



Clean Energy Council

Clean Energy Australia 2009

the future is now

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Introduction

In May this year the United Nations Environment Program* reviewed global energy investment. It found for the first time in modern history that investment in clean energy technologies had passed investment in conventional energy. Around US\$190 billion** of new clean energy generation was deployed around the world last year.

* Source: Global Trend in Sustainable Energy Investment Report 2009, UNEP

** Figure includes large hydro

Australia is blessed with abundant clean energy resources from a wide range of sources: the constant winds of the Roaring Forties, abundant sunshine, geothermal resources, bioenergy, ocean and wave energies. Currently around 6 per cent of Australia's electricity energy comes from renewable sources. Australia is already well advanced to reach and surpass its 20 per cent renewable energy target by 2020.

Source: Clean Energy Council Renewable Energy Database

The expanded Renewable Energy Target (RET) passed by federal parliament in August 2009 is expected to unleash more than \$20 billion of investment in renewable energy technologies, and alongside the government's energy efficiency strategy, create 28,000 new jobs.

Source: Access Economics, the net employment impacts of climate change policies, June 2009

Clean energy policy in Australia

Australia and the world face a considerable challenge in decarbonising energy supply to avoid the risk of dangerous climate change. Two key mechanisms to deliver this urgent reform are the accelerated development of affordable, reliable and safe clean energy technologies at scale, and measures to drive more efficient use of energy in households, business and factories.

Policy measures to drive these reforms should precede a carbon price, as the availability of effective clean energy and energy efficiency solutions will make the transition to a decarbonised economy faster and more affordable. An expanded renewable energy target is only the first step in that policy framework. Governments need to find an array of policy measures to develop all of Australia's proven and emerging clean energy resources. The abundance of our clean energy potential is both a blessing and a challenge: we have the potential to source much of our energy from clean energy sources, but will need to explore the potential of all the technologies at our disposal to achieve this.

The primary objective of the Clean Energy Council (CEC) is to support this policy challenge by co-ordinating, refining and articulating the views of the clean energy industry. Our focus is on solutions, not problems.

For the first half of 2009 the CEC's primary focus was to ensure the passage of an effective expanded renewable energy target. Since the passage of the expanded RET the CEC has been focussed on understanding how the RET is operating and ensuring it meets its core renewable electricity objective: delivering 45,000 gigawatt hours by 2020.

The CEC also proposed measures to accelerate investment in emerging clean energy technologies that represent the future of this industry. The federal government's \$1.5 billion Solar Flagships program was launched in 2009 and provides great potential for large scale solar energy in Australia. The CEC is working with the government to ensure it delivers on that promise.

The CEC strongly supports the immediate implementation of a Carbon Pollution Reduction Scheme, ensuring the full recognition of voluntary contributions to reduce emissions such as GreenPower.

The CEC also supports the development of the National Energy Efficiency Mechanism which has been recognised by the creation of a Prime Minister's task group to report in mid 2010.

Over the next 12 months the CEC will focus on:

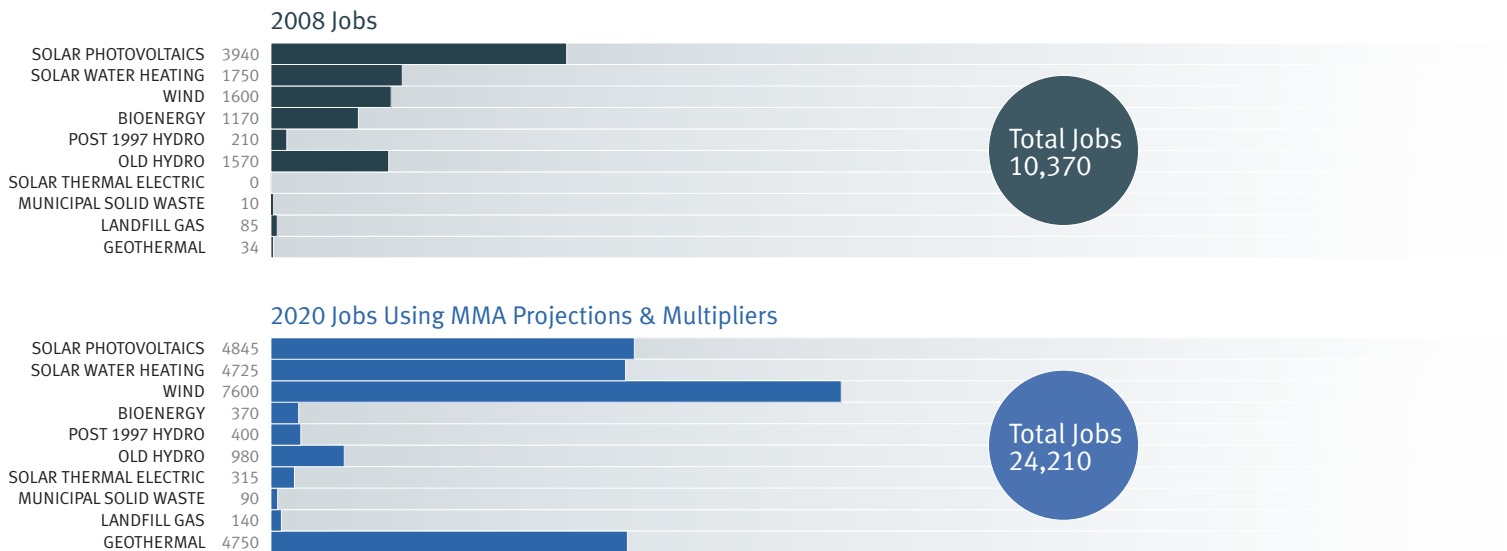
- Working with the government and industry to propose effective reforms to the expanded RET that will drive the deployment of all clean energy technologies
- Development of a comprehensive clean energy strategy for Australia to guide and co-ordinate the efforts of state and federal governments
- Continued advocacy to drive the development and deployment of emerging clean energy technologies
- Helping to give form to the challenge of achieving systemic energy efficiency improvements in all parts of the Australian economy

Australia's renewable energy industry – building a skilled workforce

New workforce and training strategies are needed to support the continued development of renewable energy infrastructure and ensure the availability of a skilled workforce to achieve Australia's renewable energy target of 20 per cent by 2020.

Currently there are 10,370 employees in the renewable energy industry. It is expected that by 2020 more than 24,000 jobs will be created.

Figure 1. Renewable energy industry employment

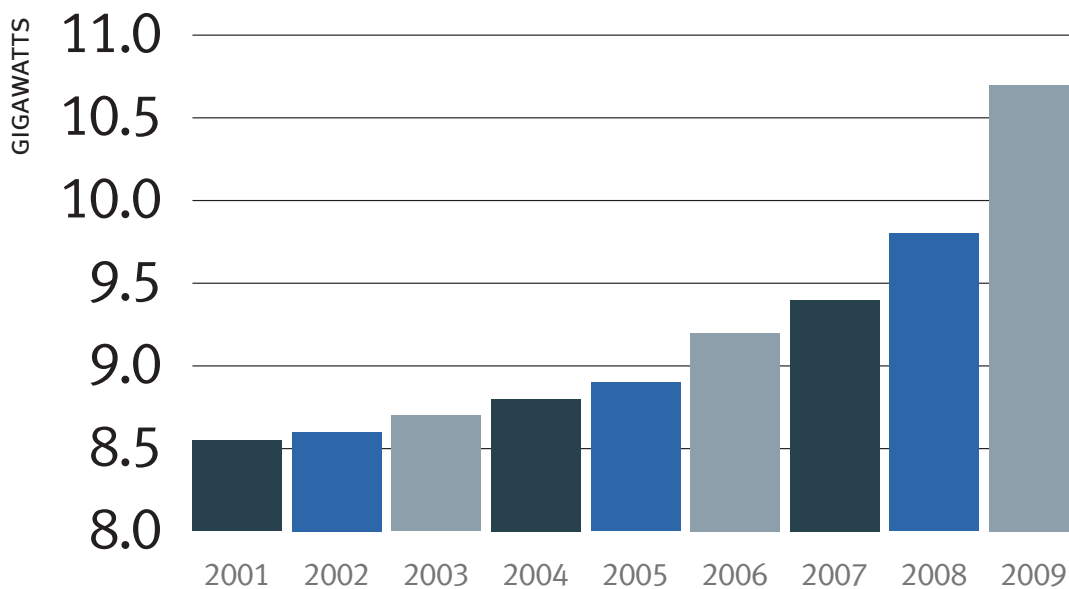


Source: Renewable Energy Training in Australia 2009, Clean Energy Council and Department of Water, Heritage and Arts

Industry snapshot

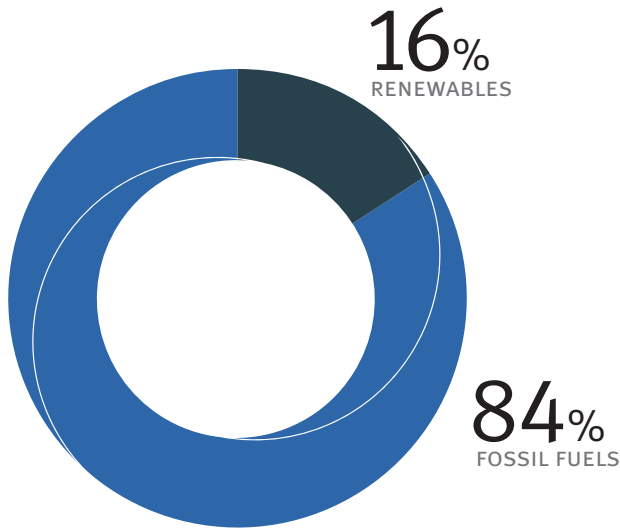
As at November 2009, there were 305 renewable power generation projects (of greater than 100kW in size) operating in Australia representing 10,629 MW of installed capacity. The total installed capacity of all power stations including renewable and fossil fuel is 65, 085MW.

Figure 2. Cumulative installed renewable energy capacity in Australia (2001–2009)



Source: Clean Energy Council Renewable Energy Database

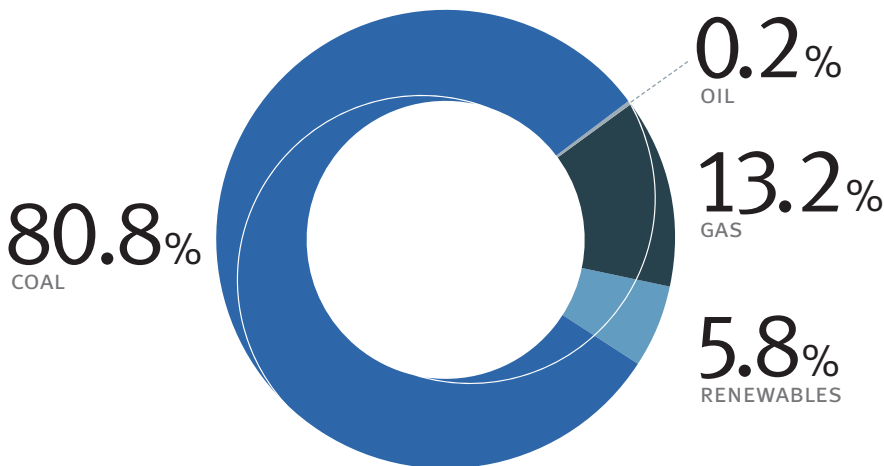
Figure 3. Percentage of installed renewable energy capacity in Australia



Installed capacity is a measure of the total capacity or “nameplate” capacity of a power plant and is measured in megawatts (MW). The installed capacity of a power plant is different to the actual electricity that is produced by the power plant. For example hydro power plants have been generating significantly less electricity than they are capable of according to their installed or nameplate capacity due to low rainfall in dam areas.

Figure 4. Australian electricity generation 2007-08

Source: ESAA, Electricity Gas Australia, 2009



The Australian energy industry generated 229 terawatt hours of electricity in 2007–08. Renewable energy comprised around 6.5 per cent of electricity generated for public consumption in 2006–7, but fell to 5.8 per cent of electricity in 2007–08: the result of lower rainfalls in key hydro catchments.

Source: Clean Energy Council Renewable Energy Database

Table 1. Renewable energy installed capacity by fuel type

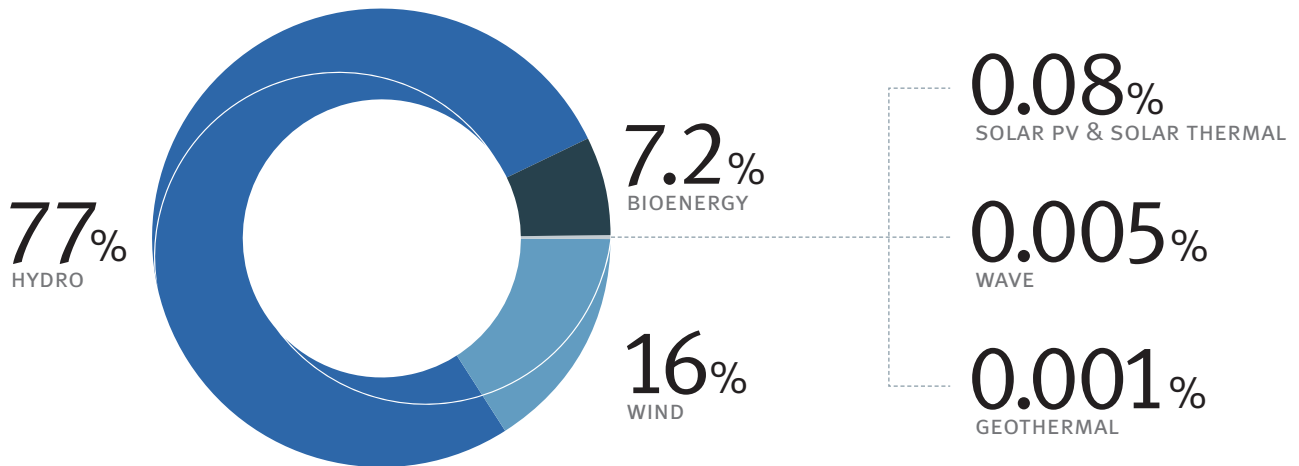
Source: Clean Energy Council Renewable Energy Database (only includes projects greater than 100kW in size)

Currently most of Australia's clean energy at present is derived from hydro electricity. It accounts for 77 per cent of total renewable generation capacity in Australia.

After hydro, wind makes the second largest contribution to clean energy capacity (16 per cent) followed by bagasse cogeneration (4.5 per cent) and landfill gas (1.5 per cent).

FUEL SOURCE	INSTALLED CAPACITY (MW)	NUMBER OF PROJECTS	PERCENTAGE
Hydro	8186	113	77 %
Wind	1668	48	16 %
Biomass:			
– Bagasse Cogeneration	474	29	4.5%
– Black Liquor	77	3	0.7%
– Crop Waste	1.5	1	0.01%
– Food and Agricultural Wet Waste	4	2	0.04%
– Landfill Gas	163	69	1.5%
– Sewage Gas	37	18	0.35%
– Wood Waste	9	3	0.08%
Bioenergy Sub-Total	765.5	125	7.2%
Large Scale Solar PV & Solar Thermal	9	17	0.08%
Wave	0.5	1	0.005%
Geothermal	0.1	1	0.001%
Renewable total:	10,629	305	100%

Figure 5. Renewable energy installed capacity by percentage



Source: Clean Energy Council Renewable Energy Database

Table 2. Small generation units

FUEL SOURCE	INSTALLED CAPACITY (MW)
Solar PV	145 MW

FUEL SOURCE	UNITS INSTALLED
Solar Water Heater / Heat pumps	600,000

Table 3. Top 20 new renewable energy projects commissioned during 2009

FUEL SOURCE	LOCATION	OWNER	STATE	INSTALLED CAPACITY
Wind	Waubra	Acciona	VIC	192 MW
Hydro	Murray 2 upgrade	Snowy Hydro	NSW	155 MW
Hydro	Tumut 3 upgrade	Snowy Hydro	NSW	150 MW
Wind	Capital Wind Farm	Infigen Energy	VIC	141 MW
Wind	Cullerin Range	Origin Energy	NSW	30 MW
Bagasse	Broadwater 2	Delta Electricity/Sunshine Sugar	NSW	30 MW
Bagasse	Condong 2	Delta Electricity	NSW	30 MW
Landfill Gas	Woodlawn Bioreactor	Veolia Environmental Services	NSW	6 MW
Solar Thermal	Liddell expansion	Ausra/Macquarie Generation	NSW	4 MW
Hydro	Silvan	Melbourne Water	VIC	2.1 MW
Landfill Gas	Summerhill	Newcastle City Council	VIC	2 MW
Landfill Gas	Bondi	Sydney Water	NSW	1.4 MW
Sewage Gas	Shepparton	Diamond Energy	VIC	1.1 MW
Hydro	Olinda	Melbourne Water	VIC	1 MW
Solar PV	Adelaide Showgrounds	First Solar	SA	1 MW
Hydro	Upper Yarra Aqueduct	Melbourne Water	VIC	0.9 MW
Hydro	Notting Hill	Melbourne Water	VIC	0.6 MW
Hydro	Mount View	Melbourne Water	VIC	0.5 MW
Solar PV	Alice Crowne Plaza	Alice Crowne Plaza	NT	0.3 MW
Solar PV	Adelaide Airport	Adelaide Airport	SA	0.11 MW

As at November 2009 seven new wind energy projects were under construction which will add another 559 MW of installed capacity to the total. New hydro projects under construction will add a further 171 MW and bioenergy projects a further 23 MW.

Source: Clean Energy Council Renewable Energy Database

Based on the current installed capacity of renewable power plants and taking into account the capacity factor of power stations, an estimation can be made of the annual electricity generation expected from renewable power stations in Australia.

Table 4. Estimated renewable electricity generation per year.

Source: Clean Energy Council Renewable Energy Database

FUEL SOURCE	ESTIMATED ELECTRICITY GENERATION PER YEAR (MWh)
Hydro	13,816,272
Wind	4,967,971
Bioenergy	5,364,624
Solar PV	262,800
Solar Thermal	8,760
Wave	1,095
Geothermal	701
*SWH (deemed)	1,244,736
Renewable Total	25,666,959

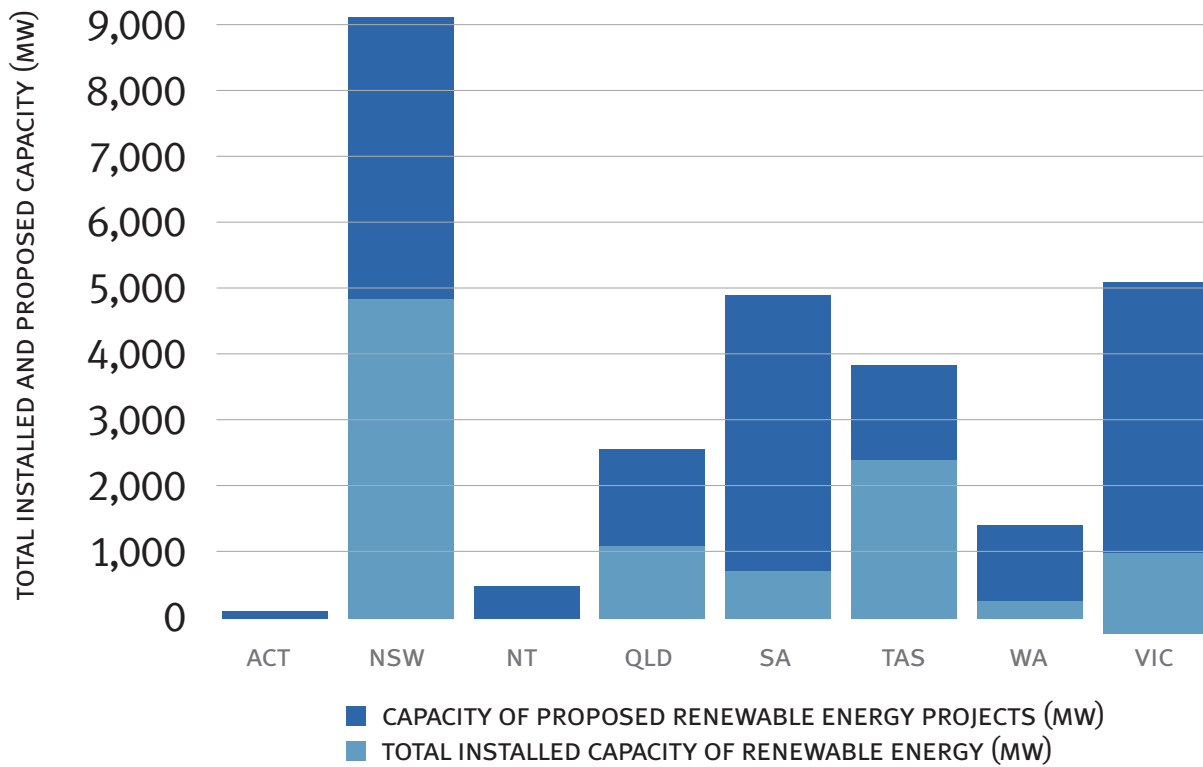
* deemed to have offset electricity

Table 5. Capital cost for new entrant plant at 2008 \$AU

Source: Access Economics Report for CEC (The net employment impacts of climate change policies), ORER 2008 Annual Report and CEC Renewable Energy Database

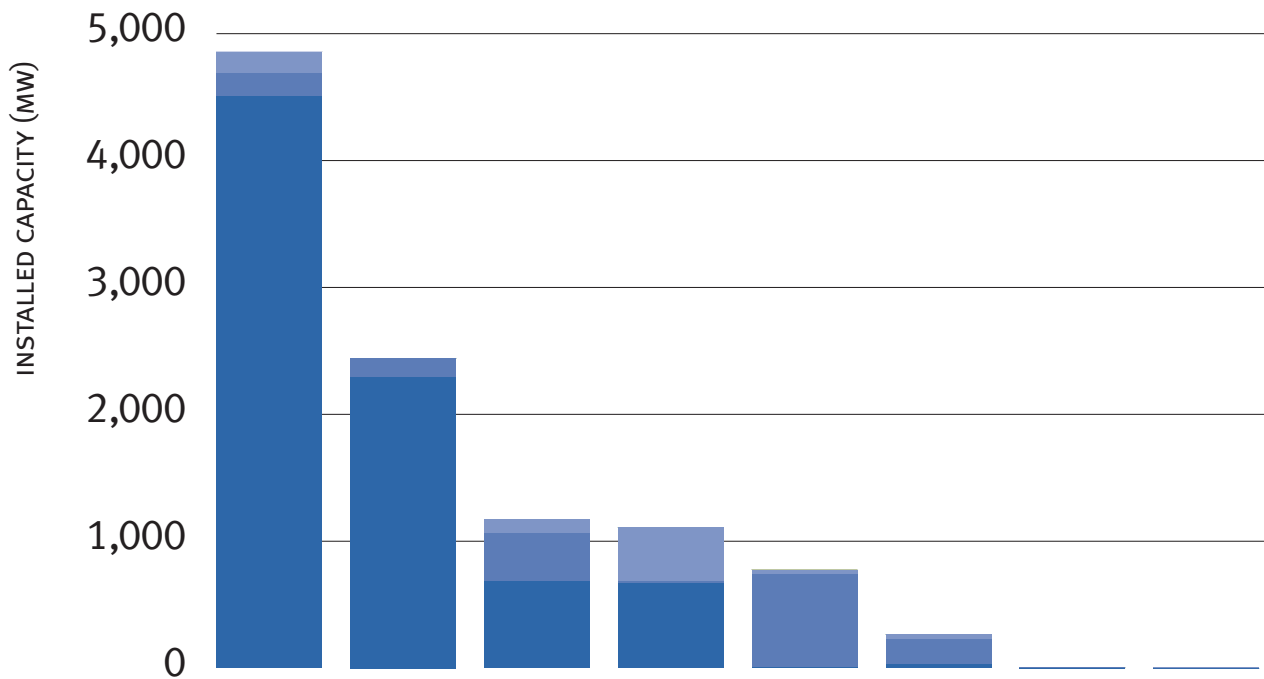
RENEWABLE TECHNOLOGY	\$M/MW	CAPACITY INSTALLED IN 2008 (MW)	CAPITAL COST OF PLANT COMMISSIONED IN 2008 (\$M)
Hydro	3.01	7	\$21
Solar Thermal	4.16	0	\$0
Solar PV- small	9.5	22	\$209
Solar PV - large	7.5	0.28	\$2
Wind	2.23	482	\$1,075
Bioenergy	2.65	14	\$37
Geothermal	2.9	0	\$0
Wave	5	0	\$0
Tidal	3.5	0	\$0
			Sub Total \$1,344
	\$M/UNIT	UNITS INSTALLED	
SWH	0.005	83,000	\$415
Total			\$1,759

Figure 6. Renewable energy projects in Australia by state



Source: Clean Energy Council Renewable Energy Database

Figure 7. Installed capacity of renewable energy projects by state



FUEL SOURCE	NSW	TAS	VIC	QLD	SA	WA	ACT	NT
Wave	0.5	0	0	0	0	0	0	0
Geothermal	0	0	0	0.1	0	0	0	0
Solar Thermal	4	0	0	0	0	0	0	0
Solar PV	2	0	1	0	2	0	0	1
Bioenergy	162	4	103	426	29	36	4	1
Wind	187	143	384	12	740	201	0	0
Hydro	4505	2295	683	669	3	30	1	0
Total	4860.5	2442	1171	1107.1	774	267	5	2

Source: Clean Energy Council Renewable Energy Database

Table 6. Renewable energy installed capacity by state

STATE	INSTALLED CAPACITY (MW)	PERCENTAGE OF NATIONWIDE INSTALLED CAPACITY	NUMBER OF PROJECTS
NSW	4860	46%	77
TAS	2,442	23%	43
VIC	1171	11%	62
QLD	1,107	10%	56
SA	774	7.3%	24
WA	267	2.5%	31
ACT	5.6	0.05%	5
NT	2.4	0.02%	6
Territories**	0.6	0.01%	1
Total	10,629	100%*	305

*Due to rounding totals may not add up to 100%. **includes Lord Howe Island, Cocos (Keeling) Island, Australian Antarctic Base

Table 7. Installed capacity of renewable energy projects commissioned during 2009

FUEL SOURCE	INSTALLED CAPACITY (MW)	NUMBER OF PROJECTS
Bagasse Cogeneration	60	2
Landfill Gas	8	2
Sewage Gas	2.5	2
Hydro	310	7
Large Scale Solar Photovoltaic & Solar Thermal	5	4
Wind	363	3
Total	749	20

Source: Clean Energy Council Renewable Energy Database (only includes projects greater than 100kW in size)

Table 8. Clean energy state-by-state snapshot

Source: Clean Energy Council Renewable Energy Database

STATE	INSTALLED CAPACITY	PERCENTAGE OF NATIONWIDE INSTALLED CAPACITY	NUMBER OF PROJECTS	TECHNOLOGIES	FEED-IN-TARIFF	SUPPORT FOR CLEAN ENERGY ESTABLISHED IN 2009
ACT	5.6	0.05%	5	Bioenergy Hydro	50.05 cents / kWh for less than 10kW 40.04 cents / kWh for 10-30kW (Gross)	Committed \$30 million of funding for large scale solar projects
New South Wales	4,860	46%	77	Wave Solar Thermal Solar PV Bioenergy Wind Hydro	60 cents / kWh (Gross)	<ul style="list-style-type: none"> NSW Wind Renewable Energy Precincts. State Government's \$700 million Climate Change Fund, established in July 2007, operational. Since 2007 funds have been allocated in the following areas: <ul style="list-style-type: none"> \$100 million Residential Rebate Program \$30 million NSW Green Business Program \$30 million Public Facilities program \$40 million Renewable Energy Development Fund \$20 million School Energy Efficiency program \$20 million Rainwater Tanks in Schools program \$150 million program under the Energy Efficiency Strategy
Northern Territory	2.4	0.02%	6	Solar PV Bioenergy	N/A	
Queensland	1,107	10%	56	Geothermal Bioenergy Wind Hydro	44 cents / kWh (Net)	<ul style="list-style-type: none"> State Government's \$50 million Renewable Energy Plan to increase deployment of renewable energy initiatives and accelerate growth of this sector established in 2009. \$15 million Queensland Geothermal Energy Centre of Excellence to drive geothermal research and technology Solar Bonus Scheme – a feed-in tariff to pay domestic and small energy customers for the surplus electricity generated from roof-top solar systems
South Australia	774	7.3%	24	Solar PV Bioenergy Wind Hydro	44 cents / kWh (Net)	<ul style="list-style-type: none"> The South Australian Government claims to offer national best practice land use planning for accommodating wind farms. Solar feed-in scheme under review. Current rates; \$0.44 per unit of electricity (kilowatt-hour, kWh) for householders and small business customers who feed solar electricity into the grid. Renewable Energy Target (RET) 33% of electricity to be produced by renewable energy by 2010

Table 8. Clean energy state-by-state snapshot

Source: Clean Energy Council Renewable Energy Database

STATE	INSTALLED CAPACITY	PERCENTAGE OF NATIONWIDE INSTALLED CAPACITY	NUMBER OF PROJECTS	TECHNOLOGIES	FEED-IN-TARIFF	SUPPORT FOR CLEAN ENERGY ESTABLISHED IN 2009
Tasmania	2,442	23%	43	Bioenergy Wind Hydro	Current retail offer – at 20 cents / kWh FIT – TBC	<ul style="list-style-type: none"> The Tasmanian Government released its Energy Policy Statement in December 2009 and has set up a Tasmanian Renewable Energy Industry Development Board.
Western Australia	267	2.5%	31	Bioenergy Wind Hydro	FIT – TBC (FIT/Net)	<ul style="list-style-type: none"> Sustainable Energy Development Office (SEDO) Grants Program – \$5,000 to \$50,000 for community-based sustainable energy projects targeting householders to increase use of renewable energy
Victoria	1171	11%	62	Solar PV Bioenergy Wind Hydro	Premium FIT for solar PV – 60 cents / kWh F&R Tariff – at least 1:1 (FIT/Net)	<ul style="list-style-type: none"> Victorian Renewable Energy Target Scheme (VRET) commenced 1 January 2007 – 10% by 2016 – 3274GWh VRET will be absorbed into the national RET scheme when it commences in 2010 Sustainable Energy Large Scale Demonstration Program – \$72m grants program to support the development of large scale, pre-commercial demonstrations of sustainable energy technologies

Table 9. Renewable energy projects under construction as at November 2009

Source: Clean Energy Council Renewable Energy Database (only includes projects greater than 100kW in size)

FUEL SOURCE	INSTALLED CAPACITY (MW)	NUMBER OF PROJECTS
Geothermal	1	1
Landfill Gas	19	1
Food & Agricultural Wet Waste	8	1
Sewage Gas	2	4
Hydro	171	6
Large Scale Solar Photovoltaic	1	1
Solar Thermal	1	1
Wood Waste	2	1
Wind	559	7
Total	763	23

Table 10. Wind farms offsetting desalination plants

Source: Clean Energy Council Renewable Energy Database

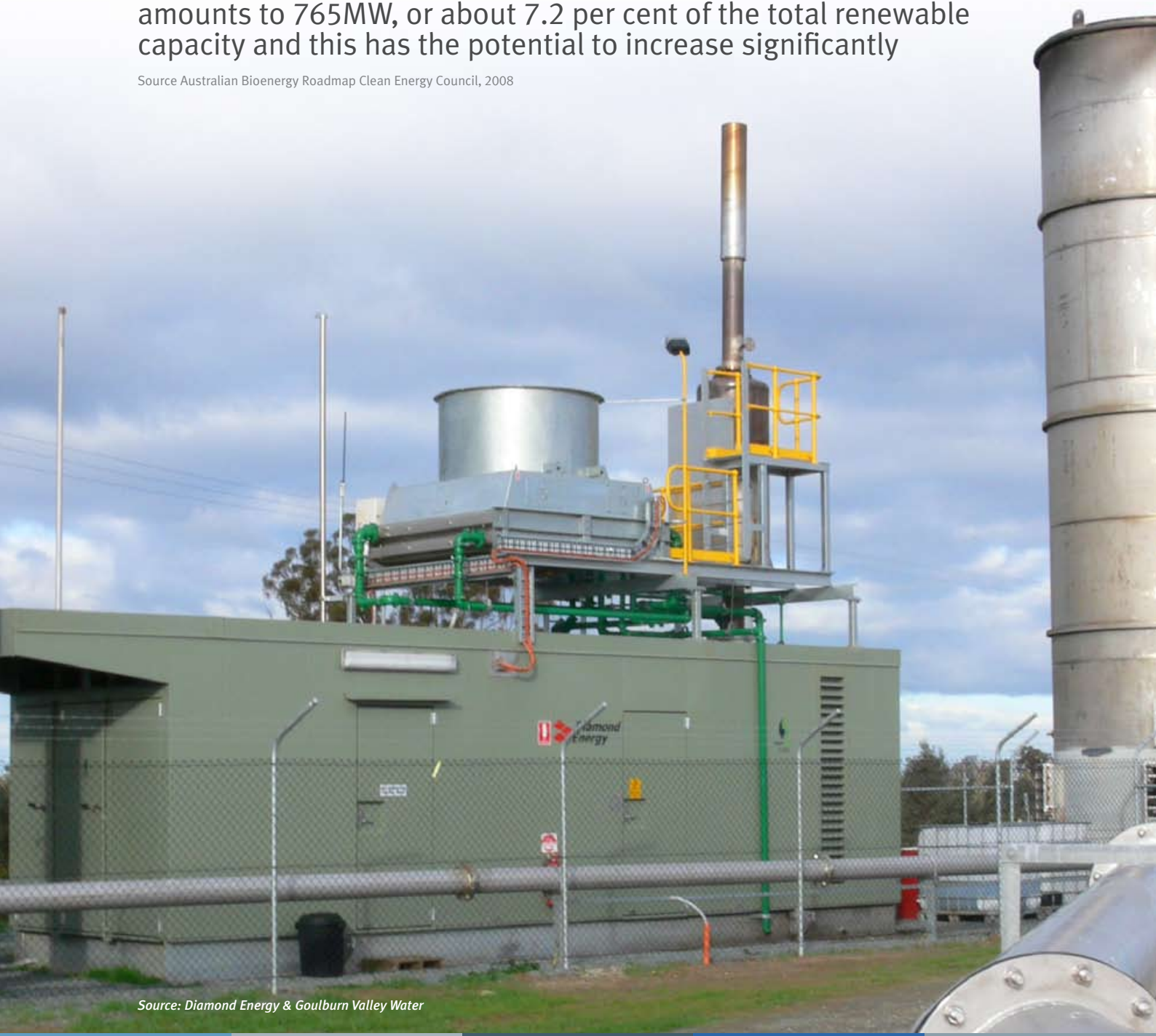
DESALINATION PLANT	OWNER	LOCATION	COMMISSION YEAR	INSTALLED CAPACITY
Victoria	AGL	Oaklands Hill	2011	86 MW
Sydney	Infigen Energy	Capital Wind Farm	2009	141MW
South Australia	AGL	Hallett Wind Farm projects	2008–2012	438 MW
WA	Transfield Services/Griffin Energy	Emu Downs	2006	79 MW

Clean energy technologies

Bioenergy 7.2% of total renewable energy capacity

The current installed capacity of bioenergy in Australia amounts to 765MW, or about 7.2 per cent of the total renewable capacity and this has the potential to increase significantly

Source Australian Bioenergy Roadmap Clean Energy Council, 2008

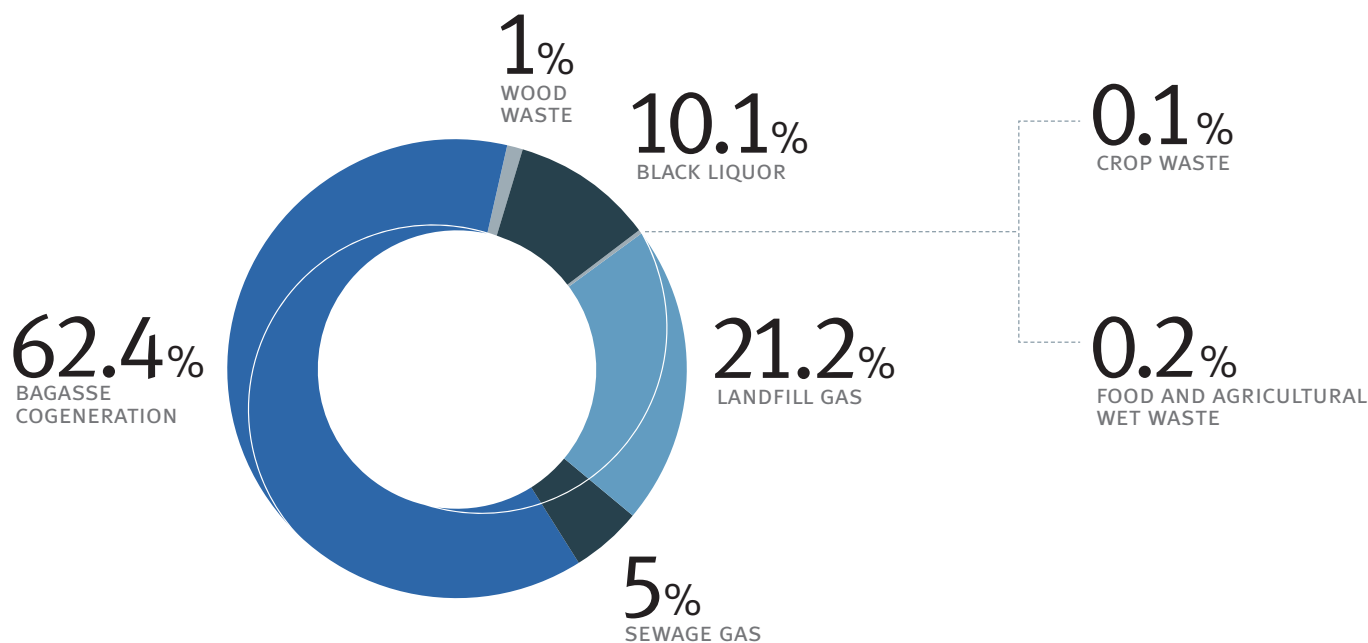


Source: Diamond Energy & Goulburn Valley Water

Bioenergy

Figure 8. Installed capacity for bioenergy sub sectors by percentage

Source: Clean Energy Council Renewable Energy Database



The current installed capacity in Australia amounts to 765MW, or about 7.2 per cent of the total renewable capacity.

Source: Bioenergy Roadmap Clean Energy Council, 2008

A biomass resource appraisal forecast that an annual target of around 11,000 gigawatt hours (GWh) each year could be delivered from this technology, equivalent to 1845 MW of installed capacity by 2020. New capacity is currently being commissioned and more plants are in the construction phase, notably in NSW.

Table 11. Bioenergy plants commissioned during 2009

Source: Clean Energy Council Renewable Energy Database

FUEL SOURCE	LOCATION	OWNER	STATE	INSTALLED CAPACITY
Bagasse Cogeneration	Broadwater II	Delta Electricity and Sunshine Sugar JV	NSW	30 MW
Bagasse Cogeneration	Condong II	Delta Electricity	NSW	30 MW
Landfill Gas	Woodlawn Bioreactor	Veolia Environmental Services	NSW	6.4 MW
Landfill Gas	Bondi	Sydney Water	NSW	1.4 MW
Landfill Gas	Summerhill	Newcastle City Council	NSW	2 MW
Landfill Gas	Shepparton	Diamond Energy	NSW	1.1 MW

Bioenergy

Table 12. Bioenergy plants under construction

Source: Clean Energy Council Renewable Energy Database

FUEL SOURCE	LOCATION	OWNER	STATE	COMMISSION YEAR	INSTALLED CAPACITY
Food and Agricultural Wet Waste	Mt Cotton	Darwalla Group	QLD	2009/10	7.6 MW
Landfill Gas	Woodlawn Stages II-IV	Veolia Environmental Services	NSW	2010	19 MW
Sewage Gas	Warriewood	Sydney Water	NSW	2009/10	0.25 MW
Sewage Gas	Wollongong	Sydney Water	NSW	2009/10	0.51 MW
Sewage Gas	Glenfield	Sydney Water	NSW	2009/10	0.53 MW
Wood Waste	Dandenong	Consolidated Energy Resources	VIC	2009/10	2.4 MW
Sewage Gas	Liverpool	Sydney Water	NSW	2009/10	0.33 MW

Bioenergy has been embraced internationally in many countries. In the US, the sector generates close to 60,000 GWh of electricity, while the European Union is aiming to double bioenergy's contribution by 2010. Already, bioenergy supplies over 20,000 GWh in Germany, contributes 14 per cent of Finland's energy needs and delivers 5 per cent in both Sweden and Austria

Source: International Energy Agency (IEA), Renewables Information, 2007

Energy Efficiency

Insulation in buildings is a key component to improved energy efficiency



Source: CSR

Energy Efficiency

Australia has a major opportunity to increase its energy efficiency, and reduce the impact of dangerous greenhouse emissions. However electricity consumption is expected to grow at an average of 2 per cent per annum over the next two decades.

Source: ABARE

In July 2009 the Council of Australian Governments signed off on a National Strategy for Energy Efficiency, supported by a Memorandum of Understanding between federal and state governments. The strategy aims to improve minimum standards for energy efficiency, accelerate the introduction of new technologies through regulatory incentives and address barriers to improve energy efficiency.

A key efficiency technology in Australia is insulation. Through the use of improved insulation, well designed shading and efficient glazing the amount of energy used for the heating and cooling of Australian buildings can be substantially reduced.

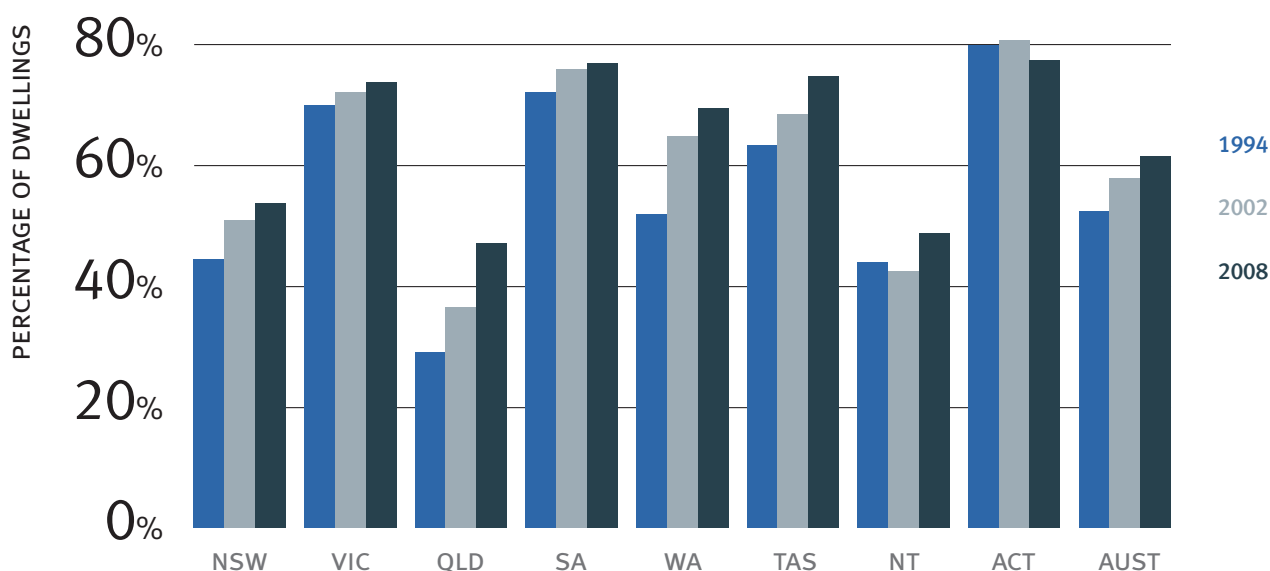
Ceiling and roof insulation can save up to 45 per cent on the energy used for heating and cooling. According to the Insulation Council of Australia and New Zealand, retrofitting uninsulated homes could save 2.4 million tonnes of greenhouse gas each year. (Source: The Federal Government's Home Technical Manual)

Around 61 per cent of Australian homes are insulated, but in most cases the insulation is in the roof only. One fifth of householders did not know whether their homes were insulated and only around 30 per cent have wall insulation.

Source: Australian Bureau of Statistics (ABS), Environmental Issues: Energy Use and Conservation, Mar 2008

Figure 9. Dwellings with insulation by state

Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2008

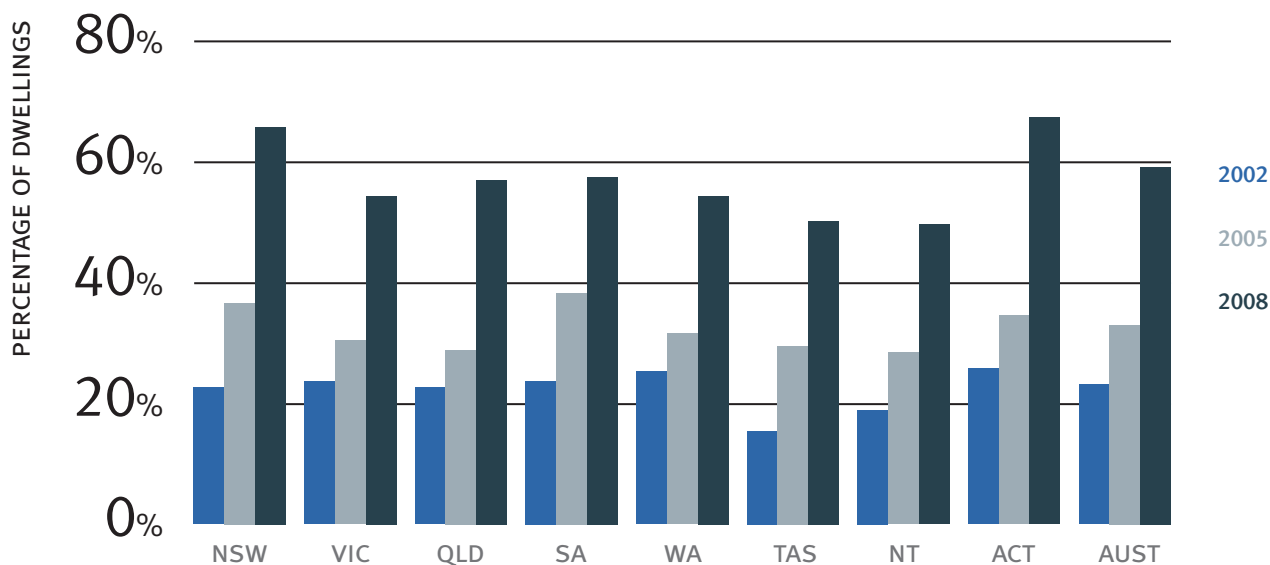


Energy Efficiency

In 2008, 58 per cent of dwellings used energy saving lights in at least one room, while 22 per cent had compact fluorescent lights in every room.

(Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2008)

Figure 10. Percentage of dwellings utilising energy saving lights by state Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2008



(a) Excludes fluorescents. Includes people's own perception of energy saving lights, e.g. low voltage halogen, etc.

- Household appliances account for about 30 per cent of total energy consumption and 53 per cent of residential greenhouse gas emissions.
- Two-thirds of Australian households have an air conditioner or evaporative cooler.
- 56 per cent have a clothes dryer, although 13 per cent reported that they never used their clothes dryer.

One third of households have two or more refrigerators in use

(Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2008)

To accelerate the uptake of energy efficiency measures across the Australian business and household community, a number of measures have been introduced by the federal government. Emerging out of amendments made to Australia's Carbon Pollution Reduction Scheme (CPRS) legislation is the possible development of a broad-based energy efficiency market mechanism in 2010. The Climate Change Action Fund provides funding for businesses to undertake energy efficiency measures from 1 July 2009. The Australian Carbon Trust will give households the opportunity to invest directly in the reduction of the country's emissions, and to drive the improved energy efficiency of buildings. Households are supported to reduce their emissions through the Energy Efficient Homes Package which provides funding to install solar water heaters and insulation; and a Green Loans Program.

A National Strategy on Energy Efficiency aims to improve minimum standards for energy efficiency, accelerate the introduction of new technologies through regulatory incentives, and address identified barriers to energy efficiency. The strategy increases the stringency of Minimum Energy Performance Standards and mandatory energy rating labelling for appliances and equipment; increases the minimum energy efficiency requirements for buildings through an enhanced Building Code of Australia for 2010; and introduces mandatory disclosure of a building's energy efficiency. The Energy Efficiency Opportunities (EEO) program was introduced in 2006 to improve energy efficiency via a mandatory reporting scheme for corporations to report on energy saving opportunities.

Geothermal .001% of total renewable energy capacity

According to estimates, hot rocks within five kilometres of the earth's surface contain enough energy to power Australia for 2.6 million years. If just one per cent of this energy could be tapped, it would be the equivalent of 26,000 times Australia's annual power consumption.

Source: Geoscience Australia



Source: Petratherm

Geothermal

The Australian Geothermal Energy Association (AGEA) estimates the generation cost of geothermal at A\$90-145/MWh in the demonstration stage, falling to A\$80-\$120/MWh in the commercial stage.

Significant exploration is already underway in Cooper Basin, (borders of SA, NSW and Queensland), Victoria, New South Wales and Tasmania.

Over 45 companies have applied for over 400 tenements around Australia and around \$1.5 billion worth of exploration work is in progress.

Drilling has begun on only a small number of these projects, but several of these are expected to have geothermal generators working within the next two to five years.

Table 13. Geothermal plant currently operating

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	INSTALLED CAPACITY
Ergon Energy	Birdsville 1	QLD	0.12MW

Table 14. Geothermal plant under construction

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	ESTIMATED CAPACITY	FUNDING
Geodynamics	Innamincka (Cooper Basin)	SA	1MW	AU\$90 million from the Australian Government's Renewable Energy Demonstration Program

Table 15. Other significant Geothermal players include Petratherm and Panax Geothermal

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	ESTIMATED CAPACITY	FUNDING
Petratherm	Paralana	SA	Initial capacity of 7.5MW by 2011, with the potential to scale up to 260MW by 2020.	AU\$62.8 million dollars from the Australian Government's Renewable Energy Demonstration Program
Panax	Penola	SA	The demonstration plant, producing 6.7MW, is expected to be operational by 2011, with the ultimate potential to deliver 100MW.	

Currently, over 20 countries globally are generating geothermal energy. In 2007 the global capacity of geothermal energy was 9732MW, which produces over 50,000 GWhs every year.

Significant producers include the USA, Iceland, Italy, New Zealand and Japan.

Forecast show that as many as 46 countries could be generating geothermal power by 2010.

Source: Department of Resources, Energy and Tourism

Hydro 77% of total renewable energy capacity

Hydro delivers the majority of Australia's renewable energy. Total hydro capacity as at November 2009 was 8186MW.

Source: Clean Energy Council Renewable Energy Database



Source: Hydro Tasmania

Hydro

The Snowy Mountains Scheme, dating from the 1950s, is the nation's largest, with 3756MW of capacity producing around 4500 GWh each year.

Another 176MW in new capacity is committed or currently under construction although environmental conditions particularly reduced rainfall, have resulted in decreased generation from some existing hydro facilities.

Table 16. Larger scale hydro plants under construction

Source: Clean Energy Council Renewable Energy Database

FUEL SOURCE	LOCATION	OWNER	STATE	COMMISSION YEAR	INSTALLED CAPACITY
Hydro	Jounama	Snowy Hydro	NSW	2009/2010	14 MW
Hydro	West Kiewa upgrade	AGL	VIC	2009/2010	12 MW
Hydro	Bogong	AGL	VIC	2009	140 MW

Hydro power is also the largest renewable energy source globally, generating 16 per cent of the world's electricity. Total global capacity is currently over 800 GW generating 3 million GWhs. The top four hydro generating countries, according to the International Energy Agency (IEA), are the USA, China, Brazil and Canada. China leads the way in new developments.

Solar 7.6%

of Australians have solar systems installed in the home

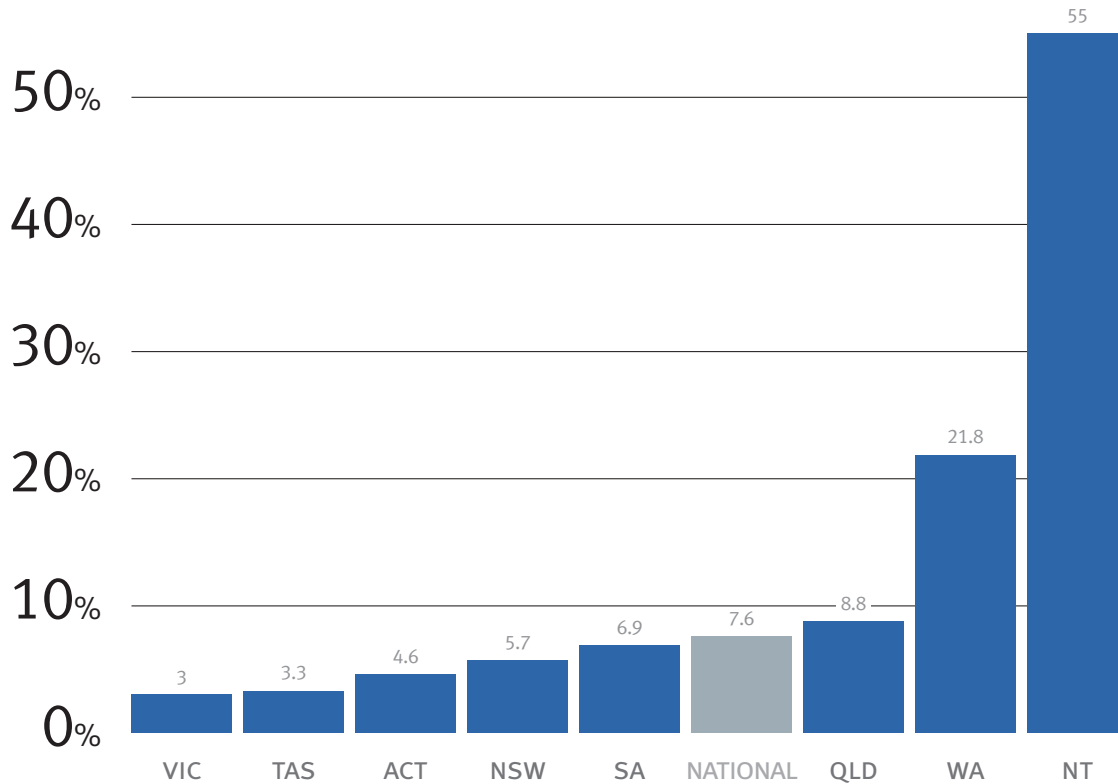
The total number of Australian households using solar energy increased by 60 per cent between 2002 and 2008.



Source: Solar Shop

Solar

Figure 11. Percentage of households using solar energy (SWH and PV) in 2008 Source: ABS 2009



The total number of Australian households using solar energy increased by 60 percent between 2002 and 2008

7.6 percent of Australians have solar systems installed in the home

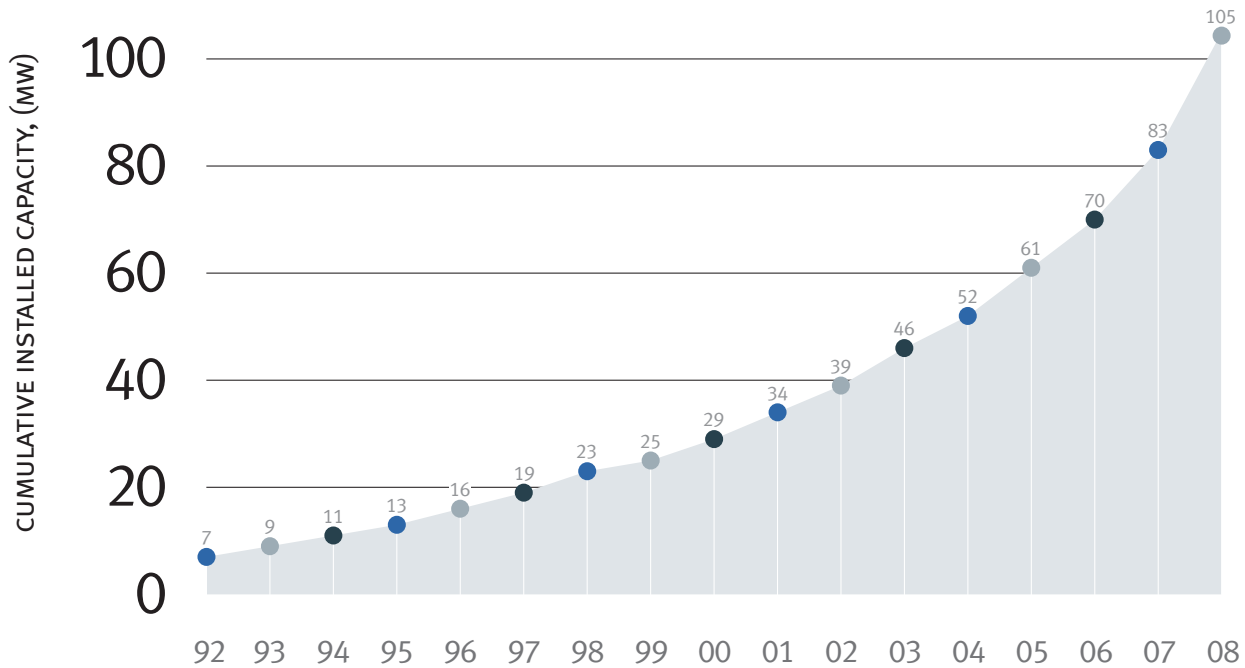
Source: Clean Energy Council Renewable Energy Database

Solar

Installations of solar panels connected to the grid and in remote off-grid locations have been rising exponentially since the 1990s. At the end of 2008, over 104.51MW had been installed nationwide with more than 40 MW installed so far in 2009. To illustrate the pace of growth, there has been a 43 per cent increase in the last two years.

Figure 12. Total installed capacity – solar PV

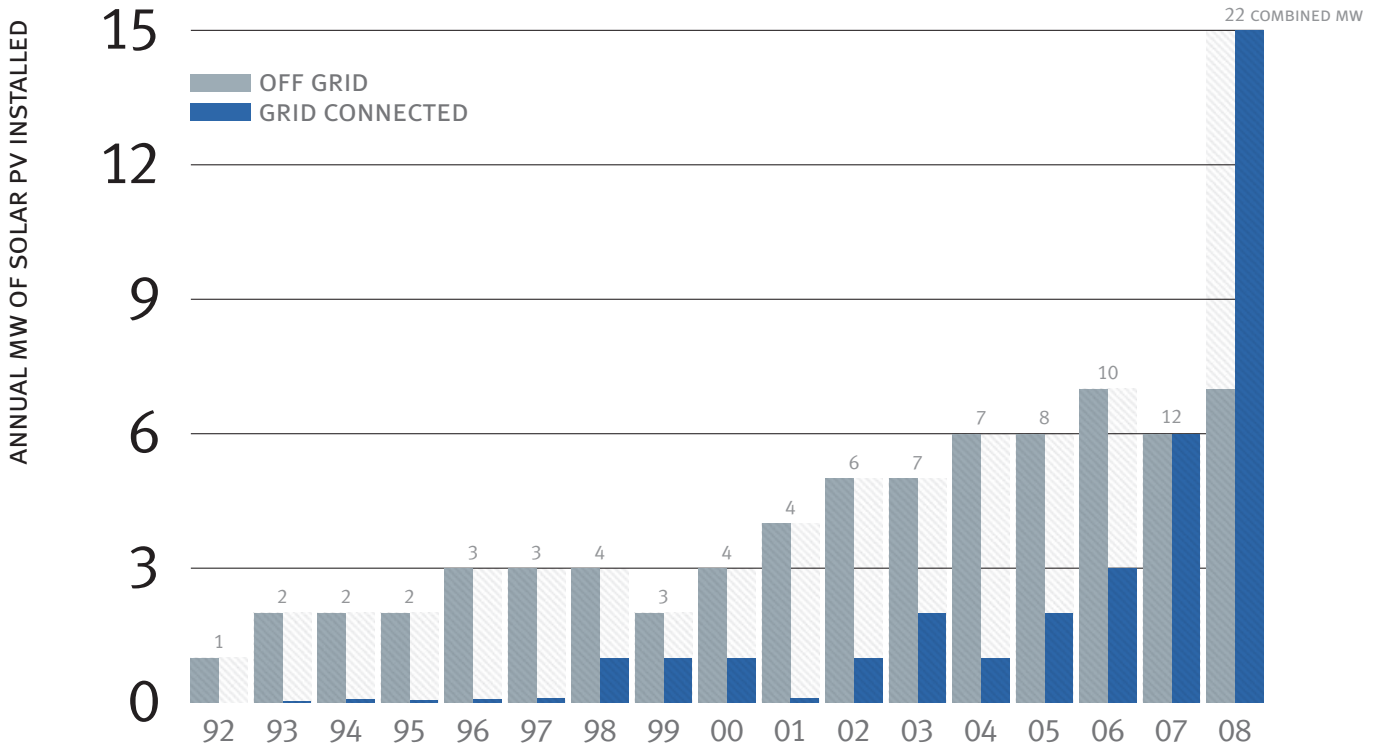
Source: Watt M. 2009



There is currently more than 145MW of installed capacity from solar PV in Australia

Solar

Figure 13. Annual capacity of PV installed Source: Watt M. 2009



Since 2007, more solar PV (particularly grid-connected) was installed in Australia than any other period on record. This trend coincides with

- A steep rise in rebates available from the Australian Government for PV installations
- A rise in awareness of climate change
- New global PV market entrants and
- A global reduction in the cost of PV.

Solar

Table 17. A sample of Australia's solar manufacturers

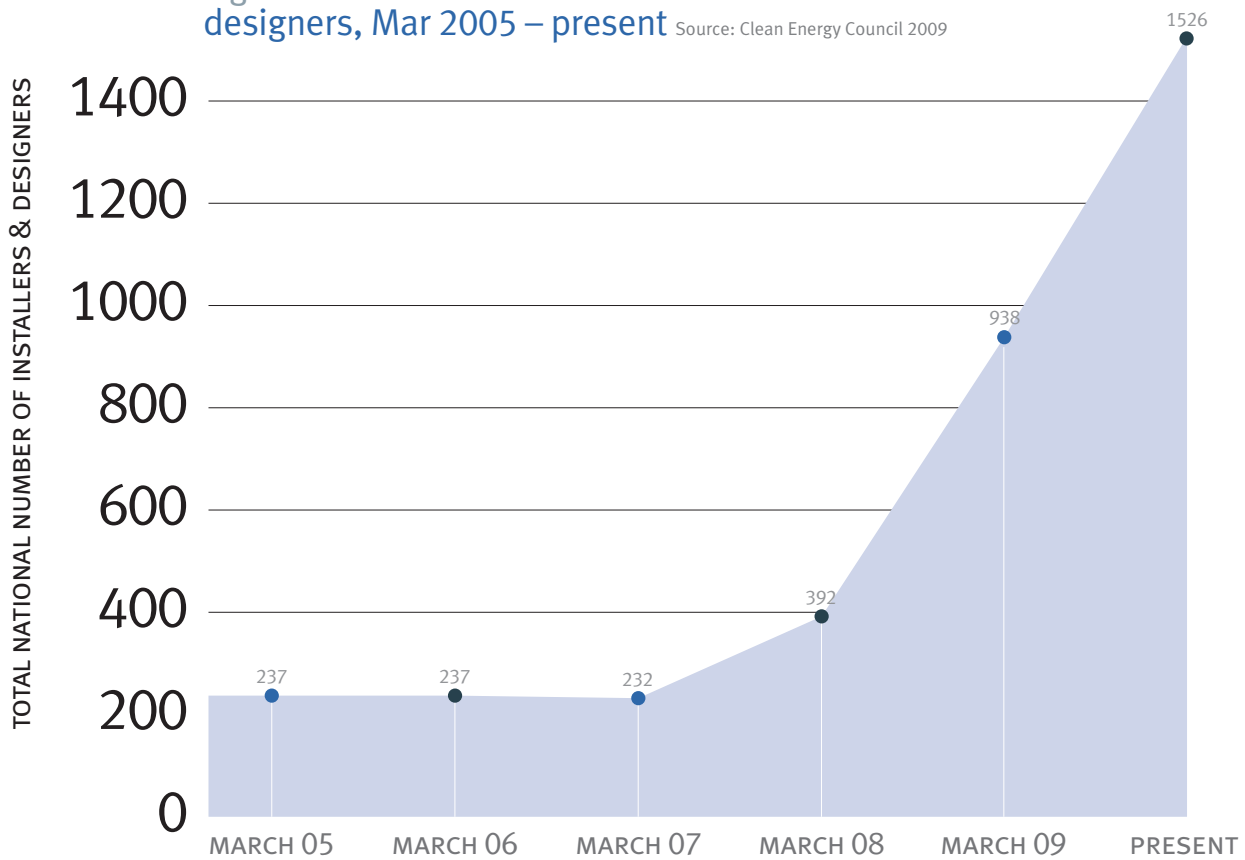
Source: Clean Energy Council 2009

COMPANY	MANUFACTURING FACILITIES
Cell and Module Manufacturers	
Origin	Regency Park, SA (Sliver® cell pilot plant)
Component and System Manufacturers	
Conergy	Bundamba, QLD & Canning Vale, WA
M&H Power Systems	Melbourne, VIC
PV Solar Energy	Sydney, NSW
Selectronics	Mooroolbark, VIC
Power Solutions Australia	Mooroolbark, VIC
Mono pumps	Melbourne, VIC
Latronics	Moffat Beach, QLD
Solco	Welshpool, WA
Plasmatronics	Melbourne, VIC
Swiss-Electric Solar	Glynde, SA
Solar Energy Australia	Mt Kuringai, NSW
Rainbow Power Company	Nimbin, NSW
Battery Manufacturers	
Century Yuasa Batteries	Carole Park, QLD
Redflow Energy	Seventeen Mile Rocks, QLD
Exide	Elizabeth, SA
Battery Energy Power	Sydney, NSW
Concentrator System Manufacturers	
Solar Systems (in administration)	Melbourne, VIC

Australia's solar PV industry is thriving with at least 17 major Australian owned companies currently manufacturing and distributing PV products to a domestic and international market.

Solar

Figure 14. National total of accredited installers and designers, Mar 2005 – present Source: Clean Energy Council 2009



In the last year, the number of accredited solar PV installers and designers has increased by more than 100 percent

Table 18. Number of accredited installers and designers by state, Mar 2005 – present Source: Clean Energy Council 2009

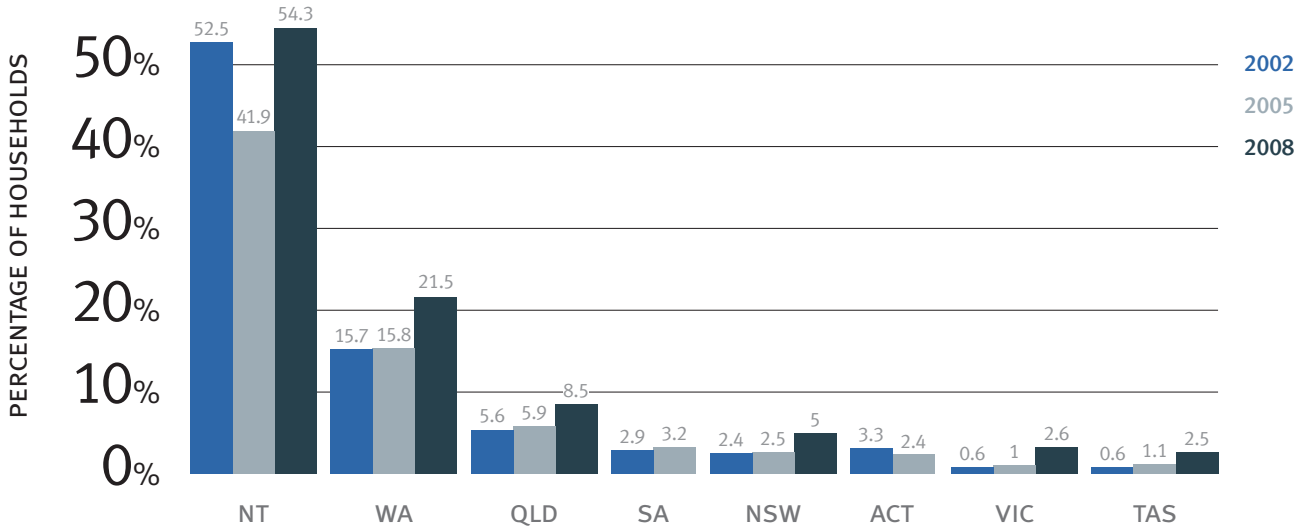
	VIC	NSW + ACT	QLD	WA	SA	TAS	NT	TOTAL
MARCH 05	48	77	49	24	23	7	9	237
MARCH 06	43	77	53	24	23	5	12	237
MARCH 07	41	69	46	28	23	6	19	232
MARCH 08	79	113	78	54	34	15	19	392
MARCH 09	286	246	170	118	74	29	15	938
PRESENT	447	352	328	217	120	45	17	1526

Victoria currently has the highest number of accredited installers and designers Australia-wide, followed closely by New South Wales and ACT

Solar

Figure 15. Percentage of homes using solar water heaters

2008 data for SA and ACT are currently unavailable. Source: ABS 2008



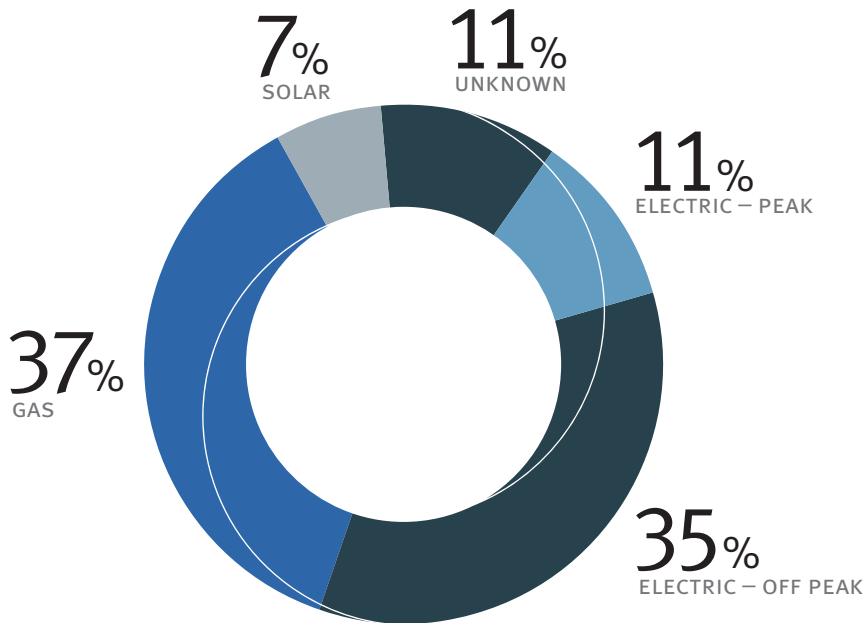
More households in the Northern Territory use solar energy to heat their water than any other region in Australia.

The number of Australian households using solar water heaters has increased by 61 percent since 2005

Solar

Figure 16. Household water heating energy sources

Source: ABS 2008



So far, only 7 percent of Australian households have made the switch to solar water heating

Most households in Australia currently use gas or electric water heaters.

Table 19. A sample of Australia's leading manufacturers of solar water heaters

Source: Clean Energy Council 2009

COMPANY	MANUFACTURING FACILITIES
Aquamax	Moorabbin, VIC
Beasley/Rinnai	Devon Park, SA
Dux Hot Water	Moss Vale, NSW
Rheem	Rydalmere, NSW
Solahart/Edwards	Welshpool, WA
Solar-Mio	Albury, NSW
Solco Industries	Welshpool, WA
Conergy	Malaga, WA
Everlast Hydro Systems Pty Ltd	Dandenong, VIC

At least nine major Australian owned companies are currently manufacturing and distributing solar water heating products to a domestic and international market.

Large Scale Solar

In May 2009 the federal government announced the \$1.5 billion Solar Flagships Program to help fund the construction and deployment of large-scale solar power stations to an overall total of 1000 MW.

Table 20. Some examples of large scale solar plants

Source: Clean Energy Council Renewable Energy Database

FUEL SOURCE	LOCATION	OWNER	STATE	COMMISSION YEAR	INSTALLED CAPACITY
Solar PV	Singleton	Energy Australia	NSW	1998	0.39 MW
Solar PV	Kings Canyon	Power and Water	NT	2003	0.24 MW
Solar PV	Windorah	Ergon Energy	QLD	2008	0.18 MW
Solar PV Concentrator	Lajamanu	Solar Systems	NT	2006	0.29 MW
Solar PV Concentrator	Yuendumu	Solar Systems	NT	2008	0.24 MW
Solar Thermal Concentrator	Liddell	Ausra/ Macquarie Generation	NSW	2009	4 MW
Solar Thermal Concentrator	Mayfield	CSIRO	NSW	Under construction	0.5 MW



Source: Ausra Technology at Liddell Power Station

Large Scale Solar

A number of companies are evaluating much larger scale solar farms. Almost 150 MW of plants utilising solar thermal concentrator technology is being evaluated in Queensland including a 10 MW plant in Cloncurry by Ergon Energy; a 110 MW plant by the Australian Solar Power Consortium; and a 23 MW plant at Kogan Creek in a joint venture by Ausra and CS Energy.

In March 2009, the Victorian Government announced up to \$100 million to attract co-funding from the Australian Government and private investors to build a large-scale solar power station in Victoria. It is targeted to generate a minimum of 330 GWh per annum of electricity from solar energy for a period of at least 20 years.

According to REN21's *Global Status Report 2009*, overseas, utility-scale solar power plants emerged in large numbers in 2008 with an estimated 1,800 utility scale plants (defined as larger than 200 kilowatts) now existing worldwide. Altogether, these plants totaled over 3 GW, a tripling of existing capacity from 2007. The majority of utility-scale plants added in 2008 were installed in Spain (over 1.9 GW added), with others in the Czech Republic, France, Germany, Italy, Korea, and Portugal. The Spanish 60-MW Olmedilla de Alarcon plant, completed in 2008, is the largest solar PV plant in the world.

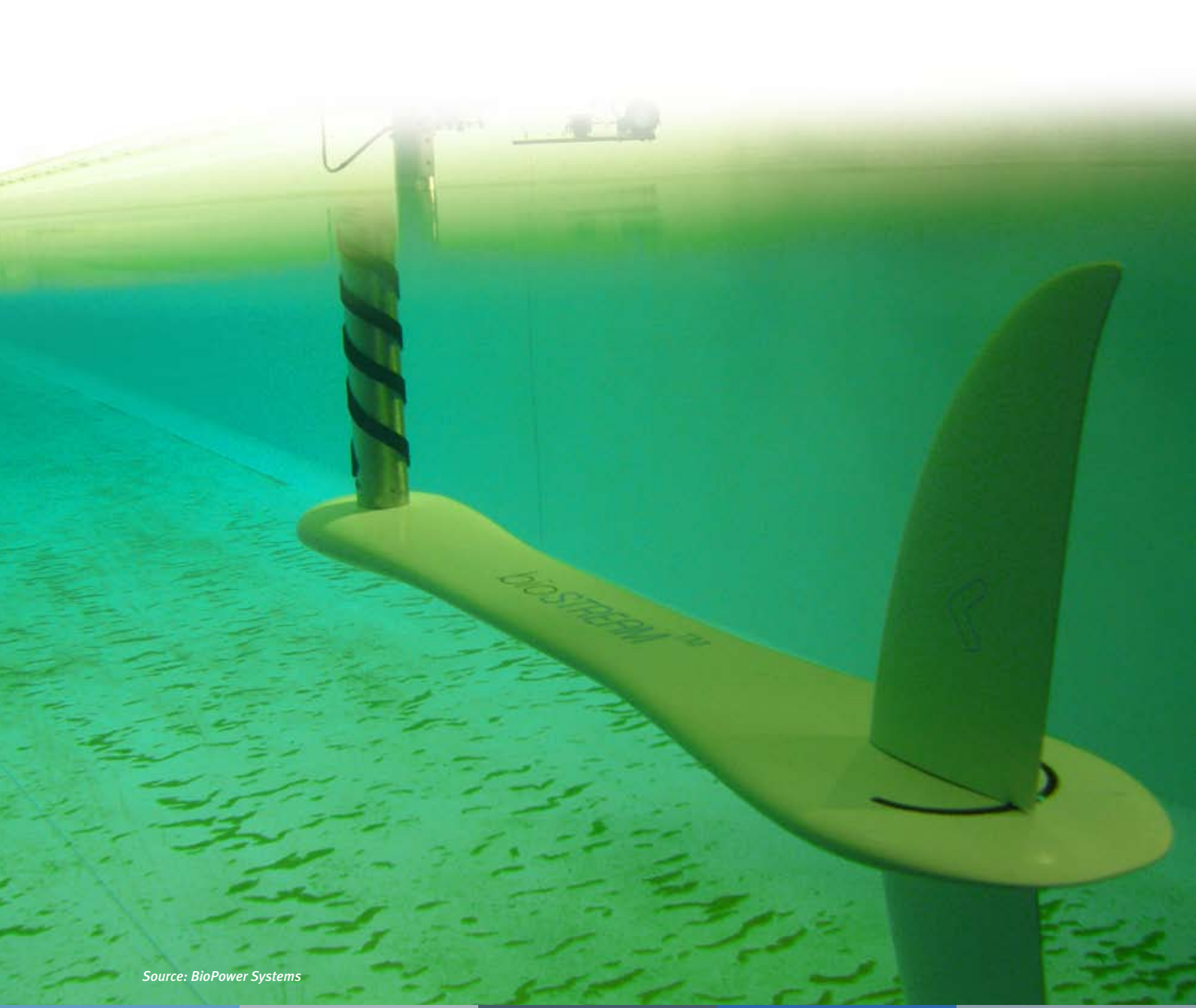
Two new solar thermal concentrator power plants were commissioned in 2008—the 50 MW Andasol-1 plant in Spain and a 5 MW demonstration plant in California with more expected in the next year including two more 50 MW plants and a 20 MW solar thermal concentrator plant integrated with a 450 MW natural-gas combined-cycle plant in Morocco. 8 GW of large scale solar power plants are planned and under development in many countries of Europe and throughout the world, including China, India, Japan, and the United States. A growing number of these future solar thermal concentrator plants will include thermal storage to allow operation into the evening hours. The Andasol-1 plant in Spain has more than seven hours of full-load thermal storage capability, and a 280 MW plant is planned in Arizona with six hours storage.

Source: Renewables Global Status Report, REN 21, 2009

Wave & Tidal .005% of total renewable energy capacity

Australia's near shore wave energy resources could create around four times the nation's current national power needs.

Source: The Power to Change: Australia's Wave Energy Future, WWF, Carnegie Corporation, 2009



Source: BioPower Systems

Wave & Tidal

The Southern Ocean is one of the world's largest and most consistent wave energy resources and could generate at least 35 per cent of our baseload power needs.

Source: The Power to Change: Australia's Wave Energy Future, WWF, Carnegie Wave Energy, 2009

Regions such as Port MacDonnell in South Australia, Portland, Warrnambool and Philip Island in Victoria, Albany and Geraldton in Western Australia and parts of the Tasmanian and NSW coastlines are optimal sites for wave energy plants.

Table 21. Wave power facility currently operating

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	INSTALLED CAPACITY
Oceanlinx Limited	Port Kembla	NSW	0.5MW

Table 22. Wave power facility under construction

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	INSTALLED CAPACITY
Carnegie Wave Energy	Fremantle	WA	0.1MW
Atlantis Resources	Newhaven	VIC	N/A

Table 23. Other tidal and wave power players

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	POTENTIAL FUTURE CAPACITY	FUNDING
Tenax Energy Pty Ltd	TBA	SA	787MW	–
Carnegie Wave Energy	Southern coastline of Australia	TBA	1500MW	–
Victorian Wave Power	Portland	VIC	19MW	\$AU66 million grant from the Australian Government's Renewable Energy Demonstration Project

Internationally wave power is still a relatively new technology and most projects are at the prototype or testing phase.

France has led the world with its tidal project at the Rance River operating since 1966, and currently delivering 600GWhs. The total current world capacity for tidal power is estimated at 300MW, according to the Renewables Global Status Report by REN21.

Wind 16% of total renewable energy capacity

Australia's total operating wind capacity as at November 2009 was 1668MW, more than double the 824MW of capacity as at end of 2007. This wind capacity is equivalent to 4,967GWh of electricity annually.



Source: Suzlon

Wind

In Australia, wind technology generates enough energy to supply power to 690,000 households.

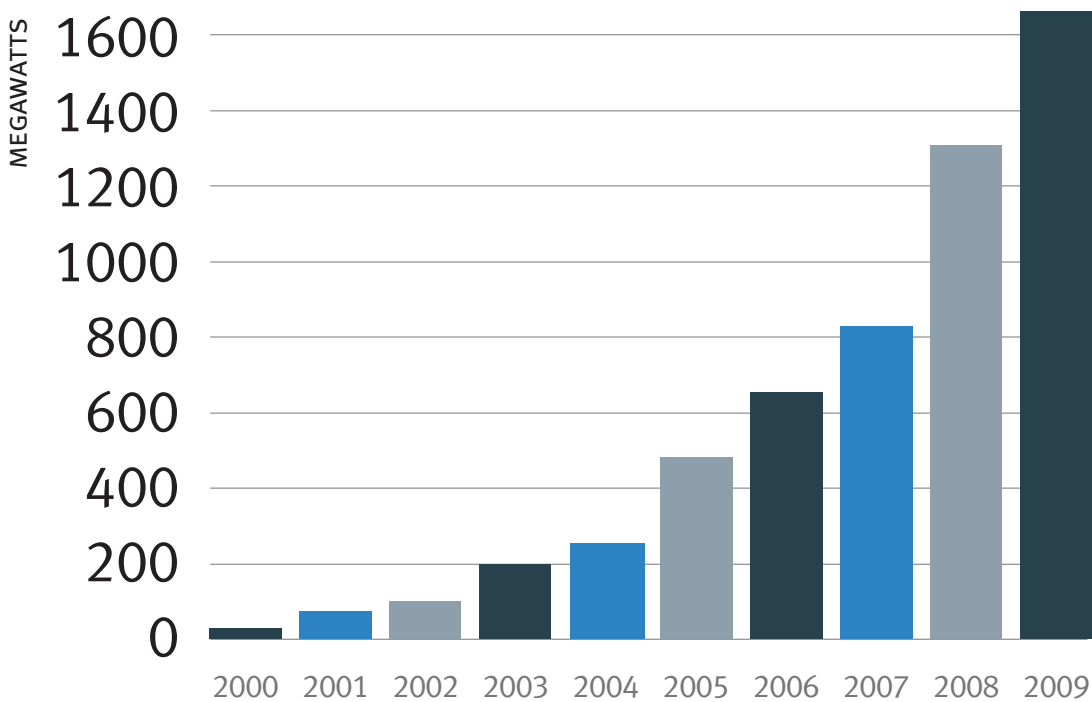
Today, Australia has 49 wind farms with a total of 962 operating turbines.

South Australia has the largest installed capacity and represents 44 per cent of the nation's total capacity. Another seven plants totalling 559MW are currently being constructed with the majority of these due to be commissioned in 2010.

An additional 6GW of wind energy projects are proposed all around the country, many of them having already received planning permission.

Figure 17. Cumulative installed renewable energy capacity in Australia (2000–2009)

Source: Clean Energy Council Renewable Energy Database



Wind

Table 24. Wind farms commissioned during 2009

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	INSTALLED CAPACITY
Acciona	Waubra	VIC	192MW
Infigen Energy	Capital Wind Farm	NSW	141MW
Origin Energy	Cullerin Range	NSW	30MW

Table 25. Wind farms under construction

Source: Clean Energy Council Renewable Energy Database

OWNER	LOCATION	STATE	EXPECTED COMMISSION YEAR	INSTALLED CAPACITY
AGL	Hallett Stage 2	SA	2009 /2010	71MW
Pacific Hydro	Clements Gap	SA	2010	57MW
Pacific Hydro	Portland Stage 3 - Cape Nelson South	VIC	2010	44MW
Roaring 40's	Musselroe	TAS	2010	129 MW
AGL	Hallett Stage 4 (Nth Brown Hill)	VIC	2012	132 MW
Infigen Energy	Lake Bonney Stage 3	SA	2010	39 MW
AGL	Oaklands Hill	VIC	2011	86 MW

Table 26. Total installed wind capacity by state

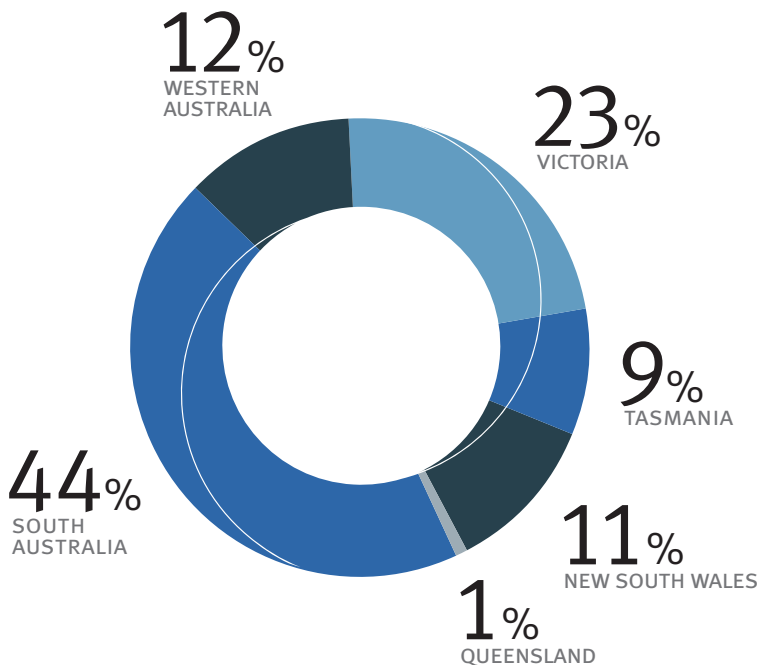
Source: Clean Energy Council Renewable Energy Database (only includes projects greater than 100kW in size)

FUEL SOURCE	INSTALLED CAPACITY (MW)	NUMBER OF PROJECTS
SA	740	10
WA	201	14
VIC	384	8
TAS	143	6
NSW	187	7
QLD	12	3
NT	0	0
ACT	0	0
Territories	1	1
Total	1668	49

Wind

Figure 18. Total installed wind capacity by state (percentage)

Source: Clean Energy Council Renewable Energy Database



Global installed capacity at the end of 2008 was almost 121GW producing approximately 260 terrawatt hours of electricity annually. More than 27GW of capacity was installed in 2008, a 28 per cent increase on 2007, according to the Global Wind Energy Council (GWEC). The Organisation for Economic Cooperation and Development (OECD) estimates that 1.5 per cent of the world's electricity is currently generated by wind.

As of 2008 the United States was the largest user, with 25.2GW of installed capacity. The US installed 8358MW of wind power in 2008: more than five times Australia's total capacity. One single wind farm in Texas accounts for 732MW.

Germany was the world's next largest wind user with 23.9 GW, Spain had almost 16.8GW and China 12.2 GW. China also doubled its capacity from the end of 2007 with the installation of a huge 6300MW of capacity. 36 per cent of all new electricity generating capacity added in the European Union last year was from wind energy, exceeding all other technologies.

The GWEC estimates that more than 400,000 people are now employed in the global wind energy industry, but the potential is for millions to be employed in the future.



Clean Energy Council

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