A Clean Energy Future for Australia

The plan for cutting greenhouse gas emissions and providing reliable energy supply

This document is a summary of *A Clean Energy Future for Australia*, a study prepared by Energy Strategies Pty Ltd. for the Clean Energy Future Group.

The Clean Energy Future Group comprises:

- Australasian Energy Performance Contracting Association
- Australian Business Council for Sustainable Energy
- Australian Gas Association
- Australian Wind Energy Association
- Bioenergy Australia
- Renewable Energy Generators of Australia
- WWF Australia

A full copy of the study is available from any of the Clean Energy Future Group's websites.

Energy is the lifeblood of Australia. How we generate it, use it or conserve it fundamentally affects everything we do and the environment we live in. Meeting Australia's growing energy demands currently produces millions of tonnes of carbon dioxide pollution, the principal greenhouse gas that causes human induced climate change. The threat of climate change is now widely accepted as being real and immediate. Australian Government analysis has concluded that "Australia is vulnerable to changes in temperature and precipitation. Australian's vulnerability to climate change is intensified by already being a generally dry continent and experiencing high natural climate variability from year to year."

This mirrors the concern of governments and industry around the globe, which are taking action to limit and reduce greenhouse emissions from energy production and use.

The principal goal of this study was to investigate the potential for reducing emissions of the main greenhouse gas, carbon dioxide (CO_2), in Australia by 2040 to a level that helps to prevent climate change.

The challenge:

- Can CO_2 emissions from stationary energy (all energy use except transport) be halved by 2040, compared to the 2001 emissions of 262 million tonnes?
- Can this be done using a mix of cleaner, commercially available technologies?
- Are these cleaner technologies sufficient and reliable enough to meet the current and growing demand for energy?

The Clean Energy Future Group has designed a plan to meet this challenge - a future using cleaner and more efficient energy. It is a strategy to achieve a critical environmental goal and maintain prosperity.

To deliver this plan by 2040 will require policies that begin today with one clear aim in mind – reducing the waste of energy and decarbonising the energy supply system as existing capital investments reach the end of their economic life.

Australia's energy sector: something has to give

Stationary energy is the single largest producer of greenhouse gases in Australia. Stationary energy comprises all energy other than that used by transport – energy for commercial and residential use and for heat, power and engines in industry.

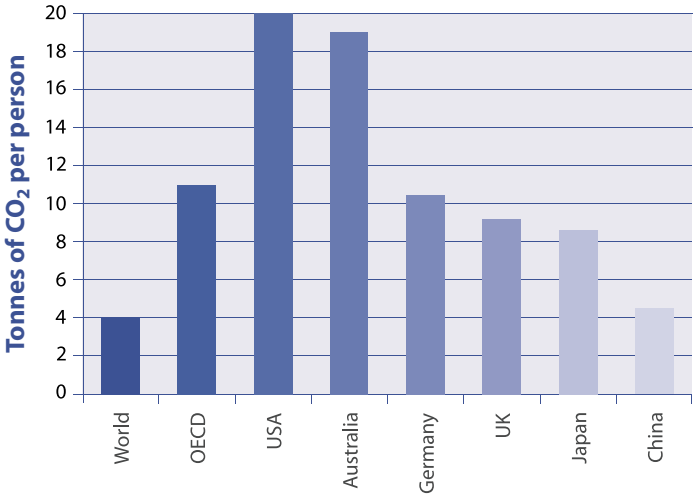
In 2001 Australia's total emissions were 543 million tonnes of CO_2-equivalent (CO_2-e) greenhouse gases, of which stationary energy contributed about half. On a per person basis Australia is one of the highest emitters of greenhouse gas pollution in the world, pumping 19 tonnes of CO_2 into the atmosphere for every Australian citizen (IEA. 2003). This puts us just behind the USA with 20 tonnes per person per annum.

Australia's position as one of the top greenhouse gas polluters (per capita) in the world is greatly influenced by the composition of our economy and by our heavy reliance on coal for producing electricity. Coal burning provides approximately 84 percent of Australia's electricity generation.

Because Australia's emissions from stationary energy are growing faster than those from any other sector of the economy since 1990, this study proposes a 75 percent reduction in coal fired electricity by 2040. Coal has served our energy demands well up until now, but in a world where the amount of CO_2 released into the atmosphere needs constraining, Australia must look to other technologies to meet our needs without producing this pollutant. Australia already has a well-established clean energy sector providing technologies and fuels capable of supplying our future needs and delivering a reliable supply through a more diverse fuel mix.

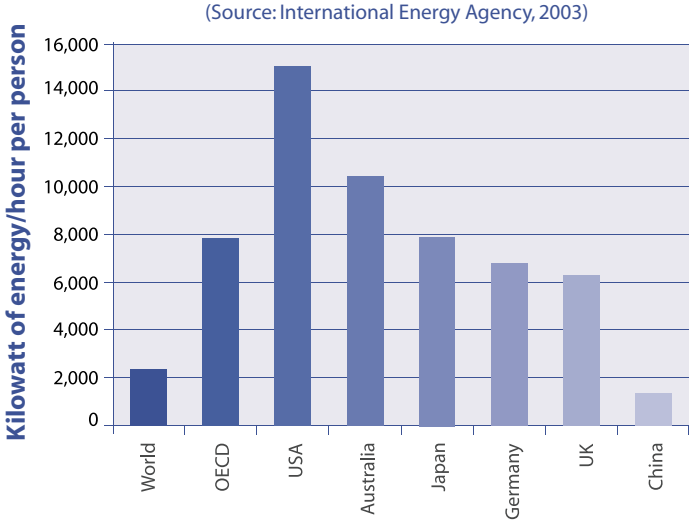
CO_2 emissions per person

(Source: International Energy Agency, 2003)



Energy usage per person

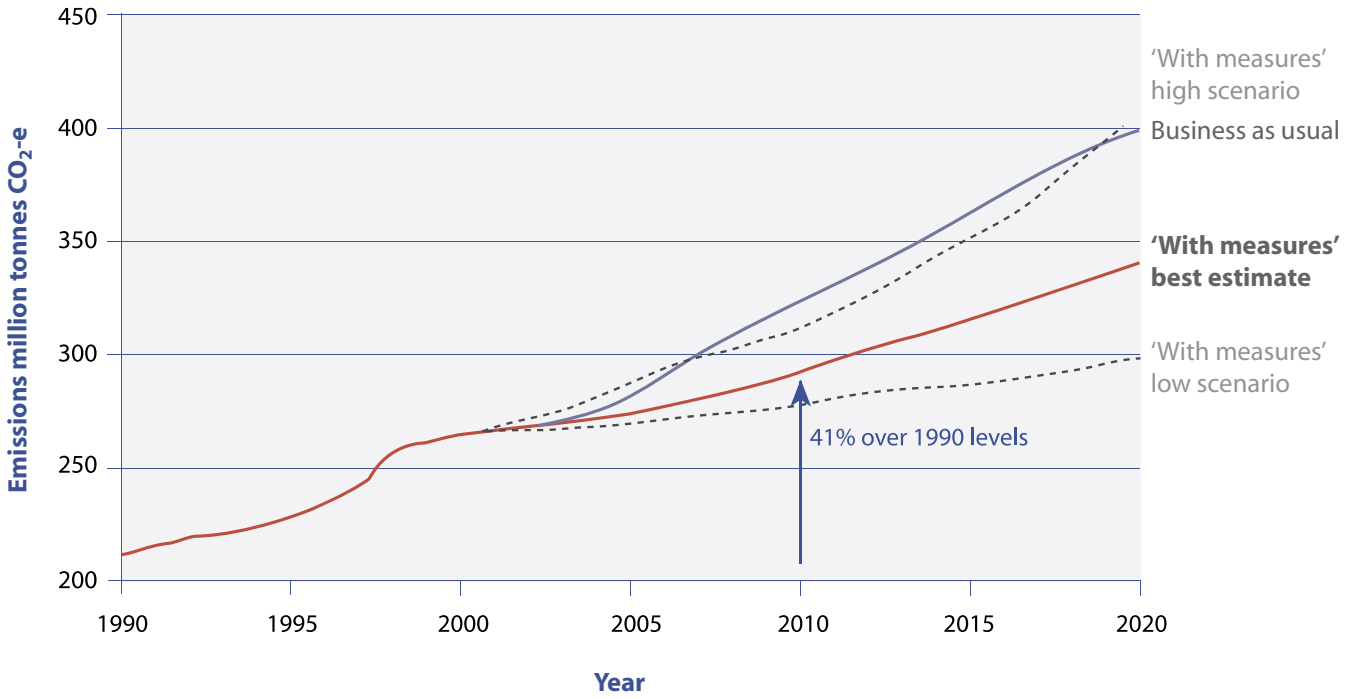
(Source: International Energy Agency, 2003)



Wallerang coal fired power station emitted 4.7 million tonnes of CO_2 in 2001

Government Estimates of Greenhouse Gas Emissions from Stationary Energy

(Source: Australian Greenhouse Office, 2003)



Polluting energy is changing the planet

The debate as to whether the greenhouse effect is human induced is over. The threat of climate change is now widely accepted as being real and immediate. The global insurance industry has publicly stated that the skyrocketing damages bills of the last few years, caused by extreme weather events – wind, storms, floods, droughts and fires – is clear evidence of climate change.

A critical mass of opinion in governments and industry around the globe is resulting in action to limit, and reduce CO_2 emissions.

- The UK has already set itself a target of a 60 percent CO_2 reduction by 2050.
- Germany has committed to reduce greenhouse gas emissions by 21 percent by 2012 and flagged its willingness to commit to 40 percent CO_2 reduction by 2020 if other nations also commit to deeper targets.
- Denmark aims to make a 50 percent cut in emissions by 2030.
- In the USA, five states have imposed mandatory limits on CO_2 emissions, including policies directed specifically at electricity sector emissions.

In line with this policy trend, this study has chosen a 50 percent reduction in CO_2 emissions from the stationary energy sector by 2040 for Australia. It is recognised however that greater cuts in emissions will be required beyond 2040.

The Study - shifting to a cleaner energy future

This study has analysed how to technically achieve a prosperous and clean energy future for Australia at a cost that is potentially lower than the real cost of continuing to rely so heavily on coal to meet Australia's future energy needs.

The energy supply and demand model that underlies this study is built on a detailed picture of the economy in 2040. Understanding what the economy is likely to look like is needed before an energy system can be designed to meet its needs.

This model is an extrapolation from today's economy using baseline data from agencies such as the Australian Bureau of Agricultural and Resource Economics (ABARE), the International Energy Agency (IEA) and the Bureau of Industry Economics (BIE). It takes into account the main driving forces for increasing energy consumption: economic growth and population growth.

This study then explores whether plausible increases in energy efficiency and modest rates of technological change could meet the energy demands of Australia in 2040 whilst also achieving a 50 percent reduction in greenhouse gas pollution from stationary energy.

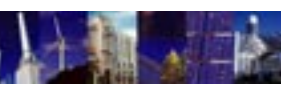
The study finds that with good policy and planning, Australians in the future can live a life similar to how we live today. The sources of energy will be different, but the uses to which it is put need not change radically.

The choice of the time horizon of 2040 is deliberate and important. It is long enough for almost all existing coal fired energy supply infrastructure and existing less energy efficient plant and equipment to be fully written off to recover costs. After this it can be replaced with higher efficiency and/ or lower emission infrastructure and equipment. The study is careful to prevent the need for costly early closures of today's infrastructure.

2040 is also long enough for a large fraction of existing residential and commercial buildings to be replaced or undergo one major refurbishment. Consequently, over the 36-year period, major improvements in energy efficiency can be achieved at minimal cost.

Steps taken to develop the Baseline Scenario 1 and the Clean Energy Scenario 2

	Where there are:	Extrapolate to get Demand Scenarios	Change in Energy demand from 2001	Where there are:	Model to get Supply Scenarios
2001 Economy 262 million tonnes of greenhouse gas emissions →	No policies to support the wide adoption of cost effective energy efficiency →	**2040 Baseline** final stationary energy demand scenario →	57 percent increase in demand by 2040	No further policy measures on top of the Baseline demand level to limit greenhouse gas emissions from stationary energy →	**Baseline Scenario 1** Greenhouse gas emissions increase by 21 percent to 310 million tonnes
2001 Economy 262 million tonnes of greenhouse gas emissions →	Extensive and achievable uptake of energy efficiency technologies and practices across all sectors of the economy →	**2040 Medium efficiency** final stationary energy demand scenario →	25 percent increase in demand by 2040 Greenhouse gas emissions decreased by 14 percent by 2040	Changes in fuel/source mix to reduce greenhouse gas emissions by 50 percent on top of the Medium efficiency demand level →	**Clean Energy Scenario 2** Greenhouse gas emissions decrease by 50 percent to 131 million tonnes



The Australian Economy in 2040

The Australia of 2040, as predicted in the study, has all the major economic activities that make up today's economy. It is a robust economy with a Gross Domestic Product (GDP) per person 86 percent higher in real terms than today. The economy is delivering higher levels of value-added goods and services to an Australian population of 25 million people and to export markets.

In the model economy of 2040 there are changes to the relative size of sectors, reflecting the 'most likely' changes to occur, but all sectors are larger in real terms in 2040 than they are today. This is as true for industries such as coal, oil and gas, and primary metals, that produce energy and energy intensive commodities for export, as it is for service industries such as tourism and information technology. Coal mining, for example, grows at half the rate of the economy as a whole, but is still 55 percent larger in real terms in 2040 than it is today.

How GDP and sectors of the economy have grown, 2001 to 2040

Category	Output ratio
GDP	2.40[a]
Coal mining for export	1.55
LNG production for export	2.62
Mining (non energy)	2.2
Iron and Steel	1.42
Food, beverages, tobacco	2.3
Sugar industry	1.21
Basic chemicals	1.42
Cement, lime, plaster and concrete	2.2
All other non metallic mineral products	2.3
Non-ferrous metals	1.79
Wood, paper and printing	1.42
All other manufacturing	2.3
Construction	2.3
Commercial / Institutional	2.5
Agriculture / Forestry / Fishing	2.3
Residential	2.3

a: Intergenerational Report (Costello, 2002)

60L - Improved building design and solar chimney

How to meet energy demands and reduce greenhouse pollution by 2040

There are two important components to delivering this future – the reduction in energy waste through increased energy efficiency and the removal of carbon emissions through changing the mix of source fuels for energy.

1. Increasing energy efficiency

The study presents two alternative scenarios of energy demand in 2040.

In the Baseline Scenario policies are assumed to remain much as they are today, though with some increase in the prices of fossil fuels, particularly petroleum. In the absence of policies to overcome the wider adoption of efficient energy use technologies, many opportunities go unrealised and energy demand grows by 57 percent between 2001 and 2040. Improvements in the efficiency of energy supply, combined with a shift towards greater use of natural gas, mean that emissions of CO_2 are 48 million tonnes or 21 percent higher than in 2001. This is the continued pollution scenario.

The second scenario, the Medium Energy Efficiency scenario, demonstrates that with effective new policies, energy demand can be contained to only a 25 percent increase between 2001 and 2040 – achieved through the widespread implementation of cost effective energy efficiency improvements. This is referred to as Medium Efficiency, because it does not achieve the maximum level of energy efficiency that many experts consider achievable.

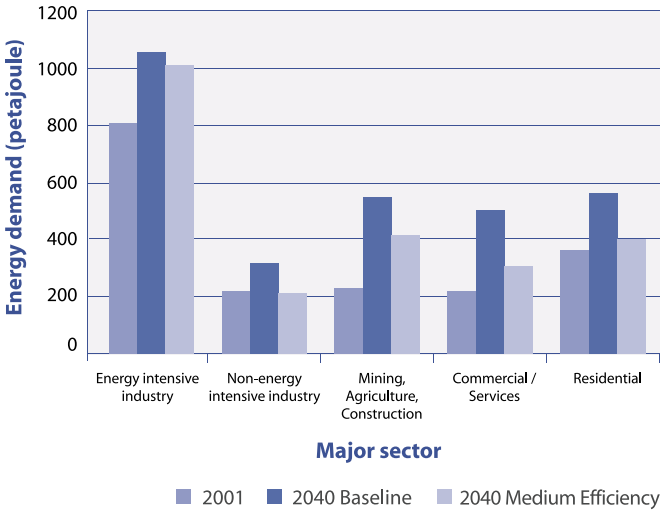
The estimates of the efficiency improvement potential in this study are smaller than those made by the Energy Efficiency and Greenhouse Working Group of the Ministerial Council on Energy (2003), a joint Commonwealth and State/Territory government body.

Energy efficiency rating on appliances

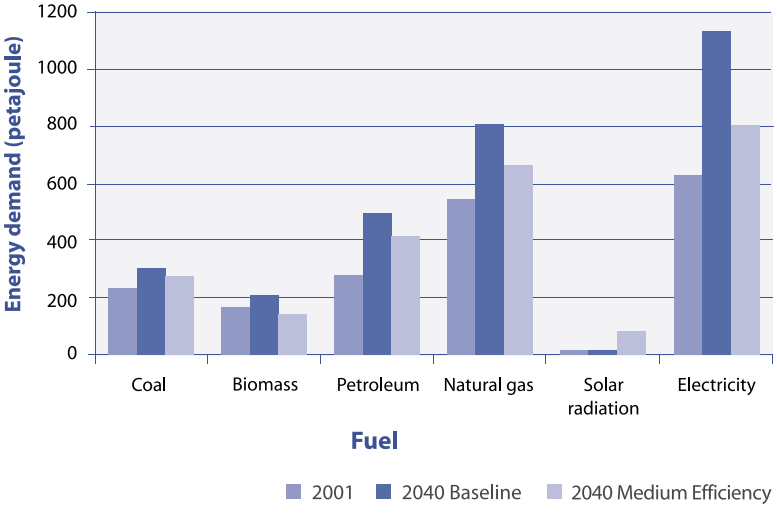
Some of these energy efficiency improvements are:

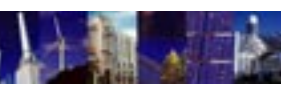
- more efficient boilers, boiler systems, kilns, furnaces and electric motors,
- improved waste recovery and associated use of waste products as fuel,
- improved building design and construction, to reduce or eliminate the need for heating and air conditioning,
- improvements in the efficiency of electrical and gas appliances and equipment, such as lights,
- shift from electric water heating to gas and solar water heating.

Using energy more efficiently – 2001 compared to 2040 Baseline & Medium Efficiency



Using fuels more efficiently – 2001 compared to 2040 Baseline & Medium Efficiency





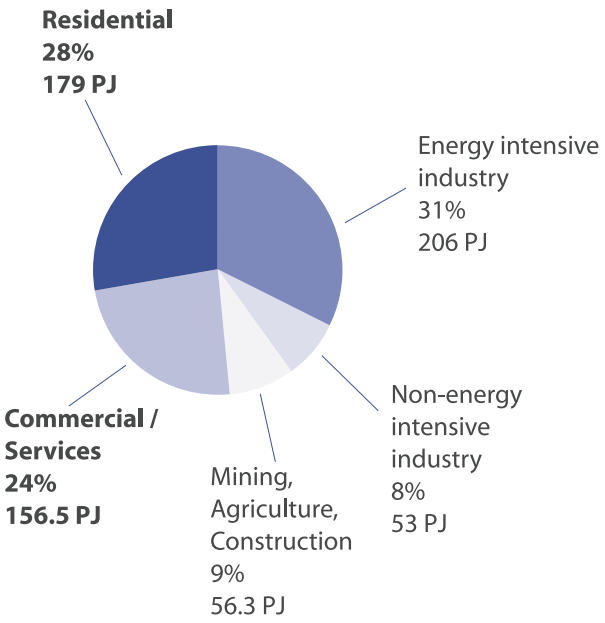
Key sectors for limiting demand

In 2001 electricity generation accounted for 69 percent of CO_2 emissions from the stationary energy sector. The remaining 31 percent is from the use of natural gas, coal and oil for industrial purposes like processing minerals. It is difficult to replace the use of fossil fuels for these industrial tasks. Therefore, if stationary energy emissions are to be halved by 2040, the electricity industry needs to shoulder more of the burden and will have to undergo profound changes in the technologies used to generate electricity.

Commercial and services industries and residential housing use a much larger share of electricity than they do of energy in total. This means that measures to limit growth in demand for electricity from these sectors, and in particular measures to stimulate greater energy efficiency, will be important for limiting greenhouse gas emissions.

Lower demand will mean lower emissions from energy use. If current trends towards an increasing contribution from natural gas continue in the Medium Efficiency scenario and if the efficiency of coal-burning increases substantially, then CO_2 emissions will be about 14 percent lower in 2040 than in 2001. While this emission cut is encouraging, to achieve the principal goal of 50 percent emission reductions, changes will also need to be made to the fuels and technologies driving our energy system.

Electricity use by major sectoral groups, 2001



2. Cut the carbon out of energy – the 2040 Clean Energy Scenario 2

Given the level of demand for energy, it is the mix of fuels and technologies used to supply that demand that will determine the quantity of greenhouse gases emitted from the energy sector. Of the total 262 million tonnes of CO_2 emissions in 2001, coal accounted for 188 million tonnes – 72 percent of the total emissions.

This report used the available data, coupled with expert interdisciplinary and industry knowledge and research about potential improvements in technologies to determine the resource base and capabilities of the different technologies in supplying energy to meet the demand – called the 2040 Clean Energy Scenario 2.

This new phase of energy production will come from a mix of technically viable, lower or zero emission energy technologies that are already established and operational in Australia.

The technologies include:

- the energy generated from the combustion of natural gas;
- the energy released from biomass from agriculture and plantation forestry residues;
- the energy of wind captured by turbines;
- the energy of flowing water harnessed through hydroelectric facilities; and
- the energy of the sun captured with photovoltaic and solar thermal systems;

Over the next four decades renewable energy and natural gas could reliably produce as much power as coal to meet Australia's growth.

Use of waste macadamia nut shells as biomass fuel

From this Clean Energy Scenario 2, four key opportunities emerge for changing the energy mix:

- a change in the mix of electricity generation technologies, away from coal and towards natural gas and renewable energy;
- introduction of solar heating into the supply of steam and hot water in industrial and commercial applications and widespread use of solar hot water in the housing sector;
- substitution of natural gas for coal in almost all non-metallurgical applications; and
- widespread adoption of cogeneration (the combined production of electricity and heat, using turbines and engines on the site where energy is used).

All the technologies needed to do this are commercially well established and in most cases are widely used throughout the energy system today. Some technologies like wind and solar, while proven and reliable, are at an early stage of their product cycle with costs expected to continue to fall considerably with mass production.

Renewable energy systems can be built within a one to three year time frame rather than five to six years for traditional coal fired power generation. Renewable energy technologies also produce little of the emissions associated with coal: acid rain, smog, air pollution, land degradation and toxic chemicals.

The barrier to the Clean Energy Scenario 2 is not that the clean technologies cannot produce enough energy at relatively affordable prices, nor is it that the cleaner fuels are not available. The barrier is a lack of achievable policies and strategies for facilitating the transition to new fuels and commitment by decision-makers.

VISY black liquor cogeneration plant

Where Australia's clean electricity can come from by 2040

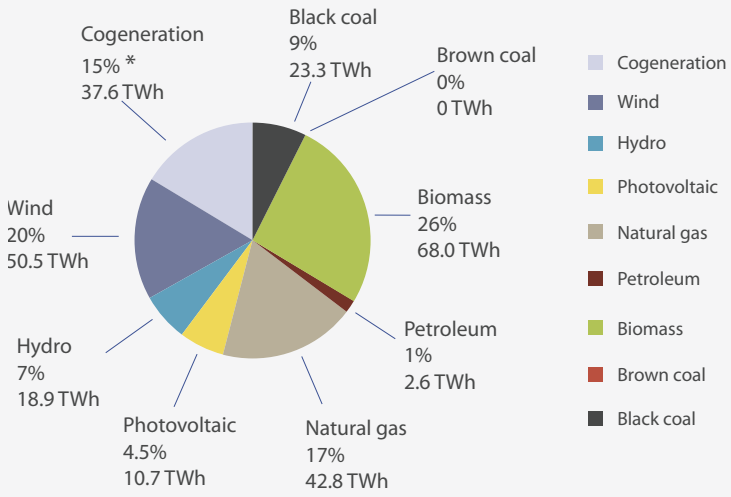
This study finds that biomass, natural gas, wind, hydro and solar heat should be the main contributors to a clean energy mix by 2040. The maintenance of our existing large-scale hydro-electric plants, with a small increase in their output, plays a continuing and vital role. Wind energy will be able to feed in significant amounts of electricity to the national electricity market and also provide power in remote communities.

Both photovoltaics and solar thermal electricity are thought to have real promise in providing a small but useful fraction of electricity supply in 2040, even without major technological breakthroughs. Other renewable technologies such as wave power, tidal power, solar chimneys and hot dry rock systems are considered to be too immature at present to be counted into the 2040 supply mix based on existing technologies.

Fossil fuels still play an important part in the electricity generation scenario of 2040, with natural gas, as the cleanest of the fossil fuels, as the main substitution for coal.

A key assumption used in the study is that no new conventional coal fired power stations are approved and built from 2004 onwards, and that by 2040 all but three of the 24 existing baseload coal fired power stations have reached the end of their useful lives.

Electricity generated by fuel/source, 2040 Clean Energy Scenario 2



*About 13% is natural gas and about 2% is biomass

Renewable energy technologies in 2040

Biomass – Biomass energy represents 26 percent of electricity generation in the 2040 Clean Energy Scenario 2.

Biomass energy is obtained from the combustion or gasification of agricultural and plantation forestry products and wastes. The major part comes from existing harvestable stubble residues from Australian grain crops (mostly wheat) and cotton and only a small fraction being supplied by dedicated energy crops. There is negligible additional land required to achieve the amount of crops needed to generate the electricity.

Biomass energy also has the potential to create far more jobs per unit of energy generation than either fossil fuels or other forms of renewable energy. These jobs are diverse, ranging from extensions to existing agricultural activities through to specialised engineering and electronic control functions. Importantly, many of these jobs will be distributed throughout rural areas where there is the greatest need for employment.

Western Power Corporation Narrogin energy crop

Wind Power – Wind power represents 20 percent of electricity generation in the 2040 Clean Energy Scenario 2.

There are sufficient suitable sites in Australia to be able to supply this level of wind generation (51 terawatt-hours per year). During the past decade wind power has been the fastest growing source of electricity generation in the world with an average annual growth rate of 25 percent to reach 32,000 megawatts (32 gigawatts) by the end of 2002. In less than one year from the end of 2002 to the time of writing this report, Australia's installed wind power capacity increased from 104 megawatts to 196 megawatts.

Wind turbines erected in Australia presently have a 40 percent Australian content (in dollars) and create 2 to 3 times more local jobs per kilowatt-hour generated than coal fired power. However Australian content is expected to rise to about 80 percent, delivering as much as 4 to 6 times the number of jobs per kilowatt-hour as coal.

Like biomass energy, this renewable resource also provides a new source of long term income for rural areas. A wind farm, when installed on agricultural land, has the lowest environmental impact of all energy sources. Wind farms occupy less land area per kilowatt-hour of electricity generated than any other energy conversion system apart from rooftop or building integrated solar energy. Wind farms are compatible with grazing and almost any crop that would be suitable for a site that would also support a wind farm.

As the capital cost of wind farms continues to decrease over the decade ahead of us, it will become economic to develop them on sites with lower, average annual wind speeds than coastal sites in southern Australia. This will open up more inland sites which do not have the siting issues or high wind regimes of coastal sites, which are presently of interest for most wind farm developers. The resource required to meet this energy need is 20,000 megawatts, the equivalent of about 200 wind farms like the Lake Bonney wind farm currently under construction in South Australia.

Woolnorth windfarm

CSR Pioneer cogeneration mill using bagasse

Clark dam

Cogeneration – represents 15 percent of electricity generation in the 2040 Clean Energy Scenario 2. (This is mostly natural gas with a little biomass).

Cogeneration is the simultaneous production of heat and power. The technology is mature and diverse. Installations in Australia range from small 200 kilowatt cogeneration plants at heated community pools and commercial laundries to more than 100 megawatt systems at industrial and chemical plants. New technologies are rapidly emerging, such as natural gas fuelled micro turbines that will make cogeneration more economical on a smaller scale at sites where both heat and electricity are required.

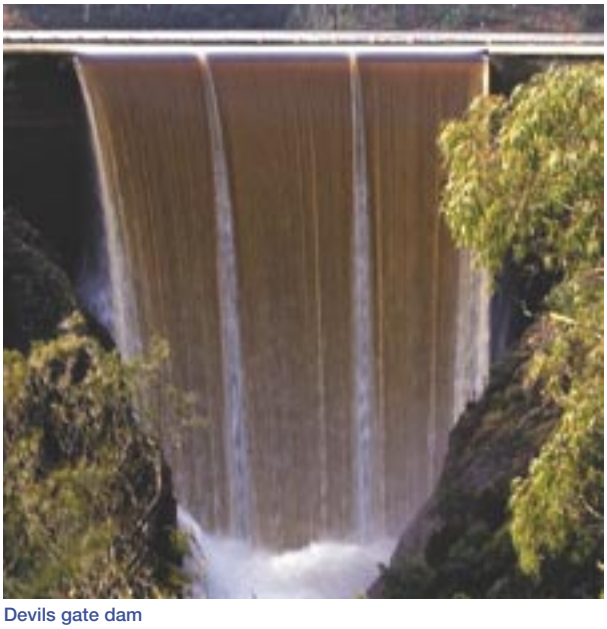
The sugar industry is Australia's largest regional employer with over 38,000 jobs. All Australian sugar mills presently run cogeneration plants fuelled by the bagasse left over after crushing the cane. Based on greater efficiencies and existing cogeneration technology it is conservatively estimated that bagasse and cane 'trash' could supply over 10,000 gigawatt-hours of electricity per annum. Producing renewable energy provides sugar mills with additional revenue streams to reduce exposure to the world sugar price, thereby increasing employment security and opportunity in the many regional communities dependent on the sugar industry. All of the older sugar mills that have not recently been refurbished have huge potential for making more energy via cogeneration.

The 2040 Clean Energy Scenario 2 includes widespread use of cogeneration in industries and facilities with a requirement for heat. Further the scenario assumes a widespread uptake of small cogeneration plants in commercial buildings.

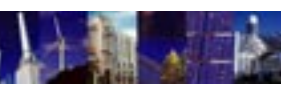
Hydro-electricity – Hydro electricity represents 7 percent of electricity generation in the 2040 Clean Energy Scenario 2.

After analysing the potential to maintain and refurbish existing hydro electricity plants, improving both the efficiency of production and the capacity, and adding new, small scale generation to existing structures, this study estimates that hydro could supply 7 percent of Australia's electricity in 2040. This represents nearly a 10 percent increase in output over today's contribution from hydro-electricity.

The importance of this contribution is not just the scale of hydro generation in Australia but also the fact that it is a zero emissions source of quick-start, peak-demand power.



Devils gate dam



Installation of photovoltaic roof tiles

Solar and gas hot water heating

Solar Electricity – Solar electricity represents 5 percent of electricity generation in the 2040 Clean Energy Scenario 2.

At the end of 2002 the total capacity of photovoltaic systems installed in IEA countries was 1334 megawatts and its rate of growth about 30 percent p.a. over the past 5 years. Australian installed capacity at the end of 2002 was 39 megawatts. While a proven and reliable technology, photovoltaics are at an early stage of their product cycle. Costs have been falling by 5 percent p.a. over the last five years and this trend is expected to continue as installed capacity continues to increase. A number of developed countries such as Germany and Japan have constructive policies and programs in place to support photovoltaics.

Photovoltaics are one of the most promising renewable sources of electricity, but also currently the most expensive. Nevertheless, they have an important role to play in Australia's future power generation mix, because their output matches the alarming growth in summer peak demand caused by our increasing use of air conditioners, which entails increased investment in generation, transmission and distribution.

The crucial policy action required is to ensure that electricity consumers pay the real cost of their energy consumption during peak periods.

Under these circumstances, based on small improvements to existing technology, photovoltaics were assessed as having a potential to satisfy about 5 percent of electricity demand. They will be most cost-effective in situations where electricity prices are high, such as in rural locations, for some commercial electricity consumers, and for a small fraction of urban residential consumers. Solar thermal electricity also contributes to the 2040 Clean Energy Scenario 2.

Solar hot water – Domestic sales of solar water heaters have been growing by more than 30 percent over the last two years. Australia has an enormous potential for increased use of solar water heaters which are now a mature and efficient technology. In many European countries, with far less sunny days, the sales of solar hot water heaters has been many times higher than in Australia.

This is due to the very low cost of coal fired electricity and natural gas in Australia compared to the electricity costs in European countries. However many European countries have had strong government support programs for many years that deliver robust domestic solar water heater demand. Heating water accounts for 27 percent of residential energy use in Australia. This study assumes that by 2040 the vast majority of residential water heaters in mainland Australia will be solar water heaters.

AGL Coopers Brewery cogeneration

Hazlewood coal mine and coal fired power station

Fossil fuel technologies in 2040

Natural Gas – Natural gas represents 30 percent of electricity generation in the 2040 Clean Energy Scenario 2.

There are several advantages to be gained from expanding the role of natural gas in electricity production, beyond the simple equation that natural gas can produce electricity with less than half the CO_2 emissions that burning coal creates.

Natural gas, including coal seam methane, is technically a superior fuel to coal on many measures. It burns more cleanly and can be piped very efficiently to sites close to the demand. It can be used directly to supply heat, or generate electricity on site, or both in cogeneration plants. Natural gas fuelled generators can be constructed and commissioned in relatively small, cost effective units, unlike coal-fuelled stations that are seldom smaller than about 500 megawatts. The cleaner burning characteristics of natural gas means power stations can be safely built closer to population centres. All of these attributes increase the overall efficiency of natural gas as a fuel for electricity production compared to coal.

A significant amount of gas fired cogeneration of heat and electricity is also assumed particularly in the energy intensive industry sectors but also in food processing and commercial sectors. Over the 36-year period of this study, a considerable amount of capital stock is turned over. The economics of cogeneration improve considerably when it is considered as part of a new facility or an expansion of an existing facility.

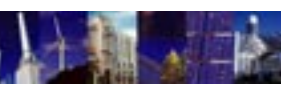
Coal – Coal represents 9 percent of electricity generation in the 2040 Clean Energy Scenario 2.

This study looked at the present and likely future state of fossil-fuelled power systems. In the year 2000 the burning of coal for electricity production in Australia produced 184 million tonnes of CO_2.

Improved coal-burning technologies that are currently coming onto the market, such as supercritical boilers and integrated gasification combined cycle systems, do not on their own reduce CO_2 emissions sufficiently to permit coal to continue as a major energy source. Capturing the CO_2 from fossil fuelled power stations and storing it underground –geosequestration – is neither a mature technology nor commercially available at this point and as a result has not been included in this study.

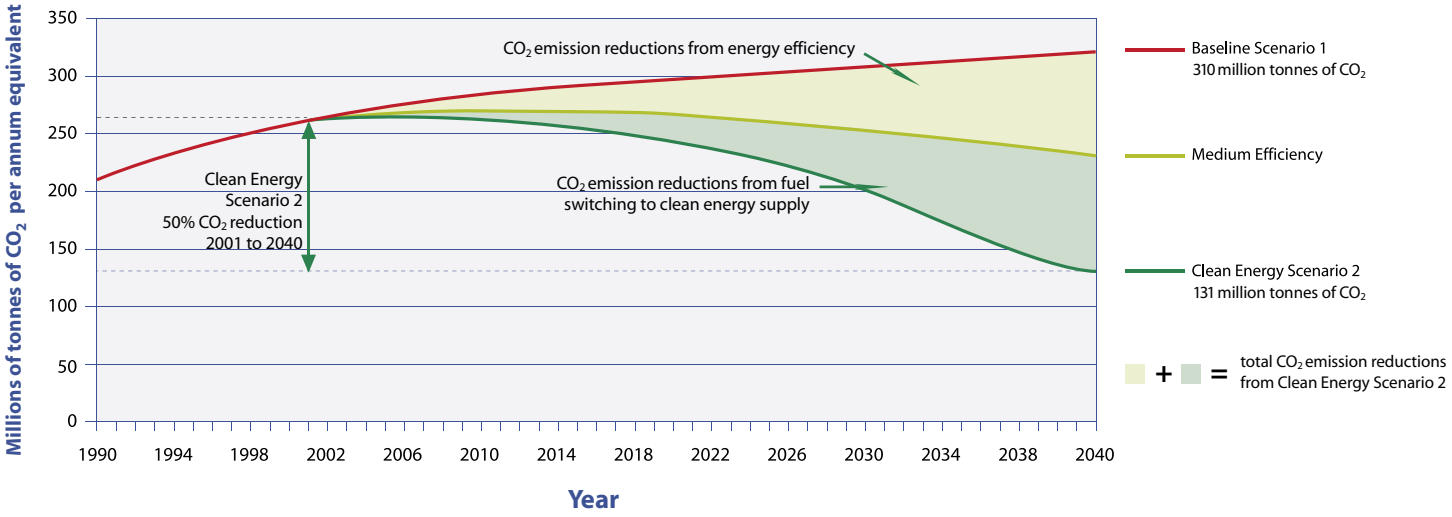
One of the constraints on transforming the electricity industry into a much cleaner industry is the long lifetimes of existing power stations. Without a major refurbishment, power stations can be expected to run for 30-35 years. This study assumes that any proposal for a major refurbishment, or for a new power station would have to meet very stringent conditions on greenhouse intensity: specifically that such stations would be required to have greenhouse intensities less than or equal to those of the best combined-cycle natural gas power stations in 2003. In practice, only with geosequestration would coal be able to meet such a standard, and this would probably make coal-fired electricity more expensive than the current prices of wind power and electricity from biomass residues.

Petroleum – Petroleum represents 1 percent of electricity generated in the 2040 Clean Energy Scenario 2.



What a Clean Energy Future for Australia looks like

Greenhouse gas emission reductions achieved under Clean Energy Scenario 2



Note: The time path shown on this diagram is a notional one, based on the assumption that our policy recommendations are adopted

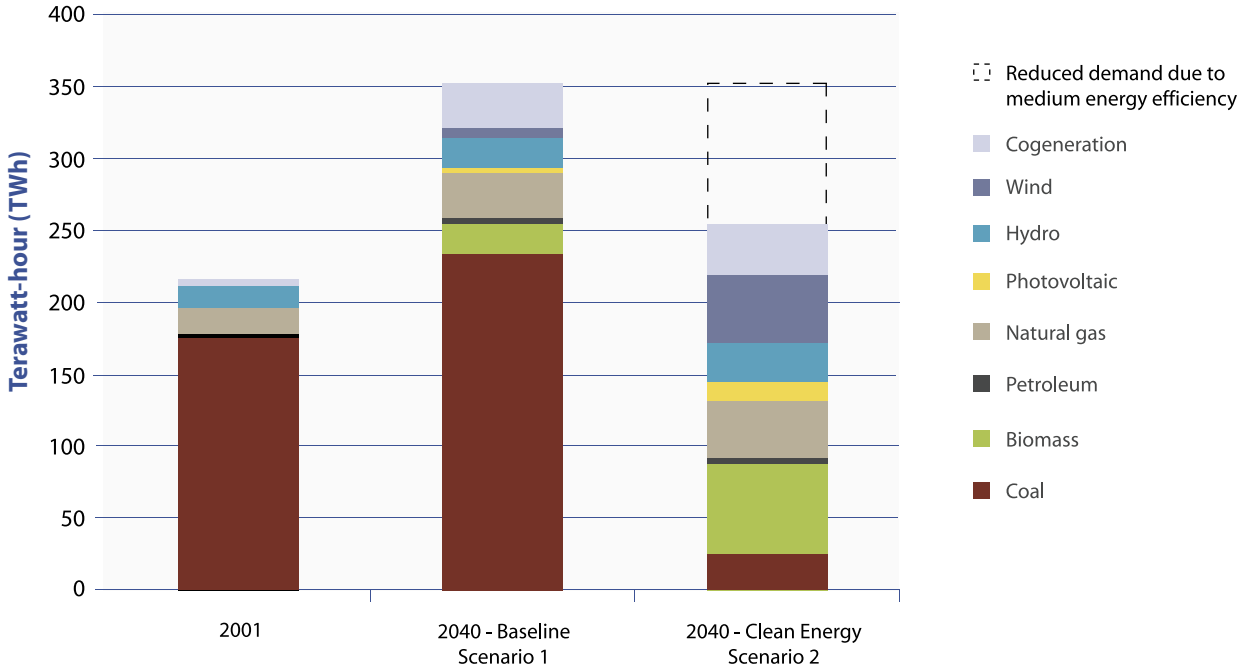
Clean energy makes economic sense

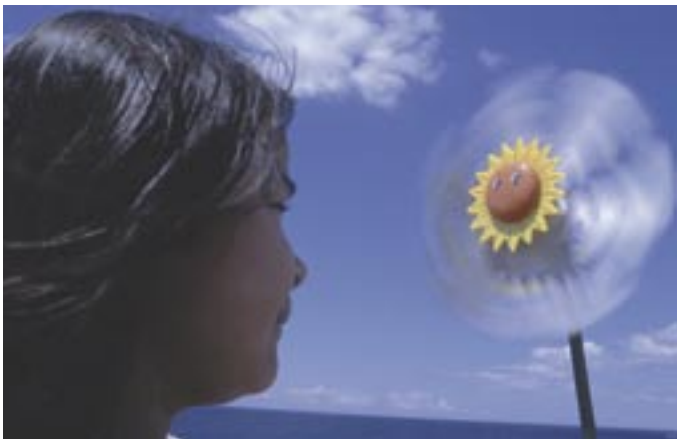
This study does not attempt to provide a full economic analysis of the 2040 scenarios as there are some very large uncertainties, most notably the prices of fossil fuels and the extent of international and national constraints on greenhouse gas emissions in the future.

While delivered electricity prices to customers are likely to rise under the Clean Energy Scenario 2, as the energy efficiency measures result in a 28 percent reduction in electricity consumption, energy bills could fall considerably.

In the long term, electricity prices are likely to rise in the Baseline Scenario as well, as oil becomes scarce, dragging up the prices of natural gas and exportable coal. Environmental taxes or levies, or a substantial amount of capture and underground storage of CO_2 from coal-fired power stations, could double the price of coal-fired electricity. So, under a range of circumstances, our Clean Energy Scenarios could be less expensive than the Baseline Scenario in 2040.

Electricity demand and fuel mix in 2001, and in the 2040 Baseline and Clean Energy Future Scenarios





CONCLUSION

Commitment is the key

'A Clean Energy Future for Australia' lays out a plan for policy makers to deliver an energy future that gives all Australians a sustainable future. Australia can cut its greenhouse gas emissions from stationary energy by more than half over the next 36 years. This can be achieved without any dramatic technological breakthroughs, taking account of limited land area and limited reserves of oil and, in the long term, natural gas, without imposing any significant economic burden, and while supporting expected levels of economic growth over the period.

Despite Australia's significant advances in economic reform, the market distortions still evident in many aspects of the energy industries are significant barriers to a low cost transition to a clean energy future. Australia has made great strides forward in labour productivity for instance, yet huge gains that could come out of a proactive focus on energy productivity are yet to be accessed.

What is now required are strong, mutually reinforcing policies and strategies involving economic instruments, regulations and standards, institutional/organisational change, directed funding with sunset clauses, and education and information. Acting only on a subset of these will be insufficient.

Benefits of a Clean Energy Future

The real benefits of a strong commitment to and comprehensive policy support for a clean energy future are too numerous to detail here, but include:

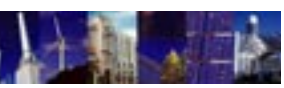
- rural employment growth;
- growth in exports, particularly to developing countries where 2 billion people do not have access to electricity infrastructure;
- reductions in household and business operating costs and the flow-ons to the domestic economy that both those savings will bring; and
- significant benefits to the environment and public health through reduction in greenhouse gas emissions and other pollutants with corresponding reductions in the costs of a degraded environment and ill health.

Recommendations

Chapter 12 of the full study contains 40 recommended policies and strategies to achieve the Clean Energy Scenario 2.

Policies urgently needed include:

- Substantially increase the Mandatory Renewable Energy Target (MRET);
- Mandate strict greenhouse intensity limits on any proposal to build a new coal-fired power station or to refurbish an existing one – these limits would require less CO_2 emissions per unit of electricity sent out than the best exisiting combined cycle natural gas power station;
- Implement national mandatory minimum energy and greenhouse performance standards and labelling for all appliances and equipment with capacity to use 50 watts or greater of electricity. Make standards increasingly stringent every 5 years;
- For all commercial buildings mandate minimum energy and greenhouse performance standards based on the Australian Building Greenhouse Rating Scheme;



- Mandate that a solar, heat pump or solar compatible natural gas hot water system with low standby losses be installed in every proposal for a new or substantially renovated residential building;
- Establish a target for cogeneration and provide grants on a dollar for dollar basis to assist in funding feasibility studies for specific projects;
- Change the MRET regulation to encourage dedicated tree energy crops for the purpose of growing biomass fuel on land that was cleared before 1990;
- Provide specific support for the development of a biomass roadmap for Australia and its implementation;
- Consult widely on, develop and implement consistent planning guidelines across all levels of government for the establishment of wind farms;
- Revise the National Electricity Code to ensure distributed generators receive fair network access and pricing, considering location of generators and time of day of generation.

This study shows that Australia can halve greenhouse emissions from stationary energy by 2040 with the appropriate policy settings. We have huge scope for energy efficiency and the natural gas and renewable energy resource base to do this using small improvements to existing technologies. Government policies must provide a framework for continued investment in research and development as more significant emission reductions are required by 2040.

With a strong commitment to a clean energy future, Australian decision-makers can ensure that Australia can continue to maintain an energy cost advantage over its competitors in a carbon constrained world.

With a clean energy future there is a living planet sustaining a healthy population enjoying greater employment opportunities. The alternative scenario – where Australia continues to increase its greenhouse gas pollution – is not economically, environmentally or ethically sustainable.

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A full copy of the study is available from any of the Clean Energy Future Group's websites listed overleaf.

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Clean Energy Future Group

AEPCA is the Australasian Energy Performance Contracting Association. Its members are formed from energy service companies, state government departments and private companies interested in the performance contracting process.
www.aepca.asn.au

The Australian Business Council for Sustainable Energy (BCSE) represents the interests of the broader sustainable energy industry including: renewables, cogeneration, gas-fired generation, waste-to-energy and energy efficiency. It has more than 250 organisations as members.
www.bcse.org.au

The Australian Wind Energy Association (AusWEA)'s vision is for a robust Australian Wind Community that makes a significant contribution to safe, reliable, economically and environmentally sustainable energy supply in Australia.
www.auswea.com.au

Bioenergy Australia was established in 1997 as a government-industry forum to foster and facilitate the development of biomass for energy, liquid fuels, and other value added bio-based products.
www.bioenergyaustralia.org

The Renewable Energy Generators of Australia (REGA) was formed in 1999 as an industry association with a common purpose of supporting the development of generation of electricity from truly renewable resources. REGA represents all sectors of the renewable energy industry.
www.rega.com.au

WWF Australia is part of the WWF International Network - the world's largest independent conservation organisation. With the help of more than 50,000 supporters across Australia, we're helping to protect and conserve our most biologically outstanding land, freshwater and marine habitats and reduce the causes and impacts of climate change.
www.wwf.org.au

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