, low-emissions technologies and energy efficiency information provision through the LivingGreener website and telephone advice line, and the Energy Efficiency Exchange 'one-stop shop' for information on energy efficiency
  - the Energy Efficiency Opportunities program's extension to energy networks, new greenfield developments and voluntary participation by medium energy users
  - building skills and capacity necessary for a low-carbon economy through the Clean Energy and Other Skills package, the National Energy Efficiency Skills Initiative, and by considering energy efficiency and clean energy skills gaps in broader workforce development initiatives under the National Workforce and Productivity Agency

7 The clean energy transformation

Highlights

- Australia faces an unprecedented challenge in transforming to a clean energy economy.
  - Treasury modelling suggests that some 260 terawatt hours of new clean energy capacity may be required by 2050.
  - This represents over $200 billion in new generation investment.
- The efficient pricing of energy and carbon through competitive market structures will drive the transformation.
  - Australia's energy mix will diversify through a combination of renewable energy, fossil fuel–based (possibly with capture technologies) and hybrid technologies with innovative storage or booster combinations.
  - This will create new business opportunities and jobs across the energy supply chain.
  - The long-lived nature of energy investments and the relative immaturity of large clean energy technology options at present mean that this transformation will be a long-term process.
  - Ultimately the lowest-cost, most reliable technologies will succeed.
- Our clean energy future holds great promise, but realising the potential of new technologies will require a concerted collaborative effort by business, government and the research community to overcome many current technical and cost barriers.
  - Australia has a range of world-class research institutions and capabilities in solar, carbon capture and storage, and other key technologies, and a strong innovation and engineering base.
  - Australia can better leverage these capabilities through national and international partnerships and deeper collaborative relationships.
- Accelerating the rate of innovation and early proving of commercial potential for key technologies will assist markets to respond to the clean energy challenge more quickly, and at potentially lower cost.
  - The Australian Government is committing up to $17 billion in the next decade for clean energy technology development, demonstration and commercialisation.
  - If large-scale technologies such as carbon capture and storage, geothermal or large-scale solar fail to emerge, future Australian governments may need to consider other clean energy alternatives to minimise the risk of significantly higher adjustment costs.
- Australia as a society must have a mature debate about our future energy directions. The more we limit our energy options, the higher will be the risk and cost of meeting our climate change and energy goals.
- Governments should invest national effort wisely, including through building a deeper global engagement on those technologies that hold greatest strategic prospects for Australia.
- Aggressive global markets for clean energy technology development, supply and services are already emerging. As a medium-sized open economy, we should be prepared to capture economic and social benefits of new jobs, skills and industrial capacities by adapting and applying overseas technologies as well as through the development of new technologies.

7.1 Introduction

The previous chapters have highlighted the significant long-term transformation that needs to occur in the way we produce and consume energy and what this will mean for policy-makers, businesses and consumers.

This transformation will be a massive challenge. Policy goals for clean and sustainable energy must be integrated with the need for ongoing energy market development and delivery of reliable, competitively priced energy if they are to prove enduring. The cost and risks must be manageable for the economy and consumers and energy security must be maintained.

To this end, the Australian Government has put in place a robust policy framework that will provide long-term market signals to drive efficient deployment and targeted support to stimulate and accelerate the development of new clean energy technologies. The key elements of the clean energy framework have been defined through previously announced measures and more recently through the government's Clean Energy Future package.

Optimising the pace of change, addressing technical and regulatory barriers, efficiently targeting and prioritising resources to help develop technologies to commercial viability, and ensuring that new technologies can effectively integrate into energy markets will remain key policy considerations over the coming decades.

7.2 Determinants of a clean energy future

What are clean energy technologies?

The term 'clean and sustainable energy' refers to sources of energy, technologies or processes that produce lower or zero greenhouse gas emissions relative to conventional counterparts and that meet appropriate social, environmental, health and safety standards.

Clean energy technologies can include zero- or low-emissions technologies for electricity generation or other applications as well as supporting technologies such as energy storage or energy systems management technologies, and clean transport technologies. Clean energy includes renewable as well as fossil fuel based technologies, or hybrid combinations which may offer a more commercial transition to broader adoption by reducing risk and innovation costs. More efficient end-use and industrial energy technologies also have an important role in promoting energy productivity and reducing greenhouse gas emissions.

Clean energy technology development and commercialisation is also linked to successful integration with information, communication and system control technologies. Examples include balancing energy systems that incorporate variable renewable energy supply sources, and remote operation of distributed or off-grid renewable energy capacity (see Box 7.1).

In the policy context, there is the need for an open mind regarding safe clean energy technologies that can form part of our clean energy future. Limiting future clean energy options would potentially lead to higher costs in meeting our environmental goals and/or not maximising our wealth creation opportunities.

Box 7.1: Enabling technologies for integrated clean energy solutions – Redflow Limited

Successful commercialisation and deployment of intermittent and variable renewable energy technologies often needs a 'bundled' solution which relies on the integration of a number of distinct technologies.

Redflow's core intellectual property centres on its development of the zinc-bromine battery module (ZBM) targeted to applications such as a companion energy storage solution for solar photovoltaic electricity generation. The company provides a packaged solution integrating its ZBM with power electronics, remote management and control systems into a fully functioning electricity storage system for grid and off-grid applications.

Key early contracts have included solar photovoltaic ZBM units for grid voltage support at peak evening times in rural areas; demonstration hybrid power supply units (solar photovoltaic, diesel generator, ZBM) to allow the overhead electricity network to be turned off in extreme bushfire weather; and demonstration of the integration of Redflow units with smart grid technology in the Australian Government's Smart Grid, Smart City trial.

The drivers of change

Driving the clean energy transformation is the need to move national and global energy systems to a lower emissions trajectory by developing and deploying cleaner and more carbon-efficient technologies, know-how and processes.

Australia will also need to ensure that our energy is clean and sustainable from a policy, social and trade perspective. A number of major studies demonstrate how delaying this transformation and not providing sufficient support for innovation can impose higher adjustment costs due to the long-lived nature of investments in the energy sector and the risk of technology 'lock-in'.[1]

The Australian Government acknowledges that cleaner energy will impose marginally higher energy costs on consumers in the short to medium term. However, it will also offer commercial opportunities for innovative Australian researchers and businesses through the creation of new jobs and skills and regional development opportunities, and potentially support our export industries.

For example, successful commercialisation of carbon capture and storage technologies worldwide could help sustain Australia's long-term fossil fuel exports.

Similarly, the experience gained from developing and trialling other clean energy technologies such as large-scale solar, geothermal and energy storage technologies may enable the export of intellectual expertise and investment opportunities for Australian companies.

[1] Treasury, *Strong growth low pollution: modelling a carbon price*, Treasury, Canberra, 2011; R Garnaut, *The Garnaut Review 2011: Australia in the global response to climate change* ,Cambridge University Press, Melbourne, 2011; N Stern, *The Economics of Climate Change: The Stern Review,* Cambridge University Press, Cambridge, 2006; IEA, *World energy outlook 2011*, IEA, Paris, 2011.

The scale of the clean energy challenge

As Chapter 3 highlighted, under the Australian Treasury's modelling of the carbon pricing mechanism (government policy scenario), clean energy technologies could provide the majority of Australia's large-scale electricity generation by 2050:

- fossil fuel–fired carbon capture and storage (CCS) plant could provide between 26 and 32 per cent of total generation (90 and 125 terawatt hours (TWh) a year)
- geothermal energy could provide between 13 and 23 per cent (50 and 80 TWh a year)
- wind energy could provide between 13 and 15 per cent (45 and 60 TWh a year)
- large-scale solar could provide around 3 per cent (10 TWh a year).[2]

To get a sense of the effort that will be required to reach these levels, there is currently no significant Australian CCS, large-scale solar or geothermal capacity in operation today, and wind energy under the Treasury's modelling comprises around 3 per cent of the current generation mix (or 6.5 TWh).

Achieving this outcome could require investment of more than $200 billion in new generation between now and 2050. This includes around $50–60 billion in gas, $100 billion in renewables, and around $45–65 billion in coal, nearly all of which is for CCS plants.[3] This compares to an estimated $12 billion investment in new generation capacity since the commencement of the National Electricity Market in 1998.[4]

A similar scale of transformation is in prospect for Australia's transport energy sector. Under scenarios recently modelled by CSIRO (see section 6A.2), by 2050 the growth in a number of transport fuels and technologies with zero or minimal presence in the market today is projected to be significant (see Box 7.2). Biodiesel could be contributing around 13 per cent of total transport fuel consumption, natural gas transport fuels around 12 per cent, bio-derived jet fuel around 8 per cent, electricity for transport around 5 per cent, and synthetic diesels around 2 per cent.[5]

These outcomes are far from predetermined. Under the carbon pricing mechanism, Australia's energy mix will be determined by the market selecting the most efficient mix of technologies and fuels in response to the combination of carbon and energy prices. The national clean energy policy framework will ensure that markets operate efficiently by supporting new technologies to quickly move to commercial viability by overcoming current technology and cost barriers so that the most cost-effective options are available.

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[2] Treasury, *Strong growth low pollution*.

[3] SKM MMA, *Carbon pricing and Australia's electricity markets*, Treasury, Canberra, 2011; ROAM Consulting, *Projections of electricity generation in Australia to 2050*, Treasury, Canberra, 2011. The reported technology component ranges reflect estimates across both sets of commissioned modelling. The reported total clean electricity investment figures are obtained directly from each model; for this reason it is not appropriate to add the component ranges to derive a total investment figure.

[4] Investment Reference Group, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, Canberra, 2011.

[5] CSIRO, *Road transport sector modelling*, report prepared for Treasury, 2011.

Box 7.2: Emerging vehicle technologies

Chapter 6A canvassed alternative liquid fuels and Chapter 6C included discussion of how improvements in transport use infrastructure and urban planning can improve transport efficiency and emissions reductions.

There are also a number of emerging technologies that provide opportunities to cut emissions, particularly electric and hybrid electric vehicles. Plug-in hybrid electric vehicles provide an intermediate step on the way from conventional internal combustion engine vehicles to pure electric vehicles by supporting early-stage design and battery technology development.[6]

Electric vehicles can include all-electric or battery electric vehicles, plug-in and hybrid vehicles. A plug-in electric vehicle has a rechargeable battery that can be charged from the electricity grid.

Plug-in hybrid electric vehicles would rely mostly on their batteries, and be recharged at night or during work hours, but could also be charged by a conventional internal combustion engine, particularly for longer trips. This means manufacturers can produce different plug-in versions that have different degrees of reliance on the electric components for the delivery of power and energy. Innovation recharging options (such as drop-in battery replacement) are also being developed to improve customer convenience.

Treasury modelling suggests that electric vehicle uptake is likely to be modest, particularly in the short to medium term, due to cost and the relatively slow speed of vehicle fleet turnover.[7] Nonetheless, a number of commentators suggest that they have significant potential as a 'disruptive' technology if current barriers can be addressed. These include:

- limitations in battery technologies that affect the cost, performance and efficiency
- establishing charging and battery infrastructure, including the development of standards for vehicle recharging equipment
- managing impacts from recharging on electricity grids (through smart metering or other measures) to avoid sudden and simultaneous recharging of numerous electric vehicles at times of peak electricity demand
- increasing consumer awareness and understanding of the performance of electric vehicles.

Initial analysis of possible impacts of increasing uptake of plug-in hybrid electric vehicles on electricity networks suggests that even a relatively high level of electric vehicle adoption would result in only a moderate increase in demand for electricity. New metering and pricing structures (including through smart metering) could support recharging patterns that create a flatter overall demand profile.[8] This could provide some benefits by reducing the need for more expensive peak generating capacity.

The Strategic Framework for Alternative Transport Fuels provides further background on electric vehicles and opportunities for electric vehicles.

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[6] IEA, *Transport, energy and CO_2: moving toward sustainability*, IEA, Paris, 2009, p. 133.

[7] Treasury, *Strong growth, low pollution*, p. 132.

[8] J Järvinen, F Orton and T Nelson, *Electric vehicles in the NEM: energy market and policy implications*, AGL Applied Economic and Policy Research, working paper 27, October 2011.

Factors for future success

Carbon, renewable energy certificate and energy prices are only three elements in a complex set of factors which will determine clean energy outcomes. Other critical factors include:

- accessibility of low-cost clean energy resources
- a strong indigenous clean energy technology capability, including in terms of:
  - access to relevant clean energy intellectual property
  - an appropriately skilled and available workforce, including entrepreneurial and management capacities
  - reliable supply chains and support industries
- links into international expertise
- alignment of regulatory and administrative regimes across jurisdictions that provide appropriate certainty for investors and confidence for the community
- an ability to attract cost-competitive financial capital
- adequate supporting infrastructure, such as electricity transmission lines, gas pipelines, water supply, rail and port infrastructure, and gas storage and export terminals.

Some of these factors are further discussed below.

Australia's clean energy resource potential

Australia has some of the world's best renewable energy resources. For example, we have:

- the highest average solar radiation per square metre of any continent in the world
- some of the world's best onshore wind resources along our southern coast
- significant potential hot rock geothermal resources, estimated at around 1.9 million petajoules, which is roughly 25 000 times Australia's primary energy use
- large and diverse bioenergy resources and significant space in which to generate bioresources
- abundant wave energy resources along the western and southern coastlines, and tidal resources particularly in the north-west.[9]

The true energy potential of some of these renewable energy resources, such as hot rock geothermal and ocean energy, is not as well understood as is our fossil fuel base. As clean energy technologies are developed, we may find that these sources of energy are significantly different than currently estimated.

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[9] Geoscience Australia and ABARE, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, Canberra, 2010.

Australia's gas reserves could also make an important contribution to our clean energy potential. As discussed in Chapter 3, gas use is projected to substantially increase. A key role for gas will be to match intermittent and variable renewable energy sources like wind and solar in order to maintain system reliability.

Australia also possesses extensive and highly prospective geological storage sites for carbon dioxide onshore and offshore. These could support development of near zero net emissions coal-fired or gas-fired baseload electricity generation.

Many of Australia's best renewable energy resources are located remote from the electricity grid. There are particularly good opportunities for renewable energy uptake in some of these areas where there is growing demand from mining activity and population growth, and rising fuel costs for gas and diesel. The Australian Government commissioned a study in 2011 into the potential to increase the penetration of renewable energy in off-grid electricity generation, focusing on the Mid-West and Pilbara regions of Western Australia. Further work in this area could improve the information base needed to take advantage of the favourable conditions for renewable energy in off-grid locations.

There is also scope for Australia to derive significant benefits from this clean energy potential in the form of clean energy exports. Apart from our expanding liquefied natural gas exports, possibilities include using solar energy to further process natural gas to hydrogen fuels, or low-emissions production of synthetic liquid fuels from coal or natural gas with the incorporation of carbon capture and storage technology. Similarly, our projected uranium resources can supply zero-emissions baseload energy for countries that use nuclear power.

Australia's technical base

The adequacy of Australia's technological and engineering capabilities will also significantly influence our ability to realise our clean energy potential. In this regard, there is established evidence that Australia is well placed. For example:

- Australian researchers have been internationally recognised for their ground-breaking work in solar photovoltaic (PV) energy research and Australia is a world leader in particular PV technologies. One example is the work and reputation of the University of New South Wales' PV research team and Solar Industrial Research Facility and the progression of trained research personnel from this team into leading solar PV companies and institutions around the world.
- Australia has well-developed basic and applied research, development and demonstration institutional capabilities in the form of CSIRO's energy and advanced manufacturing research programs, a number of world-class energy-related university research schools, and cooperative research centres such as the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) and primary industries research and development organisations.
- Australia's energy markets have been demonstrably successful in reliably integrating high levels of wind energy on Australian grids (notably in South Australia), managed within a competitive market structure.

However, enhancing or even maintaining this capacity will require focus and further resources by governments and business. In particular, there will be a growing need for education, training and workforce development.

Linking with global effort and creating commercial potential

Clean energy technology innovation is an increasingly global pursuit – many countries and companies are undertaking ambitious technology development programs.[10] Australia's success in linking with this effort will be crucial for technology innovation.

This global effort will provide enormous benefits to Australia through access to a broader set of ideas that could not all be pursued entirely domestically, lower-cost technologies made possible by manufacturing economies of scale overseas, and the opportunity to partner in international research.

In addition to linking with international efforts, it is also important to facilitate linkages within Australia between governments, research institutions and businesses. Collaborative partnerships and networks enable the knowledge sharing needed to more effectively tackle clean energy technology and cost barriers (see Box 7.3).

Box 7.3: Collaboration for world-class innovation

The Victorian Organic Solar Cell project is a promising example of world-leading clean energy innovation, although at an early prototype stage. It strongly highlights the benefits of collaboration and the strengths of Australia's national innovation system.

This project is developing technology to move away from solar cells based on silicon, to solar cells using polymer technology or dye-sensitised nanomaterials to print solar cells onto flexible sheets, including steel, using existing printing methods. This technology could allow cheap mass production of solar cells that can be installed over large areas such as rooftops.

The consortium leading this project brings together world-class scientists spanning chemistry, physics and materials science, and companies with expertise in the relevant technologies and capabilities in commercialisation. The consortium includes industry partners BlueScope Steel, Securency International, Innovia Firms UK and Robert Bosch (SEA), and research partners the University of Melbourne, Monash University and the CSIRO Future Manufacturing Flagship program, with support from the Victorian Government.

Australia, as a medium-sized open economy, is well placed to identify and capture emerging commercial opportunities to import and adapt clean energy technology and knowledge developed in other countries (also known as fast-following) for deployment in Australia.

Adapting technology developed overseas often requires significant research to work with unique Australian conditions, including our geography, energy systems and electricity markets. Fast-following can be highly efficient for economies such as Australia and can lead to spin-off innovation and the development of intellectual property in its own right. Australia's innovation support frameworks and measures must embrace this reality to ensure that the best clean energy options are available for the market.

Australian researchers and businesses can also play a key role in the development of clean energy technologies. For example, Australian researchers have made numerous solar technology

[10] Department of Innovation, Industry, Science and Research, *Powering ideas: an innovation agenda for the 21st century*, DIISR, Canberra, 2009.

breakthroughs that have been adopted internationally. Australian research institutions are also leading global players in the development of carbon capture and storage and solar technologies.

In an increasingly globalised economy, it is likely that many of the business opportunities for clean energy technologies will be in research and development and high-value-add engineering and design of specialist components inside international supply chains rather than in the development of cradle-to-grave industries.

The Australian Government, through its science and innovation and clean energy programs and through bodies such as CSIRO, is committed to supporting firm-level innovation and development and working with Australian innovators and entrepreneurs to identify sustainable commercial opportunities for wealth creation (see Box 7.4).

Box 7.4: Creating clean energy business opportunities

Engineering manufacturing and service firms have the potential to innovate and adapt to take advantage of new clean energy business opportunities, particularly as continuing structural changes in Australia's manufacturing sector alter the traditional client base for engineering firms.

Hofmann Engineering Pty Ltd is transforming its customer base from resources and mining to clean energy as part of an ongoing diversification strategy. First established in 1969 in Perth, Hoffman Engineering has over the last decade built a competitive market position in Australia and in key export markets as a high-quality specialist provider of mining equipment and industrial gearboxes.

In 2009 it expanded in Victoria and in South and North America as part of its strategy for larger, more global business integration. Leveraging from these strengths, the company has also diversified into equipment and support services for wind turbine gearboxes and has developed a 1 megawatt tidal turbine transmission prototype.

Hofmann Engineering has utilised a range of support from Australia's innovation system, including working with CSIRO's Future Manufacturing Flagship program and other research organisations.

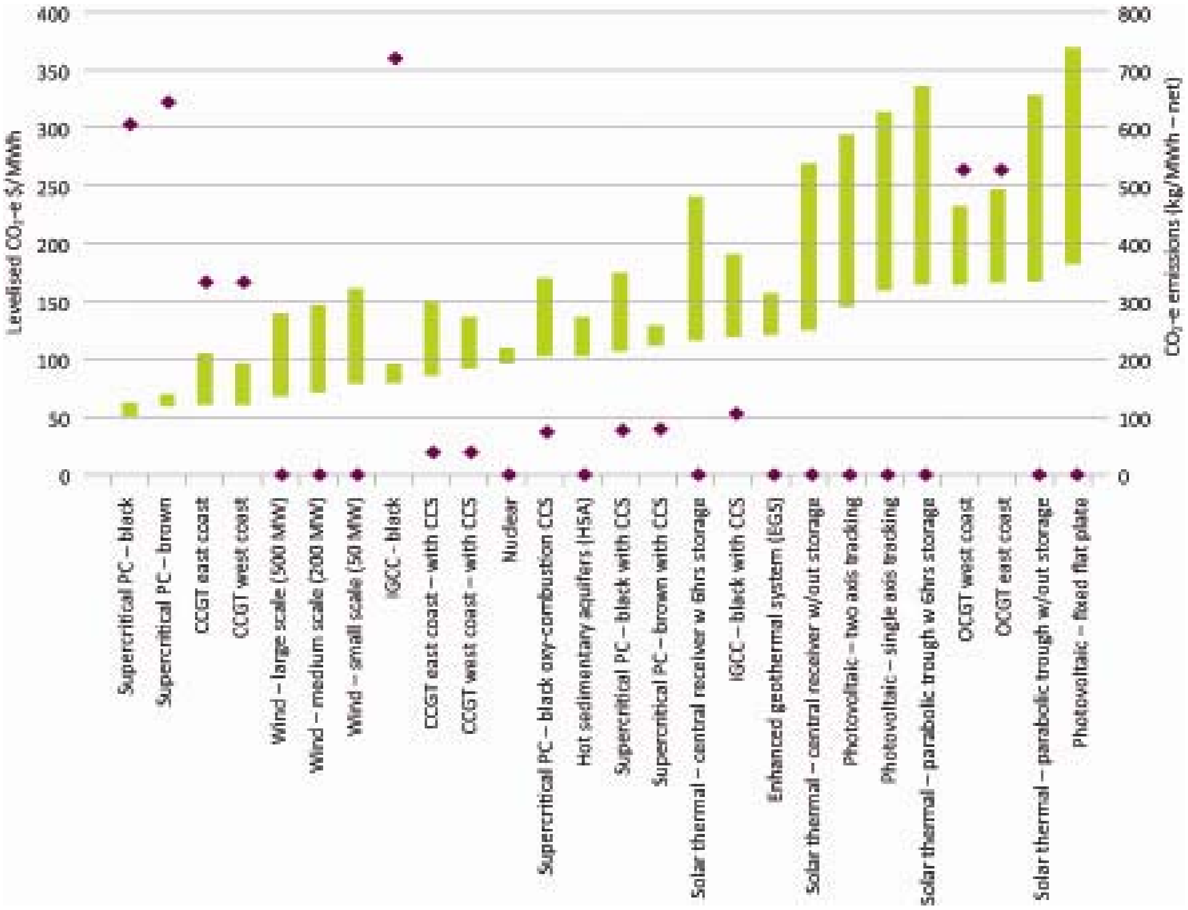
Understanding the cost of clean energy technologies

Ultimately, cost combined with reliability is the most critical determinant of a technology's success in the commercial market. Markets must have a well-developed understanding of technology cost potential, including the relative importance of capital and operating costs, the potential for enhanced learning or production efficiencies, or sensitivities to other input costs. Providing a transparent and consistent set of estimates for a range of technologies through time serves as a base input for broader assessments, and can help policy-makers assess the efficacy of policy settings and support in bringing down technology costs.

Comparisons of the costs of electricity generation from various technologies are frequently represented by the respective levelised costs of electricity (LCOE). The objective of the LCOE is to determine the price at which electricity must be generated from a specific plant to break even, taking into consideration costs incurred over the life of the plant. When applied to prospective future electricity generation technologies, particularly intermittent and variable energy sources, LCOE estimates only provide a high-level guide to possible future competitiveness.[11]

The most recent LCOE projections commissioned by the Department of Resources, Energy and Tourism for a range of electricity generation technologies in 2030 are shown in Figure 7.1. These estimates broadly suggest that new plants in a number of technologies – including wind, carbon capture and storage on coal- and gas-fired power, geothermal and solar – could successfully compete into a LCOE band range of around \$70 to \$140 per MWh (real 2009–10 dollars).

Figure 7.1: Projected technology costs ranges, 2030



Note: The green bars illustrate projected cost ranges by technology for a new-build plant, based on a range of assumptions on input costs and other factors such as rates of learning and technology efficiency. The red dots indicate an estimate of the emissions intensity (kg CO_2-e per MWh – net) by each technology based on projected efficiency gains and Australian-based technology performance. Emissions intensities are based on CO_2-e emissions from combustion and do not attempt to measure life-cycle emissions.

Source: Electric Power Research Institute, *Australian electricity generation technology costs: reference case 2010*, report prepared for the Department of Resources, Energy and Tourism, 2010.

[11] LCOE as an assessment tool has several limitations that caution against its use for predictive assessment or as an estimator of economic value in an electricity market. LCOE generally does not include exogenous policy or regulatory costs such as carbon costs, additional network-related costs or location-specific costs such as connection costs. It also does not take into account any time-varying prices for energy, which can be critical in determining market competitiveness. Understanding these factors, which are important in assessing overall viability, would require project-specific analysis or broader economic or energy system modelling.

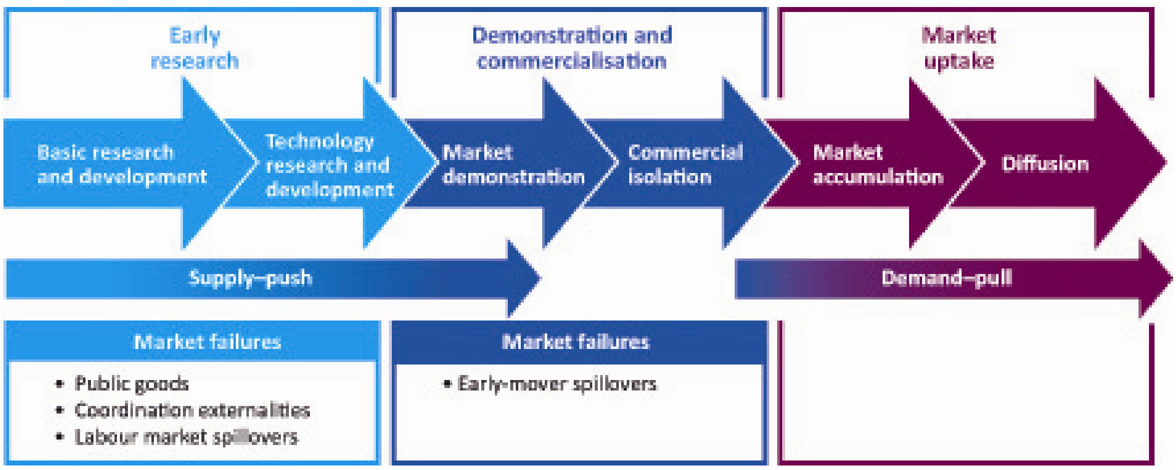
LCOE estimates for new electricity generation plants can change significantly in a short period due to global and local factors. For example, in recent years the resources boom in Australia has increased global costs of components (for example, steel) and fuels that input to the costs of building and operating a new plant. At the same time, rapid technological changes and increases in global production volumes have resulted in major reductions in the component costs of some emerging technologies such as photovoltaic solar modules. Locally, increasing deployment is also leading to learning-by-doing cost reductions in design, installation and grid integration for some technologies such as wind and photovoltaic solar.[12] Changes in the Australian dollar can also affect technology costs – particularly where significant capital components are imported.

To promote greater consistency and transparency in Australia's energy technology information base, the Australian Government (through the Department of Resources, Energy and Tourism) will work with the Australian Energy Market Operator and key business and other stakeholders to regularly update and publish the Australian Energy Technology Assessment as a companion to the Australian Energy Resource Assessment. This will build a more comprehensive set of assessments for existing and emerging energy technologies. Similarly, this work will include cost estimates for a range of transport fuels and technology in Australia. These planned assessments are discussed further in Chapter 9.

Technology innovation, market failure, risk and other barriers

Understanding the innovation cycle is fundamental to understanding the development of clean energy technologies, and can help identify where and how government support for innovation may be best applied. Policies can encourage the supply of new technologies or create a demand signal, such as the carbon pricing mechanism. Figure 7.2 shows the principal stages of innovation and associated market failures, the characteristics of which are also described in Box 7.5.

Figure 7.2: The innovation chain and key market failures



Source: R Garnaut, *Update paper 7: Low emissions technology and the innovation challenge*, Garnaut Climate Change Review – Update 2011, Canberra, 2011, p. 9.

[12] CSIRO, *Unlocking Australia's energy potential*, report prepared for the Department of Resources, Energy and Tourism, 2011.

In practice, the development and commercialisation of new technologies is a complex interaction of processes involving many actors and decision points. It is rarely linear and almost certainly will involve missteps, relearning and retesting or modification of concepts at different points. All these outcomes contribute to ultimate learning around technology outcomes. This makes predicting technology development pathways or locking in technology-specific policy frameworks a risky endeavour.

Box 7.5: The characteristics of technology development

Concept research and development – Contributions are made at a laboratory scale, with few immediate commercial returns. Discovery and developments are usually incremental and the failure rate is high. Private sector investment in concept or early-stage research and development is often low due to inherent knowledge externalities and/or public good character and lack of connection to commercial application.

Demonstration and commercialisation – The new knowledge is applied to the real world through pilot, demonstration and first commercial-scale projects. These activities require research bodies or firms to take on substantial risk as the technology requires proof in the intended operating environment and may not be cost-competitive at first (such as a first-of-a-kind deployment) – even in cases that later become commercially successful. This is often referred to as the 'valley of death' stage for clean energy technologies as the large capital requirements, long time horizons and high risk that investors perceive are attached to these projects may not be matched by prospective high returns and can cause difficulties in attracting finance.

Deployment and diffusion – Once new knowledge becomes embodied in a tested product or service, it is sold to the open market. Technologies at the market uptake stage should compete with other mature products in the marketplace, with successful instances being associated with falling costs as market share expands.

Source: Adapted from R Garnaut, *Update paper 7: Low emissions technology and the innovation challenge*, Garnaut Climate Change Review – Update 2011, Canberra, 2011.

The role of the private sector in driving commercialisation

Well-functioning energy and carbon markets that provide technology innovators and end users with efficient long-term price signals provide a powerful 'pull through' incentive for private sector investment in innovation.

As clean energy technologies develop from research towards full commercialisation, the market will build an information base about their cost and performance. It is important that private investment sources are increasingly prominent as private capital introduces the market discipline and entrepreneurial management needed for long-term commercial success. Firms and markets are also generally more effective than government at managing technology and project risks.

Addressing market failure and other barriers to innovation

However, market drivers alone are not always sufficient to support an optimal innovation effort. Well-documented market failures and non-price barriers, particularly for large-scale 'risky' technologies, mean that the private sector may not invest adequately in the commercialisation of clean energy technologies.[13]

Many disincentives stem from the inability of firms to capture sufficient benefits from their investment due to the spill-over effects of knowledge and skills transfers to other firms in the industry. In addition, early movers may bear the bulk of establishment costs. These can include the costs of developing new regulations and standards, building new reliable supply chain and services support, promoting community awareness, and educating debt and equity providers on technical and commercial performance of new technologies – all of which can benefit later competitors.

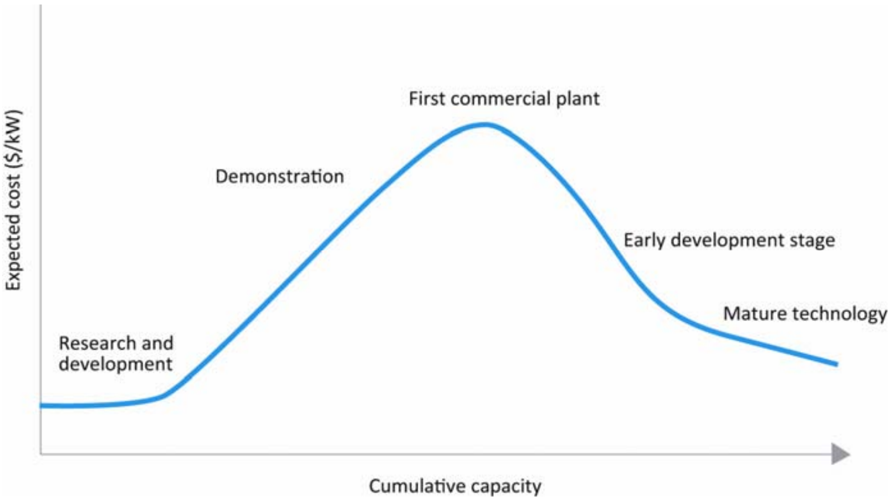
In addition, companies in the clean energy sector can often face difficulty in attracting investment capital on adequate commercial terms owing to high project risk, high up-front capital costs and therefore long-term financing requirements. To the extent that this results from a lack of accurate information on technical performance or risk, efficient investment decisions are impaired.

Government support for innovation should be based on demonstrated market failure, not displace or compete with private sector activity, and demonstrate a net public benefit.

Technology development costs typically rise during the research, development and demonstration phases, but decline as deployment increases and generates learning-by-doing and economies-of-scale cost reductions. This is illustrated in Figure 7.3.

A particular challenge can often arise for government in structuring support for large-scale first- or second-of-a-kind commercial plants where technology risks or market failures may have largely been addressed but experience is not available to provide sufficiently predictable capital and operating costs and revenue projections necessary to secure commercial finance due to the revenue earning gap. This is a particularly fraught area given the potential to distort competitive energy market decisions. The need for revenue predictability is a particular challenge as technologies are deployed early in their development phase.

Figure 7.3: Technology progression with change in cost with increasing cumulative capacity



Source: CSIRO, *Projections of generation costs*, CSIRO, Canberra, 2011.

[13] Market failures across the clean energy innovation cycle have been identified, for example, in the International Energy Agency’s Energy Technology Perspectives 2010, the Intergovernmental Panel on Climate Change Fourth Assessment Report, and the Garnaut Climate Change Review Update 2011.

Identifying or defining first-of-a-kind projects can also be challenging. A key consideration is likely to be the importance of the technology and the ability to generate learning or demonstration benefits from operation at commercial scale in the Australian market. However, it is clear that beyond this point there are fewer grounds for ongoing public support, and outcomes should be predominantly driven by the market and commercial factors.

The Australian Government should also be strategic in its investment and consider where we can adopt and adapt technologies from overseas, and where we can and should be a technology leader. These challenges are discussed further in section 7.4.

7.3 Clean energy policy framework

The Australian Government's clean energy transformation policy framework builds on the factors identified in section 7.2 and is designed to meet the overall objective of national energy policy as well as contribute to the government's overall climate change and emissions reduction targets.

The clean energy policy framework is based on a set of objectives and operating principles. The key elements of the framework are also defined in reference to the government's Clean Energy Future package and previously announced energy measures.

Objectives

The objectives of the clean energy policy framework are to:

- support the efficient long-term transformation of the Australian energy system to a low carbon footprint consistent with our national social, economic and environmental objectives and targets
- ensure that Australian energy markets have timely commercial access to the broadest range of proven and effective clean energy technology options
- capture the economic and social benefits of clean energy through the creation of new jobs, skills and industry capacities, and to promote the sustainable export of Australian clean energy goods and services.

Principles

The following principles can support the achievement of these objectives:

- Australia's energy technology and fuel mix should be determined by the market rather than government mandates.
- Government support for clean energy technology development should be prioritised and regularly re-assessed against national energy objectives, and interact efficiently with the Australian Government's broader innovation policy framework.[14]
- Government support mechanisms should reflect the long-term nature and complexity of clean energy technology development.
- Clean energy measures should interface effectively and efficiently with other aspects of energy policy (particularly energy market design and operation) and should complement carbon pricing.

[14] The Department of Innovation, Industry, Science and Research website (www.innovation.gov.au) provides details on the Australian Government's innovation framework and national innovation priorities.

Framework elements

Australia’s clean energy policy framework has three core foundations:

- clean energy deployment
- clean energy innovation
- enabling activities.

Clean energy deployment

Deployment initiatives target clean energy technologies that are already commercially accessible by the market, and generally seek to redress the current cost difference between clean energy and conventional counterparts. They also provide a ‘pull through’ incentive for the development of new technologies.

The Australian Government has two primary clean energy deployment measures – the carbon pricing mechanism and the transitional Renewable Energy Target.

The carbon pricing mechanism will apply to large emitters (over 25 000 tonnes of CO_2-e a year), with broad coverage across the energy sector. It will commence with a three-year fixed price on emissions of $23 per tonne of CO_2-e in 2012–13. This will rise to $25.40 in 2014–15, after which the mechanism will transition to a floating price with a set floor and cap price. Introducing a floating price under progressively tighter emission caps provides a powerful incentive for technology innovation.

The legislated 20 per cent by 2020 Renewable Energy Target scheme secures an additional 45 000 GWh a year of renewable electricity generation by 2020 and continuing to 2030, through the creation of a regulated market for tradeable renewable energy certificates. From 2011 the Renewable Energy Target scheme has been divided into two components: the large-scale renewable energy target and the small-scale renewable energy target. This measure supports the early deployment of least-cost, commercially available renewable energy technologies and helps to build renewable energy industry capacity ahead of the introduction and maturity of a carbon price.

As a transitional mechanism, the Renewable Energy Target has been effective in supporting additional renewable energy deployment, and particularly in developing industry capacity to integrate intermittent sources into electricity networks. However, recent analysis by the Productivity Commission has highlighted the relatively higher cost of abatement compared to that expected to be achieved through carbon pricing.[15] With the recent period of uncertainty regarding carbon pricing, the ability of the market to meet the expanded 2020 target has come under some question with lower-than-anticipated prices for tradable renewable energy certificates, which has delayed anticipated investments. Introducing the carbon pricing mechanism and the split scheme is expected to ease these pressures and the large-scale generation certificate price has stabilised during 2011.

The carbon pricing mechanism will be the principal clean energy deployment incentive mechanism, with the Renewable Energy Target acting as transitional support for eligible renewable energy generators. As the carbon price under the carbon pricing mechanism matures, the support provided by the Renewable Energy Target is designed to progressively phase down as the carbon price

[15] Productivity Commission, *Carbon emission policies in key economies*, Productivity Commission, Canberra, 2011.

provides the necessary support to enable the deployment of these technologies (resulting in lower renewable energy certificate prices). The carbon price will thus make the Renewable Energy Target cheaper and more effective. The Climate Change Authority will review the Renewable Energy Target in the second half of 2012 and every two years after that. Recommendations from these reviews must not be inconsistent with the objects of the *Renewable Energy (Electricity) Act 2000.*

It is important to avoid a situation where there are multiple and more costly interventions because this can distort investment signals by favouring particular technologies or creating uncertainties that delay investment. Clean energy deployment mechanisms should be technology neutral to provide maximum flexibility for markets to find least-cost outcomes.

A range of state and territory based feed-in-tariff schemes support deployment of small-scale solar photovoltaic and certain small-scale distributed generation. Recent analyses by the Productivity Commission and the New South Wales Independent Pricing and Regulatory Tribunal have noted that these schemes represent very high cost abatement relative to the carbon pricing mechanism and are introducing additional and inefficient costs for electricity consumers.[16]

The Australian Government will work with state and territory governments to ensure that such measures are consistent with the agreed Council of Australian Governments principles for complementarity of climate change mitigation measures[17] and do not impose an unjustifiable burden on consumers either through cross-subsidy mechanisms or their impact on the Small-scale Renewable Energy Scheme.

Clean energy innovation

There is an important role for government in addressing market failures or gaps that prevent or impair the ability of the private sector to develop and commercialise clean energy technologies. Accelerating the early development of and learning around Australia's future technology options is also an important goal, as this will enhance the ability of policy-makers and the private sector to plan a smoother and lower-cost adjustment.

Australian Government support for clean energy technology development and demonstration takes different forms and is targeted at different objectives, depending on the stage of technology development. Early-stage support tends to focus on concept development or option creation and testing, while later-stage support often focuses on addressing specific barriers to commercialisation.

The Australian Government has committed substantial resources to support clean energy technology development and commercialisation, with current commitments totalling more than $17 billion.[18] These support arrangements (which are detailed in Appendix D) include technology-neutral mechanisms as well as programs targeted at particular technologies. Together they form a comprehensive support framework from early-stage to pre-commercial development. Box 7.6 outlines key support measures for renewable energy technology development.

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[16] Productivity Commission, *Carbon emission policies in key economies*; NSW Independent Pricing and Regulatory Tribunal, *Changes in regulated electricity retail prices from 1 July 2011*, IPART, Sydney, 2011.

[17] Council of Australian Governments, *Principles for jurisdictions to review and streamline their existing climate change mitigation measures*, COAG, 2008, www.coag.gov.au.

[18] This total support figure is in addition to support provided through the carbon pricing mechanism, the Renewable Energy Target, research sector funding, concessional excise treatment for alternative transport fuels, general venture capital support from the government, and land sector measures to support the transition to a clean energy future.

A major challenge for government is providing stable policy frameworks over timeframes commensurate with long-term private sector investment requirements for developing technologies, and providing support in ways that most effectively meet the needs of technology development. Prioritising the government's limited resources is a further challenge. These issues are discussed further in section 7.4.

Box 7.6: Australian Government support for renewable energy

In addition to supporting renewable energy through carbon pricing and the Renewable Energy Target, the Australian Government is streamlining and building on the funding support available for emerging technologies.

The government is investing up to $10 billion in a commercially oriented Clean Energy Finance Corporation to facilitate and coordinate investment in technologies that financial institutions may not be familiar with, in the areas of renewable energy, enabling technologies, energy efficiency, low-emissions technologies, and refocus manufacturing businesses to supply inputs for these sectors. The aim of this initiative is to unlock significant new private sector investment.

The government has also legislated the establishment of the Australian Renewable Energy Agency (ARENA) as an independent statutory body managing $3.2 billion in funding to support research and development of renewable energy technologies and initiatives.

ARENA consolidates the existing range of renewable energy programs and provides around $1.7 billion in uncommitted funding for investment in new renewable energy projects. The funding will be allocated through a funding strategy to be developed by the ARENA board.

ARENA's activities will focus on solar energy development and commercialisation and include responsibility for managing government support for the Solar Flagships Program and Australian Solar Institute. The Australian Solar Institute supports collaborative, focused research and development on the efficiency and cost-effectiveness of solar technologies, and aims to help retain and develop solar research skills in Australia.

Geothermal energy is another focus area through the Emerging Renewables Program.

Enabling activities

There are a range of activities that provide the foundation for efficient deployment and innovation in clean energy technologies. These include:

- building the clean energy knowledge base
- providing education and training
- improving financial and technical awareness
- encouraging investment in clean energy infrastructure
- fostering collaboration
- building community acceptance
- providing effective regulatory frameworks and standards
- improving supply chain capability.

Building the knowledge base

Australia must continue to build the pre-competitive knowledge base needed to support private investment in clean energy.

The government has a role in sharing experience and knowledge (a public good) that will benefit the clean energy sector and economy more widely. This public good is a key rationale for government supporting research, development and demonstration.

There are two stages where information can be effectively shared through government action:

- providing resource assessment information – An established example of resource information is government-funded pre-competitive geological data provided to the petroleum resource industry as a precursor to commercial exploration bids. The Australian Government is funding major baseline studies on pre-commercial data acquisition and mapping of clean energy resources including solar, wind, geothermal and geological storage basins for carbon dioxide. Further efforts are needed by governments and industry to generate the next level of more finely granulated and commercially applicable clean energy resource information

- disseminating knowledge from research, development and demonstration projects – Government has a role in encouraging the sharing of experience and knowledge of lessons learned and helping build the knowledge base of clean energy industries to maximise the pace of learning. This should require some reciprocal obligation for learning and knowledge sharing from those receiving government funding support.

Ensuring that Australian technology developers can access international knowledge banks is also important. Government has a role in facilitating networks and linkages into global technology development, both for identifying the latest advances in technology and for building the knowledge and skills of technical and management professionals in the Australian clean energy sector.

An example is Australia's participation in the Clean Energy Solutions Center,[19] a partnership initiative between the Clean Energy Ministerial forum and UN-Energy, the United Nations inter-agency energy mechanism to help governments share best-practice clean energy policy and resources. Another example is the Australian Government's foundation funding support for the Global Carbon Capture and Storage Institute,[20] which works collaboratively to build and share expertise in carbon capture and storage technologies.

Education and training

Government has an important role in providing sufficient education and training opportunities to ensure that the clean energy sector has a workforce capable of supporting a shift to cleaner energy. This includes the scientific research capacity to develop new technologies and also the engineering and practical skills to install and operate clean energy equipment and facilities.

The Australian Solar Institute is supporting researchers through the ASI Skills Development Program. This provides support for doctoral scholars and postdoctoral fellows to undertake their research.

The Australian Government is introducing a new $32 million Clean Energy Skills program to provide the foundation for the new workplace skills that will increasingly become more valuable as we move

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[19] Details of the initiative are available from the centre's website, http://cleanenergysolutions.org.

[20] Details of the institute's activities is available from its website, www.globalccsinstitute.com.

to a clean energy economy. Other measures to support skills, training and workforce development are discussed in section 8.4.

Improving financial and technical awareness

A challenge for many clean energy developers has been securing capital for development and to support roll-out. Consultations undertaken in the design of the Renewable Energy Venture Capital program demonstrate a gap in early-stage capital in Australia. While Australia has a large pool of funds under management, it has a small venture capital market, and institutional investors have traditionally been reluctant to fund companies that are involved in higher-risk, early-stage technologies such as renewable energy.

Many emerging clean energy technologies have yet to establish themselves in commercial markets. One consequence of this is that investors (including finance providers) have limited experience and understanding of the technologies and the clean energy market. Combined with the high capital costs of clean energy projects, the longer timeframes for deployment and the perceived technological risks, this can increase the costs of debt and equity finance for such projects.

The ability to secure finance is also a recurring issue at the demonstration and commercial deployment stages. The Australian Government, through its flagships programs, is providing support for large-scale demonstrations to share some of these project risks.

As noted in section 7.2, targeted support for first-of-a-kind projects can assist where technology is effectively market ready but has yet to achieve genuine maturity. In these circumstances, costs have yet to fully decline and a market revenue gap may still exist that prevents financing or commercial closure.

The provision of public financing clearly can have an important role in addressing market failures or gaps. However, when considering commercial projects, public financing should not compete with private sector capital or distort important commercial disciplines. Such support should also be structured in a way that supports the efficient operation of energy markets.

Encouraging investment in clean energy infrastructure

The deployment of clean energy technologies will require investment in energy and related infrastructure.

For instance carbon capture and storage projects may need to integrate a large capture source, pipeline infrastructure and a dedicated storage site. Questions around who will provide this infrastructure, and what access regimes apply, are yet to be addressed, and at this stage it is unclear whether market failures exist that would prevent optimal private sector investment in carbon capture and storage infrastructure in Australia.

In principle, the costs of infrastructure associated with a new clean energy project should be borne by that project and reflected in resulting investment and energy costs. This provides the price signals to incentivise market decisions that will lead to optimal, least-cost clean energy solutions.

However, there may be occasions where a legitimate market failure occurs and clean energy technology is restrained from achieving full commercial deployment. Private sector investment may be inhibited if one project must bear the full costs up-front for infrastructure that will later benefit competitors or when connection involves additional costs to overcome congestion or capacity constraints resulting from previous network development. This could be particularly relevant for renewable energy as there are areas of good resources located remote from the electricity grid.

This can involve a complex consideration of appropriate risk sharing and the solution is rarely clear cut. In relation to the connection of remote electricity generation, the Australian Government will work with energy market bodies and relevant state and territory governments to monitor the effectiveness of the energy markets transmission rules framework in supporting efficient network development and connection (see section 6B.6).

Other electricity network infrastructure management and costing issues may arise with increasing levels of distributed generation such as rooftop solar systems. Uptake of electric vehicles and natural gas vehicles also poses potential challenges for infrastructure and network integration. The Standing Council on Energy and Resources has asked the Australian Energy Market Commission to investigate the costs and benefits of such vehicles for the electricity and gas energy markets and to identify the arrangements necessary within the energy markets to facilitate the efficient uptake of these vehicles.[21] These issues will be considered together with the commission's wider review of demand-side participation, the third stage of which is due to be completed in 2012.

Fostering collaboration

Government can play a coordinating role in building and strengthening the partnerships and networks needed to facilitate information sharing and achieve technology and cost breakthroughs for clean energy technologies.[22] These can be international, between research institutions, business and government, or between different levels of government.

The Australian Government, in close partnership with business and other key stakeholders, is engaging internationally to enhance cooperation on clean energy technology research, development, deployment and commercialisation, and to exchange knowledge and build capacity and expertise. The key forums and mechanisms for this engagement are outlined in section 9.2 and Appendix E.

The government is also building domestic and international collaborations between businesses, universities and publicly funded research agencies through the Powering Ideas innovation agenda and through the Australian Centre for Renewable Energy (ACRE), which is focused on using its funding support to build on early research efforts.

Many state and territory governments are undertaking valuable clean energy development initiatives.[23] Effective inter-government links have been established in the Solar Flagships Program, the Carbon Capture and Storage Flagships Program, and activities under ACRE.[24] There may be value in building further on these cooperative efforts and this will be considered further through the Standing Council on Energy and Resources and in the development of ARENA.

[21] Australian Energy Market Commission, *Approach paper: energy market arrangements for electric and natural gas vehicles*, AEMC, Sydney, 2011.

[22] Department of Innovation, Industry, Science and Research, *Powering ideas.*

[23] Department of Innovation, Industry, Science and Research, *Powering ideas*.

[24] ACRE's 2011 *Strategic directions* provides for strong collaboration with state and territory governments, industry representative bodies, other renewable energy technology funding bodies and agencies, and research institutions.

Building community acceptance

As with all new technologies, new clean energy technologies may have unanticipated impacts. This is likely to be the case in all clean energy technology developments, including geothermal, large-scale solar, ocean and carbon capture and storage. Failure to build the 'social licence to operate' can result in added difficulties in project approval and development.

Project developers need to adopt a broad consultative approach to address community concerns early in a project's life cycle and maintain engagement throughout development and operation. Governments also have a role in promoting public understanding of technology issues and ensuring that regulatory frameworks provide safe and transparent decision-making as well as encourage clean energy developers to respond quickly to concerns. Recognising the importance of this aspect, the Australian Government requires all recipients of clean energy funding to manage community consultation under a certified plan. This issue is discussed further in section 8.2.

Providing effective regulatory frameworks and standards

Nationally coordinated approaches to providing regulatory frameworks for new technologies, such as siting and planning approaches, and for water, habitat and other environmental issues are important for investor confidence.

Jurisdictions are currently developing regulatory regimes for geosequestration, geothermal energy and ocean energy.

There is potential for these regimes to develop along different paths, meaning that developers may face different regulatory requirements in different jurisdictions. The Standing Council on Energy and Resources could be an effective forum for the development of harmonised or consistent regimes where required.

Improving supply chain capability

The importance of developing energy technology supply chains should not be underestimated. The early movers absorb the burden of developing supply chains, and governments can facilitate this development by providing and sharing information, bringing key players together and lowering trading barriers.

As announced in the Australian Government's Clean Energy Future package, investment by the Clean Energy Finance Corporation will include investment in the transformation of existing manufacturing businesses to refocus on meeting demand for inputs for renewable energy and enabling technologies, energy efficiency and eligible low-emissions technologies. The Clean Technology Focus for Supply Chains initiative is providing an additional $5 million in support through industry capability networks, supplier advocates and specialist support services for small and medium-sized businesses in clean energy technology industries.

7.4 Strategic challenges

Transforming markets and developing a more diverse technology base will present a range of technical, financial and policy challenges. Many of these challenges will be managed through normal interaction of market and policy processes.

Some, such as infrastructure, skills and workforce development, will be critical ongoing policy challenges for all Australian governments and the private sector and will require a continuing dialogue and effort to ensure that they do not become unmanageable constraints in the future.

Strategic issues relating to the nature of support for clean energy are discussed below.

Managing the pace of transformation

Australia is beginning a period of significant transformation in the energy sector.

The Australian energy sector is well placed to respond to price signals and innovation support. Efficient carbon and energy pricing will provide the necessary signals for markets to make informed investment decisions on abatement, technology and fuel options. In well-functioning markets, this will over time produce the most efficient and least-cost outcomes. In addition to reduced consumer cost, a market-based transformation also provides lower adjustment costs and less risk to the security and reliability of Australia's energy systems.

Government support for innovation will also play a role by accelerating development and learning and bringing forward the point of commercial viability for new technologies.

However, the Australian Government recognises that there is likely to be a period in the early years when carbon costs have not yet matured to the point where a range of currently high-cost technologies can successfully compete in the market. This is the principal rationale for the Renewable Energy Target in supporting least-cost renewable energy deployment in the transitional period.

Even so, there will undoubtedly be calls for a faster pace of change for a range of social, environmental or business reasons.

Additional broad-scale deployment subsidies or technology targets and mandates to accelerate technology roll-out must be rigorously assessed against their costs and benefits. Pulling through higher-cost generation ahead of the market (particularly when these technologies are not yet fully commercially mature) will impose higher costs on consumers, potentially distort optimal longer-term investment outcomes and/or could introduce avoidable system risks that are difficult or costly to manage.

In particular, technology-specific targets or mandates are inherently less flexible in a dynamic world where technological progress and market circumstances may change in unexpected ways. Locking into pre-ordained outcomes, which are often hard or costly to alter, risks imposing significantly higher costs on the economy and consumers. A market-based approach allows for adjustment to changing circumstance far more efficiently than using regulated targets or mandates.

Claims that early roll-out will significantly reduce technology costs through the scale of deployment must also be carefully examined. Australia is a small market by world standards and many technologies are not produced in Australia. Australia in many cases will rely on technologies developed or produced overseas. Solar photovoltaic and wind power are good examples where cost reductions to date are more likely to have been driven by global rather than Australian deployment levels.[25] There may be some important learning-by-doing benefits, but these must be assessed realistically relative to the cost to the economy and consumers of a broad-based roll-out. Such benefits may also be realisable through less costly approaches.

There are also other factors that may influence the direction and pace of our transformation. Global and national progress in bringing forward key clean energy technologies such as carbon capture and storage, geothermal and large-scale solar in the next decade will be critical to provide business and policy-makers with a better ability to assess and plan for smooth development pathways. Should these technologies fail to emerge as expected because of technical, economic or social barriers, future Australian governments may be required to consider other clean energy alternatives to minimise the risk of significantly higher adjustment costs (see Box 7.7).

The Australian Government recognises that Australia's level of effort is not a 'set and forget' exercise and will need to be closely monitored against the evolving direction of international action to reduce greenhouse gas emissions, domestic circumstances and the ability of markets to deliver against outcomes while also maintaining overall economic and energy security.

Box 7.7: Contingency planning – a future role for nuclear?

Australia's plentiful natural endowment of a range of low-cost energy resources has played a major role in shaping our energy generation base around coal and gas.

Other countries have chosen to adopt nuclear power often as a way of diversifying their energy mix. As one of the world's largest uranium exporters, Australia has respected and supported this right through trade under strict safety and security safeguards. Nuclear-powered electricity generation currently produces around 16 per cent of the world's electricity – around 10 times Australia's total annual electricity generation. Undeniably this results in lower global carbon emissions.

The government has chosen not to permit the use of nuclear energy in Australia and the use of nuclear technology for power generation is expressly prohibited under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. At the Australian Government level, advice on this issue was most recently commissioned in 2006.[26] There has, at different times, been passionate debate on this issue.

The Gillard Government unambiguously does not support the use of nuclear energy in Australia, noting that at present there is no necessary social consensus over this technology nor is there currently a compelling economic case, even taking into account the need to reduce our national emissions. Australia will invest heavily in renewable and other clean energy technologies such as carbon capture and storage as preferred alternatives to conventional high-emissions generation.

However, noting the multi-decade focus of this draft Energy White Paper, it cannot simply be assumed that future Australian governments will necessarily hold this view. To provide a

[25] China is already demonstrating its ability to dramatically lower the costs of some clean energy technologies through its low-cost manufacturing capabilities. For example, China has become particularly prominent in the solar PV sector and Chinese solar PV manufacturers are becoming increasingly dominant. The cost of solar PV electricity over the past five years or so has approximately halved, driven by a big increase in overall manufacturing capacity and reduced manufacturing costs.

[26] In 2006 the Howard Government commissioned an independent review into the use of nuclear power in Australia led by Dr Ziggy Switkowski, resulting in the report titled *Uranium mining, processing and nuclear energy: opportunities for Australia?*.

comprehensive assessment of future possibilities, it is prudent to consider under what circumstances a future government may conceivably wish to revisit this position, and what would be required should such a choice be contemplated. This suggests the following observations:

- Given our diverse energy resource base, there does not appear to be a compelling energy security argument in support of future adoption of nuclear power for electricity generation in Australia.
- The best case supporting future consideration of nuclear power would be the failure to commercialise new low-emissions baseload energy or energy storage technologies within the timeframe that economic analysis suggests is necessary to meet long-term global and national emissions reduction objectives (from 2025 onwards).
- Estimates of future costs for representative electricity generation technologies suggest that nuclear might then represent an economically competitive backstop baseload energy option (see Figure 7.1).[27]
- However, given the long lead times for plant approval and construction and for development of appropriate regulatory frameworks, this would necessitate a decision to move ahead considerably in advance of expected deployment – lead times would be at least 10 years, with 15 years more probable.[28] If this were the case, such a decision would need to be taken by the latter part of this decade if deployment was required by 2030 or 2035.
- This would require the development of new institutional and regulatory arrangements and development of a local nuclear engineering skills base.
- Realistically, such a decision would also have to attract broad community consensus. Australian history suggests that this would require bipartisan political support and, in the wake of the recent tragedy in Fukushima, the prospect of new safer nuclear generation technologies and waste disposal options.

While there is no intention to change its well-established position on this matter, the Australian Government continues to support open public debate on all of Australia's energy options, particularly in light of the desire to reduce greenhouse gas emissions.

Stability and effectiveness of policy

Timeframes and stability for government support

Transforming Australia's energy base is a long-term process. Lead times for large-scale electricity generation projects and the timeframes to develop projects may be many years, perhaps even

[27] Electric Power Research Institute, *Australian electricity generation technology costs*. This study found that the estimated levelised cost of electricity for nuclear energy, at around $140–200 per MWh (in mid-2009 dollars) for new plants over the period 2015 to 2030 was comparable to similarly calculated costs for wind, hot rock geothermal, carbon capture and storage and large-scale solar energy technologies.

[28] Australian Government, *Uranium mining, processing and nuclear energy: opportunities for Australia?*, report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006; CSIRO, *Unlocking Australia's energy potential*; Electric Power Research Institute, *Australian electricity generation technology costs*.

decades, as they include technology development as well as project development, financing and approval stages.

Developing technologies through the innovation chain to commercial deployment can require a commitment of 10 to 20 years, covering a series of decision points where projects can be abandoned or changed in scope. Project abandonment is more common than success and this forms an important part of the knowledge-building process. However, these long timeframes (and risks) with multiple decision points do not fit well with traditionally shorter government funding cycles. Clean energy technologies require a policy framework that provides sufficient stability for long-term investor commitment.

A major issue for many clean energy developers has been the ‘boom and bust’ industry conditions resulting from a changing policy environment (at the national and state levels) over previous decades. The risk of unpredictable policy shifts can inhibit long-term business development, impair the ability to attract investment and make it difficult to attract skilled workers. To some extent, these risks are unavoidable where an industry or firm is highly reliant on an ongoing subsidy for viability. However, good policy design that promotes sustainable and stable industry conditions can help minimise these risks.

Uncertainty in other components of the policy framework can also affect investment decisions in clean energy generation, including existing arrangements such as the Renewable Energy Target and funding programs. Unexpected policy changes undermine investor confidence by creating uncertainty about the economics of projects. It is important that the design and application of policies and measures consider their economic or social sustainability. For example, some measures such as feed-in tariffs (which place open-ended and increasing cross-subsidies on a range of consumers who do not receive the material benefit of the subsidy) are less likely to prove durable than other more efficient and equitable approaches.

Fundamentals for better support mechanisms

Government funding programs that can be targeted at specific risks or barriers in the innovation process are more likely to be effective and meet industry needs, while narrowly defined programs that target a single segment of the innovation chain can challenge projects or technologies once the funding ends. Flexible programs with the potential for follow-on funding better suit clean energy technology development.

Discussions with key stakeholders during preparation of this White Paper suggested that government support programs should:

- be objective based rather than be technology focused or limited
- provide flexibility in addressing the risks encountered by funded technologies and companies in progressing through the innovation cycle, while still meeting program objectives for best-value investment by government
- promote competitive outcomes that can enhance public benefit through knowledge sharing and other requirements
- provide for a range of financing mechanisms that can be targeted at technology development challenges
- leverage significant private sector funding to verify commercial potential

- be conscious of and responsive to relevant technological changes as they emerge
- have clearly defined entry and exit criteria and program review and end points.

The Australian Government is addressing many of these issues through the design of its Clean Energy Future package, which is intended to provide greater flexibility and a more strategic focus in targeting support. However, the government will also consider how the suggestions listed above can be addressed in the development of future clean energy programs. The clear need for increased program flexibility will have to be balanced with appropriate financial and administrative safeguards.

Maximising the benefit from limited public resources

Governments have limited resources and many competing policy priorities. This can mean a trade-off between providing a minimal level of support for a broad range of clean energy technologies or focusing greater support on a narrower range of technologies that have the potential to produce larger economic or environmental benefits.

Thus government must be strategic in its investment. It is not feasible or appropriate for all clean energy technologies to be developed in Australia. Our efforts should be focused on technologies or processes where Australia may have a comparative advantage in our skill, knowledge or resource base or where it is in our long-term strategic interest to ensure or test development possibilities, including where there are local barriers or constraints that others will not address.

Technology prioritisation framework

Some method of prioritisation is clearly needed to focus on technologies with the potential to economically contribute most to Australia's emissions reduction targets as well as most efficiently build on Australia's resources and competitive advantages. Prioritisation should consider the level of a technology's development (in Australia and globally) and if government support addresses identified market failures, and if this would make a material difference to progress of the technology. It should also ensure that the proposed outcomes will yield a net benefit for the outlay provided – although this is often difficult to assess given the complexities of the innovation process and dynamic market factors.

The framework presented in Figure 7.4 is proposed as a general guide for overall strategic prioritisation of effort.[29] It is not appropriate or intended to provide a project-specific assessment framework for government agencies or programs.

The first step assesses the rationale or need for publicly funded support and whether in particular there is a need for Australian Government support, by considering the following screening questions:

- Are there critical identified market failures or other innovation barriers that inhibit the timely development of the technology?
- Would a decision by the Australian Government to provide support likely make a material difference to the likelihood or timing of development?

[29] This framework is adapted from a model developed by the UK Carbon Trust.

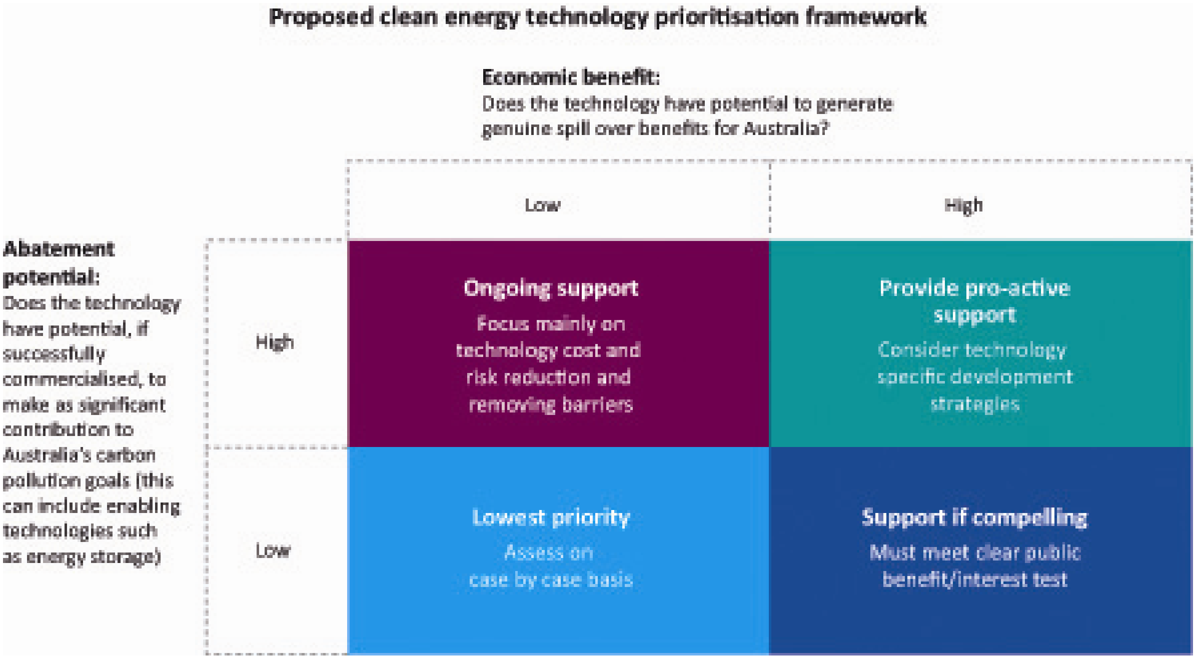
If these first-step questions are both affirmed, the technology is then assessed against the second-step test: the technology's relative importance in terms of its potential for abatement as well as other economic benefits.

This second-step question assesses the value of the technology against the key clean energy policy goals through a focus on:

- those clean energy technologies with greatest potential to contribute to Australia's clean energy generation and emissions reduction
- those clean energy technologies that offer an opportunity to capitalise on Australia's competitive advantage or promote economic benefits.

These concepts are encapsulated in the matrix shown in Figure 7.4 and discussed further in Box 7.8.

Figure 7.4: Proposed clean energy technology prioritisation framework



Box 7.8: Clean energy technology prioritisation framework

The position of a technology in the framework illustrated in Figure 7.4 helps set the general stance of the Australian Government towards it. The precise allocation of resources among prioritised technologies needs to be informed by the requirements of individual technologies themselves. This is because they will each be at different points in their development cycle and many needs are technology-specific.

The colouring in the chart defines three categories of response across both early-stage development technologies and later stage deployment.

Proactive/ongoing support (green/purple)

If the clean energy technology can potentially make a significant contribution to achieving Australia's emissions reduction target, there is a strong case for support (top row of matrix). If net economic or spill-over benefits are likely to be generated (the top right quadrant), a more proactive approach is appropriate. In this sense, benefit is broadly defined as possessing potential to generate additional wealth creation, whether through intellectual capital, developing local industry capacity and capabilities, or promoting export opportunities. If the prospects for significant spill-over benefits are low (usually the case with imported mature technology that requires adaptation rather than deep development), efforts may be best targeted at promoting market readiness (top left quadrant).

Support if compelling (dark blue)

If a technology is considered to have a relatively low potential to contribute to achieving Australia's emissions reduction target or is likely to be available from overseas, Australian Government support is only justified if a strong case can be made that net economic benefit is generated and it represents better value for money than alternatives (bottom right quadrant).

Lowest priority (light blue)

The stance for technologies in the bottom left quadrant (those assessed as unlikely to provide significant abatement or unlikely to generate net economic benefit) is to undertake sensible cost-effective actions that remove regulatory or non-price barriers to deployment or to monitor ongoing development. Additional support should be considered on a case-by-case basis and only where the possibility of a future spin-off or breakthrough exists.

Applying this analysis through the use of modelling work by the Australian Treasury and others such as the Bureau of Resources and Energy Economics can identify a number of strategically important technology classes due to their potentially significant roles in Australia's future energy mix as well as generating additional spill-over benefits in the form of intellectual property or export earnings. These are (in no particular order):

- large-scale solar
- geothermal
- carbon capture and storage (gas and black or brown coal).

Other possible priority technologies include next-generation biofuels, energy storage technologies, electricity system control and management systems, hybrid energy systems and ocean energy.

These technology groups have a high priority for the Australian Government and the importance of the technologies suggests that a strategic engagement with the business and research communities to accelerate commercial development is also required. Early testing of these technologies will provide policy-makers and the markets with a better understanding of future development options and an enhanced ability to adjust support to help those technologies where results can yield the best dividends.

The Australian Government, through ACRE, the Australian Solar Institute and the Australian Biofuels Research Institute (to be part of ARENA when established), is developing or has in place a range of technology development strategies for these key renewable energy technologies and works closely with the relevant industry groups. The government has also released a Strategic Framework for Alternative Transport Fuels that provides a roadmap and set of actions for removing barriers to commercial uptake.

The Australian Government has also established a National Carbon Capture and Storage Council comprising industry, the research sector and government to provide expert advice on carbon capture and storage issues. The government, through its Carbon Capture and Storage Flagships Program and other programs, is committing over $2 billion in support through close partnership with industry and the research community. Box 7.9 provides more detail on the government's approach to carbon capture and storage development.

Finally, technology prioritisation requires strong analytical support, constant monitoring and extensive stakeholder consultation. The biennial Australian Energy Technology Assessment will provide a transparent mechanism for this activity. It will involve periodic reassessment that allows for changes in the levels and forms of support for particular technologies to leverage technology breakthroughs, reflect broader economic and market conditions, or address particular technology roadblocks. ARENA and the National Carbon Capture and Storage Council will also provide critical expert advice on these issues.

Box 7.9: Commercialising carbon capture and storage in Australia

The International Energy Agency estimates that carbon capture and storage (CCS) will need to contribute nearly one-fifth of global emissions reductions to reduce the world's greenhouse gas emissions by 50 per cent by 2050.[30] The IEA also projected that a 10-year delay in the availability of CCS would increase the cost of meeting a 450 parts per million concentration objective by around US$1.14 trillion or 8 per cent.[31] Without CCS altogether, the marginal cost of CO_2 abatement in 2050 could be around 70 per cent higher at US$300 per tonne of CO_2.[32] Recent Australian Treasury modelling suggests that CCS generation (gas and coal) could also supply up to 30 per cent of Australia's future electricity needs by 2050.[33]

The individual components of CCS are well understood and have been proven through national and international experience. However, long-term capture and geological storage of CO_2 streams on a large scale has not yet been commercially demonstrated. Given the scale and risks inherent in such

[30] IEA, *Energy technology perspectives 2010: Scenarios and strategies to 2050*, IEA, Paris, 2010, p. 75.

[31] IEA, *World energy outlook 2011*, IEA, Paris, 2010, p. 241.

[32] IEA, *Carbon capture and storage roadmap*, IEA, Paris, 2009.

[33] Treasury, *Strong growth, low pollution*, Chapter 5.

projects, this is likely to require considerable effort and investment by industry and government. For Australia, the lead time for first-of-a-kind commercial deployment is projected to be at least eight to 10 years. There are a range of critical challenges to achieving commercialisation including:

- improving the efficiency and reducing the cost of large-scale CO_2 capture technologies – at small scale the various technology options have been successfully demonstrated
- proving of suitable commercially viable CO_2 storage sites – Australia has a range of highly prospective long-term storage sites, although further work is required to prove their viability. Long-term CO_2 storage is being practised in Australia (Otway). The Gorgon LNG project off Australia's north-west coast will be the world's largest CO_2 storage project when it commences operations in 2015
- building integrated transport networks to agreed pipeline standards – the pipeline standards of the oil and gas industry, while considered to be safe and suitable, are being assessed to reaffirm their applicability to CCS
- identifying and developing options for multi-user transport networks and hubs to provide suppliers of CO_2 common access to pipelines and/or storage sites.

The Australian Government, in partnership with the research community and the private sector, has in place a development strategy covering many aspects of the CCS innovation chain.[34] The strategy includes:

- $2 billion in support of large-scale and small- to medium-scale projects (CCS Flagships, National Low Emissions Coal Initiative projects and Low Emissions Technology Demonstration Fund projects)
- support for research and development and pilot testing of low-emissions coal and CCS technologies through the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) and $75 million for Australian National Low Emissions Coal Research and Development Limited (matched funding with the coal industry)
- $61 million to accelerate the identification and development of suitable CO_2 geological storage sites through the National CO_2 Infrastructure Plan
- development of legislation and regulations to enable CCS activities in Commonwealth offshore waters
- support for international research and development and collaboration through the Global Carbon Capture and Storage Institute, the Australia–China Joint Coordination Group on Clean Coal Technology, the Carbon Capture Use and Storage Action Group, and the Carbon Sequestration Leadership Forum.

The government has established the National Carbon Capture and Storage Council comprising industry, researchers and state and territory governments to advise on the accelerated development and deployment of CCS.

[34] Further detail on support for carbon capture and storage is available from the Department of Resources, Energy and Tourism website (www.ret.gov.au) and from the Global CCS Institute's website (www.globalccsinstitute.com).

Aligning clean energy needs within the innovation system

To achieve the maximum value from Australia's innovation system, our early-stage research incentives and structures need to be aligned appropriately with later-stage technology development goals. To this end, the Australian Government takes a strategic approach to its research and development investment, taking into account identified national research and innovation priorities and research skills needs.[35] Reducing emissions in transport and energy generation is an identified priority area under the national research priorities that guide the government's research support.[36]

In clean energy technology development, Australia has world-class strengths in a number of renewable energy and carbon capture and storage technologies through institutions such as the Australian National University, the University of New South Wales, the CO2CRC and CSIRO. To help strengthen effective linkages between the research and development sector and large-scale demonstration activity, the Australian Government has targeted additional resourcing and initiatives in the areas of solar, carbon capture and storage, and biofuel technologies. The government has established the Australian Solar Institute, Australian National Low Emissions Coal Research and Development Limited and the Australian Biofuels Research Institute, with Australian Government funding contributions of $150 million, $75 million and $20 million respectively (noting that both institutes will be absorbed into ARENA). Additional funding is leveraged from industry and state governments.

There may be scope to further target research and development support for other strategic priority areas for Australia's clean energy transformation. For example, ACRE has identified a need for stronger research and development support for geothermal energy development and commercialisation in Australia, noting the significant investment by governments at the geothermal demonstration phase. As a first step, ACRE has facilitated the establishment of a cross-disciplinary research and development network relevant to geothermal technology development in Australia, bringing together diverse expertise in information and communications technology, satellite data analysis, signals processing and geoscience. There may be value in building a better understanding of the alignment of research and development efforts (including linkages to international efforts) with clean energy technology development goals for Australia.

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[35] Department of Innovation, Industry, Science and Research, *Powering ideas.*.

[36] Details of the National Research Priorities are available from the Australian Research Council website, www.arc.gov.au.

7.5 Key actions

Recognising the importance of driving a long-term clean energy transformation in the Australian economy, the Australian Government will:

- expedite implementation of its clean energy programs to ensure continued support for innovation and commercialisation, including establishing the Australian Renewable Energy Agency by July 2012 and the Clean Energy Finance Corporation from 2013–14 as priority actions, and continuing to progress carbon capture and storage initiatives
  - progress in achieving clean energy objectives will be assessed as part of the proposed four-yearly strategic energy policy review process
  - the Renewable Energy Target scheme will be reviewed through the Climate Change Authority in the second half of 2012 and every two years after that
- work with other jurisdictions to harmonise state and territory–based micro-distributed generation feed-in-tariff schemes with the agreed Council of Australian Governments principles for complementarity of climate change mitigation measures and ensure that the schemes do not impose an unjustifiable burden on electricity consumers either through cross-subsidy mechanisms or their impact on the Small-scale Renewable Energy Scheme
- improve the quality of Australia’s clean energy information base through:
  - biennial publication from 2014 of the Australian Energy Resource Assessment and the Australian Energy Technology Assessment
  - expanding the scope of the Australian Energy Technology Assessment to specifically cover liquid fuel technologies
- continue to seek opportunities to develop collaborations with business and the research community. This will include further developing and implementing technology development plans or strategies for high-priority technologies that maintain a consistent policy approach to support, commensurate with ongoing improved cost and performance
- continue to engage in international processes and partnerships to promote clean energy technology development and deployment. A key focus of this engagement will be knowledge sharing, leveraging international effort and expertise and building market capability
- work with state and territory governments to identify the need for nationally consistent and supportive regulatory arrangements for new clean energy technologies, including carbon capture and storage, geothermal and ocean energy systems.

Part III: Supporting energy policy outcomes

8 Cross-cutting policy issues

Highlights

- Producing, generating, supplying and using energy sustainably is a core social, business and policy imperative.
- Looking ahead, there are a number of areas where further attention is needed:
  - providing for the effective interface between energy and environmental policy frameworks to promote efficient investment decisions
  - improving the effectiveness of project approvals and resource development planning, particularly duplication across all three levels of Australian government
  - ensuring that community concerns regarding energy development proposals are addressed and accepted through transparent consultation and regulatory approval processes.
- It is important that there is effective cooperation between different levels of government to ensure that optimal outcomes are delivered.
- The growth and transformation of Australia's energy industries will create new skilled and unskilled jobs in a wide range of areas. The current high demand across the sector for skilled workers means that there are good opportunities for employment in the energy sector.
- Meeting workforce needs in the energy sector will come through a combination of education and training, improving workforce participation, improving mobility and utilising skilled migration. The government is working with the education and training sector and business groups to implement initiatives in these areas to address short-term constraints and improve long-term capacity.
- Industry has a key role to play in building skills and identifying sector workforce needs.
- The energy and resources sectors play a significant role in creating long-lasting Indigenous opportunities by creating jobs and providing income for local communities. This is particularly important in remote and very remote areas of Australia.
- As part of its Closing the Gap agenda, the Australian Government is working with Indigenous groups and communities as well as industry and state and territory governments to improve Indigenous outcomes through education and training as well access to energy.

8.1 Introduction

A recurring theme throughout previous chapters has been the growing interrelationships between the energy sector and other areas of the national economy. While there is not the scope (or need) for all of these relationships to be examined in this draft Energy White Paper, there are four policy issues that are important to the consideration of future energy policy and outcomes and in Australia's continued social development. These are:

- sustainability
- cooperation between different levels of government
- skills and workforce development
- Indigenous opportunities.

The production and use of energy can pose significant environmental challenges, while solving other environmental challenges. Energy is the single largest contributor to Australia's greenhouse gas emissions. Energy projects can affect the quality of Australia's air and water, biodiversity, noise levels and heritage, and must be sensitively managed. A key challenge for government, business and the community is to ensure that Australia's environmental and cultural heritage is appropriately preserved while also ensuring our continued ability to meet future energy needs through sustainable development. There are a number of sustainability frameworks that intersect closely with energy policy; these are discussed in section 8.2.

In delivering energy sector outcomes it is important that all levels of government can work cooperatively together. The relationship between the Commonwealth and states and territories is particularly important. Issues relating to cooperation between levels of government are discussed in section 8.3.

Australia's continued economic success, coupled with the ageing of our workforce, has resulted in skills and labour pressures across the economy, including in the energy and energy resources sectors. The scale of investment and transformation required for our clean energy future highlights the urgent need for a diverse range of professional and trade-related skills in conventional and emerging parts of the energy supply and end-use chain. Section 8.4 examines projected future needs and the Australian Government's long-term workforce development strategy.

Energy-related developments provide enormous economic and social support to regional communities in Australia. This contribution can and should extend to new opportunities for Australia's Indigenous communities. Australian governments and the Australian resources and energy industries are committed to closing the gap on Indigenous disadvantage. Section 8.5 discusses the role the sector is playing in promoting Indigenous opportunities and the framework the Australian Government has in place to support this.

8.2 Sustainability and energy

In a country with high and rising living standards and a unique natural environment, sustainability is a key issue for business, consumers and government. Sustainability is more than ensuring safety and environmental protection. It involves integrating society's environmental, economic and social goals in the production and consumption of goods and services and in the design and implementation of government policies and regulation. Achieving robust outcomes also requires the active participation of business and consumers.

There has been significant evolution in the way sustainability goals have been pursued over the last 30 years. Policy frameworks have moved towards promoting transparent integrated solutions based on scientific evidence and risk management (often utilising the greater allocative efficiency of markets) rather than through heavy-handed regulation. Triple bottom line, corporate social responsibility and environmental management objectives are now integral to modern business planning and practices, and Australian consumers are more environmentally conscious, requiring higher standards in terms of environmental and sustainability outcomes. There is also a much deeper scientific understanding of environmental systems and impacts and how they might be most effectively managed.

Energy and sustainability considerations intersect in many ways. Key among these are the interactions between energy, water, land management, biodiversity management and carbon pricing policy agendas. More recently, the emergence of new sources of energy and the development of new energy technologies have generated fresh challenges and sometimes passionate debate over their social acceptance and multiple resource use. For example, competing land or resource use issues associated with coal seam gas development, groundwater and agriculture. It is important that these issues are worked through in an integrated and balanced way to ensure efficient and effective development of our natural resources and to meet our social and environmental goals.

Key Australian Government environmental frameworks

The Australian Government has in place a comprehensive set of environmental regulatory and policy frameworks covering:

- water
- air quality
- waste management
- biodiversity protection and conservation
- coastal and marine management
- landscape and heritage protection.

Within this framework, a number of mechanisms have a prominent influence on energy-related development and policy implementation.[1] These include:

- the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- the National Water Initiative and the *Water Act 2007*
- marine bioregional planning
- the National Environment Protection Measure on Ambient Air Quality and Fuel Quality Standards
- the Clean Energy Future legislative package.

In addition, the Australian Government recently released its sustainable population strategy, *Sustainable Australia – Sustainable communities*, outlining key directions to help ensure that future population change supports the economic, environmental and social wellbeing of the nation. The strategy's focus is to put in place the policy settings and governance arrangements needed to maintain and improve wellbeing at local, regional and national levels into the future, through encouraging more effective anticipation, planning and responses to the impact of population changes on our economy, communities and environment.[2]

A series of measures were announced to support the objectives of the strategy, including the development of sustainability indicators for Australia. The indicators, to be developed during 2012–13, will help improve information on key aspects of sustainability and consideration of the social, economic and environmental dimensions in government decision-making into the future.

State and territory governments also maintain environmental and sustainable development regimes that apply to energy and resource development activities undertaken within their jurisdictional boundaries. In most instances, the different levels of government seek to avoid duplication in the application of regulation, but they do not always succeed. Ensuring nationally consistent approaches across jurisdictions continues to be an issue for business.

Key challenges

The majority of sustainable development issues associated with the production and use of energy in Australia will be effectively managed within the frameworks and measures outlined above. However, looking ahead, there are three challenges that warrant further discussion, given their importance to future energy outcomes. These are:

- integrating energy and environmental policy frameworks to deliver efficient investment decisions
- improving the effectiveness and efficiency of project approvals and resource development planning
- effectively managing resource use or co-development pressures, including community acceptance ('social licence to operate').

[1] These by no means represent the full range of measures that may intersect with energy issues. Further detail on other measures can be found at www.environment.gov.au.

[2] Department of Sustainability, Environment, Water, Population and Communities, *Sustainable Australia – Sustainable communities*, DSEWPaC, Canberra, 2011.

Promoting integrated energy and environmental policy frameworks

Energy and water

A key issue for energy is access to clean and reliable sources of water.

Overall, the electricity and gas sector is a relatively small user of water and currently accounts for around 1.4 per cent of total water consumption in Australia. Around 65 per cent of the generating capacity in the National Electricity Market currently depends on fresh water for hydro-electricity generation or for cooling in coal- or gas-fired thermal generation.

During the recent prolonged drought (2002–10), average inflows in south-western and south-eastern Australia declined substantially relative to the long-term average. At the same time that demand for water increased, the drought resulted in a new emphasis on improving the efficient management of Australia's limited water resources.

While the total volume of water used in electricity generation is not as large compared to other uses such as agriculture, it is clear that water used in this way is one of its higher-value uses. The Australian Bureau of Statistics 2008–09 Water Account shows that the electricity and gas sector consumed 328 gigalitres (GL) of water to produce around 230 terawatt hours of electricity or around 0.70 GL per terawatt hour. The value-add for water consumption was around $49 million per GL. By comparison, agriculture consumed 7158 GL of water for a value-add of $4 million per GL.[3]

Access to adequate and secure water supplies is an essential issue for the security of energy supply. During the 2002–10 drought, reductions in the availability of Australia's hydro-electric capacity resulted in higher wholesale electricity prices, as more expensive gas-fired generation was required to replace hydro-electricity's usual backstop generator role. While critical levels were never reached, availability of cooling water reserves for thermal generators became a material risk in some regions and a drought simulation undertaken by the then National Electricity Market Management Company for the National Water Commission raised some concerns about short-term power supply.[4]

Water issues may also affect energy generation decisions in other ways. For example, uncertainty about future water access may affect project financing through heightened perceptions of risk. Emerging electricity generation technologies, such as solar thermal generation and carbon capture and storage, may also involve a higher intensity of water use rates (water per unit of generation) than current conventional plants; and the development of unconventional gas reserves, such as coal seam gas, involves both the treatment and disposal of significant volumes of groundwater.

The electricity industry has a number of short- and long-term technical options for securing its water requirements or reducing water use. However, most of these options are more applicable to new plant rather than existing operations due to the challenging economics of retro-fitting. Nonetheless, electricity generators have implemented water-use efficiency options. The National Water Commission report found that some coal-fired power stations have reduced their water use per megawatt hour generated by up to 15 per cent.[5]

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[3] Australian Bureau of Statistics, *Water account, Australia 2008–09*, cat. no 4610.0, ABS, Canberra, 2010. ABARES, *Energy in Australia 2011,* ABARES, Canberra, 2011.

[4] A Smart and A Aspinall, *Water and the electricity generation industry: implications of use*, Waterlines report series no. 18, National Water Commission, Canberra, 2009.

[5] Smart and Aspinall, *Water and the electricity generation industry*.

In most cases, water allocations for existing generators have been set through individual licensing agreements reflecting the historical nature of these developments. However, the take-or-pay provisions in water supply licences can introduce barriers to efficient decision-making by removing incentives to save water through more efficient risk management or investment in water efficiency, and through limitations on trade in surplus water.

In the future, there will be a greater need to provide opportunities for generators and other water users in the energy sector to flexibly manage risks and minimise costs through the efficient pricing of water inputs. These opportunities are best provided through participation in Australia's water markets.

The marginal value of water in electricity generation ranges between $14 000 and $18 000 per megalitre. During the 2002–10 drought, the price of water traded between irrigators peaked at $1200 per megalitre for volumes delivered in a given season. In 2011, however, the market price for water is less than $100 per megalitre. Given these differences, the electricity industry is well placed to compete for the water it needs within existing water markets.

Providing energy generators with the option to purchase tradeable water rights in open markets can increase their water and energy security. Appropriate pricing will also ensure better locational and technology choices in new investments. In this context, the Australian Government believes as a matter of principle that future arrangements should provide for all water users, including electricity generators and gas providers to:

- be covered by water access entitlement and water planning frameworks, with
- their use included in the consumptive pool and based on clearly specified water access entitlements that are compliant with the National Water Initiative
- settled entitlement arrangements for new sources of water, such as groundwater resulting from coal seam gas extraction
- access to participatory and transparent water planning processes that allow for consideration of supply reliability requirements
- requirements for the quality of water returned to surface and groundwater systems
- pay a price for supplied water that reflects the full costs of supply and management
- have unrestricted and equitable access to water markets in order to manage the risk associated with water access entitlements and contracts for supply
- take water availability and reliability into account when planning the location of major developments that require access to water.

A further general principle is that contractual arrangements for the supply of water to generators should reflect the same access provisions as those for other users, and not mandate take-or-pay contracts that exclude participation in water trading.

The government will also work with relevant agencies, such as the National Water Commission (or any successor from July 2012) and Geoscience Australia, to promote a better understanding of the interaction between water resources and the energy sector, including through linked mapping of energy and water resources.

Improving the effectiveness and efficiency of regulation and planning

Effective and efficient application of environmental regulations is important not only to reduce business costs, but also to ensure high-quality outcomes. Poor-quality, delayed or inconsistent decision-making can have a negative impact on business investment, impose unnecessary costs or result in suboptimal environmental outcomes. The risk of administrative duplication or inefficiency is increased due to Australia's federal system; governments at all levels must be mindful of the potential costs that can be incurred from not working effectively together.

The Australian Government has recently announced a range of significant environmental reforms that are relevant to energy. These include changes to the administration of the EPBC Act[6] and reforms to offshore petroleum regulation. The new offshore regulatory arrangements were discussed in section 5.3.

Nationally, demand for approvals under the EPBC Act has increased significantly over recent years, as has the complexity of the assessments. Much of this increase comes from the rapid expansion in Australia's energy and resource development sectors. The EPBC Act has been in force for more than a decade, yet half of all the approvals given have been granted in the past three years.

Recognising the need to improve efficiency and move assessment and approval processes to a more proactive and strategic basis, the government recently announced that it would amend the Act to include:

- a shift from individual project approvals to strategic approaches, including new regional environmental plans
- streamlined assessment and approval processes
- better identification of national environmental assets, including through a provision to list 'ecosystems of national significance' as a matter of national environmental significance under the EPBC Act
- cooperative national standards and guidelines to harmonise approaches between jurisdictions and foster cooperation between all stakeholders.

The reforms also include a commitment to developing a more clearly defined offsets policy framework. The introduction of strategic assessments, in partnership with states and territories, is designed to provide more certainty for business by looking at cumulative environmental impacts across whole regions before development begins, and reducing the need for individual environmental assessments. This also will cut red tape and reduce duplication.

The Australian Government, through the Department of Sustainability, Environment, Water, Population and Communities, is committed to working closely with industry and other stakeholders in the further elaboration and implementation of these important reforms. In addition, the government is committed to regular review of major environmental regulatory frameworks and mechanisms to ensure their ongoing efficiency and effectiveness in changing circumstances.

[6] Department of Sustainability, Environment, Water, Population and Communities, *Reforming national environment law*, DSEWPaC, Canberra, 2011.

Considering climatic conditions when building infrastructure

The Australian Government has implemented policies to reduce greenhouse gas emissions, and the need to reduce emissions from Australia's energy sector is well documented and is addressed elsewhere in this draft Energy White Paper, particularly in Chapter 7, which discusses the challenges associated with the clean energy transformation.

Industry, as a precautionary measure, must also ensure that energy infrastructure is resilient and suitable for the environment it is built in, giving consideration to climatic conditions and possible changes that could occur in the future.

Fundamentally, this is a risk management issue for industry itself to consider.

Effectively managing competing resource use

The discussion in Chapter 5 addressed the growing challenge of managing co-development of Australia's physical energy resources. The importance of effectively balancing and managing risks and competing resource use issues cannot be overstated if Australia is to continue to maximise the benefits of its resource base.

Developing new resources and new technologies that are unfamiliar or less established inevitably generates questions or concerns over potential environmental impacts as well as about issues such as human health and safety, and visual or social amenity. These concerns are usually more prominent when proposed energy developments are perceived to be in direct conflict with other established land or resource uses. If mutually beneficial solutions are not found through meaningful and effective engagement, opposition to the development or technology can be taken up more broadly.

This disquiet has been seen in debates about the location and operation of large-scale wind farms, the development or expansion of new coal mines and, most recently, the development of new and unconventional gas resources (coal seam gas and tight gas). Community acceptance of new technologies such as carbon capture and storage, hot rock geothermal drilling, underground coal gasification and large-scale solar developments has yet to be significantly tested in Australia. These concerns can be a mix of legitimate concerns about specific potential impacts or risks, moral or philosophical objections to the processes or technologies involved, and uncertainty generated by a lack of information or experience.

New technologies and projects cannot proceed in Australia unless they receive regulatory approval, usually from the relevant local and state or territory governments. In some circumstances (such as where they trigger the provisions on matters of national environmental significance in the EPBC Act), Australian Government approval is also required. This helps ensure that potential impacts and risks are appropriately managed.

However, it is increasingly apparent that it is helpful for projects and technologies to earn social legitimacy, or a 'social licence to operate'. Failure to secure social acceptance can generate entrenched community resistance, which in turn deters investors and increases project costs through delay and possible legal action. The principal responsibility for addressing community concern and establishing social acceptance lies with industry, through the project proponents and technology developers and users, rather than government. This must occur at a local and broader societal level.

A prominent example of how improved processes and outcomes can be achieved is the experience of the Australian minerals industry, which underwent a process of collective and individual lessons learned through the late 1970s and 1980s in developing best-practice sustainability and community engagement frameworks. While this does not guarantee dispute-free development, such engagement assists by transparently addressing environmental impacts and concerns, ensuring that those who might bear costs are appropriately compensated, ensuring that local communities receive tangible benefits from development, and promoting the benefits of the project or mining more generally.

Most businesses in the Australian energy sector operate responsibly and with due regard to creating and maintaining their 'social licence to operate'. The Australian Government does not believe that such practices could or should be mandated or regulated in every instance as they are most effective when they are embraced and embedded within corporate management strategies and behaviours rather than become the subject of a compliance regime. However, there is room for improvement and the government will continue to engage with business to improve operation frameworks, information flows and community engagement. The government has made the development and implementation of community consultation plans a condition of grants under the Solar Flagships Program and the Carbon Capture and Storage Flagships Program.

There is also a role for government in providing efficient and effective regulatory frameworks that ensure legitimate concerns are addressed through timely and transparent decision-making. The Australian Government will work with state and territory governments to better manage co-development pressures and to promote the need for and benefits of developing new energy resources and clean energy technologies.

As outlined in section 5.4, the government has recently announced new measures to improve the development of new coal seam gas and coal projects and to improve our understanding of associated water and related environment impacts.

8.3 Cooperation between different levels of government

Achieving our energy aspirations requires cooperative work between all levels of government, and particularly between the Commonwealth and the states and territories.

The Standing Council on Energy and Resources (and its predecessor councils) has proven to be a productive forum to achieve reform in the energy and resources sectors and deliver outcomes to the benefit of Australia as a whole.

Beyond this, in areas such as renewable energy policy, infrastructure, planning policy and environmental regulations, there is clearly a co-dependence and need to work together to progress economic development objectives.

The Commonwealth and state and territory governments have revenue-raising capacity with regard to energy resources projects, and where possible the use of taxing powers should not send conflicting signals to investors in these projects.

With the ability to raise revenue also comes a degree of responsibility to ensure appropriate outcomes with respect to infrastructure investment – both by government directly and by the private sector.

8.4 Skills and workforce development

The growth and diversification of Australia's energy industries is already resulting in considerable demand for workers across a range of skill and qualification levels. The transition to a low-emissions economy will further intensify the demand for existing skills while also creating demand for skill sets in a range of new specialised technologies, adding to the demands on the education and training system.

The energy sector does not face this challenge in isolation. Other sectors are experiencing similar pressures arising from structural change in the Australian economy, the effects of an ageing population, and an overall shortage of adequately trained and skilled personnel.

The energy sector workforce

As outlined in Chapter 2, the energy sector (energy and energy resources activities)[7] represents a relatively small proportion of Australia's overall employment at just over 106 000 jobs, or around 1 per cent of Australia's total workforce.[8]

While small overall, the energy and energy resources sectors are a significant source of regional employment; over the next five years, employment in the combined energy sectors is projected to grow well above the national average. Coal mining and oil and gas extraction are projected to grow at 7.7 per cent and 7.3 per cent annually and the energy sector at 3.9 per cent per annum. This compares to an average annual growth rate of 2.2 per cent across all industries over the same period.[9]

In general, energy-related industries are characterised by a highly skilled workforce although they also provide important job opportunities for less skilled workers. In May 2010, between 68 and 70 per cent of workers in the sector had completed a non-school qualification, compared with 62 per cent for all industries. Around 25–28 per cent of workers had a university degree, while 31–32 per cent held a Certificate III or IV qualification. Approximately 30–32 per cent of workers in the industry were without a post-school qualification.[10]

The work profile of both sectors is characterised by full-time employment. The rate of female participation is also substantially lower than the national average (45 per cent), with coal mining and oil and gas extraction recording 16 per cent and 12 per cent participation respectively and the energy sector 19 per cent.

[7] For the purposes of this section, the 'energy sector' workforce is measured through the Australian and New Zealand Standard Industrial Classification (ANZSIC) subsector of electricity supply and gas supply. 'Energy resources' comprises the ANZSIC mining subsectors of coal mining, oil and gas extraction and exploration, and petroleum and coal product manufacturing.

[8] ABARES, *Energy in Australia*.

[9] Department of Education, Employment and Workplace Relations, *Industry employment projections 2011 report,* DEEWR, Canberra, 2011.

[10] Australian Bureau of Statistics, *Education and work, Australia*, cat. no 6227.0, ABS, Canberra, 2010.

Needs for the future

The growth and diversification in our energy industries will create opportunities and pressures across a range of skill sets, particularly for highly skilled engineering and other graduate-level professionals and trades professionals to develop, adapt, install and maintain a range of new clean technologies in energy generation, end use and advanced networks and communications.

Unique technologies such as large-scale solar, carbon capture and storage and geothermal energy will require general as well as specialised skills. These include skilled workers such as chemical engineers for separation of gases and chemical heat storage systems, and gas processing, storage and transportation engineers and technicians. Carbon capture and storage and geothermal generation will have similar workforce requirements to the petroleum production and exploration sector, including drilling rig operators and crew, welders for pipeline construction and geologists.

The ElectroComms and Energy Utilities Industry Skills Council (EE–Oz) has reported that the electricity sector is currently experiencing shortages in general technical knowledge and skills, skills in new technology systems associated with energy efficiency, smart meters, industry safety and regulation, energy infrastructure development and maintenance, and information and communications technology system integration for smart grids, smart systems, the National Broadband Network and peak load management.[11]

The energy resources sector, like the mining industry more generally, will require a range of skills in its production managers, electrical, mechanical, mining and petroleum engineers, carpenters, plumbers, air-conditioning and refrigeration mechanics and automotive trades. Based on current recruitment growth rates in the mining sector, there is a forecast shortfall of 35 800 trade positions, 1700 mining engineer positions and 3800 geoscientist positions.[12]

For example, an emerging issue facing the liquefied natural gas (LNG) export industry is being able to train enough LNG plant operators. Anecdotal evidence from the industry suggests that around 1400 plant operators will be required for the six LNG projects planned for Australia. Australian capacity for the industry to provide the necessary on-site training in addition to formal qualification training is currently limited to the operating LNG trains in the North West Shelf and Darwin. Allowing for site physical limitations and safety requirements, potential annual training is estimated to be around 30 to 35 people per year, whereas the training requirement may need to be around 175 people per year.

There is also a need to ensure that Australia is well positioned beyond its immediate skill requirements through its education system. In particular, this suggests the need for a pipeline of graduates and postgraduates in energy-related engineering, chemistry and geophysics and in enabling fields such as computational science and information and communications technology. These skills will be acutely needed to support ongoing basic and applied research and development in energy technologies and processes, as well as the adaptation and roll-out of more commercially mature energy technologies.

With the Australian economy effectively at full employment and expected to remain so over the next decade, there will be strong competition in the workforce for these skills. The energy resources sector will need to ensure that it presents competitive and attractive career opportunities.

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[11] EE-Oz, *Environmental scan*, EE Oz, Canberra, 2011.

[12] Skills Australia, *Skills Australia 2011 interim report on resources sector skill needs*, Skills Australia, Canberra, 2011.

Actions to promote workforce development

Together with Skills Australia, industry skills councils, business groups, the vocational education and training sector, and secondary and higher education institutions, the Australian Government is to implement responsive training and workforce planning strategies to boost labour supply through the following core measures:

- education and training
- promoting participation
- workforce mobility
- skilled migration.

Education and training

The Building Australia's Future Workforce package includes reforming apprenticeships and the vocational education and training sector, and putting industry at the heart of the training effort. To support the new partnership with industry, the government will establish the National Workforce and Productivity Agency from July 2012. The agency will undertake a range of strategic activities, including: administering the $558 million National Workforce Development Fund; conducting skills and workforce research; driving engagement between industry, training providers and government on workforce development, apprenticeships, and vocational education and training reform; and developing and monitoring sectoral skills and workforce development plans.[13]

A key focus of the National Workforce Development Fund will be to facilitate industry-led responses to workforce development and training needs by supporting partnerships with industry skills councils, industry associations and companies, and the vocational education and training sector. The fund includes projects that are designed to increase the skills of senior tradespeople for frontline management jobs and specialist roles in mining and civil construction, training for workers in mining and quarrying, and training for new and existing workers in rail operations to support resource projects.

The Australian Government has also brought together a range of initiatives that target skills shortages in the patchwork economy and match skilled workers to new jobs under the Skills Connect initiative. This initiative allows industry to come to government with whole-of-workforce proposals that can draw on:

- the Accelerated Apprenticeships program to provide competency-based pathways that recognise skills as they are acquired
- the Apprenticeships Mentoring program to support apprentices to complete their training
- the Workplace English Language and Literacy program to support workers who lack the language and literacy skills they need to access training
- the National Workforce Development Fund.

Employers and industry bodies will be able to work with their industry skills council to develop projects that support comprehensive workforce development. The resources sector and government have developed the National Resources Sector Workforce Strategy (see Box 8.1), and the Minerals Council of Australia, the Queensland Resources Council and the Chamber of Minerals and Energy of

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[13] Further information on the Building Australia's Future Workforce package is available from www.deewr.gov.au.

Western Australia are developing an integrated careers marketing and employment portal for resources sector jobs to streamline career pathways in the mining and energy resources industries. The mining and energy resources industries also provide education materials for school students on industry-related issues.

The Clean Energy and Other Skills package will provide up to $32 million to support tradespeople and professionals in key industries to develop the skills needed to deliver clean energy services, products and advice to Australian communities and businesses. This package includes a commitment to complete a scoping study that will map the key occupations required for delivering energy efficiency projects in industry.

Reforms to higher education funding arrangements will provide for more flexibility for industry and educational institutions to design graduate and postgraduate training programs that are aligned to the medium- and long-term requirements of the energy and energy resources sectors. For example, the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), through its partnerships with industry and other research organisations, has developed programs to build technical capacity in carbon capture and storage. The centre supports undergraduate and postgraduate students in chemical engineering, geology, reservoir engineering, resource economics and mathematics.[14]

Box 8.1: National Resources Sector Workforce Strategy

The National Resources Sector Workforce Strategy is a comprehensive industry-led workforce development plan. It is designed to assist the minerals and energy resources sector to meet future workforce needs. It identified 31 actions by industry and government to address seven key areas:

- promote workforce planning and sharing of information
- increase the number of trade professionals
- graduate more engineers and geoscientists
- meet temporary skills shortages with temporary migration
- strengthen workforce participation
- forge stronger ties between industry and education
- address the need for affordable housing and community infrastructure.

Responsibility for implementing the strategy is shared by industry, state and territory governments, and the Australian Government. Each action is being led by an industry or government organisation, with strong commitment from other relevant stakeholders, such as industry associations, unions, employers, employment service providers, and education and training organisations. Skills Australia reports annually to government to update the anticipated demand for skills and labour.

A key element of the strategy is facilitating fly-in, fly-out projects. The resource sector industry skills council (SkillsDMC) and the Advance Cairns development agency have piloted a fly-in, fly-out coordinator model in Cairns, which will be progressively expanded to more locations around Australia.

More information on the National Resources Sector Workforce Strategy can be found at www.deewr.gov.au/resourcesworkforce.

[14] Further information on the CO2CRC is available at www.co2crc.com.au.

Promoting participation

Increasing the participation of people who are not currently in the labour market is important for addressing workforce supply issues. With baby boomers reaching traditional retirement age, an increasing number of highly skilled and experienced workers will be seeking to decrease their workforce commitments. This will add to skills pressures unless employers find ways to extend the engagement of older workers and also attract more people who are not currently participating. Only one-quarter of the energy sector workforce is female, so there may be opportunities to increase the participation of women, including single parents, through more flexible working arrangements.

In addition to improved incentives in the tax and transfer system, government support for increasing the participation of disadvantaged people is available through a range of measures in the Building Australia's Future Workforce package to:

- support people into work through training, and improved childcare and employment services
- provide support for the very long-term unemployed, people on the Disability Support Pension, teenage parents, jobless families and young people
- address entrenched disadvantage in targeted locations with high levels of unemployment and poor participation rates.

Workforce mobility

The strong demand for an energy resources sector workforce over the medium term will provide employment opportunities for workers from sectors of the economy that experience cyclical downturns or in sectors that are undergoing structural adjustment due to global competitive pressures, such as the manufacturing sector.

In addition, the Australian Government is facilitating labour mobility in the energy and energy resources sectors by supporting the establishment of regionally based fly-in, fly-out coordinators, enhancing skilled migration arrangements and ensuring a flexible and responsive workforce through increased adoption of national qualification recognition arrangements.

The mobility of skilled workers across industry sectors and regions is underpinned by the Australian Qualifications Framework, which ensures that skills qualifications are nationally consistent, and that training and assessment are of high quality and meet industry standards. In addition, the Council of Australian Governments (COAG) has agreed to the development of a national licensing system for specified occupations, which will remove inconsistencies across state and territory borders (see Box 8.2).

Box 8.2: Australian Electricity Supply Industry Skills Passport

> One example of a national industry response to skills management and mobility is the Australian Electricity Supply Industry Skills Passport. The Skills Passport was developed cooperatively by relevant businesses, unions and skills bodies to encourage nationally consistent practices in competencies and training authorisations in the industry. There are more than 40 000 people working in the electricity supply industry in Australia; the Skills Passport provides a single-point database to monitor their relevant qualifications and demographic information. Information on the database has appropriate privacy protections.
>
> In addition, a national database allows workers to more easily transport their qualifications to different geographic areas and businesses, which will contribute to the development of nationally consistent training units. This will significantly improve worker mobility and reduce expenditure on retraining.

Skilled migration

Migration contributes to the supply of labour through employer-sponsored permanent and temporary programs to support skilled workers who have qualifications and skills or experience in particular occupations required in Australia.

In particular, the recently established Enterprise Migration Agreement will enable tailored skilled migration support for large energy resource projects with expenditure of more than $2 billion and a peak workforce greater than 1500. The agreement requires project owners to implement training commitments that contribute towards addressing future skills needs in the resources sector that will assist in supporting a long-term pipeline of resource sector developments.

The skilled migration framework also provides for points-tested general skilled migration, for professionals and other skilled migrants who are not sponsored by an employer and who have skills in identified occupations.

Looking ahead

The Australian Government will continue to work closely with industry and the skills and training and education sectors in implementing the initiatives described above and ensuring that they are appropriately tailored to workforce needs.

In addition, the energy sector may wish to consider whether there would be benefit in an industry-led national energy sector workforce strategy to articulate specific skills requirements for the energy sector over the decade.

8.5 Indigenous opportunities

As outlined in earlier chapters, Australia's energy-related industries provide a significant contribution to the national economy through employment, wages and salary and export income. Because much energy sector activity occurs in regional and remote Australia, the sector also provides good opportunities for Indigenous Australians through employment and Indigenous business development.

The disadvantages experienced by many Indigenous Australians are well documented. Their general social and economic opportunities fall well below those available for non-Indigenous Australians. This often presents a number of challenges in ensuring that economic opportunities through resource or other development projects can be accessed.

To address barriers to Indigenous participation, the Commonwealth and state and territory governments, as part of COAG's Indigenous Reform Agreement, are implementing various programs under the national Closing the Gap policy framework, which is driven by three important imperatives to overcome Indigenous disadvantage:

- overcome decades of underinvestment in services and infrastructure
- encourage and support personal responsibility as the foundation for healthy and functional families and communities
- build new understanding and respect between Indigenous and non-Indigenous Australians.

The Australian Government has a number of measures and statutory institutions in place to support its Closing the Gap policy objectives. These include the Indigenous Economic Development Strategy, Community Development Employment Projects, the Indigenous Employment Program, the National Resources Sector Workforce Strategy, the Indigenous Land Corporation, Indigenous Business Australia, the Indigenous Employment and Enterprise Network, and the Memorandum of Understanding on Indigenous Employment and Enterprise Development between the Australian Government and the Minerals Council of Australia.

The Indigenous Economic Development Strategy aims to increase the wellbeing of Indigenous Australians by supporting greater economic participation and self-reliance. It proposes a framework to guide development of Commonwealth policies, programs and actions for Indigenous economic development.[15] Of the priority areas identified in the strategy, the energy sector has the potential to support skills development and jobs, business and entrepreneurship as well as strengthen the foundations for Indigenous economic development. The contributions the energy sector is able to make to the strategy and the Closing the Gap objectives are in the areas of employment skills and training, economic opportunities and energy access.

Employment, skills and training

Evidence from the Australian Bureau of Statistics 2006 Census data suggests the energy sector provides significant Indigenous employment opportunities in the mining (which includes energy resources projects), utilities, transport and construction sectors.[16] While absolute numbers are low, as a proportion of their respective demographics, mining employs more Indigenous Australians than non-Indigenous, equal proportions of Indigenous and non-Indigenous in the electricity, gas, water and waste sectors, and marginally fewer Indigenous Australians to non-Indigenous in the construction and transport sectors.

Whether the employment opportunities offered by the energy sector are direct or indirect, effective education and training are critical to increasing the economic participation of Indigenous Australians.

[15] The five priority areas identified in the Indigenous Economic Development Strategy are strengthening foundations, education, skills development and jobs, business and entrepreneurship, and financial security and independence.

[16] Australian Bureau of Statistics, *Indigenous statistics*, 2006 Census, labour force data, ABS, Canberra, 2007.

As discussed in section 8.4, providing incentives for disadvantaged groups to return to the workforce, coupled with training and flexible working opportunities, is important to raise participation rates in the Australian workforce. To make a successful transition from welfare to workforce participation, Indigenous and non-Indigenous disadvantaged Australians can often achieve better retention through employment options that give them the flexibility to pace their transition to work and to continue to meet family and cultural obligations.

Indigenous employment in the energy sector is broadly supported by existing measures, such as the Indigenous Employment Program. During 2010, as a result of the program more than 16 000 Indigenous Australians started employment, around 12 500 Indigenous Australians started training and more than 700 Indigenous Employment Program projects were established.

Again, as outlined in section 8.4, facilitating opportunities for Indigenous employment in the energy sector will be further supported by the Australian Government's implementation of National Resources Sector Workforce Strategy measures that have a particular regional and Indigenous focus. This regional emphasis is consistent with the place-based approach of the Indigenous Economic Development Strategy. These measures include establishing employment brokers in regional locations with strong energy sector investment activity; building stronger links with employers, trainers and employment service providers; and expanding the role of employment brokers in Western Australia to include supporting participation by Indigenous businesses in major energy projects.

Industry initiatives are also contributing to improving skills and employment for Indigenous Australians. The scholarship program offered by the Australian Petroleum Production and Exploration Association supports Indigenous education in sector-related engineering disciplines and mentoring by Indigenous graduates of other Indigenous Australians.[17]

Across the private sector, more than 200 reconciliation action plans are supporting training, employment and other actions benefiting Indigenous Australians. Through these plans, organisations have committed to recruit more than 8300 Indigenous Australians and have already placed an estimated 5300.[18] For example, Rio Tinto's Indigenous employment programs have helped increase the proportion of Indigenous employees at Rio Tinto from 0.5 per cent to 8 per cent. Rio Tinto is also involved in the Australian Government's National Indigenous Cadetship Project.

Economic opportunities

Around half of Indigenous Australians live in outer regional, remote or very remote Australia.[19] A priority for the Closing the Gap agenda is supporting opportunities for economic participation in regional and remote areas where the Indigenous population is higher than the average national population. As energy sector development projects often take place in regional and remote Australia, the energy sector has considerable potential to enhance the economic opportunities available to regional and remote Indigenous populations.

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[17] For more information on the scholarship program, see www.appea.com.au/about/awards-a-scholarships/appea-scholarships.html.

[18] Australian Government, *Closing the Gap: Prime Minister's report 2011*, Department of Families, Housing, Community Services and Indigenous Affairs, Canberra, 2011.

[19] Australian Bureau of Statistics, *Population distribution, Aboriginal and Torres Strait Islander Australians, 2006*, cat. no. 4705.0, ABS, Canberra, 2007.

For those Indigenous communities located in regional and remote areas with active or proposed energy sector projects, potential economic opportunities can be provided through land-use conditions set out in agreements under the native title or lands rights regimes. These include royalty or native title payments,[20] income derived from Indigenous business enterprise opportunities arising from a development project, wages income from employment training and education, and cultural heritage protection.[21]

In addition to energy resource sector projects, Australian Government initiatives on carbon pricing and clean energy development may present new opportunities for Indigenous communities for business development and employment through carbon farming and renewable energy projects such as concentrating solar thermal, geothermal and biofuels.

Agreement-making can deliver positive benefits to the broader Indigenous community to allow both traditional and non-traditional owners and neighbouring groups to share in the wealth creation that energy resource projects can bring to regional and remote areas. For example, agreements can be drafted to allow employment and training benefits to be accessed through a broad recruitment pool.

One of the government's principal policy objectives in this area is to encourage sustainable agreement-making, both in terms of workability and providing long-term benefits to Indigenous Australians. As partners in energy development projects, it is vital that traditional owners and native title holders fully understand their obligations and entitlements under agreements to which they are a party. Well-structured agreements will help to ensure that Indigenous interests are protected and that decision-making processes are in place to allow the benefits flowing from these agreements to be managed effectively to meet the needs of this generation and of those to come.

In addition to benefits that flow from native title and land rights regimes, access to land title and business development may be facilitated through the Indigenous Land Corporation or Indigenous Business Australia. The support provided in land acquisitions and business development may become increasingly important as potential alternative land-use opportunities arise out of the development of land-intensive renewable energy projects.

Establishing sustainable business enterprises provides potential for the benefits of an energy sector project to extend beyond its operational life and royalty stages. These businesses can also provide positive role models and learning environments for local communities. Through their reconciliation action plans, a number of resource sector companies have stimulated more than $800 million in supply contracts for Indigenous business.[22]

The banking sector has developed a number of initiatives to support the establishment of Indigenous enterprises, reflecting its commitment to Indigenous people and future Indigenous business potential. Indigenous businesses are demonstrating their business sustainability – for example,

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[20] When an energy or resource development occurs on Indigenous land, resource companies pay royalties (or native title payments) to the relevant government (state, territory or Commonwealth). In some cases the relevant government transfers an amount equal to some or all of the royalties received to the benefit of the Indigenous owners of the land. This is the case in the Northern Territory, where an amount equal to royalties received by the Commonwealth or the Northern Territory Government is credited to an account that distributes funds for the benefit of Aboriginal people in the Northern Territory. In addition, there are often separately negotiated agreements between resource companies and traditional owners.

[21] Of the 527 agreements on the Register of Indigenous Land Use Agreements, around one-third cover energy and resource sector activity. Further information on the register is available from National Native Title Tribunal website at www.nntt.gov.au.

[22] Australian Government, *Closing the Gap: Prime Minister's report*.

Indigenous Business Australia has found that, among its clients, 65 per cent of Indigenous businesses are still operating after five years, compared to only 50 per cent for the average for all small business.[23]

A number of Indigenous enterprise development organisations have been established in recent years, reflecting the significant opportunity enterprise development offers Indigenous people. Nationally, Aboriginal Enterprises in Mining, Exploration and Energy Limited seeks to commercially advance Aboriginal-owned enterprises in Australia and internationally. Regionally, a number of Indigenous organisations have been established (for example, the Pilbara Aboriginal Contractors Association and the Bowen Basin Indigenous Mining Contractors) in response to this rapidly developing sector. Business directories such as Digedi provide important opportunities for the energy and resources sector to engage with Indigenous business.[24]

Indigenous economic opportunities are also being enhanced by the activities of companies operating in the energy sector through their policies for workplace diversity and facilitating the growth of Indigenous enterprises. A review of annual reports of Australian Securities Exchange companies operating in the energy sector indicates that a range of companies have in place strategies for Indigenous employment enterprise development and workplace cultural appreciation programs to support Indigenous employee retention (see Box 8.3).[25]

Box 8.3: Woodside reconciliation action plan

Through its reconciliation action plan, Woodside seeks to increase Indigenous participation in its operations. In the Pluto development, Indigenous employment peaked at 170 (against a target of 150). Throughout 2010, the project recruited and trained 29 Indigenous people for jobs in the Pluto operations team. Woodside's Browse LNG gas project provides training and employment opportunities for the development of local Indigenous businesses.

These initiatives include commitment to Indigenous employment and new training and education programs to assist Kimberley Indigenous people to become job ready for the oil and gas industry. At the end of 2010, Woodside had employed 15 Indigenous people in Browse, including eight young people as trainees. The company has also engaged several Kimberley Indigenous contractors to provide services including transport, cultural heritage monitoring, catering, audio-visual production and workshop facilitation.

Access to energy

A key focus of the Closing the Gap agenda for Australian and state and territory governments (and supported by the Indigenous Economic Development Strategy) is providing the necessary investment in health, housing and community safety. Progressive success in improving the quality of this social infrastructure will improve the capacity for Indigenous communities and individuals to pursue the opportunities that energy and resource sector developments in their regions may provide.

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[23] Fry, C, Indigenous Business Australia, *Into Business workshops: a review of successful Indigenous pathways into business ownership*, paper presented at the Aboriginal Enterprise Mining, Exploration and Energy Conference, Mackay, October 2011.

[24] Further information on Digedi is available at www.digedi.com.au.

[25] Companies include Woodside, Santos, APA Group, Rio Tinto, BHP Billiton and Transfield Services Infrastructure.

Access to reliable, safe and efficient energy generation and supply supports community wellbeing and provides opportunity and comfort to Indigenous households and communities in exactly the same way that it does for Australian households and communities – heating, lighting, food preparation and preservation, and communications.

Arrangements for energy generation and distribution in remote Indigenous communities vary. In some larger communities that are connected to distribution networks, energy access is supported by state and territory governments through the normal service delivery arrangements between supplier and consumer in non-Indigenous communities. These normal service provider arrangements mean that grid-connected Indigenous communities do not necessarily require the skills, resources and technical expertise to effectively maintain energy services. However, not all grid-connected communities experience the benefits of regular access to energy. There are issues relating to the adequacy and reliability of existing power infrastructure, particularly as a result of increasing population, which is a common issue in Australian regional communities.

For non-grid-connected communities like outstations and homelands, energy access is often provided through a combination of diesel generators, solar arrays and/or wind generators. Energy infrastructure is generally funded through a state and territory or Australian Government program. Service provision is by a mix of major service providers, resource agencies, shire councils, community councils and community self-managed service provision. Under these arrangements power services are generally less reliable and infrastructure is not adequately maintained.

The Australian Government provides specific funding for renewable energy systems through the Bushlight Program and the Remote Indigenous Energy Program. Since 2002, the Bushlight Program has improved remote Indigenous communities' access to reliable power supplies by installing, maintaining and repairing 265 renewable energy systems across 220 communities in the Northern Territory, Western Australia and Queensland. The program is part of the Australian Government's climate change response and provides financial support to install renewable energy generation systems in remote Indigenous communities.

The Remote Indigenous Energy Program provides $40 million in support of remote renewable investment. It will provide additional financial support to install renewable energy generation systems like solar panels and wind turbines in around 55 remote Indigenous communities. This new program will also include training in power system maintenance and information to support households and communities manage their energy.

For example, Horizon Energy in Western Australia provides energy services to Indigenous communities including the installation of hybrid solar–diesel power systems in off-grid locations. The company also provides Indigenous Australians in Western Australia with the opportunity to work towards a nationally recognised electricity supply industry qualification – Remote Community Utilities Worker. The qualification will allow Indigenous and non-Indigenous people living in remote communities to build skills in support of energy access for remote communities. Participants will be trained to perform a range of tasks on overhead and underground electrical distribution networks and generation assets in their community, improving the safety, reliability and quality of their power supply. The qualification will be rolled out nationally once the Western Australian pilot project is completed.[26]

[26] Further information is available from Horizon Power's website at www.horizonpower.com.au.

8.6 Key actions

The Australian Government will work with industry and state and territory governments to ensure an efficient and effective interface between energy and environmental policy frameworks, including through:

- implementation of announced reforms to the *Environment Protection and Biodiversity Conservation Act 1999* and other relevant environmental measures, such as those relating to new coal seam gas and coal developments
- promoting effective consultation with local communities in the development and deployment of technologies or projects

All levels of government need to work cooperatively together to achieve our energy and sustainable development aspirations

The government will also work with the energy sector and the skills, training and education sectors to implement key workplace development and participation measures including actions under the National Resources Sector Workforce Strategy.

Recognising the contribution the energy sector can make to supporting the national Closing the Gap objectives, the Australian Government will:

- continue to support
  - industry initiatives arising from the National Resources Sector Workforce Strategy that facilitate Indigenous participation in workforce planning, and skills and training opportunities
  - initiatives arising from the Memorandum of Understanding on Indigenous Employment and Enterprise Development with the Minerals Council of Australia that lead to enhancing Indigenous employment and enterprise development opportunities
- work with the Standing Council on Energy and Resources and encourage jurisdictions to review and periodically report on energy supply and use issues in Indigenous communities, including plans and actions taken to address energy access issues.
- support the development of workable native title and other land-use agreements between project proponents and Indigenous communities that facilitate timely and mutually beneficial outcomes and opportunities and which provide the impetus for lasting change
- continue to encourage and work in partnership with energy sector companies to develop reconciliation action plans or consider Indigenous opportunities in their business development plans, corporate policies and programs for workplace diversity and local enterprise development.

9 International engagement and energy analysis

Highlights

- International engagement continues to play a vital role in achieving Australia's energy objectives, including the promotion of trade and investment in Australian energy, and increasing our understanding of global energy patterns, directions and technologies.
- Australia will continue to actively engage in relevant international forums to advance our energy objectives, shape global energy frameworks, and work collaboratively to pursue common energy goals.
- High-quality and timely energy information and analysis (or 'energy metrics') are vital for informed and sound decision-making on energy as well as building public awareness and understanding of energy issues.
- A number of government and independent agencies currently provide a wide range of energy metrics.
- Australia's energy information systems are relatively comprehensive, although somewhat uncoordinated. There are opportunities for their improvement, including through:
  - reviewing energy information across government with a view to better align energy data, and identify any further information needs
  - greater understanding of household energy use to inform energy policy
  - improved collection and analysis of petroleum statistics
  - better communication of energy information to improve consumer understanding of productive use of energy.
- In general, there is a need for more in-depth and transparent assessments of our energy security, resources, technologies and fuels.
- Detailed information on energy use in households and small businesses continues to be a gap in our understanding, particularly in relation to opportunities to improve energy productivity.

9.1 Introduction

The importance of international engagement is heightened in the wake of global energy diversification, shifting energy demand–supply patterns, increasing international adoption of new clean energy policies, accelerated development of clean energy technology, and the need to attract foreign investment in a highly competitive capital market. These dynamics present challenges and opportunities for Australia that can be better understood and addressed through productive international exchange.

Section 9.2 describes the principal ways in which the Australian Government engages internationally on energy issues and the policy objectives it is seeking to achieve.

Access to high-quality and transparent energy data and analysis is crucial for government, business and households in being able to make efficient and well-informed decisions. As Australia enters a period of major transition in our energy systems and markets, the need for improved information and datasets is growing rapidly and there is a constant challenge in ensuring that the knowledge is comprehensive, appropriate and timely. It is also important to ensure that information that is not commercially sensitive is accessible to the wider community and business.

Section 9.3 outlines the principal sources of energy information and data within the Australian Government and more broadly. It also considers where there are gaps that should be the focus of future attention.

9.2 Overview of international engagement

As a major global trader in energy, Australia is strongly linked into the global energy system. However, our international energy interests extend deeper. They go beyond trade interests and include the need for strategic engagement to shape international policy frameworks, further multilateral and regional cooperation, and pursue common energy goals such as energy security and stable, robust and resilient markets, and the development and deployment of clean energy technology.

Effective international engagement is crucial for realising our energy objectives. It occurs through a wide variety of mechanisms at different levels. It often involves a dynamic mix of participants from government, research agencies and institutions, business, non-government organisations and civil society. Governments have a key role in facilitating exchanges at the institutional level and in working to reduce cultural or informational barriers.

The appropriate role for government in this mix is challenging to define, as it can play a number of roles from leadership through to facilitation and coordination. Clearly, there are a range of government-level responsibilities and relationships that it must lead on. However, there may also be circumstances where government can appropriately support or participate in initiatives that contribute to Australia's energy objectives, and which may not be possible without such support.

Optimising the benefits of exchange is achieved through a focused yet flexible strategy for international engagement on energy that supports our domestic energy objectives and principles, while also remaining attentive and responsive to emerging challenges and international circumstances.

Objectives

Australia's international engagement is based around three broad objectives, under which the outcomes described above can be grouped.

1. To promote energy trade and investment, including through:
   - building and maintaining strong trade partnerships and developing new export trade opportunities
   - promoting development of robust supply chains for exports and imports
   - attracting investment in energy resources, technologies and systems.
2. To enhance understanding of energy policies, programs and directions, and accelerate energy innovation, including through:
   - enhancing cooperation on technology research, development, deployment and commercialisation
   - exchanging knowledge and building capacity and expertise
   - improving understanding of global energy trends, markets and policies.
3. To shape international policy and processes, including through:
   - promoting open, transparent and competitive global energy markets and investment frameworks
   - utilising established forums and institutions (such as the International Energy Agency) as an efficient means to convene parties and harness opportunities to collaborate and pursue common energy goals such as energy security, resilient markets and accelerated commercialisation of clean energy technology
   - contributing to global and regional energy security and response frameworks.

Mechanisms

The Australian Government will continue to pursue these objectives, working in close partnership with business and other key stakeholders, through active engagement in a variety of mechanisms and forums. These can be categorised into:

- multilateral engagement
- regional engagement
- bilateral relationships
- strengthened in-country and agency presence.

Each of these avenues has advantages for pursuing our energy objectives within the global context and with key energy trade partners. Appendix E lists the key energy-related engagements for the Australian Government. This is not an exclusive list; there are many government-to-government activities and institutional contacts not identified in the table.

Multilateral engagement

Multilateral engagements present efficient and high-level platforms for exchange, principally between national governments to discuss energy needs and promote stable and resilient energy systems; to advance national energy objectives, policies and programs and consider emerging challenges and energy directions; and to identify opportunities to collaborate on common goals. The major multilateral forums also increasingly include institutional representatives and industry participants to provide deeper dialogues and linkages.

Key multilateral energy-related engagements for Australia include, but are not limited to, the International Energy Agency, the International Energy Forum, the G-20, the International Renewable Energy Agency, the Global Carbon Capture and Storage Institute, the Carbon Sequestration Leadership Forum, and the Clean Energy Ministerial process. All these forums have broad membership and active energy-related work programs and objectives.

The United Nations Framework Convention on Climate Change process is another important forum, given its influence in shaping the global response to climate change and implications for energy markets, policy and programs.

Australia also engages in a range of specific partnerships and initiatives between government, institutions, researchers and the private sector. These focus on particular energy objectives such as accelerating the development and commercialisation of new energy fuel technologies (such as renewable, low-emissions and unconventional resources), accelerating the adoption of new sophisticated energy systems and practices (such as energy efficiency and 'smart' grids) and collaborating in research, data and information-sharing to enhance energy outcomes.

Regional engagement

Regional exchange is also important for achieving Australia's energy objectives and supporting energy security within our region. Over the coming decades, regional energy demand will grow and diversify and domestic and regional energy markets will increasingly converge. As a supplier of coal, liquefied natural gas (LNG) and uranium, Australia is well positioned to supply energy resources to meet the demand and energy security objectives of neighbours in the region. Likewise Australia, as a net importer of liquid fuels, is reliant on a stable, efficient liquid fuel supply through our regional hubs.

Australia must continue to engage with our regional partners to promote stable, efficient and resilient energy systems and open, transparent energy trade and investment markets.

In recognition of energy's role in achieving wider regional and partner country objectives (economic development, trade and sustainability), Australia's engagement can enhance energy cooperation and leverage broader regional dialogue through Asia–Pacific Economic Cooperation, the East Asia Summit and the Pacific Island Forum to focus exchange within the context of region-specific priorities, energy needs, opportunities and frameworks.

Adopting a more sustainable approach to energy is a key issue throughout the Asia–Pacific region, primarily for energy security and social development reasons, but also to assist with the global response to climate change. Australia will continue its work with other aid partners in the region to continue improving energy policy and planning broadly, and specifically to promote the adoption of clean energy.

Bilateral engagement

Bilateral engagement is important for building and strengthening our relationship with our major energy trading partners, and in addressing mutual energy resource trade (including commodities and know-how) and technology development objectives.

These exchanges are agreed on mutual terms and delivered through a range of mechanisms, such as high-level group and joint working group exchange, memorandums of understanding and commercial arrangements.

Key bilateral engagements for Australia are major current and emerging energy trading partners (Japan, China, Korea, Taiwan and increasingly India) as well as those countries that play a key strategic role in global energy frameworks or technology development such as the United States, European Union members, G-20 members and key Middle East countries such as the United Arab Emirates and those countries important in our regional energy partnerships in the Asia–Pacific.

In-country activity

Strengthening Australia's in-country energy expertise in our key and emerging energy markets will enable efficient exchange between Australian and local energy experts on energy needs and policy direction and facilitate greater awareness of new and emerging opportunities. In-country expertise is also important for promoting Australia's quality energy resources, our stable export markets and opportunities for investment in Australia, and for facilitating exchange between trade networks and participation in the Australian energy sector. This can be achieved through dedicated energy expertise and Austrade.

Similarly, strengthening Australia's resources and expertise within key energy agencies and institutions through government and industry participation will enable greater access and exchange of information and expertise, as well as increased capacity to contribute to or influence policy approaches and work programs.

Strategic challenges

As global energy demand patterns shift, the Australian Government should continue to review its international engagement to ensure that it remains appropriate and relevant. This may include a greater level of in-country engagement with new and emerging markets, strategic energy partners, as well as relevant institutions.

The Australian Government will continue to work in partnership with business, research agencies and other stakeholders, through the international mechanisms described here, to further the objectives outlined above. However, this effort will need to be prioritised against other government objectives to ensure value for money. Decisions to participate or engage in specific forums will need to be rigorously evaluated against the benefit to be received from doing so (i.e. the degree to which this contributes to the objectives outlined above). Decisions on engagement will also take into account the appropriate role for government as against business or other interests.

Australia's overall energy engagement strategy should be regularly reviewed to ensure relevance and effectiveness. This should form part of the energy policy framework review process.

9.3 Energy metrics

'Energy metrics' is a broad term referring to energy data, information and analysis. It is vital for informed decision- and policy-making, and is constantly evolving in line with energy market developments.

As global and domestic energy markets evolve, knowledge of the resources base widens, technologies advance, energy systems integrate and energy consumption patterns shift, our information needs will expand and diversify.

This knowledge base is built through research, analysis and forecasting. These measures inform planning, decision-making and policy development. They build understanding of issues and trends, support public debate and ensure that policy is evidence based and robust. They can also help inform and improve consumer understanding of energy, and promote a broader social consensus on our energy choices.

Objectives

The principal objective is to improve the Australian Government's analytical capacity commensurate with market developments, in particular to:

- strengthen the depth and scope of energy research, analysis and forecasting within government
- provide a comprehensive understanding of energy use, particularly household energy use
- better align energy data collections across the Australian Government.

Key sources of energy data and analysis

The Australian Government, independent agencies and energy institutions collect, analyse and disseminate information across a range of energy themes on a regular (although often uncoordinated) basis, including on:

- our energy resources base
- market developments
- energy technologies
- energy system planning
- energy production and use and energy-related greenhouse gas emissions trends
- environmental impacts.

Geoscience Australia, the Bureau of Resources and Energy Economics, the Australian Bureau of Statistics, and the Department of Resources, Energy and Tourism are the key agencies providing energy-related data and analysis to government, industry and the wider public (see Box 9.1 for a brief overview of Bureau of Resources and Energy Economics and Geoscience Australia).

Box 9.1: The Bureau of Resources and Energy Economics and Geoscience Australia

Bureau of Resources and Energy Economics

The Bureau of Resources and Energy Economics (BREE) is a professionally independent, economic and statistical research unit within the Department of Resources, Energy and Tourism.

BREE was formed on 1 July 2011. Its creation reflects the importance placed on resources and energy by the Australian Government and the value of these sectors to the Australian economy. Key mandates of BREE are to provide high-quality data, forecasts and research on resources and energy for Australia from an economic perspective. BREE also offers a range of professional services for external clients.

It regularly issues a range of publications on our energy and resources production, consumption and trade, as well as energy projections. This research and analysis identifies trends and highlights potential challenges, and is regularly used by government to inform planning and decision-making.

BREE is managed by an independent Executive Director/Chief Economist and is supported by an advisory board of prominent Australian experts from both the private and public sectors.

Geoscience Australia

Geoscience Australia is a prescribed agency within the Resources, Energy and Tourism portfolio and is a world leader in providing first-class geoscientific information and knowledge

The agency's activities cover onshore, offshore and spatial information:

- Onshore activities focus on enhancing mineral exploration and environmental land-use planning. The agency does this by producing geoscience maps, databases and information systems and by conducting regional geological and mineral systems research. These activities also contribute to safer communities and critical infrastructure and the maintenance of fundamental gravity, geomagnetic and seismic networks.
- Offshore activities focus on providing pre-competitive data and information to assist in identifying new prospective basins for petroleum exploration, and the geological storage of carbon dioxide, in Australia's offshore jurisdiction. Activities also include mapping and documentation of Australia's maritime boundaries, studies of the marine environment using seabed mapping techniques and determining estuarine water quality and health. These studies assist natural resource management.
- Spatial information activities focus on providing key spatial information of Australia with an emphasis on response to rapid and slow onset hazards, the detection of change, emergency management requirements, natural risk assessment and marine zone management. Activities also include coordinating the implementation of the Australian Government's policy on spatial data access and pricing.

The Department of Resources, Energy and Tourism is also a key data provider, collecting and publishing monthly national and state petroleum data through its *Australian petroleum statistics* report. This publication provides data on sales of petroleum products; exports and imports of petroleum products and crude oil; production of crude oil, condensate and liquefied petroleum gas; refinery input and output; and national stockholdings of crude oil and petroleum products.

Other Australian Government agencies also collect and analyse energy data. The Clean Energy Regulator administers the National Greenhouse and Energy Reporting system, and the Renewable Energy Target, and associated energy and emissions data reporting.[1] The Bureau of Infrastructure, Transport and Regional Economics provides economic analysis, research and statistics on infrastructure, transport and regional development issues, which is of particular relevance to our liquid fuel market.

The Australian Bureau of Statistics provides statistics on a wide range of economic, industry, energy, environmental, people and regional matters. Most of the activity data that is needed to complement core energy data is derived from the principal ABS collections.

As part of the Cleaner Energy Future package the government has allocated $10 million to the Australian Bureau of Statistics and the Department of Climate Change and Energy Efficiency to gather data on household energy consumption and expenditure. This information will assist in greater understanding of energy use.[2]

A number of independent institutions undertake specific market analysis – such as the Australian Energy Market Operator, the Australian Energy Market Commission, the Australian Energy Regulator and the Independent Market Operator – which provides information to support investment and planning in the electricity and gas markets. Independent institutions such as these have a strong depth of knowledge of markets and strong analytical skills and capabilities, and are well placed to undertake the role of information-gathering, analysis, market signalling and providing advice to government where appropriate.

The Department of Resources, Energy and Tourism undertakes a periodic strategic analysis of issues and trends related to energy security over a 20-year time period through the National Energy Security Assessment. The assessment methodology includes ‘shock scenarios’ to examine how our energy security may change in the face of sector-specific supply chain disruptions and cross-sector issues.

In addition, specific assessments are undertaken on an as-needed basis, such as the Liquid Fuel Vulnerability Assessments, which involve detailed modelling and qualitative assessment of energy system vulnerabilities and provide vital inputs for government review of strategic energy security policy settings. Reviews and assessment are also undertaken by reference groups and agencies such as the Investment Reference Group, the Productivity Commission and the CSIRO to inform policy development.

Appendix F contains a further description of the principal sources of energy data or analytics**.** However, this set by no means describes the full range of publicly available information.

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[1] Australian Government, *Securing a clean energy future: the Australian Government’s climate change plan*, Department of Climate Change and Energy Efficiency, Canberra, 2011, p. 111.

[2] Australian Government, *Securing a clean energy future*, p. 125.

Strategic challenges

While our energy data collection and analysis is relatively robust and comprehensive, there are areas where it could be improved, including:

- more frequent and in-depth assessment of Australia's energy security (see Chapter 4)
- consolidation of energy data and activity analysis across the Australian Government
- timely assessments of Australia's energy resources and technology advances (see Chapters 5 and 6)
- more frequent monitoring and assessment of energy and fuel technology development paths (see Chapter 6)
- greater understanding of household energy use (see Chapter 6C)
- higher-quality and broader coverage of Australian petroleum statistics and analytical capacity related to liquid fuels (see Chapter 6A).

As outlined in Chapter 4, the Australian Government will undertake a review of the National Energy Security Assessment methodology. A key aspect of this review will be to improve the analytical framework and will consider the development and application of quantitative indicators that can inform future assessments. The 2014 National Energy Security Assessment will also include a deeper assessment of Australia's liquid fuel vulnerabilities across the liquid fuel supply chain, including import infrastructure and critical supply linkages.

The Australian Government has taken steps to streamline metrics on energy and related greenhouse gas emissions through the establishment of the Clean Energy Regulator, and to improve understanding of household energy use. However, further review of the spectrum of Australian Government energy data and statistics is needed to align the various data sources, data collection and analysis and identify gaps or further opportunities through a whole-of-government energy roadmap exercise. This roadmap would assess the current data collection and analysis, identify any gaps in information, and better coordinate energy data and analysis across the Australian Government.

Assessing Australia's identified and potential energy resources opportunities and the factors likely to influence the use of energy over the medium term, such as market development and technological evolution, is needed to guide policy development, investment and public debate. This need is heightened in the current era of great change and diversity in our energy sector. The Australian Government believes this is best achieved through the regular assessment of our energy resources and technologies.

Given the significance of new energy fuels and technology development to our energy markets, there is a need to regularly assess their development paths, to inform future planning, and ensure that policy frameworks remain responsive and relevant to energy market developments. Similarly, the expected increasing role of gas for electricity generation in Australia, and the growth in demand for Australia's LNG exports, will require greater understanding of gas reserves, demand and exports over time. This information will aid in planning and infrastructure development over the coming decades.

The data in *Australian petroleum statistics*, which is provided on a voluntary basis, requires review to improve its completeness, consistency and accuracy to enable better assessment of our liquid fuel vulnerability and meet our international energy obligations.

While collecting additional information is always desirable, the government is mindful of the need not to impose unnecessary reporting burdens on consumers or industry. Additional data collection and analytical effort will be evaluated against the costs and benefits of collection of information, and prioritised against the need to ensure value for money. This assessment will also take into account the appropriate role for government, independent institutions, and industry.

9.4 Key actions

Australia will continue to actively engage in relevant international forums to advance our energy objectives, shape global energy frameworks, and work collaboratively to pursue common energy goals. In addition, the Australian Government will:

- maintain close engagement with key markets, institutions and strategic energy partners to advance our energy objectives.
- regularly review its international energy engagements with a view to ensure effectiveness and relevance, as part of the four-yearly review of the national energy policy framework
- improve Australia's energy information base, including through:
  - biennial publication from 2014 of the Australian Energy Resource Assessment and the Australian Energy Technology Assessment
  - expanding the scope of the Australian Energy Technology Assessment to specifically cover liquid fuel technologies
  - as part of the National Energy Security Assessment process, assess Australia's liquid fuel vulnerabilities – this will cover the liquid fuel supply chain, including import and refining infrastructure and critical supply linkages
  - lead work, in consultation with industry, to improve the quality of the Australian Petroleum Statistics
  - enhancing the quality and timeliness of public information on Australia's conventional and unconventional gas reserves and projected market developments, which will help inform policy development
  - annual publication of the Australian Energy Market Commission's report on trends in future electricity prices
  - gathering improved data on household energy consumption and expenditure
  - undertaking a road-mapping exercise to improve the scope and alignment of Australian energy data collections.

Appendixes

A Clean Energy Future package

The Clean Energy Future package has four elements: a carbon price, renewable energy, energy efficiency and action on the land.

Carbon pricing mechanism

The carbon pricing mechanism will commence on 1 July 2012 with a fixed carbon price and will transition to a flexible-price cap-and-trade scheme on 1 July 2015. The carbon price will start at $23 per tonne in 2012–13, increasing to $24.15 in 2013–14 and $25.40 in 2014–15. From 1 July 2015, the price will be flexible and determined by the market. A price ceiling and floor price will be in place over the first three years of the flexible-price period. The price ceiling will be set at $20 above the expected international price for 2015–16 and will rise by 5 per cent in real terms each year. The price floor will be set at $15 in 2015-16, $16.00 in 2016-17 and $17.05 in 2017-18.

There will be no cap on Australia's emissions during the first three years of the carbon pricing mechanism. A cap on emissions will be introduced when the carbon pricing mechanism moves from a fixed price to cap-and-trade on 1 July 2015. The cap for the first five years of the flexible-price period will be announced in 2014 and extended by one year, each year thereafter.

The use of international permits to meet scheme liabilities is not permitted during the fixed-price period. From 1 July 2015 through to 2020, only 50 per cent of an entity's liability can be met with imported international permits (the remaining 50 per cent to be met with domestic permits). This limit on the import of international permits will be reviewed in 2016.

Emissions sources captured under the carbon pricing mechanism include stationary energy, industrial processes, fugitive emissions, and emissions from non-legacy waste. There will be approximately 500 entities directly liable for their emissions under the carbon pricing mechanism.

Assistance for businesses

As part of the Clean Energy Future package, a series of measures have been established to maintain energy security and market stability through targeted support for emissions-intensive electricity generators.

The Energy Security Fund will provide up to $5.5 billion in assistance over six years for strongly affected electricity generators. The Australian Government is also seeking to negotiate the managed and orderly closure of around 2000 megawatts of highly emissions-intensive coal-fired generation capacity by 2020.

In addition, the government will offer short-term loans to generators to finance the purchase of future vintage carbon permits and support the refinancing of existing debt if commercial loans are not available on reasonable terms.

An Energy Security Council, comprising financial and energy market experts (including the heads of some of Australia's energy market bodies), has been created to advise the Australian Government in the event that systemic risks to energy security emerge. The Energy Security Council will advise the Treasurer about applications for assistance, including loans for refinancing where commercial loans are not available on reasonable terms.

In addition, the Jobs and Competitiveness Program will provide assistance for emissions-intensive, trade-exposed industries such as steel, aluminium, glass, paper, zinc, cement clinker and urea production. Initial rates of assistance will be 94.5 per cent for highly emissions-intensive activities and 66 per cent for moderately emissions-intensive activities. The assistance will be designed to reward energy efficiency and other actions that reduce the emissions-intensity of production. The $300 million Steel Transformation Plan will support and assist the industry to transition to a clean energy future. The $1.3 billion Coal Sector Jobs Package will provide assistance to help the coal industry transition to a carbon price and assist the sector in reducing emissions through the exploration and implementation of emissions reduction technologies.

The government is also delivering a $1.2 billion Clean Technology Program, over and above the Jobs and Competitiveness Program, to help directly improve energy efficiency in manufacturing industries and support research and development in low-emissions technologies. This includes $200 million to supports jobs in food processing, metal forging and foundry industries.

Assistance for households

To assist households with price impacts, there will be two rounds of tax cuts and increases in pensions, allowances and benefits. Significant tax reform will mean that more than one million people will no longer need to file a tax return. Increasing the tax-free threshold and cutting taxes also boosts incentives to work. More than 50 per cent of carbon price revenue will be spent on households. Household transport fuel consumption will not be subject to a carbon price.

Renewable energy

A $10 billion commercially oriented Clean Energy Finance Corporation will be established to drive innovation through investments in clean energy. The Clean Energy Finance Corporation will leverage private sector financing for renewable energy and clean technology projects, with a focus on renewable energy, energy efficiency and low-emissions technologies, and the transformation of existing manufacturing businesses to refocus on meeting demand for inputs for these sectors.

The Australian Government has legislated the establishment of a new independent statutory body, the Australian Renewable Energy Agency (ARENA), to support the research, development, demonstration and commercialisation of renewable energy and related technologies. ARENA will include an independent board with business, investment and commercial expertise, tasked with managing over $3.2 billion in renewable energy investments. Around $1.7 billion of this funding is currently uncommitted and will be available for ARENA to provide early-stage grants and financing assistance for renewable energy projects.

Energy efficiency

The Australian Government is providing additional support to promote energy efficiency. Low Carbon Communities will help local councils and communities improve energy efficiency in community facilities, including a new Low Income Energy Efficiency Program. As recommended by the Prime Minister’s Task Group on Energy Efficiency, the government will undertake further consultation and design work on a national energy savings initiative. Subject to economic modelling and a regulatory impact analysis, the government will make a final decision on whether to adopt a national energy savings initiative.

Action on the land

The Clean Energy Future package also includes a series of land sector and biodiversity programs to complement the government's Carbon Farming Initiative and promote emissions reductions through the land sector. These programs will provide $1.7 billion over seven years to help rural communities benefit from carbon farming and to support the restoration and protection of biodiverse landscapes.

Full details of the Australian Government's Clean Energy Future package are available at www.cleanenergyfuture.gov.au.

B Energy White Paper process and analytical input

The Energy White Paper process began in late 2008 with the development of a draft Green Paper. Work on the Green Paper was suspended in 2010 pending resolution of carbon pricing policy and the outcome of the federal election. In late 2010 the Australian Government decided to proceed directly to the draft Energy White Paper stage, incorporating the government's announced Clean Energy Future package.

A range of analytical materials were drawn upon, including:

- *Strong growth, low pollution: modelling a carbon price* (2011)
- *Australian energy projections to 2034–35* (2011)
- *Australian energy resource assessmen*t (2010)
- *Report of the Prime Minister's Task Group on Energy Efficiency* (2010)
- *Australian electricity generation technology costs: reference case 2010* (2010, and 2011 update)
- *Strategic directions for the Australian Centre for Renewable Energy* (2011)
- *National Carbon Mapping and Infrastructure Plan* (2010)
- *National Low Emissions Coal Strategy* (2010)
- *National Transmission Network Development Plan* (2010)
- *The Policy Transition Group: new resource taxation arrangements and minerals and petroleum exploration* (2010)
- The Australian Government's response to the report of the National Resources Sector Employment Taskforce
- *National energy security assessment 2011* (2011)
- *Strategic framework for alternative transport fuels* (2011)
- The Australian Energy Market Commission's *Strategic priorities for energy market development* (2011).

C Energy sector modelling

Energy sector modelling is a useful tool for assisting policy-makers, industry and the public to understand what the future energy sector would look like under a range of circumstances and its impact on the broader economy.

This appendix outlines the principal energy sector modelling informing the development of the draft Energy White Paper, and gives a general explanation of how the models work and what is driving their results. However, this information is necessarily provided at a high level, and readers are encouraged to consult the original reports.

Modelling used in the draft Energy White Paper

Several recent modelling exercises were relevant to the scope of the draft Energy White Paper:

- The Australian Treasury report *Strong growth, low pollution: modelling a carbon price* (updated in September 2011) modelled the impact of carbon pricing across the Australian economy out to the year 2050, and within this modelled the impact on the energy sector, in particular the electricity generation sector.
- The Bureau of Resources and Energy Economics (BREE) report *Australian energy projections to 2034–35* (2011) modelled the Australian energy sector out to 2035.
- The Australian Energy Market Operator (AEMO) 2010 National Transmission Network Development Plan included electricity sector modelling for Australia under five different scenarios out to 2050.

A wide range of other public and private sector organisations (such as the International Energy Agency) have also undertaken national and global energy sector modelling in the last two years. However, this appendix focuses on the three electricity modelling exercises identified above.

Model descriptions

The three modelling exercises had different objectives, modelling frameworks and timeframes. These are described below. In addition, there were important differences in inputs and assumptions used, such as:

- fuel prices
- technology costs
- carbon price
- economic drivers such as GDP and population growth
- elasticity of demand
- the scope of the model and the way it operates (bottom–up, nested or top–down).

Nonetheless, they each provide useful insights into questions such as how a least-cost uptake of power generation technologies is affected by variables such as demand, fuel costs (coal and gas), carbon pricing and technology costs, and allow comparison of outcomes across a range of assumption and parameters.

Strong growth, low pollution

The Treasury carbon price modelling combined top–down computable general equilibrium (CGE) models with a series of bottom–up, sector-specific modelling for electricity generation, road transport, agriculture and forestry.

The two top–down CGE models were developed in Australia: the Global Trade and Environment Model (GTEM) and the Monash Multi-Regional Forecasting (MMRF) model. These CGE models are economy-wide models that capture the interactions between different sectors and among producers and consumers. GTEM models the global economy, while MMRF models the Australian economy, providing both state- and territory-level detail and detailed sectoral breakdowns.

A series of bottom–up, sector-specific modelling for electricity generation, road transport, agriculture and forestry complemented these CGE models. This allowed for a detailed analysis of the supply side of these sectors, while also ensuring that economic activity in each sector took into account projected changes in the structure of the economy.

Two modelling frameworks – developed by SKM MMA and ROAM Consulting – were used in *Strong growth, low pollution*. These frameworks feature detailed representations of the Australian electricity sector on a plant-by-plant basis and were run iteratively with the Treasury CGE models.

For the purpose of this summary, the government policy scenario is described. This scenario incorporated, where possible, features of the Clean Energy Future package, and included additional government-only measures for heavy on-road transport and some of the additional assistance for the steel industry. Further detail on the Treasury modelling framework can be found at www.treasury.gov.au/carbonpricemodelling/content/default.asp.

Australian energy projections

BREE's energy projections are derived using the E4cast model, which is a dynamic partial equilibrium model of the Australian energy sector. The E4cast framework provides a detailed treatment of the Australian energy sector, focusing on domestic energy use and supply. Its main features are as follows:

- The Australian energy system is divided into 24 conversion and end-use sectors.
- Fuel coverage comprises 19 primary and secondary fuels.
- All states and territories are represented (the Australian Capital Territory is included with New South Wales).
- Detailed representation of energy demand is provided. The demand for each fuel is modelled as a function of income or activity, fuel prices (own and cross) and efficiency improvements.
- Energy-intensive industries are modelled explicitly, taking into account large and lumpy capacity expansions.
- The electricity generation module includes 17 generation technologies.

Further information can be found at www.bree.gov.au.

AEMO National Transmission Network Development Plan Energy Scenarios Modelling

The 2010 National Transmission Network Development Plan included modelling of the electricity sector undertaken by McLennan Magasanik Associates, Strategis Partners, KPMG, ACIL Tasman, Econtech and Intelligent Energy Systems.

The National Energy Scenarios Modelling – a modelling exercise commissioned as part of the Energy White Paper process – was used in developing AEMO's National Transmission Network Development Plan. The modelling defined a set of five scenarios that were selected to include a wide range of outcomes for key measures such as carbon price, economic growth, social attitude, technology and fuel prices. These scenarios predated the development of the Australian Government's carbon pricing mechanism and used a set of carbon price trajectories different from those contained in the government's Clean Energy Future package.

The modelling provided a range of outputs, including projected trends in the generation technology mix and capital costs; potential transmission system upgrade requirements, opportunities and costs; trends in electricity wholesale costs; and changes in the level of greenhouse gas emissions. It provides insights into the response of the energy industry, energy markets and the power grids to possible long-term changes, including a carbon price and changes in gas prices.

Further information on the scenarios, detailed assumptions and modelling results are contained in a number of reports that can be found on AEMO's website at www.aemo.com.au.

Key findings

A comparison of results from the Treasury and BREE reports for the Australian electricity sector is provided in Figures C.1 and C.2. These show overall demand and share of generation by technology for the SKM MMA, ROAM and BREE models.

The AEMO results have not been shown here as the design of the individual scenarios means that results cannot be compared directly against other Australian Government modelling. The five scenarios are each different to varying degrees from the Treasury and BREE single-scenario approach. The differences are such that it is impossible to select a single scenario that closely matches other modelling. However, the AEMO modelling provides valuable insights into a range of possible futures and it was instructive to compare differences in outcomes.

Both the Treasury government policy scenario and BREE modelling used a common carbon price, consistent with that announced in the Clean Energy Future package. The BREE main case used a significantly lower assumed gas price path than the Treasury models. BREE also conducted a sensitivity analysis with a higher gas price.

Figure C.1: Electricity generation, SKM MMA and ROAM to 2050

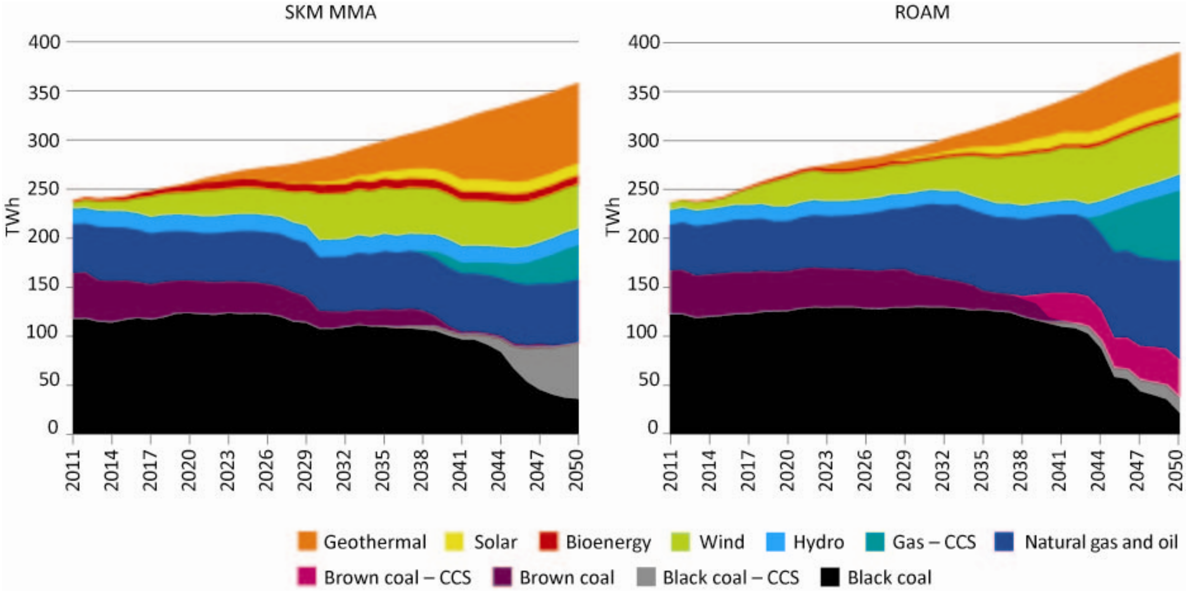

Figure C.2: Electricity generation, BREE main and sensitivity results to 2035

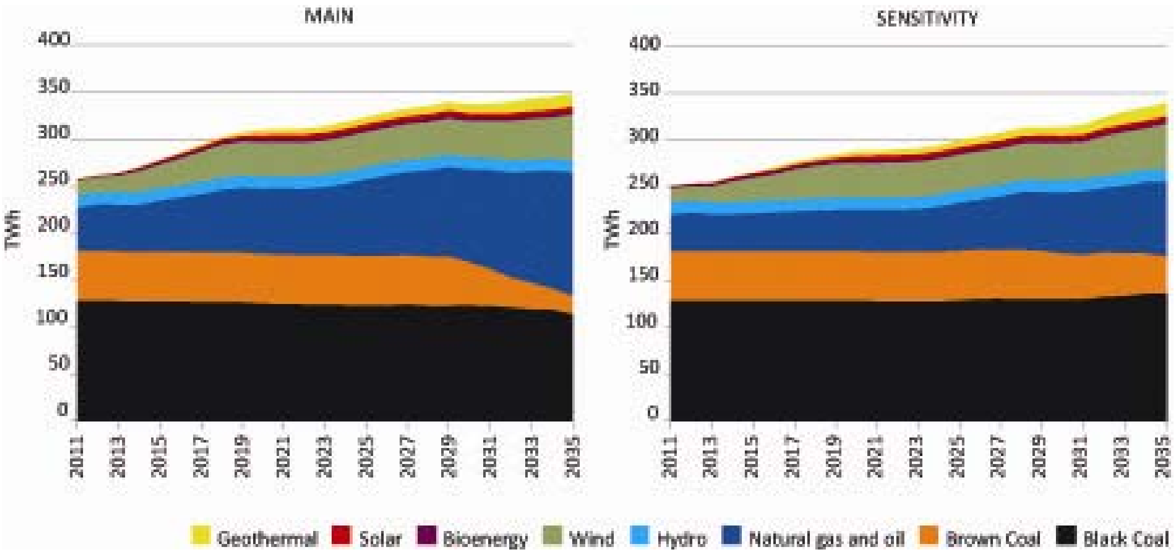

Table C.1: Comparison of model inputs and outputs, Treasury and BREE, 2011

	Actual historical data[a]	SKM MMA		ROAM		BREE	
	2009–10	2030	2050	2030	2050	2030 main	2030 sensitivity
Modelled gas price (A$2009–10/GJ)		9	11.1	9.3	11.7	6.80–8.70	9.82–12.21
Modelled coal price (A$2009–10/GJ)		2.8	3.4	2.8	3.4	1.60–2.50	1.6–2.5
Carbon price (A$2009-10/t CO_2-e)	na	52.6	130.9	52.6	130.9	52.6	52.6
Total generation[b] (TWh)	241.6	281	358.3	293.4	390.5	337	313.8
Share of generation (%)							
Black coal	51.5	38.4	10.2	44.4	5.6	36.5	41.6
Brown coal	23.2	6.6	0.3	11.3	0	13.6	15.4
Gas and oil	17.1[c]	19.4	17.8	24.1	25.9	29.3	20.9
Hydro	5.2	6.2	4.7	4.9	4.2	3.9	4.2
Wind	2.0	16.6	12.5	10.4	15	11.4	12.5
Geothermal	0	8.4	22.9	3.1	12.7	2.7	2.8
Solar	0.1	0.9	3.3	0.8	3.2	1.3	1.4
Bioenergy	0.9	3.5	2.7	1.3	1.1	1.2	1.3
Coal – CCS	0	0	16	0	14.1	0	0
Gas – CCS	0	0	9.7	0	18.3	0	0

a. Data based on ABARES, *Australian energy statistics*, 2011, Table O; provided as reference only – each of the models has slightly different base case.

b. Gross generation in BREE results; generation sent-out results in SKM MMA and ROAM.

c. Includes multi-fuel generation.

Note: Due to the iterative nature of the modelling, some differences exist between Treasury's final results (presented in the table) and the results in the reports by SKM MMA and ROAM Consulting.

Together, these results show some common trends and distinct differences over the period to 2030.

- Overall demand continues to grow, although BREE projects a higher annual average rate of demand growth at 1.5 per cent (main case) and 1.1 per cent (sensitivity) than SKM MMA (0.9 per cent) and ROAM (1.1 per cent) for the period to 2030.
- Under all three models, fossil fuels remain the dominant provider of generation to 2030 at between 64.4 per cent (SKM MMA) and 79.9 per cent (ROAM), and 79.4 per cent (BREE main).
- Gas generation is projected to grow strongly in the ROAM and BREE models, with the BREE main case showing the largest growth at 4.1 per cent a year over the period. ROAM projects growth of 2.2 per cent a year, while SKM MMA has a much lower growth figure of 0.5 per cent a year.
  - This reflects the gas price in the BREE model and the relatively higher renewable energy cost assumptions in ROAM and BREE relative to SKM MMA.
  - Higher gas prices in the BREE sensitivity scenario moderate the gas increase substantially to around 44 per cent.

- Brown coal use declines much more rapidly in the SKM MMA model and there is a spread of results for black coal that largely reflect the difference in gas and renewable energy costs (see below).
- However, all three models also show a large shift over the period towards renewable energy. SKM MMA shows the largest movement, with strong growth in wind and geothermal energy.
  - Again, this largely reflects the lower assumed technology costs for both wind and geothermal relative to other technologies in the SKM MMA model.
  - These trends continue and pick up in pace in the Treasury models from 2030 to 2050.
- Carbon capture and storage technologies do not enter the mix until after 2030, again reflecting the technology cost assumptions relative to other technologies and the projected carbon price. After 2030 these technologies potentially play a major role and could account for between 26 per cent and 32 per cent of generation by 2050.

The AEMO National Energy Scenarios Modelling shows that under different GDP, fuel price and demand-side assumptions and carbon prices, different technologies and fuels could play different roles in shaping the stationary energy sector.

Key overarching modelled results at the national level for electricity supply are:

- Without the introduction of a price on carbon, there is very little diversification in Australia's generation mix and demand continues to be met by the development of coal-fired generation.
- Fossil fuels continue to maintain a major share of generation, gas expands considerably in all scenarios (except where gas prices are high), and all scenarios show a major role for carbon capture and storage by 2050 in the presence of a carbon price.
- For renewable energy to play a significant role in the generation mix, and to compete on a commercial basis with other technologies, a carbon price or other policy is required.
- High gas prices will limit the growth of gas generation as an option and coal carbon capture and storage becomes the preferred technology by 2030–40.
- Lower gas prices result in coal-fired technology being progressively replaced by gas-fired generation.

Interpreting modelling results

Modelling is only a point-in-time study of what we know about how markets currently work, and what we assume the future will hold. The energy market is dynamic and evolving, and there is significant uncertainty about fuel costs, new technology costs and the timing of when new technology will reach commercialisation, and investment. As such, modelling results should not be considered as forecasts or targets for Australia's energy future, but more as a broad indicator of what the future could be, given the range of assumptions used.

D Australian Government funding support for clean energy technology development and commercialisation

Table D.1 outlines all clean energy programs announced or currently being delivered across the Australian Government. These programs are in addition to the carbon pricing mechanism, the Renewable Energy Target, general research sector funding, concessional excise treatment for alternative transport fuels, and land sector measures to support the transition to a clean energy future. State and territory governments, industry and tertiary institutions also provide a range of support for clean energy technology development and commercialisation.

Information on the Australian Government's carbon pricing mechanism and land sector measures under the Clean Energy Future package is available at Appendix A and at www.cleanenergyfuture.gov.au.

Table D.1: Australian Government clean energy programs

Department of Resources, Energy and Tourism
Australian Renewable Energy Agency – $3.2 billion The Australian Renewable Energy Agency (ARENA) will administer $3.2 billion in existing support (including $1.7 billion in uncommitted funding) for research, development, demonstration and commercialisation of renewable energy and related technologies. ARENA will include an independent board with business, investment and commercial expertise. Initiatives consolidated into ARENA programs as at November 2011 include: ▪ Solar Flagships Program – This program supports the commercial demonstration of large-scale solar power plants in a competitive electricity market in Australia. ▪ Australian Solar Institute – This registered not-for-profit company supports solar thermal and solar photovoltaic research and development. ▪ ACRE Solar Projects – The Australian Centre for Renewable Energy (ACRE) is providing grants to two large-scale solar energy demonstration projects: a 23 megawatt solar boost to a coal-fired power station, and a 40 megawatt concentrated solar thermal demonstration plant. ▪ Low Emissions Technology Demonstration Fund (solar) – ARENA will administer funding for the solar energy development project being funded under this program. ▪ Renewable Energy Demonstration Program – This program is providing grant funding for four commercial-scale renewable energy projects covering wave technology, geothermal sources, and an integrated mini-grid project involving wind, solar, biodiesel and storage technologies. ▪ Geothermal Drilling Program – This program is now closed. It provided grants to assist companies seeking to develop geothermal energy with the cost of proof-of-concept projects including drilling geothermal wells. ▪ Australian Biofuels Research Institute – The institute's work is designed to drive down the costs of next-generation biofuel technologies. A foundation project at James Cook University in Townsville will receive $5 million in funding. ▪ Second Generation Biofuels Research and Development Program from 2009–10 to 2011–12 – This program is now closed. It provided grants to support the research, development and demonstration of new biofuel technologies and feedstocks that address the sustainable development of a biofuels industry in Australia. ▪ Emerging Renewables Program – This program provides flexible funding and program delivery for renewable energy projects and capacity building in the sector. ▪ Renewable Energy Venture Capital Fund – This fund assists high-potential Australian renewable energy start-up companies by making critical early-stage equity investments.

Advanced Electricity Storage Technologies – $20 million

This program is now closed. It supported the development and demonstration of efficient electricity storage technologies for use with variable renewable generation sources such as wind and solar.

Carbon Capture and Storage Flagships Program – $1.68 billion

This program supports the construction and demonstration of large-scale integrated carbon capture and storage projects in Australia.

Low Emissions Technology Demonstration Fund (non-solar) – $160 million

This program is now closed. The two non-solar projects currently being supported focus on innovative technologies for reducing emissions from the combustion of coal, and the capture and storage of carbon dioxide emissions.

National Low Emissions Coal Initiative – $370 million

This initiative aims to accelerate the development and deployment of technologies to reduce emissions from coal use. Its focus is research, demonstration and deployment of low-emissions coal technologies involving carbon capture and storage. This includes $75 million for Australian National Low Emissions Coal Research and Development Limited.

National CO_2 Infrastructure Plan – $61 million

The plan has several elements including the provision of strategic advice by Geoscience Australia and the acquisition of pre-competitive exploration data to accelerate the identification and development of suitable long-term carbon dioxide storage sites in Australia.

Global Carbon Capture and Storage Institute – $315 million

The Australian Government established this independent, member-based institute in 2008–09 to accelerate the deployment of carbon capture and storage technologies by fostering cooperation and knowledge sharing on carbon capture and storage projects and technologies.

Smart Grid, Smart City – $100 million

This is a demonstration project in partnership with the energy sector. The initiative will gather robust information about the costs and benefits of smart grids to inform future decisions by government, electricity providers, technology suppliers and consumers across Australia.

Energy Grants (Cleaner Fuels) Scheme

This program is administered by the Australian Taxation Office and provides grants for the production and import of biodiesel and renewable diesel.

Department of Climate Change and Energy Efficiency (DCCEE) and Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA)

Solar Cities – $94 million

Solar Cities is trialling new sustainable models for electricity supply and use, and is being implemented in seven separate electricity grid-connected areas around Australia. (DCCEE)

National Solar Schools Program – $50 million

This program offers eligible primary and secondary schools grants of up to $50 000 to install solar and other renewable power systems, solar hot water systems, rainwater tanks and a range of energy efficiency measures. (DCCEE)

Renewable Energy Bonus Scheme – Solar Hot Water Rebate

While surplus funding has been redirected to support flood response, solar hot water rebates are still available in 2011–12 under the Renewable Energy Bonus Scheme.

This scheme helps eligible homeowners, landlords or tenants to replace their electric hot water systems with solar or heat-pump hot water systems through a rebate of $1000 for a solar hot water system or $600 for a heat-pump hot water system. (DCCEE)

Low Carbon Communities Program – $330 million

This program has three components:

- The Community Energy Efficiency Program ($200 million) will provide support for local government and community organisations to undertake energy efficiency upgrades to community-use buildings and facilities. (DCCEE)
- The new $100 million Energy Affordability Scheme component for low-income households will trial how best to improve the energy efficiency of low-income households and will be designed to build on work already being done by community organisations. (DCCEE)
- The $30 million Home Energy Saver scheme assists low-income households and vulnerable people who are having difficulty meeting their energy bills to find more sustainable ways to manage their financial situation and their energy consumption. (FaHCSIA)

Household advice line/website program – $6 million

The LivingGreener website will be expanded to include more information about energy efficiency and managing energy costs, supplemented by a household information and advice telephone service. (DCCEE)

Remote Indigenous Energy Program – $40 million

This program will provide funding to install renewable energy generation systems in approximately 50 remote Indigenous communities over the life of the program. It includes providing information on energy-efficient practices and training in basic system maintenance to encourage efficient energy management. (FaHCSIA)

Department of Education, Employment and Workplace Relations

Clean Energy and Other Skills Package – $32 million

This package provides funding for targeted workforce development and education and training projects which will support tradespersons and professionals in key industries to develop the skills and knowledge needed to deliver energy efficiency and clean energy products, services and advice.

Department of Innovation, Industry, Science and Research and its portfolio agencies

Australian Research Council Discovery Grants

A key objective of the Discovery Grants is to support excellent fundamental research by individuals and teams. The main Discovery Grants schemes are Discovery Projects, Discovery Early Career Researcher Award, Future Fellowships, Australian Laureate Fellowships and Discovery Indigenous.

Australian Research Council Linkage Program

The Linkage Program is aimed at improving research outcomes and the use of research outcomes by strengthening links within Australia's innovation system (between researchers and between researchers and end users of research) and with innovation systems internationally. Linkage Program schemes include Linkage Projects; Linkage Infrastructure, Equipment and Facilities; ARC Centres of Excellence and Special Research Initiatives. In 2011–12 the Australian Research Centre will establish new initiatives to strengthen links between industry and the research community, including research training awards to give postgraduates valuable hands-on experience in undertaking end-user-focused research.

Commonwealth Scientific and Industrial Research Organisation

The CSIRO is Australia's national science agency and one of the largest and most diverse research agencies in the world. Particular initiatives supporting clean energy technology development and commercialisation include CSIRO's National Research Flagships (such as Energy Transformed and Future Manufacturing) and the CSIRO Energy Centre.

Cooperative Research Centres Program

This program supports end-user-driven research collaborations to address clearly articulated, major challenges facing Australia. Since 1990, the Australian Government has funded 190 CRCs and committed more than $3.4 billion in CRC Program funding. Participants in CRCs have committed a further $10.9 billion in cash and in-kind contributions over the same period.

R&D Tax Incentive

The R&D Tax Incentive provides a targeted tax offset designed to encourage more companies to engage in research and development in Australia. It has two core components: a 45 per cent refundable tax offset (equivalent to a 150 per cent deduction) to eligible entities with an aggregated turnover of less than $20 million per year and a non-refundable 40 per cent tax offset (equivalent to 133 per cent deduction) to all other eligible entities.

Venture Capital

The Australian Government facilitates access to this highly specialised form of investment capital through a number of programs. Through the Innovation Investment Fund program, private sector fund managers are licensed to invest public funds alongside private capital into innovative start-up ventures. Under the current round of the program, seven venture capital funds have been licensed across a range of innovation areas with $290 million of government and private capital. The Australian Government also operates a number of complementary tax-based venture capital programs that are designed to attract private capital to the venture capital sector.

Enterprise Connect (including the Clean Technology Innovation Centre – $20 million)

Enterprise Connect services are delivered through a national network of 12 centres which enable small to medium-sized enterprises to source and finance specialised advice, know-how and technologies to improve their business performance. In particular, the Clean Energy Innovation Centre offers business reviews, supporting grants and other services to small to medium-sized businesses in the clean energy sector.

Commercialisation Australia

Commercialisation Australia is a competitive, merit-based assistance program offering funding and resources to accelerate the business-building process for Australian companies, entrepreneurs, researchers and inventors. It offers a range of funding options as well as multi-layered networking opportunities. Participants in the program work with dedicated case managers and have access to a network of volunteer business mentors.

Clean Technology Program – $1.2 billion

This program comprises three components that provide grants to support manufacturing businesses to improve their energy efficiency and support clean technology innovation activities across industry.

- Clean Technology Investment Program ($800 million) – grants to manufacturers only, to support investments in existing energy-efficient capital equipment and low-pollution technologies, processes and products.
- Clean Technology Food and Foundries Investment Program (up to $150 million to the food processing industry and up to $50 million to the metal forging and foundry industries) – grants to assist these industries to invest in existing energy-efficient equipment and low-pollution technologies, processes and products.
- Clean Technology Innovation Program ($200 million) – grants to support business investment in new research and development, proof of concept or early-stage commercialisation of clean technology products, processes and services.

Clean Technology Focus for Supply Chains – $5 million

The Department of Innovation, Industry, Science and Research currently administers programs to provide advisory and other non-financial assistance to businesses. These include the Industry Capability Network, Supplier Advocates and Enterprise Connect. The Australian Government will provide an additional $5 million over four years for the delivery of clean technology initiatives to small and medium-sized businesses through these programs.

Department of the Treasury

Clean Energy Finance Corporation – $10 billion

The Clean Energy Finance Corporation is being established to invest in the commercialisation and deployment of renewable energy and enabling technologies, energy efficiency and low-emissions technologies. It will also invest in the transformation of existing manufacturing businesses to refocus on meeting demand for inputs for these sectors. It will provide finance for projects through commercial loans, concessional loans, loan guarantees and equity. It will not invest in carbon capture and storage technologies.

Indicative total	**$17.5 billion**

E International energy engagement

	Forums	Contribution to objectives
Multilateral	• International Energy Agency • International Energy Forum • International Renewable Energy Agency • G-20 • United Nations Framework Convention on Climate Change • Clean Energy Ministerial • Major Economies Forum on Energy	Active participation enables Australia to influence international policy and processes, including by: • improving understanding of global energy trends, markets and policies • promoting open, transparent and competitive global energy markets • contributing to building global and regional energy security response frameworks • harnessing convening power to pursue common energy goals • responding to disruptions to global oil supply.
Regional	• Asia–Pacific Economic Cooperation • East Asia Summit • Pacific Islands Forum and Pacific Energy Ministers Meeting • Renewable Energy and Energy Efficiency Partnership	Active participation enables Australia to influence regional energy policy and processes, including to: • enhance understanding of regional energy needs, objectives and policies • promote regional energy security • promote open, transparent, and competitive regional energy markets • promote stable and robust energy supply chains.
Energy cooperation	• International Energy Agency Implementing Agreements • Extractive Industries Transparency Initiative • Global Carbon Capture and Storage Institute • Carbon Sequestration Leadership Forum • International Partnership for Geothermal Technology • International Partnership on Energy Efficiency Cooperation • International Partnership for Hydrogen and Fuel Cells in the Economy	Active participation enables Australia to collaborate with like-minded countries to: • build knowledge, expertise and capacity • enhance and accelerate technology research and development through collaboration • accelerate development of clean energy technologies, systems and practices.
Bilateral strategic partners	Key trading partners (Japan, China, India, Republic of Korea, Taiwan) Regional energy partners (Singapore, Indonesia, Malaysia, Papua New Guinea) Strategic energy partners (United States, European Union, United Arab Emirates)	Active participation enables Australia to collaborate with bilateral strategic partners to: • build and maintain strong trade partnerships • develop new export trade opportunities • attract investment and trade in domestic energy resources, technologies and systems.
In-country/agency	China India Japan Republic of Korea United States International Energy Agency Austrade	In-country or agency engagement further strengthens relationships with key energy partners, by facilitating greater understanding and exchange between government and industry energy experts, researchers and market participants.

F Principal energy publications

Source	Publication	Website
Bureau of Resources and Energy Economics	The annual handbook *Energy in Australia* provides historical information on Australia's energy sector. It covers all areas of energy production and use, from natural resources through to final consumption.	www.bree.gov.au
	The *Resources and energy statistics annual* contains Australian and world statistics on energy and resource commodities.	
	Australian energy statistics is the primary source for data on Australia's energy consumption. It also provides statistics on Australian energy production and trade.	
	Resources and energy statistics is a quarterly publication containing statistics on Australian resources and energy production and trade.	
	Resources and energy quarterly provides short- and medium-term forecasts of consumption, production and prices for Australia's largest traded resources and energy commodities.	
	Australian energy projections is an annual publication that provides long-range projections of Australian energy production and use.	
	Minerals and energy – major development projects is a biannual publication that provides information on major new mine and processing proposals and developments in Australia, together with analysis of exploration and capital expenditure trends.	
	Electricity generation – major development projects is an annual publication that provides information on major new electricity generation developments in Australia.	
	The *Australian energy technology assessment* will provide electricity generation technology cost and development information.	
	The *Australian fuel technology assessment* will provide fuel technology cost and development information.	
Bureau of Resources and Energy Economics and Geoscience Australia	The *Australian energy resource assessment* is a national prospectus for energy resources.	www.ret.gov.au
Australian Energy Market Operator	The *Electricity statement of opportunities* is an annual publication that provides information about demand projections, generation capacities and supply adequacy in the National Electricity Market going out 10 years. It identifies opportunities for generation and demand-side investment.	www.aemo.com.au

Source	Publication	Website
	The *Gas statement of opportunities* is an annual publication that presents information incorporating natural gas reserves; capacities and constraints of production, storage and transmission facilities; and projected annual and peak day demand for natural gas for eastern and south-eastern Australia in the 10 years following publication. The publication incorporates a 20-year outlook on reserves and annual demand.	www.aemo.com.au
	The *National Transmission Network Development Plan* is an annual, independent strategic plan for the National Electricity Market transmission network. It provides the energy industry with a comprehensive information source to support the development of a responsive transmission network.	www.aemo.com.au
Independent Market Operator of Western Australia	The *Statement of opportunities* is an annual publication that provides forecasts of maximum peak demand and energy usage for the South West Interconnected System for the following 10 years. These forecasts are used to determine the reserve capacity requirement for the following certification cycle.	www.imowa.com.au
Australian Competition and Consumer Commission	The annual *Monitoring of the Australian petroleum industry* reports on prices, costs and profits in the downstream petroleum industry.	www.accc.gov.au
Department of Resources, Energy and Tourism	*Australian petroleum statistics* is a monthly publication that provides national and state petroleum statistical information.	www.ret.gov.au
	The Energy Efficiency Opportunities program publishes annual reports of aggregate energy use and savings data based on public reports provided by companies.	
International Energy Agency	The IEA produces a variety of publications, which include statistical data and policy analysis across the range of energy commodities (oil, coal, natural gas, nuclear), and electricity. The IEA's premier publication is the annual *World energy outlook*, which provides analysis of long-term energy trends under a range of scenarios.	www.iea.org
Australian Bureau of Statistics	*Energy account Australia* is an annual publication that provides statistics to monitor changes over time in the supply and use of energy within Australia from an economic and environmental perspective.	www.abs.gov.au
Australian Energy Regulator	The *State of the energy market* is an annual publication that provides a high-level overview of energy market activity in Australia. It consolidates information from various sources to better inform market participants and assist policy debate on energy market issues.	www.aer.gov.au
Australian Energy Market Commission	The AEMC commissions the Reliability Panel to undertake an *Annual market performance review* to report on the performance of the National Electricity Market in terms of reliability of the power system and the power system security and reliability standards.	www.aemc.gov.au

List of figures and tables

Figures

Tables

Abbreviations and acronyms

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACRE	Australian Centre for Renewable Energy
AEMA	Australian Energy Market Agreement
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
APEC	Asia–Pacific Economic Cooperation
ARENA	Australian Renewable Energy Agency
BREE	Bureau of Resources and Energy Economics
CCGT	combined-cycle gas turbine
CCS	carbon capture and storage
CNG	compressed natural gas
CO2CRC	Cooperative Research Centre for Greenhouse Gas Technologies
CO_2-e	carbon dioxide equivalent
COAG	Council of Australian Governments
CSG	coal seam gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EEO	Energy Efficiency Opportunities
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDP	gross domestic product
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IRG	Investment Reference Group
LCOE	levelised costs of electricity
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LRC	Low Reserve Condition
MRRT	Minerals Resource Rent Tax
NEM	National Electricity Market
NERL	National Energy Retail Law
NESA	National Energy Security Assessment
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator

NWIS	North West Interconnected System
OECD	Organisation for Economic Co-operation and Development
PRRT	Petroleum Resource Rent Tax
PV	photovoltaic
RET	Department of Resources, Energy and Tourism
SCER	Standing Council on Energy and Resources
SWIS	South West Interconnected System

Units

GJ	gigajoule
GL	gigalitre
GWh	gigawatt hour
kW	kilowatt
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
PJ	petajoule
ppm	parts per million
Mt	million tonnes
ML	million litres
toe	tonnes of oil equivalent
TW	terawatt
TWh	terawatt hour

References

ACIL Tasman, *Liquid fuel vulnerability assessment*, report prepared for the Department of Resources, Energy and Tourism, Canberra, 2011.

Australian Bureau of Agricultural and Resource Economics and Sciences, *Land use in Australia at a glance*, ABARES, Canberra, 2010.

——, *Australian energy statistics*, ABARES, Canberra, 2011.

——, *Energy in Australia 2011*, ABARES, Canberra, 2011.

—— *Energy update 2011*, ABARES, Canberra, 2011.

——, *Minerals and energy: major development projects – April 2011 listing*, ABARES, Canberra, 2011.

Australian Bureau of Agricultural and Resource Economics – Bureau of Rural Sciences, *End use energy intensity in the Australian economy*, ABARE–BRS, Canberra, 2010.

——, *Electricity generation: major development projects – October 2010 listing*, ABARE–BRS, Canberra, November 2010.

Australian Bureau of Statistics, *Consumer price index*, cat. no. 6401.0, ABS, Canberra, various years.

——, *Indigenous statistics*, 2006 Census, labour force data, ABS, Canberra, 2007.

——, *Population distribution*, *Aboriginal and Torres Strait Islander Australians, 2006*, cat. no. 4705.0, ABS, Canberra, 2007.

——, *Education and work, Australia*, cat. no. 6227.0, ABS, Canberra, 2010.

——, *Water account, Australia 2008–09*, cat. no. 4610.0, ABS, Canberra, 2010.

——, *Australian system of national accounts, 2010–11*, cat. no. 5204.0, ABS, Canberra, 2011.

——, *Australian industry 2009–10*, cat. no. 8155.0, ABS, Canberra, 2011.

——, *Australian labour market statistics 2011*, cat. no. 6291.0, ABS, Canberra, 2011.

——, *Environmental issues: energy use and conservation*, cat. no. 4602.0.55.001, ABS, Canberra, 2011.

——, *Household expenditure survey, Australia: summary of results, 2009–10*, cat. no. 6530.0, ABS, Canberra, 2011.

Australian Centre for Renewable Energy, *Geothermal directions*, ACRE, Canberra, 2011.

Australian Competition and Consumer Commission, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, 2010.

——, *Monitoring of the Australian petroleum industry*, ACCC, Canberra, December 2011.

Australian Energy Market Commission, *Annual market performance review: draft report*, AEMC, Sydney, 2011.

——, *Approach paper: energy market arrangements for electric and natural gas vehicles*, AEMC, Sydney, 2011.

——, *Possible future retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney, 2011.

——, *Strategic priorities for energy market development*, AMEC, Sydney, 2011.

Australian Energy Market Operator, *Electricity statement of opportunities*, AEMO, Melbourne, 2010.

——, *Gas statement of opportunities*, AEMO, Melbourne, 2010.

——, *National Transmission Network Development Plan*, AEMO, Melbourne, 2010.

——, *Small generator framework design*, AEMO, Melbourne, 2010.

——, *Electricity statement of opportunities*, AEMO, Melbourne, 2011.

——, *Existing and committed scheduled and semi scheduled generation – all NEM regions*, AEMO, Melbourne, 2011.

——, *Gas statement of opportunities*, AEMO, Melbourne, 2011.

——, *South Australian supply demand outlook*, AEMO, Melbourne, 2011.

Australian Energy Regulator, *State of the energy market 2010*, AER, Melbourne, 2010.

Australian Financial Markets Association, *Australian financial markets report*, AFMA, Sydney, 2011.

Australian Government, *Uranium mining, processing and nuclear energy: opportunities for Australia?*, 2006, report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, Canberra, 2006.

——, *Closing the gap: Prime Minister's report 2011*, Department of Families, Housing, Community Services and Indigenous Affairs, Canberra, 2011.

——, *Critical infrastructure resilience strategy*, Attorney-General's Department, Canberra, 2011.

——, *Organisational resilience: position paper for critical infrastructure*, Attorney-General's Department, Canberra, 2011.

——, *Securing a clean energy future: the Australian Government's climate change plan*, Department of Climate Change and Energy Efficiency, Canberra, 2011.

Australian Institute of Petroleum, *Downstream petroleum 2009*, AIP, Canberra, 2010.

Australian Petroleum Production and Exploration Association, *Financial survey results: 2009–10*, www.appea.com.au.

Bureau of Resources and Energy Economics, *Australian energy projections to 2034–35*, BREE, Canberra, 2011.

——, *Resources and energy quarterly: September quarter 2011*, BREE, Canberra, 2011.

——, *Mining industry major projects October 2011*, BREE, Canberra, November 2011.

——, *Resources and energy statistics: June quarter 2011*, BREE, Canberra, 2011.

——, *Resources and energy statistics 2011*, BREE, Canberra, 2011.

Charles River Associates, *Peak demand on the ETSA utilities system*, Essential Services Commission of South Australia, Adelaide, 2004.

Connolly, E and Orsmond, D, 'The mining industry – from bust to boom', paper presented at the Reserve Bank of Australia Conference, The Australian Economy in the 2000s, Sydney, August 2011.

Council of Australian Governments, *Principles for jurisdictions to review and streamline their existing climate change mitigation measures*, COAG, 2008, www.coag.gov.au.

CSIRO, *Possible futures: scenario modelling of Australian alternative transport fuels to 2050*, CSIRO, Canberra, 2011.

——, *Projections of generation costs*, CSIRO, Canberra, 2011.

CSIRO, *Road transport sector modelling*, report prepared for Treasury, 2011.

——, *Unlocking Australia's energy potential*, report prepared for the Department of Resources, Energy and Tourism, Canberra, 2011.

Department of Climate Change and Energy Efficiency, *National greenhouse gas inventory: December quarter 2010*, DCCEE, Canberra, 2011.

Department of Education, Employment and Workplace Relations, *Industry employment projections 2011 report*, DEEWR, Canberra, 2011.

Department of Employment, Economic Development and Innovation, *Queensland energy management plan*, Queensland Government, Brisbane, 2011.

Department of Innovation, Industry, Science and Research, *Framework of principles for innovation initiatives*, DIISR, Canberra, 2009.

——, *Powering ideas: an innovation agenda for the 21st century*, DIISR, Canberra, 2009.

Department of Resources, Energy and Tourism, *National energy security assessment*, RET, Canberra, 2009.

——, *Report for long term training strategy for the development of energy efficiency assessment skills*, RET, Canberra, 2010.

——, *Australian petroleum statistics*, RET, Canberra, 2011.

——, *Australia's uranium industry*, RET, Canberra, 2011.

——, *Continuing opportunities: Energy Efficiency Opportunities (EEO) program – 2010 report*, RET, Canberra, 2011.

——, *National energy security assessment*, RET, Canberra, 2011.

——, *Strategic framework for alternative transport fuels*, RET, Canberra, 2011.

Department of Sustainability, Environment, Water, Population and Communities, *Reforming national environment law*, DSEWPaC, Canberra, 2011.

——, *Sustainable Australia – sustainable communities*, DSEWPaC, Canberra, 2011.

Economic Regulation Authority, *Inquiry into the efficiency of Synergy's costs and electricity tariffs: issues paper*, Perth, 2011.

Electric Power Research Institute, *Australian electricity generation technology costs – reference case 2010*, report prepared for the Department of Resources, Energy and Tourism, Canberra, 2010.

ElectroComms and Energy Utilities Industry Skills Council, *Environmental scan*, EE Oz, Canberra, 2011.

Elliot, K, *The Australian coal industry – creating value for Australia's future*, Australian Coal Association, 2010.

Energex, *Network management plan – Part A 2009–10 to 2013–14*, Energex, Brisbane, 2009.

——, *Regulatory proposal for the period July 2010 – June 2015*, Energex, Brisbane, 2009.

Energy Supply Association of Australia, *Western Australian Energy Market Study: a pathway to an efficient energy market in Western Australia*, esaa, Melbourne, 2009.

——, *Electricity gas Australia*, esaa, Melbourne, 2011.

——, *National electricity market report: week 5 ending Saturday 29 January*, esaa, Melbourne, 2011.

EnergyQuest, *Energy quarterly – February 2010*, EnergyQuest, Adelaide, 2010.

Fraser, R, 'Demand side management', paper presented at the Australian Institute of Energy symposium, NSW's Electricity Future 2020 (and beyond): What will it look like and how do we get there?, 24 May 2010, Sydney.

Fry, C, Indigenous Business Australia, *Into Business workshops: a review of successful Indigenous pathways into business ownership*, paper presented at the Aboriginal Enterprise Mining, Exploration and Energy Conference, Mackay, October 2011.

Garnaut, R, *The Garnaut Review 2011: Australia in the global response to climate change*, Cambridge University Press, Melbourne, 2011.

——, *Update paper 7: Low emissions technology and the innovation challenge*, Garnaut Climate Change Review – Update 2011, Canberra, 2011.

George Wilkenfeld and Associates, *Prevention is cheaper than cure – avoiding carbon emissions through energy efficiency: projected impacts of the Equipment Energy Efficiency Program to 2020*, George Wilkenfeld and Associates, Sydney, 2009.

Geoscience Australia, *Australia's identified mineral resources 2010*, Geoscience Australia, Canberra, 2010.

Geoscience Australia and Australian Bureau of Agricultural and Resource Economics, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, Canberra, 2010.

Global-ROAM, *Power trading schematic – Australian electricity market*, 2011.

Government of Western Australia, *Strategic Energy Initiative directions paper*, Office of Energy, Perth, 2011.

IBISWorld, *Automotive fuel retailing market research report (ANZIC G5321)*, IBISWorld, Melbourne, 2010.

——, *Petroleum wholesaling market research report (ANZSIC F4521)*, IBISWorld, Melbourne, 2010.

Independent Market Operator, *Statement of opportunities 2011*, IMO, Perth, 2011.

Independent Pricing and Regulatory Tribunal, *Changes in regulated electricity retail prices from 1 July 2011*, IPART, Sydney, 2011.

Intergovernmental Panel on Climate Change, *Fourth assessment report*, IPCC, Geneva, 2007.

International Energy Agency, *Carbon capture and storage roadmap*, IEA, Paris, 2009.

——, *Energy efficiency governance: handbook*, IEA, Paris, 2010.

——, *Energy technology perspectives 2010: Scenarios and strategies to 2050*, IEA, Paris, 2010.

——, *IEA response system for oil supply emergencies*, IEA, Paris, 2010.

——, *Transport, energy and CO_2: moving toward sustainability*, IEA, Paris, 2009.

——, *World energy outlook 2011*, IEA, Paris, 2011.

Investment Reference Group, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, Canberra, 2011.

Järvinen, J, Orton, F and Nelson, T, *Electric vehicles in the NEM: energy market and policy implications*, AGL Applied Economic and Policy Research, working paper 27, October 2011.

Ministerial Council on Energy, *Community Service Obligations: National Framework*, www.ret.gov.au.

National Institute of Economic and Industry Research, *Maximising Australia's resources boom*, Australian Steel Institute, Sydney, 2011.

National Resource Sector Employment Taskforce, *Resourcing the future*, Department of Resources, Energy and Tourism, Canberra, 2011.

Parkinson, M, *Sustaining growth in living standards in the Asian century*, speech delivered at the Melbourne Institute Economic and Social Outlook Conference, Melbourne, 30 June 2011.

Prime Minister's Task Group on Energy Efficiency, *Report of the Prime Minister's Task Group on Energy Efficiency*, Department of Climate Change and Energy Efficiency, Canberra, 2010.

Productivity Commission: *Review of national competition policy reforms: inquiry report no. 33*, Productivity Commission, Canberra, 2005.

——, *Annual report 2010–11*, Productivity Commission, Canberra, 2011.

——, *Carbon emissions policies in key economies*, research report, Productivity Commission, Canberra, 2011.

Simshauser, P and Catt, A, *Dividend policy, energy utilities and the investment megacycle*, AGL Applied Economic and Policy Research, working paper 28, 2011.

Simshauser, P, Nelson, T and Doan, T, 'The boomerang paradox, part 1: how a nation's wealth is creating energy poverty', *The Electricity Journal*, vol. 24, no. 1, pp. 72–91, 2011.

Skills Australia, *Energy efficiency in commercial and residential buildings: jobs and skills implications*, Skills Australia, Canberra, 2011.

——, *Skills Australia 2011 interim report on resources sector skill needs*, Skills Australia, Canberra, 2011.

Smart, A, and Aspinall, A, *Water and the electricity generation industry: implications of use*, Waterlines report series no. 18, National Water Commission, Canberra, 2009.

Stern, N, *The economics of climate change: The Stern Review*, Cambridge University Press, Cambridge, 2007.

Stevens, G, 'The resources boom', remarks at the Victoria University Public Conference on the Resources Boom: Understanding National and Regional Implications, Melbourne, 23 February 2011.

Treasury, *Strong growth, low pollution: modelling a carbon price*, Treasury, Canberra, 2011.

United Nations Framework Convention on Climate Change, *The Cancun Agreements*, http://cancun.unfccc.int.