Australian Government

ENERGY WHITE PAPER 2012

Australia's energy transformation

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Department of Resources, Energy and Tourism

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Foreword

The Energy White Paper sets out the Australian Government's policy framework to guide the transformation of Australia's energy and energy resource sectors.

This transformation is well underway. Australia is moving to an increasingly integrated energy system where a more diverse set of technologies and fuels will strengthen our long-term energy security and help to lower our greenhouse gas emissions.

Australia is an energy economy. As one of only three OECD energy-exporting nations and a major supplier of energy resources to the growing markets of Asia, energy underpins our prosperity.

We are well positioned to build on our current success through our enormous natural endowment of energy resources, a strong economy, robust energy markets, a highly skilled workforce, a well-deserved reputation for innovation, and a world-class research and development base.

Nevertheless, there will be challenges, not least because of changes in global markets.

Energy is an essential service and we must work hard to continue to deliver a reliable supply of energy to consumers while minimising future energy price pressures, and particularly to protect the most vulnerable among us and to maintain our economic competitiveness.

This will require all Australian governments to commit to, and carry out, unfinished reforms that will build more efficient and competitive energy markets and support more informed consumer choices. We must also work together to minimise project costs and to attract future investment by improving our productivity and streamlining the regulation and approval processes that apply to energy resource development. This will create new wealth and jobs, especially in many areas in regional Australia.

The Energy White Paper has been informed by rigorous analysis and by the input from detailed submissions by consumers, businesses, peak industry bodies, and Indigenous and community organisations. I offer my sincere thanks to all those who participated.

No long-term forecast is ever certain, but I am confident that the policies and priorities outlined here provide the soundest possible basis for the continued development of our energy markets and resources. Working together, we will be able to manage Australia's energy transformation and ensure our nation's prosperity for decades to come.

The Hon Martin Ferguson AM MP

Minister for Resources and Energy
October 2012

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Abbreviations and acronyms

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
AETA	Australian Energy Technology Assessment
AIP	Australian Industry Participation
APEC	Asia–Pacific Economic Cooperation
ARENA	Australian Renewable Energy Agency
BREE	Bureau of Resources and Energy Economics
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
EMA	enterprise migration agreement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDP	gross domestic product
IEA	International Energy Agency
LNG	liquefied natural gas
LPG	liquefied petroleum gas
NECF	National Energy Customer Framework
NEM	National Electricity Market
NESA	National Energy Security Assessment
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NSEE	National Strategy on Energy Efficiency
OECD	Organisation for Economic Co-operation and Development
PV	photovoltaic
SCER	Standing Council on Energy and Resources
SWIS	South West Interconnected System

Units

GJ	gigajoule
GL	gigalitre
GWh	gigawatt hour
kW	kilowatt
ML	million litres
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
PJ	petajoule
ppm	parts per million
t CO_2-e	tonnes of carbon dioxide equivalent
toe	tonnes of oil equivalent
TW	terawatt
TWh	terawatt hour

Executive summary

Overview

Australia's energy sector, which underpins our modern economy and high national standard of living, has entered a period of unprecedented transformation and expansion.

These changes are part of the broader restructuring of the Australian economy as we move further into the Asian century and transition to a clean energy economy. They bring opportunities for new business and wealth creation, as well as challenges and risks.

In managing this transformation, national energy policy must aim to provide secure, reliable, clean and competitively priced energy to consumers while building national wealth through the safe and sustainable exploitation of our energy resources.

Australia has a generally positive energy security outlook. This will increasingly be shaped by the strength of future investment, the cost of energy and our ongoing response to climate change. Australia's abundant reserves of energy resources underpin our energy security, but maintaining a high level of security also depends on our integration into diversified supply chains, access to well-functioning global energy markets and continued effective responses to market and non-market risks.

Rising costs of production, the need to replace ageing infrastructure and the development of clean sources of energy mean that Australia will face continued pressure on energy prices. We must position ourselves well to retain our hard-won competitive advantage in reliable and competitively priced energy.

Australian governments must collectively undertake further market, regulatory and institutional reforms to ensure the efficient supply of energy and responsiveness of demand. Greater competition will stimulate business innovation to offer consumers better services, including a suite of information and 'smart' tools to help them control their energy use and keep costs down.

We must also further develop our gas markets and improve our ability to secure the next wave of investment in our energy resources. This is particularly important in promoting economic and social development in many of our regional communities, where energy-related developments play a significant role in generating jobs, building infrastructure and providing income.

The sustainable development and use of energy, particularly to improve our productivity and reduce our greenhouse gas emissions, is paramount in our long-term economic and environmental future.

Australia's journey towards a lower-emissions economy has begun with the introduction of the carbon price and other supporting measures under the Australian Government's Clean Energy Future Plan. We must now let our energy and carbon markets operate as intended to determine the nation's future energy mix and provide for a reliable, clean and competitively priced supply of energy.

The way we generate and use energy and the volume and diversity of our energy exports are changing. We must ensure that sound energy policy prevails to manage this transition while realising opportunities to underpin Australia's prosperity for decades to come.

A policy framework for the future

This Energy White Paper sets out a strategic policy framework that builds on past energy reforms and the government's Clean Energy Future Plan to provide a clear set of actions to address our immediate energy priorities and position Australia for longer-term change. It also provides a framework to manage our energy security needs in the face of shifting geopolitical balances and changes in global markets.

The cornerstone of the government's energy policy framework is the delivery of Australia's energy needs through competitive and well-regulated markets that are operating in the long-term interests of consumers and the nation.

Well-functioning energy markets working efficiently in tandem with other key markets such as carbon and financial markets are unarguably best placed to drive business innovation and produce sustainable, reliable and least-cost energy and climate change solutions.

Australia has been well served by over a decade and a half of bipartisan energy reform and market development, achieved through the cooperation of the Australian and state and territory governments. In this context, the Australian Government will take forward the policy positions set out in this Energy White Paper to build on that record of achievement, with the clear goal of delivering better energy outcomes for consumers.

Globally and nationally, energy systems and their policy contexts are expected to be even more dynamic than in the past. Therefore, as part of its policy framework the government is institutionalising a regular four-yearly strategic review of energy policy, commencing with this Energy White Paper. The reviews will be timely opportunities for high-level assessment and adjustment so that Australia remains well positioned to meet its energy needs.

Australia's energy future

Over the next two decades, Australia's energy future will be dominated by three intersecting factors:

- the need to deliver secure, reliable and competitively priced energy for a growing population and economy
- the further expansion of our energy exports to Asia and other growth markets
- the need to become more energy efficient across the economy and to dramatically reduce carbon emissions and transform to a clean energy economy.

Australia is well positioned to respond to these needs and secure a strong and positive energy future. Our position is underpinned by our enormous endowments of energy resources, a strong and stable economy with well-established and robust energy markets, a highly skilled workforce, our established reputation for innovation, and our world-class research and development base.

Growing regional demand for energy will continue to underpin our development

The world's population stands at 7 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 global energy demand to grow by around 40%, and 90% of that growth will occur in developing economies, particularly China and India (IEA 2011a).

As the world's ninth-largest energy producer and a near neighbour to Asian economies, we are well placed to cement our role as a leading energy supplier to those nations and to assist their economic development. This is reflected in the tripling of our energy exports from $24 billion in 2004–05 to $69 billion in 2010–11, when they accounted for a third of Australia's total commodity exports.

Over the next two and a half decades, Australia's energy production is projected to more than double, largely due to export growth. We are the world's largest coal exporter and third-largest uranium producer, and in future years will be the world's second-largest liquefied natural gas (LNG) exporter. Our energy exports will continue to support higher living standards for billions of people in our region.

Australian coal production is expected to continue its strong growth by an annual average of 8%, from a value of $14 billion in 2010–11 to an estimated $20 billion by 2016–17 (BREE 2012b).

Our gas production is expected to increase dramatically by 19% per year to quadruple by 2017 (BREE 2012b). Since 2007, more than $175 billion in capital expenditure has been committed to onshore and offshore Australian LNG projects. Shell's Prelude floating LNG project is a world first and offers the opportunity to unlock currently stranded gas resources in remote offshore areas.

Our gas production will be boosted by 'unconventional' gas, particularly coal-seam gas (CSG) and potentially shale and 'tight' gas. Australian CSG production increased from 2% to 11% of total gas production in the five years to 2010–11, and future output will be bolstered by three CSG-to-LNG projects, worth $50 billion, being built near Gladstone.

Australia's extensive uranium resources, mining expertise and leadership role in nuclear non-proliferation have made us an important supplier of nuclear fuel. Our uranium is also important in satisfying the world's need for low-carbon energy.

Through this diverse portfolio of energy exports—and our efforts to develop clean energy technologies, such as carbon capture and storage and renewable energy technologies—Australia is well placed to help our customers manage their long-term efforts to address climate change.

Our changing domestic energy sector

Our domestic energy sector is also changing in fundamental ways. Through key reforms and measures being implemented under the Australian Government's Clean Energy Future Plan, we have begun the necessary long-term transition to a clean energy economy.

Coal currently accounts for 75% and gas around 15% of electricity generation. While coal and gas are expected to continue to underpin our energy security for many years, this balance is projected to change significantly in the coming decades.

Renewable energy will account for at least 20% of our electricity generation by 2020 and this may rise further to around 40% by 2035. By 2050, most of Australia's conventional fossil fuel power generation is likely to have been replaced with clean energy technologies in the form of wind power; utility-scale and distributed solar power; geothermal energy; and coal- and gas-based carbon capture and storage systems. In 2050, greenhouse gas emissions from the electricity sector are expected to be 76% below what they would have been without a carbon price.

Domestic energy-use patterns are also changing. The possibilities offered by new smart energy technologies and appliances are already beginning to change the way we use and manage energy in our households and enterprises. For example, distributed generation systems are becoming more reliable and affordable energy options for many homes and businesses. As these changes unfold, new business models will emerge. Energy suppliers and industry more generally—along with government—have a role to play in educating consumers and offering innovative products to help meet consumer needs, particularly where demand-side products can be offered to help reduce peak load.

Our gas and liquid fuel markets are also undergoing important structural changes, driven by a closer integration with global markets and supply chains, the growing development of new technologies such as electric vehicles and alternative fuels, and expanding sources of supply and demand competition. These factors have introduced new dynamics and transitional pressures in these markets and for some downstream industries (such as plastics and chemicals) that rely on them for fuel or feedstock. The full implications of this have yet to be established and need to be closely monitored.

Australia's energy challenges

Our success in securing a positive, strong and clean energy future will depend critically on how well we manage both the near- and longer-term challenges that may arise from these and other changes. Some are foreseeable, some will develop through time, and others may emerge abruptly. They include:

- attracting timely and efficient investment in our energy sector
- minimising energy price pressures
- improving energy productivity and reducing inefficient peak demand
- managing transitional pressures in our gas markets
- bringing new technologies to market
- ensuring our long-term liquid fuel security
- safely and sustainably developing our energy resources
- promoting informed energy choices.

Attracting timely investment

Meeting Australia's future energy needs will require significant levels of investment over coming decades. By 2030, the requirement in our domestic energy sector may be as much as $240 billion, while energy resource development projects may need up to $290 billion in investment.

While these estimates appear daunting, they are achievable, particularly as the investment will be spread over several decades and different components of the market.

This investment pipeline needs to be locked in more tightly. Not all proposed energy resource developments will go ahead in the face of growing global supply competition. Investment in our energy generation and supply infrastructure will also depend on a range of factors, most notably the extent to which electricity demand rebounds in coming years after its recent decline. While sustained low demand growth can be expected to defer some of the need for new generation and network capacity over the next decade, this is by no means certain and we cannot afford to be complacent.

Our ability to deliver investment in a timely and cost-effective way will depend critically on access to finance and capital. Given the relatively small pool of Australian investors with deep experience in greenfield energy investments, it is likely that a significant proportion of the required capital—debt and equity—will need to be sourced from overseas.

The footloose and competitive nature of foreign capital means that Australia must maintain attractive and stable investment and policy frameworks, particularly if the current turmoil in international financial markets is sustained. This includes ensuring that energy markets provide opportunities for fair commercial returns.

In this context, governments must take decisive steps to define and implement a program of reform that provides clear direction to markets during a period of heightened public debate about our energy future. The Australian Government has acted to provide long-term certainty to the market by implementing carbon pricing and other critical clean energy measures. However, the lack of bipartisanship on key climate policies continues to generate uncertainty and risks for investors in electricity generation, downstream energy users and emissions-intensive industries.

Minimising energy price pressures

Rising energy costs are affecting the costs of living of many Australian households and the competitiveness of Australian firms. In particular, retail electricity costs have increased on average by around 40% in the past three years, and by well over 50% in some regions. Wholesale energy costs for large users have also risen. Increases of that size are unsustainable.

Addressing the causes of price rises presents complex policy challenges for governments and, unfortunately, there are no easy fixes.

For example, recent increases in power prices reflect mainly increases in network costs caused by a complex combination of increasing peak demand, the need to replace and augment ageing infrastructure and meet higher reliability standards, as well as a marginal impact from various energy efficiency and renewable energy policy interventions at the national and state levels.

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 suppress efficient pricing outcomes will have detrimental investment and supply consequences that are not in the long-term interests of consumers.

There are positive signs that some price pressures may begin to ease into the future. In particular, lower growth in demand for electricity may defer some of the projected investment need until current capacity is fully utilised. Proposed changes to market rules will also assist in more efficiently targeting network investment—a key driver of recent price rises—to consumer needs.

However, many of the underlying factors driving price rises are likely to continue into the future. Governments have a responsibility to ensure that the cost of supplying energy is as efficient as it can be, but do not have exclusive control over price pressures (such as the prices of liquid fuels, which are largely set by international market forces). Governments have a role in ensuring that consumers are confident that the costs they are paying for services are justified.

Governments at all levels need to embrace key reforms to improve market and regulatory efficiencies, promote competition and innovation and eliminate inefficient policies that impose unnecessary costs on consumers. The Australian Government is committed to advancing an ambitious energy market reform agenda through the Council of Australian Governments' Standing Council on Energy and Resources (SCER), in cooperation with the states and territories.

Nor can the social impacts of rising energy prices be forgotten. There is a need to better understand the impacts of rising energy prices, particularly for lower-income households, and to ensure that any assistance effectively targets those who need it. Market protections for vulnerable customers are critical, so the National Energy Customer Framework should be implemented as a matter of priority by jurisdictions that have not yet done so.

Improving energy productivity and reducing inefficient peak demand

Strong growth in peak or maximum daily demand over recent years has been a significant contributor to rises in electricity costs. This is because of the need for high-cost, fast-start generation capacity and the additional proportion of network infrastructure that must be maintained to service demand that exists for very short periods.

In our main markets, between 10% and 25% of maximum demand occurs for only 1% of the time, which means we are all paying higher power bills because of this inefficient use of system capacity (AEMO 2011).

For example, it has been estimated that 25% of retail electricity costs in New South Wales are derived from peak events that occur over a period of less than 40 hours per year (Fraser 2010).

The main drivers of the growth in inefficient peak demand are the increased use of relatively low-cost, energy-intensive domestic appliances, such as air conditioners and large-screen TVs, and inefficient pricing structures. Current electricity pricing does not reflect the true cost of generating and supplying electricity at various times of the day, and so fails to provide a critical financial incentive for more efficient behaviour. As a result, some consumers are likely to be paying more than they otherwise should and are effectively cross-subsidising those who are driving the growth in peak demand.

One example of how significant this can be is the true cost of air conditioning. It is estimated that the installation of a 2 kilowatt reverse-cycle air conditioner can cost a consumer around $1500, but imposes costs on the energy system of up to $7000 when adding to peak demand—costs that are spread across all customers.

Action to lower the growth in peak demand and improve end-use energy productivity can reduce system costs for consumers.

Demand-side participation and improved energy efficiency are fundamental to curbing peak demand. This requires an integrated approach to market reform that provides efficient market signals to guide behaviour, along with the right incentives for energy service businesses to provide consumers with better information and better products to manage their energy use at peak times.

Smart meters and smart appliances are also important tools to reduce peak demand. They can assist consumers to become more engaged in their energy use and help to inform their energy choices. Finding the right deployment model—with appropriate consumer protections—is essential.

In this context, competitive retail markets are critical to accelerating business innovation and the rollout of new products and services, which could include smart meters connected to industrial, commercial or domestic energy management systems, allowing energy users either directly or remotely to efficiently cycle major appliances such as air conditioners or pool pumps. In the near future, such products could be part of competitive retail packages offered to customers along with differentiated tariff structures that provide incentives for customers to shift energy use to lower-cost periods.

Protecting the interests of vulnerable consumers must be part of any reforms in this area. This includes recognising the varying ability of consumers to access programs and information and shift usage patterns to respond to price signals, and understanding that communication may be needed through a range of channels to reach the intended audience.

Managing transitional pressures in our gas markets

Australia's eastern and western gas markets are undergoing major transformation, including increased demand competition and rising costs of production from new gas fields.

While we have adequate overall reserves of gas to meet projected domestic and export production needs in all markets until at least 2035, there may be some transitional tightness in the east coast gas market as new coal-seam gas and LNG projects ramp up to full production. These factors are already manifesting in higher gas prices and tighter supply dynamics.

This has led to some suggestions that more commercially attractive export opportunities, particularly new LNG developments, may be compromising Australia's energy security, and to calls to mandate a proportion of gas reserves for the domestic market.

The government does not believe that such an approach would effectively address current pressures or be in the long-term interests of consumers and the Australian community. However, maintaining Australia's energy advantages (cost, supply, diversity of sources and reliability) are critical in attracting investment in large-scale transformative industrial plants and technologies.

There is little convincing evidence that interventions designed to force non-commercial outcomes are effective. Given that they are more likely to constrain rather than increase incentives for exploration and new supply, they would impede the development of more efficient gas markets and should be considered only where there is a clear market failure.

Export development will continue to play a critical role in Australia's energy future, bringing substantial economic benefits by maximising the returns from our resources. Many of the new energy developments in Australia are unlikely to have occurred without export prices and volumes to justify their massive capital infrastructure requirements, or would have been delayed until domestic prices rose well above historical levels. Importantly, a number of the LNG projects now underway will provide a critical long-term backbone for the continued development of Australia's domestic gas markets.

While there will need to be a period of adjustment to changing market dynamics by market participants, financiers, regulators and policymakers, there is no clear evidence at this time to suggest market failure or that our gas markets cannot deliver the necessary supply.

However, the Australian Government recognises the ongoing pressures in these markets, particularly for large industrial users, and remains committed to ensuring that the market has access to adequate supplies of gas. The government will work with relevant jurisdictions to implement a gas market development program through the SCER to improve the operation of our markets, and will continue to monitor Australia's domestic gas development.

Important reforms that could improve market transparency and trading opportunities include developing an upstream trading hub and boosting market supply by resolving current impediments to the development of new unconventional gas reserves, particularly in New South Wales, which is exposed to transitional pressures. The government is also updating its offshore retention and production lease arrangements to continue to promote transparency and domestic supply outcomes and will engage with the gas supply industry as a priority to identify options to improve market liquidity.

Bringing new technologies to market

Because electricity generation accounts for just over a third of Australia's greenhouse gas emissions, our ability to commercially deploy clean energy technologies such as solar or carbon capture and storage at scale—and to integrate them into our networks—will be a significant determinant of our success in reducing domestic emissions.

The development of commercial clean energy technology could also generate national wealth and employment through the creation of new business opportunities as part of national and global supply chains and the capture of ideas and knowledge in the form of intellectual property and innovation.

Australia can build on its well-established and world-class research and development capacities in a range of clean energy technologies. Australian researchers have been recognised internationally for their groundbreaking work in solar photovoltaic energy research, and Australia is a world leader in a range of photovoltaic technologies. We are also among world leaders in the development of ocean energy, enhanced geothermal energy and carbon capture and storage technologies, their application, or both.

While clean energy has enormous potential, outcomes are not predetermined. The success of individual technologies that are not yet commercial hinges on developers overcoming current technical, social and cost barriers.

Our future success will in large part require research and development and the adaptation, demonstration and commercialisation of clean energy technologies. Initiatives such as the Australian Renewable Energy Agency, the Clean Energy Finance Corporation and the Clean Technology Innovation Program will be essential in supporting long term development and deployment outcomes.

Working to accelerate the commercialisation of key technologies is critical so that markets have earlier access to a wider set of options, reducing the potential future cost of technology lock-in. We will also benefit from an earlier understanding of key technologies so that policymakers and businesses can plan ahead and adjust if necessary.

Australia has relatively modest and open energy markets by world standards and will remain largely a technology taker. Given the commercial reality that many of the technologies 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 make the best use of global technological developments so that Australian energy markets and consumers have access to a larger range of lower-cost products and services.

Ensuring our long-term liquid fuel security

Australia's liquid fuel supplies and markets are also undergoing structural changes. Our domestic crude oil production is declining while strong competition from larger and newer Asian refineries, which continue to lower the break-even benchmark that our refineries compete against, has led to reductions in our domestic refining capacity.

Coupled with rising demand for liquid fuels, this will make Australia more reliant on imports of crude oil and refined petroleum product. Australia is not the only country in this position: European nations and the United States are also undergoing similar structural adjustment in their refining industries.

These changes are not considered to reduce our liquid fuel security, which is assessed as high trending to moderate over the longer term. This is due to Australia's access to diverse and well-established supply chains and the planned replacement of lost refining capacity with import facilities to maintain market supply. The commercial development of alternative fuels could also help us meet our liquid fuel needs, although that is expected to take some time. Because of the commercial potential of unconventional sources of petroleum, the International Energy Agency (IEA) believes that there is a very low probability of reaching global supply limits (so-called 'peak oil') in the period to 2035 (IEA 2011a).

However, while these changes are unlikely to affect normal market supply, they raise questions about Australia's ongoing noncompliance with our IEA 90-day stockholding obligation. The collective stocks held by all IEA members form an important strategic reserve that can assist in managing major disruption in global oil markets.

The Australian Government does not maintain a physical stockholding and has traditionally relied on market responses to meet our obligation. While our market based stocks may not change substantially, the prospect of rising net imports suggests that we will be increasingly less compliant, and the government is currently considering its response to this matter, informed by the views of industry and other stakeholders.

Safely and sustainably developing our energy resources

Few countries can compete with Australia's attractiveness for energy resource development. We offer 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 positioned at the doorstep of the Asia–Pacific region. However, our energy extraction and development industries are confronted by a range of challenges.

While we have an impressive portfolio of energy resource investment proposals, around a third have yet to secure final approval by investors. In an increasingly competitive investment environment, our immediate focus must be to ensure that we deliver on committed projects and turn proposed investments into working projects.

Australia is a high-cost producer compared to many other potential energy suppliers. High global energy prices are stimulating growing competition from an increasing number of countries with lower costs and a higher perceived resource prospectivity than Australia.

Increasingly, resource developments are intersecting with other land or resource uses or critical conservation priorities. Striking an effective balance between competing interests is a key challenge for the energy industry, governments and communities in general. There is an important role for governments in ensuring that regulatory frameworks provide for transparent, sustainable and safe development, particularly where developments involve multiple resource use and co-development. There is also a need for industry to engage with local communities and other stakeholders to earn a 'social licence to operate', particularly for new technologies or developments.

The Australian Government is taking important steps to address these issues through its reforms to improve business regulation and its offshore and environmental regulatory frameworks, including measures to promote the safe development of our CSG resources. In addition, the government is working closely with the resources sector and the skills, education and vocational sectors to meet workforce needs through training, mobility and short-term worker migration initiatives.

The energy and resources sectors are also creating many opportunities for Indigenous Australians by creating jobs and income streams for local communities. This is particularly important in remote areas of Australia. Industry, government and Indigenous communities are working together to ensure that these opportunities create deep and durable benefits.

Promoting informed energy choices

Australia must have a mature, informed and ongoing public dialogue on our energy future, the transition to clean energy, and ways to reduce our greenhouse gas emissions.

As a society, we face potentially difficult decisions about the pace and strength of our efforts, the environmental, social and economic impacts, and the policies that will be needed to drive the transition.

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

The IEA has estimated that around 80% of global carbon dioxide emissions allowable under a scenario that keeps atmospheric greenhouse gas concentrations under 450 parts per million and global warming under 2°C 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, fuels and energy efficiency measures, particularly those that can be retrofitted to existing capital stock, and that the world cannot afford to limit options if we are to meet increasingly urgent climate goals (IEA 2011a).

Similarly, much of Australia's energy infrastructure is locked in, but we are fortunate in having renewable, demand-side, gas, and carbon capture and storage options to aid us in the transition to a cleaner future. All credible analysis supports the need for a portfolio approach within a well-functioning market-based framework, drawing on the most effective options across the economy.

The more we limit these options, the higher will be the cost and the risks of meeting our clean energy and emissions reduction goals.

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

Energy policy priorities for the future

The Energy White Paper defines a comprehensive strategic policy framework to guide the further development of Australia's energy sector over the next four years. This framework is set against a review of Australia's energy needs and goals over the period to 2035.

At its core, the policy framework is based on a clear vision of building 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.

The Australian Government has identified four identified priority areas that will strengthen Australia's ability to fully realise this objective:

- delivering better energy market outcomes for consumers
- accelerating our clean energy transformation
- developing Australia's critical energy resources, particularly gas resources
- strengthening the resilience of Australia's energy policy framework.

Delivering better energy market outcomes for consumers

Past reforms have provided a strong foundation for competitive national energy markets. However, several major areas of reform remain outstanding.

In the face of rising cost and transitional pressures and the challenge of transforming energy markets, we need to ensure that our market settings and regulatory frameworks are delivering better benefits to consumers. We also need to continue to improve our energy productivity and provide for a better demand responsiveness.

For Australia's *electricity markets*, the government will pursue an ambitious package of reform with the states and territories to improve market efficiency, regulation and competition and to deliver a wider range of services and products for consumers. Key areas of action include:

- strengthening market institutions and governance by
  - ensuring that our energy market bodies have the necessary capacities, capabilities and accountabilities to perform their assigned functions
  - levelling the playing field by removing conflicts of interest where they arise from the ongoing public ownership and governance of energy businesses
  - ensuring that the interests of consumers, including vulnerable consumers, are better represented in market development and decision-making processes
- improving network efficiency and performance by
  - actioning recommendations from current reviews to ensure that the regulatory framework, including appeals or review processes, provides for efficient investment outcomes
  - ensuring greater transparency in network investment, balancing the need to deliver a consistent standard of reliability at minimal cost, and improving performance, connections and network services for the benefit of consumers
- empowering consumers by
  - ensuring that markets are enabled and incentivised to provide consumers with better information and choice about their energy-use decisions, as well as a greater ability to participate in the energy market through demand-side opportunities and the deployment of smart meters, other advanced energy management applications and smart appliances
  - ensuring that consumer protections are maintained through the full implementation of the National Energy Customer Framework
- ensuring competitive and efficient wholesale and retail markets by
  - seeking a clear commitment and timeframe for deregulating retail price controls where effective competition exists, or developing a pathway to effective competition and deregulation where it does not
  - developing national guidelines that provide a benchmark approach to a 'fair and reasonable' feed-in tariff for micro-generation to encourage competition, and clear rights and obligations for connections
  - rationalising policies and programs that are not complementary to a carbon price, or are ineffective, inefficient or impose duplicative reporting requirements on business.

See Chapter 10: *Energy markets: electricity* and Chapter 11: *Energy productivity* for a full list of actions to benefit electricity consumers and businesses.

To further develop our ***gas markets*** and to ensure the overall adequacy of supply and forward investment, the Australian Government will work closely with the states and territories to implement an ambitious gas market development program. Key areas of action include:

- developing options for a national gas supply hub trading model to enhance transparency and the reliability of supply
- exploring the merits of reviewing pipeline capacity trading, including potential mechanisms for utilising unused (but contracted) capacity
- identifying additional market information and potential reporting mechanisms to promote the development of more robust gas market arrangements
- engaging with key stakeholders to promote a long-term vision for the development of Australia's gas markets as a framework for guiding near-term market reform directions.

The government will also closely monitor developments in Australian gas markets, including the emergence of potential impediments to adequate domestic supply, and will actively engage with gas suppliers to identify options to improve liquidity in key markets.

See Chapter 9: *Energy markets: gas* for a full list of actions to develop our gas markets.

Because of ongoing changes in our ***liquid fuel markets***, governments must maintain the right balance in our policy settings to ensure that we attract investment in new supply infrastructure, maintain access to diverse and reliable supply chains, and address regulatory or policy barriers that impede the efficient market-based development of alternative fuels or technologies. Key areas of action include:

- assessing Australia's liquid fuel supply vulnerabilities associated with the decline in domestic refining capacity, and continuing to monitor developments in the liquid fuel market
- continuing to work with industry and, guided by the Alternative Transport Fuels Implementation Advisory Group, pursuing a market-led approach to the development and deployment of alternative transport fuels
- undertaking biennial Australian transport fuel technology assessments and improving the quality of our liquid fuel statistics (possibly through mandatory reporting).

See Chapter 8: *Energy markets: liquid fuels* for a full list of actions to improve our liquid fuel markets.

Accelerating our clean energy transformation

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 and support for innovative technologies. The ability of emerging technologies to establish their commercial reliability and competitive cost will determine market outcomes.

Accelerating the pace of commercialisation for new clean energy technologies is critical if the market is to have early deployment options that could reduce the longer-term cost of meeting national greenhouse gas abatement goals.

Through the Clean Energy Future Plan and earlier commitments, the Australian Government has already put in place the key mechanisms to drive a transformation to cleaner energy. They include:

- pricing carbon emissions
- the 20% by 2020 Renewable Energy Target
- legislating the $10 billion Clean Energy Finance Corporation
- establishing the $3.2 billion Australian Renewable Energy Agency

- the $1.68 billion Carbon Capture and Storage Program
- the $370 million National Low Emissions Coal Initiative
- the $300 million Low Carbon Communities Program
- the $200 million Clean Technology Innovation Program.

These policies are intended to work together to drive the shift to cleaner energy sources and to be mutually supporting. For example, the Australian Renewable Energy Agency will enhance research and development into renewable energy, the Clean Energy Finance Corporation will help overcome financial barriers to commercialisation, and the Renewable Energy Target will work alongside the carbon price to drive deployment in the market.

We must continue to identify and overcome potential market gaps or barriers to the efficient take-up of clean energy technologies and processes. This might include identifying and addressing problems in network connection and integration and ensuring that there are appropriate regulatory standards to support take-up. Key areas of action include:

- expediting the implementation of clean energy programs to ensure continued support for innovation and commercialisation
- responding to any recommendations by the Climate Change Authority's current review for improving the efficiency and effectiveness of the Renewable Energy Target scheme in achieving its 2020 target
- monitoring the impacts of increased levels of intermittent renewable generation on network stability, particularly the need for any new requirements for the structure and operation of networks
- identifying the need for nationally consistent and supportive regulatory arrangements for new clean energy technologies and working with states and territories to promote the efficient development and take-up of clean energy.

See Chapter 6: *Clean energy* for a full list of actions to accelerate the clean energy transformation.

Developing Australia's critical energy resources, particularly gas resources

Competition among nations for investment and market share in key energy export markets is growing as many new suppliers seek to take advantage of strong demand. While Australia has been enormously successful in capturing investment in our energy resources to date, we will need to work hard to attract further projects. To remain competitive, we must maintain and improve our standing as a reliable and competitively priced energy supplier.

In some markets, there are ongoing tensions between export and domestic demand for important energy resources. We need to manage this while maintaining sound market arrangements, as both factors have critical roles in our future economic development.

The Australian Government is working on reforms to ensure the timely and sustainable development of our energy resources. Key areas of action include:

- streamlining environmental regulations that apply across Australian and state government jurisdictions, including by working with states and territories through the Council of Australian Governments and the Business Advisory Forum to improve business regulation
- pursuing an active approach to the development of its offshore gas resources, including by
  - updating offshore retention lease arrangements to continue to promote transparency and the timely development of resources
  - paying close attention to the potential for offshore LNG projects to supply the domestic gas market when assessing retention leases or granting production licences
  - examining the possible introduction of cash bidding for offshore petroleum acreage release

- promoting the safe and sustainable development of our energy resources, particularly our gas resources, by
  - working through the SCER to develop a nationally harmonised regulatory framework for the CSG industry, and undertaking additional actions to develop a better understanding of the direct and cumulative impacts of proposed coal mining and CSG developments on groundwater and the environment
  - working through the SCER to develop a world-class multiple land-use framework to promote coexistence, rather than exclusion, as a key principle in land-use policy
- enhancing Australia's energy resource prospectivity by
  - supporting the continued provision of high-quality pre-competitive information through Geoscience Australia
  - updating the Australian Energy Resource Assessment every three years from 2013
  - working with states and territories through the SCER on options to improve mineral resource and ore reserve disclosure by companies not listed on the ASX, and developing the National Exploration Strategy to address Australia's greenfield mineral exploration challenge
- capturing opportunities for local industry and communities by
  - implementing changes to Australian Industry Participation plans and working with industry to enhance firms' competitiveness and ability to win work and integrate with global supply chains
  - continuing to work with the energy resources sector and Indigenous communities and groups to promote economic and social opportunities.

See Chapter 5: *Energy resources* for a full list of actions to develop our energy resources.

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 assessments of key policy settings will provide policymakers and businesses with a better ability to anticipate and respond to emerging risks or changing circumstances. This is recognised in the IEA's recent review of Australia's energy policies (IEA 2012a).

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

- institutionalising a regular four-yearly national strategic review of energy policy from 2016, providing an opportunity to assess overall progress in meeting our national energy goals and to identify emerging risks or changing circumstances and consider appropriate responses
- undertaking the National Energy Security Assessment on a two-yearly basis, starting from 2014, and reviewing the assessment framework with the aim of providing a more systematic assessment of energy security risks
- undertaking the National Energy Risk Preparedness Audit, in collaboration with states and territories, industry and market bodies, across the energy sector as part of the National Energy Security Assessment, to test the appropriateness and effectiveness of response mechanisms to manage critical risks to the energy sector
- improving Australia's energy information base through more regular assessments of resources, technologies and market conditions, including work to streamline and better coordinate existing data collection and assessment activities to reduce the burden on business.

See Chapter 4: *Energy security* and Chapter 14: *Energy information* for full list of actions to make the energy policy framework more resilient.

PART I

Australia's energy in context

1 A framework for national energy policy

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.

The efficient generation and supply 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 depend on for our daily activities. Without it, our society simply cannot function. Society also requires sustainable patterns of energy production, supply and consumption.

Energy is also a commodity that is transformed and traded. Energy-intensive industries have prospered in Australia and 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.

Realising the transformation to a clean energy economy is a long-term undertaking. Under the Australian Government's Clean Energy Future Plan, the efficient pricing of greenhouse gas emissions is now a legislated reality for Australia's energy sector and economy more broadly. Combined with well-functioning energy markets and targeted support for the development of new clean energy technologies, this will drive long-term change in our energy system, creating opportunities for new industries, technologies and jobs.

Australia's economy is increasingly integrated into global markets. We are now a leading supplier of energy to citizens in many countries throughout our region, and there is significant potential for further growth. Our global engagement is critical not just for export opportunities but for our ability to finance development and for making the most of new technologies and expertise.

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.

Managing our energy choices efficiently and sustainably will bring enormous social and economic benefits. Undeniably, it will also present challenges. The key purpose of energy policy is to manage those challenges and, in doing so, to improve the wellbeing of Australia and its citizens.

1.2 Why the time is right for a new Energy White Paper

Much has changed in Australia, in our region and across the globe since 2004, when the last Energy White Paper was published:

- Increased energy demand, particularly for peak electricity, is driving significant new investment in Australia's energy infrastructure and rising energy prices.
- There is a bipartisan commitment to unconditionally reduce greenhouse gas emissions by 5% below 2000 levels by 2020. The Australian Government's Clean Energy Future legislation also sets down a long-term target to reduce Australia's carbon pollution by 80% below 2000 levels by 2050. Carbon pricing was introduced on 1 July 2012 as part of the Clean Energy Future Plan and will ensure that we meet our emissions reduction commitments.
- Australia energy exports have tripled to around $70 billion in 2010–11, driven largely by sustained industrialisation and urbanisation in Asia (BREE 2012a).
- Our energy base is being transformed. Major new gas developments, notably the expansion of east coast coal-seam gas and our LNG industry, and large-scale renewable energy initiatives are underway with significant potential for further expansion.
- Energy policy is increasingly intersecting with many other areas of policy, such as climate change, innovation, industry and social policy, national security, and transport and urban planning.

Over the next decade we will see additional factors in play:

- Carbon pricing will drive transformational investment in clean energy that will continue for many decades.
- We will need major new investment, particularly in clean energy generation and energy infrastructure, over the next two decades. Depending on such factors as future growth in energy demand, this could be as high as $240 billion, with around as much again for the development of our energy resources. Foreign investment and open trade will be critical to our growth and prosperity.
- Australia is likely to experience further structural change in its liquid fuel supply arrangements.
- Long-term energy security to support economic and social development will continue to be a key concern for many countries, driving their energy and technology choices.

While markets are highly flexible and generally efficient at managing risk, uncertainty can impede or increase the cost of investment and, ultimately, costs for consumers. Clear policy frameworks and objectives will provide stability and instil market confidence.

1.3 The energy policy framework

This Energy White Paper sets out a strategic policy framework to guide the development of Australia's energy systems—our means of producing, supplying and using energy and energy-related services—into the next decade and beyond.

In doing so, it provides a set of clear policy positions and priorities set against an assessment of Australia's long-term energy needs and the challenges that may emerge. It also identifies measures by which we can judge progress towards our goals.

1.3.1 A long-term national vision for energy

At its core, the Australian Government's energy policy framework is based on a clear vision of building a secure, resilient and efficient national energy system[1] that:

- provides accessible, reliable and competitively priced energy and energy services for all Australians
- enhances Australia's domestic and export growth potential
- delivers clean and sustainable energy.[2]

This vision and the supporting policy framework are based on the imperative of striking a balance between energy supply and demand while also meeting energy security, economic development and clean energy transformation goals.

Providing competitively priced energy that minimises costs for households and businesses while also providing a commercially attractive environment for investors is at the heart of that equation.

The Australian Government believes that market-based approaches are the best means to efficiently deliver policy outcomes, promote competitive efficiencies and provide the flexibility needed to respond to future developments. This position has been reaffirmed by evidence from over 30 years of continuous reform to our energy markets, as well as the comprehensive analysis undertaken during the design of Australia's carbon pricing framework.

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1 In this White Paper, the term 'energy system' is defined inclusively to encompass the production, supply and use of energy as well as associated services.

2 '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.

The government also recognises that markets have natural limitations and require effective and efficient policy and regulation to guide them and ensure that they function well, and to address areas where markets cannot deliver as required. Such interventions should always be fit for their context, justifiable and transparent.

1.3.2 Policy principles

This approach is encapsulated in the following overarching policy principles to guide the development of energy policy:

1. Australians have the right to clean, secure, reliable and competitively priced energy.
2. Energy policy and associated actions should promote long-term efficiency and productivity and enhance national wellbeing.
3. Energy is most efficiently delivered through well-functioning markets supported by effective and efficient policy and regulation.
4. Energy frameworks and markets should operate in the long-term interests of consumers and provide appropriate consumer protections and 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 take into account 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 will engage internationally with governments and organisations to promote Australia's energy interests.
8. Australia will meet its international commitments.

1.3.3 Key elements of energy policy

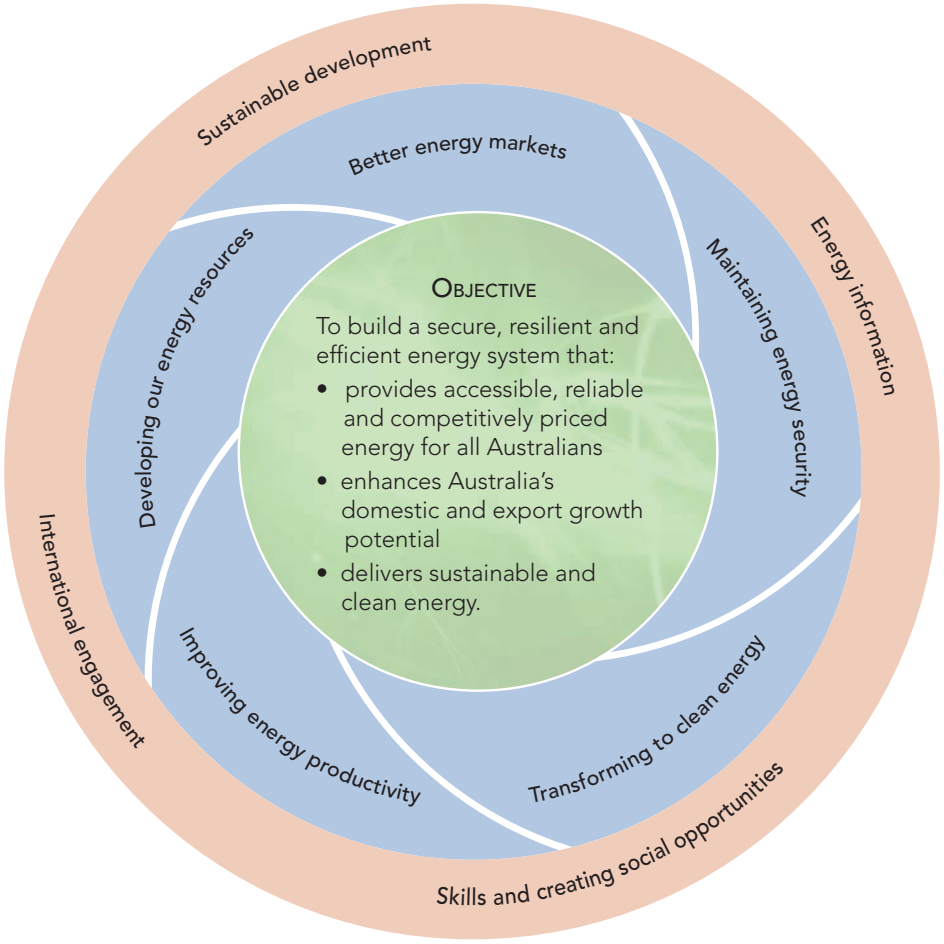
Australia has a mature and complex energy system reaching all sectors of the economy and society. The system comprises producers, networks, retailers, customers, regulatory bodies and governments, as well as providers of capital and technology.

The Energy White Paper therefore covers energy security, the development of our energy resources, clean energy development and deployment, the operation of Australia's energy markets, and demand-side and consumer participation mechanisms.

This system does not operate in isolation: an intersecting set of social, economic and environmental frameworks must be properly understood and considered. The energy policy framework therefore also includes aspects such as the need for international engagement, sustainable development, improving our energy information base and promoting social and workforce opportunities. There are many other aspects, but these are considered the most important for this White Paper.

The key elements of Australia's energy policy framework, and thus the Energy White Paper, are shown in Figure 1.1.

Figure 1.1: Key elements of national energy policy



1.3.4 Priorities for energy policy

The objectives, principles and the policy challenges identified in subsequent chapters of the Energy White Paper lead to four core policy priorities:

- delivering better energy market outcomes for consumers
- accelerating our clean energy transformation
- developing Australia's critical energy resources, particularly gas resources
- strengthening the resilience of Australia's energy policy framework.

Delivering timely action under these broad priorities will promote better outcomes for Australian households and businesses though enhanced energy security, more efficient and competitive markets and service delivery, improved productivity, timely and safe development of our energy resources and a cleaner energy base. More specific actions under each priority are discussed in subsequent chapters.

1.3.5 The need for ongoing review

Regular review and assessment of Australia's energy policy and energy security settings is needed to ensure that our energy security is maintained, particularly during this period of significant transformation and investment (IEA 2012a). Periodic reviews should be regular, but not so frequent as to cause market uncertainty or instability.

In the past, the Australian Government has reviewed and updated national energy policy through ad hoc White Paper or other processes. Those reviews have been relatively infrequent, leading to a build-up of policy pressures over time and resulting in a need for greater clarity in overall policy objectives and direction.

The government will therefore conduct a regular four-year cycle of strategic policy review, starting in 2016. The reviews will take into account changes in markets, progress in the commercialisation of important 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.

The reviews will formally align with the National Energy Security Assessments (see Chapter 4: *Energy security*). They will also take into account and inform other relevant policy processes and reviews across government, in particular where other policy areas (for example, climate policy) intersect closely with energy policy.

The reviews will also assess progress against key energy and related policy goals (as outlined in this White Paper), evaluate the resilience and preparedness of our energy security framework, and re-examine national energy policy settings in the light of current and expected global and national energy developments. Future reviews will be undertaken in consultation with the states and territories, industry and the public.

1.4 Shaping the Energy White Paper

1.4.1 Timeframe

The Energy White Paper defines a policy agenda for the next four years. However, the directions and priorities we set in this period must take into account our long-term policy goals, expected trends and any challenges that will emerge over the next two decades and, in some cases, beyond.

Many investments in the energy sector have lengthy operating lives and long-term policy implications, and transformation driven by incremental investment decisions takes time to flow through the sector. Just as we have largely 'locked in' our energy base to 2020 through decisions in past decades, the decisions we make in this decade will shape our energy future in the years beyond. In this sense, we are rapidly approaching a 2035 planning horizon.

However, while the Energy White Paper generally focuses on the period to 2035 in its outlook, it also recognises that the focus in different areas may vary and may be context-dependent. For example, some aspects of energy market reform have a more immediate horizon than others, while technology development may extend over many decades.

1.4.2 Relationship to other government policies

The Energy White Paper builds on existing key government policies, such as the Clean Energy Future Plan and the new resource rent taxation arrangements. In this sense, it does not revisit well-established Australian Government positions on issues such as climate change, water policy, fiscal settings or broader environmental management.

However, it recognises that those and other policy areas intersect closely with energy policy, and that it is important to be clear about the nature of the interrelationships and ensure that they are delivering mutually supporting outcomes as efficiently as possible.

1.4.3 Energy policy in the federal context

The Energy White Paper recognises the complexities imposed by various shared and separate responsibilities for energy-related functions across the different levels of government in Australia.

Australia's energy governance arrangements are defined through a mix of constitutionally defined responsibilities, intergovernmental agreements and market governance agreements. Australia is also a party to a number of international agreements with implications for energy policy.

At the national level, the Council of Australian Governments (COAG) and its predecessors have been the main drivers of change in energy policy, particularly for interconnected markets in the east.[3]

The COAG Standing Council on Energy and Resources, established in September 2011, has general responsibility for Australia's energy markets under the Australian Energy Market Agreement and associated laws. The standing council also performs a range of functions in the development of the nation's mineral and energy resources.[4]

These arrangements mean that much of energy policy, particularly in relation to our national energy markets, is developed and implemented through cooperative action between the Australian and state and territory governments.

For this reason, the positions framed in the Energy White Paper may not always translate into policy in shared decision-making environments. Nonetheless, the White Paper will shape the fundamental direction of energy outcomes sought by the Australian Government.

1.4.4 Structure of the White Paper

The 2012 Energy White Paper is structured in three parts, each with multiple chapters:

Part I: *Australia's energy in context* sets out the Australian Government's high-level energy policy framework (Chapter 1), gives a snapshot view of the energy sector (Chapter 2), and outlines a vision for the future along with the key challenges for energy policy over the next decade (Chapter 3).

Part II: *Core elements of Australia's energy policy* examines the government's energy frameworks, key policy challenges and priorities for energy security (Chapter 4); energy resource development (Chapter 5); the clean energy transformation (Chapter 6); our liquid fuel, gas and electricity markets (chapters 7 to 10); and improving energy productivity (Chapter 11).

Part III: *Supporting energy policy outcomes* describes key supporting policy frameworks that contribute to the achievement of energy policy objectives, including sustainability, skills and workforce development, and promoting Indigenous outcomes (Chapter 12); Australia's international engagement on energy (Chapter 13); and improving our energy information (Chapter 14).

A supporting appendix is available online at the Energy White Paper website.[5]

3 COAG comprises the Prime Minister, state premiers, territory chief ministers and the president of the Australian Local Government Association.

4 More detail on the intergovernmental and market arrangements for energy and energy resources is in Chapter 2: *Energy in Australia* and in the policy chapters in Part II.

5 www.ret.gov.au/energywhitepaper.

2 Energy in Australia

Highlights

- Australia has abundant and diverse renewable and non-renewable energy resources.
- Our reserves of thermal coal and uranium can sustain current production levels beyond 2100. Demonstrated gas reserves are estimated to sustain current production levels for around 54 years, and there is good potential for further discoveries of new gas resources, particularly coal-seam gas and shale gas.
- In 2011 Australia was one of only three OECD net energy exporting countries. Exports accounted for around 80% of Australia's total energy production (in energy content terms) in 2010–11.
- The Australian energy industry is a significant contributor to the national economy, providing over $68 billion of gross value added and more than 100 000 jobs. Indirectly, it supports many more.
- Fossil fuels accounted for around 96% of Australia's primary energy consumption and 90% of electricity generation in 2010–11.
- While renewable energy is a relatively small part of our overall energy mix, it is experiencing high rates of growth and is expected to play a much more significant role across the economy into the future.

Australia has a mature, well-functioning energy system comprising a set of interlinked energy, carbon and financial markets. This is supported by extensive energy networks and supply infrastructure as well as diverse and robust supply chains that reliably deliver energy to our homes and businesses. Our abundant energy resources can provide secure supply into domestic and international markets for many decades to come.

Energy is a major contributor to our national economy through the employment and wealth creation it generates, as well as through its vital role in underpinning all facets of social and economic activity.

Increasingly, energy policy and the delivery of energy services are a shared responsibility governed through a complex set of frameworks across the different levels of the government. The Council of Australian Governments, acting through state and territory premiers and chief ministers and through its ministerial councils, plays a critical role in energy market oversight and development.

2.1 Overview

Australia's energy sector includes electricity generation (fossil fuel based and renewable), coal mining, gas and oil extraction, liquid fuel refining and distribution, gas supply and energy services.

The sector employed more than 100 000 people in 2009–10 and contributed $68.2 billion of gross value added to the economy. Many of these jobs are in regional Australia, making the sector critical for the sustainability of regional areas.

In 2010–11, Australian energy exports reached $69 billion or around one-third of total commodity exports (BREE 2011a:12). Coal is Australia's largest energy export earner, followed by crude oil and liquefied natural gas (LNG).

Table 2.1 shows the contribution of Australia's energy sector to the economy.

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

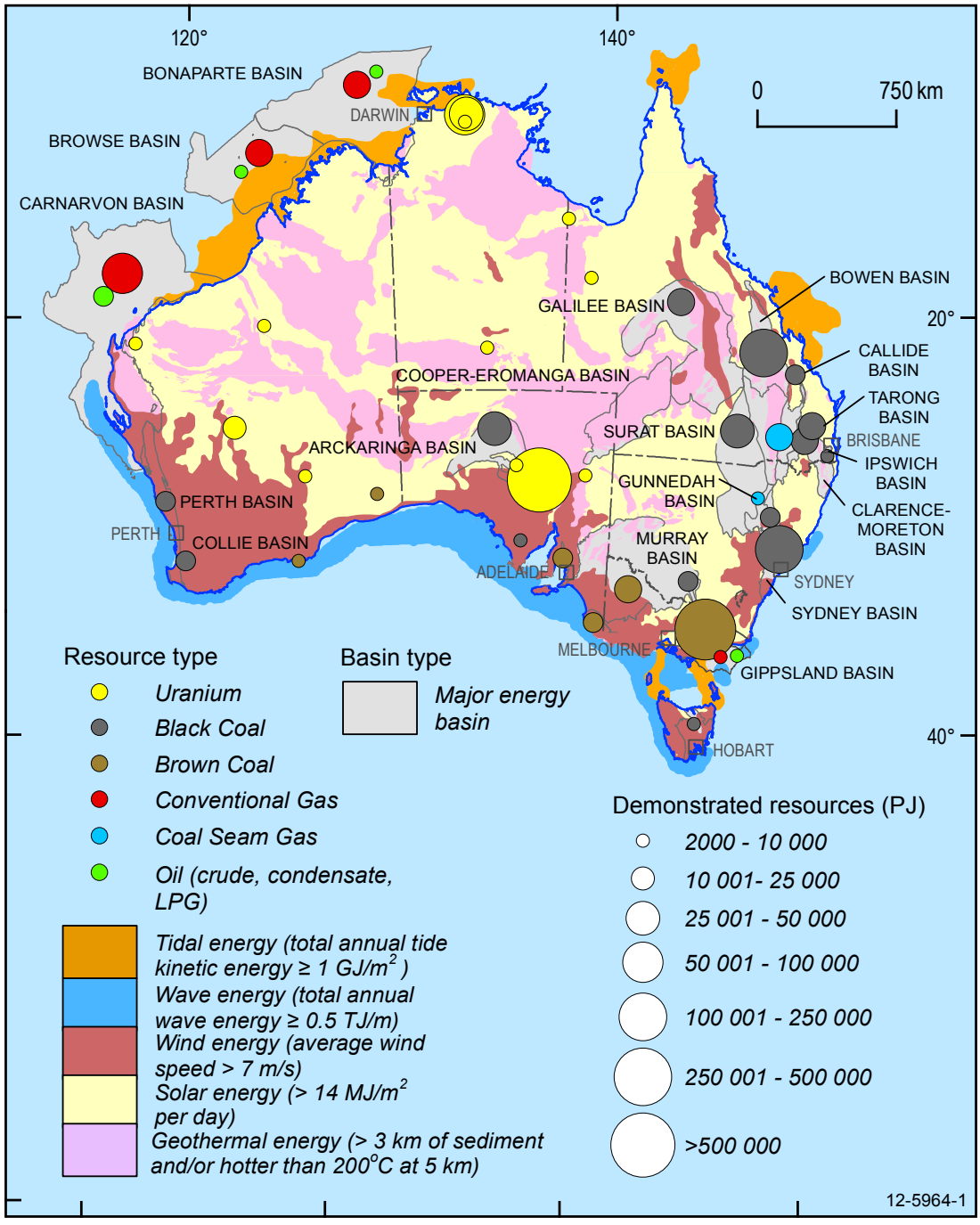
	Gross value added ($b)	Employment '000
Coal mining	27.0	38
Oil and gas extraction	27.0	15
Petroleum and coal product manufacturing	1.8	6
Electricity supply	22.5	51
Gas supply	1.1	2
Total—energy-related industries	79.3	112
Total—Australia economy-wide	1 320.1	11 354.5

Source: ABS (2011a, b).

2.2 Energy resources

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

Figure 2.1: Australia's major energy resources, excluding hydro and bioenergy, 2012



Source: GA–ABARE (2010:3), updated for BREE (2012a).

2.2.1 Non-renewables

In 2010, our economic demonstrated resources of thermal coal and uranium were estimated to last well into the next century, and our natural gas for over half a century (Table 2.2).

Our largest high-quality reserves of thermal black coal are in New South Wales and Queensland. Victoria holds the largest commercial brown coal resources. Australia's brown coal is currently used domestically for power generation, as its high moisture content makes it unsuitable for export. Work is underway to develop alternative uses for this vast resource (see Chapter 5: *Energy resources*).

Australia's identified conventional gas resources have increased threefold over the past 20 years. In addition to known coal-seam gas reserves, Geoscience Australia estimated in 2011 that there may be about 258 900 petajoules (PJ) of additional coal-seam gas, 435 600 PJ of shale gas and 22 000 PJ of tight gas, although the extent to which those resources are economically recoverable is untested. Flows from Australia's first shale well in the Cooper Basin in August 2012 was a milestone on the path towards commercial production of Australia's shale gas resources. Most of the coal-seam gas is in the black coal deposits of Queensland and New South Wales.

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

Our crude oil reserves are relatively limited and in long-term decline in the absence of further discoveries. Our largest petroleum-producing basins are the Carnarvon Basin in the north-west and the Gippsland Basin in Bass Strait.

Australia's carbon capture and storage potential is estimated to be around 417 gigatonnes, equivalent to 2000 years storage (RET 2009).

Table 2.2: Australia's economic demonstrated energy resources, 2009 and 2010

	Australia (petajoules)	Share of world (%)	Reserves to production (years)
Coal[a]			
Black coal	1 255 470	10.3	128
Brown coal (lignite)	384 689	8.6	517
Petroleum			
Oil	5 685	0.2[b]	9
Condensate	12 413	n.a.	38
Liquefied petroleum gas	4 063	n.a.	38
Gas			
Conventional gas	113 373	1.6	66
Coal-seam gas	35 055	n.a.	175
Uranium[c]	648 480	33.0	134

n.a. = not available.

a Recoverable resources at 31 December 2010.

b Crude oil, condensate and liquefied petroleum gas combined.

c Reasonably assured resources recoverable at costs of less than US$80/kg U.

Source: BREE (2012a).

2.2.2 Renewables

Australia has some of the best wind resources in the world. Most wind farms are on high-quality sites in South Australia and Victoria. At the end of 2010, Australia had 2175 MW of installed wind generation capacity.

Solar power is a vast potential source of energy. The solar radiation falling on Australia each year is around 58 million PJ, which is about 10 000 times the nation's annual energy consumption (GA–ABARE 2010:268).

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

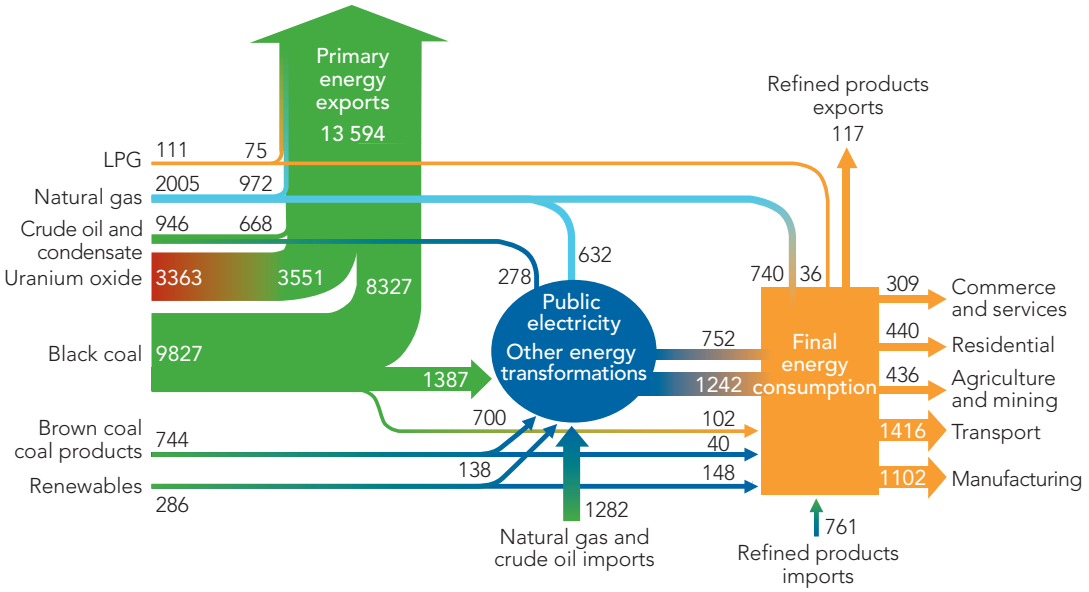
Hydropower generation is mainly in New South Wales, Tasmania, Queensland and Victoria. The expansion of hydro has been limited by the availability of suitable sites and some environmental concerns.

We also have significant potential geothermal, ocean energy (tidal and wave) and biofuel resources.

2.2.3 Energy flows in the economy

Figure 2.2 shows the principal energy flows in Australia in 2009–10. It demonstrates the significance of Australia's energy exports and shows the breakdown of consumption in the domestic economy. These flows will change in coming years as exports expand and the composition of electricity generation changes.

Figure 2.2 : Australia's energy flows, 2009–10 (PJ)

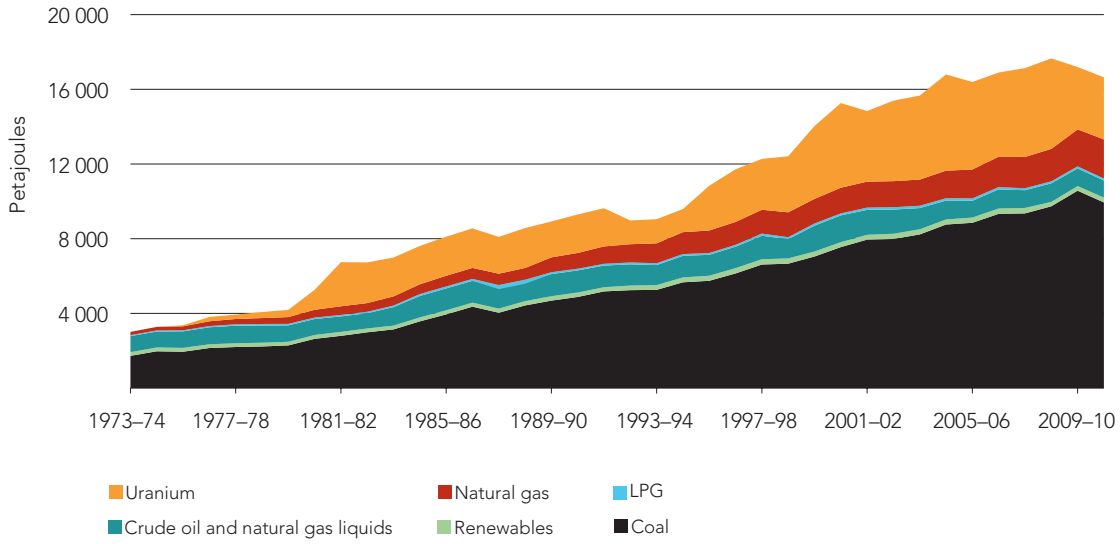


Source: ABARES (2011a).

2.2.4 Production

Australia is the world's ninth-largest energy producer, accounting for around 2.5% of the world's energy production (BREE 2012a). Energy production has grown strongly over the past decade (Figure 2.3), and most of it is now exported. In 2010–11, coal dominated energy production (about 60%), followed by uranium (20%), gas (13%), liquid fuels and renewables.

Figure 2.3: Australian energy production, 1973–74 to 2010–11



Source: BREE (2012a).

2.2.5 Exports and imports

In 2010–11, the value of Australian energy exports was around $69 billion (BREE 2011a:133). Table 2.3 shows export volumes, values and rankings in that year.

Table 2.3: Australia's energy exports 2010 and 2011

	Unit	Exports[a]	Value ($m)[a]	Proportion of world trade (%)	International ranking
Thermal coal	Mt	133	31 106	18[b]	2
Metallurgical coal	Mt	148	15 561	49[a]	1
Crude oil[c]	ML	18 054	12 272	<1[d]	28[e]
Refinery products	ML	797	602	n.a.	n.a.
Liquefied petroleum gas	ML	2 164	962	n.a.	n.a.
Liquefied natural gas[f]	Mt	19	11 084	8[g]	5[g]
Uranium (U_3O_8)	t	7 017	705	n.a.	n.a.

n.a. = not available.

a BREE (2012b).

b BREE (2010b, 2012a:61)

c Includes condensate and other refinery feedstock.

d Calculated from BP (2012a).

e IEA (2010a: Oil trade data).

f BREE estimate.

g Calculated from BP (2012b, using LNG exports only, excluding pipeline gas).

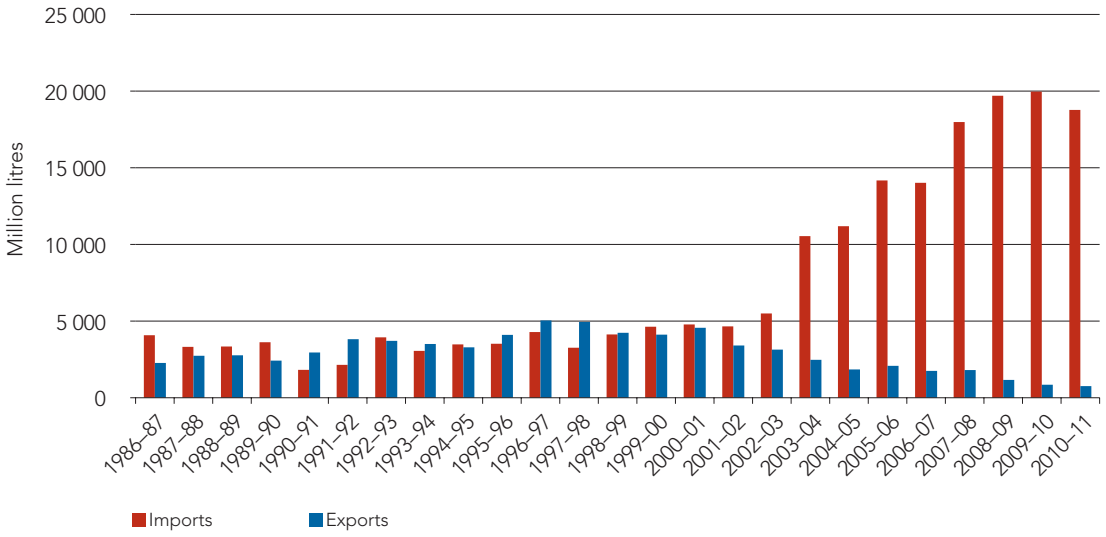
We are a net importer of crude oil and petroleum products, and our reliance on petroleum imports is increasing. Over the past decade, our domestic refining capacity declined while domestic consumption increased (Figure 2.4).

In 2010–11, Australia exported 2471 ML of liquefied petroleum gas (oil production in Australia's north-west is closer to Asian refineries than to domestic refineries on our east coast).

Australia has 11 major deepwater ports with facilities to export petroleum products. Our 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 nine major coal-exporting terminals had a combined capacity of almost 400 million tonnes and loaded nearly 290 million tonnes of coal in 2010-11. Further planned investment in coal, rail and port infrastructure in the next decade will support growth in this vital export industry.

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



Source: BREE (2011b:110).

2.2.6 Consumption

Australia is the world's 20th-largest primary energy consumer (15th on a per person basis). Energy consumption growth has slowed over the past 50 years, from an average of 5% a year in the 1960s to 1.8% a year since 2000. This is due to improved energy efficiency and more rapid growth of less energy-intensive sectors, such as the commercial and services sectors (BREE 2012a).

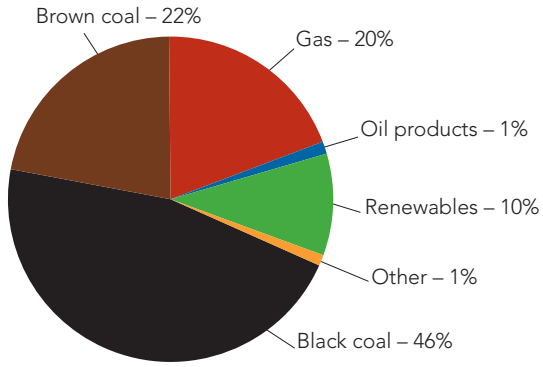
The transport sector is the largest end user of energy in Australia, consuming over a third of final energy, followed by the manufacturing and construction sectors, and then the residential, mining and commercial sectors.

2.2.7 Supply

In 2010–11, black and brown coal constituted 35% of Australia's primary energy supply. Since 1960–61, our coal consumption has increased by an average of 5% each year.

Oil makes up 36% of primary energy supply, although its share has been declining from a high of almost 50% in the late 1970s. Domestic consumption of oil, particularly for transport, continues to grow, but generally at rates below those experienced before the 1980s.

Figure 2.5: Electricity production, by fuel, 2010–11



Source: BREE (2012c).

Gas contributed 25% of total primary energy supply in 2010–11, growing strongly in the past five years at an annual average rate of 5.6%. Manufacturers and electricity generators are the largest consumers of domestic gas. The largest industrial users include smelting and refining, the chemical industry and the cement industry. The strong share of the mining sector is dominated by the use of natural gas in the production of LNG.

Renewable energy accounted for 4% of our primary energy supply in 2010–11. Around half of Australia's renewable energy is used to generate electricity. The other half is used for thermal and water heating in industrial and domestic applications.

In 2010–11 power generation from coal provided around 68% of Australia's electricity needs, but the use of gas and renewables is growing and coal is projected to decrease in market share over the coming decades (Figure 2.5).

2.2.8 Energy markets

Australia has a series of well-established liquid fuel, gas and electricity markets. They have different structures and coverage, largely reflecting geographical and jurisdictional arrangements. Australia's National Electricity Market and the east coast gas market form interconnected trading systems between the east coast states and the Australian Capital Territory.

These markets are described further in Chapter 7: *Energy markets: overview* and in chapters 8, 9 and 10 (liquid fuel, gas and electricity).

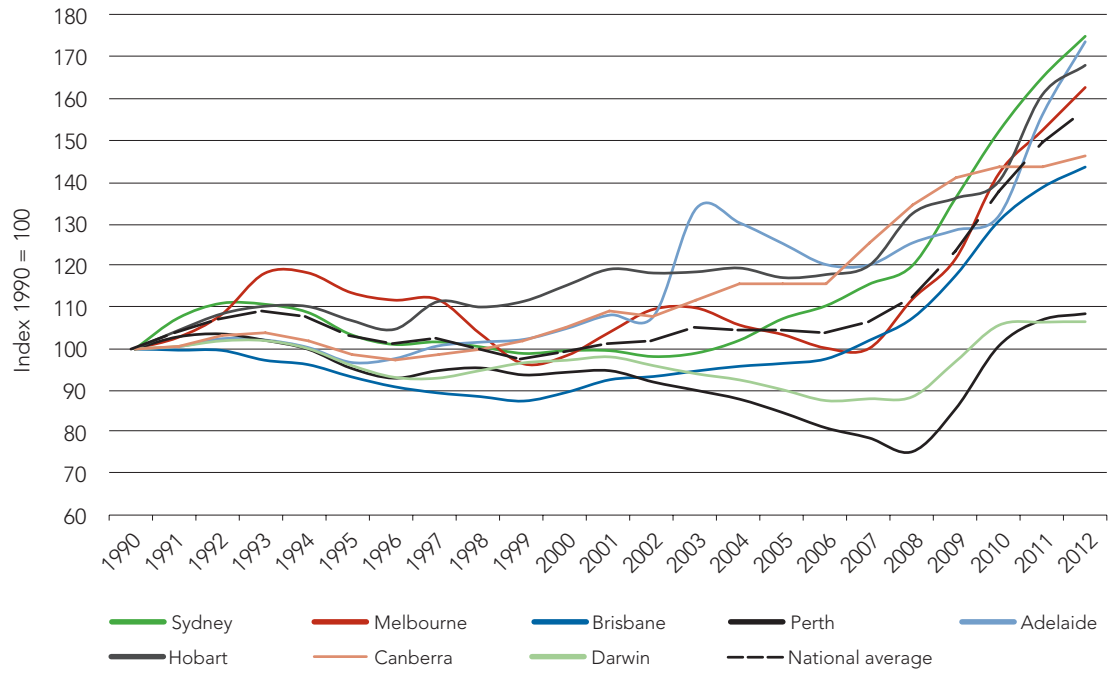
2.2.9 Prices

After a period of relatively stable retail electricity and gas prices throughout the 1990s and into the first decade of the new century, significant retail price increases occurred from 2007 onwards (Figure 2.6). The increases have been driven primarily by increased network (mainly distribution) costs, as well as a range of government measures to promote clean energy and energy efficiency (AEMC 2011a).

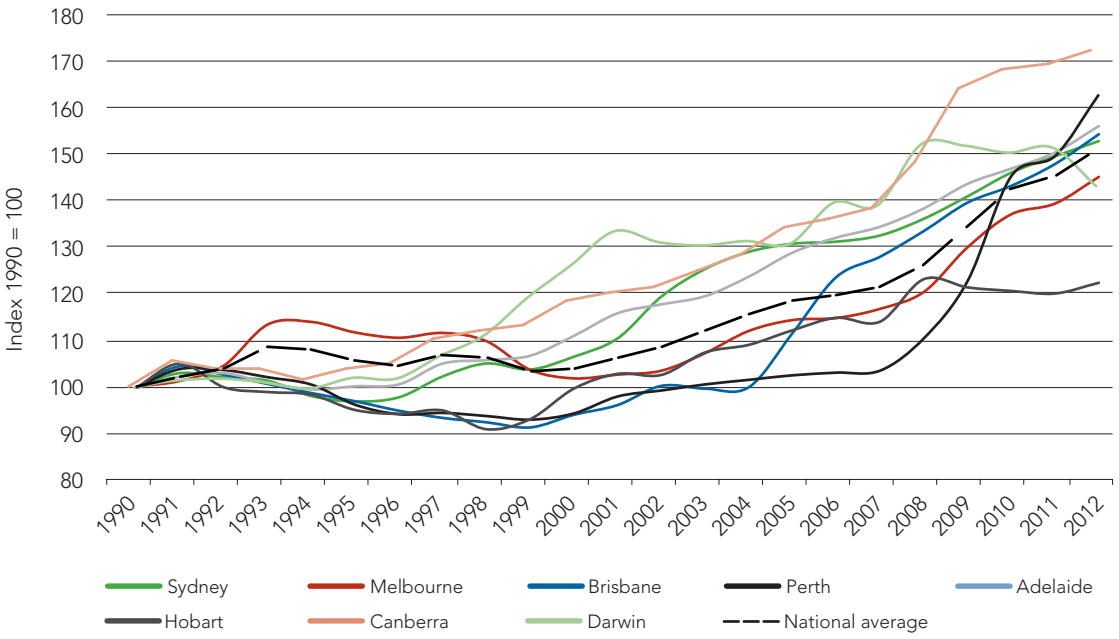
Overall, retail petrol prices have increased only marginally above 2007 levels, largely because of the moderating effects of a strong Australian dollar.

Figure 2.6: Electricity and gas retail price index (inflation adjusted), Australian capital cities, 1991 to 2012

Electricity



Gas

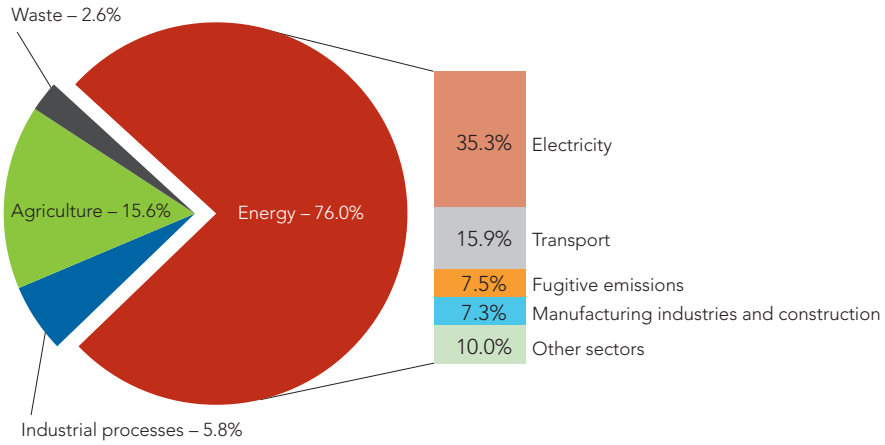


Source: ABS, *Consumer Price Index* (various years).

2.2.10 Greenhouse gas emissions

The energy sector accounts for around three-quarters of Australia's greenhouse gas emissions (Figure 2.7). Electricity generation is the single largest contributor, producing 38% of total emissions. This reflects Australia's high reliance on fossil fuels for electricity generation.

Figure 2.7: Australia's greenhouse gas emissions profile (excluding land-use change)



Source: DCCEE (2011).

2.3 Energy governance

Australia's energy governance arrangements are a mix of constitutionally defined responsibilities, intergovernmental agreements and market governance agreements. Australia is also a party to a number of international agreements with implications for energy policy.

2.3.1 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. The Australian Government is responsible for resources beyond three nautical miles, which are administered under Commonwealth–state arrangements.

2.3.2 Intergovernmental arrangements

At the national level, COAG and its predecessors have been the main drivers of change in energy policy, particularly for interconnected markets in the east. COAG established the Ministerial Council on Energy in 2001 to deliver economic and environmental benefits for Australia from the implementation of the COAG national energy policy framework.

The COAG Standing Council on Energy and Resources, established in September 2011, has replaced the former COAG Ministerial Council on Energy and Ministerial Council on Mineral and Petroleum Resources. The standing council is responsible for ensuring the development of the nation's mineral and energy resources and markets to optimise long-term benefits to the community.

The COAG Select Council on Climate Change was established in January 2012 to support an effective response to climate change policy issues with national implications, and to provide a forum for the Australian Government to engage with states, territories, local government and New Zealand on program implementation issues. The select council is responsible for overseeing the National Partnership Agreement on Energy Efficiency (which includes the National Strategy on Energy Efficiency and the former National Framework on Energy Efficiency) and for implementing joint measures related to energy use.

Regulatory arrangements for Australia's energy resources are described in Chapter 5: *Energy resources*.

2.3.3 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 in 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. The Australian Energy Regulator will have an increasing role in regulating aspects of retail electricity markets under the National Energy Customer Framework.

The Australian Consumer and Competition Commission is an independent statutory authority. Its primary responsibility is to ensure that individuals and businesses comply with the competition, fair trading and consumer protection laws. The commission is also responsible for monitoring the prices, costs and profits of unleaded petroleum products. In addition to monitoring petrol prices, it reviews diesel and automotive liquefied petroleum gas prices.

The liquid fuel market in Australia differs significantly from the more defined electricity and gas markets established under shared Commonwealth–state legislation. It is regulated through various intersecting frameworks at the Commonwealth, state and territory levels.

See chapters 7 to 10 for more detail on Australia's energy market arrangements.

2.3.4 International agreements

Australia is an active member of a number of international energy-related organisations. Those with treaty-level obligations include the International Energy Agency, the International Renewable Energy Agency and the United Nations Framework Convention on Climate Change. Australia's engagement in the international energy policy space is discussed in greater detail in Chapter 13: *International energy engagement*.

3 Future energy trends and challenges

Highlights

- Energy markets and systems around the world are entering a period of fundamental change. Energy security remains a key concern for many countries, as does responding to climate change. Together, those concerns will drive innovation and technological advancement and shape the future direction of markets.
- Global and national demand for energy will continue to grow, although rising prices and policies to reduce greenhouse gas emissions and encourage energy efficiency are expected to moderate the rate of growth.
- Fossil fuels are projected to underpin our energy security for several decades. However, Australia's energy base will become increasingly diverse with strong growth in clean energy technologies. By 2035 renewable energy could provide as much as 40% of our electricity needs. Changes can also be expected in transport fuels and engine technologies. Rising energy prices will sharpen the focus on demand management and on the efficiency of market and policy settings.
- Key strategic policy and market challenges for Australia over the next decade include:
  - continuing to attract sustained investment in Australia's energy system in order to maintain secure and reliable energy supply and services for consumers
  - successfully developing, adapting and deploying new technologies to support clean energy objectives and to provide more options in managing energy use and costs
  - managing ongoing change and risk, including changing market dynamics introduced by new technologies, carbon pricing and growing links between national and international markets, as well as unforeseen shocks or natural events.
  - minimising energy prices and related cost-of-living pressures through more efficient markets, policy and regulatory frameworks and greater energy productivity.

Energy systems will evolve further over coming decades in response to a growing demand for energy, the emergence of new technologies, changing energy and climate policy frameworks and the interaction of broader socioeconomic forces.

There is a very positive outlook for our energy future, although transforming to a clean energy economy and minimising energy price pressures remain threshold issues.

However, our long-term energy path is by no mean 'locked in' and cannot be guaranteed by simply mandating predetermined outcomes, which would almost certainly position Australia inflexibly in rapidly changing world. Successful energy policies will build on the inherent strength and efficiency of markets by providing clear and stable guidance, as well as effective and efficient regulation supported by well-targeted measures that address areas of identified market failure. This will provide Australia with a platform capable of rapid and efficient adjustment while meeting our energy goals at an affordable cost.

3.1 Overview

Many factors will shape Australia's energy future, including an expanding demand for energy from changing demographic and socioeconomic patterns, evolving consumer needs and choices, and how we respond to the threat of dangerous climate change.

In particular, our growing integration with global energy and carbon markets as we move into the Asian century will heavily influence our development, including through expanding export opportunities and through two-way flows of technology, know-how and skills.

This chapter summarises important global and national energy trends, sets out potential development paths and describes the overarching challenges that must be overcome to realise our energy goals. More specific policy issues are discussed in subsequent chapters.

The chapter presents a generally positive picture of how global and Australian energy sectors may develop from now through to 2035, and in some instances beyond, but this is only one of many possible futures. Because of the long lives of energy assets and infrastructure, the policy choices we make today will have consequences that last for many decades.

3.2 Global energy trends

The global energy system will change in fundamental ways over coming decades. New fuels and technologies will progressively capture market share and diversify the world's energy supply. A growing and more affluent population will demand more reliable access to energy and better environmental protection, particularly reduced greenhouse gas emissions and improved air quality.

Many current challenges will persist, including entrenched global energy poverty and concerns about long-term energy security. These will continue to be key drivers in national energy policies and development decisions.

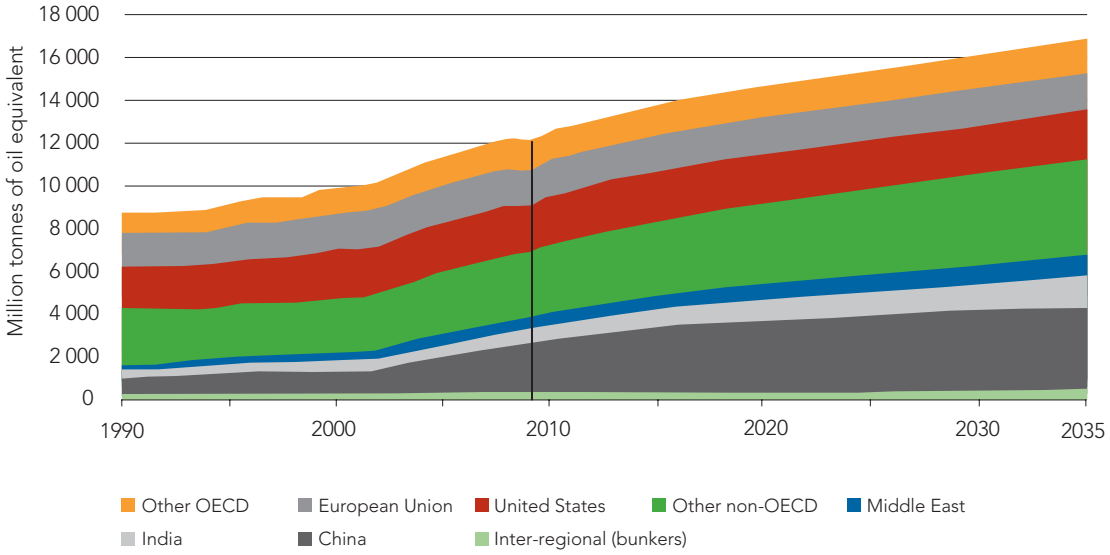
3.2.1 Global energy demand

The *World energy outlook 2011*, published by the International Energy Agency (IEA), modelled three scenarios based on the IEA's assessments of key parameters affecting global energy development from now to 2035 (IEA 2011a). The scenarios were the maintenance of current climate and energy policies; the successful implementation of current and announced climate and energy policy commitments (the 'new policy' scenario); and the adoption of an energy pathway consistent with keeping global warming to under 2°C (the '450 ppm' scenario).

Under all three IEA scenarios, world primary energy demand increases, although the strength of the global response to climate change will largely determine the rate of growth, particularly after 2020. In the absence of further greenhouse gas reduction measures, energy demand is projected to grow at 1.6% a year, compared to 0.8% under the 450 ppm scenario. In large part, the difference reflects the extent of energy efficiency measures implemented in each scenario (IEA 2011a:70).

However, growth in global energy demand will not be evenly distributed, reflecting broader shifts in world economic and social balances. Under the new policies scenario, non-OECD countries account for around 90% of growth in primary energy demand to 2035. China accounts for more than 30% and India about 16%. In contrast, aggregate growth across the OECD is expected to be around 8% from 2009 to 2035 (Figure 3.1).

Figure 3.1: World primary energy demand in the new policies scenario, by region, 1990 to 2035 (Mtoe)



Source: IEA (2011a:80).

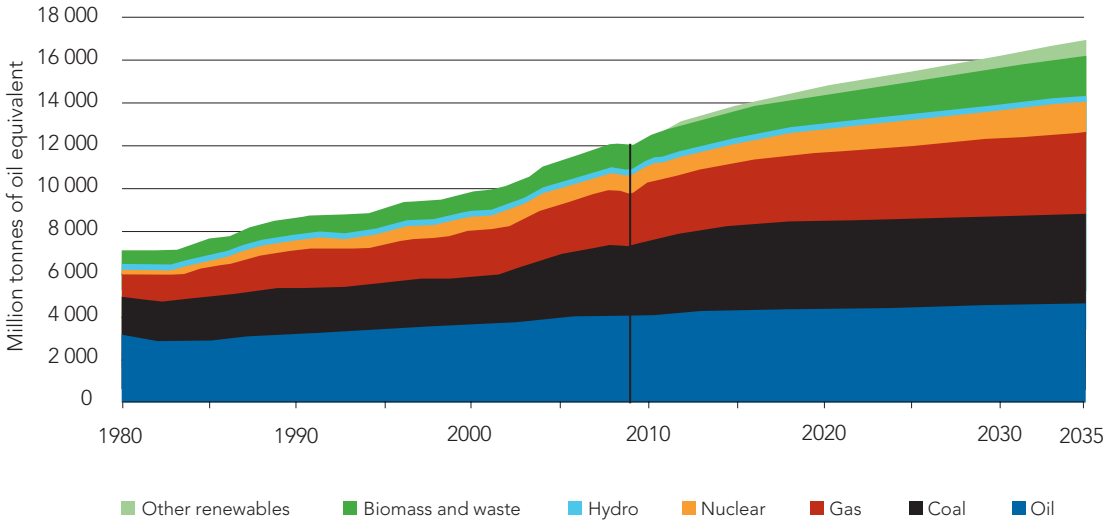
3.2.2 Fuel and technology patterns

Changing global fuel and technology patterns will have important implications for demand for Australia's main energy exports and the speed (and cost) at which new technologies are commercialised through mass deployment.

Under the new policies scenario, the use of all fuel types expands but fossil fuels still account for more than half of the overall increase (Figure 3.2). Renewable energy expands its share of total primary energy demand, from 13% in 2009 to 18% in 2035 (IEA 2011a:79). The share of electricity generation from renewable energy grows from 19% to around 31% (IEA 2011a:175).

The Fukushima tragedy in Japan in 2011 is not expected to significantly affect the growth of nuclear generation in the medium to long term. Planned reactor decommissioning in Europe and Japan will be offset by expansion in China, South Korea and other developing countries (IEA 2011a:79).

Figure 3.2: World primary energy demand in the new policies scenario (Mtoe)



Source: IEA (2011a:76).

The IEA forecasts that global oil production will continue to grow as conventional supplies are increasingly complemented by unconventional sources to meet demand. Physical production limits (so-called 'peak oil') are unlikely to be reached before 2035.

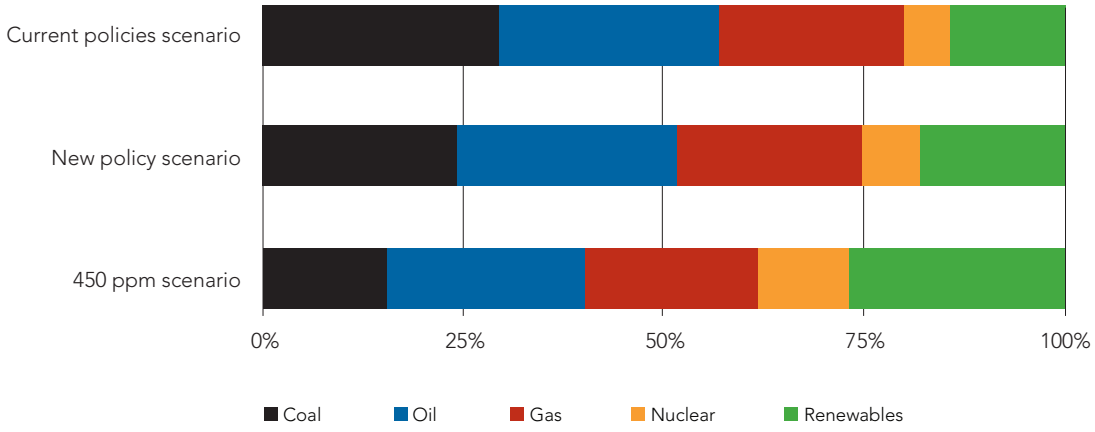
However, rising oil prices and demand-changing policies and technologies could produce a demand-induced peak in production after 2020, depending on the strength of global climate change action. Should high oil prices be sustained, substantial unconventional oil reserves, such as Canadian tar sands, are expected to enter the market, sustaining global reserves for many decades.

While oil will remain the main energy source for the transport sector to 2035, there will be increasing take-up of alternative transport fuels (Treasury 2011:62). There is also likely to be increasing electrification of transport and adoption of energy-efficient technologies (IEA 2011a).

The IEA predicts that global gas demand will grow by 55% to 2035 (IEA 2011a:156), possibly equalling demand for coal. New drilling and extraction technologies are unlocking enormous new coal-seam, shale and tight gas resources that are transforming gas (and oil) markets in regions such as North America, which may become largely energy self-sufficient over the next decade (BP 2012b). This may have important implications for global energy trade.

These trends are shown to accelerate dramatically in the 450 ppm scenario, as global use of fossil fuels (mainly coal) declines markedly while renewables and nuclear energy grow (Figure 3.3). In particular, coal use is projected to decline from 27% of the global mix to around 16% (IEA 2011a:71).

Figure 3.3: Shares of energy sources in world primary demand, by scenario, 2035



Source: IEA (2011a:72).

3.2.3 Achieving global climate goals

According to the IEA, securing 450 ppm or even 550 ppm global emissions outcome will require integrated energy and climate policy frameworks at the national level to reduce carbon emissions, improve energy efficiency and drive the development and deployment of new clean energy technologies (IEA 2012b).

The *World energy outlook 2011* analysis (IEA 2011a) also found that:

- about 80% of the world's allowable carbon dioxide emissions under the 450 ppm scenario is already locked in because of existing infrastructure
- for every $1.00 of investment in the power sector avoided before 2020, an additional $4.30 would need to be spent after 2020 to compensate for future emissions
- solutions must be found from a portfolio of technologies and fuels, and the world cannot afford to limit its options
- a 10-year delay in the development of carbon capture and storage could increase the cost of achieving the 450 ppm goal by 8% to 2035

- a major reduction in the use of nuclear energy would make achieving that goal extremely challenging and impose similar costs.

3.3 Australia's long-term energy future

The Australian energy sector has entered a period of major transformation. The introduction of carbon pricing and the possibilities of new technology development will drive fundamental long-term changes in how we generate and use energy. Our domestic energy needs will expand at the same time, although more slowly than in the past, creating economic opportunities as well as challenges.

The scale and nature of change in Australia's energy systems will be affected by such factors as population and development patterns; structural changes in the economy; carbon and energy prices; technology development costs; consumer choices; varying opportunities across regions; and, importantly, Australian, state and territory government policies.

3.3.1 Economic and demographic trends

Australia will expand and prosper over coming decades. By 2050, our population is projected to increase by 62% to around 36 million (Treasury 2011). Much of the growth will be in capital and major regional cities (DSEWPaC 2011a). In real terms, national GDP is projected to grow by an average of 2.6% a year and average gross national income per person is projected to rise by 56% or $30 000 in real terms by 2050 (Treasury 2011).

This will increase overall energy consumption and change patterns of demand. For example, a growing population is likely to require a sharp increase in the housing stock, while increased urbanisation will see more use of different forms of mass transit.

Sustained industrialisation and urbanisation in Asia are likely to support Australia's resources boom for many years, adding wealth to our economy. The Australian economy will become more closely integrated into global and regional trading systems and will continue to restructure around its competitive strengths. In particular, resource-based industries and the services sector are forecast to grow strongly in the next decade (BREE 2012c).

While higher energy prices and high terms of trade will place pressure on a range of end-use industries over the short to medium term, productivity-enhancing reforms, including further investment in our human and physical capital, can maintain or improve our competitiveness.

3.3.2 Australia's climate change response

Australia's commitment to reducing greenhouse gas emissions will be a major factor shaping our energy sector over the next 30 to 40 years.

The Australian Government has set a 2020 goal of reducing greenhouse gas emissions by 5% from 2000 levels irrespective of actions by other countries, and by up to 15% or 25% under strict conditions relating to the extent of international action. As part of its plan to secure a clean energy future, the government has adopted a long-term target to reduce greenhouse gas emissions by 80% compared with 2000 levels by 2050.

These goals will be reached through the measures implemented under the government's Clean Energy Future Plan. In particular, fundamental long-term changes will be driven by carbon pricing and complementary mechanisms, such as the Renewable Energy Target, the Australian Renewable Energy Agency and the Clean Energy Finance Corporation. Treasury modelling suggests that by 2035 energy-related actions could provide around 85% of Australia's domestic abatement, increasing to around 89% by 2050.[1] This reflects deepening change over time in Australia's energy sector (Treasury 2011).

1 Energy-related emissions are defined here as those from electricity generation, stationary energy and transport, plus fugitive emissions from mines and landfill.

An effective global carbon market will reduce global and Australian abatement costs by ensuring that the cheapest abatement opportunities are pursued first, regardless of where in the world they occur. The linking arrangement between Australia and Europe enables Australian businesses to buy European allowances to use in the Australian scheme from 1 July 2015. This will be expanded to allow full, two-way linking between Australia and Europe from 1 July 2018. The arrangement demonstrates the cumulative effort that emissions trading schemes can make in lowering global emissions and addressing the challenge of climate change.

3.3.3 Energy trends

In addition to the imperatives to reduce greenhouse gas emissions and develop clean energy systems, three key intersecting policy drivers will also shape Australia's energy future:

- the need to deliver secure and reliable energy and energy services to a growing population and economy
- the ongoing expansion of our energy exports to Asia and other growth markets
- the need to minimise energy cost pressures as we reinvest in energy infrastructure, particularly our ageing electricity assets and networks.

These factors will require a change in the way we think about and use energy. We will need to take a more integrated approach that recognises the mutually supportive roles played by different energy sources in a more diverse and competitive marketplace. The market will also integrate supply and demand considerations into its decision-making more efficiently, and energy providers and service companies will offer more innovative and cost-effective products for consumers to manage energy use.

Through time, our energy markets will become more closely linked, particularly the electricity and gas markets. This will ultimately improve energy security and price outcomes by providing for greater substitution between fuels or energy sources according to real-time supply and demand balances.

Increased competition and innovation will also generate better outcomes for consumers, particularly as technology becomes more efficient, widespread and cheaper in real terms. Far-reaching advances in information and computing technologies will provide greater interconnectivity and change the way we use and manage energy in our homes and businesses.

3.3.4 Fuel production

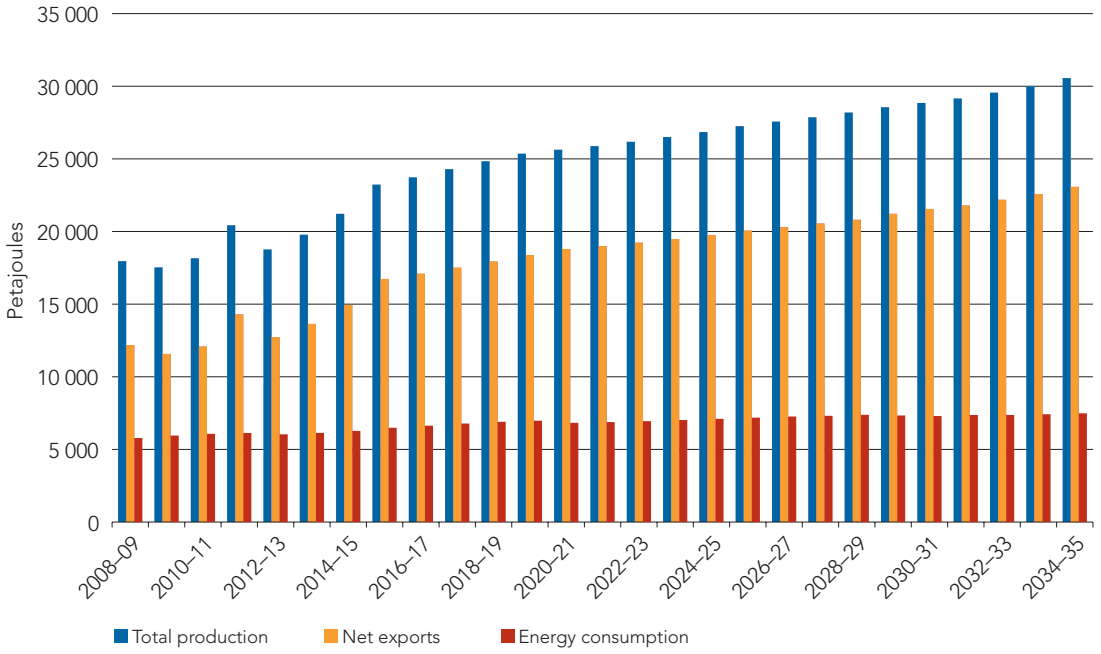
Australia's abundant energy resources, reliability as a supplier and proximity to growing economies mean we are well placed as a major global supplier of coal, liquefied natural gas (LNG) and uranium. Rising living standards across the region are also likely to prompt higher environmental standards, which may provide Australia with innovation opportunities in clean energy products.

The Bureau of Resources and Energy Economics (BREE) forecasts an acceleration in the production of energy resources over the two decades to around 30 500 PJ in 2034–35, about three-quarters of which will be exported. In contrast, domestic energy consumption is projected to grow only modestly over the period (Figure 3.4).

Based on current projects, Australia's exports of uranium are expected to decline. However, given Australia's large uranium reserves and a number of projects in the planning stages, there is good potential for uranium production and export to expand over the next two decades.

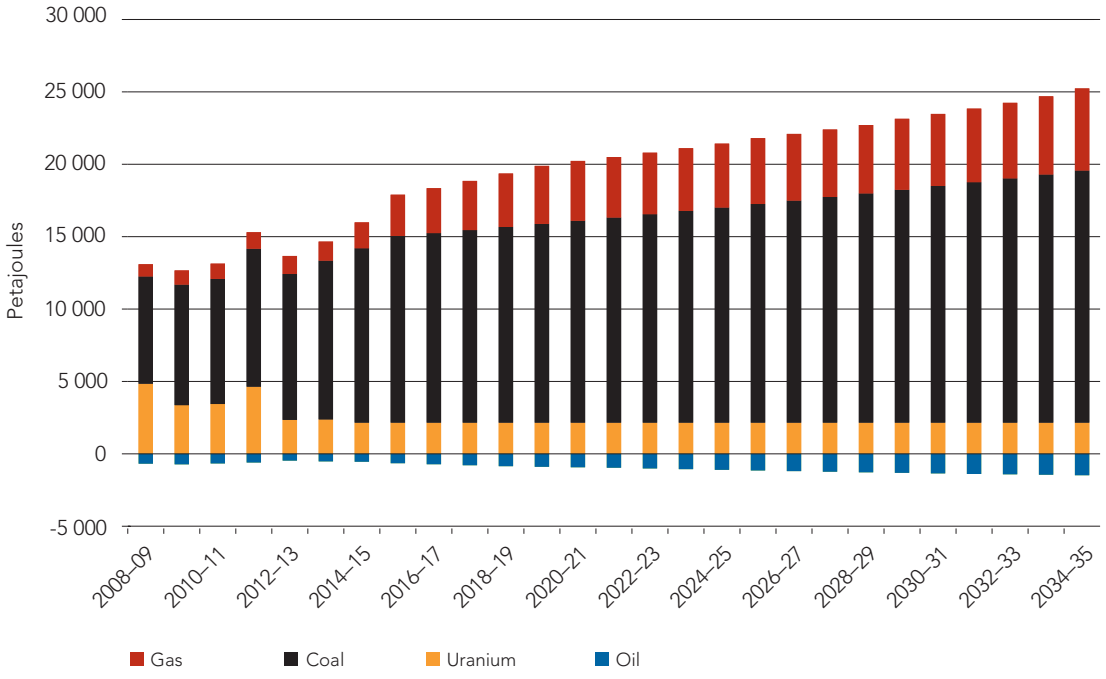
Coal and gas exports will grow, as will oil imports (Figure 3.5). A large expansion in thermal coal exports is expected to increase black coal production grow by an average of 2.8% a year, while brown coal production (used for domestic power generation) is expected to remain steady to 2020 and then decline over the next decade unless alternative uses for the resource can be commercialised (possible alternative uses for Australia's brown coal reserves are outlined in Chapter 5: *Energy resources*).

Figure 3.4: Australian energy production, consumption and net exports, 2008–09 to 2034–35 (PJ)



Source: BREE (2011c).

Figure 3.5: Australian energy trade projections, by fuel, 2008–09 to 2034–35 (PJ)



Source: BREE (2011c).

Australia's gas production is expected to increase nearly fourfold, driven by strong growth in the LNG trade and the expansion of domestic gas markets.

Export developments will provide the critical backbone for the further development of our domestic energy infrastructure, but in the nearer term increased demand competition will place pressure on price and availability, contributing to changing market dynamics. The impact of new dynamics on Australia's energy security and on gas market development is discussed further in Chapter 4: *Energy security* and Chapter 9: *Energy markets: gas*.

Without major new oil discoveries, Australian oil production will decline. Domestic refining capacity is also expected to decline, so there will be a corresponding increase in imports of refined petroleum products (see Chapter 8: *Energy markets: liquid fuels*).

Rising oil prices are expected to spur the commercial development of indigenous alternative fuels, such as second-generation biofuels from 2020, as well as new market opportunities for gaseous transport fuels, such as LNG and compressed natural gas. We do not yet know whether synthetic fuel production, such as coal-to-gas or coal-to-liquids, will be viable in Australia. However, with higher future oil prices, some prospective projects could be established using carbon capture and storage technologies to offset carbon emissions. This could potentially unlock otherwise stranded brown and black coal resources.

3.3.5 Energy demand

Over the next two decades, Australia's demand for final energy is expected to grow modestly at around 1.2% per year, reflecting relatively steady growth in gas and liquid fuel use, but potentially slower than previous forecast growth in electricity demand.

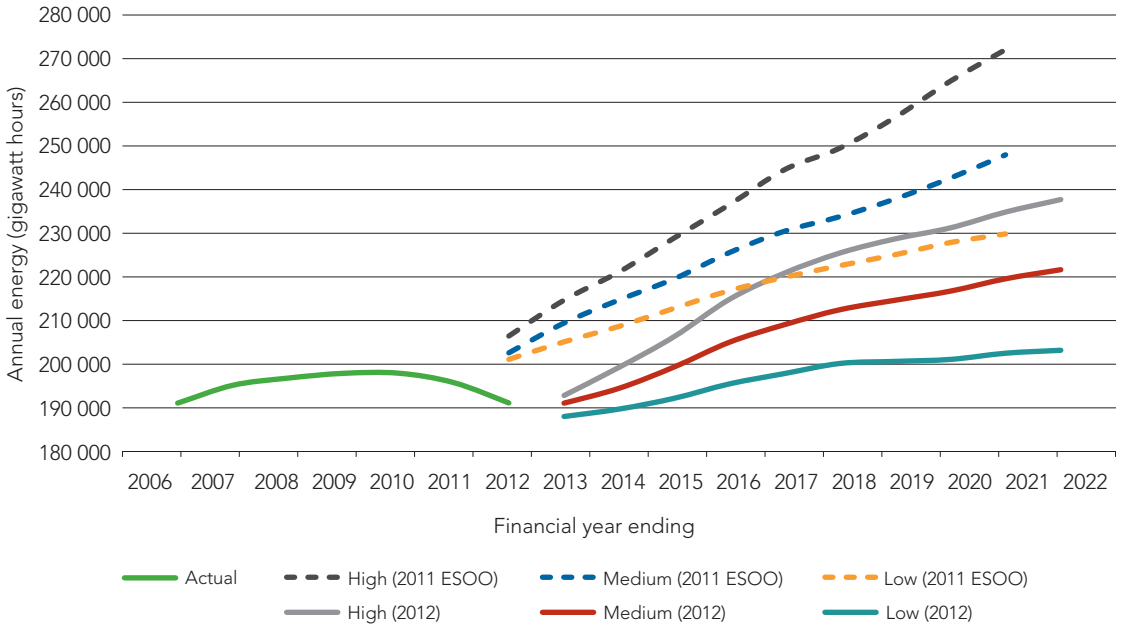
Demand patterns in the National Electricity Market (NEM), which accounts for around 90% of Australia's electricity demand, have changed significantly in recent years. Average annual demand in the NEM has fallen by 3.4% since its peak of 197.9 terawatt hours in 2009–10. Demand is expected to remain steady at its current level during 2012–13 (AEMO 2012b) before returning to growth over the remainder of the decade (Figure 3.6).

A combination of factors underpins this result, including a fall in demand from large industrial and manufacturing sector users, consumer responses to sharply rising prices, the impact of energy-efficiency measures and the gradual take-up of distributed solar photovoltaic generation in the residential sector.

How sustained these changes might be is unclear. Much is likely to depend on broader economic conditions, particularly future levels of industrial activity.

Substantial regional variation is also likely. Growth in the NEM will be strongest in Queensland, driven by the needs of LNG pipeline and production facilities. Other states and territories in the NEM are generally expected to record subdued growth, although demand in New South Wales has the potential to rebound strongly. Off-grid electricity demand in Western Australia and the Northern Territory is expected to grow strongly, driven largely by the resources sector.

Figure 3.6: Electricity demand in the National Electricity Market to 2021–22



Source: AEMO (2012b).

In the absence of market reforms, peak demand is expected to continue to grow, although at rates closer to average demand. The 2012 Australian Energy Market Operator's forecasts for maximum demand growth in NEM states range from 1.0% to 2.5% per year.

The substantial difference between high and low forecasts of about 34 terawatt hours by 2020 (or slightly more than the size of the Victoria's annual average demand in 2012) means that there could be very different operational and investment implications for the electricity market depending on the future direction of key demand drivers. These issues are discussed further in Chapter 10: *Energy markets: electricity* and Chapter 11: *Energy productivity*.

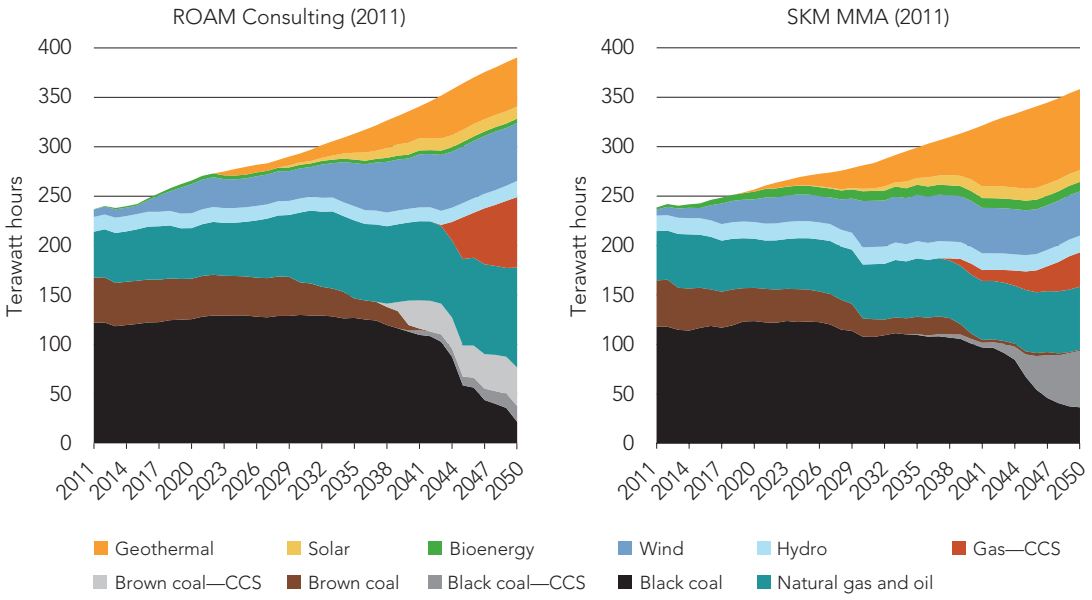
3.3.6 Electricity generation

The electricity sector is perhaps the part of Australia's energy system facing the greatest long-term change.

Three projections of potential changes are shown in figures 3.7 and 3.8, which show the profile of Australian electricity generation by major technology type over the period to 2050.

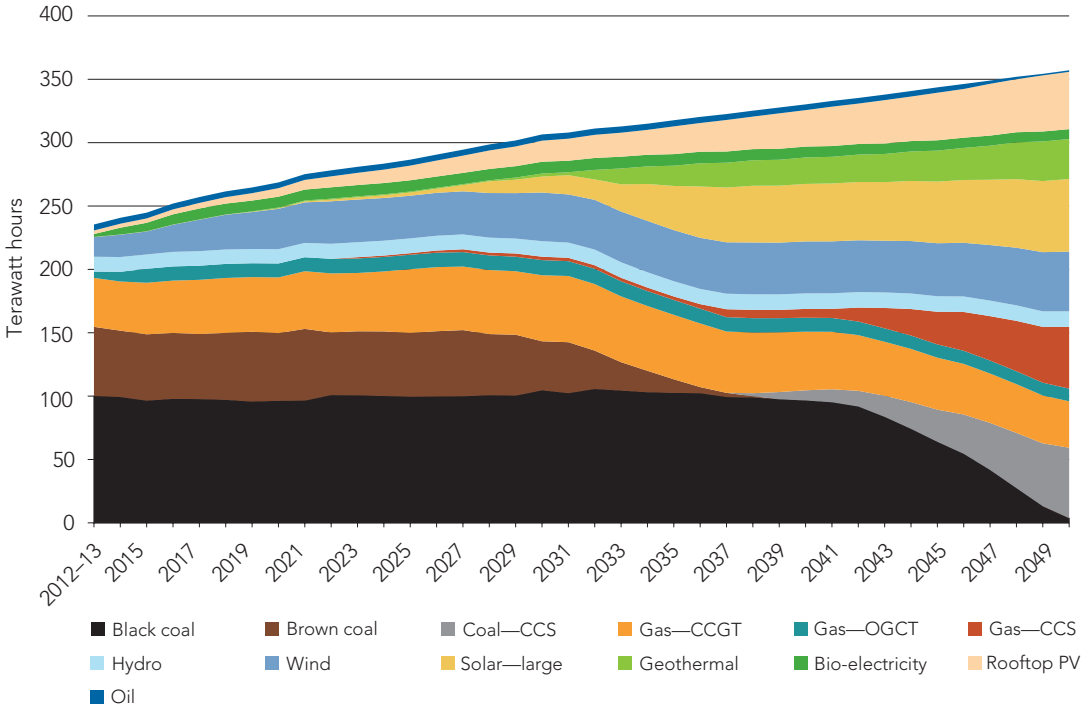
Figure 3.7 shows the results of modelling by Treasury in 2010–11. Figure 3.8 shows recent modelling by BREE incorporating AEMO (2012b) mid-range demand forecast (including AEMO projections of household photovoltaic deployment) and updated energy generation technology costs (BREE 2012d). Both sets of results use the same carbon price forecast and similar fuel price assumptions.

Figure 3.7: Australia's electricity generation mix to 2050—Australian Treasury projections



Source: Treasury (2011).

Figure 3.8: Australia's electricity generation mix to 2050—AEMO medium demand scenario



CCGT = combined cycle gas turbine; OGCT = open cycle gas turbine.

Source: BREE (2012d).

These results show a broadly consistent pattern of change, although variations in the technology mix begin to emerge after 2020, largely reflecting the differences in assumed technology costs.

Overall, the results show fossil fuels continuing to provide most of our electricity supply for at least the next two decades. In these scenarios, black and brown coal fired generation maintain relatively consistent output until 2030, although their overall market share declines as the market grows.

Gas generation is also expected to play a major role, although the differences in modelling results suggest that its growth prospects beyond the middle of the next decade will depend on relative fuel costs and the possible early emergence of commercially viable utility-scale renewable alternatives, such as solar, wind or potentially geothermal.

While incumbent generators are likely to remain in the market for some time, carbon pricing and the Renewable Energy Target will drive deeper change as clean energy technologies evolve and renewable energy costs decline. As the market grows, technologies such as solar, wind and geothermal may provide around 40% of total generation by 2030, up from around 20% in 2020. By 2050 their share could potentially be over 50%.

From 2035, carbon capture and storage technology could also begin to make an important contribution to clean electricity generation. In this scenario, carbon capture and storage would be applied to between 26% and 32% of fossil-fuel-fired electricity generation by 2050 taking clean energy to over 80% of our total electricity supply.

These results point to a number of potential challenges in the electricity sector. In particular, the projected large long-term increase in intermittent supply (wind and large-scale solar), as well as more variable demand load (driven in part by a large take-up of distributed photovoltaic systems), means that grid and network balancing will increasingly be tested (see Chapter 6: *Clean energy*).

Combined with lower demand growth, this is likely to make Australia's electricity markets more competitive with a less predictable business environment than in the past with increased pressure to innovate and manage market risk. This is already happening through higher levels of business integration across electricity generation, gas and retail markets along with a move to more diversified generation portfolios.

To help inform the future outlook for generation technologies, BREE released the Australian Energy Technology Assessment in July 2012. This provides additional insight into the key drivers of technology costs by allowing users to vary key parameters for 40 different technologies. The CSIRO has also released an interactive modelling tool in conjunction with the Energy White Paper. The tool uses the Australian Energy Technology Assessment estimates and allows the user to vary future technology costs and other parameters (within feasible ranges) to project a range of different generation mixes.[2]

3.3.7 Energy networks

As our energy base evolves, so will the energy networks that transmit and distribute energy to our homes and businesses.

Growing energy demand, particularly peak electricity demand, and a more rapid deployment of distributed generation technologies will require the augmentation and reinforcement of electricity and gas networks to meet the standards of reliability that we set. Network costs (particularly for distribution networks) have been the main driver of electricity and gas price increases over the past five years, and this is expected to continue over the next decade.

Increasing differences in demand growth between regions suggest that there may be significant investment in new interconnector capacity in the NEM as new gas and renewable generators emerge (AEMO 2010a). This will allow more trading of electricity between regions and more tightly integrate gas and electricity markets.

Economic development is expected to drive significant line extension into regional areas in South Australia and northern and western Queensland. In Western Australia, it will lead to the expansion of existing grids and the potential development of new ones. However, the cross-continental connection of gas or electricity is unlikely in the period ahead, given the poor economics and low need.

2 Available from www.csiro.au.

There are various early-stage proposals for major new transmission links, including from Papua New Guinea to import hydro-electric power and for a new link across the eastern states (NEMLink) to underpin grid development. However, the economics of these ideas are yet to be tested, particularly in the light of revised demand forecasts.

The projected strong growth in large- and small-scale distributed generation systems will require greater flexibility in the distribution network. This may bring some reduction in the need for network investment but may also pose challenges, such as managing more variable load and ensuring that consumers are paying appropriately for the cost of network use and backup.

These factors will culminate in a more complex network system with sophisticated communications and information technology platforms to enable real-time load management by electricity distributors, customers, retailers and other energy service providers. This will require technological advances as well as ongoing support through further reforms of market arrangements.

Existing gas transmission and distribution infrastructure will also need to be augmented within the next decade as demand reaches capacity. This will require state and territory governments to ensure timely planning approvals and access for pipeline corridors.

3.3.8 Transport

Transport activity is expected to continue to grow strongly through the period, reflecting rapid population growth and increasing incomes. However, significant changes in the modal mix, new engine technologies and changes in the fuel mix are to be expected. Demographic patterns and oil prices are as likely as any other factor to drive those changes.

The transport sector currently accounts for around 15% of our greenhouse gas emissions, and reducing emissions in the face of growing demand will remain a challenge. While increased fuel efficiency will be essential if emissions are to be reduced, innovation in the use and efficiency of transport systems, along with the greater use of public transport and better urban planning, will also play important roles.

As our growing population concentrates further in our cities and urban areas, traffic congestion and road costs are likely to create a shift towards mass transit systems. This has the potential for improving energy efficiencies, although it will pose infrastructure and planning challenges for governments at all levels.

Road transport is projected to more than double by 2050, shipping to triple, and rail and air transport to more than quadruple. Growth in light commercial vehicle and heavy truck activity is expected to be faster than for private and passenger vehicles. This will influence the types of fuels used as well as the transport infrastructure required (CSIRO 2011a).

Most projections show that alternative fuels (such as biofuels) are unlikely to make a significant impact until after 2020 due to very small production volumes, cost, consumer acceptance and technical barriers. In the longer run, rising oil and carbon prices and improved production technologies are expected to lead to wider commercial take-up. Success will depend on the ability of these technologies to meet consumer needs and, in the case of biofuels, industry's capacity to produce and supply large volumes sustainably.

Similarly, there is likely to be scope for biodiesel to become a mainstream fuel (or fuel blend) in the heavy-duty vehicle sector, with a forecast use rate of 76% by 2050 (Treasury 2011:132). Biofuels may also be increasingly used in aviation. There is also scope for developing and using synthetic fuels, but their production under carbon pricing is likely to depend on the commercial viability of new technologies such as carbon capture and storage.

New commercially attractive technologies are emerging for LNG and compressed natural gas use in heavy-duty vehicles under Australian operating conditions and have the potential to transform the transport sector, particularly for heavy-duty vehicles. Over time, this could also allow the light vehicle market to share fuel distribution infrastructure with the heavy-duty sector. In the longer run,

hydrogen may also become a mainstream transport fuel, although technology and infrastructure costs are expected to remain a major hurdle for some time.

There will be further development and take-up of hybrid and fully electric passenger vehicles. While this is expected to be slow to 2020, it is likely to accelerate over the following decade (Treasury 2011). Success will depend on the availability of cost-effective vehicles suitable to Australian conditions, improved battery technologies, timely and effective energy supply options, and the management of the effects on the energy distribution network.

Conventional internal combustion engine vehicle efficiencies will improve, driven by higher fuel prices, the introduction of mandatory CO_2 emission standards for light vehicles (in both Australia and those countries from which we import vehicles) and the need to remain competitive against electric and hybrid vehicles.

3.3.9 End-use industries

Energy-intensive industries, which currently account for around 33% of end-use demand (BREE 2012a:27), are expected to continue to prosper, albeit under continuing pressures from sustained high terms of trade and a high exchange rate. Continued access to competitively priced and reliable supplies of electricity, feedstock coal, gas and petroleum products will be important for transformative industries such plastics, chemicals, alumina and steel.

The Australian Government acknowledges the competitive pressures facing many of these industries. It remains committed to developing commercially sustainable energy-intensive downstream projects, including by pursuing further market and policy reforms to minimise energy price pressures. The government is also providing support to improve business productivity and competitiveness, including assistance under the Clean Energy Future Plan.

3.3.10 Regional development

The development of Australia's energy resources will continue to support the economic and social development of many Australian regions. The development of energy hubs such as Gladstone, the Kimberley and Darwin and of our major coal basins will provide a base for further industrial development through local engineering, port, shipping and other services. Once established, those developments will provide a competitive alternative for the co-location of downstream industries.

While Australia's coal and gas industries in particular are set to expand, the rapid increase in renewables and the longer term development of alternative fuels will also develop local businesses and capacities in regional Australia.

The government will also work closely with the Australian energy and resources sector to improve outcomes for Indigenous Australians in regional areas through employment and training opportunities, as well as through native title arrangements that provide fair returns to local communities.

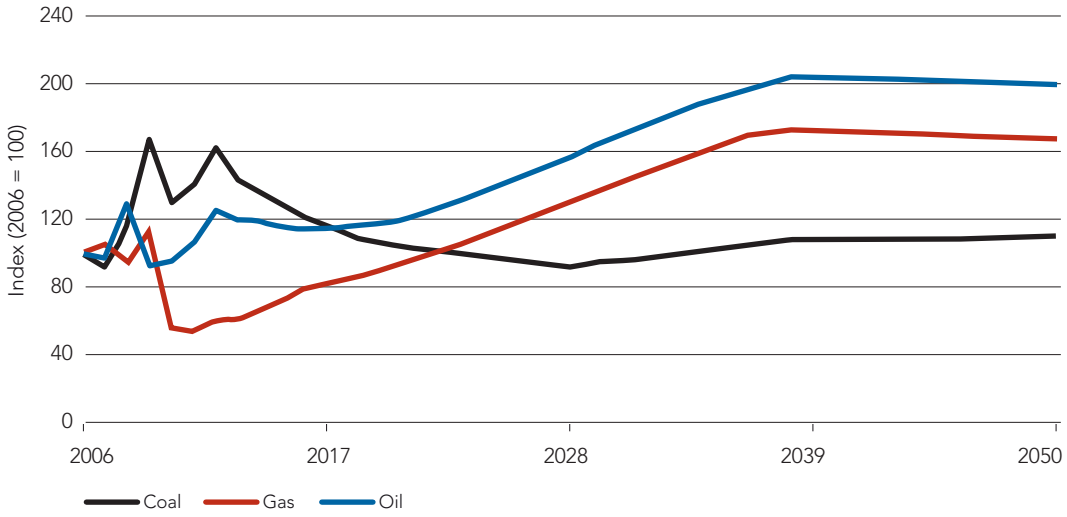
3.3.11 Energy prices

Global and Australian fuel and electricity prices are expected to rise in real terms to 2020 and beyond, reflecting rising costs of production and growing demand for energy (Figure 3.9).

Using its new policies scenario, the IEA has modelled a rise in oil prices in real terms from US$78 a barrel in 2010 to US$120 in 2035 (IEA 2011a:64). Domestic petrol and diesel prices will continue to track international oil prices closely and are unlikely to be affected by domestic refinery developments (see Chapter 8: *Energy markets: liquid fuels*).

Historically, Australia's domestic coal, gas and electricity prices have not been directly linked to international prices, and we have maintained relatively low delivered energy prices compared to other OECD countries (BREE 2011a). However, this separation is expected to decline over the coming decade, particularly as LNG and coal exports increase competition in domestic markets.

Figure 3.9: Fuel price index, 2006 to 2050



Source: Treasury (2011).

Nationally, the Australian Energy Market Commission forecasts an increase in residential electricity prices of around 37% in nominal terms in the period from 2010–11 to 2013–14. This would be a 22% increase in real terms, or 8.34 cents per kilowatt hour (AEMC 2011a).

Distribution network and wholesale generation costs will continue to be the main driver of price increases in this period. Renewable and feed-in tariff schemes will also add to costs (by 3% each). The Australian Treasury has forecast that carbon pricing will add around 10% to costs by 2018. The prospect of lower demand growth may begin to ease some of the network-related price pressures from 2014 (AEMO 2012b).

Wholesale gas prices have risen markedly on the west coast and are forecast to increase significantly in the eastern market. BREE has reported gas price projections of between $7.70 and $13.90 per gigajoule, depending on state, by 2020 (see Chapter 9: *Energy markets: gas*).

3.4 Strategic challenges

The global and national assessments outlined in this chapter project an encouraging energy future for Australia. However, that future is by no means locked in: it will depend on the interaction of dynamic factors, such as patterns in international and domestic economic growth, changes in carbon and fuel prices, the commercialisation of new technologies and investor confidence.

In this context, achieving Australia's energy goals at the lowest cost is most likely to require the maintenance of a flexible policy framework that provides clear direction to markets, along with effective regulation and targeted support to address identified areas of market failure.

While the key elements of the government's policy framework, along with specific challenges and energy policy priorities, are discussed further in Parts II and III of this White Paper, some strategic challenges are common to all elements. These challenges, which are discussed below, are:

- managing ongoing change and risk in energy markets
- continuing to attract sustained investment in Australia's energy system
- successfully developing, adapting and deploying new technologies to support clean energy objectives and to provide more options in managing energy use and costs
- addressing energy prices and related cost-of-living pressures on households and businesses
- improving consumer and community engagement.

3.4.1 Managing ongoing change and risks

As outlined in Section 3.3. Australia's energy markets are undergoing significant reshaping that is producing new competition and supply dynamics, driven by the advent of new technologies and growing links to global markets. Carbon pricing and changes in international financial markets are also important factors.

The implications of some of these changes will emerge over time, while some may develop abruptly. There may also be unforeseen price or other market shocks, including geopolitical turmoil in key areas.

Markets and businesses are generally best equipped to deal effectively with many of these risks. However, well-targeted policy can assist in sharing, managing or reducing a number of non-market risks.

To ensure that national energy policy is up to date and resilient over a period of great change, the Australian Government will undertake four-yearly strategic reviews of energy policy, as outlined in Chapter 1: *A framework for national energy policy*. Chapter 4: *Energy security* also outlines the government's policy framework for managing ongoing risks that may disrupt energy markets or supply chains.

3.4.2 Attracting timely investment

Meeting Australia's future energy needs will require higher levels of investment in many parts of the energy system over coming decades. In our domestic energy sector, the requirement may be as high as $240 billion by 2030, while currently proposed energy resource and related infrastructure development projects could require as much as $250 billion in investment by 2030 (IRG 2011, BREE 2012f).

While this appears daunting, it is achievable, particularly as it will be spread over several decades and across different components of the market. It is also not yet fully locked in.

Not all projected energy resource projects will go ahead, and the final size and timing of downstream investments will depend on a range of factors, most critically on how much electricity demand grows in coming years. Sustained lower growth in demand is likely to delay or even avoid a significant proportion of investment in new generation capacity and network upgrades (AEMO 2012a).

Nonetheless, challenges in attracting the necessary capital, which will come from a mix of foreign and domestic debt and equity markets, will include:

- increasingly competitive and less predictable energy markets with rising business costs
- more risk-averse financial markets
- lack of bipartisan support for key policy settings
- ongoing price regulation and government participation in competitive elements of energy markets.

Foreign markets and investors are vital for achieving our energy goals. Foreign institutional investors hold 40% of Australian Stock Exchange equity and up to 20% of AGL Energy and Origin Energy, Australia's two largest listed energy companies (IRG 2011). Anecdotal evidence suggests that project financiers are now seeking lower leverage in the wake of the global financial crisis, while capital costs are higher, reflecting a lower risk appetite.

In general, Australia maintains a highly attractive investment environment with sound macro-economic settings, competitive fiscal regimes and a skilled labour force. Austrade monitors international investment risk ratings and reports that Australia generally ranks in the top 10 for many important indicators.

However, our competitive position cannot be taken for granted. Further efforts are needed to maintain or increase our attractiveness as an investment destination, particularly because of the rapid growth and improvement in competitor markets. We also need to build confidence in our energy markets through further reforms to promote competition and efficiency.

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 lives of many energy sector investments, providing practical certainty about future policy is also important. This is critical for Australia to attract the capital needed in highly competitive financial markets.

The continued regulation of retail electricity prices in most states and territories is a continuing barrier to competition, innovation and investment. These and other energy market reform issues (discussed in Chapter 10: *Energy markets: electricity*) must be addressed if we are to attract the investment we need.

3.4.3 Bringing new technologies to market

Meeting Australia's emissions reduction and other sustainable development goals will require a massive rollout of clean energy technologies, a number of which are not yet commercially available.

This is an achievable challenge. Commercial opportunity is a powerful incentive, and the right 'push' and 'pull' policy signals and commercial incentives will mobilise the private sector to innovate and deploy. This has begun to happen through the reforms being implemented through the Australian Government's Clean Energy Future Plan.

Globally, the clean energy effort is underway and, through growing public and private sector collaboration, is no longer purely a national affair. As an open economy that relies heavily on adopting and adapting international technology, Australia will contribute to this effort and benefit from it.

Determining the optimal level of public support in this space requires governments to strike a balance between technology support measures, other competing policy priorities and costs to consumers. This is why the Australian Government has developed a clean energy framework based on addressing market failures and using public funds to obtain maximum leverage from private sector activity. Support must be flexible and well targeted, and move away from the boom–bust cycle of resourcing that has characterised past efforts. The establishment of the Australian Renewable Energy Agency and the Clean Energy Finance Corporation are important steps in this direction.

The optimal take-up of new technologies is best promoted through a flexible market-based approach that allows the energy sector to adjust to changes in the capabilities, timing and costs of different technology options. For that 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 that would risk a potentially inefficient and costly lock-in should future developments move in a different direction or at a different pace (as they almost certainly will).

Inevitably, there will be pressure to accelerate the development and deployment of particular technologies. Proposals for additional Australian Government support will be rigorously assessed against criteria that draw out the rationale for and benefit of providing such support. That assessment will also consider how support might affect the efficiency of energy (and carbon) markets, and the additional costs to energy consumers and taxpayers.

Finally, technological development is a long-term undertaking, and there will be failures along the way. Failure is part of the innovation process and provides necessary and valuable lessons to support future development. Building an early understanding of potential is important and will help

markets and policymakers to plan and make timely adjustments if required. For this reason, better sharing of knowledge about successes and failures must be an important dividend from public funding and project support.

3.4.4 Addressing the rising costs of energy

Access to reliable low-cost energy has contributed to our national competitive advantage and high standard of living. However, after a long period of relatively stable prices, recent sustained increases in energy costs suggest that Australia's era of cheap energy is being challenged.

Energy price increases are the result of complex market and regulatory interactions. Underlying production costs are generally rising along with greater demand competition, particularly in gas markets. Measures to improve the environmental and social performance of energy developments are also increasing and have to be factored into the cost of delivery.

Regulated retail electricity prices in all states and territories have increased substantially, by between 37% and 80% since 2007 (Chester & Morris 2012), driven largely by the sector's need to meet increased consumer demand (particularly peak demand) and high reliability standards. Further average increases of 37% in the larger eastern states are projected over the next two years (AEMC 2011a), placing additional pressure on households and business competitiveness, particularly in energy-intensive industries. Meeting our clean energy and emissions reduction goals will also add marginally to price pressures.

Understanding impacts on households and businesses

Definitive statistics on the impacts of rising prices on household and industry are difficult to identify, making this a serious gap in our understanding of energy cost impacts.

The 2009–10 Australian Bureau of Statistics household expenditure survey indicated that energy bills make up about 2.6% of average household expenses (ABS 2011c). That proportion has remained relatively constant over the past decade.

However, this almost certainly masks significant differences in energy cost impacts between income groups. The energy share of expenditure was nearly 55% higher for the lowest income households, at 4%.

Recent studies and submissions to the Energy White Paper also point to growing evidence that lower income households are spending as much as 10% of their disposable income on energy. A growing number of households are also reporting some form of energy-related stress or are accessing consumer hardship mechanisms (Chester & Morris 2012, IPART 2012a).

Increases in household energy costs are regressive in their impact. Lower income groups are also likely to be less able to access options to reduce energy use or manage costs. Distributional impacts, as well as differences in the ability of groups to access energy services, should therefore be a material consideration for government when it contemplates interventions in the energy market.

To better understand the social and economic implications of energy costs, the Australian Government has allocated $10 million over three years to gather information on household sector energy consumption.

For most non-energy-intensive businesses, energy is a relatively small component of overall costs (typically less than a few per cent). However, for intensive operations, energy costs can make up 10%–30% of overall costs. Increases in businesses' energy costs, particularly those that cannot be passed through to the market, can erode profitability and competitiveness.

While large energy users are generally well placed to negotiate energy prices directly with wholesale suppliers, it is clear that rising energy costs are a growing concern in the mix of competitive pressures on many industries, particularly the rising impact of multiple regulatory and policy interventions, which are difficult to manage or hedge.

Minimising price pressures

The Australian Government is very concerned about the social and economic impacts of rising energy prices. It believes that governments can collectively do better in ensuring that markets are delivering competitively priced energy, and in giving consumers more choice in how they manage their energy use.

While there is no easy fix to these difficult challenges, all Australian governments must work to preserve our national advantage in competitively priced energy. They should maintain overall affordability by ensuring that energy markets, energy regulation and market reforms are delivering efficient and sustained outcomes for consumers. Policies should also stimulate and support markets to provide better options that help consumers manage their energy demand and costs.

Some have argued that recent price rises demonstrate that moving to more competitive energy markets has failed to deliver better outcomes for consumers. An examination of the source of cost drivers does not support that proposition.

Energy market reforms over the past two decades have resulted in much improved and more efficient energy markets compared to the publicly run and heavily regulated energy markets and businesses of the past (ERIG 2007). The evidence is clear that effective business competition drives down cost and promotes efficiency and innovation, which is in the short- and long-term interests of consumers.

In contrast to the relatively stable prices in the competitive wholesale generation market, electricity prices have risen in the regulated components of the market. The rises have been driven by a combination of rising demand and the need to meet specified reliability standards, and to a lesser extent by various federal and state government interventions aimed at achieving non-market policy objectives.

There is a need to ensure that these policies and our market regulation are producing the most efficient outcomes for consumers.

Australian governments recognise the need to prioritise a review of existing federal and state and territory carbon reduction and energy efficiency measures with a view to rationalising those that are not complementary to a carbon price, or are ineffective, inefficient or impose duplicative reporting requirements on business.

COAG has requested a new interjurisdictional taskforce on regulation and competition reform to do further work and advise it in late 2012 on any additional action needed to deliver a regulatory framework that promotes a competitive retail electricity market, including appropriate support for vulnerable customers, and efficient investment. This process will be informed by the Standing Council on Energy and Resources work program, including proposed responses to various energy market reviews and reports currently underway or recently completed (see Chapter 10: *Energy markets: electricity*).

However, more needs to be done. In particular, it is necessary to address the growth in inefficient peak demand and to provide a more equitable allocation of costs among consumers, including through retail price reforms and the development of more effective demand-side measures. Ensuring that the regulated component of markets is delivering efficient outcomes is also a priority.

These matters are taken up in chapters 8, 9 and 10 of this White Paper.

It is equally important that governments at all levels continue to support the essential energy needs of the more vulnerable groups in the community.

State and territory governments provide support such as energy rebate programs for low-income households, and service obligations are in place to ensure that vulnerable and regional consumers are not materially disadvantaged.

The Australian Government is also providing assistance under the Clean Energy Future Plan to support households, jobs, businesses and communities to help them adjust and lower their carbon pollution and to protect our international competitiveness. The government's Household Assistance Package helps to ensure that the impact of a carbon price is manageable for low and middle income Australian households, especially for people who have less financial room to adjust to change.

However, it is clear that if energy costs continue to increase at rates well above other living costs there will be more energy-related financial stresses for households. In these circumstances, the adequacy and effectiveness of consumer hardship and safety net provisions will be tested.

To deal with this issue, we need a better understanding of the true impacts of rising energy prices on households, particularly on low-income households. There is anecdotal evidence but little detailed information in this area. The financial pressures faced by these groups may be compounded by gaps in consumer protections and the inconsistent application of such measures. The government recognises that this is an important issue and considers that there would be merit in further work to better understand the distributional impacts of rising energy costs, including whether current pricing structures add to the problem by imposing inequitable cross-subsidies between different classes of consumers. The implementation of the National Energy Customer Framework (NECF) should be a priority for all governments.

Finally, cost concerns should not be used to justify policies that undermine or distort markets and pricing. Efficient, cost-reflective pricing is vital in achieving a more productive energy system and one of the keys to unlocking demand-side responses that can reduce future costs.

Past approaches in the energy sector have shown that poorly designed interventions aimed at short-term price suppression can lead to distorted investment or demand, producing higher costs for consumers in the longer run.

In this context, all Australian governments should:

- implement further energy market reforms, particularly network, demand-side and retail reforms, to promote efficiency and competition and drive better outcomes for consumers
- review and remove inefficient or ineffective policies that are non-complementary to the carbon price
- ensure that energy costs are taken into account in transparent and effective social policy frameworks (including regional and rural assistance and community service obligations)
- ensure that effective protections are maintained for vulnerable consumers, including through the implementation of the NECF
- work with business, consumer and welfare groups to improve energy literacy and participation in the energy market.

3.4.5 Building community engagement and energy awareness

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

Individuals and enterprises would benefit from a better understanding and awareness of their energy choices. Decision-making informed by good product information and an understanding of environmental and/or monetary costs will lead to greater energy efficiency and productivity and reduce the impact of cost increases. This information may need to be communicated through a variety of mechanisms to reach all social sectors.

Governments and the energy sector at all levels should improve public consultation and engagement in decision-making, program design and other aspects of energy policy. This will deepen Australians' understanding of energy issues, particularly the drivers of energy costs and the importance, challenges and impacts of the development of new technologies and resources.

Without a broad social consensus on our future directions, meeting Australia's long-term energy goals will be more difficult and costly. There will also be a risk that concerns about new technologies will lead the community to close off safe, sensible and environmentally sound options to meet the clean energy 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 work transparently and proactively to address them.

The Australian Government is committed to working with businesses, state, territory and local governments and communities to improve transparency and community engagement in the development of climate change and energy policy and programs. It will also work with energy market stakeholders to increase their ability to engage on market design and regulation issues, and will expand the energy information base to promote a better understanding of Australia's energy choices.

PART II

Core elements of Australia's energy policy

4 Energy security

Highlights

- Australia's energy system is meeting the economic and social needs of Australians, and is expected to do so into the future. However, this will require a focus on challenges such as:
  - ensuring a smooth transition to a clean energy economy
  - securing timely investment in all aspects of our energy system
  - adjusting to the changing dynamics in key international and domestic energy markets.
- Energy security is best delivered through well-functioning markets supported by established and diversified supply chains.
  - Australia's energy resource base underpins our energy security, but access to global energy markets, such as open and well-functioning global oil markets, is also critical.
  - Self-sufficiency as an energy policy goal is costly and likely to be misplaced, given the proven ability of international markets to respond to changing circumstances.
  - Australia's emergency response arrangements also play an important role in ensuring effective and timely responses to unforeseen events.
- The Australian Government's energy policy framework is designed to improve Australia's energy security through:
  - continuing supply- and demand-side market reforms to maximise investment and improve the flexibility and resilience of energy markets
  - encouraging diversity of supply and infrastructure reliability for supply chain resilience
  - attracting the necessary capital investment and skilled labour to meet future energy demand
  - promoting long-term investment certainty through carbon pricing.
- Ensuring that we have a resilient policy framework is critical in managing challenges, particularly in a rapidly changing world. This requires regular monitoring and assessment.

Energy security underpins our economy by allowing markets and consumers to function and plan in the knowledge that they have access to adequate, reliable and competitively priced energy.

It requires careful balancing of many policy objectives, including maintaining well-functioning energy markets and an attractive economic and investment environment, implementing integrated and efficient policies to move to a clean energy economy, and providing frameworks to support workforce needs, innovation and technological development. It also requires emergency response and system security frameworks that are able to anticipate as well as respond to critical events.

Energy security is a responsibility shared by all Australian governments—a fact recognised through the Standing Council on Energy and Resources and other energy-related arrangements under the Council of Australian Governments framework.

4.1 Overview

Ensuring Australia's short-, medium- and long-term energy security is a high priority for the Australian Government.

The government defines energy security as 'the adequate, reliable and competitive supply of energy and energy services 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 affect the competitiveness of the economy and that supports continued investment in the energy sector (RET 2011a).

These three dimensions are interrelated and can involve trade-offs. For example, if energy supplies are not adequate, energy prices will need to rise or intervention in the market may be required to allocate scarce resources.

Energy security should not only be viewed from a supply-side perspective. Improved energy productivity through demand management and end-use energy efficiency also has an important role in ensuring that Australia's energy needs continue to be met.

Given their importance in determining our day-to-day access to energy, the Energy White Paper considers energy security and associated risk factors largely in terms of market development, access and supply issues. However, it recognises a range of important non-market factors that can influence our energy security, including national security developments. The 2008 National Security Statement identified energy security as an emerging influence on national security decision-making.

4.1.1 Factors determining energy security

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, open access to international markets and high-performing economy with the capacity to attract investment in the energy system all contribute to our energy security.

A range of interacting drivers play a critical role in determining Australia's short-, medium- and long-term energy security:

- the ability to bring our energy resources to market efficiently and sustainably
- domestic and global geopolitical and economic conditions that influence energy supply and demand, as well as key inputs for system development such as investment capital
- the efficiency, robustness and resilience of our energy infrastructure, markets, and market participants
- the degree of integration with international energy markets and supply chains
- changes in domestic and global energy prices.

Other important factors include the broader policy and economic framework (such as sound macro-economic and regulatory settings), the supply of skilled labour, and the interconnected nature of our principal domestic electricity and natural gas markets.

Energy market reforms over the past decade and a half, coupled with improved regulation and the development of stronger and more nationally based market institutions, have improved our energy security, economic productivity and market efficiency (ERIG 2007). Energy outcomes are increasingly a product of well-regulated market forces rather than government direction, allowing Australia to benefit from the greater efficiencies and flexibilities that markets can provide.

A range of non-market factors also have the ability to cause signficant short-term disruption to energy production and distribution, and thereby affect Australia's energy security. These factors include damage to physical infrastructure, critical dependencies and control systems as a result of threats and hazards ranging from terrorism and cyberattacks through to natural disasters and industrial incidents. These threats have the ability to disrupt the operation of the commercial market, which Australia relies on to maintain our energy security.

Non-market threats to energy security are largely addressed through a range of government policies and frameworks, including the National Energy Security Assessment (NESA) and associated processes, as well as the Australian Government's Critical Infrastructure Resilience Strategy, which considers all hazards that have the potential to disrupt the continuity of essential service delivery, including services delivered by energy infrastructure. The NESA, in particular, has informed the White Paper on the role of energy security in the broader national security context.

While the main focus of the Energy White Paper is on the market factors outlined above, it is important to acknowledge the potential linkages and flow-on impacts between non-market and market factors determining energy security.

4.1.2 Energy security trends

The 2011 NESA assessed Australia's short-, medium- and long-term energy security for the liquid fuels, natural gas and electricity markets for the period to 2035 (RET 2011a).

The report found that Australia's energy security situation is meeting our economic and social needs, albeit with some emerging market and policy uncertainties that could have implications for maintaining our current level of energy security. The detailed NESA findings have been incorporated into much of the discussion throughout this White Paper. Summary findings for each of the three markets are outlined in this section.

Liquid fuels

Liquid fuel energy security is assessed as high, trending to moderate[1] in the long term, as Australia has continued access to adequate and reliable supplies of liquid fuels at prices that are manageable within the broader economy. The long-term moderate assessment recognises that our rising imports of petroleum products will lead to greater reliance on international supply chains and a consequent need for investment in import and storage infrastructure. The assessment also recognises a likely trend of high crude oil prices driven by increasing global demand and greater reliance on more expensive sources of supply, the significant global investment challenge in meeting rising demand, and continued risks of geopolitical uncertainty in key oil-producing countries.

The NESA also found that diversifying fuel types and sources is increasingly important in improving Australia's liquid fuel security. However, because of the small contribution made by alternatives such as biofuels (around 5% of the current market), and the technical and commercial challenges they face over the assessment period (see Chapter 7: *Energy markets: liquid fuels*), they were seen as likely to remain as niche products. Moves to mandate the take-up of alternative fuels may reduce energy security where there is lack of adequate supply sources.

The decline in Australia's domestic refining capacity (following announcements of the Clyde and Kurnell refinery closures) is not considered to impair Australia's liquid fuel security. The closures will occur over 18 months, and will be complemented by an expansion of import terminal capacity to ensure that market supply is maintained. Substituting imports of crude oil for imports of refined fuel at this scale does not pose any additional risk to market security.

1 'High energy security' is defined as meeting Australia's economic and social needs. 'Moderate energy security' means that needs are being met but that there could be a number of emerging issues that will need to be addressed to maintain that level of security. 'Low energy security' means that needs are not being, or might not be, met.

Gas

Overall gas energy security will remain moderate over the 2011–35 period, reflecting a rapidly developing market with distinct regional differences and challenges. This assessment recognises the mixed influences on gas security of the development of the coal-seam gas and LNG export industries on Australia's east coast, which are due to begin 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 (discussed further in Chapter 9: *Energy markets: gas*).

The gas supply–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 in the short to medium term. However, there is a risk that some downstream projects may find it difficult to source gas at prices that maintain their viability.

Electricity

Electricity energy security is rated as moderate over the period to 2035. While some factors (such as drought[2]) have eased since 2009, the sector faces significant challenges—most notably reliability, price pressures, the implementation of climate change and renewable energy policies, and the need to provide market certainty about future climate and clean energy policy. Some investment in new and ageing infrastructure is also needed. However, further market reforms and the assistance and energy security mechanisms announced in the Clean Energy Future Plan should allow the market to respond to these challenges.

Market shock scenarios

The NESA also modelled a limited set of hypothetical physical infrastructure supply chain 'shocks' in the liquid fuel, natural gas and electricity sectors to test the resilience of the energy system (RET 2011a). The modelling highlighted the continuing importance of resilient infrastructure and the diversification of supply arrangements and transmission infrastructure to avoid or respond to economically damaging supply disruptions. The report also included a cybersecurity case study to explore the emerging risks to energy security from this evolving threat.

The Liquid Fuels Vulnerability Assessment 2011 (ACIL Tasman 2011) found that collective action by the International Energy Agency (IEA) effectively muted the impacts of the 2005 Hurricane Katrina supply disruption. While the assessment found that prices would rise in the event of supply disruptions, the market would respond and readjust supply lines to replace supplies lost. Additionally, IEA collective actions were found to reduce the size and duration of the impacts.

2 See Chapter 12: *Sustainability, workforce and Indigenous opportunities* for a discussion of electricity generation in relation to water resources.

4.2 Energy security policy framework

Policy objective

Consistent with the core objective of the Australian Government's energy policy, Australia's energy security framework aims to ensure an adequate, reliable and competitively priced supply of energy and energy services to support our ongoing economic and social needs.

Principles

The framework is guided by the following principles:

- Australia's 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 management 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. Those 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 (including demand-side management and end-use energy efficiency), reduce barriers and improve regulatory transparency and consistency across jurisdictions.
- Australia's energy security policies should take into account our national security needs and objectives, including building critical infrastructure resilience.

Framework elements

The key elements of the government's energy security policy are:

- maintaining and supporting well-functioning and efficient energy markets
- maintaining responsive and effective energy emergency response arrangements
- building critical energy infrastructure resilience.

These elements are described in this section. Details on key issues such energy resource development, energy markets and energy productivity (demand-side reforms and end-use energy efficiency) are in subsequent chapters.

4.2.1 Maintaining and supporting well-functioning energy markets

Well-functioning and competitive markets supported by effective policy and regulation underpin our ongoing energy security through their intrinsic ability to:

- anticipate and respond to changing energy demand and supply needs
- deliver timely investment in the energy system, from upstream energy resource development to customer supply
- access a diversity of supply chains
- respond flexibly to energy shocks through energy substitution, diversion of energy supplies, and demand reduction responses
- allow free-forming competitive prices, which are an efficient balancing mechanism and a stimulus for the development of additional supply and supporting infrastructure.

Markets also play an important role in managing supply disruptions before and after government-managed emergency management and interventions, as well as during them. This role was demonstrated in 2011 by the way global energy markets adjusted to supply disruptions following the Libyan oil disruption and the shutdown of nuclear plants in Japan in the wake of the Fukushima tragedy.

In the case of Libya, 1.2 million barrels per day of oil was lost from global supply. The market responded by increasing production from other sources, particularly Saudi Arabia and other countries in the Organization of the Petroleum Exporting Countries (OPEC). This effectively replaced the loss of Libyan oil supplies and allowed markets to continue to meet global demand. This market response was supported by the IEA Libya Collective Action, in which IEA member countries released oil stocks to add short-term liquidity to the market, and cushioned the economic impact of surges in oil prices. Australian fuel prices reflected movements in the global market, and we did not suffer any disruption to our liquid fuel supply.

Japan managed the consequences of the shutdown of its nuclear power plants by moderating demand with rationing and switching to gas supplied through the global LNG market. These supplies were in large part made available by a substitution of LNG stocks normally sold into European markets, supported in turn by an increase in coal exports from the United States. Responses to both of these large-scale disruptions were enabled by the market's ability to increase production, access to a diversity of supply options, fuel-switching, and responsive, well-connected supply chains across key markets (BP 2012c).

In Australia, the market was able to contribute significantly to the response to the Varanus Island incident in 2008 where, in conjunction with emergency management measures in Western Australia, it established an emergency gas bulletin board, undertook fuel-switching where possible and returned mothballed coal-fired generation to service. This was also supported by voluntary (and involuntary) reductions in energy use by consumers.

Australia's abundance of energy resources allows us to meet our electricity and gas needs. However, we are a growing net importer of petroleum products due to declining crude oil production.

Our lack of oil self-sufficiency and the prospect of further refinery rationalisation does not in itself compromise or reduce our energy security (see Box 4.1). Our liquid fuel security is expected to remain high because of our access to reliable, mature and highly diversified international liquid fuel supply chains.

Diversity of supply prevents over-reliance on any single supply source and helps mitigate risks from potential supply disruptions. Australian governments at all levels will not allow energy security to be compromised and will intervene to maintain supply if necessary. However, government intervention should always be a last resort, since it can have negative short- and long-term consequences, including by increasing consumer costs.

Box 4.1: 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. Instead, the growing interconnectedness of the global energy trade provides Australia with flexibility and energy security benefits, as we are both a buyer and seller of liquid fuel and other energy commodities in global markets. The international trade in energy resources is like the trade in other commodities: the benefits unambiguously increase national development options and boost national and global wealth.

While disruptions in international markets can increase short-term energy costs, history has shown that they are generally managed with minimal or no supply disruption. Since the mid-1990s, most of the crude oil and refined petroleum product consumed in Australia has been imported. We share this reliance with most other OECD countries that lack extensive indigenous oil resources.

Pursuing self-sufficiency in energy resources such as liquid fuels would impose higher costs on Australian consumers without necessarily providing a material economic benefit. Maintaining diversity of supply (with alternative source countries, import points, and commercially viable fuels and technologies) is prudent, but does not justify the pursuit of self-sufficiency as a goal in itself.

For a major energy trading nation like Australia, pursuing a goal of national energy self-sufficiency would make little sense.

4.2.2 Maintaining responsive and effective energy emergency response arrangements

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, including those caused by extreme weather. While the arrangements identify supply options, facilitate communication and ensure effective responses 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 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

Where an event or circumstances in liquid fuel supply are beyond the capacity of the market to manage, the state and territory governments have constitutional responsibility for planning and coordinating emergency responses within their jurisdictions. Those regulatory powers are primarily focused on supply allocation and demand restraint and the priority needs of essential users.

As a member of the IEA, Australia is a signatory to the 1974 Agreement on an International Energy Program, which contains a commitment by participating countries to 'establish a common emergency self-sufficiency in oil supplies'. To that 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.

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 drawdowns of oil stocks, demand-restraint measures, fuel-switching from oil to alternative energy sources, 'surge' oil production and the sharing of available supplies.

Australia does not hold government-controlled or regulated industry stocks for drawdown in an emergency, and our capacity for short-term surge production and fuel-switching is limited. Therefore, we rely on commercial stockholding practices of industry and market flexibility to maintain supply during short-term global and domestic supply disruptions. To manage deeper disruptions without activating the *Liquid Fuel Emergency Act 1984* (which provides wide-ranging rationing powers to the Commonwealth Minister for Resources and Energy—see below), we can only participate in an IEA-coordinated emergency response, or collective action, through a combination of market and industry mechanisms and voluntary demand restraint.

In the event of a fuel shortage with national implications or the need for Australia to meet its commitments to the IEA under treaty obligations, the Australian Government can activate the Liquid Fuel Emergency Act, which then provides the Minister for Resources and Energy 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 National Gas Emergency Response Advisory Committee is a committee of officials that reports to the Standing Council on Energy and Resources and provides a communication channel to resolve gas supply disruptions.

Recent developments in the Australian gas markets, such as investments in pipelines to major demand centres, the National Gas Market 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 made market arrangements more resilient.

Electricity

The Australian Energy Market Operator is responsible for ensuring a coordinated and timely response to power system incidents, and for fulfilling its obligations under the National Electricity Market rules and policy framework to return the power system to a secure operating state.

The Australian Energy Market Operator also provides leadership and decision-making during a power system emergency to ensure cooperation between industry participants and coordination with jurisdictional authorities. National Electricity Market jurisdictions can also intervene by using energy emergency powers in response to power system emergencies.

As the Northern Territory and Western Australia are separate networks, those jurisdictions maintain separate electricity emergency response arrangements under their market operators.

As part of the Clean Energy Future Plan, the Australian Government has established the Energy Security Council to provide additional assurance and advice to the government in the event that systemic risks to energy security emerge from financial impairment arising from any source, including from the introduction of carbon pricing.

The Energy Security Council's role and responsibilities reflect the intention of the Clean Energy Future Plan, which is to transform Australia's energy sector from high-emissions intensity electricity generation to cleaner forms of generation. The ongoing need for the council will be assessed in a review to be completed no later than 1 July 2014.

4.2.3 Building critical energy infrastructure resilience

Resilient systems can adapt to and manage change by reducing risk and responding to and recovering from any type of hazard, from natural disasters to terrorist or cybersecurity attacks. Resilience is a shared responsibility of individuals, households, businesses and communities, as well as of governments. The managers of such systems learn from adverse incidents to build capacity. An important part of national security and a more resilient Australia is more resilient critical infrastructure (Australian Government 2011a).

The responsibility for building resilient 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 allows infrastructure owners and operators to share information on protection, resilience and cross-sectoral dependencies. It comprises seven groups for different business sectors and is overseen by the Critical Infrastructure Advisory Council.

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

Climate change adaptation is another way the energy sector is enhancing infrastructure resilience. Since 2009, the COAG Ministerial Council on Energy (now the Standing Council on Energy and Resources), the Australian Energy Market Commission, the Australian Energy Market Operator and the Australian Energy Regulator have considered climate change adaptation in their work programs.

More frequent or severe extreme weather and the incremental pressures of climate change, such as peak demand and water availability, have the potential to increase risks to energy security. However, investment in infrastructure and planning can ameliorate risks in the longer term. Ultimately this is a responsibility of infrastructure owners, rather than governments.

4.3 Policy challenges and priorities

Australia's overall energy security is expected to remain adequate and reliable, but will increasingly be shaped by the strength of future investment, the cost of energy and our ongoing response to climate change. All of these factors will be materially influenced by global trends (RET 2011a).

A number of emerging issues highlighted in the 2011 NESA could have implications for maintaining our energy security in the medium to long term. They include the need to attract steady investment to maintain system security and reliability, ensuring a smooth transition to a clean economy, the development and integration of new technologies, and continued energy price pressures. These issues are addressed in following chapters on energy resources, energy markets and clean energy.

Four issues warrant further consideration as overarching energy security policy challenges, given the expected trends over the next decade:

- managing risk and uncertainty
- adjusting to changing market dynamics
- managing our international liquid fuel stockholding obligation
- providing a resilient energy security response.

4.3.1 Managing risk and uncertainty

Accelerated and continual change will remain a dominant theme in global and Australian energy markets in the coming decades. Some changes will emerge slowly, while some may occur abruptly and pose risks to energy security.

Markets and businesses are generally well equipped to deal effectively with market and price risks. However, well-targeted policy can assist in sharing, managing or reducing a number of non-market risks.

Uncertainty, particularly policy uncertainty, is considerably more difficult to manage. While sometimes not apparent, left unaddressed it can impose additional costs through suboptimal investment decisions or 'wait and see' risk-aversion in the market (IRG 2011:72).

Key strategic considerations 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
- unanticipated increases in production costs.

The nature and timeframe of global and national responses to climate change are key strategic issues for Australia's energy future. The energy choices of our trading partners, along with carbon prices, abatement strategies, and the speed and direction of technological development, will affect the development of our energy sector and broader economy.

There is broad consensus among nations to collectively reduce greenhouse gas emissions (UNFCCC 2010). Ninety countries, representing over 80% of global emissions and 90% of the global economy, have pledged to limit their emissions. However, there remains uncertainty about how deep those cuts will be. Australia's Clean Energy Future legislation and plan, including the carbon pricing mechanism, effectively translate much of this international policy uncertainty into manageable risk for business. They are deliberately constructed so that changes in international settings or scientific understanding can be relatively easily aligned with Australian conditions, with less risk of sharp adjustment costs.

A confluence of higher than expected carbon prices, higher fuel prices and poor technological progress could increase costs, although this is considered less likely because energy and carbon markets can have in-built adjustment and cost-capping features that work to mitigate extreme outcomes.

As seen in recent Australian energy trends, high energy costs or poor economic conditions will work through the market to moderate demand and induce supply-side innovation and substitution responses. Australia's carbon pricing, energy security and target-setting arrangements also allow the government to calibrate settings to ensure that the economic cost of action remains tolerable. However, governments should adopt a cautious and well-considered approach in any response to price movements, which are critical signals that drive market and consumer responses and underpin efficient investment.

Australia's energy security policy framework also positions us well to respond to geopolitical or other events that may disrupt energy markets or supply chains. The government also has well-tested response frameworks for managing economic and financial crises.

While one approach to managing risk is to 'design for the worst', experience in energy markets over the past 50 years suggests that this would be very costly and largely unnecessary.

Most energy security events, if they emerge at all, are likely to develop over time. Rather than implementing prescriptive and potentially costly policies in an attempt to eliminate risk, a more effective and less costly approach is to ensure predictable, resilient policy frameworks, efficient markets and robust institutional arrangements that allow us to look ahead and to respond quickly

if we need to. Apart from the highly exceptional circumstances that could arise from major unforeseen national, regional or global security events, the Australian Government believes that the practical set of energy security developments considered possible in the foreseeable future can be managed effectively using existing energy security mechanisms and market responses.

That said, Australia's energy security policies are continuously informed by and interface with Australia's broader national security framework, including any relevant needs or emerging risks and threats. For example, critical infrastructure resilience is an element of energy security that complements the interests of national security.

From the strategic defence perspective, the Australian Government is committed to ensuring that Australia's energy security is not compromised. The *Australian Defence Force Posture Review*, released in May 2012, addresses a range of current and emerging global, regional and national strategic and security factors (Australian Government 2012a). This includes energy and other security issues associated with expanding offshore resource developments in Australia's north-west and northern approaches.

4.3.2 Adjusting to new market dynamics

Carbon pricing, growing export opportunities, new technologies and evolving consumer preferences are changing the dynamics of Australia's energy markets. While our refining sector is undergoing structural change consistent with global trends in the industry, our liquid fuel market is comparatively stable. This is largely because this market was internationalised through price parity and supply in earlier decades.

However, this is not the case in our coal and gas markets, in which domestic prices are expected to become more closely linked with international prices as our LNG and coal exports increase competition in domestic markets and as international carbon markets expand.

New dynamics in Australia's gas and electricity markets have yet to mature, and the impacts of changes are not yet fully understood. Market competition is expected to intensify, and large users will look for more sophisticated and flexible ways to manage supply and price risk. As markets adjust, there are likely to be transitional pressures and conservative strategies are likely to guide market behaviour.

These pressures may push gas prices, and to some extent coal prices, towards international or netback levels[3] over the course of the decade, with a consequent impact on the competitiveness of large energy users as well as higher prices for other consumers. This has led to some suggestions that more commercially attractive export opportunities, particularly new LNG developments, may be compromising Australia's energy security, particularly our low-cost energy base, and are not necessarily in the nation's long-term interests.

The government strongly supports the efficient development of new supply, infrastructure and downstream industries in Australia, and believes that markets and competitively formed prices are a natural and necessary balancing mechanism providing the critical incentive to guide efficient development.

Export development will continue to play a critical role in Australia's energy future and bring substantial economic benefits to the nation, and particularly to the regions where developments are located. Many new energy resource developments are unlikely to have occurred without export prices and volumes to justify their massive capital infrastructure requirements, or would have been delayed until domestic prices rose well above historical levels. In particular, many of the LNG projects currently underway will provide a critical long-term backbone for the continued development of Australia's domestic gas markets and our energy security.

3 The LNG netback price is based on the delivered price of the gas, less the costs of marketing, liquefaction and transport (BREE 2012i).

While there will need to be a period of readjustment and learning by market participants, financiers, regulators and policymakers, there is no clear evidence at this point to suggest that our energy markets cannot deliver as needed.

Transitional pressures and market development issues in the liquid fuel, gas and electricity markets are discussed in more detail in chapters 8, 9 and 10, respectively.

4.3.3 Managing our IEA 90-day stockholding obligation

Australia's ongoing liquid fuel security is not considered to be at risk, given our access to international supply chains, however our membership of the IEA and 90 day oil stockholding obligation needs to be managed.

Although our five-year average stock levels have not fallen, continually increasing net imports of liquid fuels have led to an increased stockholding obligation, which Australia's commercial stockholdings no longer meet. The projected long-term decline in Australian domestic oil production, combined with growing liquid fuel demand, suggests that Australia's IEA stockholding gap will continue to increase in the absence of action. The 2011 NESA did not find any evidence that breaches of Australia's IEA stockholding obligation were an indication of a decline in domestic energy security.

The IEA collective emergency response arrangements help provide added insurance against the effects of a temporary large-scale global supply disruption and are an important part of global energy security.

The Australian Government is currently considering possible options to respond to the issue of Australia's non-compliance with the IEA 90-day stockholding obligation.

4.3.4 Providing a resilient energy security response

Many of the challenges in our energy future will be managed through well-designed policy and regulation, along with targeted support from governments to help mobilise the private sector and markets. However, the likely prospect of further significant changes in national and global energy systems, as well as evolving relationships between the energy sector and other sectors mean that our frameworks and systems need to be constantly monitored and tested in line with those developments.

In that sense, this Energy White Paper plays a key role in testing whether our policy frameworks and markets are resilient to emerging challenges and risks.

The government will also institutionalise the biennial release of the NESA, with the next assessment to be delivered in 2014. The NESA framework will be reviewed with the aim of providing a more systematic assessment of energy security risks, and the associated resilience measures for managing those risks. As part of the NESA review, consideration will be given to whether the use of quantitative indicators can better inform the assessment.

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 way. Therefore, the government will undertake a national energy risk preparedness audit across the energy sector as part of the NESA process to test the appropriateness and effectiveness of response mechanisms for managing critical risks to the sector.

In addition to these assessments, the government will continue to implement policies and measures to improve the resilience of Australia's energy system by:

- promoting the timely, efficient and sustainable development of Australia's energy resources
- encouraging diversity of supply, infrastructure reliability and supply chain resilience

- undertaking further reforms to ensure robust energy markets that provide reliable and efficient supply-side and demand-side outcomes
- providing climate policy certainty through the Clean Energy Future Plan, particularly the carbon pricing mechanism
- ensuring that energy and related resource policies are appropriately and efficiently integrated with climate change and other key environmental policy frameworks, such as those covering biodiversity, water, pollution and marine protection
- supporting the development of new energy generation and end-use technologies, diversifying the energy system and reducing critical dependencies
- undertaking the four-yearly strategic reviews of energy policy (as discussed in Chapter 1: *A framework for national energy policy*)

Acknowledging the relationship between Australia and the global energy market, the government will also continue to work to:

- provide a stable, attractive and open economy that facilitates international trade and investment
- undertake effective international engagement and collaboration with key trading partners and international energy organisations
- promote well-functioning international energy markets.

The focus should remain on developing mutually reinforcing policy frameworks that deliver our energy security objectives, enhancing markets while maintaining Australia's economic prosperity, and meeting our social, environmental and climate goals.

Stable policy is central to the delivery of the framework and our energy security objectives. Without this fundamental underpinning, it will be difficult or more costly to attract investment to meet our energy needs.

4.4 Measuring policy success

Policy success in this area over the next decade will maintain or improve our liquid fuel, gas and electricity security. It will include:

- well-functioning energy markets with resilient and diverse international and national energy supply chains
- the effective mitigation of transitional or other market risks and the management of supply challenges, so that market intervention is used as a last resort to minimise serious disruptions of energy services to consumers
- timely and effective responses to unforeseen disruptions or critical events
- the maintenance of an investment pipeline into Australia's energy systems that is able to meet our projected energy needs
- an improved understanding of critical interdependencies in domestic and international energy markets.

Energy security policy actions

In addition to actions already underway through its energy security and energy policy frameworks, the Australian Government will pursue improved energy security by:

- undertaking a rigorous assessment of the costs and benefits associated with options to address Australia's 90-day oil stockholding compliance
- regularly monitoring and assessing Australia's energy security situation, including by undertaking the National Energy Security Assessment (NESA) on a two-yearly basis, starting from 2014
  - This will include reviewing the NESA framework to provide a more quantitative assessment of energy security risks.
  - It will also include the development of a risk preparedness audit of Australia's energy sector in collaboration with states and territories, industry and market bodies to identify risks, map existing response mechanisms and identify whether there are any critical gaps.

5 Energy resources

Highlights

- Australia has abundant world-class renewable energy resources and many decades worth of coal, gas and uranium, with good potential for more discoveries. Our oil reserves are more limited but could be supplemented through new discoveries and technological advances.
- With around $290 billion of energy resource projects in planning or under development, we are well placed to supply our domestic energy needs and service global energy markets over the coming decade. These projects will make an enormous contribution to our economy, in particular through jobs and regional development.
- However, high energy commodity prices have stimulated intense competition for investment and new supply from other producers, so there is no room for complacency. As a relatively high-cost producer, we must continue to improve our competitiveness to attract further investment and lock in a long-term pipeline of new exploration and development projects.
- The private sector will develop the vast bulk of our energy resources and is well equipped to overcome many of the technical challenges associated with those developments. Government has an important role in ensuring that there are clear and supportive policy and regulatory frameworks to guide efficient development. The key policy challenges in this area include:
  - promoting competitiveness by streamlining and improving regulation
  - improving prospectivity by building our energy resources knowledge base, and continuing to provide high-quality geoscientific information
  - managing co-development pressures and ensuring that developments are economically, socially and environmentally sustainable, and support the transformation to a clean energy economy
  - improving our capacity to support development by ensuring that infrastructure keeps pace with energy and export needs and that there is a skilled and available workforce.
  - promoting opportunities for local businesses and Indigenous communities.

Continued economic and social expansion in the rapidly industrialising economies of Asia is fuelling growing demand for Australian energy resources. We are now a leading supplier to markets such as China, Japan and Korea, and into emerging markets such as India.

There is an impressive pipeline of energy resource investments, but around a third of that investment has yet to be finally decided. In an increasingly competitive environment, our focus must be on ensuring that committed projects go ahead and on facilitating new projects from early stages through to delivery.

Australian society increasingly demands that economic development, particularly the exploitation of our natural resources, is undertaken sustainably and with social, environmental and economic considerations equally in mind. This is a shared responsibility: government, business and the community all need to make important contributions to find lasting solutions.

5.1 Overview

Australia's energy resources sector has undergone a massive expansion since the last Energy White Paper in 2004. For most Australians, the physical manifestations of this growth are out of sight in regional and remote locations and, for many, out of mind. However, the economic benefits flow to us all.

Earnings from Australia's energy resource exports reached a record of around $70 billion in 2010–11, accounting for about one-third of our total exports in that year. This growth will continue: export earnings are forecast to be $82 billion in 2012–13 (BREE 2012b) and to grow at an average of around 4% per year out to 2034–35 (BREE 2011c).

While the continued expansion of the energy resources sector has added to pressures in some parts of the economy, it has also created valuable business and job opportunities in many supporting activities and in many of Australia's regional areas. The contribution of the sector to the economy is broader and deeper than is commonly appreciated. For example, in 2010–11 the black coal industry employed more than 48 000 people across Australia, and thousands were employed in supporting industries. The oil and gas extraction sector employed 13 000 (BREE 2012b), and that number is expected to increase sharply over coming years as several liquefied natural gas (LNG) projects enter the peak construction phase.

In financial terms, the energy resources sector also contributes significantly to the Australian economy. In 2011, the oil and gas sector contributed a total of $23.7 billion. Similarly, in 2011 the coal industry contributed $21.8 billion in direct value added (ABS 2012a). This stimulated a large indirect contribution to the economy through the industries supporting resource developments, such as the engineering, maintenance and construction, financial services, contract mining, mining services and transport and storage sectors.

It is undeniable that Australia is much better placed as an economy because of the continued development of our energy resources (Stevens 2011). The challenge is to sustain this economic success while also managing the resulting economic, social and environmental pressures so that its full benefits can be realised across Australia through coming decades.

5.1.1 A pipeline of investment

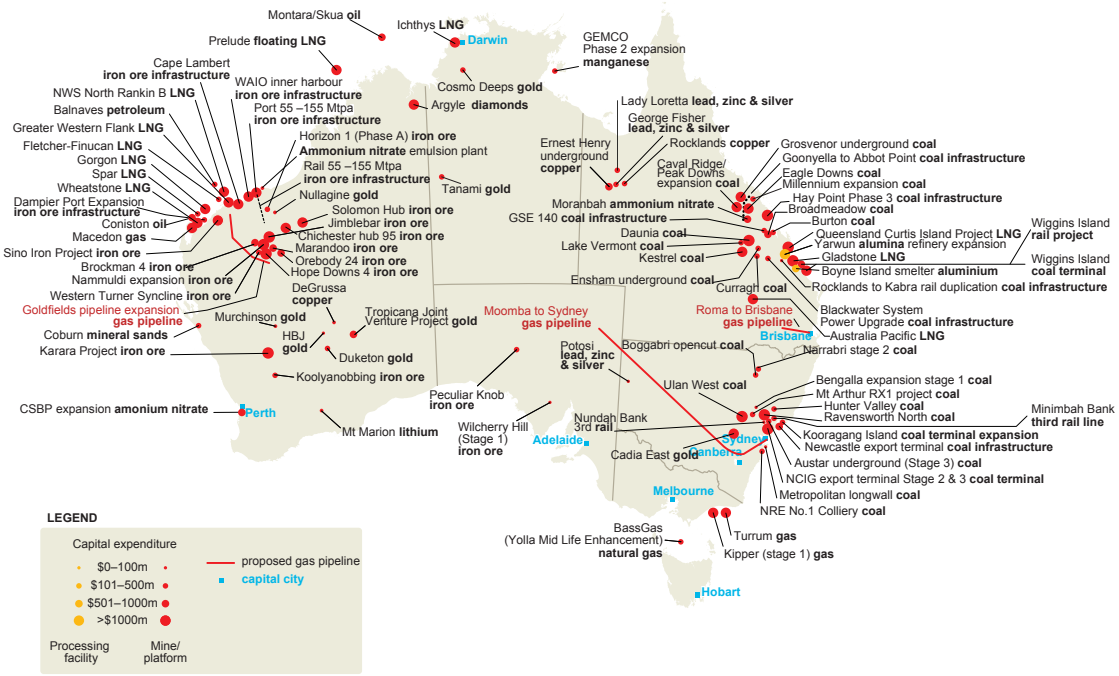
Energy resource development companies have announced a stream of Australian projects worth more than $290 billion. Of this, advanced energy projects account for $197 billion (BREE 2012e). Advanced energy and mineral resource projects are illustrated in Figure 5.1.

This investment is dominated by gas developments. Seven LNG projects under construction, valued at over $164 billion, will more than triple Australia's LNG export capacity from around 24 million tonnes to over 80 million tonnes per year (BREE 2012e), putting Australia on track to be the world's second-largest exporter of LNG in 2015 and potentially the largest exporter by 2021.

There has also been a suite of new investments in coal to expand existing operations and launch new developments. Increasing demand has meant that an entirely new coal precinct has opened up in Queensland's Galilee Basin.

In the past 10 years, around $30 billion has been invested to develop and improve port, rail and other export infrastructure to service our energy and mineral resource industries (BREE 2012f). This investment must continue to ensure that our export infrastructure keeps pace with the growing demand for our resources.

Figure 5.1: Advanced mineral and energy projects in Australia, April 2012



Source: BREE (2012e).

5.1.2 Our energy resource potential

Australia possesses abundant world-class energy resources. High-quality non-renewable energy resources are widely distributed across the country. With the exception of oil, they are projected to last well into this century at current rates of extraction.

Our renewable energy resources, many of which have yet to realise their full potential, and emerging unconventional energy resources and technologies also create almost limitless opportunity to diversify our energy mix and support the transition to a clean energy economy (see Chapter 6: *Clean energy* for details on how Australian Government policy is supporting the development of these important resources).

Unlocking this potential is challenging. There are resource-specific technical and economic barriers (for example, the challenge of deepwater drilling for oil and gas and constructing closed water transfer loop systems in deep hot rock formations), as well as environmental and social challenges.

The protection and management of Australia's important environmental assets is fundamental to the sustainable development of our onshore and offshore energy resources sector. Demonstrating that energy projects can operate safely and responsibly, particularly in environmentally sensitive areas and in harmony with other land and resource users, is essential for future resource development.

Coal

Coal is, and will remain, an integral part of Australia's economy through its contribution to regional economic and social development, the revenue it provides and its important role in underpinning our ongoing energy security.

A well-advanced pipeline of coal mining projects is under development, including $17 billion of investment already committed and around $40 billion under consideration. Another $10 billion has been committed for coal infrastructure such as rail and ports, with a further $38 billion under consideration (BREE 2012e).

Exports of thermal and metallurgical coal are expected to grow strongly to between 527 million tonnes and 689 million tonnes a year by the middle of the next decade (BREE 2012f). The domestic outlook for coal is also positive. Black thermal coal production is likely to remain strong through to 2035. Australia's brown coal industry, which has historically been tied to brown-coal-fired generation in the Latrobe Valley, rather than to export sales, faces potential decline over the longer term unless cost-effective emissions reduction technologies can be commercialised or alternative uses for the resource can be found (see Box 5.1).

Coal producers face continuing challenges, including co-development pressures, infrastructure bottlenecks and the need to adjust to carbon pricing. Recognising these pressures, the Australian Government has established transitional assistance arrangements under the carbon price package for 'gassy' coal mines, as well as for the highest-emitting power generators.

Box 5.1: The future of lignite

Victoria's Latrobe Valley contains over 20% of the world's economically demonstrated reserves of lignite (brown coal). Lignite is a competitive source of energy for electricity generation and provides more than 90% of Victoria's supply.

While Victoria's lignite has very low levels of contaminants it has high moisture content (around 60%–70% by weight). This means that a significant amount of the energy is expended in evaporating the water in the coal during combustion. As a result, greenhouse gas emissions from brown coal are higher than those from black coal and other fossil fuels, such as natural gas.

The major challenge in exploiting these resources is in developing commercially viable technologies that can use lignite more efficiently, particularly by producing substantially lower net CO_2 lifecycle emissions.

The Australian and Victorian governments announced the Advanced Lignite Demonstration Program on 3 August 2012 under which each party will contribute up to $45 million to fund upgrading processes for raw lignite that link to fully integrated lignite projects offering prospective end-use products and processes for many possible applications.

Technologies eligible for funding under the program must encompass coal upgrading and will include, but not be limited to, drying, dewatering, liquefaction, char production and separation. The program may also include funding for pre-commercial coal conversion technologies, such as combustion and gasification, where they are directly related to the pre-commercial coal upgrading technology.

The aim is to maximise the economic, environmental, technological and social benefits from the economic use of the Latrobe Valley's extensive lignite reserves while ameliorating environmental impacts.

The Advanced Lignite Demonstration Program will complement Victoria's first carbon capture and storage project, CarbonNet. The project aims to capture carbon emissions from power plants, industrial processes and new coal-based industries in the Latrobe Valley and store it in geological basins. Combined funding of $100 million ($70 million from the Australian Government and $30 million from the Victorian Government) will support feasibility work as part of the $1 billion plus CarbonNet project to demonstrate low-emission brown coal electricity generation in the region.

In addition, initiatives such as the Victorian Government's new brown coal market assessment have the potential to stimulate innovative forms of economic activity in regional Victoria.

The long-term sustainability of the thermal coal industry will depend on the successful commercialisation of carbon capture and storage and low-emissions technologies in Australia and elsewhere (government support for the development of carbon capture and storage technologies is outlined in Chapter 6: *Clean energy*). New technologies may also offer the opportunity for unconventional uses of stranded coal assets through synthetic fuel technologies, such as coal-to-liquids or coal-to-gas.

Uranium

Australia has around a third of the world's uranium resources, and our identified resources have more than doubled over the past two decades (BREE 2012a). Our uranium makes an important contribution to the world's supplies of low-carbon energy.

Australia's uranium exports were worth $610 million in 2010–11 and are expected to continue to grow to 2012–13.(BREE 2012b). The size of Australia's uranium deposits and the number of new projects in the planning stages suggest that there is potential for further expansion in coming decades despite the recent decision on Olympic Dam.

Uranium is currently mined in the Northern Territory and South Australia, and new projects are under development in Western Australia. In March 2012, the New South Wales Government lifted a ban on uranium exploration in that state, which brings it into line with Queensland in allowing exploration but not mining. To support further exploration and development, the Australian Government encourages New South Wales and Queensland to consider lifting their bans on uranium extraction in future.

Our uranium resource base, combined with our mining expertise and leadership role in nuclear non-proliferation, means that we have the potential to increase production and exports over this decade to a level commensurate with our resource endowment. In increasing our market share, the sector faces challenges similar to those in other resource sectors, but also some sector-specific challenges.

One is the transport of uranium, which is currently shipped out of the ports of Adelaide and Darwin. Since 2008, the number of global shipping routes available to Australian producers has declined. Australian governments and the industry are working to achieve national consistency in transport regulation for uranium, including by opening up additional ports (particularly on Australia's east coast) and increasing access to international shipping routes to better meet international demand and improve competitiveness.

Gas

Natural gas is Australia's third-largest energy resource after coal and uranium. Our reserves of conventional and unconventional gas are located across the country. Most conventional gas deposits are offshore in north-western Australia and Bass Strait, while coal-seam gas (CSG) and shale/tight gas can be found in most Australian states and territories.

Australia has identified gas resources of 431 706 petajoules (PJ), or 392 trillion cubic feet (tcf) (Table 5.1), of which economic demonstrated reserves account for 149 305 PJ (136 tcf). This is around 184 years of gas at current production rates. There are additional potential in-the-ground CSG and shale gas resources of around 694 488 PJ (631 tcf), although those resources remain relatively poorly understood and quantified (RET, GA & BREE 2012).

Table 5.1: Total Australian gas resources

Resource category	Conventional gas		Coal-seam gas		Tight gas		Shale gas		Total gas	
	PJ	tcf	PJ	tcf	PJ	tcf	PJ	tcf	PJ	tcf
EDR	113 400	103	35 905	33	–	–	–	–	149 305	136
SDR	59 600	54	65 529	60	–	–	2200	2	127 329	116
Inferred	–11 000	–10	122 020	111	22 052	20	–	–	155 072	141
All identified resources	184 000	167	223 454	203	22 052	20	2200	2	431 706	392
Potential in ground resource	unknown	unknown	258 888	235	unknown	unknown	435 600	396	694 488	631
Resources—identified, potential and undiscovered	184 000	167	258 888	235	22 052	20	435 000	396	900 540	619

EDR = economic demonstrated resources; SDR = sub-economic demonstrated resources; tcf = trillion cubic feet.

Note: Conventional gas demonstrated resources as of January 2011; CSG demonstrated resources as of January 2012. CSG probable reserves and contingent resources are used as proxies for EDR and SDR, respectively.

Source: RET, GA & BREE (2012).

Australian gas production is expected to almost triple to 2020 and to grow at an average of 5.5% a year to 2034–35 as reserves in north-western Australia are developed and CSG production in eastern Australia comes on line (BREE 2011c). This growth will be driven largely by LNG exports.

Further details on Australia's gas markets are in Chapter 9: *Energy markets: gas*.

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 more likely to be in deep water, smaller and higher cost. In the medium term, sustained high oil prices and new production technologies may enable the 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 deepwater frontier basins (such as in the Great Australian Bight). We also have large undeveloped oil shale resources that require significant processing to release liquid hydrocarbons (GA–ABARE 2010). The development of onshore shale gas may also unlock unconventional liquid hydrocarbons.

Issues relating to Australia's liquid fuel markets, including the development of alternative fuels, are discussed further in Chapter 8: *Energy markets: liquid fuels*.

Renewables

Australia is fortunate to have high-quality and widely distributed wind, solar, geothermal, hydro-electricity, ocean energy and bioenergy resources with enormous commercial potential. With the exception of hydro-electricity, for which the available resource is largely developed, and wind energy, which is growing rapidly, our renewable energy resources are mostly underdeveloped.

However, various commercial, technological and development challenges must be overcome before the potential is realised—most of which will be addressed by the private sector. Government support for renewable energy development and policy challenges are discussed further in Chapter 6: *Clean energy*.

5.2 Energy resource development policy framework

The Australian Government uses the following policy objectives, principles and elements to support the sustainable development of Australia's energy resources.

Policy objective

To support the sustainable development of Australia's energy resources, including by:

- ensuring that Australia's energy resources are sustainably developed for the benefit of all Australians
- providing reliable and competitively priced supplies of energy resources
- enhancing Australia's role as a leading reliable global supplier of energy resources.

Principles

- The efficient commercial development of our energy resources should be promoted to provide the highest-value return for the community.
- Energy resource development should be safe and sustainable, and consistent with all relevant national environmental and health and safety standards and obligations.
- The development of Australia's energy resources should contribute to our ongoing domestic energy security.
- The development our energy resources should enhance Australia's international competitiveness.
- Our energy resource development framework should interface appropriately and effectively with other relevant markets or regulatory frameworks to support efficient investment in upstream development and downstream supply capacity.

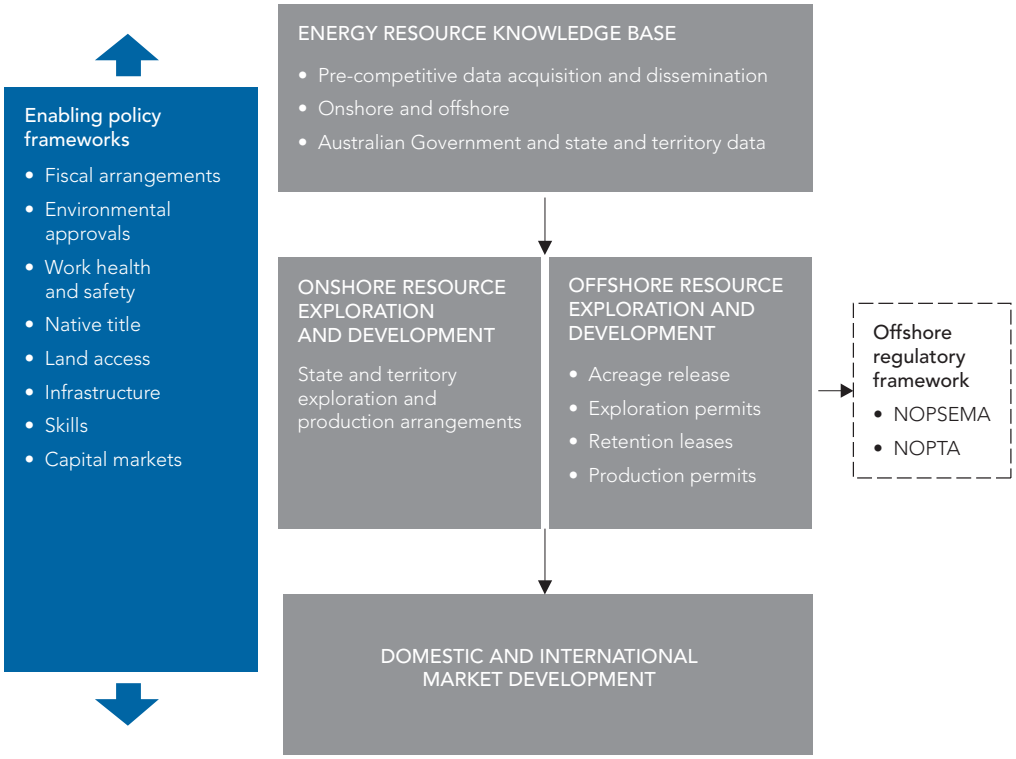
Framework elements

The government's energy resource development framework has four central elements:

- the energy resource knowledge base, including pre-competitive data acquisition and dissemination
- offshore resource exploration and development arrangements
- onshore resource exploration and development arrangements
- domestic and international market development.

Reflecting Australia's constitutional arrangements, Australia's energy resource development framework is governed by policies at the national, state and territory, and local government levels. Four specific resource development components, as well as a number of intersecting policy frameworks, shape the overall business environment (Figure 5.2).

Figure 5.2: Australia's energy resource development framework



NOPSEMA = National Offshore Petroleum Safety and Environmental Management Authority; NOPTA = National Offshore Petroleum Titles Administrator.

Onshore petroleum and mineral resources are regulated by the state or territory in which they are located.

The Australian Government is responsible for offshore petroleum resources (from the limit of the coastal waters to the limit of Australia's continental shelf), although in some cases those resources can be cooperatively managed with the relevant state or territory in cross-jurisdictional projects.

The government also has a key role in the regulation of onshore and offshore projects that trigger certain matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999*. Other important enabling Australian Government policies that affect energy resource development include those concerning native title, land access, fiscal arrangements, infrastructure provision and workforce development.

5.2.1 Australia's energy resource knowledge base

A comprehensive dataset of Australia's energy resources is important for attracting early commercial interest. The Australian Government, through Geoscience Australia, provides companies and other interested parties with pre-competitive geoscientific information. This information base and the pre-competitive information program is developed in consultation with state and territory agencies and industry to ensure strategic targeting and relevance.

The information helps businesses to assess the potential risks and rewards of more detailed exploration and can substantially enhance prospectivity (the chance of finding and commercialising resources). Because of the 'public good' nature of this information, it is collected or acquired by government and made available to interested parties at minimal cost.

The Australian Energy Resource Assessment is a comprehensive and integrated scientific and economic assessment of Australia's energy resources, both onshore and offshore. It 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.

5.2.2 Offshore resource exploration and development

Offshore petroleum activities in Australia are regulated by the Australian, state and Northern Territory governments.

Operations beyond 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'). Offshore petroleum activities in both state/territory and Commonwealth waters are also regulated under the Environment Protection and Biodiversity Conservation Act.

The legislation covers exploration for petroleum resources, their production and the geological storage of greenhouse gases and sets out a framework of rights, entitlements and responsibilities of governments and industry. It provides for a system of petroleum exploration, retention and production lease arrangements as well as core environmental and operational safety regulations.

While ultimate responsibility for Australia's offshore areas beyond three nautical miles from the territorial baseline rests with the Australian Government, the regulatory regime is jointly administered and offshore petroleum industry activities are supervised cooperatively with each state and the Northern Territory through 'joint authority' arrangements.

Regulation of petroleum activities in offshore waters

On 1 January 2012, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) became the regulator of petroleum activities in Commonwealth waters. NOPSEMA performs regulatory functions in relation to occupational health and safety; the structural integrity of facilities, wells and well-related equipment; environmental management; and the regulation of day-to-day petroleum operations. At the same time, the National Offshore Petroleum Titles Administrator (NOPTA) was established to provide advice to the joint authorities, administer titles and manage data.

These reforms retain the joint authority, comprising the Australian Government minister and the relevant state or Northern Territory minister, as the key decision-maker on petroleum titles in Commonwealth waters. Other reforms include the provision for statutory timeframes to prevent unnecessary delays in title decisions. State and Northern Territory governments have also been given the option of conferring their regulatory and administrative powers in their coastal waters on NOPSEMA and NOPTA.

Exploration acreage release

The Australian Government administers the annual offshore petroleum exploration acreage release which facilitates petroleum exploration in Australia's offshore areas. Each year, the Department of Resources, Energy and Tourism releases offshore exploration acreage for competitive bidding by prospective explorers. This enables industry to plan for the longer term and provides certainty in the release process.

In support of the acreage release, Geoscience Australia provides comprehensive pre-competitive geological and geophysical data to assist explorers in assessing the areas on offer. Ready access to this geoscientific information encourages new companies to consider Australian exploration opportunities.

The government is currently considering whether there are benefits in using a cash bidding basis for some acreage release, rather than the current work program bidding arrangements.

Offshore retention leases

Retention leases provide security of title over petroleum resources discovered through an exploration permit that are not yet commercial but have genuine development potential (that is, development is likely to be commercially viable within 15 years). They were introduced in 1985 to encourage oil and gas explorers to work in deeper water and commercially challenging areas. The retention lease holder is expected to address barriers that prevent the commercialisation of petroleum resources in the lease area during the retention lease term. Retention leases are issued for five years and can be renewed for further five-year periods, subject to meeting set criteria.

5.2.3 Onshore resource exploration and development

Onshore resources-related activities in Australia are generally the responsibility of state and territory governments. While each maintains separate legal and regulatory frameworks, those regimes are similar in content and administration and are generally based on exploration and production titles.

Increasingly, national cooperation is occurring on resource development frameworks and regulatory arrangements. The Standing Council on Energy and Resources has an active role in setting policy and regulatory direction to improve the governance of Australia's energy resource development.

5.2.4 Market development

Australia's energy resource market development framework promotes openness, transparency and competition in the markets. It seeks to secure access to key economies and global markets, add value to existing markets, foster participation in emerging markets, and plan for periodic fluctuations in demand for our energy resources.

The Australian Government uses bilateral, multilateral and ministerial engagement mechanisms to promote trade and investment opportunities by engaging with other governments and by facilitating their engagement with Australian industry.

5.3 Policy challenges and priorities

Few countries can compete with Australia's attractiveness for energy resource development. In addition to available and potential resources, we offer 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 positioned at the doorstep of the Asia–Pacific region.

The dramatic growth in energy demand across our region means that we potentially have a once-in-a-generation window of opportunity to lock in investments that will generate a long-lived stream of income and other benefits if we can capitalise on our strengths.

Central to this is our ability to attract foreign investment and promote and develop a stream of new projects into the future. This will depend on factors such as prospectivity; an attractive business environment with stable and efficient policy and regulatory settings; access to supporting infrastructure and skilled workforces; efficient commercial markets; and supportive fiscal regimes.

Australia is well placed on many resource development indicators, such as the 2011 World Risk Survey, in which we were ranked seventh overall. However, in the 2004 survey Australia was ranked first, which shows that investment attractiveness can change quickly. As global energy supply– demand balances change and prices adjust, or political and economic circumstances alter, the risk–reward ratio starts to shift and countries once considered less appealing can become attractive investment destinations.

High global energy prices have stimulated supply responses and we face growing competition as an increasing number of countries develop their energy resources. Many competitors have lower costs of production and, as they are relatively underexplored for energy resources, are perceived

as more prospective than Australia. In the next few years, Indonesia is likely to overtake Australia as a thermal coal producer, and new LNG capacity will emerge in the Middle East, the Caribbean, North America and possibly East Africa. Improving our industrial productivity and providing a business-friendly investment environment will be major factors in maintaining our competitiveness.

In this context, there are challenges we must overcome to gain the maximum return on our national energy assets and build on our attractiveness as an investment destination. They include:

- promoting more efficient and effective business regulation
- promoting the safe and sustainable development of our energy resources
- enhancing our energy resource prospectivity
- addressing capacity constraints
- capturing opportunities for local industries and communities.

5.3.1 Promoting more efficient and effective business regulation

Australia is becoming a high-cost producer compared to some potential energy suppliers, so maintaining efficient and effective regulatory frameworks to continue to attract new investment is important. The Australian Government, in conjunction with states and territories, is undertaking several key reforms in this area to reduce the costs of regulation, increase productivity and improve offshore oil and gas regulation, including development approval reforms.

Reducing the costs of regulation and enhancing productivity

In April 2012, following discussions at the Business Advisory Forum, the Council of Australian Governments (COAG) agreed to reforms in six priority areas to strengthen Australia's competitiveness and productivity:

- addressing duplicative and cumbersome environmental regulation
- streamlining the process for approvals of major projects
- rationalising carbon reduction and energy efficiency schemes
- delivering energy market reforms to reduce costs
- improving assessment processes for low-risk, low-impact developments
- lifting regulatory performance by implementing best-practice approaches.

To advance this work, COAG has established an interjurisdictional taskforce chaired by the Secretary of the Australian Department of Finance and Deregulation and consisting of officials from First Ministers and Treasury portfolios. The taskforce will report to the next meeting of the Business Advisory Forum and COAG in late 2012.

Improving offshore oil and gas regulation

The government has undertaken reforms to offshore oil and gas regulation to improve the effectiveness and consistency of health, safety and environmental regulation and thereby reduce business costs. Further reforms are in train to promote greater transparency in offshore oil and gas development approvals.

In April 2009, the Productivity Commission's Review of Regulatory Burden on the Upstream Petroleum (Oil & Gas) Sector identified significant unnecessary costs from delays and uncertainties in obtaining approvals, duplication of compliance requirements, and inconsistent administration of regulatory processes (PC 2009). It found that these burdens could be reduced through new institutional arrangements—principally the establishment of a national offshore regulator—and the implementation of best-practice regulatory principles in all jurisdictions.

Inquiries into the 2008 Varanus Island pipeline explosion and the 2009 Montara well blowout also highlighted some inadequacies in petroleum regulatory oversight and gaps arising from overlapping safety regulations. The government has moved to implement the actions outlined in its final response to the Offshore Petroleum Safety Regulation Inquiry and the report of the Montara Commission of Inquiry.

In response to the recommendations of those reviews and inquiries, the government established new regulatory arrangements for petroleum activities in Commonwealth waters. The National Offshore Petroleum Safety and Environmental Management Authority now regulates petroleum activities in Commonwealth waters, and the National Offshore Petroleum Titles Administrator provides advice to the joint authorities, administers titles and manages data for Commonwealth waters.

Offshore development approval reforms

While the introduction of the retention lease framework has served the offshore sector well, the Australian Government believes that its implementation can be improved. Consultation undertaken as part of the review of the retention lease framework supported the continuation of the system, with broad support for the commerciality test, greater transparency, and reviews of work programs in advance of formal notification of intent to offer the grant or renewal of a retention lease.

Improving transparency will benefit titleholders and assist third parties to comment on retention lease awards or renewals and offer alternative development options. However, legitimate commercial data and information will remain protected.

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 national interest. To better reflect the realities of LNG development and the need to provide certainty of gas supply over long project timeframes (30 years or more), the government will consult industry on potential changes involving a 'project title' concept, balancing the need for certainty with other pressures, including promoting commercial domestic gas supply.

These changes will ensure that policy settings and the administration of retention leases are appropriate in the light of future energy needs. The new arrangements will also ensure that petroleum resources are brought into development in a timely fashion. In addition, the government will have greater regard for the potential of projects to supply the domestic market, where that is commercially feasible, when considering the granting of a production licence.

The establishment of NOPTA has provided greater certainty about approval timeframes, parameters for ministerial decisions, commerciality tests and triggers for reviews.

5.3.2 Promoting the safe and sustainable development of our energy resources

It is important that the development of Australia's energy resources occurs in ways that are environmentally, economically and socially sustainable. This responsibility is shared between industry and all levels of government. In recent times, the importance of sustainability and community engagement has been highlighted during the development of various energy-related activities, including CSG, LNG, wind and coal resource projects.

The Australian Government maintains a comprehensive environmental protection and management framework that covers energy resource projects for which the government is responsible. Those responsibilities and key policy frameworks are described in more detail in Chapter 12: *Sustainability, workforce and Indigenous opportunities*, along with reforms underway to streamline their operation and improve their effectiveness.

In addition, Australia's offshore petroleum regulatory framework provides for the safe and environmentally responsible development and operation of oil and gas projects in Commonwealth waters, including the geological storage of carbon dioxide.

Safely developing our gas resources

The development of new unconventional gas resources in Australia and in other countries has sometimes been controversial, generating highly visible and passionate debate. Currently, attention is focused on the development of new CSG deposits, particularly the use of chemical agents in underground seam fracturing, and on water extraction and the potential for contamination. Concerns have also been expressed about the loss of productive farmland and reduced local amenity (from noise, dust and traffic), greenhouse gas emissions, land subsidence, and induced seismicity (earth tremors). The government takes these concerns seriously.

Because CSG is an onshore energy resource, the primary responsibility for its regulation lies with the state and territory governments. By itself, the extraction of CSG or other forms of gas does not provide a trigger for Commonwealth regulation except where it is likely to have significant impacts on matters of national environmental significance, as defined by the Environment Protection and Biodiversity Conservation Act.

Where the Act has been triggered, the Australian Government has adopted a conservative approach to approving CSG projects. Conditions that are adaptive have been applied, which means that improvements and changes to the regulatory requirements can be made to take into account changing scientific knowledge and to more fully consider cumulative impacts from multiple projects.

As part of the announcement of new CSG approval arrangements by the Prime Minister in November 2011, the Australian Government has entered into the National Partnership Agreement on Coal Seam Gas and Large Coal Mining Development with the New South Wales, Victorian, Queensland and South Australian governments.

The agreement provides mechanisms for each government to seek and take into account the advice of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments in relevant environmental assessment and approvals decisions. The committee will be established through an amendment to the Environment Protection and Biodiversity Conservation Act. Its role is to address knowledge gaps and to provide scientific advice on CSG and large coal mining proposals that are likely to have significant water-related impacts.

These arrangements will substantially improve the scientific evidence that informs regulatory decisions, make regulatory processes more transparent and open, and ensure that independent expert advice on all relevant project proposals is available to communities, governments and industry. The Australian Government will invest $200 million over five years to support this work.

The new initiatives complement and support existing research by the Australian Government and its agencies on CSG and other resource extraction activities that may affect groundwater. This includes:

- work by the National Water Commission to examine the local and cumulative effects of mining on groundwater
- work by Geoscience Australia to assess the potential impacts to groundwater resources by providing advice on regional hydrological characterisations (a range of collaborative scientific studies will be undertaken to address knowledge gaps through multidisciplinary data collation and analysis to support the assessment of CSG and coal mine developments)
- 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
- the Namoi Water Study, which determined the potential impacts of CSG and coal mining on water resources in the Namoi catchment
- work by the Queensland Water Commission to develop a regional groundwater model for areas affected by CSG developments.

Governments have also done extensive work to ensure that the regulatory framework for CSG in Australia is robust. The Australian Government is working with the states and territories through the Standing Council on Energy and Resources to develop a nationally harmonised regulatory framework for the CSG industry based on key community concerns and encompassing:

- water management and monitoring
- well integrity and aquifer protection
- monitoring of hydraulic fracturing and chemical use.

The implementation of a harmonised framework will generate greater public confidence in the effective regulation of the industry while supporting the commercial extraction of CSG.

State and territory governments are also independently pursuing initiatives to strengthen their regulation of CSG, improve community engagement and develop strategic land-use policies.

The future development of other unconventional gas resources, such as tight gas and shale gas, may raise similar social and environmental concerns. Although there are some significant differences between CSG and shale and tight gas (which may therefore require different treatments), it is important that governments and the industry ensure that lessons learned from the development of the CSG sector are applied to future shale gas and tight gas developments. The Australian Government will work with other jurisdictions to ensure that these resources are developed sustainably, and with appropriate community consultation.

Managing co-development pressures

While energy and mineral resource developments affect less than 1% of Australia's landmass (ABARES 2010), the expansion of mining, agricultural and residential activity in some regions is causing tension between overlapping or adjoining activities and communities. This has been particularly evident in the recent development of CSG and coal mining operations in New South Wales and Queensland and in wind energy development in southern states.

While the regulation of these activities is the responsibility of state and territory governments, there is a need to promote nationally consistent approaches that provide for responsible and sensible development and coexistence (where appropriate), based on transparent risk management and the best available science.

Historically, multiple land use has been commonplace in Australia (for example, agriculture and mining have coexisted for generations). However, the development of new energy projects in regions that have had little previous involvement with the resources sector can be challenging for people and businesses in those places.

The extractive industries are not alone in generating community tensions. For example, the growing number of wind farms has become an increasing concern in some rural communities. Some emerging technologies, such as geothermal and carbon capture and storage, have yet to test community views in practice.

Multiple land use—working towards a solution

Multiple land use involves using land for different purposes simultaneously or sequentially, and accommodating those different uses efficiently and sustainably to retain the widest options for current and future use. The aim is to maximise the net benefits to present and future generations.

Multiple and sequential land use are considered the two key components of the Multiple Land Use Framework currently under development by the National Land Access Working Group of the Standing Council on Energy and Resources. The intention is to develop a world-class multiple land-use framework which will ensure that coexistence rather than exclusion is the key driver in land-use policy. Critical for this is a deeper understanding of community engagement and better leadership of it.

In some cases, resource development may not be appropriate in or near residential or culturally and environmentally sensitive areas. On the other hand, locking up areas for specific purposes to the exclusion of sensible co-development could result in higher future costs for the nation. It would also limit the earning potential of rural landowners from cooperative access arrangements with resource companies.

Individual states and territories are also moving to improve land access arrangements. For example, the Queensland Government has developed a policy framework for land access. Resource companies must 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.

A nationally consistent approach to mine health and safety

The Australian Government, the states and territories, businesses and unions are working towards a more nationally consistent approach to mine health and safety through the National Mine Safety Framework. This aims to deliver greater consistency in legislative duties and responsibilities, more consistent approaches to risk identification and hazard management, greater worker mobility and the development of a national mine safety database to record and report incident data.

This will be encapsulated in nationally consistent mine safety legislation to commence during late 2012, in either model Work Health and Safety (Mines) Regulations or separate industry-specific mine safety legislation. The national mine safety database will be available for use from December 2012.

5.3.3 Enhancing Australia's energy resources prospectivity

Although demand for our energy resources is expected to be long-lasting, our share of global mineral exploration expenditure (within which uranium and coal are the energy commodities) is not increasing. Australia was the world leader in mineral exploration investment in the mid-1990s with a share of 20%, but this declined to 13% in 2011 (ABS 2012b).

Factors that may be contributing to this decline include perceptions of Australia as a mature exploration destination where there are fewer opportunities for discovery; intense global competition for exploration; the high cost of exploration in Australia, due to the high Australian dollar and labour costs; insufficient pre-competitive information; and the difficulty in exploring for deposits buried under the overlying sand, soil and sediment that cover much of Australia.

To sustain the contribution of Australia's mineral and energy resources to the national economy in the longer term, additional high-quality resources need to be discovered and developed. In particular, Australia needs world-class discoveries in new greenfield areas. The challenge is to make our greenfield areas some of the world's most attractive investment destinations.

Support for world-class pre-competitive geoscience

The value of pre-competitive geoscience in attracting exploration investment has been well documented (Australian Government 2011b). Australia's geological surveys both acquire pre-competitive geoscience information and attract industry interest. 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. The information must also be detailed enough to enable companies to assess whether investment in exploration in specific geographical areas can be justified on the basis of technical risk and the prospect of commercial returns.

Governments' continuing commitment to geological surveys and pre-competitive geoscience sends a clear message that investment in the high-risk energy resource exploration and development industry is welcome.

A national mineral exploration strategy

Establishing frameworks and policies that are conducive to exploration and will develop the next generation of Australia's energy and mineral resources is critical. The Australian Government believes that a national mineral exploration strategy is required, including:

- a national geoscience research initiative
- a renewed commitment to pre-competitive geoscience in all jurisdictions
- the promotion of Australia as a centre of excellence in exploration, geological surveys, resources services and research.

This initiative will be undertaken in cooperation with all states and territories through the Standing Council on Energy and Resources (SCER).

While the National Exploration Strategy is focused mainly on mineral resources (including uranium), it is also relevant to exploration for geothermal energy resources.

Removing barriers to exploration

In 2010, the Policy Transition Group advised the Australian Government that there was evidence that costly, time-consuming and inconsistent or contradictory policies and regulations were acting as potential barriers to efficient levels of exploration in Australia.

In response, the government will task the Productivity Commission to inquire into the non-financial barriers to mineral and energy resource exploration. The inquiry will determine whether there is evidence of unnecessary regulatory burden and examine Australia's framework for exploration, including the various approvals required before exploration can begin and the opportunities for improving regulatory processes.

The Productivity Commission is expected to begin the review by the end of 2012.

Filling information gaps

Because our mineral and energy resources belong to the nation, all Australians are entitled to full information about those resources and their reserves. Consistent and accurate information from all companies that mine or have rights to exploit mineral deposits in Australia also encourages further development of our resources and enables a comprehensive understanding of our resource endowment. It improves governments' ability to forecast production for policy and revenue purposes and allows industry to better assess the risks and rewards of exploration or mining.

In recent years, many resources companies have been delisted from the Australian Stock Exchange (ASX) following takeovers or mergers with other, primarily foreign-listed, companies and therefore may not be required to report publicly on exploration results, mineral resources and ore reserves. The same holds for private and foreign resources companies not listed on the ASX. Companies listed on the ASX are required to report this information publicly.

A considerable number of unlisted companies are involved in black coal exploration and extraction in Queensland, New South Wales, Tasmania and Western Australia. Only 38% of Australia's economic demonstrated resources of black coal is publicly reported. None of Australia's brown coal economic demonstrated resources is reported, as the resources are all owned by unlisted companies or overseas consortiums.

The integrity of our public resource information base may be compromised by this inconsistency in reporting. To help address this problem, the SCER is considering options to increase formal reporting of Australian resources, such as a voluntary survey, regulation reform, or the realignment and increased use of current mechanisms.

5.3.4 Addressing capacity constraints

The productivity of our energy resources sector depends on reliable access to a skilled workforce and on the availability of efficient infrastructure to deliver product to markets across the globe. Both are critical in avoiding constraints or bottlenecks along the supply chain.

Energy resources infrastructure

Australian energy resources are often in remote locations, and getting product to market reliably requires efficient rail networks, roads and ports as well as systems to ensure distribution through to domestic consumers. This section focuses largely on our export infrastructure needs, although some of this capacity is also important in maintaining supply to domestic energy and feedstock markets.

Issues relating to infrastructure for delivering energy within Australia, such as electricity poles and wires and gas pipelines, are outlined in chapters 9 and 10.

Over the past decade, the energy and resources sector has generated a wave of large-scale infrastructure investment. However, competition for investment is fierce, and remote projects inevitably compete for resources against infrastructure developments in towns and cities.

This infrastructure is provided mainly through private investment, although some common-use infrastructure can be provided or supported by the public sector. The challenge for resources companies, rail operators and port owners is to plan, build and deliver export infrastructure in the right locations, on time and in an environmentally sustainable way.

To help policymakers better understand likely future requirements, the Bureau of Resources and Energy Economics was commissioned to develop detailed forecasting of projected export infrastructure needs for Australia's bulk energy and mineral commodities. The bureau's report, *Australian bulk commodity exports and infrastructure—outlook to 2025*, was released in July 2012 (BREE 2012f).

The report showed that over $30 billion has been invested in export-facilitating infrastructure over the past decade, enabling the current expansion of wealth-creating energy and minerals projects. It also found that, on the basis of expected growth in Australia's coal and LNG exports, there is adequate planned and proposed infrastructure to meet forecast demand.

The report recognised that large-scale developments, such as infrastructure projects, are often susceptible to planning delays and that this can be a critical factor affecting upstream resource development. While it found that the risk of not having sufficient capacity under different growth scenarios is manageable, that finding relied on all planned infrastructure projects being developed on time.

The Australian Government is aware of these risks, particularly where critical infrastructure developments intersect with environmentally sensitive regions such as the Great Barrier Reef Marine Park or similar zones. For this reason, the government is working closely with the Queensland Government Port Infrastructure Working Group to ensure a coordinated approach on regulatory issues affecting the resources sector.

The Australian Government also engages in a range of investment, advisory, reform and facilitation initiatives to help developers overcome infrastructure challenges:

- Infrastructure Australia was established to support a transformation in the way Australia invests in infrastructure. It is a statutory body that advises governments on infrastructure issues, including Australia's current and future infrastructure needs, impediments to the efficient utilisation of national infrastructure networks and mechanisms for financing investment in infrastructure. It also advises on investment priorities and on policy and regulatory changes to ensure that existing infrastructure is used efficiently and to enable the timely and coordinated delivery of national infrastructure investment.

- The National Building Program is investing around $36 billion in Australia's land transport infrastructure between 2008–09 and 2013–14, including significant investments in major road and rail projects. The next phase of the program will run from 2014–15 to 2018–19 and aim to lift Australia's productivity through work on nationally significant land transport infrastructure.
- The Major Project Facilitation Program provides assistance with government approvals processes and identifies existing government assistance programs for proponents of strategically significant major projects. It aims to coordinate Australian, state and territory government processes so that, where feasible, they occur simultaneously and without duplication.
- The Regional Infrastructure Fund will inject $6 billion from 2010–11 to 2020–21 into mining communities and those that support the mining industry. Roads, rail, ports, airports, energy, water and communications infrastructure will be funded to support the mining industry's future growth and the communities that support the industry.

Workforce development

The Australian Government (together with the Australian Workforce and Productivity Agency, industry skills councils, business groups, the vocational education and training sector, and secondary and higher education institutions) will implement training and workforce planning strategies to boost skilled labour supply through education and training and by promoting participation, workforce mobility and skilled migration.

Because skills and workforce development issues in many industrial sectors are similar, they are discussed in detail in Chapter 12: *Sustainability, workforce and Indigenous opportunities*.

5.3.5 Capturing opportunities for local industry and communities

The development of Australia's energy resources occurs in cooperation with the community. It is important that opportunities for local businesses and Indigenous communities, and broader societal benefits, are captured from those developments.

Improving Indigenous opportunity

Access to Indigenous land for mining and other resource development activities can provide enormous social and economic benefits to Indigenous communities and their broader regions. The benefits include financial compensation for land access and use, 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.

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 for mutual benefit.

Efforts to promote better Indigenous opportunities involve multiple policy areas and are discussed further in Chapter 12: *Sustainability, workforce and Indigenous opportunities*.

Promoting Australian industry participation

Australia's energy resources sector creates flow-on business opportunities for Australian firms in industries such as construction, materials, maintenance and associated services. In particular, resources projects create lasting local business opportunities for servicing and maintenance in their operational phases.

For example, in 2010–11 the Queensland resources sector purchased $20.5 billion in goods and services from Queensland businesses, up from $18.8 billion in 2009–10 (MCA 2011). In addition, local content is reported to be around 60%–70% for many current LNG projects (DAE 2012).

Australian firms' access to energy resource development opportunities varies from project to project and depends on a range of commercial factors. The Australian Government does not support mandated levels of local participation, as developers' ability to maximise cost efficiencies is critical to our ongoing competitiveness. However, the government believes that Australian businesses should be given a fair opportunity to compete in the manufacture and supply of goods or services in the resources and energy sectors. The government's Australian Industry Participation (AIP) policies and programs, and initiatives such as *Buy Australian at Home and Abroad*, enhance opportunities for local businesses to participate in the growing energy and resources sector.

Following an announcement by the Prime Minister on 6 October 2011, important reforms to AIP initiatives came into effect on 1 July 2012. The reforms strengthen the Australian Government's approach to AIP and will provide more opportunities for Australian industry to win work supplying goods and services to major projects. The reforms include requiring the publication of AIP plans and outcomes, and extending AIP plans to major Australian Government grants and infrastructure projects.

5.4 Measuring policy success

Policy success will be based on Australia's ability to maintain a continuous stream of new and committed energy resource projects moving through the project pipeline, from exploration to production, and will be observed through the following outcomes:

- Australia becomes a more competitive destination for investment in the energy resources sector, including through:
  - reduced regulatory and approval costs, including efficient and effective regulatory arrangements for energy resource projects that comply with agreed timeframes for project approval while maintaining a high level of health, safety and environmental performance
  - addressing potential development bottlenecks by facilitating access to an appropriately skilled workforce and adequate efficient and competitively priced infrastructure.
- Taking into account commodity price cycles and broader economic conditions, Australia is able to:
  - maintain a robust pipeline of exploration and energy resource development projects that can meet our export and domestic energy needs into the future
  - convert prospective energy resource developments into production in a timely fashion
  - increase levels of exploration for energy resources, particularly in greenfield areas.
- A National Mineral Exploration Strategy will be developed to deliver nationally harmonised, world-class pre-competitive geoscience and an increased level of information gathering and availability.
- A multiple land-use framework is implemented and promotes more mutually beneficial co-development, rather than exclusions and disputes.
- Opportunities for Australian industry participation and Indigenous business and employment associated with energy resources development are improved.

Energy resources policy actions

To advance energy resource development in Australia, the Australian Government will:

- promote more efficient and effective regulation for the energy resources industries by:
  - working with states and territories through COAG and the Business Advisory Forum to improve business regulation
  - updating offshore petroleum retention lease arrangements to continue to promote the timely development of resources, improve regulatory transparency and facilitate third-party comment on the commerciality of offshore petroleum developments, while also providing certainty of gas supply over long timeframes including for highly capital-intensive LNG projects
  - paying closer attention to the potential for offshore LNG projects to supply the domestic gas market when assessing retention lease applications or considering the granting of a production licence
  - considering the introduction of cash bidding for offshore petroleum acreage release
- promote safe and sustainable development of our energy resources, particularly our gas resources, by:
  - working through the SCER to develop a nationally harmonised regulatory framework for the CSG industry
  - developing a better understanding of the direct and cumulative impacts of proposed coal mining and CSG developments through the formal establishment of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments
  - undertaking further work to assess the potential impacts to groundwater resources by providing advice on regional hydrological characterisations (Geoscience Australia will undertake collaborative scientific studies to address gaps in scientific understanding through data collation and analysis to support the assessment of coal-seam gas and coal mine developments)
  - working with states and territories to help ensure that shale and tight gas resources are developed sustainably and with appropriate community consultation
  - working through the SCER to develop a world-class multiple land-use framework to promote coexistence, rather than exclusion, as a key principle in land-use policy
- enhance Australia's energy resource prospectivity by:
  - supporting the continued provision of high-quality pre-competitive information through Geoscience Australia
  - updating the Australian Energy Resource Assessment every three years from 2013
  - working with states and territories through the SCER on options to improve mineral resource and ore reserve disclosure by companies not listed on the ASX
  - working with states and territories through the SCER to develop the National Exploration Strategy to address Australia's greenfield mineral exploration challenge
  - considering the recommendations of the forthcoming Productivity Commission inquiry into non-financial barriers to mineral and energy resource exploration

- address capacity constraints in our energy resource export infrastructure by monitoring its adequacy and undertaking regular forecasts of export infrastructure requirements for bulk commodities, such as coal and LNG
- capture opportunities for local industry and communities by:
  - requiring greater transparency and accountability in implementing Australian Industry Participation plans
  - working with industry to enhance firms' capability and competitiveness to win work and integrate with global supply chains.

6 Clean energy

Highlights

- Through its Clean Energy Future Plan, the Australian Government is implementing key reforms to drive a long-term transformation to a clean energy economy. The central elements most relevant to energy policy are a carbon price, renewable energy and energy efficiency. The government has committed up to $17 billion over the next decade to support more innovation and deployment of clean energy and energy efficiency, including for technology research and development, demonstration and commercialisation.
- By 2035, clean energy sources could potentially supply about 40% of Australia's electricity needs, or around four times as much as today. Around $200 billion in investment may be required by 2050 to assist in meeting Australia's national greenhouse gas reduction goals.
- Accelerating the rate of innovation, early proving of commercial potential and in-country adaptation of key technologies will help markets move to a clean energy future more quickly, and at potentially lower cost. Ultimately, the lowest-cost and most reliable technologies, as determined by the market, will succeed.
- Realising the potential of new technologies will require collaborative approaches that can make the best use of Australia's strengths and capabilities.
- Growing global markets for clean energy technologies are already helping to drive down clean energy costs. Australia should be flexible and ready to apply overseas experiences and put the necessary enablers in place to adopt new, cost-effective technologies quickly.
- Maintaining flexibility in our energy options will reduce the risk and cost of meeting short- and long-term climate change and energy goals.

The transformation to a clean energy economy is a critical long-term policy reform for the Australian economy and our environment. It has already begun: clean energy is now firmly embedded in our energy generation mix, our markets and our policy frameworks. The transformation will create new business opportunities and jobs in many parts of Australia. Our world-class science and research base also position us well to create wealth through new knowledge and clean energy innovation.

Achieving success at an affordable cost requires the efficient pricing of carbon and the development of efficient energy markets that provide both sufficient certainty for investors and the necessary flexibility to respond to developments.

Many of the technologies likely to be needed to meet our clean energy goals, particularly in the long term, are not yet commercially available or mature. Key challenges for governments over the coming years will be overcoming existing technical, financial and regulatory barriers, properly targeting resources to help develop commercially viable technologies, and ensuring that new technologies can integrate effectively into energy markets. It is also important that the costs and risks of the transformation be manageable for the economy and consumers and that we maintain our energy security.

6.1 Overview

As outlined in Chapter 3: *Future energy trends and challenges*, Australia's emissions reduction goals will require a large-scale transformation to cleaner energy sources, resulting in a substantially decarbonised energy system by the middle of the century.

This transformation to a clean energy economy will open up commercial opportunities for Australian innovators, particularly through export markets, create new jobs and promote regional development.

While these reforms will impose moderate increases in energy costs on consumers in the short to medium term, delaying them would be likely to impose higher adjustment costs on the economy because of the long lives of investments in the energy sector and the risk of technology 'lock in' (IEA 2011a, Treasury 2011).

This chapter outlines the drivers and scale of the clean energy transformation under the government's Clean Energy Future Plan, the key policy challenges involved in transitioning the energy sector, and the actions that the government will take to address them.

6.1.1 Defining 'clean energy'

There is no fixed definition of 'clean energy'. This Energy White Paper adopts a broad and pragmatic interpretation, as a clean energy future will require the pursuit of a broad suite of technology options. In this document, 'clean energy' means sources of energy, technologies or processes that produce zero greenhouse gas emissions or lower emissions than their conventional counterparts while meeting social, environmental, health and safety standards.

Clean energy technologies include zero- or low-emissions electricity generation, energy storage and management systems and transport technologies. They include renewable as well as fossil-fuel-based technologies, or hybrids of both, and can be applied to centralised or distributed generation systems. Energy efficiency and demand-side technologies are also part of the clean energy mix (these are covered in Chapter 11: *Energy productivity*).

The deployment of clean energy technologies is also interlinked with information, communication and system control technologies. Examples include 'smart' energy systems that manage variable renewable energy supply sources and the remote operation of distributed or off-grid renewable energy capacity.

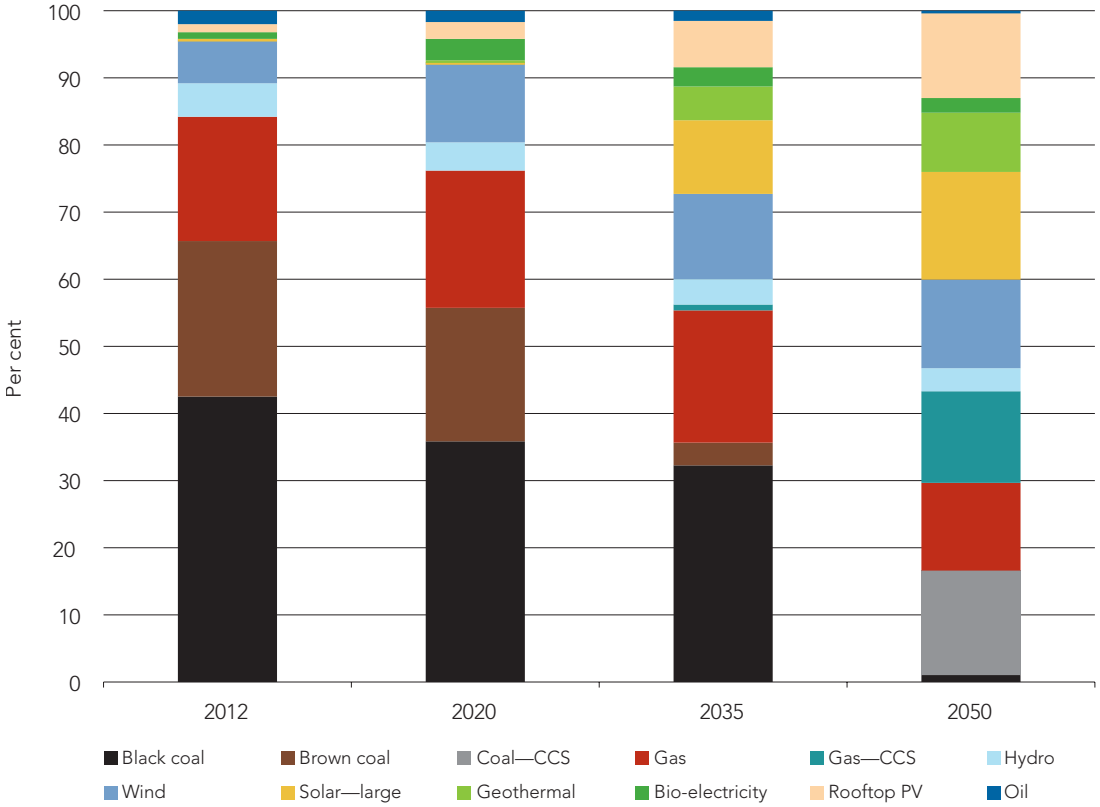
One strength of carbon pricing as a policy instrument is that it largely avoids the need for the government to regulate or mandate what are (and are not) clean energy technologies. Instead, the market will determine the energy mix that meets our assigned emissions caps most cost-effectively.

It is reasonable to expect that this transition will require our energy system to be a mix of different technologies and fuels for many decades as the penetration of new clean energy technologies and fuels deepens. Our understanding of clean energy technologies will also change as they develop and shift further towards zero emissions over time. Thus, technologies defined as 'clean' today may no longer be considered clean by 2050 (or earlier).

6.1.2 The scale of transformation

The transformation that is needed to support our greenhouse gas emissions objectives will have large impacts and take a long time. To illustrate this, Figure 6.1 shows a possible projected share of generation technologies in Australia's electricity sector based on the recent Bureau of Resources and Energy Economics modelling described in Chapter 3: *Future energy trends and challenges.*

Figure 6.1: Electricity generation technology shares to 2050



Source: BREE (2012d).

Based on the recent Australian Energy Technology Assessment mid-point technology cost estimates, this suggests that clean energy technologies could provide around 40% of Australia's electricity generation by 2035 and up to 85% (or 305 TWh) by 2050, when fossil-fuel-fired generation with carbon capture and storage (CCS) would contribute 29%, large-scale solar 16%, wind energy and household solar photovoltaic (solar PV) 13% each, geothermal energy 9%, and hydroelectricity and bioelectricity 5%.

While these long-term estimates are heavily qualified and should be treated more as illustrations than predictions, they point to an enormous long-term change.

This ambitious transformation will be achieved from a currently modest but growing clean energy base: renewable energy (largely hydro-electric, wind and a small but growing component of household solar systems) contributed around 10.1% of electricity needs in 2010 (or 19.4 TWh) (BREE 2012a).

The transformation may require more than $200 billion in new generation investment between now and 2050, including around $50–60 billion in gas, $100 billion in renewables and $45–65 billion in coal, nearly all of which is for CCS plants (SKM MMA 2011, ROAM Consulting 2011). To put this into context, we may need an additional 286 TWh of new clean energy capacity by 2050, but no significant Australian CCS, large-scale solar, ocean or geothermal generation systems are in operation today.

Australia's transport energy sector is likely to undergo a similar scale of transformation. By 2050 there will be significant growth in transport fuels and technologies that have little or no presence in the market today (see Box 6.1). Biodiesel could contribute around 13% of total transport fuel consumption, natural gas 12%, bio-derived jet fuel 8%, electricity for transport 5%,[1] and synthetic

1 As a percentage of energy. Expressed as kilometres travelled, it may be significantly higher.

diesels 2% (CSIRO 2011a). Demand for transport services is affected by many factors, including land-use planning, registration and road charges, the availability public transport and freight logistics; these factors are outside of the scope of this White Paper.

These are not predetermined or mandated outcomes. The market is best placed to drive the pace and shape of the transformation and the relevant technologies. The role of government is to establish a market-based framework, such as by establishing a carbon price and the Renewable Energy Target, which enables the market to allocate resources efficiently to test various technologies. Public funding will support those decisions and priorities to ensure that a mix of technologies is given the opportunity to commercialise within the market.

Box 6.1: Emerging vehicle technologies

Emerging transport technologies, particularly electric and hybrid electric vehicles, provide opportunities to cut emissions.

Electric vehicles include all-electric (battery), plug-in and hybrid vehicles. A plug-in vehicle has a rechargeable battery that can be charged from the electricity grid. Plug-in hybrids are an intermediate step on the way from internal combustion vehicles to purely electric vehicles because they support early-stage design and battery technology development (IEA 2009:133).

Plug-in hybrids rely mostly on their batteries, which can be recharged at night or during work hours, but can also be charged by their internal combustion engines, particularly for longer trips. Innovative recharging options (such as drop-in battery replacement) are also being developed.

Most analysis suggests that the take-up of electric vehicles will be modest in the short to medium term due to cost and slow fleet turnover (Treasury 2011:132). However, it is possible that car and battery development could move more quickly than projected, leading to faster adoption.

Analysts suggest that even a relatively high level of electric vehicle adoption would result in only a moderate increase in demand for electricity. However, recent analysis by the Australian Energy Market Commission found that new metering and pricing structures are required to support efficient charging patterns and allocation of cost. If electric vehicle charging is left unmanaged, the commission estimates that each electric vehicle could add up to an additional $10 000 in electricity network and generation costs, of which $6500 to $7000 would be borne by consumers other than the vehicle owner (AEMC 2011d).

While the electricity consumed by such vehicles reduces net emissions savings, the emissions from the electricity that these vehicles use are being cut over time as a result of cleaner electricity production and technological advances in vehicle design.

6.1.3 Clean energy resources

The 2011 Australian Energy Resource Assessment (GA–ABARE 2010) demonstrates that we possess some of the world's best renewable energy resources, including:

- the highest average solar radiation per square metre of any continent
- world-class wind resources along our southern coast
- large-scale potential hot rock geothermal resources, estimated at roughly 25 000 times Australia's primary energy use

- a large and diverse bioenergy potential
- abundant wave energy resources along the western and southern coastlines, and tidal resources in the north-west.

We also possess extensive and highly prospective geological storage sites for carbon dioxide onshore and offshore, which we could use to develop near-zero net emissions coal-fired or gas-fired baseload electricity generation.

Despite this assessment, the true potential of our clean energy resources will not be properly understood until these technologies mature and are commercially deployed at scale.

6.1.4 Our clean energy capacity

The adequacy of Australia's technological and engineering capabilities will affect our ability to realise our clean energy potential. In this area, we are well placed:

- Australia has well-developed basic and applied research, development and demonstration capabilities in the CSIRO's energy and advanced manufacturing research programs, some world-class energy-related university research schools, cooperative research centres and primary industries research and development (R&D) organisations.
- Australian researchers have been recognised internationally for their groundbreaking work in solar PV energy research, and Australia is a world leader in a range of PV technologies.
- Similarly, we are among the world leaders in the development and/or application of ocean, enhanced geothermal and CCS technologies.
- The Australian Government maintains a strong national innovation framework that aims to improve skills, expand research capacity, boost collaboration and increase incentives for innovation across the economy.
- We have a strong track record in utilising new generation technologies and reliably integrating intermittent energy into Australian grids (notably wind power in South Australia) and in applying off-grid solutions.

Improving this capacity will require an ongoing commitment from the public and private sectors to the education, training and development of Australia's workforce.

6.1.5 Technology cost potentials

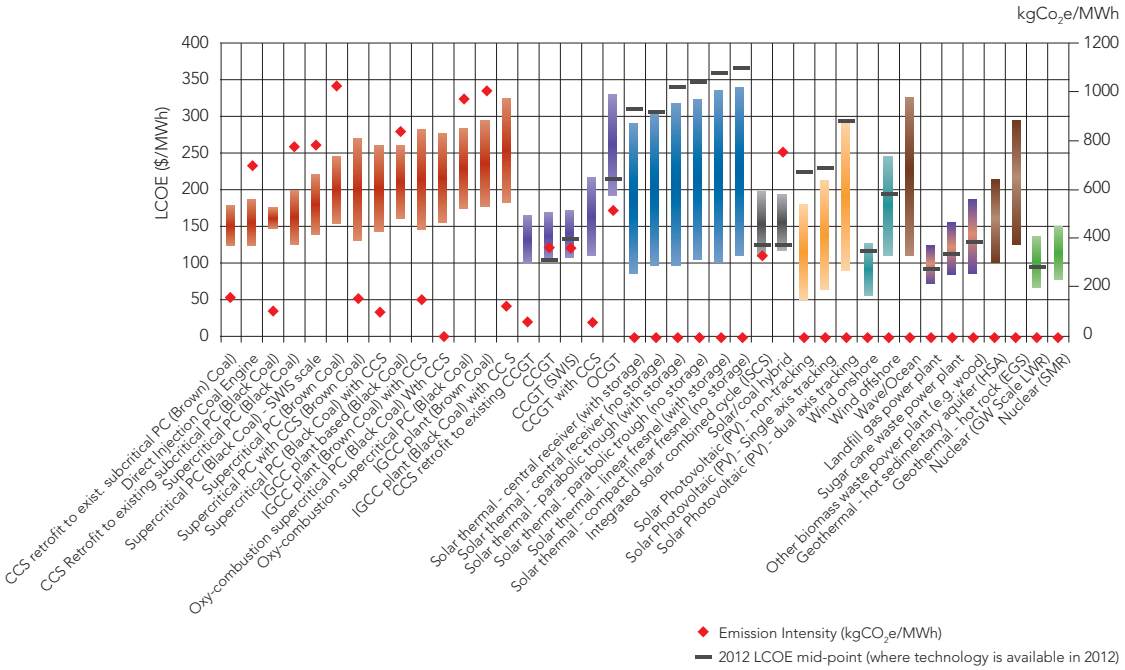
Investors and policymakers considering where best to focus private and public sector resources require a sound understanding of technology cost potentials, including the relative importance of capital and operating costs, the potential for technology improvement, and sensitivities to other input costs.

The 2012 Australian Energy Technology Assessment (AETA) by the Bureau of Resource and Energy Economics substantially revises previous technology cost projections for 40 different large-scale stationary energy generation technologies through to 2050 (BREE 2012d). A comparison of cost estimates for these technologies in 2012 and 2030 is shown in Figure 6.2. While many clean energy technologies are currently not cost-competitive, that is expected to change dramatically over the next two decades.

However, it is also important to understand the limitations of cost projections. The analysis in the AETA, while based on comprehensive research and peer review, is not a predictive tool. It is better understood as an indication only of the known cost drivers for a range of technology classes. The estimates also do not include any localised or system-based cost factors (such as connection costs or backup costs), which can have significant impacts on delivered energy costs from individual projects. Investment decisions should, and will, be made based on the actual costs of projects and not levelised cost-of-electricity estimates.

Many factors other than those drivers can radically alter a technology's future potential. For example, few could have predicted the dramatic reduction in solar PV costs that has occurred over the past few years, driven substantially by the emergence of large-scale Chinese manufacturing capacity. Along with a substantial winding back of solar subsidies in many markets, this is resulting in a significant restructuring of the global PV industry, which may also have further effects on price paths.

Figure 6.2: AETA projected technology cost ranges (2030)



CCS = carbon capture and storage; IGCC = integrated gasification combined cycle; LCOE = levelised cost of electricity; PC = pulverised coal; PV = photovoltaic; SWIS = South West Interconnected System (Western Australia).

Notes:

Default region is New South Wales, except for brown coal technologies (Victoria) and SWIS scale (as specified).

LCOE includes, where relevant, allowance for:	LCOE excludes:	LCOE sources of uncertainty include:
• carbon price • CO_2 transport and sequestration cost • plant capital cost (EPC basis) within battery limits • owners' costs excluding interest during construction • fixed and variable O&M • fuel costs • economic escalation factors.	• decommissioning costs • project residual value • network connection costs and augmentation • effects of taxation • financing costs • plant degradation.	• capital cost • operating cost • fuel cost • carbon cost • sequestration cost.

Source: BREE (2012d).

6.2 Clean energy policy framework

Policy objectives

The objectives of the clean energy policy framework are to:

- support the efficient long-term transformation of the Australian energy system to a clean energy future, consistent with Australia's national economic, social and environmental objectives and greenhouse gas emissions reduction targets
- ensure that Australian energy markets have timely commercial access to the broadest range of proven and effective clean energy technologies
- capture the economic and social benefits of clean energy through the creation of new jobs, innovative capabilities, skills and industry capacities, and the promotion of the sustainable export of Australian clean energy goods and services.

Principles

- Australia's energy technology and fuel mix should be determined by the market, guided by clear policy objectives and supporting market frameworks that internalise and reflect relevant energy and environmental costs.
- Government support for clean energy technology development should be prioritised against national energy objectives, be appropriate to market conditions, and interact efficiently with the Australian Government's broader innovation policy framework.
- Government support mechanisms should reflect the long-term nature and complexity of clean energy technology development.
- Government assistance to support households and industry in the transformation to a clean energy future should be provided in a way that maintains incentives to reduce carbon pollution.
- Clean energy measures should interface effectively and efficiently with other aspects of energy policy (particularly energy market design and operation) and should be complementary to carbon pricing.

Framework elements

The core elements that underpin Australia's clean energy transformation are:

- efficient deployment based on market price signals
- clean energy innovation at an early phase
- enabling measures that address potential non-price market barriers along the development chain.

6.2.1 Clean energy deployment

Market-based price signals will drive the least-cost deployment of clean energy technologies in Australia's overall energy mix.

The Australian Government has legislated two key market measures to support the deployment of clean energy technologies: a price on carbon and the Renewable Energy Target. The carbon pricing mechanism (in concert with energy prices) will provide the primary long-term price signal to drive clean energy investment, while the Renewable Energy Target complements it by providing additional support for renewable energy investment and industry development in the transition period to more mature carbon prices and technology costs.

As visible signals, these measures also provide a powerful 'pull through' incentive for technology development. This generates a longer-term transparent price signal to guide long-lived investment decisions. A third form of deployment driver offered by some states and territories in Australia is feed-in tariffs, which provide an agreed buyback rate for power sold into the market from distributed generators (including co- or tri-generation systems).

6.2.2 Clean energy innovation

From early-stage research through to early-stage commercialisation, there are a range of well-recognised market failures and non-price barriers that, if not addressed, will result in national underinvestment in clean energy innovation (Garnaut 2011, IEA 2012b).

The Australian Government has committed substantial resources across the innovation system to support clean energy technology development. Current commitments total more than $17 billion.[2]

This includes the establishment of the commercially oriented Clean Energy Finance Corporation with funding of $10 billion to invest in renewable energy, low-emissions and energy-efficiency projects and technologies, as well as in manufacturing businesses that supply inputs to those technologies. The government has also established the Australian Renewable Energy Agency (ARENA) as an independent statutory body managing $3.2 billion in funding to support renewable energy R&D, demonstration, commercialisation and deployment (see Box 6.2). In addition, the government has provided $1.2 billion in the Clean Technology Program to support the development and early-stage commercialisation of clean technologies across industry.

The government is also providing around $2 billion in support for the research, development and demonstration of CCS technology, including the CCS Flagships program.

Support for innovation extends beyond technology development. The government has established world-class innovation facilities and capabilities through the CSIRO and through its support for university-level research. The government also provides support and services for clean energy technology companies to commercialise new ideas and find new markets. This includes Enterprise Connect's services through the Clean Technology Innovation Centre, the Clean Technology Supplier Advocate and Austrade's Inward Investment Strategy.

2 This 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.

Box 6.2: The Australian Renewable Energy Agency

The Australian Renewable Energy Agency (ARENA), which commenced operation on 1 July 2012, is integral to the government's plan to move to a clean energy future.

Under the direction of an independent board and with $3.2 billion of funding, ARENA will invest in a portfolio of renewable energy assets with the aim of achieving diversity across several dimensions—technologies, funding sources and business models. ARENA will draw on the lessons learned from previous renewable energy support programs to design and implement funding mechanisms that deliver the right type and quantum of assistance at different stages of the innovation cycle.

Some of the ways in which ARENA will help to improve the competitiveness of renewable energy technologies and contribute to increasing the supply of renewable energy in Australia include supporting:

- demonstration projects that enable learning by doing and help move renewable energy technologies and systems closer to commercialisation
- the growth in renewables in regional areas where there is a growing demand for energy and distributed generation, which would help reduce greenhouse gas emissions and/or potentially avoid or defer infrastructure upgrades and associated costs
- enabling initiatives such as pre-competitive data acquisition and resource mapping
- strategic knowledge generation and sharing of knowledge and information from the projects it funds
- initiatives that provide system-wide solutions to renewable energy output variability
- the creation of critical mass in renewable energy technology development
- initiatives that assist with finance sector risk reduction
- the development of skills in the renewable energy industry.

6.2.3 Enabling activities

Enabling activities attempt to address non-price barriers to the take-up of clean energy to remove roadblocks in the innovation cycle and provide a foundation for deployment and innovation.

Fostering collaboration and building the knowledge base

Building the knowledge base in the clean energy sector domestically and internationally will require collaboration between government and industry to ensure that the lessons from technology deployment are absorbed.

The Australian Government supports these efforts through continued engagement in a range of international energy and clean development forums, such as the International Energy Agency, the International Renewable Energy Agency and the Clean Energy Ministerial Forum, and through bilateral engagements with key trading partners.

Skills and training

The Australian Government is providing significant support for skills and training in clean energy industries. For example, the government is providing funding of up to $32 million over four years through the Clean Energy and Other Skills Package to address clean energy skills gaps in professional and trades training and to support training in clean energy for current workers. In addition, the Australian Solar Institute (which will be part of ARENA from 1 January 2013) is supporting researchers through its Skills Development Program. Skills and workforce development issues are discussed further in Chapter 12: *Sustainability, workforce and Indigenous opportunities*.

Regulatory frameworks

Nationally consistent approaches to the regulation of new technologies on matters such as siting, planning and managing environmental impacts are important for building investor confidence and community acceptance.

Australian jurisdictions are currently developing regulatory regimes for CCS, geothermal energy and ocean energy. There is potential for those regimes to develop along different paths, meaning that developers may face different regulatory requirements in different jurisdictions. Through the Standing Council on Energy and Resources, Australian governments are working towards harmonised or consistent regimes for CCS and geothermal technologies.

The Standing Council on Energy and Resources and Australia's key energy market organisations have been considering Australia's energy market arrangements to ensure that they do not include any unintended barriers to the connection, integration and efficient use of new clean energy technologies, and to ensure that the benefits of demand-side response and distributed generation are optimised.[3]

Improving financial and technical awareness

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 how they may operate in energy markets. Combined with the high capital costs of clean energy projects, their longer timeframes for deployment and the perceived technological risks, this can increase the costs of debt and equity finance for such projects.

One objective of the government's clean energy innovation and technology programs is to improve market understanding and experience in financing and operating clean energy technologies in order to significantly 'de-risk' clean energy technologies and resource developments. This includes professional assessments of technology potential and the size and intermittency of clean energy resources around the country.

The government has established the Clean Energy Finance Corporation to overcome capital market barriers that hinder the financing, commercialisation and deployment of renewable energy, energy efficiency and low-emissions technologies. This will potentially include support for supply chain businesses that focus on producing inputs required in such projects. The government also manages a suite of equity and tax-based initiatives to help develop the Australian venture capital sector—an important source of seed funding for clean energy innovation.

The government is working to improve financial understanding of CCS technology through the CCS Flagships program and Global CCS Institute.

6.3 Policy challenges and priorities

The clean energy measures put in place by the Australian Government provide a comprehensive long-term framework that will guide and support the market in achieving our clean energy goals. However, policy development and delivery are not static exercises, and developing a more diverse technology base will continue to involve significant technical, financial and policy challenges.

There are three broad areas where ongoing effort will be needed to transform our economy in an efficient and coherent way:

- ensuring a sustainable pace of transformation
- capturing opportunities from clean energy innovation
- efficiently integrating a diverse range of new technologies into the energy system.

3 The Australian Energy Market Commission's reviews of energy market frameworks, distribution frameworks and demand-side participation are addressing issues relating to barriers to the connection, integration and efficient use of new clean energy technologies.

6.3.1 Ensuring a sustainable pace of transformation

Balancing energy and climate goals

Setting and achieving clean energy goals requires an ongoing balance between climate change, economic and energy security objectives.

The pace and shape of our clean energy transformation will depend critically on four factors:

- the speed at which emerging clean energy technologies reduce costs and overcome technical barriers, which will occur through global efforts and Australia's ability to take up new technologies
- global and national carbon price paths, which will be a key determinant of the timeframe over which new clean energy technologies become competitive against conventional alternatives
- the size and pattern of energy demand growth (particularly for electricity)—slow or flat demand growth will reduce opportunities for new clean energy capacity to enter the market
- Australian energy prices, particularly wholesale electricity prices and gas prices—sustained lower wholesale prices and/or higher gas prices will support incumbent capacity.

Many clean energy technologies are currently not commercially mature or are more expensive than conventional technologies. Combined with an outlook of slower growth in electricity demand, this makes it likely that the pace of transition will be incremental rather than disruptive, and that take-up over the next decade will be driven largely through mandated market share under the Renewable Energy Target. From the mid-to late 2020s, clean energy deployment is projected to accelerate as existing energy assets are retired and more competitive large-scale clean energy technologies become market ready. That said, clean energy growth rates will be high due to the technologies' modest starting base.

Over this period, we are also likely to see a growing take-up of distributed (household and industrial) energy as such systems become increasingly commercially attractive compared to grid energy. This may place pressure on the network cost base and consumers, and it will be important that distributed energy outcomes reflect efficient investment decisions based on fair value, rather than distorted incentives.

While there will undoubtedly be calls for a faster (or slower) rate of deployment of different technologies, the principal policy aim is to meet Australia's greenhouse gas emissions targets at the least cost while maintaining energy security. A market-based approach to deployment is the best way to achieve that goal.

Moreover, reducing greenhouse gas emissions is an international effort. The extent to which other countries commit to reducing their emissions, and the support they give to the development of clean energy technologies, will be important factors determining how quickly innovative clean energy technologies become commercially available in Australia.

The importance of policy stability and sustainability

Ensuring that Australia's clean energy policy framework and related measures provide stable and sustainable support to investors and energy markets is critical. Such support provides investment clarity for the long-term development of new technology.

All policies need to be affordable: measures that impose unsustainable costs across the community are not likely to maintain the community's support, be effective or produce optimal results. Important lessons can be learned from past policies, which sometimes generated undesirable boom–bust cycles for clean energy suppliers and confusion among consumers.

Premium feed-in tariffs for rooftop solar PV, which were expanded and then wound back, are a case in point. The Australian Government strongly supports the states' and territories' move towards more efficient and equitable electricity buyback rates that better reflect the real value of the supplied generation (including any network benefits). With the introduction of carbon pricing, the clear long-term policy goal should be to transition to a level playing field for all forms of energy, necessitating the gradual phasing down of deployment subsidies.

In this context, the government is working with the states and territories through the Council of Australian Governments (COAG) to develop a national approach to assessing the complementarity of existing and future climate change measures with the carbon price mechanism.

The government acknowledges that the Renewable Energy Target, by design, imposes marginally higher costs on consumers in order to 'pull through' renewable energy technologies. However, the target is also designed to achieve this at least cost, thereby minimising the cost impact on consumers. It remains a key transitional measure supporting the government's overall objective of increasing the deployment of renewable energy while the carbon price matures.

The need for review and response

Regular review and monitoring, including of the factors that influence the direction and pace of our clean energy transformation, will assist in addressing any unintended consequences or barriers to progress.

The government will monitor progress in achieving its clean energy objectives, including through the implementation of the Clean Energy Future Plan, the National Energy Security Assessment, four-yearly strategic reviews of energy policy and scheduled Renewable Energy Target reviews. Under the Clean Energy Future Plan, the government established a new independent statutory body, the Climate Change Authority, to advise on pollution caps and progress towards targets and to review the carbon pricing mechanism.

In that work, it will be important to focus on potential barriers to efficient deployment, to ensure smooth interactions between energy, renewable energy certificate and carbon markets, and to monitor the effectiveness of support for innovation, while taking into account the importance of policy stability for market and industry development.

From Australia's perspective, global and national progress on potentially key technologies such as CCS, large-scale solar and other renewables in the next decade will be important to monitor. If those technologies fail to develop as expected, future Australian governments may need to consider other clean energy alternatives to meet our emissions reduction targets and to minimise the risk of higher adjustment costs (see Box 6.3).

Box 6.3: Is there a future role for nuclear energy in Australia?

Australia's range of abundant low-cost energy resources has shaped our energy generation base around coal and gas. While other countries have adopted nuclear power as a way of diversifying their energy mix, Australia has not deployed the technology because it has never been economically competitive with fossil fuel technologies and because a community consensus on deployment is lacking.

The Australian Government does not support the use of nuclear energy in Australia. It notes that there is currently no social consensus on the technology or an economic case for its deployment, even taking into account the carbon price and the need to reduce our emissions.

Future Australian governments might not necessarily hold that view. However, in considering the circumstances in which a future government might revisit this issue, the following observations may be pertinent:

- 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 strongest justification for developing nuclear energy would be a failure to commercialise new low-emissions baseload energy technologies within the timeframe that analysis suggests is necessary to meet long-term global and national emissions reduction objectives.
- Estimates of future costs for representative electricity generation technologies suggest that nuclear energy could potentially be an economically competitive backstop energy option (see Figure 6.2). However, based on experiences in other countries, the establishment of a commercially based nuclear energy industry in Australia would also require additional financial and/or other forms of government support to kick start initial facilities (Australian Government 2006).
- This would require a decision to move ahead considerably in advance of expected deployment—lead times would be at least 10 years, with 15 years more probable (Australian Government 2006, EPRI 2010, CSIRO 2011b). A decision would need to be taken by the later part of this decade if deployment were required by 2030 or 2035. This would require new institutional and regulatory arrangements and the development of a local nuclear engineering skills base.
- Such a decision would require broad community consensus, including bipartisan political support, particularly in the wake of the Fukushima accident.

6.3.2 Capturing opportunities from clean energy innovation

An increasing global effort to develop clean energy technologies is underway. This will benefit Australia by accelerating commercialisation and providing lower-cost options for meeting our emissions reduction targets. However, Australia should not rely on buying clean energy technology 'off the shelf'. There are good reasons why we should invest in clean energy innovation, including:

- capitalising on established research and technical strengths, such as solar, or on emerging market opportunities, such as for ocean power or alternative fuels
- capitalising on the opportunities that arise from tackling the specific challenges posed by Australia's geography, climate and demographics, for example, by developing off-grid renewable energy solutions
- exploiting Australian clean energy resources, such as deep geothermal resources

- accelerating the development and commercialisation of technologies with the potential for significant returns to the national interest, such as CCS, which could support our fossil fuel export trade in the longer term if it were exported or further developed elsewhere (see Box 6.4)
- attracting international expertise and investment to Australia and promoting the timely adaptation and demonstration of imported technologies in Australian markets and operating conditions, which would generate further flow-on technology development and know-how.

Box 6.4: Commercialising carbon capture and geological storage in Australia

Despite slow progress to date, commercialising CCS remains critically important to meeting long-term global emissions reduction goals, given the expansion of coal-fired power generation planned by China and India. The International Energy Agency estimates that CCS could account for up to 20% of cumulative CO_2 reductions by 2050. Abandoning CCS as a mitigation option now would significantly increase the cost of achieving emissions reductions to limit average global temperature increases to 2°C.

In Australia, work is well underway to develop the legal and regulatory frameworks and to test and demonstrate the technologies needed to support the long-term commercialisation of CCS.

Legislation is in place for CO_2 storage in Commonwealth-controlled offshore waters, and the states and the Northern Territory have either completed or nearly completed the mirroring regulatory frameworks for their jurisdictions.

The National CO_2 Infrastructure Plan, which is intended to strengthen investor confidence by reducing barriers to CO_2 transport and storage, is being implemented. The government is also assessing whether existing pipeline standards are suitable for the safe transport of CO_2.

In partnership with industry, the research community and several states, the Australian Government is implementing a technology development strategy that includes:

- $2 billion in support of large-scale demonstration (CCS Flagships) and small- to medium-scale pilot projects
- support for R&D and pilot testing of low-emissions coal and CCS technologies through the CSIRO, the CO2CRC and Australian National Low Emissions Coal Research & Development ($75 million, with matching funding from the coal industry)
- support for international R&D 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.

To clearly articulate the framework for commercialising CCS in Australia, by June 2013 the Department of Resources, Energy and Tourism, in collaboration with the National Carbon Capture and Storage Council, will develop a CCS Roadmap for Australia to 2030. This will focus on:

- completing pre-competitive CO_2 storage assessments and regulatory frameworks
- identifying single and multi-user transport and storage hub infrastructure options to inform investment decisions
- implementing the large-scale demonstration projects announced under the CCS Flagships program
- investing in R&D to improve the efficiency and reduce the cost of large-scale CO_2 capture technologies
- increasing public awareness of the role and benefits of CCS
- exploring the commercial imperatives, investment conditions and transitional incentives needed to deploy CCS in Australia.

Australia is unlikely to develop large-scale manufacturing industries for clean energy technologies as we lack the market scale and lower cost base of many competitor economies. However, there is considerable opportunity for high-value niche industries. Our resource, skills and knowledge bases are already creating valuable intellectual property in many sectors, including manufacturing, construction and professional services, and we are well positioned to continue to develop value-adding business opportunities as part of global clean energy supply chains.

The role of private and public sector investment

Well-functioning energy and carbon markets give technology innovators and end users a powerful pull-through incentive for private sector investment in innovation. It is appropriate that the private sector, which is best equipped to manage business risk, remains the principal driver of technology development and deployment. Private capital also introduces the market discipline and entrepreneurial management needed for long-term commercial success.

However, there is an important role for targeted public sector support to stimulate the creation of markets, to address market failures and, in certain circumstances, to share development and commercialisation risks. Public finances are limited, so innovators need to leverage larger private sector resources effectively and efficiently. Public sector investment should support, rather than reduce, commercial discipline.

While there is an established case for public support of clean energy deployment and development as it builds along the pathway to commercial maturity, the government has removed remaining subsidies for conventional energy or fossil fuel industries over the past several decades (see Box 6.5).

Box 6.5: Does the Australian Government provide subsidies to fossil fuels at the expense of developing clean energy technologies?

Contrary to claims by some groups, the Australian Government does not provide subsidies for the production of fossil fuels or subsidies that encourage the inefficient or wasteful consumption of fossil fuels. This was confirmed by a review of Australian Government energy programs and policies by the G20 Group of Nations in 2010.

A number of these claims relate to the existence of various business tax deductions or specific tax treatments for activities associated with energy resource development or production.

The Australian Government notes that the ability to deduct business expenses does not in itself constitute a subsidy. This is a normal and necessary step in determining business profit and therefore tax liabilities. Particular tax treatments recognise the different risk factors and project circumstances applying in these activities and industries.

The fuel tax credit for business use of transport fuels reflects the principle of not taxing business inputs. It is similar to the tax credits that are given to businesses for any GST they pay on inputs. Thus, excise, collected from manufacturers and importers of fuel, should be a tax on final consumption of fuel rather than a tax on business inputs. Like the GST input tax credits, the fuel excise credit is not regarded as a subsidy.

Fossil fuel taxation contributes many billions to government revenues each year. This is projected to increase through the implementation of new energy taxation arrangements and the coverage of fossil fuel production and some fossil fuel consumption under carbon pricing.

Under the Clean Energy Future Plan, the carbon pricing mechanism is designed to provide an incentive to reduce emissions that primarily result from the production and use of fossil fuels, and to encourage energy efficiency. To assist entities that undertake emissions-intensive and trade-exposed activities, the Australian Government provides assistance through the Jobs and Competitiveness Program. The program is designed to help Australian emissions-intensive, trade-exposed businesses to manage the carbon price impact, while retaining incentives to reduce emissions. Assistance under the Jobs and Competitiveness Program reduces over time and is subject to regular independent review.

In the period to 2020, the Australian Government will provide around $17 billion in support to clean energy development and deployment, along with an estimated market subsidy of up to $20 billion for renewable energy under the Renewable Energy Target.

Improving the effectiveness of government support—lessons learned

Over a decade of government support for clean energy and technology development has produced a number of lessons, including the following:

- Many Australian clean energy industries are at a relatively immature stage of development characterised by calls for large-scale early-stage support and relatively low success rates at later stages. There is a need to build capacity and ensure that project proponents have suitable project management and engineering skills, entrepreneurial capacities and the ability to attract financial support to be able to move projects from concept to closure.
- Attempts to leapfrog key stages in the innovation chain are usually unsuccessful. Funding should be targeted to move technologies incrementally along the innovation chain to the larger-scale demonstration stage. Specific barriers and risks at different stages must be addressed and follow-up support must be provided to ensure that projects or technologies with merit do not become 'stranded'.
- Large-scale demonstration projects are far more difficult, and some have taken longer than expected, particularly because of their higher risk of failure and higher financing costs. There is a need to minimise the risks in order to attract capital investment. This may require the delivery of funding support through mechanisms other than traditional milestone-based grants programs, while maintaining accountability for the use of taxpayers' resources. For example, wider knowledge sharing should be a condition of public support for innovation.
- There are benefits in having strategies or outcome-focused substrategies to frame policy advice, program design, technology prioritisation and funding decisions.
- Effective engagement between the Australian and state and territory governments will be critical to accelerating the deployment of clean energy technologies.

Aligning clean energy needs within the innovation system

To produce maximum value, Australia's early-stage research incentives and structures need to be aligned with later-stage technology development goals. To that end, the Australian Government takes a strategic approach to its R&D investment, taking into account identified national research and innovation priorities (DIISR 2009). Reducing emissions in transport and energy generation is an identified priority area under the National Research Priorities, which guide the government's research support.

Australia has world-class strengths in a number of renewable energy and CCS technologies through institutions such as the Australian National University, the University of New South Wales, the CO2CRC and CSIRO. New centres such as the Newcastle Institute of Energy and Resources are

also bringing together the expertise of industry and the research sector. To help strengthen links between the R&D sector and large-scale demonstration activity, the Australian Government has targeted resourcing and initiatives in the areas of solar, CCS and biofuels. The government has established the Australian Solar Institute, Australian National Low Emissions Coal Research and Development Limited and the Advanced Biofuels Investment Readiness program with funding contributions of $150 million, $75 million and $20 million, respectively.

There may be scope to target R&D support for other strategic priority areas. For example, the Australian Centre for Renewable Energy (ACRE, now absorbed into ARENA) identified a need for stronger R&D support for geothermal energy development and commercialisation in Australia, after significant government investment at the demonstration phase. As a first step, ACRE helped to establish a cross-disciplinary R&D network relevant to geothermal technology.[4] In 2013, ARENA will also integrate the R&D capacity of the Australian Solar Institute into its innovation activities.

Enhancing collaborative effort

Working internationally with key partners provides a valuable opportunity to collect global market intelligence on developments in clean energy, to leverage Australian investment in clean energy and to increase the impact of Australia's research, development and deployment effort. For example, the Global CCS Institute is building links with a range of partners to encourage knowledge sharing and information dissemination to accelerate the development of CCS technologies.

Multilaterally, the Australian Government is working with the United States and the United Nations Energy Initiative on the Clean Energy Solutions Center. The centre is an online information and resource portal that puts policymakers, industry and researchers together to explore the challenges facing clean energy development. This work will also support ARENA as it develops its online resources for industry.

Bilaterally, Australia and China have established a close and productive relationship addressing the challenges of reducing greenhouse gas emissions from the combustion of fossil fuels. The Australian Government has allocated $20 million to support a range of activities and projects under the Australia–China Joint Coordination Group on Clean Coal Technology that are specifically focused on the development, application and transfer of low-emissions coal technology.

The Australian Government also works with a number of other countries and the European Commission to foster initial contacts and early-stage collaborations between researchers, industry (particularly small and medium-sized enterprises) and other innovation actors to enable strong, strategic, clean energy research, development and deployment.

Collaboration among Australian governments is also essential. The COAG Standing Council on Energy and Resources has established the Clean Energy Working Group to improve policy coordination and ensure that suitable legislative regimes are in place to regulate new clean energy technologies as they arise. The working group is currently considering the regulatory regimes applying to CCS, geothermal and ocean energy projects.

6.3.3 Efficiently integrating new technologies into the energy system

Australia's energy systems have historically been developed with conventional fossil fuel technologies, centralised supply and standards calibrated to those technologies.

This will change in coming decades with more decentralised and intermittent large-scale generation and more distributed generation. Depending on the rate of deployment, challenges in managing the efficient integration of these new technologies into the market could include:

- cost-effectively managing growing intermittent supply from solar and wind energy and more variable network demand from distributed energy systems

4 More details are available at http://minister.ret.gov.au/MediaCentre/MediaReleases/Pages/GeothermalExploration.aspx.

- overcoming or removing barriers to efficient connection, in particular by small- and large-scale distributed and remote generators
- gaining maximum utility from off-grid power generation.

Managing variable supply and demand in the electricity network

In the future, the installed capacity of intermittent power generators such as wind and large-scale solar PV or solar thermal units will increase and possibly start to exceed current market reserves, creating challenges for electricity system backup and storage.

The structure of the National Energy Market (NEM) positions it well to integrate current and expected levels of intermittent energy. NEM rules have been updated in recent years specifically to improve the management of intermittent generation through the introduction of a new semi-scheduled class of generator. The potential for longer-term impacts on the efficiency of NEM dispatch and pricing from the wider deployment of low marginal cost capacity is discussed further in Chapter 10: *Energy markets: electricity*.

The Australian Energy Market Operator (AEMO) has introduced a state-of-the-art wind energy forecasting system to deliver forecasts of production from wind generators to all market participants. Good-quality forecasting data supports the semi-scheduled generation category by providing the AEMO and generators with forecasts of output and advance warning of rapid changes, reducing the risk to reliability and supply. Other intermittent renewables, such as solar and wave energy, will require similar forecasting systems to integrate into the NEM. The AEMO is well placed to build on this system for other forms of renewable energy.

The costs of current storage technologies remain high. This suggests that an effective approach would be to explore cost-effective solutions that could be applied across the electricity system, including by increasing fast-start backup system interconnections, demand response mechanisms, load shifting, thermal storage and advanced electricity storage technologies. The government is examining the impact of growing renewable penetration in the NEM through ARENA's Emerging Renewables Program (see Box 6.6). Energy storage and energy management technologies are both eligible for funding through ARENA.

The economics of off-grid and on-grid storage differ because of the higher cost of providing power in remote locations. As a result, remote off-grid storage options may be developed before urban applications.

Box 6.6: Modelling how the NEM might respond to higher flows of renewable energy

A broad range of work is underway to improve the cost-effectiveness of energy storage and our understanding of how storage technologies could be used in the market.

One example is a recent $900 000 grant by the Australian Government to the University of Melbourne, through the Emerging Renewables Program, as a contribution to a $1.2 million study, Achieving Cost-effective Abatement from Australian Electricity Generation.

The project will produce software modelling of Australia's electricity market to examine how the NEM might achieve the cheapest cuts in CO_2 emissions while using more renewable energy, such as wind, solar PV and solar thermal power.

The open-source modelling software, which will be publicly available, will assess the performance of future energy systems, including transmission networks, under different levels of renewable energy penetration.

The project began on 1 July 2012 and is scheduled to end in early 2015. The University of Melbourne is conducting the study with support from the University of New South Wales. Other participants include the Australian Energy Market Operator, the Bureau of Meteorology, the Victorian Department of Treasury and Finance, General Electric and consultants Market Reform.

Given the relatively low penetration of distributed generation in Australia, there is less experience in managing greater variability in network flows, which is one of the consequences of that form of generation. This is not a major overall concern at this point, although network connection has been refused in some cases because of localised constraints.

Clean energy infrastructure and barriers to connection

The deployment of clean energy technologies will require investment in energy and related infrastructure and the removal of barriers to network connection.

Various barriers to connection may be impairing the timely and efficient development of distributed generation and co-generation. Most relate to the application of standards and processes rather than to market rules. The Australian Energy Market Commission's reviews of energy market frameworks, distribution frameworks and demand-side participation are addressing these issues.

New investment in generation should be based on market and locational signals, and least-cost generation (taking transmission and carbon costs into account) should be preferred. Some clean energy proponents argue that the cost of connection to the transmission network, which is significant in remote renewable energy locations, is a barrier to deployment. However, the market will choose between sites with more prospective renewable resources but higher connection costs and those that are less prospective but have lower connection costs (and transmission losses).

The government also recognises the particular challenge faced by first connectors in remote areas, which may result in suboptimal investment in nodal connections. The Australian Energy Market Commission rule change on scale-efficient network extensions attempts to address this issue (see Chapter 10: *Electricity markets: electricity*).

CCS projects are also likely to require multi-user pipelines and hubs feeding dedicated storage sites. CCS infrastructure planning and development will be a core element of the government's CCS Roadmap.

Off-grid power

Off-grid power generation in Australia occurs mainly in remote Australia in mining projects, in Indigenous communities, and on farms and cattle stations. Rising diesel and gas costs mean that renewable energy technologies, either as stand-alone or diesel–renewable hybrid systems, are now becoming more cost-effective in these areas.

The rapid expansion of mining activity in areas such as the Pilbara offers good opportunities for larger-scale solar and solar hybrid systems to reduce carbon and fuel costs for major projects and to support the development of more common-use systems (ACRE 2011).[5] However, lack of familiarity with such projects and their perceived higher technology risks mean that take-up may be limited, despite their competitiveness. ARENA will continue to examine opportunities for renewable energy in these regions.

6.4 Measuring policy success

Policy success in promoting Australia's clean energy transformation could be expected to produce:

- the achievement of Australia's national emissions reduction targets
- a more diverse, resilient and integrated energy portfolio with a growing penetration of clean energy (including better demand management and distributed generation and a widening range of cost-competitive clean energy products and services) commensurate with the efficient achievement of our national greenhouse gas emissions reduction and renewable energy targets

5 A list of relevant studies is available at www.ret.gov.au/energy/clean/acre/studies/Pages/Studies.aspx.

- successful demonstrations in the Australian market of clean energy technologies, leading over time to reduced risks and lower financial hurdles for future projects
- improved sharing of knowledge about the successes (and failures) of clean energy technologies and systems
- a better understanding within government, the community and the energy and financial sectors of clean energy resource and technology potentials
- closer public and private sector collaboration on clean energy development, here and overseas
- the capture of a greater share of global clean energy intellectual property and knowledge by Australian businesses and researchers
- the development of robust national supply chains (including skilled workforces) and adequate access to international supply chains to support the needs of the clean energy sector
- a robust pipeline of clean energy deployment and innovation investment that can support sustained transformation and the outcomes described above.

Clean energy policy actions

To ensure a sustainable pace of transformation, the Australian Government will:

- continue to ensure the effective and efficient implementation of carbon pricing and the Renewable Energy Target
- provide ongoing support for the development and deployment of renewable and other clean energy technologies through the Clean Energy Finance Corporation, ARENA and other clean energy programs
- actively monitor progress in achieving clean energy objectives, including through the Clean Energy Future Plan implementation process, the National Energy Security Assessment, four-yearly strategic reviews of national energy policy, and scheduled Renewable Energy Target reviews
- improve network planning and connection outcomes through a timely response to the Australian Energy Market Commission Transmission Frameworks Review and further work to develop a national framework for distribution connection.

To capture opportunities from clean energy innovation, the government will:

- improve the effectiveness of Australian Government support for clean energy technology development, taking into account lessons learned from program delivery to date
- seek opportunities to develop collaborations with business and the research community to build a better understanding of the alignment of clean energy R&D to large-scale demonstration and commercialisation (including linking to international efforts)
- engage in value-for-money international processes and partnerships to make the best use of experience and capacity and to promote clean energy technology development and deployment.

To ensure the efficient integration of new technologies into the energy system, the Australian Government will, in conjunction with energy market bodies, monitor the impact of increased intermittent and distribution generation on the NEM.

7 Energy markets: overview

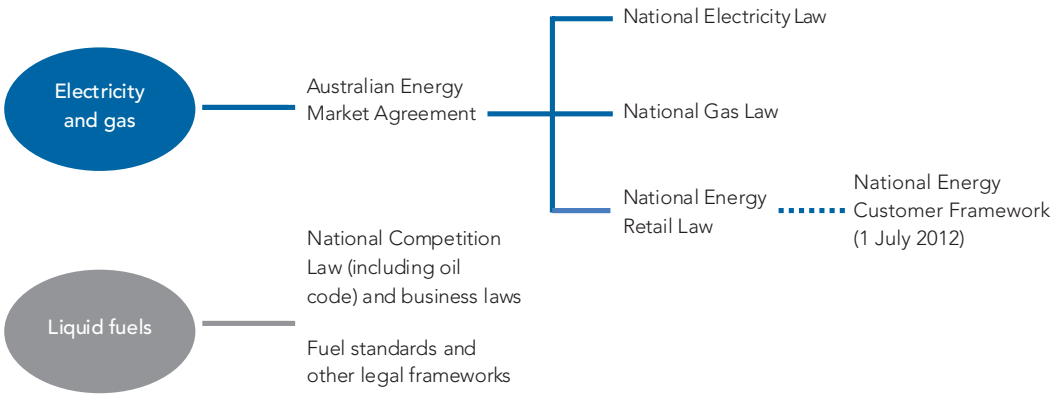
Energy markets involve the production, wholesaling (including importing), transmission, distribution and retailing of energy products and services.

Robust, well-functioning energy markets are fundamental to delivering Australia's national energy objectives, and contributing to broader policy goals such as Australia's response to climate change, at the lowest possible cost. Our energy markets depend increasingly on a complex set of relationships with other sectors and markets to function effectively.

Australia has three main energy markets, for liquid fuels, electricity and gas. The electricity and gas markets are geographically and economically separated in the eastern, western and northern regions of Australia. The liquid fuels market is more national in its scope.

Australian energy markets are regulated by a number of laws and regulations (shown at the highest level in Figure 7.1). There is a close relationship between electricity and gas markets through a common legislative and policy framework under the Australian Energy Market Agreement (see Box 7.1). Australia's liquid fuels market is regulated separately.

Figure 7.1: National energy markets framework



Note: The National Energy Retail Law forms the substantive part of the National Energy Customer Framework. The National Energy Customer Framework legislative package, on application by jurisdictions, amends the National Electricity Law and the National Gas Law and applies the National Energy Retail Law (see Box 7.1).

Our energy markets have generally performed well in delivering safe, reliable and competitively priced energy. Past reforms, though incomplete, have been critical to that result. However, the markets will face new pressures and challenges in coming decades from continued expansion (albeit at potentially slower rates than previously forecast) and in the transformation to clean and sustainable energy. Further reforms are needed to improve the operation and productivity of our energy markets and to ensure that regulatory frameworks are supporting efficient outcomes in order to minimise future cost pressures for consumers.

To meet these challenges, the markets will need to become more efficient and flexible. This will require policy and regulatory frameworks that can:

- efficiently interface with other mechanisms and markets, such as the carbon pricing mechanism and financial markets, to ensure that the necessary investment and operational results are achieved at least cost
- smoothly integrate rapidly evolving technologies and robustly adapt to changing dynamics
- more efficiently balance supply and demand
- provide consumers with better information and a wider range of options to manage their energy needs.

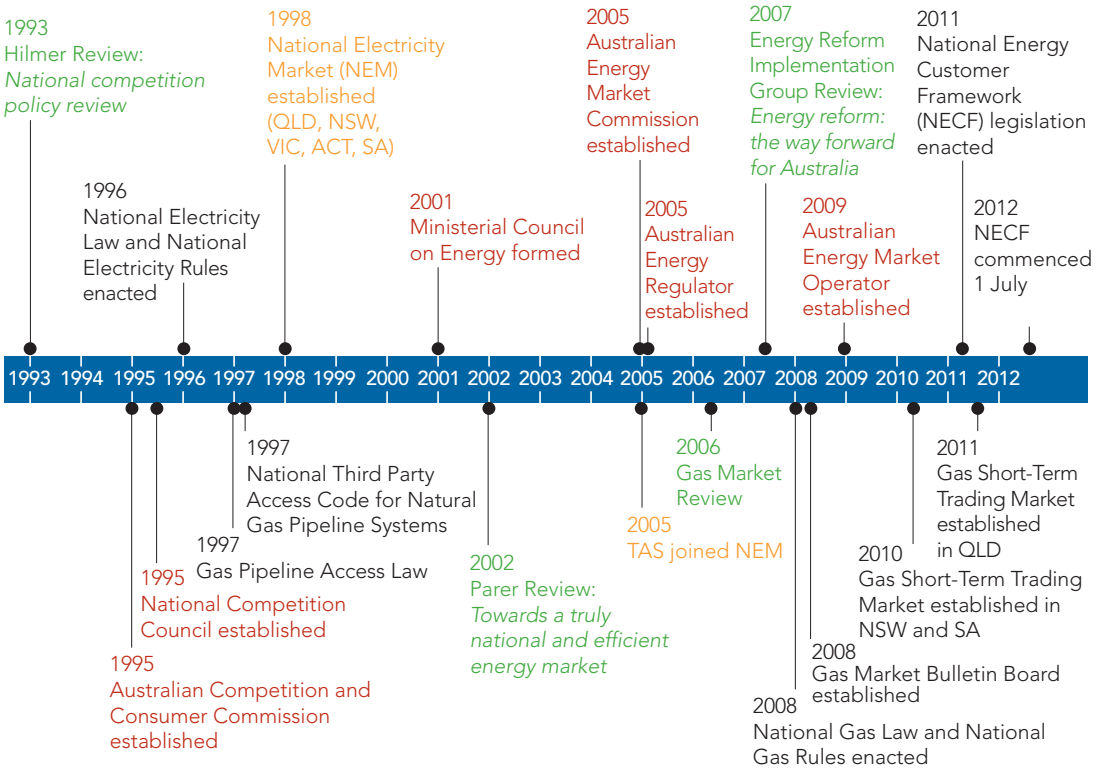
7.1 Market reform: underway but incomplete

Australian energy market reforms that began in the 1990s created national frameworks for governance, network regulation, planning, pricing, demand-side participation and non-economic regulation (Figure 7.2). They were accompanied by structural changes, such as the increasing privatisation of energy assets. This process has largely been driven by the Council of Australian Governments (COAG) Ministerial Council on Energy, which has now been replaced by the Standing Council on Energy and Resources.

Two major reviews of electricity and gas market reforms were conducted under the auspices of COAG to deliver productivity improvements in the energy sector: the 2002 Parer Review (Parer 2002) and the 2007 Energy Reform Implementation Group Review (ERIG 2007).

Many of the reforms identified in the two reviews have been implemented, including the development of more independent and effective market governance arrangements and reforms to network and retail arrangements.

Figure 7.2: History of Australian energy market reform



However, a number of areas are yet to be completed:

- addressing issues related to government ownership, and potential problems from cross-ownership between generation and transmission (as identified in whole market reviews)
- promoting greater competition in retail markets through the introduction of full retail contestability in all jurisdictions and, where effective competition exists, the deregulation of retail prices
- improving the opportunities for efficient levels of demand response in the market
- determining frameworks for the efficient deployment and use of interval meters, smart meters and smart grids
- applying uniform non-economic regulation across jurisdictions

- further optimising network regulation
- reviewing derogations and differences between jurisdictional arrangements and the national regime
- applying reforms in non–National Electricity Market (NEM) jurisdictions, most notably in Western Australia's electricity and gas markets, for which the current Western Australian Strategic Energy Initiative is the key.

Some of these matters are beyond the jurisdiction of any single government and require a sustained, cooperative commitment over time. Despite differences in views between jurisdictions on some matters, the Australian Government considers that the COAG structure remains the most appropriate mechanism to advance these reforms, as demonstrated by its success in energy reform to date.

A number of market overview activities by the energy market bodies in the NEM and the non-NEM jurisdictions are underway, along with a range of market- and jurisdiction-specific reviews and development actions (outlined in chapters 8, 9, 10 and 11).

7.2 Energy market policy framework

The Australian Government uses the following framework to guide its consideration of energy market design and operation. These principles complement the overall energy policy framework set out in Chapter 1: *A framework for national energy policy*.

Policy objectives

To maintain well-functioning energy markets and services that deliver reliable, safe, secure and competitively priced energy for all Australians, including by:

- encouraging 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.

Policy principles

- Energy markets and services should deliver outcomes that are in the long-term interests 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 comply with competitive neutrality policy.

Ensuring that energy markets should operate in the long-term interests of consumers is fundamental to the government's approach. This means efficiently balancing supply and demand while promoting accessibility and reliability in meeting Australia's long-term energy needs at a competitive price. It also follows that market participants must be able 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.

7.2.1 Characteristics of well-functioning markets

In assessing whether energy delivery goals are being achieved (and therefore whether there is a case for government intervention in the markets), the definition of 'well-functioning markets' is critical.

While the needs of the liquid fuels, electricity and gas markets differ, all well-functioning energy markets seek to maximise competition, including through:

- transparent and effective market objectives
- transparent 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
- appropriate information systems to inform market participants, policymakers and regulators
- efficient regulation of monopoly network infrastructure
- price signals that reflect the full costs and benefits of production, supply and consumption
- well-functioning financial markets to provide certainty, strengthen competition and lower entry costs for new participants
- active consumer participation
- non-integrated and competitive ownership structures throughout the supply chain.

7.3 Policy challenges and priorities

While each energy market has a specific set of issues, there are three overarching challenges and priorities:

- aligning energy market and other policy objectives
- maintaining the momentum for reform
- promoting consumer engagement in market processes.

7.3.1 Aligning energy market and other policy objectives

It is important that energy markets also contribute effectively to a broader range of social, environmental and economic goals. This is reflected in the objective and goals of the Australian Energy Market Agreement (see Box 7.1)

Box 7.1: The Australian Energy Market Agreement

On 30 June 2004, the Australian Government and the state and territory governments entered into the Australian Energy Market Agreement to establish the Ministerial Council on Energy (now the Standing Council on Energy and Resources), the working arrangements for the energy market institutions and a national framework for distribution, retail and other market arrangements.

The agreement is supported by the *Australian Energy Market Act 2004*, which sets out the national laws and rules that apply to electricity, gas and energy retailing. The National Electricity Law, National Gas Law, National Energy Retail Law, National Electricity Rules, National Gas Rules and National Energy Retail Rules are agreed and applied by each Australian state and territory and the Commonwealth, with some variations between jurisdictions.

The overarching objective of the Australian Energy Market Agreement 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 agreement 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 reducing 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 are differing perspectives on whether the objectives for the Australian Energy Market Agreement, the national energy market laws or both should be amended to refer explicitly to other specific 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 and that they provide a robust basis for market regulation and development. The core objective and operating principle—ensuring that markets operate in the long-term interests of consumers—allows a broad range of interests to be taken into account and provides enough scope for effective interfaces between energy markets and other policy frameworks.

Given that no regulatory or market failure associated with the overall objectives in the Australian Energy Market Agreement has been identified, making such changes would risk introducing unnecessary complexity and potential confusion for market operators, regulators and participants. It is also unclear how non-energy policy goals, which differ across jurisdictions, could be coherently reflected in a single set of national market rules. These issues are best dealt with outside the market settings through direct and targeted policy, as this allows for properly targeted, efficient and effective outcomes.

For example, concerns about energy cost impacts on low-income households are most efficiently addressed through mechanisms such as transparent community service obligation payments or through various social 'safety nets', rather than through market or price regulation. Similarly, environmental outcomes are generally best achieved through appropriate pricing of externalities or the direct management of impacts, rather than through market rules that impose inflexible preferences for particular technologies or fuels or restrictions on access to resources.

However, decisions on energy market design and regulation must take into account and efficiently interface with other important policy frameworks. To ensure that energy and other policy goals are achieved harmoniously, and to build the necessary community acceptance of reforms, these decisions should be tackled holistically and transparently.

This approach underlies the design of the government's carbon pricing mechanism, which includes a range of measures to ensure the efficient integration of the carbon and energy markets, particularly the electricity market.

7.3.2 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 to drive a surge in productivity growth. In the past decade, Australia's productivity growth—measured in terms of both labour productivity and multifactor productivity—has slowed (Parkinson 2011). Productivity has declined markedly in the electricity and gas sectors, driven by factors such as rising peak demand (which reduces capital utilisation rates), greater investment in higher-cost, lower-capacity generation plant and additional network building standards (PC 2012).

The Australian Government considers that there is a need to continue with reforms that increase the flexibility of the economy and its productive capacity if people and businesses are to embrace change, adapt and innovate.

It is perhaps more important than ever that attention and momentum are given to the promotion of greater efficiency and resilience in market structures to minimise cost-of-living and business cost pressures.

Australians have generally been served well by the cooperative effort across jurisdictions to promote ongoing reform and the development of Australia's principal energy markets. Those efforts have provided real and lasting benefits to consumers and the economy (see Box 7.2).

Box 7.2: The benefits of energy market reform

Reforms of Australia's main energy markets were a key part of Australia's competition policy reforms of the 1990s and have brought lasting and tangible benefits to the economy and energy consumers. In 2005, the Productivity Commission estimated that the reforms had increased Australia's GDP by 2.5%.

In particular, the creation of new national electricity and gas markets restructured previously separate state-owned and operated energy entities into a competitive and interconnected wholesale market involving business-on-business competition supported by more transparent and nationally regulated networks. This delivered:

- a highly competitive and efficient wholesale electricity market with substantially improved efficiencies and generation capacity utilisation rates (which helped to maintain wholesale energy prices at lower levels in real terms than in 1996–97)
- the world's longest interconnected electricity grid, which has consistently provided power at a high standard of reliability

- energy market structures (independent, national and consistent energy laws and institutions) that are well placed to respond efficiently to broader policy objectives
- more competition in the retail sector, where most customers can now choose suppliers and find better deals.

Some misconceptions about reform

One common misperception is that reforms have led to higher prices. Energy prices in Australia generally remained stable and low through the late 1990s to around 2007. Recent price rises largely reflect a combination of increasing production costs and the high point of an investment cycle in Australia's energy infrastructure.

A second common misperception is that deregulation means a lack of oversight and the loss of consumer protections. Australia's energy consumer protections are generally higher than in many other markets, and further reforms will be accompanied by an appropriate safety net. Competitive markets also strengthen the consumer's position through greater efficiency and by allowing consumer choices between services.

But we can do better ...

- Further improvements are needed to the regulatory frameworks for networks to minimise cost pressures without inhibiting efficient and necessary expenditure. This is a complex task, so any changes must be carefully considered and evidence based.
- Government ownership of energy assets may create the potential for conflict in both policy and operational decisions. However, government ownership of energy businesses is a decision for the respective governments.
- Competitive and efficient retail energy markets will deliver benefits for both consumers and the energy sector. Where competition is sufficient, COAG processes should assist jurisdictions' transition to deregulated prices. A robust and effective customer protection framework is vital. Where prices continue to be regulated, there is scope for more consistent regulatory methodology.
- Consumers should be empowered to participate in the market, and improve productivity, through demand-side participation and better information and products. Pricing, regulatory and technical agendas should support this goal.
- Over the longer term, an active work program is needed to improve the harmonisation of national energy markets and to apply national laws and use national institutions consistently in all markets. A particular focus on gas markets and energy market resilience is needed.
- The mechanisms for tracking reform, measuring it against objectives and communicating it can be improved.

However, some important reforms have not yet been completed. There is still work to do in areas such as retail price deregulation, strengthening network regulation, improving demand-side outcomes, improving the productivity of government-owned businesses, and further developing our gas markets as they mature and can support more efficient structures. Hard decisions about pricing and competition will make our markets more truly national and, more importantly, deliver sustained benefits to consumers (these issues are discussed further in Chapter 9: *Energy markets: gas* and Chapter 10: *Energy markets: electricity*).

In the longer term, the policy and regulatory frameworks for the liquid fuel market need to provide for a more consistent, market-based treatment of all fuels and technologies, and a more stable and predictable framework for the development of new products and industries (see Chapter 8: *Energy markets: liquid fuels*).

Unfortunately, progress in some areas of reform or market development (such as retail market reform) has been slower or more patchy than desired, particularly in the light of previous commitments. This has been to the detriment of consumers and energy businesses.

The Australian Government believes that there is a need for ongoing and transparent monitoring of progress in market reform. The chair of the Standing Council on Energy and Resources currently reports annually to COAG on progress against the standing council's agreed work plan. The government will examine how this could be improved to provide a more holistic assessment of progress and remaining gaps or needs.

The complexity of the market and its interactions should not be underestimated. It is important that policy development responds to those challenges based on good arguments, research and analysis to develop policies that can stay in place over the long term.

While these and other reforms will not eliminate price increases for consumers, they can help to ensure that energy services are delivered efficiently, investors receive efficient and fair returns, and future price pressures are limited to those that are necessary. While some reforms may be politically challenging, they are important in the long term and necessary if consumers are to get the best results.

7.3.3 Consumer engagement in market processes

Energy reforms must be well targeted and supported by key stakeholders if they are to produce the best outcomes, so we need better communication and consumer engagement in the reform process. While market rule-setting and review processes allow for consumer input, in practice this is often constrained by stakeholders' time, technical capacity and resource limitations. This is particularly the case for many welfare and small consumer groups.

It is also vitally important that the consumer voice is heard during policy and market development. The Australian Government currently provides support to the Consumer Advocacy Panel, which provides a vehicle for consumer representation. There is a need, however, to consider how consumer advocacy organisations can participate more effectively in the national reform agenda. The government will work with consumer advocacy groups to explore opportunities for more effective and nationally focused engagement.

In addition, there may be merit in considering how reform processes could be improved. This could involve more inclusive use of experts, including from business and consumer groups, at the working level on market design and development to ensure that proposed approaches are robust and represent best practice. This can be done in ways that address potential conflicts of interest and preserve appropriate policy and decision-making responsibilities.

Energy markets policy actions

To guide its consideration of energy market design and operation, the Australian Government will:

- ensure through its policy development and review processes that non-market policies and measures effectively and efficiently interface with energy markets to deliver stated objectives at the least cost
- continue to advance a comprehensive reform agenda in Australia's electricity and gas markets and pursue ongoing improvements in the liquid fuels sector, with a view to improving productivity and competition and ensuring that these markets are operating in the long-term interests of consumers and are subject to regular monitoring and comprehensive reporting
- consider options to provide for more effective consumer engagement in energy market processes and for the use of business and community experts in market design and development.

8 Energy markets: liquid fuels

Highlights

- Australian liquid fuel markets are functioning efficiently and effectively and are well placed to meet future needs.
- Projected reductions in our crude oil production and refining capacity will mean that demand will increasingly be met by imports of crude oil and refined product.
- This is not considered to affect our liquid fuel security because we have ready access to mature, diverse and reliable international supply chains and robust market governance and emergency response arrangements. Announced refinery closures will occur on the basis of an orderly transition to increase import capacity to ensure continuity of supply.
- A number of challenges need to be addressed to ensure that Australia remains well positioned to meet future liquid fuel needs. They include:
  - ensuring the timely development of new import terminal capacity and securing further investment to maintain the efficiency and reliability of existing refineries
  - addressing any regulatory or policy barriers that impede the efficient market-based development of alternative fuels or technologies to complement conventional products
  - improving our understanding of the liquid fuels sector, including production and consumption balances in the economy, the potential for alternative fuel development and any critical dependencies in downstream activities that rely on specialised locally made fuel products.

Liquid fuels will remain a major component of Australia's energy system, supplying almost half of the nation's final energy needs over the next two decades (BREE 2011c).

During that time, the sector is expected to undergo further change with the announced closure of two refineries and the possibility of further capacity rationalisation as Australian operations face continued competitive pressure from Asian mega-refineries. These changes are manageable.

Global production of liquid fuels is not expected to be resource constrained: there is sufficient conventional and alternative supply available to meet projected demand to at least 2035. While currently a small fraction of the market, alternative fuels will continue to be developed and will increasingly enter the market over the longer term. This will contribute to a more diverse market. While overall demand for fuels is expected to increase, environmental performance and fuel efficiency will improve as transport and engine technologies evolve.

Meeting future demand will require the right balance in policy settings to ensure that we attract investment in new supply infrastructure and in the development of efficient and sustainable alternative fuel products that can compete in the market. The best way to ensure our long-term liquid fuel security is to remain firmly embedded in open, diverse global supply chains supported by stable long-term fiscal and regulatory frameworks. Those frameworks should allow the market to respond efficiently to price and policy signals.

8.1 Overview

Australia's liquid fuel market is a critical component of our energy system, fuelling our transport system, feeding industrial processes and supplying electricity generation, particularly in remote areas of Australia.

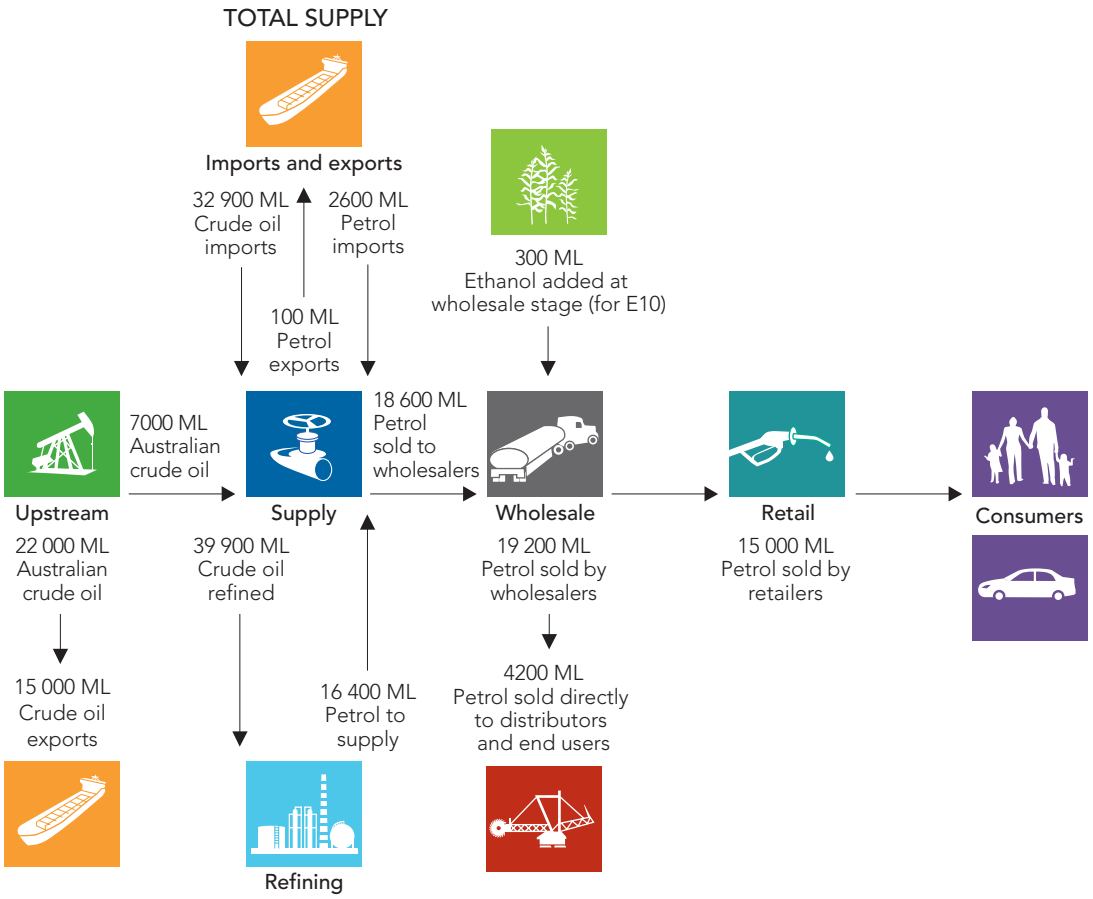
Products in this market include a wide range of feedstock and fuels, including crude oil, condensate, liquefied petroleum gas (LPG), refined petroleum products used as fuels, petroleum-based feedstocks, and alternative transport fuels such as biofuels (ethanol, biodiesel and advanced biofuels), compressed natural gas (CNG), liquefied natural gas (LNG), synthetic fuels such as gas-to-liquids and coal-to-liquids products, and hydrogen.

This chapter builds on the upstream petroleum exploration and development issues discussed in Chapter 5: *Energy resources* and the broad energy market policies and objectives presented in Chapter 7: *Energy markets: overview*. It outlines the structure of Australia's liquid fuels market, key trends and regulatory frameworks, discusses likely future pressures in the market and outlines the Australian Government's approach to addressing these challenges. Issues specifically related to our ongoing energy security, such as potential supply disruption, are addressed in Chapter 4: *Energy security*.

8.1.1 Market profile

The key elements of the Australian liquid fuel market are shown in Figure 8.1, which illustrates petrol flows in Australia from source to end use. The liquid fuel market encompasses the supply of Australian-produced and imported crude oil and liquefied gases; 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).

Figure 8.1: Australian petrol flows, 2010–11 (ML)



Source for data: ACCC 2011.

8.1.2 Liquid fuel demand and production

Australian demand for liquid fuels has risen steadily over the past decade, and consumption of refined petroleum products is projected to grow. The transport sector is the largest final consumer of liquid fuels, accounting for around three-quarters of Australia's final fuel use. The remainder is used in industrial processes, electricity generation and other non-transport applications.

Australia's liquid fuels are largely supplied through a mix of crude oil imports, domestic crude production, imports of refined products and alternative fuel production.

In 2010–11, Australia imported around 83% of its crude oil and other refinery feedstock, much of it from Malaysia, Indonesia and the United Arab Emirates (BREE 2012a). Bulk fuel terminals for refined products are located throughout Australia, servicing geographical regions where the demand for fuel is concentrated.

In 2010–11, around 79% of Australia's crude oil and condensate production was exported due to its physical characteristics (which make it more suitable for higher-value products elsewhere) and the proximity of sources to export markets (BREE 2012a).

Figure 8.2: Australian refineries, ports and terminals

Refinery	Capacity: (ML/year)
Bulwer Island (BP—Brisbane)	5 910
Lytton (Caltex—Brisbane)	6 300
Clyde (Shell—Sydney)	4 990
Kurnell (Caltex—Sydney)	7 820
Altona (Mobil—Melbourne)	4 640
Geelong (Shell—Geelong)	7 470
Kwinana (BP—Kwinana, WA)	8 300
Total	45 430

Source: Australian Institute of Petroleum (2011).

In 2010–11, seven major petroleum refineries were operating in Australia, producing 38 395 ML or around 74% of the refined petroleum products consumed domestically (RET 2011b). To meet total demand, Australia also imported around 17 030 ML of refined product, much of it from Singapore and South Korea.

In June 2012, Shell announced that refining operations at its Clyde refinery would cease on 30 September 2012, and that it would convert the Clyde refinery and Gore Bay terminal into fuel import facilities by mid-2013. In July 2012, Caltex announced the closure of the Kurnell refinery and its conversion to a major import terminal. It also announced further investment in the Lytton refinery to improve its competitiveness.

Australia's maximum refinery capacity will decline by around 28% to 32 620 ML. Following these closures, BREE forecasts that domestic refiners will produce just over half the fuel consumed in Australia; the remainder will be imported.

Australia's storage capacity was reported as 6693 ML in August 2009. Since that time, an additional 588 ML of storage has become operational or is under construction. In addition to the port facilities at the seven refineries, Australia has 64 refined product import terminals. Of those, 11 are major deepwater ports.

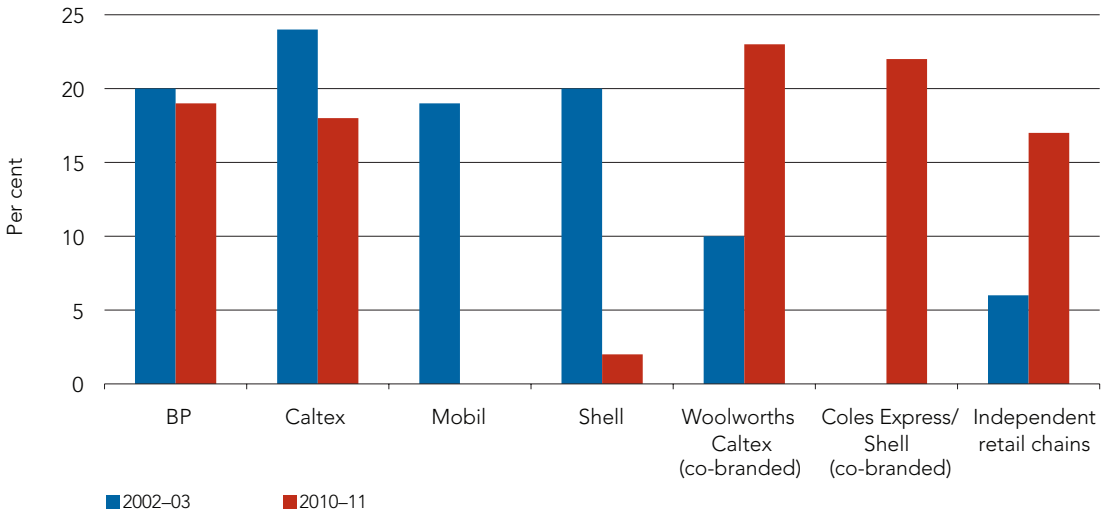
Alternative transport fuels supplied approximately 5% of the liquid fuel market in 2010–11. Most of this was LPG, along with a smaller amount of biofuels, LNG and CNG (BREE 2012a).

8.1.3 Wholesale, distribution and retail markets

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 they account for a small part of the wholesale market, they have continued to increase their share of wholesale sales, reaching 7% in 2010–11 (ACCC 2011).[1]

The liquid fuel retail sector has undergone significant structural change in the past decade, including the rationalisation of retail sites, a scaling down of retail activities by refiner–marketers and an increasing presence of specialist retailers. Two supermarket chains are in the retail fuels market, operating co-branded retail fuel outlets: Woolworths with Caltex and Coles with Shell. Mobil sold its retail business to 7-Eleven in 2010, thereby exiting the retail fuel market in Australia. While the refiner–marketers and the supermarket chains account for most of the retail fuel market, a number of independents with a growing share of sales volumes also operate in this area (see Figure 8.3).

Figure 8.3: Share of retail volumes, by brand, 2002–03 and 2010–11



Note: The Mobil sites that were sold to 7-Eleven in 2010–11 are included in 'Independent retail chains'.
Source: ACCC (2011).

8.1.4 Prices

Australia's liquid fuel market has operated on the principle of import price parity since 1977, which means that domestic fuel prices are closely linked to international events. Monitoring by the Australian Competition and Consumer Commission (ACCC) confirms that the international benchmark price is the largest component of domestic petrol, diesel and automotive LPG prices (Figure 8.4).

1 Only firms monitored by the ACCC are included in this figure.

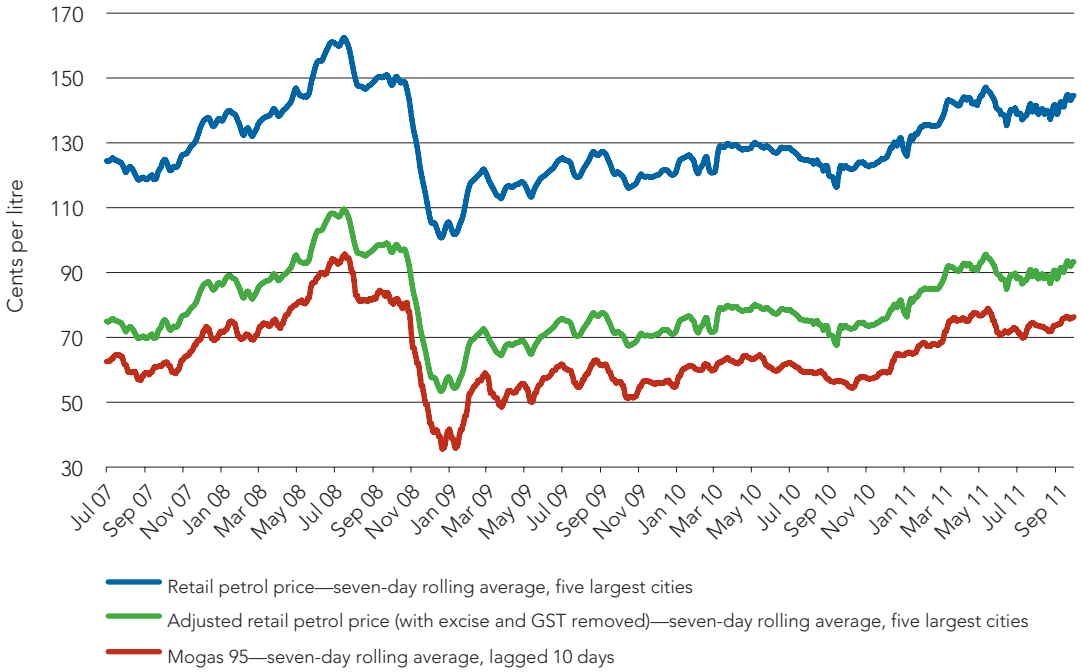
The international benchmark price, which differs for each fuel, is a base price for Australian suppliers. The benchmarks for each fuel are:

- petrol—Singapore Mogas 95 Unleaded
- diesel—Singapore Gas Oil 10 parts per million (ppm)
- LPG—Saudi Contract Prices (Saudi CP)

As these benchmarks are priced in US dollars, changes in the value of the Australian dollar also affect the domestic price of fuel.

The final domestic price also includes the wholesale and retail margins and costs such as freight, wharfage and insurance. In the case of petrol and diesel, a quality premium to reflect Australia's higher fuel quality standards is added. Petrol price cycles also influence the daily price of fuel.

Figure 8.4: Average Australian unleaded petrol prices, July 2007 to September 2011



Source: ACCC (2011) using Platts, RBA and Informed Sources data.

Liquid fuels (mostly diesel) are also used for electricity generation, particularly in remote parts of Australia as they are practical and reliable sources of power for industrial, agricultural and residential users. These supplies are largely sourced directly from overseas through import facilities in major regional ports. Off-grid power is discussed further in Chapter 6: *Clean energy*.

8.2 Market regulation

Australia's liquid fuel markets are regulated through a complex set of intersecting frameworks at the national and state and territory levels covering competition policy, taxation, environmental, and health and safety issues. The principal Australian Government regulations are outlined in this section.

8.2.1 Oilcode

The Competition and Consumer (Industry Codes—Oilcode) Regulation 2006—formerly known as the Trade Practices (Industry Codes—Oilcode) Regulations 2006—is a mandatory industry code under the *Competition and Consumer Act 2010*. It regulates the conduct of suppliers, distributors and retailers in the downstream petroleum retail industry and 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 by all customers (including small businesses) to petroleum products at the terminal gate price
- an independent dispute resolution scheme, including a dispute resolution adviser, to give the industry a cost-effective alternative to taking action in the courts.

8.2.2 Monitoring and enforcement

The ACCC formally monitors prices, costs and profits of unleaded petroleum products following a ministerial direction under the Competition and Consumer Act. It also informally monitors diesel and automotive LPG prices. The monitoring functions are overseen by a commissioner of the ACCC.

Part IV of the Competition and Consumer Act promotes competitive markets through prohibitions on anticompetitive practices, such as misuse of market power, price fixing and other collusive conduct. The ACCC has powers under Part IV of the Act to investigate and take enforcement action where necessary.

8.2.3 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 (excluding carbon price impacts).

New taxation arrangements for alternative fuels came into effect on 1 December 2011 (Table 8.1), with a five-year transition of the gaseous fuels into the regime and 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 domestically produced 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.

Table 8.1: 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 (c/L)	2.5	5.0	7.5	10.0	12.5
LNG (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/L)	38.143	38.143	38.143	38.143	38.143
Biodiesel (c/L)	38.143	38.143	38.143	38.143	38.143

CNG = compressed natural gas; LNG = liquefied natural gas; LPG = liquefied petroleum gas.

Source: *Legislation Amendment Act 2011*.

A broad review of the operation of the legislation and its impact on arrangements for gaseous fuels will take place after 1 July 2015. The taxation and grant arrangements that apply to biodiesel, ethanol, renewable diesel and methanol will be reviewed after 1 July 2021.

8.2.4 Environmental regulation

Fuel quality standards

Fuel quality at the national level is regulated under the *Fuel Quality Standards Act 2000*. The Act regulates fuel supplied in Australia in order to reduce the level of pollutants and emissions arising from the use of fuel that may cause environmental and health problems; facilitate the adoption of better engine technology and emissions control technology; allow the more effective operation of engines; and ensure that, where appropriate, information about fuel is provided at the point of supply.

Australian fuel quality standards have been made for petrol, automotive diesel, biodiesel, autogas and E85, a high-ethanol blend with petrol. A fuel quality standard is being considered for diesel–biodiesel blends containing at least 5% but not more than 20% biodiesel with diesel, known as B20.

Carbon pricing

The Australian refining sector has been subject to carbon pricing since 1 July 2012. Petroleum refiners are eligible for assistance in relation to carbon costs from direct emissions and electricity consumption under the Jobs and Competitiveness Program. The assistance provided covers emissions associated with the refining of petroleum products that may be used by end-customers as transport fuels.

Transport fuel used in the rail, domestic shipping and domestic aviation sectors is subject to an effective carbon price from 1 July 2012. International aviation and shipping fuel use are not subject to the carbon price.

Light commercial vehicles (4.5 tonnes or less gross vehicle mass) and households do not face a carbon price on the fuel they use for transport. In addition, the agriculture, forestry and fishery industries do not pay a carbon price on their fuel use. The government intends that on-road heavy vehicles will be subject to an effective carbon price from 1 July 2014, although gaseous fuels used in heavy on-road vehicles will be effectively exempt, as gaseous fuels excise rates are lower than the road user charge. Carbon pricing does not apply to the use of biofuels (ethanol, biodiesel and renewable diesel).

Since 1 July 2012, a carbon price has been included in the cost of the natural gas used to produce non-transport CNG. Furthermore, from 1 July 2013 non-transport usages of LPG and LNG will be covered by the carbon pricing mechanism. Before then, non-transport LPG and LNG suppliers will pay an equivalent carbon price through a reduction in the remission of excise for non-transport LPG and LNG. CNG, LPG and LNG users in the agriculture, forestry and fisheries sectors will not pay a carbon price or an effective carbon price.

8.3 Policy challenges and priorities

The most recent National Energy Security Assessment (NESA) found that overall the Australian liquid fuel market and systems are functioning efficiently and effectively and are well placed to meet Australia's future liquid fuel needs.

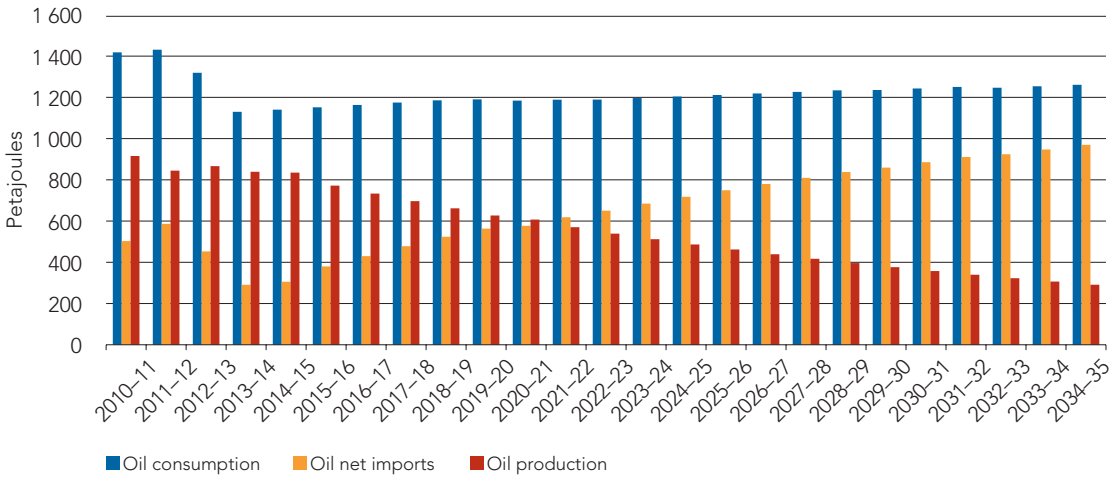
Australia's access to well-functioning markets for liquid fuels has helped create robust and flexible supply chains for crude oil and other refinery feedstock and refined petroleum products, and has encouraged a high diversity of supply (RET 2011b). In addition, the overall strength of the Australian 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.

However, maintaining this outlook means that a number of emerging challenges need to be addressed in coming years. Primarily, we need to ensure that Australia is positioned to meet its liquid fuels needs and to improve our understanding of the liquid fuels sector.

8.3.1 Ensuring that Australia is positioned to meet its liquid fuels needs

In the absence of major new discoveries, domestic crude and condensate production and export are projected to decline. We will continue rely on imports to supply our refineries (Figure 8.5).

Figure 8.5: Crude oil and condensate balance, 2010–11 to 2034–35 (PJ)



Note: Excludes stock changes. Excludes production from Icthys and Prelude projects.

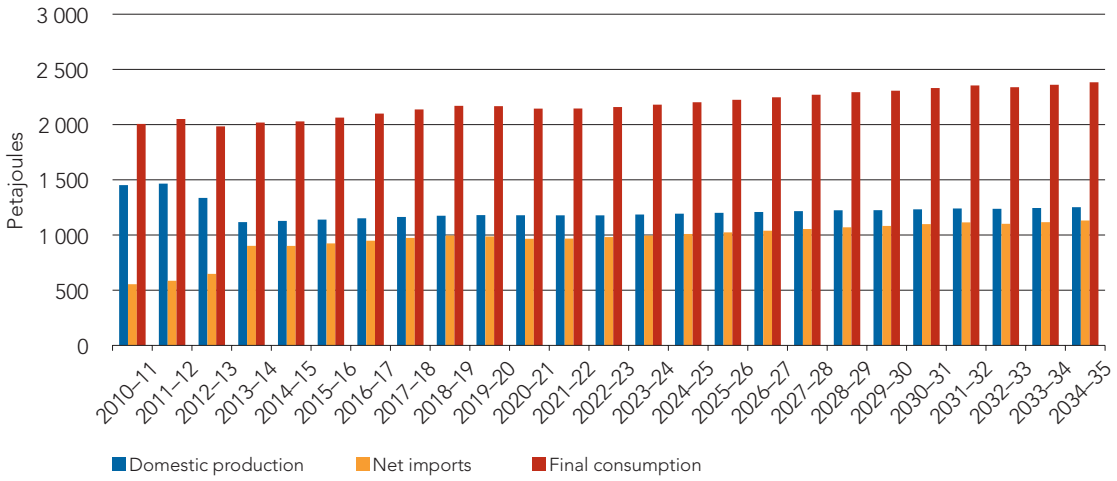
Source: BREE, internal, 2012.

At the same time, the decline in our refinery capacity and continued growing demand for liquid fuels will lead to a greater share of refined petroleum products being sourced from imports (Figure 8.6).

Australia's refining industry is undergoing structural change in response to strong competitive pressure from larger and newer Asian refineries, which continue to lower the break-even benchmark that our refineries compete against. The domestic pressure of high local costs, coupled with a high exchange rate, is expected to keep Australian refineries under pressure for some time.

Structural change in this highly capital and infrastructure-linked industry tends to follow a very orderly transition over a long timeframe, so that the market can respond accordingly to ensure that supply security is maintained and supplier market shares are preserved. In order to continue to meet market demand, refinery closures are very unlikely to occur until alternative supply capacity has been secured. This is the case with the recent announcements by Shell and Caltex.

Figure 8.6: Australia's refined product balance, 2010–11 to 2034–35 (PJ)



Source: BREE, internal, 2012.

Australia is not unique in this experience: Europe and the United States are also undergoing similar structural adjustment. This may extend the transitional period globally as companies manage international refinery portfolios while seeking to maintain or extend market share.

The 2011 NESA found that a significant reduction in refining capacity is not expected to cause fuel security problems, given our access to well-functioning global markets that can provide adequate and reliable supplies (RET 2011a). Australia's fuel security is assessed as part of the biennial NESA Findings on long-term fuel security and measures to respond to short-term shocks are outlined in Chapter 4: *Energy security*.

Asia is increasingly becoming the global refining and trade centre, with significant refining and storage capacity, highly complex and export-oriented refinery operations, and proximity to major trade routes. Significant net additions to Asia–Pacific export refining capacity are forecast to come online, including more refined fuels from India that meet Australian standards. This will maintain a surplus in regional refining capacity through to 2020.

A domestic refining presence provides Australia with a limited ability to process domestically produced crude in-country, and a degree of supply flexibility and reliability. While there is the prospect of some further reduction in Australia's refining capacity, the underlying competitiveness of most Australian operations, along with the strategic advantages that some in-country refining presence offers, suggests that the prospect of a severely reduced or no refining capacity in Australia over the next decade is very remote.

However, the extent to which a domestic refining presence is considered critical from a security perspective must also be considered in conjunction with the cost of maintaining such capacity, supply flexibility, and the security benefits of global trade. Global trade provides energy security through the diversity of source countries, multiple import points and ample terminal infrastructure at major demand centres.

The closure of existing Australian refineries is unlikely to have any major impact on consumer fuel prices, as import parity pricing is the basis for wholesale and retail fuel pricing in Australia.

Building infrastructure and import capacity

Rising imports will require timely investment in import infrastructure, even in the absence of further refinery rationalisation. Currently, the market is delivering adequate terminal and importing infrastructure to meet Australia's liquid fuel needs, and investment in new import infrastructure and storage is keeping pace with increasing consumption (RET 2011a:13).

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. This will support future investment in import fuel terminals, storage facilities and distribution infrastructure.

Australia's refineries are in key geographical locations and have access to existing distribution infrastructure (pipelines or roads) to meet market demand. Therefore, any future refinery closure decisions are expected in most cases to be accompanied by decisions to convert the refineries to import terminals, maintaining these supply connections.

A change in supply from refining to imports is expected to lead to changes in inventory levels. While overall stocks held are reduced when a refinery is converted into a terminal, the volume of readily usable finished products increases. The drop in overall inventories associated with a refinery closure will have little, if any, impact on Australia's supply security.

Developing alternative fuels as part of our future fuel mix

While alternative transport fuels currently make up around 5% of Australia's liquid fuel supply, over time it is expected that they will play a growing role in the market, complementing conventional supply. Some of these products are already cost-competitive in certain applications, but many others require further development to overcome technical and cost barriers.

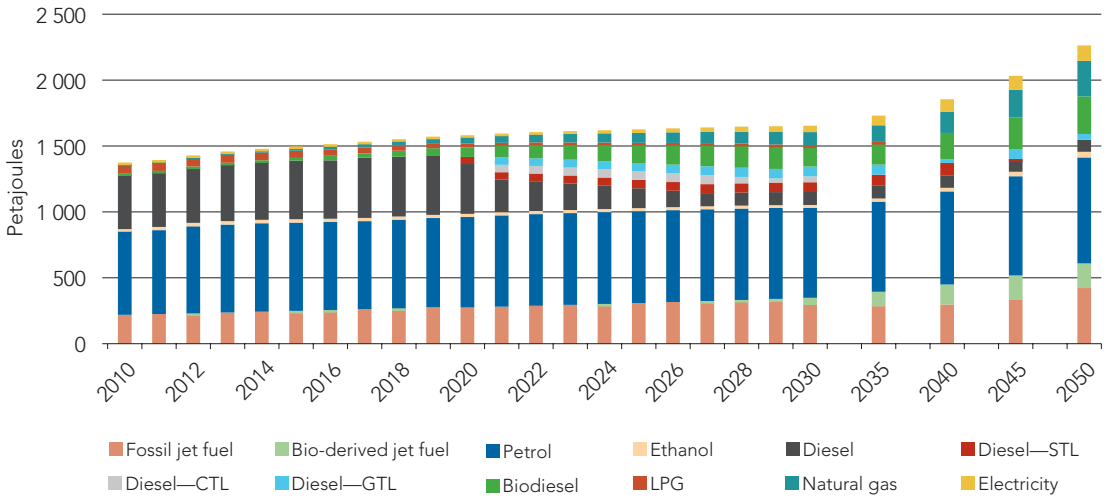
Figure 8.7 shows a possible future mix of transport fuels in Australia based on scenario modelling (CSIRO 2011d). The modelling suggests that over the period to 2050:

- transport fuel demand will increase steadily, driven mainly by the freight task and air travel
- conventional fuels will continue to be the mainstay of the liquid fuel market
- the take-up of alternative transport fuels is likely to be limited over the rest of this decade (however, stronger growth is expected in alternative fuel consumption from 2020 onwards, driven by higher oil prices and declining production costs)
- there will be greater supply diversity in alternative fuels such as gas-to-liquids, coal –to-liquids and shale-to-liquids
- almost all of the alternative transport fuels considered in the modelling will be taken up in the road sector during the period to 2030
- the rail sector will adopt some diesel substitutes and increase electrification where feasible
- the aviation sector will 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.

While modelling provides a useful tool to inform thinking on future trends, this by no means defines the set of possible market outcomes. For example, while not shown in Figure 8.7, LNG has some commercial applications in heavy vehicle transport. Similarly, CNG is currently used in some metropolitan buses and has commercial potential in purpose-built heavy vehicles. LPG is currently the only alternative transport fuel that has nationwide infrastructure.

While there has been a decline in consumption in recent years, the emergence of dedicated LPG vehicles may see renewed growth in this market. Hydrogen is projected to be taken up in small volumes in fuel cell vehicles towards 2050, but could take a larger share if the cost of fuel cell vehicles declines faster than assumed.

Figure 8.7: Modelled transport fuel mix to 2050, by fuel type (PJ)



GTL = gas-to-liquids; CTL = coal-to-liquids; STL = shale-to-liquids.

Source: CSIRO (2011c: Scenario 2).

As for many emerging technologies, the commercial development and adoption of alternative transport fuels in Australia is being influenced by such factors as:

- investment uncertainty
- policy, legislative and regulatory barriers
- infrastructure hurdles
- information barriers
- technology constraints (including cost)
- performance risk
- labour force skills constraints
- high adjustment costs.

The Australian Government, in consultation with industry, has developed the Strategic Framework for Alternative Transport Fuels to address barriers to the take-up of alternative fuels to allow them to enter the market when they are commercially viable. The framework outlines 20 actions for industry, government and other stakeholders to take in the period to 2030. The actions are grouped under the themes of leadership and certainty; research, development and demonstration; commercialisation; and information and verification. Their implementation is expected to lay the foundations for the market-led diversification of Australia's transport fuel mix.

In addition, through the Australian Renewable Energy Agency, the government is providing support under the $15 million Advanced Biofuels Investment Readiness program to build the investment case for significant and scalable pre-commercial demonstration projects for the production of advanced high-energy, 'drop-in' biofuels in Australia. This builds on the achievements of the Second Generation Biofuels Research and Development Program.

The government also provides grants for the purchase new LPG vehicles and the conversion of existing vehicles to LPG under the LPG Scheme. As noted in Section 8.2.3, the Ethanol Production Grants program and Energy Grants (Cleaner Fuels) Scheme support ethanol, biodiesel and renewable diesel.

Developing a consistent long-term framework for liquid fuels

The current liquid fuel market regulatory environment reflects the government's broader aim to improve environmental standards, reduce economy-wide emissions and promote alternative fuels.

Australia's fuel quality standards have improved urban air quality, facilitated the introduction of new engines and fuel-efficient technologies, and reduced greenhouse gas emissions.

The government will continue to promote environmentally sustainable production, supply and use practices, including reducing the sector's greenhouse gas emissions while maintaining industry competitiveness.

Any changes to fuel specification standards will need to consider Australia's circumstances and be subject to rigorous economic analysis of the costs and benefits to industry, consumers, and society more broadly, including consideration of domestic refining impacts and environmental and public health outcomes.

Our current fuel excise arrangements are a reflection of various excise and excise-equivalent customs duties and support measures, which have been developed and implemented over time in response to prevailing circumstances. This has resulted in some distortion in the market, with different treatments for different fuels.

For example, the New South Wales Independent Pricing and Regulatory Tribunal's review of ethanol supply and demand found that the market supply for ethanol is illiquid, primarily because ethanol production grants effectively exempt domestic producers from excise duty (in contrast to importers) and effectively remove import competition. This can undermine supply reliability where domestic production is insufficient or interrupted (IPART 2012b). This risk is compounded where ethanol mandates are used. This was demonstrated in 2011 when ethanol supply was disrupted by flooding and the lack of adequate, established and economically viable imports inhibited supply.

In this context, the government has announced that the Productivity Commission will review fuel excise arrangements, including by examining the merits of a regime that is based explicitly and precisely on the carbon and energy content of fuels. The review will be an important step in improving market regulation, and will be completed in time to allow any changes to be implemented by 2015–16.

There is a further need for governments to take into account the range of regulations applying to the liquid fuels industry, and to ensure that those regulations are appropriate and minimise the regulatory burden on industry while maintaining environmental standards (this is discussed further in Chapter 12: *Sustainability, workforce and Indigenous opportunities*).

8.3.2 Improving our understanding of the liquid fuels sector

With the expected changes and the diversification of our liquid fuels market, the government must continue to improve its understanding of the market, including through assessments of trends, developments and potential vulnerabilities; improved data collection; and assessments of new and emerging fuels and technologies.

Assessing vulnerabilities

The Australian Government regularly monitors and assesses the state of the liquid fuel market through the NESA, analyses of International Energy Agency research, and analyses of the Australian Petroleum Statistics collection.

These assessments alert the government to potential emerging risks and challenges, and the government and markets are well positioned to respond appropriately if necessary.

As described in Chapter 4: *Energy security*, most risks will be managed through normal market and policy processes. However, the government will continue to assess Australia's liquid fuel vulnerabilities regularly as part of the biennial NESA process covering the liquid fuel supply chain, including import and refining infrastructure, and will identify any critical supply linkages to downstream industries, such as plastics and chemical manufacturers.

Australian Petroleum Statistics

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.

The Australian Petroleum Statistics provide data on the production, sale and trade of petroleum products across the supply chain. The data is collected on a voluntary basis, and requires review to improve its completeness, consistency and accuracy and to inform assessments of liquid fuel vulnerability. This will also improve the analytical capability of government and assist in reporting to the International Energy Agency.

The industry has acknowledged the importance of this data for security assessments, and indicated support for all major fuel suppliers and importers supplying data to the Australian Petroleum Statistics. It has indicated support for the mandated data provision requirement under the Liquid Fuel Emergency Act (Australian Institute of Petroleum 2012).

The Australian Government is considering mandatory stock reporting in the context of its consideration of aspects of our international stockholding obligations (see Chapter 4: *Energy security*).

Australian Transport Fuel Technology Assessment

The Australian Government recognises that new fuels and technologies are in development, and that over time there will be changes in:

- the cost-competitiveness of different transport fuel technologies
- the timing of fuel technologies' commercialisation and market entry
- the timing and costs of production methods (such as processing technologies for advanced biofuels and lower-emissions technologies for synthetic fuels)
- vehicle engine technology, in conventional internal combustion engines, hybrids, plug-in hybrids and pure electric vehicles
- costs and timeframes for 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 will be addressed through a regular assessment of fuel technologies as part of the Australian Liquid Fuel Technology Assessment, which will encompass all major technology options for conventional and alternative transport fuels in the Australian transport fuel market.

8.4 Measuring policy success

Policy success in Australia's liquid fuel market could be demonstrated through the following outcomes:

- continued open access to reliable and diverse international and national supply chains that provide sufficient volume and product range to meet current and projected liquid fuel needs
- a pipeline of investment sufficient to ensure the timely development of adequate import and distribution infrastructure, as well as further commercial reinvestment in domestic refining capacity
- ongoing improvement in Australian fuel and vehicle performance standards, consistent with our environmental (including climate), health and safety, and energy policy objectives
- further commercial development of Australian alternative fuel opportunities, including through research and development, market testing and trials of commercial products
- the development of a consistent and coherent market-based framework that moves towards an even playing field for all liquid fuels in the long term.

Liquid fuel market policy actions

To ensure that Australia is positioned to meet its liquid fuel needs, the Australian Government will:

- continue to monitor developments in the liquid fuel market, including liquid fuel supply vulnerabilities associated with the decline in domestic refining capacity
- work with industry and, guided by the Alternative Transport Fuels Implementation Advisory Group, pursue a market-led approach to the development and deployment of alternative transport fuels
- develop a more consistent long-term policy framework for liquid fuels so as to promote stability and certainty for future investment, with the first step being the Productivity Commission review of fuel excise arrangements and an examination of a regime based precisely on the carbon and energy content of fuels, which is to be completed in time to allow any changes to be implemented by 2015–16.

The government will maintain and improve our understanding of the liquid fuels market through:

- assessing Australia's liquid fuel vulnerabilities as part of the National Energy Security Assessment (this will cover the liquid fuel supply chain, including import and refining infrastructure and critical supply linkages)
- improving the quality of the Australian Petroleum Statistics, including consideration of mandatory reporting
- undertaking biennial Australian Liquid Fuel Technology Assessments from 2013.

9 Energy markets: gas

Highlights

- Australia's gas production is projected to quadruple, reaching over 8000 petajoules in 2034–35, driven by the growth of our liquefied natural gas (LNG) export industry. There is also potential for substantial growth in domestic demand.
- By the end of this decade, Australia may rival Qatar as the world's largest exporter of LNG. Around 70% of the world's LNG capacity currently under construction is in Australia, and the benefits of those projects will continue for decades.
- Along with the development of major new gas resources, this is driving important changes in Australia's eastern and western gas markets. While there is sufficient gas to meet long-term domestic and export needs, there are likely to be short- to medium-term transitional pressures in the eastern market until project start-up risks diminish and new trading dynamics are established. These transitional pressures will manifest in tighter supply and higher prices.
- Security of supply to consumers is vital, and maintaining open market arrangements will be critical to allow supply to respond flexibly to changing circumstances.
- In this context, the Australian Government will work with relevant jurisdictions, gas market bodies and industry to:
  - address impediments to the development of our onshore and offshore gas resources
  - identify ways to improve market information
  - consider the merits of reviewing pipeline capacity trading, including potential mechanisms for utilising unused (but contracted) capacity
  - explore a development path for establishing a gas supply hub market that expands upstream trading opportunities and allows gas and capacity to be traded separately.
  - monitor gas market conditions, particularly the emergence of potential impediments to adequate supply, and work with the gas supply industry to identify ways to improve market liquidity.
- The Australian Government does not support calls for market interventions such as a reservation policy. Such measures should be a matter of last resort, undertaken only where there is clear evidence of market failure. Currently, there is no compelling evidence to support this.

Our gas markets have provided reliable and competitively priced gas, which has supported the development of downstream industries and greater availability of gas in homes and for power generation.

The emergence of transitional market pressures may particularly affect gas-intensive businesses. Responses to those pressures should be consistent with the development of more efficient and flexible gas markets, rather than impose distortionary or constrictive regulation. There are opportunities, which the Australian Government is pursuing through the Standing Council on Energy and Resources, to improve information flows and trading opportunities. The government also encourages a broader conversation on long-term objectives and directions for our gas markets to guide nearer term development directions.

9.1 Overview

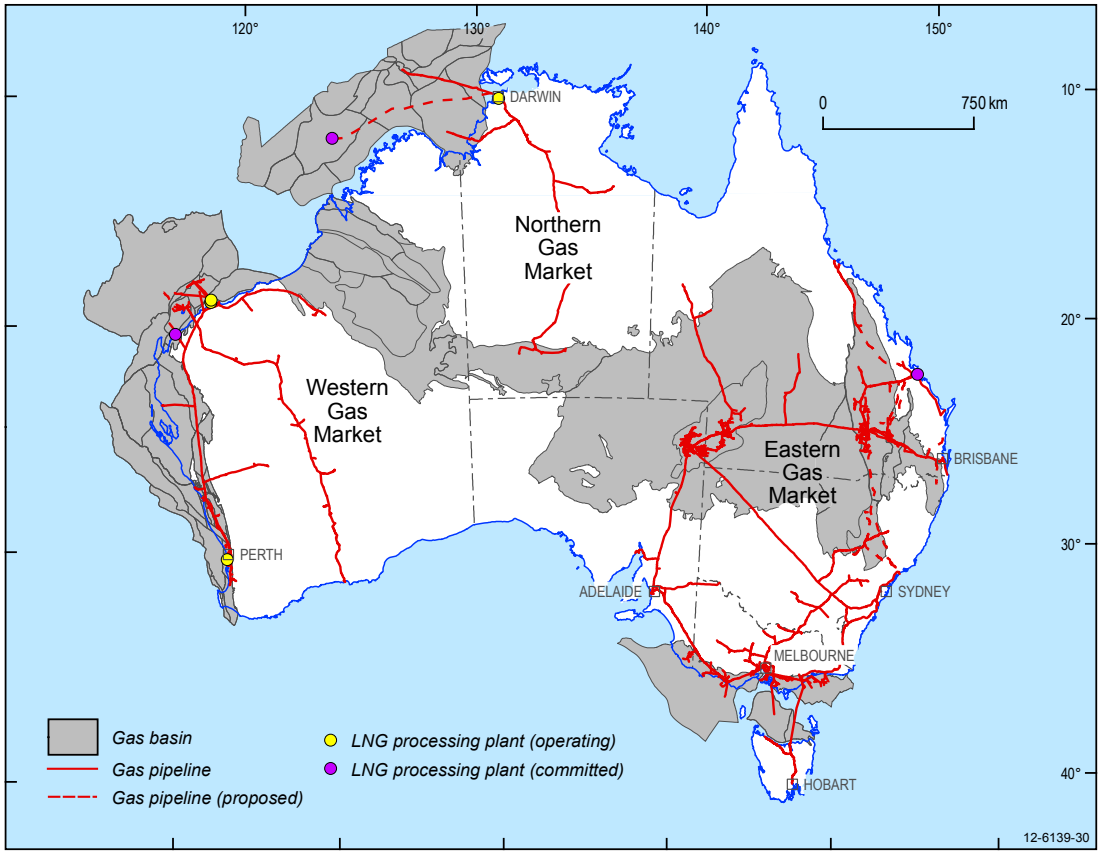
Australia's gas markets are a key part of Australia's energy system, servicing the manufacturing sector with a fuel source and feedstock, electricity generation, mining and residential consumers, as well as supporting the development of a world-class liquefied natural gas (LNG) export industry.

Australian gas resources are distributed through well-established pipeline networks to domestic markets and LNG terminals for export. The Australian domestic gas market consists of three geographically and economically separate markets: the eastern, western and northern markets (Figure 9.1).

In addition to our economically demonstrated reserves of 149 305 petajoules (PJ), we have large potential onshore shale and tight gas resources of around 450 000 PJ, although the extent to which they are economically recoverable has yet to be tested (RET, GA & BREE 2012).

This chapter describes each of Australia's gas markets and its operating environment, examines emerging challenges, and sets out the Australian Government's policy priorities for market development.

Figure 9.1: Australia's gas basins, pipelines and markets



Source: RET, GA & BREE (2012).

9.1.1 Market profile

Trading in Australian gas markets is largely through confidential long-term bilateral contracts, which means that market transparency is limited. In recent years, there has been an increase in the volume of spot market trading, but this remains a comparatively small proportion of the overall market.

In 2010–11, Australia produced 2095 PJ of gas, of which 1515 PJ was used domestically and 1086 PJ was exported (BREE 2012c). The industrial sectors (including manufacturing, electricity generation

and mining) account for about 87% of domestic gas consumption; the residential sector consumes a further 10% (BREE 2012c). The largest industrial consumers include metal product industries (mainly smelting and refining activities), the chemical industry (fertilisers and plastics), and the cement industry. Most of our LNG exports go to Japan and China, but smaller volumes go to the Republic of Korea and other markets (RET, GA & BREE 2012)

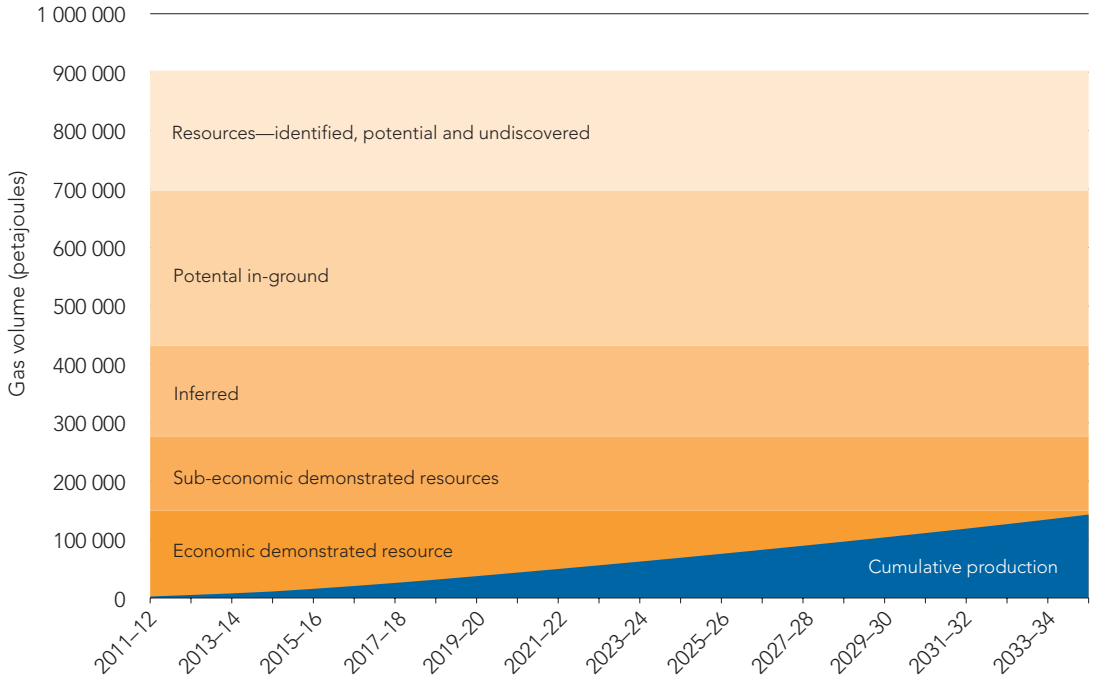
Over the next two decades, Australia's gas production is projected to increase almost fourfold, driven largely by LNG exports, which are projected to reach 5663 PJ by 2034–35. Supply to domestic markets is expected to reach 2611 PJ by 2034–35 (RET, GA & BREE 2012:38–39).

Seven Australian LNG projects are under construction and scheduled to come on line between 2014 and 2017, providing over 60 million tonnes of additional LNG export capacity (BREE 2012g:39). Three are in Queensland, exposing the eastern market to international gas export markets for the first time. Two projects are operating from the Carnarvon basin (Gorgon and Wheatstone), and two from the Browse basin—Prelude (floating LNG) and Ichthys, including the Darwin LNG plant (BREE 2012i:44). The outlook for LNG in the Asia–Pacific region is for continued strong demand. While there is growing supply competition, there are good prospects for further expansion of Australian LNG capacity (see Chapter 5: *Energy resources*).

This, along with the emergence of major new coal-seam gas (CSG) and, potentially, shale gas deposits, is driving important changes in the structure and operation of the eastern and western markets.

Australia's overall gas resources exceed projected demand in domestic and LNG markets. Figure 9.2 shows projected cumulative production volumes to 2034–35, set against Australia's current categories of gas resources. Over time, some of these resources are expected to be 'proved up' and available to supply the market.

Figure 9.2: Demonstrated and potential Australian gas resources and cumulative production to 2034–35, plotted against gas resources in 2012 (PJ)



Note: Gas resource category is plotted by volume, not time.

Source: RET, GA & BREE (2012).

9.1.2 Eastern market

Physically, the eastern market is the largest and most mature, competitive and interconnected gas market in Australia. It covers Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania.

In 2010–11, 664 PJ of gas was produced, mainly from the Surat–Bowen, Gippsland, Otway and Cooper basins but with smaller amounts from the Bass and New South Wales basins. Around a third was supplied from CSG production (BREE 2012g).

Domestic consumption has increased by 3% a year over the past decade, underpinned by increased gas-fired electricity generation (BREE 2012i:37). Exports of LNG are scheduled to start in 2014 and are projected to reach 1332 PJ by the end of the decade; at least six LNG 'trains' are expected to enter production (RET, GA & BREE 2012:26). The bulk of LNG gas production in the future will be supplied from CSG resources.

9.1.3 Western market

The western gas market is Australia's largest in terms of production volumes. In 2010–11, 1393 PJ of gas was produced, 647 PJ of which was consumed in the domestic market (BREE 2012c). Domestic gas consumption has increased by 6% per year over the past decade, underpinned by strong demand from the mining, manufacturing and electricity generation sectors (BREE 2012i:33).

Around 60% of Western Australia's domestic gas is supplied through long-term contracts from the North West Shelf Venture. The remaining 40% is supplied through the Apache-operated Varanus Island gas hub, along with a small amount from the onshore Perth Basin. The Apache-operated Devils Creek domestic gas plant has begun production, using gas from the offshore Reindeer gas field.

Further domestic gas projects have come on line or will do so over the next few years, including projects such as the Halyard, Spar and Reindeer gas fields. The Macedon gas field will also supply the domestic market from 2013. There may be opportunities for additional supply from onshore shale and tight gas resources, although their commercial potential has yet to be demonstrated.

9.1.4 Northern market

The northern market is the smallest of Australia's gas markets. In 2010–11, 22 PJ of gas was produced for domestic use. In addition, the Darwin LNG project, sourced from the Joint Petroleum Development Area in the Bayu Undan field in the Timor Sea, exported 14 PJ of LNG (EnergyQuest 2011).

Supply into the domestic market was previously sourced from the Amadeus Basin, although this has been increasingly replaced by gas from the offshore Bonaparte Basin. Mining accounts for the largest proportion of domestic gas consumption.

The northern market is expected to grow in the coming decades, largely through LNG exports from the Prelude and Ichthys LNG projects, but also through the development of other downstream gas and related industries. Further expansion of gas supply from developments in the Timor Sea is also expected. In the longer term, additional expansion could occur through onshore tight and shale gas developments, although this would require significant new gas infrastructure.

Northern market gas prices for electricity generation and residential supply are locked in under contract for up to 25 years at a fixed price plus annual escalators. However, gas prices for new industrial users are expected to trend over time towards LNG netback levels[1] NT Government 2012).

1 The LNG netback price is based on the delivered price of the gas, less the costs of marketing, liquefaction and transport (BREE 2012i).

9.2 Market arrangements

9.2.1 Regulation

The ownership and regulation of offshore gas resources is vested in the Commonwealth, while ownership and regulation of onshore resources rests with the states and territories.

Australian gas markets are governed under a national framework defined through the intergovernmental Australian Energy Market Agreement, the National Gas Law and the National Gas Rules. The National Gas Law applies in all states and territories, except Western Australia, which has adopted a modified version. Under the national framework:

- the Australian Energy Market Commission is responsible for rule-making and market development in gas markets, reviewing the energy market framework and providing advice to the Standing Council on Energy and Resources (SCER)
- the Australian Energy Market Operator (AEMO) is responsible for the day-to-day operation and administration of the gas wholesale and retail markets in all jurisdictions except Western Australia and the Northern Territory
- the Australian Energy Regulator is responsible for the economic regulation of pipelines subject to regulatory arrangements under the National Gas Law, for gas transmission and distribution networks and for enforcing the National Gas Law and National Gas Rules in all jurisdictions except Western Australia.

The Western Australian Economic Regulation Authority regulates the western market (including gas pipelines), while the Retail Energy Market Company is responsible for retail market operation and settlement in Western Australia.

9.2.2 Gas market reform

Over the past 20 years, Australian gas markets have been subject to reform designed to support development in line with the long-term interests of users. So far, reform has been focused mainly on transmission and distribution competition and access issues. This has led to the introduction of national regulation of pipeline infrastructure to facilitate more efficient investment and operation of Australia's gas networks.

In 2004, COAG made the Ministerial Council on Energy (now the SCER) responsible for accelerating the development of a 'reliable, competitive and secure natural gas market'. The scope of the reform agenda expanded from networks to facilitating greater provision of market information and the establishment of new shorter term trading market options. Specific eastern market reforms in recent years have included the National Gas Market Bulletin Board, an annual Gas Statement of Opportunities and short-term trading markets in Adelaide, Sydney and Brisbane. A wholesale daily trading market was introduced in Victoria in 1999 and has subsequently introduced intra-day trading. A more recent SCER initiative has been the consideration of options for a gas supply hub trading market.

The Western Australian Government is developing a gas bulletin board and gas statement of opportunities for implementation by March 2013.

9.3 Policy challenges and priorities

Australia's gas markets will continue to grow and evolve with the emergence of new resource developments and greater demand.

Australian gas markets are based primarily on confidential bilateral contracts, and while that is unlikely to change in the near future, the gas industry and consumers are moving towards a more dynamic operating environment in the way they use and trade in gas. It is critical that

government policy provides the right policy structure to support growth and facilitate changing market dynamics.

It is the government's strong view that these issues should be approached in the context of the overarching objective of ensuring adequate supplies of gas to Australian markets and that these markets should operate in the long-term interest of consumers.

This section examines the challenges and priorities associated with:

- changing market dynamics in the eastern and western gas markets
- the development of more efficient gas markets
- responses to transitional market pressures.

9.3.1 Changing market dynamics

Important changes are underway in the dynamics of Australia's gas markets, driven by increased demand competition, the development of new but higher-cost gas reserves, and changing patterns in domestic use, including a growing interaction between gas and electricity markets. Because of the emerging connection between the domestic and international gas markets, changes in the LNG markets, particularly in the Asia–Pacific region, could also affect the development of our domestic markets in the longer term.

These changes are already affecting terms, prices and market structure in the eastern and western gas markets (discussed in detail below), and further transitional pressures are likely to emerge over the short to medium term as markets adjust.

Each of Australia's gas markets is different from the others in its resource base, its current and future production, its demand profile and the maturity of its infrastructure. While headline trends may appear similar, each market should be assessed separately. Experiences in the western market cannot simply be translated to the eastern market (or vice versa) without considering their underlying differences. As market circumstances continue to evolve, it is also unrealistic to expect past price and trading dynamics in each market to apply automatically in the future.

Western market

Change has been underway in the western market since 2006–07, when domestic gas demand began to exceed North West Shelf long-term take-or-pay contracts and prices began to rise, reflecting the cost of new supply. Prices in new contracts have been reported to range from $5.55/GJ to $9.25/GJ (WA Government 2011).

Australia's western gas resources are diverse and generally have high development costs. New offshore gas fields are in deeper waters and require higher volumes and export sales to support up-front development capital and to cover higher project risks. Where the resources are within economically feasible distances to domestic supply infrastructure, there are opportunities to monetise gas at an early stage and provide important cash flow. Stand-alone LNG production from smaller fields is generally not viable unless they can form part of a larger LNG project, but development for domestic supply can be commercially attractive where prices support production costs.

This has meant that domestic supply has been and remains heavily dependent on LNG projects. The scale of LNG developments has also meant that new supply has generally been available only in comparatively large increments, which has sometimes challenged new entrants and those contracting smaller domestic volumes.

This is now changing. The domestic market is diversifying as higher prices stimulate new domestic supply. Onshore exploration for tight and shale gas has also increased; for example, activity is underway in the Perth and Canning basins (WA Government 2012). However, while prices are likely to stabilise, it is unrealistic to expect a return to historical levels for the reasons outlined above.

Recent analysis suggests that projected supply capacity is capable of meeting likely demand to at least 2030, although there may be periods of short-term tightness (EnergyQuest 2011, WA Government 2011). While the progressive roll-off of existing North West Shelf supply contracts over this decade creates some future domestic supply risk, there is no reason to believe that the owners will not maintain a substantial market presence, given their existing commercial investments in domestic processing capacity. Further market response from other suppliers is also likely if supply or price begins to tighten and market flexibility and price incentives are maintained.

The Australian Government believes that future development of the Western Australian gas market will benefit from increased competition between different sources of supply. To increase competition, the government notes the importance of building customer numbers, increasing the liquidity of the market, improving transparency and mechanisms for trading gas, particularly on short-term arrangements, and adding alternative injection points and storage facilities. It notes in particular that the current joint marketing arrangements for the north-west shelf would be unnecessary with further development of the market.

Eastern market

Australia's eastern gas market has entered a period of extended transition as new CSG reserves and LNG developments reshape market dynamics and structure. LNG supply requirements are sharpening competition for gas and will remain the main driver of market expansion for the next decade or longer.

Many domestic large-user contracts expire from 2014 onwards, and new supply contracts have yet to be negotiated. The impacts of carbon pricing and lower than previously expected electricity demand on the prospects for gas-fired power generation are also unclear. While there may be a need for additional 'peaking' plant, new gas-fired baseload capacity may not be needed until later this decade (or beyond) if overall demand remains subdued (AEMO 2012a). The combined impact that these factors will have on final demand for gas is not yet clear, although overall growth is expected.

The cost base of the market is also increasing because new production is from higher-cost resources (BREE 2012i). However, demand competition from LNG expansion is also expected to become a more significant driver of prices, which are widely forecast to increase towards LNG netback levels by the second half of the decade. The 2012 Queensland gas market review modelled domestic gas prices ranging from $6.50/GJ to $10/GJ by 2015, depending on the LNG development outlook (DEEDI 2012:vi). Acil Tasman has projected regional gas prices rising to $11 and above by 2030 (BREE 2012i:61).

While developing CSG remains challenging, there is projected to be enough gas to meet all expected demand well beyond 2035 if known reserves can be brought on (AEMO 2012c, RET, GA & BREE 2012, DEEDI 2012), and there is good potential to identify further commercially viable CSG and new shale and tight gas resources.

Nonetheless, pressures are emerging in the market. Recent floods in Queensland slowed CSG production, and some LNG producers have begun to supplement contracted reserves in the ramp-up period from conventional supplies in the Cooper Basin (DEEDI 2012). The 2012 Queensland gas market review has pointed to suggestions that some LNG producers may also be building contracted gas positions to preserve options for further LNG train development (DEEDI 2012). Meeting project development schedules is resource intensive and remains a principal focus of business development for these producers. These factors suggest conservative supply positioning.

Recent market assessments suggest that this could result in transitional supply tightness from 2015, potentially until 2020 (BREE 2012i, DEEDI 2012). However, given current uncertainties about future demand and the timing of new supply, including the extent of additional LNG expansions and CSG flows, it is not yet clear how material that risk may be.

In these circumstances, large industrial gas users without existing upstream positions are particularly exposed to rising prices and may face ongoing difficulties in securing long-term contracts at prices they deem to be acceptable. Residential customers will also face rising gas prices over the decade. Increases in residential prices are likely to be proportionally less than rises for industrial customers because fuel costs are only around 30% of the delivered gas price (BREE 2012i).

It is clear that the market has yet to establish a new trading dynamic, particularly around contracting terms and prices. Given the factors discussed above, this is likely to take some time to emerge. While long-term bilateral contract arrangements are likely to continue to dominate in the future, market participants are increasingly likely to look for more sophisticated and flexible ways to manage supply and price risks, perhaps through greater use of short-term and multiparty trading than in the past. This can be supported through further market development.

The following two sections examine the need for further development of our gas markets and, in that context, the government's approach to managing transitional pressures in the markets.

9.3.2 Developing more efficient gas markets

Australian gas markets have evolved considerably in the past 20 years, developing deeper competition and wider trading possibilities. However, as emerging pressures are showing, there is a need (and capacity) for further market development to promote more informed and balanced long-term decision-making and to improve trading flexibility. It is important that market design and regulation facilitate efficient market evolution in the face of changing circumstances.

Setting market reform in a long-term context

The next steps in the reform process should be considered in the context of the longer-term direction of gas markets and, in particular, the characteristics that mature gas markets should display. Those characteristics could include:

- mature and well-functioning physical and financial markets with upstream and downstream trading platforms to promote flexible trading and transfers of gas
  - this could include a greater reliance on harmonised spot markets supported by robust secondary markets for managing risk and promoting market transparency
  - arrangements could also provide for competitive access to unused pipeline capacity and easier title transfers
- highly flexible and connected networks, including interactions between electricity and gas
- mature sets of commercially public market information that supports efficient trading, including information on prices, volumes and infrastructure capacity.

Options for achieving these goals will rightly be the subject of ongoing discussion between governments and market participants. The Australian Government welcomes open debate about the longer-term direction of the market.

The government considers that current market development priorities should include a greater ability to go to market for price, easier transfers of title, competitive access to unused pipeline capacity, better rewards for efficient pipeline investment, and confidence in the ability to access gas from the market.

Australia can draw lessons from a number of overseas gas market models, such as the Henry Hub market in the United States. Australian gas markets may be some way away from the physical maturity that would support such models and, given our unique market characteristics, might not develop to that level of sophistication. However, incremental reforms can be made now to provide the appropriate policy and regulatory framework for their efficient operation and evolution. These reforms should take market development down a path consistent with our long-term objectives.

Improving market information

Because of the significant developments in the gas industry, including the growing role of gas in the National Electricity Market, it is critical that sound and timely market information is publicly available. It is arguable that this is not currently the case.

While there is much gas market information in industry reports such as the AEMO's *Gas statement of opportunities* and the Australian Energy Regulator's *State of the market reports*, gaps remain in areas such as the forecast domestic supply of gas, the forecast adequacy of supply, current and forward prices and market liquidity. This information asymmetry can lead to suboptimal decisions by participants, policymakers and regulators. The lack of public information is partly due to its commercial sensitivity, but the Australian Government believes that information provision can be improved for the benefit of all participants while balancing legitimate commercial concerns and the cost of provision.

A range of options could be considered to achieve this, including incremental improvement to existing mechanisms such as the Gas Statement of Opportunities to provide a more detailed market outlook, the establishment of a market-driven mechanism to report price expectations (such as a gas price index), and mandated reporting of price and contract terms. These options may not be mutually exclusive.

In March 2012, the AEMO concluded that there is potential value in amending the Gas Bulletin Board to include a medium-term outlook. This would help market participants plan for scheduled outages or changes in available capacity that affect transmission pipelines and gas storage and processing facilities. The AEMO has also proposed extending capacity outlook information from three to seven days to provide longer lead times for operational decisions.

The Australian Government supports the proposed provision of short- and medium-term outlook information as a necessary foundation for a more efficient and evolved market, and notes that the AEMO's recommendations are currently being considered by the Australian Energy Market Commission through the rule change process.

Improving price transparency and trading opportunities

There is a need for more flexible and transparent upstream transactions between parties, beyond the current market frameworks, to enable market participants to manage gas portfolios and contract obligations efficiently, especially in the face of variable supply and demand.

Upstream trading opportunities could be expanded through the establishment of a supply hub trading market that would allow gas and capacity to be traded separately. The objective of a gas supply hub is to enhance transparency and reliability of supply by creating a voluntary market that offers a low-cost, flexible method to transfer title of gas from one party to another.

A national supply hub trading market 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 LNG plants and gas-fired generators. This has the potential to provide a mechanism to balance gas supplies at least cost.

Through the SCER, the Australian Government and other jurisdictions have agreed to the development of a national gas supply hub trading model, and have tasked the AEMO to prepare a report, in close consultation with industry participants, on the detailed design of a gas supply 'brokerage hub' trading market at Wallumbilla, Queensland. Ministers will consider this issue further in December 2012.

Improving infrastructure efficiency

Gas transmission and distribution developments need to be efficient and timely to ensure access to the market. This is fundamental to the further development of an efficient gas market and end-use industries, such as electricity generation and manufacturing.

To date, investment in Australia's gas transmission and distribution networks has been mainly demand driven. As a result, new pipeline investments have historically been underpinned by long-term pre-investment contracts with large foundation customers. While this appears to have delivered on-time investment, there is a risk of poorly timed investment if market signals are dampened by a lack of price transparency and forward price discovery.

A related issue is the efficiency of current infrastructure and access to pipeline capacity. Although most pipeline capacity is fully contracted, there is often considerable unused capacity on any given day. The underutilised capacity could be used by participants to ship gas, increasing network flexibility and trading opportunities. The current owner of that capacity would need to be fully compensated for its 'sale'.

Access to pipeline capacity affects the ability of shippers to participate in a supply hub trading market: haulage rights on what are currently fully contracted pipelines into Wallumbilla are needed for market participants to ship gas to and from the hub.

Understanding potential linkages between gas and other energy markets

Over the long term, carbon pricing is expected to increase domestic demand for gas-fired electricity generation, including for distributed or co-generation, peaking and baseload capacity. With appropriate storage facilities, energy businesses may be able to develop well-balanced coal, gas and renewable energy portfolios that provide for more flexible generation management based on relative cost and availability. Such developments would improve Australia's energy security and, if managed efficiently, reduce overall costs.

It will be important that these investments, including locational decisions, are efficient. However, there is some potential for distortion through mismatched locational incentives in gas and electricity transmission and distribution incentive structures. This may occur where electricity infrastructure and connection costs that meet certain tests are able to be spread across a broader customer base, while pipeline and other gas infrastructure costs must be directly recouped from users.

These issues are not currently well understood, so further analysis of the potential interactions and their drivers is needed to underpin a considered policy and operational response (if one is required).

9.3.3 Responding to transitional pressures

Emerging pressures in our gas markets must be addressed smoothly, efficiently and in ways that are consistent with the principle of market-based development. Well-functioning markets with access to timely and adequate supply remain the most effective mechanism for providing energy security.

While current pressures may remain for some time, both the eastern and western markets have the production capacity to respond to tightening conditions. In the eastern market this can occur through a range of options, including adjusting production schedules, increasing production from existing fields, such as Gippsland, bringing forward incremental capacity from new CSG reserves, or any combination of those options. In this context, there is a critical window of opportunity to develop the Gunnedah CSG basin in New South Wales, although with a four- to five-year development timeline the contribution that may make to market supply in this period is fast narrowing.

However, the key to stimulating effective and timely market response is to maintain open trading arrangements that do not constrict the proven ability of the market to deliver. This must allow price to play its role as a balancing incentive that can drive the development of additional supply. It is also critical that current impediments to the safe and sustainable development of new gas resources are addressed as a matter of priority.

For this reason, the Australian Government does not support calls for a national gas reservation policy or other forms of subsidy to effectively maintain separation between domestic and international gas markets or to quarantine gas for domestic supply.

While the immediate focus of industry and governments should be on ensuring adequate supply, it is critical that this is not focused solely on addressing shorter-term transition issues, but is consistent with the broader future needs and direction of Australia's gas markets. This should recognise how the changing dynamics will affect the medium- to long-term operation of the market and provide a supporting framework for smooth adaptation to them. This will help to ensure that gas market policy is effective in the long term, to the benefit of both industry and consumers.

The policy objective should be to provide the most efficient framework for the market to flexibly manage emerging pressures while monitoring market outcomes closely to ensure that the market is responding as necessary. The provision of better information on production, supply, demand and prices will also work to increase market confidence and give industry greater certainty in its decision-making.

In this context, a national reservation policy would add to, rather than reduce, long-term market risk by eroding development and supply incentives. It would be likely to impede the development of efficient gas markets and reduce returns to the economy from the development of our natural gas resources. Furthermore, the government notes that as a policy instrument for ensuring affordable supply, gas reservation does not in itself promote market or price separation or ensure timely supply in response to changing market conditions beyond that which would be incentivised through free-forming market incentives.

The prima facie evidence from the application of reservation policy in Western Australia supports this view. There is no compelling evidence that it has constrained domestic prices, and domestic supply obligations placed on the North West Shelf project have been exceeded well ahead of schedule, driven by commercial incentives rather than mandated production requirements.

Beyond concerns about its impact on market efficiency, a national reservation policy would also be damaging to the nation's investment reputation, and would be at odds with our longstanding national commitment to open and fair trade.

Claims that intervening to provide cheap domestic gas would support the large-scale development of new industries must be also tested against the investment outcomes that occurred when gas was available at such prices over the past two decades. The best value-add outcome for Australia will be achieved by allowing resources to flow to their highest valued uses.

Comparisons of higher Australian gas prices with the low prices in the United States to justify intervention are also misplaced. The US gas market has been transformed by the development of shale gas reserves that are high in valuable liquid content (oil and condensate) with easy access to interconnected gas pipelines, resulting in extremely low-price gas. In contrast, Australian CSG has no liquid content and our prospective shale and tight gas resources are likely to be lower in liquids than those in the United States (due to differing geology) and, with the exception of the Cooper Basin, will require costly new infrastructure to develop.

The government does not accept the proposition that export developments are compromising Australia's gas security. Transitional pressures notwithstanding, LNG exports provide a critical platform for the expansion of our domestic markets and gas supply infrastructure. LNG projects are expected to produce $30 billion in export earnings by 2016–17 (BREE 2012g). These projects provide enormous returns to the Australian economy that would not be possible from domestic development alone.

Market interventions should always be a matter of last resort and undertaken only where there is clear evidence of market failure. In the government's view, those conditions do not currently exist in Australia's gas markets.

However, the government does not dismiss the potential risks associated with emerging pressures, particularly the ongoing lack of liquidity in the long-term contract market on the east coast and the impact that might have on existing large users.

Therefore, it will work as a matter of priority with the relevant jurisdictions and gas market bodies to further develop gas market arrangements as described above and to closely monitor market conditions to ensure that markets are delivering against stated objectives, particularly the provision of timely and adequate domestic supply.

As discussed in Chapter 5: *Energy resources*, when assessing retention leases or considering grants of production licences, the Australian Government pays close attention to the potential for offshore LNG projects to supply the domestic gas market. Further responses, if any, would be developed through the SCER and be consistent with market development objectives.

The government will continue to engage with the gas industry and relevant jurisdictions to identify opportunities to promote market liquidity, while recognising that it is not the role of government to interfere in commercial negotiating processes.

9.4 Measuring policy success

Policy success in further developing our gas markets and addressing transitional pressures should produce:

- more competitive and efficient gas markets with:
  - greater trading flexibility, including through the development of an upstream trading facility in the eastern market and the development of a short-term trading market in the west
  - improved transparency, including on price discovery, supply–demand balances and pipeline capacities
  - increased market liquidity, including in secondary markets
  - adequate supply to meet current and projected domestic and export needs
  - efficient interactions with electricity markets
- a more interconnected and extensive gas pipeline network driven by efficient and timely investment signals
- an investment schedule in gas development, processing and transmission pipeline and distribution infrastructure that can meet projected demand in all three geographical markets.

Gas market policy actions

The Australian Government will promote more efficient gas markets by working through the SCER's gas market reform program to:

- develop options for the development of a national gas supply hub trading model, to enhance transparency and reliability of supply and support a gradual evolution towards a liquid gas commodity market
- further consider the merits of reviewing pipeline capacity trading, including potential mechanisms for utilising unused (but contracted) capacity.

In addition, the government will:

- work with industry to identify additional market information and potential collection and reporting mechanisms that could address areas of information asymmetry and promote the development of more robust gas market arrangements and outcomes
- engage with industry to develop a shared long-term vision for Australia's key gas markets as a framework for guiding near-term market reform directions.

The Australian Government will work with other jurisdictions and industry to address emerging transitional pressures by:

- maintaining open and well-functioning gas market arrangements to encourage the timely and efficient supply of gas at competitive market prices
- addressing regulatory and other impediments to the timely development of our gas resources, particularly new CSG and shale gas resources
- ensuring timely commercial development of Commonwealth offshore gas resources, including through updated Commonwealth retention and development approval conditions, as described in Chapter 5: *Energy resources*
- exploring options to promote increased liquidity in gas markets
- closely monitoring developments in Australian gas markets, particularly projected supply–demand balances, and the emergence of potential impediments to adequate domestic supply.

10 Energy markets: electricity

Highlights

- More than a decade and a half of bipartisan reform of our electricity markets has delivered secure, reliable and competitively priced electricity to millions of Australians.
  - The National Electricity Market is one of the most advanced electricity markets in the world.
- The next decade will see continued pressure on prices, a less certain demand outlook and changes in the way we generate and use energy as we transition to a clean energy future.
- While many underlying cost drivers will remain, the Australian Government is committed to delivering reforms that will help keep price rises to those that are absolutely necessary and to ensuring that markets are delivering efficient services to consumers.
- The Standing Council on Energy and Resources has a work program targeted at improving key aspects of network regulation, developing a more effective demand-side framework, improving network planning and connection (including for distributed generation), and strengthening important consumer frameworks. There is a need to ensure timely implementation before the next round of regulatory decisions.
- There is a need to complete unfinished market reforms, which can deliver significant additional benefits for electricity consumers, including:
  - implementing commitments to retail price deregulation where effective competition exists (where it does not, governments should commit to a transitional program to promote competition and move to regulated pricing structures that reflect competitive outcomes)
  - promoting greater efficiency and transparency in publicly owned energy businesses through improved corporate governance and accountability
  - extending governance arrangements and principles to all electricity markets through a more national application of energy laws and by ensuring that energy institutions have sufficient capacity, capability and accountability to carry out their functions
  - improving mechanisms to support consumer participation in markets and market processes.

A long-term transformation is now underway in our electricity sector. It includes the replacement of ageing infrastructure, the integration of new cleaner generation and smart energy management technologies, and a greater consumer influence on market outcomes.

Consumers have faced substantial electricity cost increases in recent times, in some cases well over 50% in the past four years, to support record levels of investment in infrastructure needed to meet growing levels of demand and supply reliability, sometimes with little sense of the benefits that this service provides.

There is a need to improve confidence in our markets and take action to stimulate greater competition and business innovation and to ensure that markets are operating in the long-term interests of consumers. Better communication is also needed on the reasons for price increases. Consumers, through their energy choices, also have an important role to play in reducing costs.

10.1 Overview

Recent sharp rises in power prices have focused attention on the drivers of prices and the need to improve the performance and regulation of our electricity markets, which is now firmly integrated with the need to reduce greenhouse gas emissions and transform to a clean energy economy.

This chapter provides an overview of Australia's electricity markets and explores emerging challenges and the priority reforms needed to promote better long-term outcomes for consumers.

It identifies opportunities to improve wholesale and retail market efficiency, network regulation and market institutions, while ensuring flexibility and adaptability to integrate clean energy sources and technologies in the transition to a clean energy system. It also outlines further actions for promoting a sound investment environment and improving market competition.

Many complex interactions along the electricity supply chain and with other markets, such as the carbon or financial markets, lie behind the delivery of electricity to consumers and its cost. Therefore, policy needs to be considered from a system-wide perspective. This includes ensuring that supply and demand considerations are appropriately balanced in market decision-making and that electricity market policy interfaces effectively with climate policy.

10.1.1 Australia's electricity markets

Australia's electricity markets and systems are critical components of our economy. They supplied around 21% of our final energy consumption in 2010–11.

An electricity 'market' is actually a series of connected systems: a wholesale market in which generation is traded and dispatched, transmission and distribution networks that provide the high- and lower voltage connections through to homes and businesses, and the retail market, which provides services to household and non-industrial business customers.

Australia has two major electricity markets: the National Electricity Market (NEM) in eastern Australia and the physically separate South West Interconnected System (SWIS) in Western Australia (Figure 10.1). There are also a number of other large systems in which electricity is not traded, which are often referred to as 'non-market' and 'off-grid' installations.

The National Electricity Market

The NEM, established in 1998, is the world's longest interconnected power system and the largest electricity market in Australia. It is also one of the most advanced electricity markets in the world (IEA 2012a). It has approximately 88% of Australia's generation capacity and serves about 92% of Australia's load. The NEM extends about 5000 kilometres from Port Douglas in Queensland to Port Lincoln in South Australia, including an interconnector to Tasmania, and covers six states and territories. It has around 200 large and 100 smaller generators, five state-based transmission networks and 13 major distribution networks.

The NEM is based on a real-time energy-only wholesale pool market that is financially linked through the spot market and, for large users, through 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.

Figure 10.1: Australia's electricity systems

Source: Geoscience Australia.

In 2010–11, the NEM supplied about 182 835 gigawatt hours (GWh) to more than 9 million customers (esaa 2012a). Since 2001–02 the maximum daily or peak demand each year has grown from around 26.6 GW to 36 GW (NEMMCO 2004, AEMO 2012a).

Coal-fired generation capacity supplied around 78% of total electricity consumed in 2010–11. Gas generation and renewable energy, mainly in the form of hydro-electricity and wind generation, each provided around 10% (esaa 2012a). While fossil fuel generation is projected to continue to provide most of our electricity for several decades, clean energy generation will grow strongly, making for a more diverse market (see Chapter 3: *Future energy trends and challenges*).

Non-NEM markets and systems

Western Australia's networks consist of the SWIS, which includes Perth, and a smaller North West Interconnected System for the mining areas in the north of the state. While not connected electrically, the two systems are connected through gas pipelines and in 2010–11 supplied approximately 18 298 GWh to more than a million customers (esaa 2012a).

The electricity was mainly generated from coal (51%) and gas (about 45%); renewables contributed around 4% (esaa 2012a).

In contrast to the NEM, the SWIS has two components: a wholesale electricity trading market and a capacity component. The reserve capacity mechanism creates a market for capacity, including demand-side management, alongside the market for energy.

The Northern Territory's small electricity industry comprises three regulated systems: Alice Springs, Darwin–Katherine and Tennant Creek. In 2010–11 it supplied some 1814 GWh to around 76 500 customers. Around 98% was generated from natural gas (esaa 2012a).

There are also many isolated small networks and stand-alone systems servicing remote communities, mostly in Western Australia and the Northern Territory. They are generally the responsibility of state, territory or local governments, although a growing number of privately run and mostly diesel-fired systems service remote mining operations.

10.2 Market arrangements

10.2.1 Regulatory frameworks

The objectives that underpin Australia's electricity markets are set out in the Australian Energy Market Agreement, first signed by the Council of Australian Governments (COAG) on 30 June 2004, and in national energy laws that apply in the NEM—the National Electricity Law and the National Energy Retail Law. The aim is to promote efficient investment in energy services, and their efficient operation and use, in the long-term interests of consumers, including on measures of price, quality, safety, reliability and security of supply.

This objective reflects the need for market settings and regulation to efficiently balance prices with the maintenance of a high-quality and reliable energy service. This continues to be a point of tension in much of the current debate about recent price rises and market regulation. Trade-offs or balance points are not always set or applied transparently.

The National Energy Retail Law complements general consumer protection laws that apply at the state and territory and national levels, including the Australian Consumer Law. The National Energy Retail Law, and the rules and regulations under it, form the main part of the National Energy Customer Framework, which was applied by Tasmania, the Australian Capital Territory and the Commonwealth on 1 July 2012. Other participating jurisdictions are expected to apply the National Energy Retail Law as soon as is practical.

National Electricity Market

The operation and regulatory framework for the NEM is overseen by three independent institutions (described in Chapter 2: *Energy in Australia*): the Australian Energy Market Operator (AEMO), the Australian Energy Regulator (AER) and the Australian Energy Market Commission (AEMC).

The creation of the three independent bodies ensures that the day-to-day operation and regulation of the market are at arm's length from governments, providing greater transparency, stability and confidence for market participants.

South West Interconnected System

Western Australia has its own institutional arrangements for electricity. The SWIS is serviced by two market institutions: the Independent Market Operator, which has the roles of both market operator and rule maker, and the Economic Regulation Authority, which acts as regulator. In addition, Western Power, as the owner and operator of the SWIS, has a ring-fenced component, System Management, that is responsible as a market governance participant for the secure and reliable operation of the SWIS and for managing the physical aspects of market dispatch. The Minister for

Energy also has an ongoing role in the SWIS, being responsible for appointing the board of the Independent Market Operator and approving changes to protected provisions in the rules.

10.2.2 Market development activity underway

At the national level, the Standing Council on Energy and Resources (SCER) has an extensive work program addressing a range of market development needs on behalf of COAG. This includes developing and implementing national energy market legislation and the national electricity, gas and retail laws and rules; improving the efficiency of network regulation; pursuing greater competition in the retail sector, including by removing retail price regulation where effective competition exists; and developing a framework for efficient demand response in the market.

The SCER, energy market bodies and individual state and territory governments are taking action in a number of these areas. This work includes:

- regular assessments of the effectiveness of retail competition, pathways to remove pricing regulation where competition exists, and ways to develop competition where it is not yet effective
- ongoing work to ensure that transmission and distribution frameworks are delivering reliability through optimal investment and operating decisions by generators and network businesses
- an independent review of the limited merits review regime[1] to assess whether the review and appeal process is delivering against its objective
- the development of options for market and regulatory arrangements to facilitate efficient demand-side participation.

The Australian Government has also initiated a public inquiry by the Productivity Commission to advise on the possible benchmarking of regulated network businesses and to examine whether the transmission regulatory regime is delivering efficient levels of interconnection to support the market. This work is due in 2013.

The COAG Select Council on Climate Change supports an effective response to climate change policy issues with national implications, and is responsible for overseeing the National Partnership Agreement on Energy Efficiency and for implementing joint measures related to energy use.

10.3 Policy challenges and priorities

Australia's electricity market arrangements are the product of over a decade and a half of continuous cooperative and bipartisan reform and market development by successive Australian and state and territory governments. The process has been guided throughout by the core objective of acting in the long-term interests of consumers.

In the case of the NEM, this has transformed a set of inefficient state-based systems into an interconnected market covering southern and eastern Australia, with business-on-business competition and highly reliable delivery of services. Two important benefits have been the more efficient use of existing system capacity and a decade of relatively stable average wholesale electricity prices.

However, investment in the electricity sector, particularly in networks, began to rise from about 2007 in response to increasing consumer demand (particularly peak demand), the need to replace and augment ageing infrastructure and meet higher reliability standards, and the implementation of energy-efficiency and renewable energy policies at the national and state levels (a breakdown of electricity costs is provided in Chapter 3: *Future energy trends and challenges*).

1 The limited merits review regime gives parties affected by the decisions of the energy regulator—mainly transmission and distribution network businesses—recourse to a review mechanism. Limits are placed on this mechanism to avoid revisiting settled decisions and to minimise uncertainty.

These factors together generated nominal average increases in household electricity prices of over 40% nationally over the past three years (ABS 2012c). It is difficult for consumers to influence some important cost drivers (such as reliability standards) or easily observe all of the benefits of this expenditure, so it is important for regulators to explain the reasons for price increases and to ensure that consumers continue to receive value for money.

A number of factors in our electricity markets are creating a less certain investment and operational environment. One of the most significant factors over the next decade will be future demand outlooks. While strong growth is projected for the SWIS and other non-NEM regions, largely due to the resources boom, the AEMO has recently revised its expectations for annual average and peak demand growth in the NEM; it now forecasts substantially lower growth rates and a more divergent range of possible outcomes (see Section 10.3.1).

Other factors expected to contribute to changing market conditions over the next two decades include the following:

- *Rising input costs*—Because of the changes underway in these markets and continuing international economic uncertainty, further rises in fuel and financing costs are expected. This will particularly affect gas, but coal will also be affected because of export competition.
- *Evolving supply- and demand-side technologies*—Energy generation, grid management and end-use technologies continue to evolve. Some technologies, such as advanced metering and distributed energy systems, are expected to drive profound change in business models and system management.
- *The evolution of our energy systems towards a clean energy future*—The legislated carbon price and Renewable Energy Target will influence investment decisions in the market. Investment incentivised by the Renewable Energy Target is likely to contribute most new capacity in the NEM to 2020. Through the market support offered by these policies and rapid cost reductions due to global economies of scale in manufacturing, renewable energy technologies are emerging as mainstream large- and small-scale generation options.
- *Continuing market uncertainty*—A lack of bipartisan support for carbon pricing and an uncertain outlook for longer term carbon prices make investments in long-lived energy assets challenging.

Managing this combination of factors will be challenging for businesses, regulators and governments. Electricity price rises are increasing the cost of living for many Australians, so we need to make our energy markets, regulatory frameworks and institutions more efficient and improve the productivity of our electricity systems and end-use of energy.

As the Productivity Commission has recently noted, further market reforms can generate sustained benefits for consumers through a better functioning market supported where necessary by more effective regulation (PC 2012).

The Australian Government believes that this effort should be directed at the following areas:

- improving efficiencies, innovation and competition in wholesale and retail markets (see Section 10.3.1)
- strengthening network regulation and performance (Section 10.3.2)
- strengthening market institutions and corporate governance (Section 10.3.3).

Issues relating to improving demand-side outcomes are discussed in more detail in Chapter 11: *Energy productivity*. Issues relating to ensuring flexibility and adaptability to integrate clean energy sources and technologies consistent with the Clean Energy Finance Corporation's objectives and the broader Clean Energy Future Plan are discussed in more detail in Chapter 6: *Clean energy*.

In the NEM, reform cannot be delivered effectively by jurisdictions acting in isolation. Success will require a cooperative and sustained commitment by all.

Some of these reforms are politically challenging, but they are critical steps in making electricity markets more efficient. The interaction of market competition, price and technological innovation will stimulate the development of innovative products and services for managing energy costs.

Reforms should be considered and well informed, and consultation with all participants in the energy sector, including commercial, industrial and household consumers, will be critical.

Decisions on some aspects of electricity markets, such as asset ownership, remain the responsibility of state and territory governments. In such cases, this chapter provides observations from a national perspective. The Australian Government remains committed to working closely with all jurisdictions to promote more efficient investment and better results for all consumers.

10.3.1 Improving efficiency, innovation and competition in the wholesale and retail markets

The wholesale market

An effective, competitive and robust wholesale market underpins the reliable supply of electricity and provides confidence that future electricity needs can be met at an efficient cost. So far, the NEM wholesale market has passed this test.

The NEM wholesale market has a healthy level of competition, and prices generally reflect the cost of supply. In 2010–11 all NEM regions except Tasmania recorded their lowest average spot prices in at least five years (AER 2011). In addition, the NEM has consistently met a very high reliability standard of less than 0.002% of unserved energy demand (AER 2011) and is maintaining a pipeline of investment projects that is able to meet projected future demand.

Changing patterns of demand, interacting with policies such as carbon pricing and the Renewable Energy Target, are driving an evolving and more diverse technology and fuel mix. These important measures create new business opportunities in the electricity generation sector. This is already leading to business models based on a diversified portfolio of fuels and technologies that provides more opportunities to manage fuel supply and price risks.

However, these changes are also likely to test market structures and could produce a challenging and less predictable operational and investment environment in the short to medium term.

Maintaining a sound environment that supports timely and efficient investment responses to market signals is an important part of the transition to a clean energy future. We must also ensure that the market has effective structures to manage risk, including robust prudential and forward contract arrangements.

The market should supply price signals to promote more efficient energy consumption (particularly during peak periods), so we need an effective demand-side framework that promotes efficient signals and participation across the supply chain.

Building an efficient and cleaner generation mix

The pace, scale and direction of changes to the generation mix will be determined largely by:

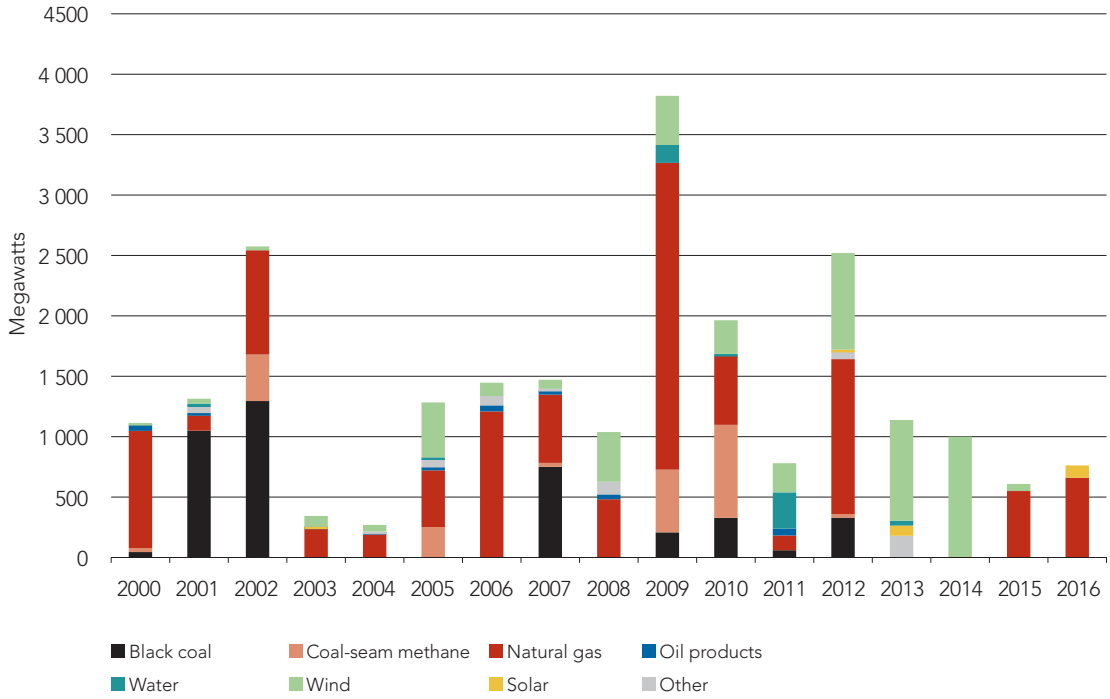
- the pace of growth in average and peak demand in each region of the NEM
- the impact of policy initiatives under the Australian Government's Clean Energy Future Plan, including carbon pricing, the Renewable Energy Target and the $10 billion Clean Energy Finance Corporation
- relative changes in fuel prices and technology costs
- the extent to which existing generation capacity is retired from service in the period to 2025.

Constructing utility-scale plant usually takes three to five years, so it is critical that the market can send timely and efficient investment signals and deliver the necessary capacity. This includes the ability to refinance existing generators.

Past investment patterns in the NEM show that it can supply effective signals for new capacity. Over the past decade, there has been significant investment in new renewable (wind) and open-cycle gas turbine peaking plants, which continue to account for most of the committed and proposed generation investment (Figure 10.2). Announced proposals include 13 000 MW of wind and 11 000 MW of open-cycle gas generation capacity (AEMO 2012a).

This generation investment has been 'pulled through' by the Renewable Energy Target and the rapid rise in peak demand, which requires backup or fast-start capacity. The lack of investment in baseload generation reflects a longstanding overhang of supply capacity from past investment cycles and a flattening of demand since 2008–09.

Figure 10.2: Investment in electricity capacity since 2000 (MW)



Note: Includes capacity installed, under construction or in advanced planning. At the end of June 2011, 15 projects with a total capacity of 2760 MW were under construction, and 5700 MW of capacity was at an advanced planning stage. An additional 174 projects with a total potential capacity of over 43 GW are proposed.

Source: esaa (2012a).

Future investment in electricity generation will be driven by the private sector. Because of their longevity and capital intensity, these investments require a high level of confidence in the market and the policy frameworks that guide decisions. In submissions to the Energy White Paper, potential investors raised the following as material considerations:

- an unclear demand outlook, making market conditions and revenue projections less certain
- the impact of policies, such as the Renewable Energy Target, which have the potential to distort investment signals in the wholesale market so as to increase renewable energy investment
- carbon and fuel price risks (the risk of asset stranding under carbon pricing is likely to discourage new coal-fired baseload investment; rising gas prices may delay the point at which combined-cycle gas plant becomes competitive)

- changing dynamics in financial markets with lower risk appetites, which have resulted in higher costs and larger equity requirements
- continued public sector participation in the market, which increases perceptions of an uneven playing field and investor risk
- the lack of bipartisan support for carbon pricing.

A changed demand and investment outlook

For the first time since the NEM began, average annual demand in the market has flattened out after a 3.4% decline over the past two years. While accurately forecasting demand is notoriously difficult, the AEMO predicts that average annual demand under a medium growth scenario is not likely to return to 2009–10 levels until 2014–15. Future projected annual growth to 2030 ranges from 1.6% in a high demand scenario, to 1.1% with medium demand and just 0.5% with low demand. The AEMO forecasts for peak demand show ongoing growth in all regions, although at rates closer to average demand.

These scenarios, which show a difference between high and low demand growth of around 34 terawatt hours in 2020–21 (roughly the volume of Victorian consumption in 2010–11), have quite different implications for the NEM's investment and operating outlook.

Table 10.1 shows the immediate impact of lower demand on the investment outlook. Under a medium growth scenario, additional large-scale generation capacity (other than that required to meet the Renewable Energy Target) is unlikely to be needed in most NEM regions before 2020. Under a low growth trajectory, additional capacity will not be needed until well into the next decade. However, if demand were to rebound under a high growth scenario, new capacity may be needed from around the middle of this decade. Businesses have already responded to this changed outlook with a number of announced deferrals of new large-scale generation projects.

Most new investment is likely to be for renewable capacity required by mandated market shares under the Renewable Energy Target, possibly supported by some additional fast-start peaking or system backup capacity.

Wind energy developments are expected to dominate as the lowest-cost source of large-scale renewable energy, while open-cycle gas peaking plants are likely to continue to be the preferred form of non-renewable investment because of their comparatively lower capital costs, ease of construction and potential for future conversion. The current higher overall costs of both forms of generation are expected to add a marginal increase to delivered electricity prices.

Table 10.1: National Electricity Market supply–demand outlook

	Low scenario		Medium scenario		High scenario	
Region	LRC point	Reserve deficit (MW)	LRC point	Reserve deficit (MW)	LRC point	Reserve deficit (MW)
Queensland	>2021–22	–	2020–21	79	2016–17	93
New South Wales	>2021–22	–	>2021–22	–	>2021–22	–
Victoria	>2021–22	54	2018-19	115	2015–16	50
South Australia	>2021–22	–	2019–20	24	2015–16	3
Tasmania (summer)	>2021–22	–	2021–22	–	>2021–22	–
Tasmania (winter)	>2022	–	>2022	–	>2022	–

Note: Tasmania's winter outlook is included because the maximum demand occurs during winter.

Source: AEMO (2012a).

The general operating environment for businesses may also vary depending on demand patterns. With medium or low growth in demand, the share of renewable energy in the NEM is likely to exceed 20% by 2020. Under this scenario, renewable energy is likely to begin to displace the market share of non-renewable generators. How significant that displacement will be is not clear at this point, but it could potentially challenge incumbent generators.

A set of complex factors contributes to the revised demand outlook, including changes in large industrial and manufacturing electricity demand, a continued increase in distributed solar photovoltaic systems, the impact of energy-efficiency measures, and consumer responses to higher prices (AEMO 2012b). This is likely to make business planning more difficult until a clearer picture of demand patterns emerges.

Ensuring efficient interactions with clean energy initiatives

Various climate change policies are designed to interact with the electricity market to change investment or operational outcomes.

At the national level, they include the Renewable Energy Target and the carbon pricing mechanism, which are key elements of the Australian Government's Clean Energy Future Plan and a powerful incentive for the wider deployment of clean energy technologies. The states and territories also manage a range of feed-in tariff schemes and energy-efficiency or 'white certificate' programs.

It is important that these measures interact efficiently with the electricity market so that our energy and climate goals are achieved at least cost. This includes managing any unintended risks or impacts that might flow into the electricity market.

In April 2012, COAG recognised the need to prioritise a review of existing federal, state and territory carbon reduction and energy-efficiency measures and to remove those that are not complementary to the carbon price, or are ineffective, inefficient or impose duplicative reporting requirements on business. The Climate Change Authority's review of the Renewable Energy Target will be used as an input to the COAG complementarity review.

In the medium to long term, the growing deployment of renewable generation may make it harder to maintain efficient dispatch and effective price signals for investment. This could occur where the subsidy provided by the Renewable Energy Target allows large-scale renewable energy generators to bid into the market at lower (near zero) marginal rates than might otherwise be the case. At high levels of penetration, this has the potential to alter bid stack and market clearing price outcomes in ways that are not necessarily well understood. This is the so called 'merit effect' (IEA 2011b).

In a recent review, the AEMC found that the Renewable Energy Target was marginally suppressing wholesale pool prices in different NEM regions (AEMC 2011b). There is no clear consensus about the impact this may have on market efficiency or investment signals. Its main effect may be to transfer rent between conventional and renewable energy generators or retail agents. However, this issue may warrant longer-term attention and will be monitored through the government's four-yearly strategic reviews of energy policy.

High levels of intermittent generation (such as wind or solar) may also pose additional operational challenges in balancing supply and demand in the system. While this is considered manageable at current and projected levels, in the longer term there may be a need for additional backup capacity or innovative system management and storage solutions (see Chapter 6: *Clean energy*).

Feed-in tariffs set above the market rate have resulted in inefficient deployment of household distributed generation systems. While overall deployment is still relatively thin, such systems have a disproportionate impact on delivered electricity costs, and consumers who do not have systems receive little or no benefit and effectively cross-subsidise those who do. This also imposes a greater proportional cost burden on low-income households.

Existing state-based schemes are now under review or have been wound back to provide a fair market value for generated power, which should minimise the risk of market distortion in the future. The Australian Government strongly supports the move to more efficient feed-in tariff rates that more accurately reflect the costs and benefits of energy delivery (including demand management) and is working with other jurisdictions through the SCER to develop options for a nationally consistent framework for 'fair and reasonable' tariffs.

Managing risks and emerging pressures

The introduction of carbon pricing with a clear policy framework under the Clean Energy Future Plan provides greater certainty to the market to plan and commit to necessary investment in new generation assets. It has also changed the nature of energy markets, and the new dynamics in these markets will need time to consolidate. This 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.

Recognising the risks inherent in any major market transition and the potential pressures from ongoing turmoil in international financial markets (which will be critical sources of investment capital), the Australian Government has established the Energy Security Council and a package of energy security measures under the Clean Energy Future Plan that are intended to transform Australia's energy sector from highly emissions-intensive electricity generation to cleaner forms of generation. The Energy Security Council will provide additional assurance and advice to the government if systemic risks to energy security emerge from financial impairment arising from any source (see Box 10.1).

Box 10.1: Clean Energy Future Plan—Energy Security Package

To help smooth the transition to a clean energy future, a series of measures has been established to maintain energy security and market stability through targeted support for emissions-intensive electricity generators.

- The Energy Security Fund will provide approximately $5.5 billion in assistance over six years for highly emissions-intensive coal-fired electricity generators.
- In addition, the government will offer short-term loans to generators to finance the purchase of future vintage carbon permits and may support the refinancing of existing debt if commercial loans are not available on reasonable terms.
- The Energy Security Council, comprising financial and energy market experts (including the heads of Australia's energy market bodies), has been created to advise the government on possible support measures to promote energy security, including loans for refinancing.

In response to the global financial crisis in 2008, G20 governments have committed to increased prudential and reporting requirements for financial markets. It is important that any measures introduced for the electricity financial markets are specifically tailored to improve the management of financial risks and their exposure to the wholesale spot price without compromising market stability. There is also scope to improve the interoperability of the prudential and regulatory frameworks for the wholesale physical market and the over-the-counter and exchange financial markets.

There is merit in SCER examining these opportunities, which could materially improve the efficiency of capital deployment and the regulatory oversight of the markets.

A sound market framework

The Australian Government believes that the energy-only market pool design and key market settings continue to be appropriate and provide a robust basis for the future efficient supply and dispatch of electricity in the NEM.

Changes in the market and the settings of key parameters should be contemplated only where there is a clearly established need. Any changes should be in proportion to the need: this is not a 'set and forget' exercise. Given emerging market pressures, it will be important that market conditions and the factors that shape them are closely monitored to detect early signs of difficulties or loss of efficiency, and to provide confidence that consumer needs will continue to be met.

The retail market

Electricity retailers are the principal interface with the electricity market for the vast majority of businesses and households. For that reason, maintaining competitive retail markets with efficient pricing structures and the right tools to enable informed consumer participation is an essential part of delivering energy supply and services.

There are clear opportunities to improve outcomes for consumers by freeing up our retail markets to promote business competition and innovation. This should be done by implementing the National Energy Retail Law and fulfilling commitments to deregulate retail electricity prices where effective competition exists. In addition, further work is needed to make consumers more able to manage their energy use and costs effectively, including through better information, 'smart' metering and more efficient pricing structures, including time-of-use charging. Ensuring that consumer interests are adequately represented in market and policy development is also essential.

Moving towards national retail consumer frameworks

Recognising the benefits associated with a single national retail framework, the South Australian Parliament, as lead legislator on behalf of the SCER, passed the National Energy Retail Law in early 2011 to act as template legislation for the National Energy Customer Framework (NECF), which will then be applied by participating jurisdictions. The National Energy Retail Law 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.

While the implementation of the National Energy Retail Law is a significant achievement, the Australian Government does not see implementation as an end point. The framework and associated consumer protections will require ongoing monitoring and attention. They may need revision in the future to provide flexibility and adaptability to deal with the dynamic nature of energy markets and prices, including responding to the further rollout of advanced metering.

The implementation of COAG's NECF across jurisdictions will be important in ensuring robust and harmonised consumer protection. The NECF was implemented on 1 July 2012 by the Commonwealth, Tasmania and the Australian Capital Territory. New South Wales, Victoria and South Australia have agreed to implement it as soon as is practical, while Queensland is yet to consider the matter.

Early adopting jurisdictions have already seen benefits in competition and improved information to consumers. Consumers will benefit further when all jurisdictions adopt the NECF—splintering the market, as has occurred with the delayed implementation, creates additional costs to consumers at a time when governments should be working to reduce pressures on energy prices. The Australian Government strongly encourages the implementation of the NECF by all remaining jurisdictions without further delay.

The NECF is not the only way to increase consumer participation in the markets. The AEMC's Power of Choice review will identify opportunities to remove barriers to consumer engagement and will provide recommendations for energy ministers.

Retail price reform

Most Australian states and territories have introduced full retail contestability in retail energy markets, but so far only Victoria has deregulated retail price controls.[2]

The Australian Government recognises that states' and territories' retention of regulatory control over retail prices remains a sensitive issue for their governments, but believes that this continues to be an area of unfinished, necessary and previously agreed reform (see Box 10.2).

Under the Australian Energy Market Agreement and the COAG National Partnership Agreement to Deliver a Seamless National Economy, jurisdictions have committed to the removal of retail energy price regulation where effective competition can be demonstrated. As part of the process, the AEMC is reviewing retail energy market competition in each jurisdiction with full retail contestability.

So far, the commission has reviewed competition in Victoria, South Australia and the Australian Capital Territory. It deemed competition to be effective in Victoria and South Australia, but not yet effective in the Australian Capital Territory. While each review has recommended price deregulation, only Victoria has implemented the AEMC's recommendation. New South Wales is currently under review. The Australian Government strongly encourages jurisdictions to act on the advice of the AEMC to meet agreed commitments.

Box 10.2: Retail price reform

What do we mean by retail price reform?

Where retail prices are deregulated, the price is set by the market through competition rather than through a regulated process. This can involve two separate, but related, mechanisms: the setting of tariffs by businesses to recoup their supply costs (plus a competitive return), and allowing retailers to offer differing pricing structures that better match customer needs, including an incentive to manage energy use based on time-of-use costs.

Why do we need more efficient electricity pricing?

Regulated tariffs are inherently less flexible and efficient, and there is an almost certain risk in markets where effective competition exists that regulators will set prices at levels that do not reflect the competitive price of supply. While it can be tempting for governments to set prices below the cost of supply, this is not in the long-term interests of consumers because it ultimately results in sharper catch-up costs and can lead to a loss of competition in the market.

Having prices set through competitive markets provides for a more efficient and responsive adjustment of business margins based on costs and performance. This introduces extra incentives for efficiency and competition—all to the benefit of consumers.

While regulated retail markets can provide a range of services, a deregulated business environment has greater potential to accelerate and deepen competition and innovation. Deregulated markets are more likely to respond to consumer needs, leading to a wider range of services and products (as has happened in the telecommunications sector). New products could include time-differentiated tariff packages and advanced energy management services (including smart metering), giving customers more options to manage costs.

2 Tasmania and Western Australia have not introduced full retail contestability in electricity markets, although Tasmania has announced an intention to do so from 2014.

More cost-reflective pricing is an important (but not the only) step in driving more efficient use of energy and infrastructure. This would lower supply costs for all consumers. Regulated uniform tariffs may also be generating an inequitable distribution of costs between peak and non-peak customers. This may mean that households that use less energy in peak periods are paying more than they might otherwise need to.

Does deregulation lead to loss of consumer protection or higher costs?

The experience in Victoria demonstrates that deregulation does not in itself drive higher costs. In fact, Victoria has Australia's most competitive retail electricity market.

There may be an initial adjustment in price levels in markets where retail margins have been set at below market rates for some time. A transition to deregulated prices could provide a mechanism to manage larger price adjustment risks. Other approaches are also possible.

Similarly, a move to time-of-use pricing should not result in higher overall electricity costs or mean that households and small business consumers will be exposed directly to the volatility and maximum peaks in the wholesale market. Retail and generation businesses manage volatility and risk through their trading arrangements in order to provide predictable and smooth tariff regimes for customers.

However, costs would be distributed more equitably and some customers with high energy use, particularly in peak periods, may pay more. Conversely, those that can manage their time of use or those with low overall usage could pay less. Time-of-use pricing can therefore offer consumers greater choice.

As part of these reforms, governments will need to ensure that protections for vulnerable consumers are maintained, and that those consumers are not forced into adopting disadvantageous pricing structures.

The lack of progress in deregulating retail pricing has been criticised by market participants and other stakeholders. While aspects of these reforms are politically challenging, the Australian Government believes it is important to re-establish momentum and direction towards agreed goals.

Price reform to date has been resource and time intensive. The government believes that there is a need to re-examine the approach, in particular to identify opportunities for streamlining the current market assessment process. This should be framed around a fresh commitment to developing competitive retail markets with fully deregulated prices, complemented by effective consumer protections.

Where sufficiently competitive markets do not exist, jurisdictions should develop and implement transitional strategies to improve competition and move to regulated pricing structures that more closely reflect a competitive market outcome.

Jurisdictions currently differ in the methodologies they use to determine regulated retail prices, most notably in the way the wholesale energy component is set. This contributes to very different business conditions for retailers between jurisdictions and in the long term may disadvantage consumers through price catch-up pressures or sustained underinvestment in supply. The government intends to raise the development of a consistent methodology for price regulation that balances consumer and market interests for consideration by the SCER. The adoption of a consistent methodology may, in itself, require a well set out transition.

The government strongly believes that jurisdictions should fulfil commitments made under the Australian Energy Market Agreement to remove price regulation where markets are deemed to be competitive. It considers transitional approaches, accompanied by strong accountability by individual jurisdictions, to be one means of fulfilling those commitments.

Supporting vulnerable customers

The government recognises that rising energy costs and the unwinding of cross-subsidies have uneven distributional impacts on households, and that lower-income households face proportionally greater impacts than high-income households (see Chapter 3: *Future energy trends and challenges*). Therefore, retail price deregulation and greater consumer empowerment must be accompanied by appropriate protections for vulnerable customers, such as effective hardship policies, strong marketing rules, select standard terms and conditions for energy contracts, and close monitoring of market outcomes.

Ensuring that consumers, particularly those who are most vulnerable, are able to manage energy costs effectively is also increasingly important. The continued provision of adequate assistance to vulnerable consumers through a sound general safety net, well-targeted jurisdictional concession regimes and appropriate community service obligations remains critical.

Such assistance should be transparent and not undermine competitive pricing structures, which reflect, as efficiently as possible, the underlying costs of supply. It is more efficient for assistance to be provided through properly targeted social policy settings, rather than energy policy settings, to ensure that energy market signals are preserved.

Empowering consumers—improving price information and transparency

Effective decision-making by policymakers, consumers and energy providers requires a better understanding of the causes and likely duration of further price increases as well as other critical information on products and services.

At its December 2011 meeting, the SCER noted the publication of the second in a series of pricing reports by the AEMC. The council agreed to institutionalise annual reporting by the commission on possible future trends in electricity prices, including the drivers of prices.

The Australian Government is also supporting a number of measures to improve energy price and use information:

- The NECF contains a number of provisions designed to help consumers understand and compare pricing offers by different retailers.
- The AER has administered the Energy Made Easy website[3] since the commencement of the NECF on 1 July 2012, allowing consumers to make more informed choices about energy retail offers.
- $10 million has been allocated in the Clean Energy Future Plan to gain a better understanding of how households use energy.

The Australian Government is committed to working with the states and territories, market institutions and stakeholders to improve the consumer energy data access system, possibly by creating a hub, to improve the flow of consumption information for consumers (see Chapter 14: *Energy information*). The government's scoping study has identified some movement by energy suppliers towards providing customers with access to their data. However, the study also identified some major barriers that may affect the ability of consumers to make informed choices, including significant information inequality between different providers, timeliness of access to information and access by other parties approved by the customer.

Smart metering

Advanced metering technologies or 'smart' meters potentially offer consumers greater choice and flexibility in managing energy bills and energy use, particularly at peak times. They can also provide benefits to service providers in managing network loads by providing real-time information on

3 www.energymadeeasy.gov.au.

energy use, and may potentially enable remote energy end-use management. Smart meters, smart appliances and their uses are discussed further in Chapter 11: *Energy productivity*.

In April 2007, COAG committed to a mandated national rollout of electricity smart meters in areas where benefits outweigh costs, but so far only Victoria has undertaken a rollout. Support from consumers and other stakeholders has been mixed, largely because consumers have borne the up-front costs and because the benefits (which are shared between consumers, distributors and retailers) necessarily follow broad deployment and so take time to be observable to the consumer.

Some of the benefits of the Victorian rollout are now evident. For example, retailers and distributors such as Origin Energy, Jemena and United Energy have been able to provide energy-use information to existing consumers on a self-service basis through web portals. Within the next year, it seems likely that most customers with interval or other smart metering (including many outside Victoria) should be able to access their own historical consumption data by such means.

The Smart Grid, Smart City project, which has developed a community and industry engagement strategy, also offers lessons for deployment. One of the aims of the strategy is to 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 also assist in future communications activities. The Smart Grid, Smart City project is expected to provide important information to policymakers and the energy sector from mid-2012 to inform the potential wider deployment of smart grid technologies.

To help inform future deployments of smart meters, the Australian Government is developing a framework that:

- promotes a minimum level of national consistency
- 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 services and maintaining appropriate consumer safeguards.

Facilitating a market-driven rollout of smart meters in which providers negotiate deployment and costs directly with consumers may be a way to overcome concerns about mandated approaches. For example, retailers are increasingly likely to see smart meters as a point of differentiation with customers as part of combined energy management and structured tariff packages. This would not preclude jurisdictions mandating rollouts where the benefits outweigh the costs.

Promoting market competition

Competition in well-functioning generation and retail markets provides effective incentives for higher efficiency and innovation and promotes supply at least cost. Competition depends on factors such as:

- the unbundling of 'natural monopoly' network activities from all other activities
- equal rights of access to the network for all generators and all consumers
- coordination between the parties in the supply chain to ensure that investment is timely and efficient
- competitively neutral market rules, design and regulation
- the provision of regular and transparent information to inform decision-makers
- a level playing field to encourage new entrants.

In Australian energy markets, the main mechanisms for monitoring and regulating competition are state regulators in retail pricing, and the AER and the Australian Competition and Consumer Commission (ACCC) more generally. State and territory regulators retain residual functions where they have not been transferred to the AER.

Market structure

Two key aspects of the national competition and energy market policies established in the 1990s were the separation of competitive markets (wholesale and retail) from monopoly markets (transmission and distribution) and the disaggregation of state-owned, vertically integrated energy businesses.

Since then, there has been a trend towards reaggregation in retail and generation businesses and greater cross-ownership in the electricity and gas sectors. This has been driven largely 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 fuel costs, the cost of Renewable Energy Target liabilities or security of supply). This has led to the rise of a number of so-called 'gen-tailers' as dominant business models and as a form of risk management.

The owners and operators of generators selling into the wholesale pool market are diverse. There are 299 registered generators in the NEM (AER 2010). Around 34 companies or groups own the 200 or so scheduled and semi-scheduled power stations with at least 30 MW capacity in the market (AEMO 2011b, AER 2010, esaa 2011). About half the output capacity of NEM generators is currently controlled by governments, although this will change with the privatisation program underway in New South Wales (esaa 2011).

Ongoing government ownership in wholesale electricity markets may be a risk factor for private sector investors, particularly new entrants. The risk (or even the perception) of distortionary behaviour, conflicting incentives or future government interventions to support public businesses creates additional investment complexity and risk in a challenging commercial environment.

The retail market in the NEM is less diverse: in October 2011, there were 22 retail companies with active licences (AER 2011). The sector is dominated by three major retailers: AGL, Origin Energy and TRUenergy. The retail market is considered to be effectively competitive in Victoria and South Australia, although the Australian Capital Territory is the only other jurisdiction to have been reviewed by the AEMC.

Concerns have been raised about the implications over the longer term if the trend towards reaggregation continues to the point at which competition is unacceptably reduced or trade between markets is eroded or compromised. This could also create a barrier to entry for merchant operators that do not have well-hedged positions in multiple markets.

Substantial vertical integration reduces business transparency and the liquidity of the contracts market, which could pose a potential barrier to the entry of new market participants. However, based on trends in the NEM, there is no compelling evidence to support claims that current market structures are uncompetitive or causing economic harm. While those structures may be different from those envisaged at the establishment of the NEM, the factors listed above suggest that Australia's optimal market structure for the foreseeable future is one that has a balance of integrated energy businesses and merchant operators.

The ACCC addresses market structure and market power in enforcing competition and fair trading provisions in the *Competition and Consumer Act 2010*. In addition, the AEMC is doing further work in relation to generator market power in the NEM. The ACCC's recent decision not to object to the acquisition of Loy Yang A by AGL noted the importance of competition from the remaining generators and new investors. The ACCC has also indicated that more scrutiny of such transactions is expected in the future.

A number of reforms can help to promote competition, including deregulating retail prices where effective competition exists, avoiding crowding out by a dominance of government-owned assets or the perception of an uneven playing field for private investors, reforming pricing to support demand-side participation, and identifying areas for contestable services in regulated markets.

10.3.2 Strengthening network regulation and performance

Maintaining efficient and reliable transmission and distribution networks is critical in providing a high-quality and reliable supply of power to consumers. The cost of providing these services is also a major factor in the delivered price of electricity for consumers.

The Australian Treasury estimates that network charges account for around 51% of an average residential electricity bill.[4] In large part, this reflects Australia's large area and dispersed population, which result in the NEM being one of the world's largest integrated electricity networks. The total length of networks in the NEM is about 790 000 kilometres, and the distribution network is approximately 18 times longer than the transmission network (AEMC 2012). As a result, distribution networks require significantly larger capital and operating expenditure than transmission networks (AER 2011).

As the cost of servicing this large network must be spread over a comparatively small consumer base, it accounts for a higher proportion of costs than in other comparable countries. For example, the United Kingdom has a similarly sized network but three times the number of electricity consumers. As a result, network costs comprise around 23% of total costs (Ofgem 2012).

The rapid rise in Australian network costs has been the most significant driver of recent electricity price increases. Most of this cost pressure is concentrated in the distribution system. The AEMC estimates that household electricity prices at the national level will rise (on average) by around 37.2% over the period from 2010–11 to 2013–14, and that network costs will account for around 40% of that increase (6% for transmission and 34% for distribution).[5]

The contribution of these costs to overall electricity price increases has focused attention on the performance of network businesses, the drivers of network investment, and the rigour of the regulatory framework for this element of the market. In particular, there are some concerns that the framework provides insufficient incentive for least-cost investment outcomes.

The increase in network costs has occurred for a range of complex reasons, most notably the need to expand and augment the grid in accordance with state-based reliability standards to meet growing demand, particularly peak demand. The need to replace ageing assets has also contributed significantly: the AEMC notes that this will account for from 22% to 35% of projected spending for many network businesses in the next three years. Other factors include increased borrowing costs since the global financial crisis and higher material and labour costs (AEMC 2011c).

Many of these pressures are expected to remain in the future. However, if demand growth remains subdued, expenditure on planned network augmentations may be deferred, which will flow through to future network determinations. Sustained lower demand (particularly at peak times) may also defer some of the near-term requirement for investment until existing capacity is more fully utilised. However, over the longer term, there will still be an ongoing need to replace ageing assets, as well as to expand the networks to service a growing population and future business activity.

While acknowledging these pressures, the government considers it essential that consumers have confidence that network costs are efficiently based and clearly targeted at providing a high-quality service. This includes assurance that network regulation is placing enough weight on the long-term interests of consumers.

4 Including GST.

5 This will differ between jurisdictions (see AEMC 2011c).

The government believes that the fundamental approach to network regulation and participation is sound, but that there is scope for strengthening the network model in the following areas:

- the regulatory framework, particularly determination and review processes, demand-side reforms and competitive services
- network reliability, planning and connections.

Network regulatory framework

Transmission and distribution networks are natural monopolies. Therefore, they operate under a regulated business model that maintains structural separation between monopoly and contestable elements of the market to ensure that efficient outcomes are delivered for consumers.

Regulatory processes, which effectively set the prices that networks can charge, must minimise cost increases for consumers without inhibiting efficient and necessary expenditure by providing for a fair return on investment for network businesses.

Failure to achieve the right balance would result in either overinvestment or underinvestment. Overinvestment would impose unnecessary costs on consumers. Sustained underinvestment could potentially reduce the reliability of supply, as evidenced by disruptions in supply in Sydney's central business district in early 2009 and sustained supply failures in Queensland in 2004. Blackouts in Victoria due to extreme weather conditions in January 2009 were estimated to cost that state's economy about $100 million (Houston & Reilly 2009).

Actions underway to promote a more effective regulatory framework include the following:

- The AEMC has released proposed changes to the economic regulation of network businesses for public consultation. It will issue its final rule determination in November 2012. Proposed changes include:
  - *Rate of return*—A new common framework will enable the regulator to make the best possible estimate of the rate of return at the time a regulatory determination is made. This will allow the regulator to take into account changing market conditions, estimation methods, financial models and other relevant information. It will also provide for greater transparency in the AER's processes.
  - *Capital and operating expenditure allowances*—The ability of the AER to interrogate proponents and to review and amend expenditure proposals will be further clarified. This will give the AER greater scope for targeted benchmarking to test proposals through annual benchmarking reports setting out the relative efficiencies of the network businesses.
  - *Capital expenditure incentives*—Amendments to the National Electricity Rules will provide the AER with a set of tools that it can apply to provide adequate incentives for network businesses to spend capital efficiently. This includes undertaking ex-post reviews of capital expenditure above that which was originally approved in a determination to ensure that only efficient capital expenditure is added to the recoverable asset base for future determinations.
  - *Regulatory process*—Regulatory process changes will improve transparency and the ability of stakeholders to engage in the regulatory determination process.
- The SCER has brought forward a statutory and independent review of the current network regulatory appeals process (the limited merits review regime) to ensure that it is delivering outcomes that are fair both for consumers and for network businesses. In its Stage 1 report, the review panel noted the comparatively high use of limited merits reviews and identified a number of areas of potential weakness in the appeals arrangements. The SCER will consider the recommendations of the final report before developing its policy response ahead of the next round of regulatory determinations.

- The Australian Government has tasked the Productivity Commission to advise on the possible benchmarking of regulated network businesses and to examine whether the transmission regulatory regime is delivering efficient levels of interconnection to support the market. The commission's report, which is due in 2013, will inform the government's position on the SCER's energy market reform agenda.
- The AER is investigating ways to improve its data on network business operations to better equip it to make more informed regulatory decisions, including through the use of benchmarking. This process involves the AER engaging with network businesses through its Network Information Strategy. Any issues identified by the AER in this process would be referred to the AEMC through a rule change request, or to the SCER if policy clarification is required.
- The AEMC, through its Power of Choice review, is recommending possible reforms to network regulation to promote efficient demand-side outcomes. The SCER will consider the review report at its December meeting.

Many of these workstreams are scheduled to allow any changes to apply before the next round of five-yearly network determinations, which commences in mid-2014 for New South Wales, the Australian Capital Territory and Tasmania.

While the basic network model will continue to include monopoly service providers, there may be some services that could be made contestable (that is, open to third-party providers). They could include network connection (mainly in distribution, although the current arrangements for transmission may also require modification), and services such as street lighting and some aspects of metering. In this context, the SCER is investigating ways to develop a national framework for the provision of contestable distribution connections. Such a framework would ensure that the costs of those services would be set competitively and be borne by the direct users.

Where market circumstances change significantly within a determination period, it is important to ensure that network businesses have the right incentives to adjust their expenditure plans. This requires a balance between the need to provide certainty for business planning and the need to ensure that investment is efficiently targeted. Ideally, this should be driven by sensible commercial disciplines; however, the government will consider whether the regulatory framework remains robust in such circumstances.

The SCER will consider the recommendations of the review of the limited merits review regime and the AEMC Power of Choice review, and will report on the recommendations to inform COAG's response to these and related energy market reform issues at meetings scheduled for October and December 2012. This is in addition to the separate but complementary work of the COAG taskforce looking at competition and regulatory reform, which is working to the same timeframes. Sensible, timely reform in these areas will promote efficient investment in our networks, thereby minimising the costs passed on to consumers.

Network reliability

The need to meet specified network reliability standards plays a large part in determining levels of investment in new, replacement and upgraded network infrastructure. Providing a high-quality, reliable service is a core element of Australia's national energy objectives, but increases costs for consumers.

In recent years, some state governments increased network reliability standards largely in response to a series of dramatic supply disruptions, particularly the poor reliability of the Queensland network in the lead-up to the 2004 Somerville inquiry and the blackouts in Sydney's central business district in 2009.

While the higher standards have improved the reliability of supply, those decisions were made without public understanding of the costs involved and have added to the costs that must be considered by regulators (Somerville 2011).

Given the impact of these standards on costs to consumers, it is important that the standard-setting process is transparent and considers both the costs and the benefits of different levels of reliability. It is also crucial that network businesses have greater flexibility in how they achieve required outcomes, as this can result in substantial cost savings for consumers (Somerville 2011). Because of reliability standards' complex interaction with other important market and investment parameters, they are best set through a holistic assessment of costs and benefits across the supply chain. The standards should specify reliability outcomes, rather than prescribe specific investment behaviours or equipment.

The Australian Government is working through the SCER to investigate the methodologies that underpin distribution network reliability settings and to assess the most effective approach, which could be applied nationally through the AEMC's national workstream in its Review of Distribution Reliability Outcomes and Standards. The final report is expected in 2013, subject to SCER's advice on the areas that the AEMC is required to cover.

As part of this review, the AEMC also undertook a workstream specific to New South Wales that included a study of consumers' willingness to pay for a given level of reliability. This was based on a methodology used to assess Victorian consumers' willingness to pay, which was used to inform planning. The final report for the New South Wales workstream, released in August 2012, showed that consumers in that state place a relatively high value on reliability of supply. The aim of this work was to inform the state government's reliability standard setting process. Where other states and territories set such standards, the Australian Government encourages them to consider following the New South Wales example and seek advice from the AEMC about distribution reliability levels and trade-offs between meeting the required level of reliability and the reliability performance experienced by consumers.

Network planning

In the NEM, the AEMO oversees the strategic development of the national electricity grid. It prepares independent demand forecast and network development information and examines expenditure on new transmission infrastructure using an economic cost–benefit framework that strikes a balance between network costs, reliability and market operating benefits.

New transmission network planning functions and rules have been in place for a relatively short time. The AEMO's National Transmission Network Development Plan was first published in 2010, and a new regulatory investment test for transmission (known as the RIT-T) has been in place since 1 August 2010. The RIT-T is an economic cost–benefit test used to ensure that regulated electricity transmission network development proposals are the most economic options and deliver broader benefits to the market while meeting mandated reliability standards. The RIT-T process involves extensive consultation and greater transparency and consistency in the prescription of market benefits and costs.

Based on the limited evidence to date, the Australian Government believes that the RIT-T has been effective. However, there may be scope to alter these arrangements in the future, based on evidence of their performance, such as by more effectively integrating the investment test with the economic regulatory framework.

The AEMO's *National Electricity Forecasting Report* provides annual energy and maximum demand forecasts over the next 10 years for each of the five NEM regions. In its inaugural 2012 report, the AEMO made major revisions to its demand forecasting methodology. Because the report is an important input into network planning decisions, the government strongly supports regular revisions of the methodology to ensure that it remains robust.

Two reviews currently underway are testing whether incentives for generation and network investment and operating decisions are effectively aligned to deliver efficient overall outcomes:

- The AEMC's Transmission Frameworks Review is examining arrangements for the provision and utilisation of electricity transmission services in the NEM. The review is focusing on transmission investment; network operation; network charging, access and connection; and the management of network congestion. The AEMC has issued an interim report, which identified five possible pathways for further reform. Its final report is due in March 2013.
- The Australian Government has commissioned the Productivity Commission to review transmission interconnections to assess whether optimal levels of investment are being delivered. The commission's report is due in April 2013.

As noted above, the AEMC is working on rules to establish a national framework for distribution planning and expansion in response to a proposal from the SCER. The aim is to deliver a clear and efficient planning process, encourage demand-side engagement, and provide transparency on distribution network service provider planning and investment activities (including the introduction of a regulatory investment test for distribution). The AEMC expects the framework to be in force by the end of 2012.

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 over the next decade, as well as a wider take-up of electric and hybrid vehicles.

Some of these technologies are already creating challenges in connection and grid management. For example, highly intermittent output from large wind power developments can contribute to localised congestion, and increasing photovoltaic and other distributed generation can place stress and costs on distribution networks that have not been developed to handle large two-way power flows. These problems are currently being managed case by case by distribution businesses. The AEMO, with assistance from the Australian Government, has made major investments to improve forecasts of wind generation to augment market operating systems, notably through the $14 million Australian Wind Energy Forecasting System.

The AEMC's Power of Choice review Stage 2 report found that the flexibility allowed to distribution companies in determining minimum technical standards for small generators is causing delays and increasing costs for embedded generators. This issue should be addressed through the adoption of appropriate minimum technical standards for embedded generators, and by resolving how to allocate any network augmentation and connection costs appropriately between distribution companies and the installers of small generators.

The market's understanding of the operation of these technologies has improved greatly, and work is underway to overcome barriers to the integration of distributed generation, new energy storage technologies and electric vehicles into the energy system. These matters are being investigated in the AEMC's reviews of demand-side participation and of energy market frameworks in the light of market penetration by electric and natural gas vehicles (which could result in an added source of demand, with implications for the grid).

Through the SCER and the COAG Select Council on Climate Change, the Australian Government is assessing the feasibility of technical standards for network connections to complement a rule change proposal currently being considered by the AEMC. The SCER is also 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 and will deliver a range of functions that are now enshrined in legislation, including a right of connection for embedded generators and disclosure provisions for information on connections.

Connecting remote generation

New entrants in the generation sector already face a number of challenges. This is particularly the case for generators in remote locations, where the additional cost of connection to the transmission grid (often at the end of the line) can be significant.

The cost of connection is an important factor in determining the least-cost and most efficient combination of generation and network investment. Investment should be firmly based on market and technology-neutral locational signals (including the carbon price, which covers emissions associated with generation and transmission and distribution losses). The AEMC is examining the efficiency of connection development as part of its Transmission Frameworks Review.

The AEMC has indicated that there may be a continuing barrier to efficient connection in areas where a number of generators connect to the electricity network over time (known as 'nodal' development).

In June 2011 a rule for Scale Efficient Network Extensions was introduced to allow the sizing of connections to meet future expected generation capacity. The AEMC amended the rule (from the original rule change proposed in February 2010) to bring it into line with the National Electricity Objective (part of the National Electricity Law), which ensured that any risks and costs of stranded assets would not be borne by consumers. The impact of the rule change will take time to become clear.

The Australian Government will monitor this issue through its four-yearly strategic reviews of energy policy to assess whether there are ongoing barriers to efficient connection and the development of the network.

Pricing of network augmentations and connections

Network businesses vary in their approaches to pricing network augmentation and connections. This reflects historical differences in jurisdictions' regulatory approaches and the differing physical characteristics of local networks. While a general national framework now applies to most network businesses, it remains subject to differences in interpretation and application. Greater consistency in the approach to network pricing (in the case of connection to the network or augmentation of the network) could be beneficial.

Consistent access to reliable and robust information on network business costs is also necessary to improve energy productivity. The current rule change proposal to establish a consistent distribution network planning framework will help to achieve this. In addition, current work by the AEMC on behalf of the SCER to develop a national transmission reliability standard framework and approaches for delivering distribution reliability will improve consistency and transparency across jurisdictions.

There may also be some longer-term challenges to current network pricing models. In particular, the increasing deployment of distributed generation systems (and the longer-term effects of local distributed storage), combined with a potential sustained reduction in average demand, may mean that network costs (which reflect peak load and thus may not decline proportionally with average demand) are spread across a declining revenue base. This could lead to higher costs per kilowatt of electricity sold. This issue is being considered by the SCER, as it could have large effects with more distributed generation and storage.

10.3.3 Strengthening market institutions and governance

Sound and robust regulation is critical to ensure that energy markets are delivering efficient outcomes that are in the long-term interests of consumers. The creation and ongoing work of the AER, the AEMC and AEMO have been significant steps forward in COAG's energy market reform agenda.

However, the rapid increase in costs in the regulated component of the NEM has focused attention not just on the regulatory framework but also on the roles of the AER and AEMC and

their ability to balance business and consumer interests. Governments, regulated businesses and consumers need to be confident that the national rule-making and regulatory bodies can perform their functions effectively.

The creation of an independent, national, energy-specific regulator along with a separate rule-making and advisory body was a pillar of COAG's energy market governance reforms, and remains at the heart of a truly efficient and national regulatory system.

As Australia's electricity market has evolved, the AER has played an increasingly complex and national role in the regulation and oversight of activities throughout the energy supply chain –wholesale, network and retail– and that role can be expected to grow further in the future. Therefore, it is increasingly important to ensure that the national regulator continues to be resourced adequately. Similarly, the scope of work undertaken by the AEMC (often at the request of governments) has expanded since the commission's inception.

The experience of recent determinations, and of processes currently examining the rules underpinning the AER's regulatory determinations for network businesses and the limited merits review process, will provide useful insights into opportunities to further enhance the AER's capabilities. The Australian Government will examine closely the recommendations of those reviews to identify opportunities to strengthen the capabilities, capacity and accountability of the AER where it can. It will give similar consideration to the AEMC.

The government strongly supports regular assessments of the accountability and performance of the three national institutions. COAG has determined that the performance of the new energy market governance arrangements should be examined five years after their commencement. It will be important that this review is on time and transparent.

In the longer term, the government also believes that national governance arrangements should be extended to cover all Australian electricity and gas markets in order to make market oversight and development more consistent and efficient.

Ensuring effective consumer participation in market processes

The consumer voice should be heard effectively in policy development and in all energy policy reviews. Specific recommendations on how this might be achieved are being considered through the review of the limited merits review regime.

The Australian Government believes this also creates an opportunity for consumer advocacy organisations to participate more effectively in the national reform agenda, and will work with them to allow more effective and nationally focused engagement.

Providing more effective management and oversight of government-owned businesses

The behaviour of energy businesses can have significant implications for consumers, particularly for their energy bills. Government or private ownership of these businesses can be an important determinant of their business costs. In particular, different cultural practices or approaches to managing risk may result in an overemphasis on engineering objectives at the expense of business efficiency or optimal commercial outcomes.

Government ownership has the potential for conflicts of interest in operational or investment decisions, dividends and equity margins. Capital markets can provide an important discipline for private businesses, but are not always able to do so for state-owned businesses.

Better corporate governance of government-owned businesses, particularly network businesses, is essential to drive higher productivity. This must include greater transparency about dividends and other payments to governments.

In government-owned network businesses, a cultural shift may also be needed in their approach to their business task—that is, delivering supply reliability at least cost—while also facing appropriate incentives to drive productivity improvements. The Productivity Commission is currently looking at

whether there are barriers in the existing framework that prevent network businesses using tools such as benchmarking to improve performance.

One of the ways to achieve that cultural shift is for government to adopt more flexible, evidence-based approaches where it is required to make decisions that affect the business, such as setting reliability requirements for distribution network businesses. Whether state governments also remove themselves from ownership to reinforce this change is a matter for them. The New South Wales Government has taken a positive step by asking the SCER to task the AEMC with looking into reliability standards in the state as part of its review of distribution reliability outcomes and standards. The review's final report, which was released on 31 August 2012, will inform the state government's setting of reliability standards. Another positive move has been the NEM jurisdictions' agreement to a national transmission reliability standard framework that ensures that the body that sets the standard is separate from the body that applies the standard.

Similarly, the Electricity Supply Industry Expert Panel commented on what was required for effective corporate governance of publicly owned companies:

> The Shareholder Ministers' oversight of State Owned Energy Business performance should provide a sufficient level of accountability to drive continuous improvement in the efficiency and effectiveness of the business. The economic regulatory framework will only partly drive efficiency in the businesses. There is, therefore, a clear responsibility on the Shareholders, through their interaction with the Boards, to provide additional impetus for efficiency. (ESIEP 2012)

These are critically important steps in giving consumers confidence that expenditures by these businesses (and therefore their costs) are aimed at efficiently meeting service delivery requirements.

10.3.4 The SWIS and other non-market systems

The South West Interconnected System

The design and regulation of the SWIS creates challenges different from those in the NEM. They include ensuring that wholesale price signals drive efficient investment in new generation, fostering greater market competition, creating a more level playing field by removing government from the market, and the continued cross-subsidy of retail prices.

Decisions on these matters are the responsibility of the Western Australian Government, which published its Strategic Energy Initiative on 28 August 2012. The Australian Government supports further reforms to develop a more efficient and competitive electricity market, noting the very strong links between this market and the western gas market.

The Australian Government also notes that while there are a number of fundamental design differences between the NEM and the SWIS (which are likely to remain), there is also growing convergence in many aspects of market operation and regulation. This suggests that there may be benefit in considering the opting-in of this market to national arrangements as provided for in the Australian Energy market Agreement.

Wholesale market

The development of a separate wholesale energy market and a capacity market (through the reserve capacity mechanism) was intended to provide an efficient mechanism for allocating supply and a guarantee of payment to investors who build and secure capacity. However, having separate markets for capacity and energy means that there are separate price signals for each.

The Independent Market Operator has begun a review of the reserve capacity mechanism to identify potential changes to improve the economic efficiency of investment signals. The Australian Government supports that review. A related review of the price-setting methodology for the reserve capacity mechanism, which is almost complete, is expected to recommend changes with the potential to reduce prices associated with the mechanism by 10%–15%.

Retail prices

Regulated retail prices in the SWIS are not yet at cost-reflective levels, and there is a shortfall between the income received and the cost of supplying electricity. Since 2009–10, the shortfall has been funded by a community service obligation payment (ERA 2011). While price adjustments will have impacts on consumers, the Australian Government believes that there would be benefit in developing a clear pathway to efficient pricing levels, coupled with protections and support for vulnerable customers.

Networks

The AEMC has identified a number of inefficiencies in the connection process and transmission network planning in the SWIS (AEMC 2009). The commission has recommended the introduction of a formal regime for transmission connection and augmentation, and reviews of the workability and clarity of regulatory approval processes and the network augmentation charging regime.

The Western Australian Government has considered network issues in its Strategic Energy Initiative. In its final report, it stated its intention to:

- integrate energy infrastructure planning, funding and augmentation with whole-of-government strategies focused on the development of the state
- design, augment and use essential energy infrastructure in an efficient and safe manner to promote competition and investment.

The Australian Government supports those aims and encourages the Western Australian Government to continue to engage with its stakeholders and, where relevant, the national energy institutions, in developing its reform package.

Competition

The SWIS has a concentrated ownership structure in which Verve Energy, a state-owned utility, accounts for more than half of generation capacity. The entry of new, privately owned generators since the market began is expected to continue. In June 2011, there were 12 active retail licences in the SWIS; however, most generators are contracted to the state-owned retailer, Synergy (Global–ROAM 2011).

The growing Western Australian economy will increase the demands on the SWIS. Attracting investment to meet those demands will be important if the market is to continue to maintain a secure and reliable supply of electricity.

Continued government ownership of energy assets could be a barrier to effective competition. Regulators should ensure competitive neutrality in all circumstances.

Other non-market systems

Off-grid electricity generation in Australia was estimated to be 12 803 GWh in 2009 (BREE 2012a). Growth in mining operations, particularly in Western Australia, has led to an increase in off-grid generation, most of it from diesel- or gas-fired generators.

While the lack of comprehensive data for remote power generation makes forecasting overall growth difficult, it is clear from industry forecasts that resources developments are fuelling rapid growth. For example, electricity demand in the Pilbara region is projected to increase by around 12 000 GWh by 2015, mostly from gas-fired self-generation. Growth in the Mid-West region will add an additional 4000 GWh, about half of which is likely to be off-grid (CMEWA 2011).

This expansion creates both opportunities for regional development and challenges in promoting the development of common-use infrastructure. In particular, rising fuel costs and improvements in hybrid renewable–fossil generation technologies suggest that there could be good opportunities for large-scale commercial systems.

The Western Australian and Northern Territory governments are working with local communities and the minerals industry to balance public and resource sector infrastructure needs while achieving the most efficient outcomes for the community. This includes further work to collect better information on energy use and needs in non-market regions and to explore options for securing greater productivity and efficiency through the development of common-use energy infrastructure in larger regions. The Australian Government fully supports that work.

10.4 Measuring policy success

Policy success in reforming our electricity markets, which requires a commitment to continued reform by all jurisdictions, would result in:

- more efficient and competitive retail and wholesale markets with transparent and market-based price signals that promote efficient patterns of investment and energy use
  - this should also include improved service delivery and a greater range of energy management products and services
- more efficient and transparent delivery of network services with investment aligned with evolving market and consumers' needs, with reduced barriers to connection and demand-side participation
  - this should also include transparent and effective network regulation and customer-appropriate reliability and other performance standards that strike an efficient balance between cost and service delivery
- electricity networks and markets that effectively encourage and accommodate an efficient balance supply- and demand-side opportunities and a more diverse national generation profile, with an accelerating deployment of clean energy, including distributed generation
- a more commercially disciplined market (including networks) with less government participation, greater transparency, and better governance of businesses that remain publicly owned
- an investment pipeline capable of meeting expected future needs in all market segments
- a more national approach to the regulation of energy markets, including the implementation of the National Energy Customer Framework and the full transfer of non-economic retail regulatory functions to national market bodies, along with a robust and effective framework to protect vulnerable customers
- high-performing independent national energy market institutions with adequate capacities, capabilities and accountabilities to perform their assigned functions.

Electricity market policy actions

The Australian Government will work with the states and territories to improve the efficiency of Australia's electricity markets through a comprehensive program of market and regulatory reform focusing on:

- strengthening institutional arrangements and market governance by
  - enhancing the capability, performance and accountability of the AER and AEMC, including exploring options for an industry-contribution funding model (for the AEMC)
  - encouraging state and territory governments to create a more level playing field in energy markets and to promote greater commercial efficiency and discipline in energy businesses, including through enhanced corporate governance (jurisdictions will also be encouraged to provide greater transparency around dividend and other payments)
  - improving consumer representation and participation in market processes, including support for the development of a national energy customer advocacy body and better access and capabilities to constructively participate in regulatory decisions
  - exploring options consistent with the provisions of the AEMA to extend national governance arrangements to cover all Australian electricity and gas markets
- improving network efficiency and performance by
  - supporting the independent AEMC rule change process for the economic regulation of networks so that new rules (and any transitional arrangements) can take effect before future regulatory determinations
  - enhancing the limited merits reviews regime applying to network determinations by responding to the recommendations by the independent panel, including making any necessary amendments to the National Electricity Law
  - investigating the need to review scheduled network expenditures in the light of revised demand forecasts
  - responding to recommendations of the Productivity Commission inquiry investigating the application of performance benchmarking to network businesses
  - supporting the development of a national and independent approach to the setting of distribution network reliability standards
  - improving network planning and connection outcomes through a timely response to the AEMC Transmission Frameworks Review and further work to develop a national framework for distribution connection
  - examining areas to open network services, including connection services, to competition
- empowering consumers by
  - improving demand side outcomes by responding to the AEMC's Power of Choice review
  - developing a national framework to guide smart meter deployment
  - seeking a clear commitment, from jurisdictions yet to do so, to introduce or investigate more cost-reflective pricing, ensuring the interests of vulnerable consumers are protected

  - implementing an industry-wide system for access to distributor- and retailer-held customer information
  - seeking a commitment to implement the National Energy Consumer Framework by all NEM jurisdictions
- ensuring competitive and efficient wholesale and retail markets by
  - seeking a clear commitment and timeframe for deregulating retail price controls where effective competition exists
  - developing national guidelines that provide a benchmark approach to a 'fair and reasonable' feed-in tariff for microgeneration to encourage competition and clear rights and obligations for the terms of connection
  - ensuring that key non-market interventions continue to interface efficiently with the electricity market
  - rationalising policies and programs that are not complementary to a carbon price, or are ineffective, inefficient or impose duplicative reporting requirements on business
  - undertaking further work to improve the efficiency of capital deployment and prudential and regulatory frameworks for the wholesale, over-the-counter and exchange markets
  - continuing to closely monitor market conditions, including the robustness of planned and committed investment and the functioning of supporting financial markets.

11 Energy productivity

Highlights

- Households and businesses will be better able to respond to rising energy costs and contribute to greenhouse gas reductions through further market reforms that unlock cost-effective demand-side gains and well-targeted actions to improve end-use efficiency.
- We can achieve greater system and end-use productivity by building an integrated market framework that better balances supply and demand incentives by:
  - moving to pricing structures that better reflect time-of-use or peak demand costs and consequently provide incentives for demand reduction and the more efficient use of energy
  - improving the ability of consumers and market agents to respond to price signals and market opportunities, including through easier market access
  - reforming network regulations to provide more efficient incentives for demand-side investment as an alternative to more costly network augmentation
  - driving a faster rollout of enabling technologies such as smart metering, load control and distributed generation and storage.
- The Australian Government will work with industry and other groups to facilitate the development and availability of productivity-enhancing energy technology and services, and to address areas of market failure that inhibit efficient end-use energy efficiency.
- Obtaining the most efficient, deepest and sustained gains requires an integrated approach to the design and delivery of market and regulatory reform and end-use measures. This can be improved through enhanced coordination of policies and programs and greater collaboration with stakeholders to develop long-term energy productivity gains.
- We also need to better understand the drivers of changes in energy use and productivity, and to broaden the range of information available to support informed decisions.

In a period of rising energy prices, actions to improve energy productivity can help consumers manage energy costs. They can also provide important social, economic and environmental benefits, such as improving national productivity, increasing energy security and lowering greenhouse gas abatement costs. While government has an important role in facilitating change, improving energy productivity will ultimately require consumers to take greater responsibility for their own energy-use decisions.

Australia's energy policy and market frameworks have historically focused on maintaining an adequate and reliable supply of energy. While the demand side has more recently become a point of focus, regulated prices and muted incentives along with other non-price barriers are still preventing the development of market-driven energy management and services opportunities. Consumers also lack efficient price signals and the information and tools to help them make choices about their energy use.

11.1 Overview

Improving energy productivity involves increasing the ratio of economic output or social utility relative to the cost of the energy used in their production. At its core it involves the efficient generation, distribution and use of energy. Improved productivity can reduce the need for investment in energy systems and lower energy and carbon costs for households and businesses. However, achieving sustained economic, social or environmental benefits requires the whole supply and end-use chain to operate efficiently.

Its scope involves ensuring that our energy markets are structured to provide an efficient balance between demand-side and supply-side choices. Energy must be priced efficiently throughout the system, and end users need appropriate tools, information and incentives to make rational decisions. Where appropriate, we must also ensure that regulation, planning standards and other policy measures are coordinated to promote efficient energy outcomes without unnecessary costs to consumers.

While some uses of energy are essential to maintain minimum living standards and support business, many are discretionary and can be traded off against costs or against other benefits. Energy users are increasingly responsive to the cost of energy and are making decisions on energy use in the same way that they decide on other factors of production (such as capital, labour and environmental or resource inputs). Many businesses and households are also seeking cost-effective opportunities to reduce their greenhouse gas emissions.

This chapter focuses on three related aspects of energy productivity:

- developing more efficient markets that better balance supply and demand in decision-making
- addressing market failures and encouraging behavioural changes to promote end-use energy efficiency and energy performance generally
- improving the effectiveness, coordination and application of government policies and programs to increase energy productivity.

11.1.1 The benefits of enhancing energy productivity

Taking cost-effective action to improve energy productivity offers a wealth of benefits to consumers, and a way for businesses to better manage energy and carbon costs and improve their competitiveness. Many actions that increase energy productivity also have flow-on benefits, such as better air quality, more efficient heating and cooling, and more efficient transport. They can also help households to minimise energy-related cost of living pressures (IEA 2012b).

Greater productivity in the use of energy can generate substantial savings. By 2011, companies participating in the Australian Government's Energy Efficiency Opportunities program reported identifiable energy savings of 164.2 petajoules (PJ) per year, of which 88.8 PJ are to be implemented for a net reported financial benefit of around $808 million per year (RET 2012).

In addition, concerted action to deal with growth in peak energy demand and improve system efficiencies could realise significant economic benefits, leading to cost savings for consumers. Analysis indicates that peak wholesale electricity prices, which apply for less than 30 hours per year in total, account for more than 30% of the annual value of wholesale electricity purchased on behalf of households and small businesses (SRG 2012).

The Energy Supply Association of Australia indicates that strategies to manage consumption at those times, combined with appropriate energy purchasing arrangements, could deliver gross benefits (that is, before taking the cost of actions into account) of $1.6–$4.6 billion in the decade to 2022 (esaa 2012b). For consumers, that could mean electricity bill savings of around $4–$15/MWh in 2022, or savings of between 1.6% and 6%, offset against the cost of taking action.[1]

1 Department of Resources, Energy and Tourism estimate based on an assumed constant real average retail electricity price of around $250/MWh.

The savings are not just in energy. Improvements in energy productivity can help reduce our demand for emissions-intensive energy while Australia develops new zero- and low-carbon energy sources. In the nation's pursuit of energy affordability, climate change mitigation and energy security, energy productivity stands out as perhaps the single most cost-effective way to achieve those goals. The International Energy Agency estimates that energy efficiency improvements could contribute as much as 72% of the global emissions reductions needed to hold atmospheric CO_2 under 450 parts per million by 2020 (IEA 2011a).

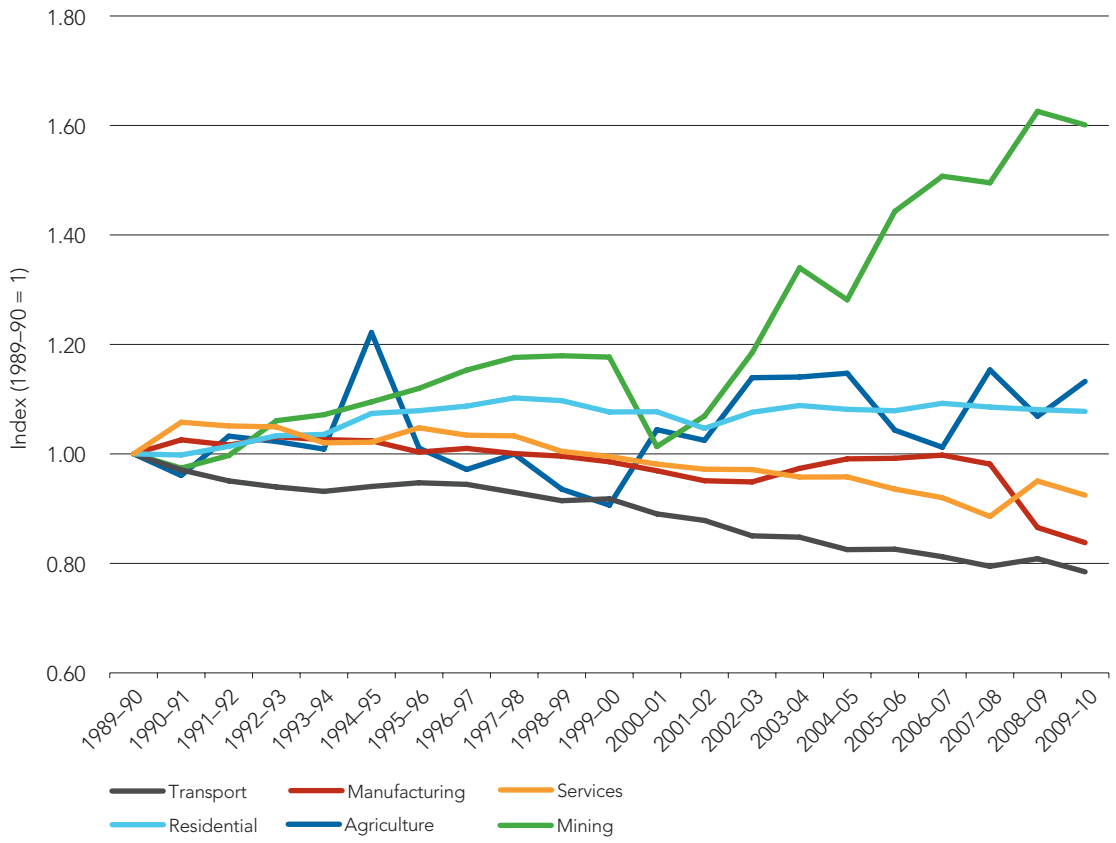
11.1.2 Energy productivity trends

Over the past two decades, the Australian economy has become less energy-intensive by 1.3% per year (Figure 11.1) (BREE 2012h). This was largely caused by a shift within the economy from energy-intensive manufacturing to the services sector. However, the improvement in energy intensity (the ratio of output to energy input) has slowed since 2000. Factors such as the mining sector's exploitation of deeper and lower-grade ores and the sharp rise in liquefied natural gas production as a proportion of mining have contributed to this change (BREE 2012h).

In the electricity supply sector, multifactor productivity (labour and capital usage) also appears to be declining for a number of reasons, including greater deployment of more expensive generation and supply options and growth in network expenditure to service peak demand (PC 2012).

The improvements in Australia's energy intensity have been smaller than those observed in many other OECD countries. This may be because we have had, until now, less incentive to improve performance due to our relatively cheap energy prices, high levels of energy security and stronger policy emphasis on supply.

Figure 11.1: Trends in energy intensity across the Australian economy, 1989–90 to 2009–10



Note: These trends in energy intensity do not imply any weighting of energy consumption by sector.

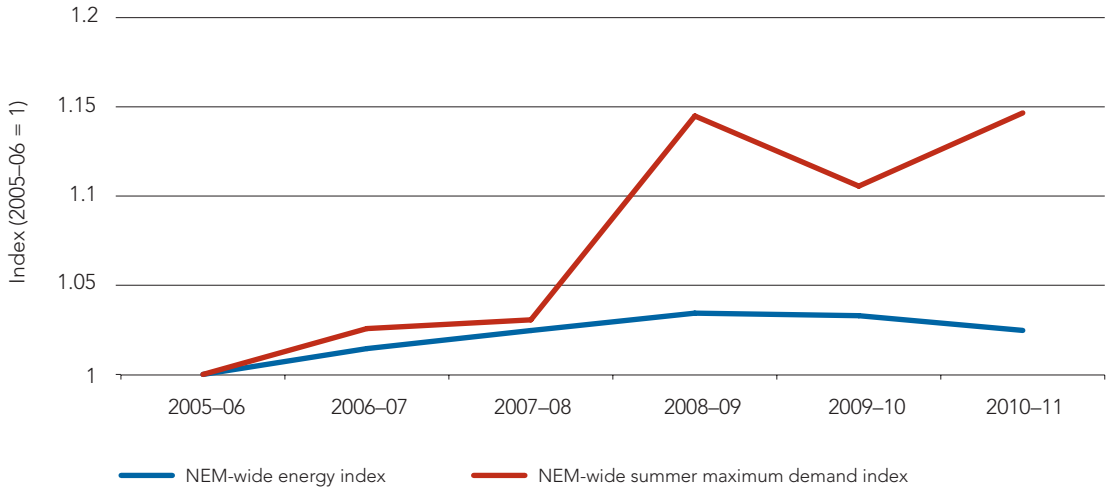
Source: BREE (2012h).

There have been important recent changes in electricity demand in Australia. Over the five years to 2010–11, demand in the National Electricity Market grew at an average of around 0.5% per year. Over the same period, peak or maximum demand grew by an annual average of 2.8% in the National Electricity Market (Figure 11.2) and by 6.3% in Western Australia's South West Interconnected System (DTT 2012). This largely reflected the impact of the high take-up of air conditioners and other energy-using appliances. Peak demand growth has been a major driver of the growth in network and generation costs.

More recently, data from the Australian Energy Market Operator indicates that in the past two years there was a 3.4% decline in average annual consumption in the National Electricity Market and reduced rates of peak demand growth. The market operator has also substantially revised down future annual and peak demand growth forecasts (see Chapter 3: *Future energy trends and challenges*).

The recent fall in demand appears to be due to a combination of factors, including the impact of weather, the global financial crisis, a larger consumer response to rising power prices and a greater take-up of energy-efficient technology and distributed generation (AEMO 2012b). While this is encouraging and may point to future easing in some drivers behind recent price pressures, it will take time to see how sustained those patterns may be.

Figure 11.2: Total and maximum energy demand index, 2005–06 to 2010–11



Source: Derived from data from AEMO (2011a).

11.2 Energy productivity policy framework

The Australian Government's energy productivity policy framework addresses a range of barriers and enabling factors affecting decisions about the supply, demand and use of energy. The objectives, guiding principles and key elements of the framework are shown below.

Improving energy productivity requires effective cooperation among jurisdictions. The Australian Government does not have sole responsibility for the energy market, demand-side policy or other factors affecting energy use, such as building regulation, transport policies and urban and other land planning strategies. Crucially, retail electricity price regulation remains a state and territory responsibility.

The Australian Government works cooperatively with the states and territories through the Council of Australian Governments (COAG) Standing Council on Energy and Resources and the Select Council on Climate Change. Under COAG arrangements, the National Partnership Agreement on Energy Efficiency was agreed in 2009. The related National Strategy on Energy Efficiency has provided a nationally consistent and coordinated approach to energy efficiency and sets out a range of measures designed to help households and businesses prepare for carbon pricing.

While those processes have improved cooperation among jurisdictions, implementation challenges in delivering nationally consistent and complementary energy productivity measures remain. There is also a need to reduce unnecessary compliance burdens on industry resulting from the duplication of programs across jurisdictions.

Policy objective

To improve the productivity of Australia's energy production and use, including by:

- developing regulatory and market frameworks that provide for an efficient balance of demand-side and supply-side responses in our energy system
- empowering energy consumers directly, or through the market, to manage their energy use and costs efficiently and effectively.

Principles

- Cost-reflective energy and carbon prices supported by sound market and regulatory frameworks are critical incentives for consumers to use energy efficiently.
- Complementary action to overcome identified market failures or other non-price barriers can help consumers make informed choices about energy use.
- Market failures and other non-price barriers should be addressed directly, cost-effectively and in ways that do not distort the efficient operation of markets or the carbon price.
- Governance arrangements should support a consistent national approach to energy productivity policies to minimise consumer costs and overall regulatory burden.

Framework elements

The Australian Government's energy productivity policy framework has four central elements:

- developing more efficient market structures, including better price signals
- better coordinating regulation and planning
- fostering better technology and services options to manage energy use
- providing information to support efficient decision-making and enable behavioural change.

11.2.1 Developing more efficient market structures, including better price signals

Pricing structures that reflect the costs of supply, including time-of-use costs, will provide more efficient signals for demand response and encourage improvements in energy efficiency. There is also a need to ensure that market structures allow for balanced choices between demand and supply, including an ability to trade in demand reduction.

Markets are generally the most effective means of providing efficient energy price signals. However, in the case of monopoly energy networks, regulation takes the place of the market in setting prices. Importantly, while price signals are a fundamental underpinning of more efficient choices, there are natural limitations that mean such signals may not always be effective on their own.

11.2.2 Better coordinating regulation and planning

Energy market regulation needs to provide balanced incentives for supply-side and demand-side options and to ensure that alternatives such as distributed generation, demand response and energy storage do not face barriers to their efficient adoption.

Planning approaches should consider the potential of supply-side and demand-side options, and provide information about future conditions to help consumers assess the value of those options.

In some cases, direct regulatory measures may be necessary where there are market or information failures or where individual benefits are highly diffuse and difficult to capture. Those measures must be integrated to maximise policy results and minimise compliance costs.

11.2.3 Fostering better technology and services options to manage energy use

New technologies will enable a greater range of demand-side and energy-efficiency options, including in energy services. This will open up opportunities for consumers to better understand and manage their energy use.

Technology improvements are already underway in areas such as distributed generation; energy efficient products and processes; energy storage; metering and control systems; and electric vehicles.

Governments have a role in ensuring that institutional structures can support the commercial adoption of such technologies and their integration into the energy system. Energy research, development and demonstration frameworks should support innovation and technology deployment in this area.

11.2.4 Providing information to support efficient decision-making and enable behavioural change

Improving 'energy literacy' through consumer information is fundamental to the effective management of energy use and costs. The enabling aspect of technology also means there are strong links between technological innovation and the quality of energy information available for decision-makers (whether they are consumers, their agents or energy providers).

To bring about behavioural change, information should be designed for different audiences and provide meaningful context on the impact of different actions, including likely benefits and costs.

Government, industry and consumer groups have an important role to play as trusted information sources to support consumer decision-making and build capability.

11.3 Policy challenges and priorities

There are many policy challenges involved in improving Australia's energy productivity.

The barriers to improved energy productivity are generally well understood. They include lack of access to information about energy use, a lack of necessary skills and capability, inefficient pricing, principal–agent or split incentives (whereby owners' or providers' incentives to invest in energy efficiency differ from those of tenants or consumers), organisational barriers to effective energy management, and perceptions of additional risk in energy-efficiency or demand-management investments or technologies.

Energy is invisible, and its use (including its cost) is embedded within other activities. As a result, decisions about energy are not always efficient. The interrelationship between barriers within the market is complex, and individual benefits are not always large or shared equally. This makes it difficult to realise potential gains. As shown by the International Energy Agency and others, it is necessary to develop a suite of enabling policies and measures (such as appliance standards, labelling, information tools and incentives) to overcome these barriers and enable more effective and efficient decision-making (IEA 2012b). Consistent with the COAG Complementarity Principles for Climate Change Mitigation Measures, policy interventions should be tightly targeted to market failures and the benefits should outweigh the costs.

Over the next four years, work is needed in three areas to achieve our energy productivity goals:

- further reform of electricity markets to promote energy productivity
- actions to unlock broader end-use productivity potential
- improved effectiveness, coordination and application of government policies and programs.

11.3.1 Reforms to improve energy productivity in electricity markets

Demand for electricity in Australian markets is 'peaky'. In 2010–11, the top 25% of demand in South Australia occurred less than 1% of the time (AEMO 2011a). In other National Electricity Market jurisdictions, the proportions of maximum demand occurring for less than 1% of the time were around 20% in Victoria, 15% in New South Wales, 10% in Queensland and 5% in Tasmania. This is a very poor use of capacity and imposes potentially avoidable costs on all electricity consumers.

The need to meet growing peak demand in the electricity system has driven large investments in generation and network infrastructure. Peak demand is expected to be a significant contributor to an estimated $38 billion in electricity network augmentation costs in the current five-year cycle (IRG 2011:15–16).

Growing peak demand also imposes higher costs by requiring more fast-start backup generation. Recently, this has been through investments in open-cycle gas turbine peaking plants, which have much higher costs per unit of delivered energy.

These costs are reflected in network and generation prices paid by electricity retailers, which feed through to rising retail electricity prices for consumers. Uniform electricity pricing (mainly in the form of regulated tariffs) means that consumers who use energy at peak times are often not paying their full share of system costs, while those with lower peak usage may be paying more than they should. This drives higher (and inefficient) demand for energy at a higher overall cost and may be resulting in inequitable cross-subsidies between different groups of consumers.

For example, while it may cost around $1500 to buy and install a 2-kilowatt (electrical) reverse-cycle air conditioner, such a unit could impose capital costs on the energy system as a whole of $7000 when adding to peak demand (based on DEEDI 2011:4). The additional system capital costs are recovered over time through energy bills spread across all customers, but because energy is generally priced using a fixed tariff approach, only some of the costs are paid by the purchaser of the air conditioner.

Despite slower growth rates in recent years, peak demand has continued to increase, while at the same time total electricity consumption has been flat or declining. This means that increasing system costs are being spread over a smaller transactional base. Projections of continued subdued average demand growth and increased penetration of distributed generation suggest that this trend may continue into the future (AEMO 2012b, Simshauser & Nelson 2012).

Improving demand-side outcomes in the market is not just about reducing the growth in peak demand—there are other important benefits. Reducing overall demand through efficient price responses can defer the need for large-scale investment in baseload generation capacity, and there

is already evidence that this is happening (AEMO 2012b). Stimulating demand-side investment can also defer or avoid network augmentation.

Areas of market reform that would promote more efficient patterns of demand include:

- pricing structures that better reflect the time-of-use or peak demand costs and, consequently, the value of demand reduction in the market
- greater ability on the part of energy consumers (or their agents) to respond to market opportunities, including through alternative options for wholesale market access
- network regulatory reforms that provide efficient incentives for demand-side alternatives to network augmentation
- the efficient adoption of enabling technologies, such as smart metering, load control and distributed generation and storage.

Efficient retail market pricing

Overall price levels are one of the main signals for long-run energy efficiency improvements. Reform of Australia's electricity pricing regimes (discussed in Chapter 10: *Energy markets: electricity*) is needed to better reflect the variable cost of supply.

Retail price deregulation to allow competitive markets to set prices efficiently will give consumers an overall incentive to manage their energy use.

Reforms that support the adoption of time-varying pricing would also develop opportunities for the energy services sector to help consumers manage costs, and encourage energy supply businesses to more closely align investments with consumers' willingness to pay.

Energy providers might offer customers a number of pricing structures. The simplest incremental change could be a two- or three-part tariff with predetermined peak, shoulder and off-peak daily periods, seasonal charging periods, or both. More advanced pricing models, such as critical peak pricing or rebates, could apply on a predetermined number of days with extreme weather conditions.

Australian trials have shown good results. For example, critical peak pricing trials in New South Wales have delivered average peak demand reductions of over 20%. A critical peak rebate program conducted by Endeavour Energy in the summer of 2010–11 achieved a higher than expected average peak demand reduction and reductions in peak period consumption ranging from 29% to 51% below the customer's baseline energy consumption (Futura Consulting 2011). An international study of 69 critical peak pricing trials showed an average peak reduction of 16%, resulting in overall lower bills for consumers (VaasaETT 2011).

Different consumers may want a range of pricing structures, reflecting their (or their agents') interest in and ability to manage consumption, or different appetites for price and supply certainty risk. Pricing options could also be matched with energy management options tailored to consumers' needs.

Allowing or encouraging a market move away from the historical (and well-understood) model of uniform customer tariffs is challenging, particularly in the mass market (households and small businesses). Long-term success in this area will be driven by consumer demand for and acceptance of alternative pricing options, so future pricing structures must meet the needs of consumers as well as the needs of providers. This balance is best achieved by allowing competitive markets to respond innovatively to changing consumer preferences and evolving technologies. A market-driven approach will also allow the benefits of demand response to be shared more flexibly between providers and consumers.

The market is already moving in this direction, and a number of jurisdictions and energy providers now have options, developed after pricing trials, for differentiated tariffs. However, this

process would be accelerated and deepened if it were supported by retail market reforms that deregulate retail pricing and encourage greater competition and innovation, including in services such as metering.

There may be some risks for consumers from uneven market power, particularly in the early stages of market development when products are new and consumers' knowledge is relatively undeveloped. Appropriate consumer safeguards and information tools would be needed to mitigate or reduce those risks, particularly for vulnerable consumers, and to support greater consumer energy literacy (see Chapter 10: *Energy markets: electricity*).

Electricity consumption is generally observed to be inelastic, meaning that a unit increase in price leads to a proportionally lower decrease in consumption. For this reason, while demand response to price is important in delivering an efficient balance of demand and supply in the long term, effective competition between suppliers (or the regulation of monopoly suppliers) is also needed to maintain prices at or near supply costs.

Improving wholesale market participation

A number of barriers may be limiting the ability of participants to offer demand reduction in energy markets, including the wholesale market (AEMC 2012). They include onerous registration requirements that inhibit participation by third-party demand aggregation businesses and make it difficult or unprofitable for them to operate.

In addition, current wholesale market rules do not allow the separation of demand response from energy purchase arrangements. Options to trade demand reduction, either as predictable peak management or as ancillary services, are technically and economically feasible, but the transaction costs are relatively high because current arrangements require consumers to establish a customised energy procurement strategy as well as the technical and operational controls to manage energy use.

While the Australian Government generally takes a cautious approach to proposals that require changes to wholesale market structures, there is a strong case for reforms to improve access to energy markets and the ability of third-party demand aggregation agents to engage.

Network pricing, regulation and information

Networks have an important role in promoting more efficient demand patterns. More cost-reflective network pricing would give retailers and their customers a commercial incentive to take up demand management options that target long-run costs.

Where transaction costs or other factors prevent cost-reflective network pricing, network companies can engage through other providers or with consumers and their agents to invest in demand-side alternatives to network augmentation.

A number of biases in the application of the network regulatory arrangements in practice are inhibiting the balanced consideration of demand-side investments, and changes to incentives in this area are likely to be needed. For example, the Australian Energy Market Commission considers that the current regulatory arrangements may bias network businesses to prefer capital expenditure over operating expenditure, because of both the potential to make a profit and the certainty of cost recovery (AEMC 2012). If demand-side projects are more likely to involve operating expenditure (for example, to search for, enrol and reward customers in a demand reduction program), a network business's incentive to invest in demand management may not be as strong as the incentive to invest in network infrastructure.

The value of demand-side actions is largely time and location dependent, reflecting different demand trends and network constraints. With reforms to provide the right balance of economic incentives, network businesses should be free to decide how to deal with those constraints with the most efficient combination of investment in supply-side infrastructure (such as 'poles and wires') and

demand-side contracts. This should mean that there may be no need to set demand-side targets. However, an overall requirement to consider demand-side options remains appropriate, at least initially, to overcome historical biases against such options. There may also be some cultural biases within network businesses against demand-side investments (AEMC 2012). As discussed in Chapter 10: *Energy markets: electricity*, a sharper focus on driving business efficiency in network businesses, including through improved transparency and governance of business operations, may also result in more attention to cost-effective demand-side alternatives.

Energy management is likely to be an expanding business opportunity. The institutional framework needs to ensure that the opportunity is open to a range of parties and is not developed internally through cross-subsidies from other network business areas. This problem is not unique to demand-side participation in the electricity market, and should be addressed through ring-fencing arrangements that separate the supply business from demand-side activities.

Timely, up-to-date and accessible public information on network capacity and limitations is also necessary to allow parties (other than the network businesses) to identify opportunities for augmentation deferral, and to allow demand-side options (including distributed generation) to be more easily evaluated and implemented by consumers and their advisers. This will be supported by a proposed change to the distribution network planning and expansion framework rules being finalised by the AEMC. The change will harmonise planning approaches and information publication requirements in this area.

Enabling technologies

A growing number of enabling technologies can contribute to efficient demand-side participation, including 'smart' meters, more sophisticated energy management systems and a range of industrial- and household-scale distributed generation technologies. More extensive household and business computerisation and connectivity provide new commercial options for energy management (for example, direct load control of major appliances, such as air conditioners and pumps), and make it easier to collect, understand and communicate information about energy use.

Many of these developments will be market driven, and the main role of regulation is to support their safe, timely and efficient deployment. However, because many technologies benefit both consumers and energy providers, how those benefits are realised and shared between parties is an important question. In many cases, an equitable division is likely to be achieved through market-based approaches that allow customers and providers to negotiate commercial arrangements. However, there may be a role for regulation or market guidance where opportunities and risks are split across both competitive and monopoly sectors.

Some energy service providers and consumers will want to use and trade energy from distributed generation and other new energy technologies, which suggests a growing need for a broader range of metering options in future (for example, to allow a consumer to buy and sell energy from different providers at the same site).

Smart meters also have communication capabilities that can support additional energy services, such as remote reading, the automated control of appliances, and the provision of timelier energy-use information to guide consumer decision-making. These functions need to be applied more effectively, drawing on lessons from trials such as the Smart Grid, Smart City and Solar Cities programs and major deployments such as the Victorian rollout of smart meters. In this context, the Standing Council on Energy and Resources is developing a flexible national framework to guide the deployment and use of smart meters (see Chapter 10: *Energy markets: electricity*).

The take-up and efficient operation of distributed generation and energy storage technologies will help to balance supply and demand in the market more efficiently, and may support cost-effective reductions in network investment. SP AusNet's critical peak pricing structure for commercial and industrial customers, under which customers are eligible for lower network capacity charges if

they reduce their energy use during five notified peak days, demonstrates this potential. Almost all customers with distributed generation run their generators to avoid drawing energy from the network at critical peak price times.

As discussed in Chapter 10: *Energy markets: electricity*, there is a need for further work to develop consistent connection standards for distributed generators, and to resolve the allocation of network augmentation and connection costs between distribution companies and the owners of small and medium generators. The Australian Government strongly supports current work in this area.

The Australian Energy Market Commission is also examining the potential impacts of the growing penetration of electric vehicles on grid and market integration. The Australian Government is demonstrating the benefits of using smart technology to promote more efficient traffic management through the National Smart Managed Motorways Program, which will provide significant fuel, emissions and time savings while also improving road safety.

The benefit of a comprehensive approach to demand-side reform

Reforms in the areas described above will provide incremental benefits to consumers, energy providers, or both. However, a comprehensive and strategic approach that addresses them together could produce a mutually supporting combination of market and regulatory incentives across the energy supply chain and a more efficient and equitable distribution of costs and benefits.

The government recognises that these reforms deal with complex issues, some of which may have major market implications. Changes should be initiated on the basis of careful analysis. In this context, the government supports the objectives of the Standing Council on Energy and Resources demand-side participation framework and will work with the states and territories to carefully assess and respond to the outcomes of the Australian Energy Market Commission's Power of Choice review. As indicated by the Prime Minister in her speech on energy market reforms on 7 August 2012, this will be a key part of a package of reforms that the government will take to COAG in December 2012.

11.3.2 Actions to unlock broader gains in end-use energy productivity

Higher energy prices and the introduction of carbon pricing will provide a strong incentive for consumers to focus on their energy management, but there remains a need for well-targeted complementary actions to address recognised market failures, information gaps and other barriers in business and household decision-making (PMTGEE 2010). Those actions can empower consumers to participate more effectively in the market and to realise savings in energy use and costs.

There is also a need for government action to address market failures that reduce incentives for the private sector to invest in innovation that improves energy productivity. While these barriers are generally the same as those faced in other areas of innovation (such as first-mover disadvantage and the inability to capture all the benefits), investment in this area has been quite low compared to investment in supply-side technology developments, such as carbon capture and storage and renewable energy. There is also a traditional interest in expanding business opportunities where returns could be higher than savings from minimising recurrent costs (so-called 'sunk' costs).

As a result, a comprehensive and cohesive mix of policies is needed to support households and businesses to improve their end-use energy efficiency through:

- the provision of information that will facilitate incremental improvements and behavioural change in the use of existing processes and practices
- balanced regulation to support the take-up of higher-performing energy-efficient technologies and to promote greater inclusion of energy efficiency in the up-front design and operation of long-lived investments

- a technology, innovation and deployment framework that recognises the inherent risks and barriers companies face when researching or investing in new technologies, and can drive innovation to deliver step-change improvement in how energy is used.

The Australian Government, through measures outlined in the Clean Energy Future Plan and other initiatives, has in place a broad set of policies and measures that seek to address these issues in different sectors of the economy.[2]

Informing households and enabling behavioural change

Information on options to improve end-use efficiency empowers consumers to respond effectively to market price signals and change their behaviour or optimise their business practices. Households and smaller businesses, in particular, often lack easily accessible, understandable and relevant information. In addition, factors such as habits, social norms and individuals' limited time and ability to make considered decisions have been identified as having an equally important role in influencing the take-up of energy-efficient technologies and behaviours.

Energy bill benchmarking allows households to compare their electricity consumption to that of similar households and motivates them to use less. Bill benchmarking is occurring in the Australian Capital Territory and Tasmania under the National Energy Customer Framework (see Chapter 10: *Energy markets: electricity* for more detail on the framework and its implementation).

The Low Income Energy Efficiency Program is providing $100 million to support groups of service providers to demonstrate smart energy use in low-income households across Australia. Websites such as Living Greener[3] are also providing households and small businesses with information on energy management strategies in a form that is easily accessible and understandable. As part of the National Energy Customer Framework, the Australian Energy Regulator has recently launched an energy retail price comparison website for consumers.[4] Similar services are also available in the private sector. Advisory services delivered as part of the Home Energy Saver Scheme will also support low-income households to understand options for making longer-term energy efficiency improvements.

In future, a consumer energy data access system or hub to improve the flow of consumption information could allow consumers, or other parties authorised by them, easier access to their energy information to help inform decisions affecting energy use. Energy providers and service companies could use such data to provide energy management tools and support better consumer decisions. The data access system will also provide de-identified data to support policymaking. A scoping study by the Australian Government on this issue found that some energy suppliers were moving towards providing their customers with greater access to their data. The study also identified some major barriers, such as significant information inequality between different providers, untimely access to information and limitations on access by other parties approved by the customer, which may affect the ability of consumers to make informed choices.

Recognising that solutions to multiple barriers may be better provided by the private sector, the Australian Government is investigating the merits of a national energy savings initiative (a national energy efficiency or 'white certificate' trading scheme). This would place obligations on energy retailers to find and implement energy savings in households and businesses. Such a scheme would only be implemented if supported by COAG and on the basis that it replaces existing state-based schemes. It would also need to be complementary to the carbon price.

2 See www.cleanenergyfuture.gov.au.

3 www.livinggreener.gov.au.

4 www.energymadeeasy.gov.au.

Box 11.1: Managing energy use in the future

How we use and manage energy in our homes and businesses may change dramatically in coming years through an expanding range of 'smart' end-use appliances and applications and a more diverse range of services offered by a growing number of energy providers, including retailers, distributors and specialist energy services companies.

More households and businesses will be able to access smart meters that will allow them to see electricity consumption data almost in real time via internal home or business displays, the internet or even smartphone apps. Many homes in Victoria already have this capability.

Using the information collected by smart meters, consumers will be able to see how much electricity they are using at different times of the day, check how their consumption is tracking compared to last month's bill, and use that information to reduce their consumption before the next bill arrives. They will be able to remotely switch off TVs, computers, pool pumps or lights that have been left on and quickly see what this does to their electricity use. They should also be able to provide their detailed data to an energy-efficiency adviser, who will then be able to provide tailored advice to help them save electricity and money.

Energy retailers will begin to offer a wider range of energy tariff packages that better reflect the needs of their customers, taking into account the real cost of electricity supplied at different times of the day. This will allow consumers to reduce their energy use or use energy-hungry appliances during lower-cost periods.

For businesses with equipment such as chillers or pumps that can be shut down for a few hours several days a year, a tariff that offers cheaper electricity in return for switching off at particular times could provide considerable savings. One-quarter of the capacity in our electricity system is used to supply power during peak events that last for less than two days each year in total. If consumers can change the times when they use, say, pumps, chillers or dishwashers, some of the need for new capacity can be avoided and they can start to reduce their energy bills.

Energy and energy service companies and market aggregators will also begin to develop sophisticated energy management tools and technologies that can use the functionality offered by smart meters and appliances.

The future of energy management holds great promise, but to unlock that potential and accelerate change we need to make sure we have the right market and regulatory frameworks to incentivise energy businesses and appliance manufacturers to be more innovative and to empower and reward consumers who want to better manage their costs.

Overcoming information barriers in business

For businesses, energy use can be a relatively invisible component of their cost structures, concealed among other business priorities.

The Energy Efficiency Opportunities program has demonstrated the potential for large, cost-effective savings when companies adopt better energy management systems and are able to analyse and understand how energy is used in their operations. Many businesses participating in the program have indicated that better analysis and communication of energy-use data has helped them shift from the traditional view of energy as a 'sunk' cost to a more proactive approach to energy use and management.

To encourage the consideration of energy use at the design stage where significant energy savings are most easily and cost-effectively realised, the Clean Energy Future Plan will extend the Energy Efficiency Opportunities program to major new development or expansion projects.

The government is consulting industry and conducting trials to determine options in this area, taking into account the need to avoid imposing unnecessary burdens or inefficient costs on business. The program has also been extended to smaller energy users on a voluntary basis to support the take-up of good energy management practices.

The Australian Government is improving access to information for small business through initiatives such as the Energy Efficiency Information Grants Program, which is providing funding to help industry associations and non-profit organisations provide practical, tailored energy-efficiency information to small and medium-sized enterprises and community organisations.

The Energy Efficiency Exchange website is a good example of how Australian governments can collaborate to consolidate quality information in one location to reduce business research costs.[5] The website includes best-practice resources in a range of areas, including energy management, technologies and business support programs.

Rating and guidance tools can guide companies when they make important procurement decisions. For example, the Commercial Building Disclosure program requires the disclosure of a building's energy efficiency to potential buyers or lessees of office space of 2000 square metres or more. This is creating an informed market that rewards better-performing buildings and delivers strong market-based incentives for owners to improve their properties.

In the transport sector, the Australian Green Vehicle Guide aims to help consumers make better-informed choices by assessing the environmental performance of vehicles. The guide provides information about the greenhouse gas emissions, air pollution ratings and fuel consumption of light vehicles produced in 2004 or later.

Balanced regulation to embed long-term energy efficiency gains

In some circumstances, even with efficient pricing and market incentives, direct regulation can be a cost-effective way to address market failures, raise energy-efficiency standards and help to ensure that inefficient energy use is not locked in over a long period.

Appliance, building and vehicle standards can overcome diffuse small-scale market failures that would otherwise result in inefficient decision-making or poor use of technology. Work in this area is ongoing and includes the following:

- Greenhouse and energy minimum standards legislation is due to come into effect on 1 October 2012 and provides for a nationally consistent energy standards framework incorporating the Equipment Energy Efficiency (E3) program. It also provides for coverage of new product areas, including non-energy-using products such as insulation and window glass.
- Changes to the Building Code of Australia raise the minimum standards for the energy performance of new buildings, including a 6-star energy rating or equivalent for new residential buildings and a significant tightening of energy-efficiency requirements for all new commercial buildings.
- A draft national building energy standard-setting, assessment and rating framework aims to establish a pathway for potential future increases in minimum building standards to 2020 and to improve the approach to assessing and rating buildings. This will be incorporated into a framework policy statement for consideration by governments in the near future.
- The introduction of mandatory CO_2 emissions standards for all new light vehicles is expected to commence from 2015.
- Standards Australia is working with jurisdictions to establish a standard interface for demand response in appliances such as air conditioners and pool pumps. This will help to lower transaction costs for direct load control and the smart use of appliances more generally and will reduce future transaction costs for their deployment and commercial use.

5 www.eex.gov.au.

Improving Australia's transport energy productivity requires the collaboration of infrastructure and land-use planning bodies to make better use of existing infrastructure. The Australian Government has recently released the National Land Freight Strategy, a long-term blueprint for a streamlined, integrated and multimodal transport system. The strategy includes recommendations to more effectively use existing infrastructure, including the use of technology to improve traffic flows along major motorways, using higher productivity vehicles on key freight routes, creating dedicated freight routes and separating passenger trains from freight trains.

The Australian Government is committed to investing in transport infrastructure networks and better strategic planning for urban areas to support its energy productivity objectives. The National Urban Policy builds on COAG's strategic planning reforms for capital cities and will improve the way energy efficiency is considered in infrastructure investment decisions. A $90 million investment through the Australian Rail Track Corporation for a trial of the Advanced Train Management System aims to make our rail system more productive and efficient. The Australian Government is providing funding of over $3.8 billion to upgrade Australia's freight rail network and over $3.6 billion for urban rail to provide genuine alternatives to road travel and transport.

Improving transport efficiency will also require collaboration between government and the transport industry. The Smart Transport for a Growing Nation project, implemented by the National Transport Council, recognises that Australia's transport system is facing many challenges that threaten its sustainability and efficiency. The project involves the council collaborating with government and industry stakeholders to identify regulatory and operational reforms that will improve the performance of Australia's transport system over the longer term.

Technology innovation and deployment

When major investment decisions are made, the deployment of the most energy-efficient end-use technologies is crucial if we are to maintain energy productivity improvements over time.

Customers and energy providers can have different incentives to invest in energy efficiency, and those incentives do not always align. Customers often have limited time and financial resources to devote to reducing their energy costs, while providers may be incentivised to maximise sales rather than to invest in demand reduction.

Access to capital for projects outside a business's usual scope or not closely linked to its core business drivers can be difficult to obtain. Developing a business case can also involve high transaction costs in proving feasibility or negotiating finance. In addition, benefits from such investments may be unclear or perceived as higher risk, further dampening investment appetite.

The Australian Government is taking action to address these issues:

- The Clean Technology Program is providing $1.2 billion in funding over seven years from 2011–12. Its largest component is the $800 million Clean Technology Investment Program, which is supporting Australian manufacturers to invest in energy-efficient capital equipment and low-emissions technologies, processes and products.
- Low Carbon Australia is working in partnership with the financial and energy services sectors to develop innovative financing options that can make investment in energy-efficiency projects more appealing and in tune with companies' internal capital requirements. This will help to stimulate the development of energy performance contracting and similar financing models, which can guarantee energy savings to an end-using company with minimal up-front capital costs.
- From 2013–14, the Clean Energy Finance Corporation will provide $10 billion in finance to support the commercialisation and deployment of renewable energy, energy-efficiency and low-emissions technologies. It will also invest in the transformation of existing manufacturing businesses to refocus on meeting demand for inputs in those areas.
- The Community Energy Efficiency Program is providing $200 million to assist local government, not-for-profit and community organisations to undertake energy-efficiency upgrades to community infrastructure.

Driving step-change improvement

Evidence from the Energy Efficiency Opportunities program suggests that there has been much less investment in projects involving best available technologies or innovative approaches that could deliver larger step-change improvements in energy efficiency, but which involve higher risk (or perceptions of risk) or longer paybacks.

The Australian Government is working to improve the level of research and innovation in energy-efficient technologies and processes. This includes providing support for early-stage innovation and demonstration projects in the private sector through incentive-based measures such as the Clean Technology Innovation Program and tax rebates through the R&D Tax Incentive.

The government also recognises that industry may benefit from a more structured approach over time to improve its energy productivity as it transitions to a low-carbon future. In the Netherlands, the government has worked with industry to develop energy-efficiency roadmaps with short-, medium- and long-term strategies to deliver up to 50% reductions in energy use over a 20-year period. The roadmaps place a strong emphasis on government working with industry on productivity growth and innovation.

Consistent with its economic and industry policy agenda to boost business innovation and productivity, the Australian Government proposes to explore opportunities to work with industry and other stakeholders, including research agencies, to develop energy productivity roadmaps in key industry sectors. The sectoral roadmaps would identify areas where energy productivity can be improved and greenhouse gas emissions reduced. They would also explore cost-effective actions that could be taken to foster process and product innovation and drive energy productivity improvements over the short, medium and long terms.

Emissions-intensive, trade-exposed activities, such as aluminium, steel and cement clinker production, use around a quarter of Australia's electricity and constitute a significant portion of our non-electricity stationary energy demand. The Jobs and Competitiveness Program within the government's Clean Energy Future Plan is designed to support the competitive position of these industries and to provide an incentive for them to improve their energy productivity. Manufacturing activities that are not emissions-intensive can access the Clean Technology Program for grant-based funding to improve their energy productivity.

11.3.3 Improving the effectiveness, coordination and application of government policies and programs

Addressing the many barriers to improved energy productivity in different sectors of the economy has led to an array of policies and programs that have grown incrementally over time. In addition, most energy programs have mandated boundaries or separate drivers. This can limit their ability to integrate and optimise effort among government programs and private sector initiatives, particularly in changing circumstances.

With the implementation of carbon pricing and the government's commitment to reduce the regulatory burden on business, a more coordinated and integrated approach is needed. At its 13 April 2012 meeting, COAG recognised the need to prioritise the completion of a review of carbon reduction and energy efficiency schemes and tasked a cross-jurisdictional taskforce to advise it on how to rationalise policies and programs that are not complementary to the carbon price, or are ineffective, inefficient or impose duplicative reporting requirements on business. This review has begun in consultation with COAG's Select Council on Climate Change and is due to report by February 2013.

11.3.4 Improving coordination through a more strategic approach

There would be benefits in adopting a more strategic and systematic approach to improving energy productivity in key sectors of the Australian economy. This would involve better coordination of business-related energy-efficiency and innovation programs and the development of sector-specific strategies, where appropriate, to focus government and industry effort.

The National Strategy on Energy Efficiency (NSEE) provides a mechanism for coordination across jurisdictions on the approaches and strategies needed to improve energy productivity. A review of the NSEE is currently exploring how jurisdictions can collaborate most effectively to streamline energy-efficiency programs and policies and reduce the duplication of programs and reporting requirements among jurisdictions.

The review is also a timely opportunity to focus the NSEE on strategic outcomes required in key areas of the Australian economy (households, industry, buildings and transport) to improve energy productivity. The NSEE could define the energy productivity outcomes sought in those areas. This would involve the development of energy productivity strategies to achieve short-, medium- and long-term objectives. The focus would be on improving the coordination of policies and programs to reduce barriers to greater end-use efficiency (including by defining the optimal mix of information, incentives, regulation and other measures) and on the removal of duplication and unnecessary compliance burden.

11.4 Measuring policy success

Policy success in improving energy productivity will result in energy management becoming a more established business practice, as well as a more important financial and social consideration for consumers. Policy success could be observed through:

- sustained reductions in sectoral energy intensities and related greenhouse gas emissions
- lower rates of growth in energy demand, particularly peak electricity demand
- greater ability of households and businesses to manage their energy use and energy bills, including through a wider range of energy-efficiency products and services and enhanced access to high-quality and timely energy-use information and analysis
- growing market adoption of more cost-reflective pricing structures and contractual arrangements and an accelerating deployment of enabling technologies, such as smart meters
- a higher level of demand-side participation in energy markets and a higher ratio of demand- to supply-side investments, improved capacity utilisation rates and lower relative costs of energy supply capacity
- a deeper and more competitive energy services sector offering a broader range of energy management and service options, including:
  - a larger number of active energy services companies
  - increasing deployment of commercial and residential energy management systems, including metering and control systems and analytical tools
  - greater capacity on the part of energy services businesses to identify commercial opportunities by using timely and accessible network planning information
- a more energy-efficient transport fleet and building stock
- a streamlined and coordinated set of complementary government policies and programs that support more effective market participation, address non-price barriers and improve energy productivity for consumers while minimising associated costs or compliance burdens.

Energy productivity policy actions

The Australian Government will:

- improve energy productivity in the national electricity market by working with jurisdictions, market institutions and stakeholders to develop an effective demand-side framework, taking into account recommendations from the Australian Energy Market Commission's Power of Choice review, including on
  - network and retail market pricing
  - network regulatory incentives
  - consumers' access to and control over their energy data
  - market access
  - the timely and efficient deployment and use of enabling technologies
  - further actions that may be necessary to address non-market failures in the electricity system and to effectively support informed decision-making by consumers
- unlock broader gains in end-use energy productivity by
  - working with industry to develop energy productivity roadmaps in key sectors to drive productivity improvements and business innovation
  - developing options for a possible national energy savings initiative
- improve the effectiveness, coordination and application of government policies and programs, particularly by eliminating unnecessary effort and improving coordination, including by
  - working through COAG to review and streamline emissions reduction and energy-efficiency schemes that are not complementary to the carbon price, are ineffective or inefficient, or impose duplicative reporting requirements on business
  - considering further opportunities within the government to develop a more coordinated approach to the delivery of its own industrial energy-efficiency and related innovation programs and to streamline energy and greenhouse reporting measures.

PART III

Supporting energy policy outcomes

12 Sustainability, workforce and Indigenous opportunities

Highlights

- The sustainable and safe production, supply and consumption of energy is a core social, business and policy imperative. The Australian Government, as well as the states and territories, applies a comprehensive system of regulation to ensure that those goals are achieved.
- Better cooperation between different levels of government is required to ensure that environmental regulation is both effective and efficiently applied. Areas in need of further attention are:
  - effectively interfacing energy and environmental policy frameworks to promote efficient investment decisions
  - improving the effectiveness of project approvals and planning, particularly by removing duplication at all three levels of Australian government
  - ensuring that the concerns of communities about energy developments that affect them are addressed through effective engagement and rigorous and transparent regulatory approval processes.
- The growth and transformation of Australia's energy industries will create jobs across a broad range of industries. Current high demand for skilled workers in the energy sector demonstrates that there are many employment opportunities in a range of skills and locations.
- Government and industry are working to meet future energy industry skills needs through a combination of education and training, improving workforce participation and mobility, and skilled migration.
- The energy and resources sectors play a significant role in creating long-lasting opportunities for Australia's regional areas by creating jobs, building infrastructure and providing income for local communities. This is particularly important in remote areas.
- As part of its Closing the Gap agenda, the Australian Government is working with Indigenous communities, the energy and resources industries, and state and territory governments to improve Indigenous outcomes through education and training as well as access to energy.

An ongoing challenge for government, business and the community is to ensure that Australia's environmental and cultural heritage is preserved while also ensuring our continued ability to meet future energy needs.

Our continued economic success, coupled with an ageing workforce, is adding to skills and labour pressures across the economy. The energy sector will require a diverse range of professional and trade-related skills in all parts of the energy supply and end-use chain.

Energy-related developments provide enormous economic and social support to regional communities in Australia. This contribution also provides for new opportunities for Australia's Indigenous communities.

12.1 Overview

The growing interrelationships between the energy sector and other sectors of the Australian economy are reflected in interlocking government policies.

This chapter examines three cross-cutting policy areas that are particularly important for future energy policy and the nation's continued economic and social development:

- sustainability and energy
- skills and workforce development
- opportunities for Australia's Indigenous communities.

12.2 Sustainability and energy

Sustainability requires the integration of society's environmental, economic and social aspirations with the production and consumption of goods and services. The design and implementation of government policies and regulation also plays a key role in this integration.

The evolution in social, business and government thinking on sustainability and environmental management in the past 50 years has been significant. Policy has moved towards transparent and integrated approaches based on scientific evidence and risk management (often drawing on the efficiency of market-based approaches), rather than regulation. Australian consumers are also more environmentally conscious, requiring high environmental and sustainability standards. Corporate social responsibility and environmental management objectives are now integral to modern business planning and practices. There is also a much deeper scientific understanding of ecological systems and impacts and how they might be most effectively managed.

The Australian Government has in place a comprehensive set of environmental regulatory and policy frameworks covering such areas as climate change, water, air quality, waste management, biodiversity protection and conservation, coastal and marine management, and landscape and heritage protection. All intersect in some way with energy policy and energy development.

The governance and legislative mechanisms with the greatest influence on energy-related development and policy implementation include:

- the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- the 2004 National Water Initiative and the *Water Act 2007*
- marine bioregional planning, including the newly proposed Commonwealth Marine Reserves Network
- the National Environment Protection Measure on Ambient Air Quality and the *Fuel Quality Standards Act 2000*
- the Clean Energy legislative package.

In addition, the Australian Government's sustainable population strategy, *Sustainable Australia—Sustainable Communities*, outlines ways to help ensure that future population change sustainably supports the economic, environmental and social wellbeing of the nation (DSEWPaC 2011a). The strategy's focus is on putting in place the policy settings and governance arrangements needed to maintain and improve wellbeing at the local, regional and national levels by encouraging more effective anticipation of, planning for and responses to the impacts of population changes on our economy, communities and environment.

State and territory governments also maintain environmental and sustainable development regimes that apply to energy and resource development in their jurisdictions. Inconsistency or duplication in regulation at different levels of government is not always successfully avoided. Work currently underway with the Council of Australian Governments (COAG) is aimed at

minimising duplication, inconsistency and delays to reduce the regulatory burden and provide greater certainty for business.

Most of the sustainable development issues associated with the production and use of energy in Australia will be managed effectively within current frameworks and measures. However, there are three areas that need further work:

- integrating energy and environmental policies to deliver efficient investment decisions
- improving the effectiveness and efficiency of project approvals and resource development planning
- effectively managing resource use and co-development pressures, including community development and acceptance.

12.2.1 Promoting integrated energy and water policy

Overall, the electricity and gas sector currently accounts for approximately 2% of total water consumption in Australia (ABS 2012d). Around 65% of the generating capacity in the current National Electricity Market depends on fresh water for hydro-electricity generation or for cooling in coal- or gas-fired thermal generation (Smart & Aspinall 2009).

Reductions in the availability of Australia's hydro-electric capacity during the 2002–2010 drought 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, the availability of cooling water reserves for thermal generators became a material risk in some regions and a drought simulation by the then National Electricity Market Management Company for the National Water Commission raised some concerns about short-term power supply (Smart & Aspinall 2009). This may become more important if regions in Australia begin to experience sustained reductions in water availability due to the impacts of a changing climate.

Water may also affect energy generation decisions in other ways. For example, uncertainty about future water access may affect project financing by heightening perceptions of risk. Some emerging electricity generation technologies may involve a higher intensity of water use than conventional technologies, 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 range of technical options for securing its water requirements or reducing water use. However, most are more applicable to new plants than to existing operations because of the high cost of retrofitting. However, some coal-fired power stations have reduced their water use per megawatt hour generated by up to 15% (Smart & Aspinall 2009).

In the future, there is likely to be a greater need to allow generators and other water users in the energy sector to manage risks and minimise costs flexibly. Giving generators the option to purchase tradeable water rights in open markets can increase flexibility in using water for the production of energy in response to changing water availability. Appropriate pricing will also ensure better location and technology choices for new investments.

The National Water Commission has recommended that, where extraction and consumption of water occurs as an input to electricity or gas generation, governments should seek to ensure that water licensing arrangements, including those relating to pricing and access, are made as consistent as possible with the National Water Initiative. The trading of water entitlements should not be expressly excluded (NWC 2009). In its 2011 biennial assessment of progress under the initiative, the commission recommended that these arrangements also apply to water associated with mining and petroleum activities, including groundwater brought to the surface during coal-seam gas extraction (NWC 2011). Under the terms of the National Water Initiative, all users should pay a price for water that reflects the full costs of supply and management and have equitable access to trading opportunities in water markets.

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 work with agencies such as Geoscience Australia to promote better understanding of the interaction between water resources and the energy sector, including through linked mapping of energy and water resources.

12.2.2 Improving the effectiveness and efficiency of regulation and planning

Environmental regulation and planning are essential but can be streamlined and better coordinated to minimise business costs. Poor-quality, delayed or inconsistent decision-making hinders investment, imposes unnecessary costs or produces suboptimal environmental results. In Australia, our federal system presents particular challenges of administrative duplication and inefficiency.

The Environment Protection and Biodiversity Conservation Act

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 three years to 2011.

In 2011, the Australian Government announced significant reforms to the administration of the EPBC Act (DSEWPaC 2011b), including:

- a shift from individual project approvals to strategic assessments, including new regional environmental plans
- streamlined assessments and approvals
- better identification of national environmental assets
- cooperative national standards and guidelines to harmonise approaches between jurisdictions and foster cooperation among all stakeholders.

The reforms include a package of measures designed to conserve protected matters of national environmental significance in a streamlined way.

One focus of the reforms is on greater use of existing strategic approaches to environmental management. Under the EPBC Act, strategic assessments are landscape scale assessments and unlike project-by-project assessments, which look at individual actions, they can consider a much broader set of actions. They enable the Environment Minister to approve classes of actions that can proceed without further assessment, avoiding the need for individual referrals and assessments of projects. The reforms will also allow regional environment plans to be developed in partnership with states and territories outside of Commonwealth areas of responsibility, and in consultation with local government, natural resource management bodies, industry and the community. Similarly to strategic assessments, they will allow landscape-scale assessment and planning and provide for the approval of certain classes of actions, as long as those actions are carried out appropriately, removing the need for the referral of individual projects.

The reforms also include a commitment to developing a more clearly defined offsets policy framework to provide more certainty to business about how these conditions are applied.

These reforms will deliver better environmental protection and more timely environmental assessments, remove duplication between national and state and territory environmental regulation, cut red tape, and provide greater transparency and a nationally consistent approach.

Reducing regulatory burdens

On 13 April 2012, recognising the impact of duplication and double handling, COAG agreed to fast-track Australian Government accreditation of state and territory environmental assessment and approval processes for matters of national environmental significance, supported by specific national environmental standards.

In its decision, COAG reaffirmed the commitment of all governments to high environmental standards. COAG agreed:

- to fast-track the development of bilateral arrangements for accreditation by the Australian Government of state and territory assessment and approval processes (frameworks are to be agreed by December 2012 and agreements finalised by March 2013)
- to develop environmental risk and outcomes based standards (to support the bilateral agreements) with the states and territories by December 2012
- that the Australian Government will work with the states and territories, bilaterally or collectively, to improve the process for approvals in areas where the Commonwealth retains its existing final approval responsibilities, for consideration by COAG at its next meeting
- to examine and facilitate the removal of unnecessary duplication and reduce business costs for significant projects.

Work to implement these COAG reforms is well underway. The Commonwealth held initial discussions with the states and territories in May and June 2012, and stakeholder consultations with industry and non-government groups began in July 2012. Consistent with COAG's decision to maintain high environmental standards, the bilateral agreements with the states and territories must be consistent with the EPBC Act.

As part of its response to the Hawke review of the EPBC Act, the government agreed to consider opportunities to streamline the legislative arrangements under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the EPBC Act as they relate to offshore petroleum activities. Discussions are ongoing between the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA—the independent national regulator responsible for health and safety, well integrity and environmental management of offshore petroleum activities since 1 January 2012), the Department of Resources, Energy and Tourism, and the Department of Sustainability, Environment, Water, Population and Communities to implement this reform. The Department of Resources, Energy and Tourism is also conducting a review of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 to ensure that the regulations are an up-to-date basis for regulation by NOPSEMA.

Integrating a changing climate into energy planning

The Australian Government has put in place a comprehensive range of measures to reduce carbon pollution through its Clean Energy Future Plan (discussed in detail in Chapter 6: *Clean energy*). It is also important to plan for unavoidable climate change impacts, as Australia's energy sector is vulnerable to projected changes in the frequency and intensity of extreme weather and other events, such as intense precipitation, storms, bushfires, heatwaves and floods, as well as to incremental changes in climate, such as rising temperatures and sea levels. In particular, critical infrastructure must be resilient to manage the long-term impacts and risks.

Fundamentally, this is a risk management issue for industry itself to consider. However, to support better business planning the Australian Government is supporting research to improve our understanding of potential climate impacts, including at the regional and subregional levels. The government will work with industry to ensure that critical infrastructure is protected from climate impacts. Critical infrastructure protection issues are discussed in Chapter 4: *Energy security*.

Better project assessment in transport infrastructure planning

The government has also made assessments of transport infrastructure projects much more transparent and rigorous. For example, there is now a greater emphasis on the conduct and publication of cost–benefit analyses. Because those analyses account for savings in fuel and vehicle emissions, this approach identifies the most energy-efficient projects.

12.2.3 Effectively managing multiple resource use

Developing unfamiliar energy resources and technologies may generate concerns about potential environmental impacts, human health and safety, and visual or social amenity. Such concerns are usually heightened when proposed developments are perceived to be in conflict with other established land or resource uses. In recent times, coal-seam gas projects, new or expanded coal mines and large-scale wind farms have caused disquiet among some members of local communities.

Projects and technologies must earn a 'social licence' to operate, as failure to do so can generate community resistance, deterring investors and increasing project costs. The task of establishing social acceptance lies mainly with project proponents and technology developers and users, rather than government, and must occur at the local and broader societal levels.

Projects such as coal-seam gas or wind farm developments require a high degree of community engagement to ensure that environmental, economic and social changes associated with them are supported. By understanding the benefits of the project or the sector more generally and by having a better understanding of the science and risks associated with the project, local communities are better placed to see tangible benefits from the development (see Chapter 5: *Energy resources*). While a social licence does not guarantee dispute-free development, it assists by transparently addressing environmental and community impacts and concerns.

The vast majority of businesses in the Australian energy sector operate responsibly and with due care to create and maintain 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 when they are the subject of a compliance regime.

However, there is room for improvement. The government will continue to engage with business to improve operational frameworks, information flows and community engagement. It 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 promoting the benefits of developing new energy resources and clean energy technologies by providing efficient and effective regulatory frameworks which ensure that concerns are addressed through robust, transparent decision-making. The Australian Government will continue to work with state and territory governments to better manage co-development pressures and to promote the benefits of innovation and new energy resources and technologies.

Another role of government is to provide geoscientific and geographic data and knowledge to support the management of multiple resource use.

12.3 Skills and workforce development

The growth and diversification of Australia's energy industries are resulting in considerable demand for workers. The transition to a low-emissions economy will further increase the demand for traditional and new skills, adding pressure on the education and training system. Additional skills will be required to support businesses and households that use energy to understand ways to become more efficient, reduce energy costs and take advantage of demand-side opportunities.

There is strong competition in the energy resources sector for skilled workers, and this is expected to continue over the next decade. The sector will need to ensure that it offers competitive and attractive career opportunities.

12.3.1 The energy sector workforce

The energy sector[1] employs 106 000 Australians, or around 1% of the workforce (ABARES 2011b), and in some regions is a very significant local employer. In the next five years, jobs in the sector are expected to grow by 3.9% annually, compared to an annual average of 2.2% for all industries. Employment in coal mining and oil and gas extraction is forecast to grow by 7.7% and 7.3%, respectively, per year (DEEWR 2011). As Australia moves to a cleaner energy system, employment in new clean energy and services businesses is also expected to expand strongly, albeit from a small base.

Energy-related industries are generally characterised by their highly skilled workforces, although they also provide important job opportunities for less skilled workers. Most employees are full-time workers. Female participation, at 19%, is lower than the national average of 45%. In May 2010, 68%–70% of workers in the sector had completed a non-school qualification, compared with 62% for all industries. Around 25%–28% of sector workers had a university degree, while 31%–32% held a Certificate III or IV (ABS 2010).

12.3.2 Needs for the future

The energy industry is a fast-growing sector in which skilled energy workers are increasingly required to adapt to new clean technologies for energy production, transportation and end use and energy efficiency. Australian Workforce and Productivity Agency (formerly Skills Australia) modelling of employment growth in mining operations (excluding oil and gas) from 2012 to 2017 suggests that the sector will need an additional 53 600 workers over that period.

Capability gaps and skills deficiencies exist across industry in areas such as energy literacy, data collection and analysis, and business case development (Allens Consulting 2012). Graduates and postgraduates in a range of technical and energy literacy areas are also required, including in the fields of engineering, chemistry and geophysics and in enabling fields such as computer science and information and communications technology, accounting and business analysis (which plays an important role in investment decisions).

Emerging clean energy technologies such as large-scale solar, carbon capture and storage and geothermal will require general as well as specialised skills. In particular, there is a need for timely growth in specialist engineering and technical skills to ensure that capacity does not become a bottleneck, slowing growth in clean energy power systems and infrastructure. Other clean energy technologies need skilled workers such as chemical engineers 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 for drilling rig operators and crew, welders for pipeline construction and geologists. The design, installation and integration of fit-for-purpose on-site generation systems and distributed energy networks will also require new and specialised skills in the workforce.

The training requirements to overcome skills shortages are significant. For example, a major challenge facing the liquefied natural gas (LNG) export industry is providing on-site training for enough LNG plant operators, about 1400 of whom will be needed for planned projects. Current training levels are around 30 to 35 people per year, but this will need to increase to around 175 people per year to meet the skills shortage (Skills Australia 2011).

1 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.

12.3.3 Actions to promote workforce development

Together with the Australian Workforce and Productivity Agency, industry skills councils, business groups, the vocational education and training sector, and secondary and higher education institutions, the Australian Government is implementing responsive training and workforce planning strategies to boost labour supply through education and training, promoting participation, workforce mobility and skilled migration.

Education and training

The Australian Government is committed to delivering education and training opportunities to improve access to required personnel across our economy. The government's commitment includes:

- the Building Australia's Future Workforce package, which includes the National Workforce Development Fund, to reform apprenticeships and the vocational education and training sector[2]
- the Skills Connect initiative to allow industry to come to government with whole-of-workforce proposals that promote effective training outcomes, such as the National Resources Sector Workforce Strategy (see Box 12.1)
- the Clean Energy Skills Program 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.

In addition, reforms to higher education funding arrangements will provide 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, energy resources and energy-using sectors. For example, the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) 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.[3]

The resources sector and the government have developed the National Resources Sector Workforce Strategy (see Box 12.1). To support the employment of Australian workers, the government has also established the Resources Sector Jobs Board—a dedicated website that allows users to search for employment in the resources sector and provides potential employers with job seeker profiles.[4]

The resources industry has also developed websites to promote career pathways and jobs: the Australian Mines and Metals Association has launched an online career centre for the industry;[5] the Australian Petroleum Production and Exploration Association supports the Resources Channel,[6] a commercial jobs site that also offers career information; and the People for the Future website operates as a national resources sector careers portal.[7]

2 Further information on the Building Australia's Future Workforce package is available from www.deewr.gov.au/Skills/Programs/SkillTraining/nwdf/Pages/BuildAustFutureWork.aspx.

3 Further information on the CO2CRC is available at www.co2crc.com.au.

4 www.jobsearch.gov.au/resourcesectorjobs.

5 www.miningoilandgasjobs.com.

6 www.theresourcechannel.com.au.

7 www.peopleforthefuture.com.au.

Box 12.1: The National Resources Sector Workforce Strategy

The National Resources Sector Workforce Strategy was announced by the government on 15 March 2011. It is an integrated workforce development plan designed to help the minerals and energy resources sector meet future workforce needs. The strategy identifies 31 actions by industry and government to address seven key areas, from workforce planning to affordable housing and community infrastructure.

Each action is being led by an industry or government organisation, with strong support from industry associations, unions, employers, employment service providers, and education and training organisations. The Australian Workforce and Productivity Agency (formerly Skills Australia) reports annually to government to update skills and labour demand forecasts.

More information on the National Resources Sector Workforce Strategy can be found at www.deewr.gov.au/resourcesworkforce.

The implementation of the National Resources Sector Workforce Strategy has resulted in significant progress on 15 recommendations, and work on the remaining 16 recommendations is underway. Recognising the continuing growth in demand for skilled labour as a result of expanding resources sector investment, the Australian Government will review the strategy and consider what further opportunities could be created, with an emphasis on promoting benefits nationally for Australia's energy and resources sectors.

The National Resources Sector Workforce Strategy indicates potential for whole-of-project workforce planning. Opportunities also exist for industry, government, unions and communities to promote project-based outcomes. As well as demonstrating to project investors the capacity to supply labour to a project, such collaboration can also provide a means for government to effectively deliver fit-for-purpose skilling outcomes through the integration of existing programs.

Promoting participation

Increasing the participation of people who are not currently in the labour market is important in addressing workforce shortages. Given Australia's ageing workforce, an increasing number of highly skilled and experienced workers will be seeking to reduce their work commitments, which will add to skills pressures. Consequently, there may be scope to increase the engagement of older workers.

In addition to improved incentives in the tax and transfer system, government support for increasing the participation of disadvantaged people is available through measures in the Building Australia's Future Workforce package.

Workforce mobility

Strong demand in the energy resources sector over the medium term will provide employment opportunities for workers from other sectors of the economy.

The Australian Government is facilitating labour mobility in the energy and energy resources sectors by supporting regionally based fly-in, fly-out coordinators, enhancing skilled migration arrangements and ensuring that qualifications and licensing standards are recognised. A number of mechanisms have been set up to further support the Australian Qualifications Framework in recent years and to promote national qualification recognition, underpinned by the framework. In addition, COAG has agreed to the development of a national licensing system for specified occupations, which will remove inconsistencies between states and territories.

Skilled migration

Australia's skilled migration framework contributes to the supply of labour through employer-sponsored permanent and temporary migration programs, as well as the general migration of skilled workers, not sponsored by an employer, who have qualifications, skills or experience in demand in Australia, including in regional areas.

One of the 31 initiatives identified in the National Resources Sector Workforce Strategy was to introduce enterprise migration agreements (EMAs), which are designed to address skills shortages on large-scale projects. EMAs provide a custom-designed, project-wide migration arrangement for major resources projects with capital expenditure of more than $2 billion and a peak workforce of more than 1500 workers, and which are conducted by Australian legal entities. EMAs are intended to ensure that peak workforce needs are met when demand cannot be filled from the Australian labour market, easing capacity constraints and ensuring that economic and employment benefits can be realised. The EMA guidelines provide detailed information on how to prepare an EMA submission and how to meet the training requirements associated with an EMA. Project owners are required to implement training that helps address future skills needs in the resources sector.

12.4 Indigenous opportunities

Much of Australia's large-scale energy resources is in regional and remote Australia, where the sector 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 and employment participation rates fall well below those of other Australians.

To overcome barriers to Indigenous participation, the Australian 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.

COAG recognises that overcoming Indigenous disadvantage will require a sustained commitment from all levels of government to work together and with Indigenous Australians, directing major effort to seven action areas or 'building blocks', of which economic participation is one.

The Indigenous Economic Development Strategy 2011–2018 sets out a long-term agenda for Indigenous economic participation that will guide government decision-making and program development through to 2018.[8]

The contributions that 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 access to energy.

12.4.1 Economic opportunities

Where energy sector development is underway or proposed, opportunities for Indigenous communities can be provided through land-use conditions set out in agreements under the native title or lands rights regimes. Of the 527 agreements on the Register of Indigenous Land Use Agreements, around one-third cover energy and resource sector activity. The benefits include royalty or native title payments, income for Indigenous business enterprises, wages income, training and education, and cultural heritage protection.

One of the government's main policy objectives in this area is to encourage the making of agreements that are sustainable, workable and provide long-term benefits to Indigenous Australians.

8 www.indigenous.gov.au/economic-participation/policy-programs/ieds.

Through their reconciliation action plans, companies in the resources sector (including energy resources) have delivered more than $800 million in supply contracts for Indigenous businesses (Australian Government 2011c). The banking sector has also developed initiatives to support Indigenous enterprise establishment.

In the private sector, more than 200 reconciliation action plans are supporting training, employment and other actions benefiting Indigenous Australians. Through the plans, organisations have committed to recruiting more than 8300 Indigenous Australians and have already placed an estimated 5300 (Australian Government 2011c).

In addition to energy resources projects, Australian Government initiatives under the Clean Energy Plan may create new opportunities for Indigenous business and employment through carbon farming, solar, geothermal and bioenergy projects, and related services and infrastructure.

Indigenous businesses are demonstrating their commercial sustainability. For example, Indigenous Business Australia has found that, among its clients, 65% of Indigenous businesses are still operating after five years, compared to only 50% of all small businesses (Fry 2011).

A number of Indigenous enterprise development organisations have been established in recent years. Nationally, Aboriginal Enterprises in Mining, Exploration and Energy Limited seeks to commercially advance Aboriginal-owned enterprises in Australia and internationally. Regional Indigenous organisations, such as the Pilbara Aboriginal Contractors Association and the Bowen Basin Indigenous Mining Contractors, have been created.

Indigenous economic opportunities are also being enhanced by energy sector companies' workplace diversity policies and corporate policies to promote Indigenous enterprise. The annual reports of ASX-listed companies operating in the energy sector indicate that many companies have strategies for Indigenous employment and enterprise development, and workplace cultural programs to support the retention of Indigenous employees.

12.4.2 Employment, skills and training

Energy projects and the business opportunities they create are offering important opportunities for jobs and training. Indigenous employment in the energy sector is broadly supported by existing employment measures, such as the Indigenous Employment Program. As a result of the program, more than 16 000 Indigenous Australians started employment during 2010, another 12 500 started training and more than 700 projects were established.

Industry initiatives, such as scholarship programs, offered by the Australian Petroleum Production and Exploration Association, support Indigenous education in sector-related engineering disciplines and mentoring by Indigenous graduates of other Indigenous Australians.

The Australian Employment Covenant is also a national industry-led initiative. It brings all Australians together to help close the gap between Indigenous and non-Indigenous Australians in employment and employment opportunities. The mining and energy industries have committed to providing many of the 50 000 Australian Employment Covenant job opportunities on offer for suitably qualified Indigenous Australians.

In May 2009, the Australian Government and the Minerals Council of Australia agreed to the new Memorandum of Understanding on Indigenous Employment and Enterprise Development, which is an important conduit for collaboration between Australian Government departments and the Minerals Council.

The memorandum of understanding provides for high-level strategic engagement and collaboration with the mining industry. It aims to foster links between employers and government programs to more effectively address barriers experienced by Indigenous Australians in accessing employment and business development opportunities through the resources sector and related industries. This work is supported by a coordinator network in the East Kimberley, Pilbara, south-west Western Australia, Wiluna, Alice Springs and western Cape York.

12.4.3 Access to energy

Achieving many of the objectives under the Closing the Gap agenda will depend on Indigenous households and communities having reliable, safe and efficient energy.

Some larger Indigenous communities that are connected to the power grid operate under the same service delivery arrangements as non-Indigenous communities. However, some experience interruptions to supply, particularly as a result of increasing population, which is also a common problem in some non-Indigenous regional towns.

In non-grid-connected communities such as remote townships, outstations and homelands, energy is often provided through diesel generators, solar arrays, wind generators or combinations of technology. Energy infrastructure is usually funded through both state and territory and Australian Government programs, and service provision can be by major service providers, resource agencies, shire councils, community councils and self-managed community services. Under these arrangements, power services are generally less reliable and infrastructure is not adequately maintained.

The Australian Government's Remote Indigenous Energy Program began service delivery 1 July 2012, and the first systems will be on the ground by 30 June 2013. The program builds on the previous work of the Bushlight program delivered by the Centre for Appropriate Technology (see Box 12.2).

Box 12.2: Improving energy supply for Indigenous communities

The Centre for Appropriate Technology is a non-profit organisation that provides technical advice and services to Indigenous communities throughout regional and remote Australia.

The centre has been working with Indigenous communities for over 30 years and has worked with more than 260 communities in remote central and northern Australia to improve their energy services. One of the strategies to assist communities is the community energy planning model, which sets out a step-by-step energy process. The model can easily be replicated, which provides a consistent approach across each community.

The Bushlight program delivered:

- reliable and sustainable energy supplies through the design, installation and maintenance of renewable energy systems
- training and energy-efficiency education
- support for local enterprise and activity development.

Bushlight installed over 140 renewable energy systems in more than 120 communities. In recent years, the program also developed many large community systems using either stand-alone solar or solar–diesel hybrid technology.

Building on Bushlight, the Australian Government is providing funding of $40 million over five years for the Remote Indigenous Energy Program to install renewable energy systems in up to 50 smaller remote Indigenous communities in Queensland, South Australia, Western Australia and the Northern Territory. The program will also deliver energy-efficiency education, training in basic system maintenance and repairs and maintenance to existing systems.

Sustainability, workforce and Indigenous opportunities policy 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 by:

- implementing announced reforms to the EPBC Act and other 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
- reducing duplication and double handling of environment assessments and approvals processes, while maintaining high environmental standards.

Recognising the importance of effective coordinated action to address skills and workforce development proactively, the government will:

- continue to work with the energy sector and the skills, training and education sectors to implement current workplace development and participation measures, including actions under the National Resources Sector Workforce Strategy
- continue to review the National Resources Sector Workforce Strategy, in order to identify opportunities and undertake further action to ensure sufficient skilled labour is available to meet the continued growth of the resources sector
- consult with industry, government, unions and communities on future opportunities to promote project-based outcomes.

Recognising the contribution that the energy sector can make to support 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 and initiatives arising from the Memorandum of Understanding on Indigenous Employment and Enterprise Development with the Minerals Council of Australia
- encourage jurisdictions to periodically report through the SCER 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 provide impetus for lasting change
- encourage and work in partnership with energy sector companies to develop reconciliation action plans or to consider Indigenous opportunities in their business development plans, corporate policies and programs for workplace diversity and local enterprise development.

13 International energy engagement

Highlights

- International engagement continues to play a vital role in achieving Australia's energy objectives, including by promoting trade and investment in Australian energy resources and increasing our understanding of global energy patterns, directions and technologies.
- Australia will continue to engage actively in international forums to advance our energy objectives, shape global energy frameworks, and work collaboratively to pursue common energy goals.

The importance of Australia's international engagement is heightened by global energy diversification, shifting energy demand–supply patterns, international adoption of clean energy policies, and the need to attract foreign investment.

Our international energy interests go beyond trade to include the shaping of international energy policy; multilateral and regional cooperation; the pursuit of common energy goals, such as energy security and stable, robust and resilient markets; and the development and deployment of clean energy technology.

This chapter describes the main ways that the Australian Government engages internationally on energy issues and the policy objectives it seeks to achieve.

13.1 Overview

Effective international engagement occurs through a wide variety of mechanisms at different levels, involving governments, research agencies, businesses and non-government organisations.

Governments play a number of roles in engagement: on some issues, they lead; on others, they facilitate, coordinate and support.

The Australian Government optimises the benefits of international exchanges by using a focused but flexible strategy that supports our domestic energy objectives and principles, while remaining attentive and responsive to emerging challenges and international circumstances. International engagement effort will be prioritised based on where Australia can most efficiently and effectively meet national interest objectives.

13.2 Objectives

Australia's international engagement has three broad objectives:

- To promote energy trade and investment, including by:
  - building and maintaining strong trade partnerships and developing new export trade opportunities
  - promoting the development of robust supply chains for exports and imports
  - attracting investment in energy resources, technologies and systems.
- To enhance understanding of energy policies, programs and directions and accelerate energy innovation, including by:
  - 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.
- To shape international policy and processes, including by:
  - promoting open, transparent and competitive global energy markets and investment frameworks
  - using established forums and institutions to collaborate and pursue common energy goals
  - contributing to global and regional energy security and response frameworks.

13.3 The need for continued international engagement

Australia has capitalised on its resource endowments over the past decade, and energy exports are now a key driver of the Australian economy. Building effective trade relationships has also provided Australia with the opportunity to influence global energy policy discussions on energy and resource issues, including on important energy policy developments.

Our ability to influence international developments will underpin our continued success, particularly where they are likely to have long and lasting impacts on our own energy policy. International engagement also allows us to benefit from international experiences in the development of important clean energy technologies.

The ultimate goal of Australia's international engagement effort is to shape international energy policy on strategic energy topics and relationships. For example, participating in multilateral energy forums gives Australia the opportunity to engage with energy ministers and governments from many countries to influence outcomes and build cooperative renewable energy policies and programs.

13.4 Mechanisms

The Australian Government pursues its objectives through multilateral engagement, regional engagement, bilateral relationships, and a strong in-country and agency presence. Table 13.1 lists the government's main international energy engagements.

Table 13.1: Australian international energy engagement

	Forums	Contributions to objectives
Multilateral	International Energy Agency Clean Energy Ministerial International Energy Forum G-20 International Renewable Energy Agency United Nations Framework Convention on Climate Change	Improves understanding of global energy trends, markets and policies Promotes open, transparent and competitive global energy markets Helps to build global and regional energy security response frameworks Harnesses convening power to pursue common energy goals Improves responses to disruptions to global oil supply. Builds international architecture to encourage reductions in global greenhouse gas emissions, including from the energy sector.
Regional	Asia–Pacific Economic Cooperation East Asia Summit Renewable Energy and Energy Efficiency Partnership Pacific Islands Forum and Pacific Energy Ministers Meeting	Improves understanding of regional energy needs, objectives and policies Promotes regional energy security Promotes open, transparent and competitive regional energy markets Promotes stable and robust energy supply chains.
Energy cooperation	Global Carbon Capture and Storage Institute Carbon Sequestration Leadership Forum International Energy Agency Implementing Agreements International Partnership on Energy Efficiency Cooperation International Partnership for Geothermal Technology Extractive Industries Transparency Initiative	Builds knowledge, expertise and capacity Enhances and accelerates technology research and development through collaboration Accelerates development of clean energy technologies, systems and practices.

	Forums	Contributions to objectives
Bilateral strategic partners	Key trading partners (Japan, China, East Timor, India, Republic of Korea, Taiwan) Regional energy partners (Singapore, Indonesia, Malaysia, Papua New Guinea) Strategic energy partners (United States, European Union, United Arab Emirates)	Builds and maintains strong trade partnerships Develops new export trade opportunities Attracts investment and trade in domestic energy resources, technologies and systems.
In-country representation	The Australian Government makes extensive use of Department of Foreign Affairs (DFAT) and Austrade global networks to strengthen energy and resource relationships. In addition, the Department of Resources, Energy and Tourism has a dedicated Australian-based staff member and locally engaged staff in the Australian High Commission in India, locally engaged staff in the Australian Embassy in China, an Australian-based Counsellor in Japan (shared with DFAT), and a representative in the International Energy Agency.	Strengthens relationships with key energy partners by facilitating greater understanding and exchange between government and industry energy experts, researchers and market participants.

13.4.1 Multilateral engagement

Key multilateral energy-related engagements for Australia include 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 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 the implications for energy markets, policy and programs.

Australia also engages in a range of specific partnerships and initiatives between governments, institutions, researchers and the private sector. This work focuses on particular energy objectives such as accelerating the development and commercialisation of new energy fuel technologies, speeding the adoption of new energy practices and systems (such as energy efficiency and smart grids) and collaborating in research, data and information-sharing.

13.4.2 Regional engagement

Over the coming decades, regional energy demand will grow and diversify, and domestic and regional energy markets will converge. As a supplier of coal, liquefied natural gas and uranium, Australia is well positioned to meet our neighbours' demand for energy resources and energy security. As a net importer of liquid fuels, we also rely on a stable, efficient liquid fuel supply through regional hubs.

We can deepen energy cooperation and regional dialogue through the Asia–Pacific Economic Cooperation forum, the East Asia Summit and the Pacific Island Forum to focus on region-specific energy priorities, needs, opportunities and frameworks.

Energy sustainability is an important issue throughout the Asia–Pacific region, mainly for reasons of energy security and social development, but also to aid the global response to climate change. Australia will continue its work with aid partners in the region to improve energy policy and planning, and specifically to promote the adoption of clean energy.

13.4.3 Bilateral engagement

Bilateral engagement is important for building and strengthening our relationships with our major energy trading partners, and for achieving mutual trade and technology development objectives.

These exchanges occur through a range of mechanisms, such as high-level groups, joint working groups, memorandums of understanding and commercial arrangements.

Our key bilateral engagements are with major current and emerging energy trading partners (Japan, China, Korea, Taiwan and increasingly India); countries with strategic roles in global energy frameworks or technology development, such as the United States, European Union members, G-20 members and some Middle East countries; and countries that are important regional energy partners in the Asia–Pacific region.

13.4.4 In-country and international agency activity

Postings of Australian energy experts in other countries and work through Austrade facilitate exchanges of information and build awareness of new and emerging opportunities. They are also important for promoting Australia's quality energy resources, our stable export markets and opportunities for investment in Australia.

Strengthening Australian government and industry participation in international energy agencies and institutions also increases our capacity to contribute to or influence their policies and work programs.

13.5 Challenges and actions

As global energy demand patterns shift, the Australian Government will continue to review the nation's international engagement to ensure that it remains appropriate and relevant. This may include a deeper in-country engagement in new and emerging markets and with strategic energy partners and energy agencies.

The Australian Government cannot engage in every international energy forum or partnership. Our international effort will be prioritised against other government objectives to ensure value for money. Decisions to participate in specific forums will be rigorously evaluated against the likely contribution of participation to achieving the objectives outlined in Section 13.2. Decisions will also take into account the appropriate roles for government and business or other interests.

The government will review Australia's overall energy engagement strategy to ensure relevance and effectiveness as part of regular energy policy reviews.

International energy engagement policy actions

The Australian Government will maintain close engagement with key markets, institutions and strategic partners to advance Australia's energy objectives, and will regularly review its international energy engagement as part of the four-yearly strategic reviews of national energy policy.

14 Energy information

Highlights

- Maintaining comprehensive, high-quality, timely and accessible sets of energy information is important to:
  - promote public understanding of Australia's energy systems and technologies
  - assist regulatory, policy and market development
  - empower informed decision-making by government, business and households
  - meet national and international reporting obligations.
- Many government agencies collect and produce energy information sets, and there is a need to minimise the reporting burden on industry and maximise the efficient use of energy and related data available to government.
- The Australian Government will work collaboratively with other collectors and providers of energy information to:
  - streamline reporting requirements and improve energy information governance through greater agency coordination
  - build a more comprehensive knowledge base while minimising the reporting burden
  - improve the accessibility and usefulness of information to support complex decision-making.

New ways of producing and using energy, evolving and expanding consumer choices, increasingly complex and holistic approaches to policymaking, and more advanced and accessible analytical tools are rapidly altering the nature of energy-related information and the way it is communicated and used. For these reasons, further effort is needed to ensure that Australian Government energy information sets are meeting our needs.

A more integrated approach across governments to meet energy information needs is required. It should ensure the maximum practical alignment with non-government energy information sets and make reporting processes as efficient as possible to minimise the burden on businesses and other information providers.

14.1 Overview

This chapter focuses on government sourcing and provision of energy and related activity or indicator data, analysis and projections. It outlines the institutional capacities and governance arrangements that are required for information collection, sharing, analysis and dissemination.

Timely, comprehensive, independent and high-quality sets of publicly available energy information are vital for informing businesses and consumers about their energy and greenhouse gas mitigation options, including how to manage their energy use, improve productivity and reduce energy costs, as well as for supporting energy research and innovation and accelerating technological innovation.

Sound information is also critical to support the ongoing work of government. In particular, this information is used to assess the effectiveness of current government interventions, including assessing compliance with program or regulatory requirements, and to inform the development of new policies and programs or regulatory frameworks. Robust and comprehensive energy information is also needed to meet our international energy and emissions reporting obligations.

14.2 Energy information activities and key agencies

A wide range of government agencies regularly collect, analyse and publish a range of energy information across the energy system. This information extends from Australia's energy resource base through to energy production, supply and demand balances and the way energy is used (including productivity and efficiency trends). The government also publishes information on key energy technologies and fuels along the supply chain, as well as market information, including prices, economic indicators and consumer information. It also undertakes analysis on energy-related environmental and social impacts and communicates energy standards and regulations.

Key data collection agencies include:

- the Australian Bureau of Statistics
- the Bureau of Resources and Energy Economics (BREE)
- Geoscience Australia
- the National Offshore Petroleum Safety and Environmental Management Authority
- the Bureau of Infrastructure, Transport and Regional Economics
- the CSIRO
- the Clean Energy Regulator
- the Department of Climate Change and Energy Efficiency.

Australia's national energy market bodies—the Australian Energy Regulator, the Australian Energy Market Operator and the Australian Energy Market Commission—and state and territory government agencies and regulators also hold significant energy-related information sets.

14.3 Energy information policy framework

Policy objective

The objective guiding the Australian Government's overall approach to energy information is to develop and maintain comprehensive high-quality, timely and accessible information sets to promote public understanding of Australia's energy systems and technologies, assist regulatory, policy and market development, ensure informed decision-making, and meet national and international reporting obligations.

This will also support the effective management of economic, social and environmental issues associated with energy production, supply and use.

Principles

- Australian Government energy data and information should as far as possible be:
  - accurate, robust, transparent, consistent and relevant to current developments in the Australian energy system
  - aligned across Australian Government agencies to promote efficiency, usefulness and accessibility
  - comprehensive across the energy system and through time
  - made accessible to a broad range of stakeholders, including businesses, researchers, consumers, state and territory agencies, market bodies and international agencies
  - produced and maintained with the minimum reporting burden on industry, government and other providers (thereby promoting productivity)
  - aligned with state and territory agencies, energy market bodies and the energy sectors to promote efficiency and more effective analysis and advice
  - supported by transparent and consistent methodologies, definitions, data quality statements and metadata.
- Australian Government agencies will work together to maximise the sharing of relevant information. Agencies will examine effective ways to meet legitimate cross-agency information needs, consistent with their legislative requirements and any confidentiality obligations that apply.
- New reporting requirements will be established only where there is a demonstrated need and where existing information sets cannot supply suitable information.

14.4 Issues, challenges and actions

Australia's energy data and information challenges include:

- streamlining the reporting effort and improving energy information governance through greater agency coordination
- building a more comprehensive knowledge base while minimising the reporting burden
- making information more accessible, and strengthening research capabilities to support complex decision-making

14.4.1 Streamlining reporting effort and improving energy information governance

In April 2012, following advice from its Business Advisory Forum, the Council of Australian Governments (COAG) agreed to progress six priority areas for major reform that will help strengthen Australia's competitiveness and productivity. As part of this work, COAG agreed to prioritise the completion of a review of unnecessary carbon reduction and energy efficiency schemes. COAG tasked an interjurisdictional taskforce with providing urgent advice on how to fast-track and rationalise policies and programs that are not complementary to a carbon price, are ineffective or inefficient, or impose duplicative reporting requirements on business.

The national assessment of complementary measures will be undertaken by the Complementary Measures Working Group through COAG's Select Council on Climate Change. COAG also asked the taskforce to report on specific ways to remove overlaps in Commonwealth and state and territory reporting obligations, including the expanded use of online business reporting.

The Australian Government is committed to continuing to improve energy information collection, management and reporting and is working with key departments and agencies to examine opportunities to achieve that aim (see Box 14.1), to streamline reporting and to remove duplicative reporting requirements. For example, the government has streamlined the reporting of energy-use data to the National Greenhouse and Energy Reporting Scheme and the Energy Efficiency Opportunities program so that it only needs to be reported once, and has introduced a module in the National Greenhouse and Energy Reporting Scheme online reporting tool to enable companies to report to both the scheme and the Energy Efficiency Opportunities program at the same time.

While there are worthwhile opportunities, there will also be practical limitations on how far existing data collection mandates and processes can be adjusted or streamlined, such as regulatory or legislative requirements, the need to ensure continuity, and the terms on which information is collected.

Box 14.1: Australian Government interagency governance and coordination of energy data and information

The Australian Government is taking a series of steps to improve the management and exchange of Australian Government energy and related information sets and analytical outputs, including by:

- identifying Australian Government and major users' requirements in relation to key energy data, including critical gaps in the knowledge base, and identifying efficient pathways to expedite improvements
- improving coordination and collaboration among Australian Government agencies to develop and enhance energy information sets
- working collaboratively to improve data access and sharing among Australian Government agencies
- promoting best practices in the collection and dissemination of energy statistics, including the application of common standards and definitions
- improving governance arrangements for the management and exchange of Australian Government energy information and for establishing new information sets.

The Australian Government will also engage with other energy information providers, including energy market bodies and state and territory governments, to share information and support agencies' research and analytical capabilities.

14.4.2 Building a more comprehensive knowledge base

To ensure that our energy knowledge base is up to date, comprehensive and accurate, the Australian Government needs to update core information sets regularly, maintain data quality, fill critical gaps, and build connected information sets to support holistic approaches to complex issues.

Updating core information sets

The government is committed to updating core information sets to ensure that there is accurate, independent and relevant public energy information. Recent initiatives include four formal assessments:

- The Australian Energy Resource Assessment, the first of which was released in 2010, is a comprehensive assessment of Australia's energy resources, extraction technologies and projected energy use and production. The government is committed to regular assessments, every three years.
- The Australian Energy Technology Assessment provides cost estimates for electricity generation technologies under Australian conditions and reflects the potential evolution of those technologies. The latest technology assessment, released in July 2012, provides an important set of information to inform policymaking, planning and investment, and to track policy success.
- The Australian Liquid Fuel Technology Assessment, to be published for the first time in 2013, will examine current and prospective fuel technology costs (see Chapter 8: *Energy markets: liquid fuels*).
- The National Energy Security Assessment, released in 2009 and 2011, provides a periodic strategic analysis of issues and trends affecting energy security over a 20-year period (see Chapter 4: *Energy security*). The government is committed to regular two-yearly National Energy Security Assessments.

Complementing these efforts are a number of initiatives recently announced by national energy market bodies to improve the quality of market and consumer information:

- The Australian Energy Market Operator has revised its annual electricity demand forecasts for the National Electricity Market to provide a more accurate picture of demand patterns and drivers.
- The Australian Energy Market Commission has agreed to publish annual reports on energy price movements to improve understanding of price drivers.
- On 1 July 2012, the Australian Energy Regulator published an online tool[1] to help residential and small business energy consumers navigate the often complex electricity and gas retail markets to find suitable energy offers.

Improving quality and addressing gaps

Additional work in a number of areas will improve the coverage and quality of Australia's energy information:

- *The Australian Petroleum Statistics.* The government is developing enhanced methodologies and information systems to report and analyse Australian Petroleum Statistics data and is considering a number of options to improve the dataset.
- *Household energy use.* As part of the Clean Energy Future Plan, $10 million has been allocated to the Australian Bureau of Statistics to gather data on household energy consumption and expenditure.

1 www.energymadeeasy.gov.au.

- *Off-grid energy.* This is one of the fastest growing areas of supply, but comprehensive statistics on generation and use patterns are needed. The government will work with industry and state and territory governments to fill this gap.
- *Industrial energy end-use.* While there are good energy information sets on industrial energy use and energy savings at the corporation and site levels, greater granularity of data on energy end-use (that is, at the technology and process levels) is needed to enable better targeting of energy efficiency opportunities. Work in this area through the Industrial Energy Efficiency Data Analysis project has begun.
- *Energy resources reporting.* Non-ASX-listed companies are not currently required to disclose details of mineral resources or ore reserves. The COAG Standing Council on Energy and Resources (SCER) is considering options to increase formal reporting of this information, such as a voluntary survey, regulation reform, or realignment and increased use of existing mechanisms. In addition, there is a growing need for better reporting of resources data, including volumes and frequencies of gas and water production for new gas resources such as coal-seam gas, tight gas and shale gas. The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments has been established to provide scientific advice and address scientific knowledge gaps on projects that are likely to have significant water-related impacts (see Chapter 5: *Energy resources*).

Building connected information sets to support holistic approaches to complex issues

Governments, businesses and society are adopting more holistic approaches to energy development and use, taking into consideration strategic planning, environmental impacts (such as climate change or ecosystem outcomes), and broader social and economic impacts. Bringing these elements together requires the development of connected information sets that link primary energy data with related activity or indicator data. For example, understanding the impacts of groundwater extraction requires comprehensive sets of geological, hydrological and land-use data to allow basin-wide assessments. Much of this data is collected by government minerals, energy and environmental agencies and is relatively easy to access and align. The SCER uses a number of working groups to address these issues (see Box 14.2). There is a need to extend this work to other relevant COAG ministerial standing councils, most notably the COAG Select Council on Climate Change.

Box 14.2: Interjurisdictional cooperation on energy resource information

The Exploration Investment and Geoscience Working Group, which operates under the COAG Standing Council on Energy and Resources, is an excellent example of cross-jurisdictional collaboration to the benefit of all states and territories and the nation. It consists of the directors of the geological surveys from each jurisdiction and works to ensure the complementarity of programs, avoid duplication and overlap, and develop common standards and national approaches to all aspects of geoscience data and documentation that can be used to attract investment in mineral exploration in Australia

By working towards nationally consistent industry reporting requirements and government data delivery, the Exploration Investment and Geoscience Working Group is creating more efficient processes for the minerals exploration industry, making Australia (and each jurisdiction) a more attractive destination for global exploration investment. The working group also promotes investment opportunities in Australia at major international mining industry trade shows using a united and complementary 'Team Australia' approach

Work on aligning energy-use information sets with industrial sectors' energy-efficiency performance has begun. The Industrial Energy Efficiency Data Analysis project, which is jointly funded by the Australian and state and territory governments, is examining energy use and energy savings in 40 industry subsectors, broken down by fuel type and energy end-use. The aim of this project is to better target cost-effective energy-efficiency activities.

In addition, the Australian Government is working to improve the collection and coordination of firm-level performance and productivity data matched to energy use. This will help to build greater understanding of the relationship between productivity and energy intensity to inform the development of government policy and programs.

Industry also generates large quantities of environmental and performance information (often when preparing environmental impact statements), much of which can be used to build the public knowledge base. While this information is often reported in aggregate or in transformed information sets, the raw data is retained by consultants for whom it has little or no ongoing value.

There is an enormous opportunity for this information to complement government-collected data to form a common baseline and trusted information source for regulators and industry. While the Australian Government does not want to appropriate legitimate commercial information, it is interested in exploring opportunities to access such data and will work closely with industry associations to achieve that aim on a voluntary basis.

14.4.3 Improving access to energy information

The main purpose of government-held data collections, and the analysis of that data, is to inform business, consumer and government decision-making. It is therefore very important that this information is accessible to stakeholders. Recent initiatives to improve access include the following:

- The Bureau of Resources and Energy Economics is developing a data hub to allow data sharing and access by various stakeholders. This platform will help improve analyses required for complex decision-making.
- The bureau's online electricity technology cost worksheet allows users to vary technology cost assumptions.
- CSIRO's interactive electricity technology modelling allows users to vary assumptions to explore different electricity sector outcomes.
- The National Electronic Approvals Tracking System (implemented by the National Offshore Petroleum Titles Administrator in May 2012) provides access to publicly available information about offshore petroleum titles and applications.
- The EnergyRating website provides a tool for comparing the energy performance of all available models of regulated appliance types.
- The Australian Energy Regulator's energy comparison tools are available online.
- The Clean Energy Regulator is establishing memorandums of understanding with various national and state and territory agencies to facilitate confidential access to data collected under the National Greenhouse and Energy Reporting Scheme.

The Australian Government will also pursue opportunities to improve market and consumer information. These include:

- improving gas market transparency (see Chapter 9: *Energy markets: gas*)
- undertaking a scoping study for the development of an energy user information hub to provide consumers with access to their energy-use information currently held by retail and network providers (Chapter 10: *Energy markets: electricity*)
- developing options through the SCER and the Australian Energy Market Commission demand-side participation work programs to enhance the public provision of network performance data (Chapter 10: *Energy markets: electricity*).

Energy information policy actions

To streamline energy metrics and improve governance arrangements, the Australian Government will improve interagency coordination of energy data activities, identify and implement actions to improve the scope and quality of information collected, and minimise burdens on data providers, including by:

- enhancing methodologies and information systems for the Australian Petroleum Statistics data collection
- collecting household energy consumption and expenditure through the Australian Bureau of Statistics as part of the Clean Energy Future Plan
- working with industry and state and territory governments to better understand patterns and growth in off-grid energy use
- developing a better understanding of industrial energy end-use
- working with states and territories through the SCER to consider improvements in energy resources reporting from all companies, including non-ASX-listed companies.

The government will build connected information sets to support holistic approaches to complex issues. It will:

- engage closely with the states and territories through the SCER and other relevant ministerial councils, as well as through standing bilateral arrangements, to improve the reciprocal sharing of energy and related information sets
- engage with the key energy sector business groups to explore how access to and sharing of foundational data can be increased while respecting legitimate commercial or proprietary rights

The Australian Government will continue to improve the accessibility of its energy metrics, including through the Bureau of Resources and Energy Economics' development of a data hub. This work includes ensuring that information is responsive to different stakeholders' needs and capacities for access, and that information is provided in an easily understood and transparent way.

References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) 2010, *Land use in Australia at a glance*, ABARES, Canberra.

——2011a, *Australian energy statistics*, ABARES, Canberra.

——2011b, *Energy in Australia 2011*, ABARES, Canberra.

ABS (Australian Bureau of Statistics) 2010, *Education and work, Australia*, cat. no. 6227.0, ABS, Canberra.

——2011a, *Australian industry 2009–10*, cat. no. 8155.0, ABS, Canberra.

——2011b, *Australian labour market statistics 2011*, cat. no. 6291.0, ABS, Canberra.

——2011c, *Household expenditure survey, Australia: summary of results, 2009–10*, cat. no. 6530.0, ABS, Canberra.

——2012a, *Australian National Accounts: national income, expenditure and product*, cat. no. 5206.0, ABS, Canberra.

——2012b, *Mineral and petroleum exploration expenditure*, cat. no. 8412.0, ABS, Canberra.

——2012c, *Consumer price index*, cat. no. 6401.0, ABS, Canberra.

——2012d, *State and territory statistical indicators*, 2012, cat. no. 1367.0, ABS, Canberra.

——, various years, *Consumer price index*, cat. no. 6401.0, ABS, Canberra.

ACCC (Australian Competition and Consumer Commission) 2011, *Monitoring of the Australian petroleum industry*, ACCC, Canberra.

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

AEMC (Australian Energy Market Commission) 2009, *Review of Energy market frameworks in light of climate change policies: 2nd interim report*, AEMC, Sydney.

——2011a, *Possible future retail electricity price movements: 1 July 2010 to 30 June 2013*, final report, AEMC, Sydney.

——2011b, *Impact of the Renewable Energy Target on energy markets*, AEMC, Sydney.

——2011c, *Possible future retail electricity price movements: 1 July 2011 to 30 June 2014,* final report, AEMC, Sydney.

——2011d, *Energy market arrangements for electric and natural gas vehicles*, AEMC, Sydney.

——2012, *Power of choice: giving consumers options in the way they use electricity*, directions paper, AEMC, Sydney.

AEMO (Australian Energy Market Operator) 2010a, *National Transmission Network Development Plan*, AEMO, Melbourne.

——2011a, *Electricity statement of opportunities*, AEMO, Melbourne.

——2011b, *Existing and committed scheduled and semi scheduled generation—all NEM regions*, AEMO, Melbourne.

——2012a, *Electricity statement of opportunities*, AEMO, Melbourne.

——2012b, *2012 National electricity forecasting report*, AEMO, Melbourne.

——2012c, *Eastern and southern Australia: projected gas reserves*, Core Energy Group, AEMO, Melbourne.

AER (Australian Energy Regulator) 2010, *State of the energy market 2010*, AER, Melbourne.

——2011, *State of the energy market 2011*, AER, Melbourne.

Australian Institute of Petroleum 2011, *Downstream petroleum 2011*, Australian Institute of Petroleum, Canberra.

——2012, Submission to draft Energy White Paper, ref. EWP094.

Allens Consulting 2012, *Review of energy efficiency skills demands and training provision across the trades and professions*, Department of Industry, Innovation, Science, Research and Tertiary Education, Canberra.

Australian Government 2006, *Uranium mining, processing and nuclear energy: opportunities for Australia?*, report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, Canberra.

——2011a, *Organisational resilience: position paper for critical infrastructure*, Attorney-General's Department, Canberra.

——2011b, *Strategic review of Geoscience Australia*, Department of Finance and Deregulation, Canberra.

——2011c, *Closing the gap: Prime Minister's report 2011*, Department of Families, Housing, Community Services and Indigenous Affairs, Canberra.

——2012a, *Australian Defence Force Posture Review*, Australian Government, Canberra.

BP 2012a, 'Oil trade movements 2011', *Statistical review of world energy 2012*, BP p.l.c., London.

——2012b, 'Natural gas trade movements 2011', *Statistical review of world energy 2012*, BP p.l.c., London.

——2012c, 'Energy in 2011—disruption and continuity', *Statistical review of world energy 2012*, BP p.l.c., London.

BREE (Bureau of Resources and Energy Economics) 2011a, *Resources and energy quarterly: September quarter 2011*, BREE, Canberra.

——2011b, *Resources and energy statistics: June quarter 2011*, BREE, Canberra.

——2011c, *Australian energy projections to 2034–35*, BREE, Canberra.

——2012a, *Energy in Australia 2012*, BREE, Canberra.

——2012b, *Resources and energy quarterly: June 2012*, BREE, Canberra.

——2012c, *Australian energy statistics: energy update 2012*, BREE, Canberra.

——2012d, *Australian energy technology assessment 2012*, BREE, Canberra.

——2012e, *Mining industry major projects—April 2012*, BREE, Canberra.

——2012f, *Australian bulk commodity exports and infrastructure—outlook to 2025*, BREE, Canberra.

——2012g, *Resources and energy quarterly: March 2012*, BREE, Canberra.

——2012h, *Economic analysis of end-use energy intensity in Australia*, BREE, Canberra.

——2012i, *Gas market report*, BREE, Canberra.

Chester, L & Morris, A 2012, 'A new form of energy poverty is the hallmark of liberalised electricity sectors', *Australian Journal of Social Issues*, 46(4):435–459.

CMEWA (Chamber of Minerals and Energy of WA Inc) 2011, *State growth outlook*, CMEWA, Perth.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) 2011a, *Road transport sector modelling*, report prepared for Treasury.

——2011b, *Unlocking Australia's energy potential*, report prepared for the Department of Resources, Energy and Tourism, Canberra.

——2011c, *Possible futures: scenario modelling of Australian alternative transport fuels to 2050*, CSIRO, Canberra.

DAE (Deloitte Access Economics) 2012, *Advancing Australia: harnessing our comparative energy advantage*, Australian Petroleum Production and Exploration Association Limited.

DTT (Deloitte Touche Tohmatsu) 2012, *Analysis of initiatives to lower peak demand*, report prepared for the Energy Supply Association of Australia, Melbourne.

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

DEEDI (Department of Employment, Economic Development and Innovation) 2011, *Queensland energy management plan*, Queensland Government, Brisbane.

——2012, *2012 gas market review: Queensland*, Queensland Government, Brisbane.

DEEWR (Department of Education, Employment and Workplace Relations) 2011, *Industry employment projections 2011 report*, DEEWR, Canberra.

DIISR (Department of Innovation, Industry, Science and Research) 2009, *Powering ideas: an innovation agenda for the 21st century*, DIISR, Canberra.

DSEWPaC (Department of Sustainability, Environment, Water, Population and Communities) 2011a, *Sustainable Australia—sustainable communities*, DSEWPaC, Canberra.

——2011b, *Reforming national environment law: an overview*, DSEWPaC, Canberra.

EnergyQuest 2011, *Energy quarterly—August 2011*, EnergyQuest, Adelaide.

EPRI (Electric Power Research Institute) 2010, *Australian electricity generation technology costs—reference case 2010*, report prepared for the Department of Resources, Energy and Tourism, Canberra.

ERA (Economic Regulation Authority) 2011, *Inquiry into the efficiency of Synergy's costs and electricity tariffs: issues paper*, ERA, Perth.

ERIG (Energy Reform Implementation Group) 2007, *Energy reform: the way forward for Australia*, report to COAG, Department of Industry, Tourism and Resources, Canberra.

esaa (Energy Supply Association of Australia) 2011, *Electricity gas Australia*, esaa, Melbourne.

——2012a, *Electricity gas Australia*, esaa, Melbourne.

——2012b, Supplementary submission to the Energy White Paper, esaa, Melbourne.

ESIEP (Electricity Supply Industry Expert Panel) 2012, *An independent review of the Tasmanian electricity supply industry: final report*, Tasmanian Government, Hobart.

Fraser, R 2010, '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, Sydney.

Fry, C 2011, 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.

Futura Consulting 2011, *Power of choice: giving consumers options in the way they use electricity: investigation of existing and plausible future demand side participation in the electricity market*, report for the Australian Energy Market Commission, Sydney.

GA–ABARE (Geoscience Australia and Australian Bureau of Agricultural and Resource Economics) 2010, *Australian energy resource assessment*, Department of Resources, Energy and Tourism, Canberra.

——2012, *Australian energy resource assessment: gas update*, Department of Resources, Energy and Tourism, Canberra.

Garnaut, R 2011, *Update paper 7: Low emissions technology and the innovation challenge*, Garnaut Climate Change Review—Update 2011, Canberra.

Global–ROAM 2011, *Power trading schematic—Australian electricity market*.

Houston, C & Reilly, T 2009, 'Heat leaves $100m black hole', *The Age*, 1 February, http://www.theage.com.au/national/heat-leaves-100m-black-hole-20090131-7ugc.html.

IEA (International Energy Agency) 2008, *Agreement on an International Energy Program*, IEA, Paris.

——2009, *Transport, energy and CO_2: moving toward sustainability*, IEA, Paris.

——2011a, *World energy outlook 2011*, IEA, Paris.

——2011b, *Interactions of policies for renewable energy and climate*, working paper, IEA, Paris.

——2012a, *Energy policies of IEA countries—Australia 2012 review*, IEA, Paris.

——2012b, *Energy technology perspectives*, IEA, Paris.

IPART (Independent Pricing and Regulatory Tribunal) 2011a, Submission to the draft Energy White Paper, ref. EWP142.

——2011b, *Changes in regulated electricity retail prices from 1 July 2011*, IPART, Sydney.

——2012, *Ethanol supply and demand in NSW*, IPART, Sydney.

IRG (Investment Reference Group) 2011, *Report to the Commonwealth Minister for Resources and Energy*, Department of Resources, Energy and Tourism, Canberra.

Järvinen, J, Orton, F & Nelson, T 2011, *Electric vehicles in the NEM: energy market and policy implications*, AGL Applied Economic and Policy Research, working paper 27, October.

MCA (Minerals Council of Australia) 2011, Submission on *Measures to extend Australian industry participation* consultation paper.

NEMMCO (National Electricity Market Management Company Limited) 2004, *Statement of opportunities*, NEMMCO.

NT (Northern Territory) Government, Submission to the draft Energy White Paper, ref. EWP146.

NWC (National Water Commission) 2009, *Water and the electricity generation industry: implications of use*, Waterlines report no. 18, NWC, Canberra.

——2011, *The National Water Initiative—securing Australia's water future: 2011 assessment*, NWC, Canberra.

Ofgem (Office of the Gas and Electricity Markets) 2012, *Updated: Household energy bills explained—factsheet*, factsheet 97, Ofgem, London.

Parer, WR 2002, *Towards a truly national and efficient energy market* (the Parer review), Australian Government, Canberra.

Parkinson, M 2011, 'Sustaining growth in living standards in the Asian century', speech delivered at the Melbourne Institute Economic and Social Outlook Conference, 30 June.

PC (Productivity Commission) 2009, *Review of regulatory burden on the upstream petroleum (oil and gas) sector*, Productivity Commission, Canberra.

——2012, *Productivity in electricity, gas and water: measurement and interpretation*, staff working paper, Productivity Commission, Canberra.

PMTGEE (Prime Minister's Task Group on Energy Efficiency) 2010, *Report of the Prime Minister's Task Group on Energy Efficiency*, Department of Climate Change and Energy Efficiency, Canberra.

RET (Department of Resources, Energy and Tourism) 2009, *National Carbon Mapping and Infrastructure Plan–Australia: concise report*, Carbon Storage Taskforce, RET, Canberra.

——2011a, *National energy security assessment*, RET, Canberra.

——2011b, *Australian petroleum statistics*, RET, Canberra.

——2012, *Continuing opportunities: the first five years 2006–2011*, RET, Canberra.

RET, GA & BREE (Department of Resources, Energy and Tourism, Geoscience Australia and Bureau of Resources and Energy Economics) 2012, *Australian gas resource assessment 2012*, RET, GA and BREE, Canberra.

ROAM Consulting 2011, *Projections of electricity generation in Australia to 2050*, Treasury, Canberra.

Simshauser, P and Nelson, T 2012, *The energy market death spiral: rethinking customer hardship*, AGL Energy Ltd, Brisbane.

Skills Australia 2011, *Employment growth projections in mining operations, 2010–2016*, Skills Australia, Canberra.

SKM MMA 2011, *Carbon pricing and Australia's electricity markets*, Treasury, Canberra.

Smart, A & Aspinall, A 2009, *Water and the electricity generation industry: implications of use*, Waterlines report series no. 18, National Water Commission, Canberra.

Somerville, D 2011, *Electricity Network Capital Program Review 2011: detailed report of the independent panel*, Department of Employment, Economic Development and Innovation, Brisbane.

SRG (Sapere Research Group) 2012, Scoping study for a consumer energy data access system for the Department of Resources, Energy and Tourism, Canberra.

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

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

UNFCCC (United Nations Framework Convention on Climate Change) 2010, *The Cancun Agreements*, http://cancun.unfccc.int.

VaasaETT 2011, *Empower demand: the potential of smart meter enabled programs to increase energy and systems efficiency: a mass pilot comparison*, VaasaETT.

WA (Western Australian) Government 2011, *Inquiry into domestic gas prices*, report no. 6, 2011, Economics and Industry Standing Committee, Legislative Assembly, Parliament of Western Australia, Perth.

—— 2012, *Petroleum in Western Australia*, Department of Mines and Petroleum, Perth.

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