



Australian Government
Australian Trade Commission

Australian Solar Energy Generation Industry Capability Report

**Prepared by the Clean Energy & Environment
Team**

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To obtain information about the content of this report, please contact:

Kerry Rooney
National Industry Manager – Clean Energy
The Australian Trade Commission (Austrade)
Tel. +61 2 6201 8350
Email: kerry.rooney@austrade.gov.au
Web www.austrade.gov.au



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Overview

Renewable energy is an important element of Australia's future electricity supply. The Australian Government has set a target of 20% of electricity supply by 2020 (an additional 45,000 giga watt hours (GWh) of electricity) from renewable energy generators. Australia's natural endowment of wind, solar, geothermal, water and land resources provides an excellent base to host a renewable energy generation industry.

Australia's comparative advantages in solar energy generation are:

- High levels of solar radiation;
- Demonstrated expertise in research and development, design and installation of solar energy systems;
- Available land in regional areas for large-scale technology installations;
- Close proximity to high growth export markets;
- Skilled labour base; and
- Access to raw materials (silica) for upstream refining;

Key market drivers for the development of a solar industry in Australia are:

- Strong research and development infrastructure and expertise creating new technologies for commercialisation;
- Need to meet peak electricity market demand;
- Increasing market awareness of climate change and the importance of energy efficiency and low emissions energy generation technologies;
- Steady population growth and construction of new residential, commercial and industrial buildings; and
- Supporting government policies and incentives.

Dynamic Market¹

In 2007–08, Australia's solar energy use was 7 peta joules (PJ), or about 0.12% of Australia's total primary energy consumption. Solar thermal water heating has been the predominant form of solar energy use to date, but electricity generation is increasing through the deployment of photovoltaic and concentrating solar thermal technologies. Total solar energy use in Australia is projected to increase to 24PJ in 2029–30, with solar energy used for electricity generation projected to increase from 0.1 terra watt hours (TWh) in 2007–08 to 4TWh in 2029–30.

Table 10.1 Key statistics for the solar energy market

| | Unit | Australia (2007-08) | OECD (2008) | World (2007) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------|-------------|--------------|
| Primary Energy Consumption^a | PJ | 6.9 | 189.4 | 401.8 |
| Share of Total | % | 0.12 | 0.09 | 0.08 |
| Average annual growth from 2000 | % | 7.2 | 4.3 | 9.6 |
| Electricity Generation | | | | |
| Electricity Output | TWh | 0.1 | 8.2 | 4.8 |
| Share of total | % | 0.04 | 0.08 | 0.02 |
| Average annual growth from 2000 | % | 26.1 | 36.3 | 30.8 |
| Electricity Capacity | GW ^b | 0.1 | 8.3 | 14.7 |
| ^a Energy production and consumption are identical because solar energy can only be stored for several hours at present. ^b giga watts (GW) Source: IEA 2009b; ABARE 2009a; Watt 2009; EPIA 2009 | | | | |

¹ Australian Government, Geoscience Australia (2010) *Australian Energy Resource Assessment, Chapter 10: Solar Energy* (pp 261-284), available online at: https://www.ga.gov.au/image_cache/GA17057.pdf



Solar Radiation

Solar radiation is Australia's largest potential energy source. The average solar energy that falls on Australia is about 15,000 times the national energy use. Over 90% of Australia's land surface receives sunshine in excess of 1950 kilowatt hours (kWh) per square meter per annum.

The Australian Renewable Energy Atlas illustrates solar radiation levels across Australia, and can overlay transport and electricity infrastructure, human settlements, mean annual sunshine (hours per day), amongst other data sets, to support your market research and analysis. Access the Australian Renewable Energy Atlas at www.environment.gov.au/apps/boobook/mapervlet?app=rea

Projects

The Australian Government maintains a database and map of operating and proposed energy projects across Australia at www.ga.gov.au/renewable.

Five commercial-scale solar projects with a combined capacity of around 5MW have been commissioned in Australia since 1998. The only project to have a capacity of more than 1MW is Ausra's solar thermal attachment to Liddell power plant, which has a peak electric power capacity of 2MW (2009). There are five proposed commercial solar projects, with a combined capacity of 116MW. The largest of these projects is Wizard Power's A\$355 million Whyalla Solar Oasis, in South Australia. The project is expected to have a capacity of 80 MW and is scheduled to be completed by 2012.² The Australian Government has also short listed eight consortia to build two projects with a combined capacity of up to 400MW, under its A\$1.5 billion Solar Flagships program (refer Australian Government Initiatives section).

Niche areas with further growth potential include telecommunications, railway signalling systems, navigational aids, cathode protection, water pumping, street lights and remote fuelling (aviation) installations. Installing photovoltaic solar cells in remote areas, usually as hybrid systems, to replace or supplement diesel generators, is an important market in Australia

Demonstrated Expertise

Australia's solar industry expertise and range of research and development projects provide an opportunity for partnerships and licensing agreements to commercialise innovative technologies and complementary technology transfers such as for heat and electricity storage.

Leading research and development players in Australia include: Australian National University; University of Melbourne (OPV), CSIRO, Dyesol; University of Sydney, University of New South Wales; Solahart, Adelaide University (Centre of Expertise in Photonics) and , University of South Australia (Institute for Sustainable Systems and Technologies) (please refer to the Photovoltaic, Solar Hot Water and Solar Thermal sections).

Access to raw materials

High-grade silica is exported from Australia to produce solar energy products internationally. Australia's strong growth in demand for solar energy products, access to raw materials and skilled workforce presents an opportunity for investment in the upstream supply chain in Australia. Over the period 2001-02 to 2006-07, 26 million tonnes of silica was produced, with a value of A\$387 million.³

Simcoa Operations Pty Ltd, based at Kemerton in Western Australia is Australia's chief refiner, producing over 32,000 tonnes per annum of silicon metal, silicon for aluminium, and silica and micro-silica products for Australian and export markets. Other silica producers in Australia are: Glenella Quarry Pty Ltd, Cowra Quartz Pebble and Sand, and Darryl McCarthy Contractors Pty Ltd, in New South Wales; Cape Flattery Silica Mines Pty Ltd, Unimin, Cement Australia Pty Ltd, Sunstate Sands (Australia) Pty Ltd, and Calcifer Industrial Minerals Pty Ltd in Queensland; Unimin Australia Ltd in Victoria; One Steel Manufacturing Pty Ltd, Unimin Australia Ltd and Rocla Pty Ltd, in South Australia; and Tasmanian Advanced Minerals Pty Ltd.

² ² Australian Government, Geoscience Australia (2010) *Australian Energy Resource Assessment, Chapter 10: Solar Energy* (pp274, 282-283), available online at: https://www.ga.gov.au/image_cache/GA17057.pdf

³ Australian Bureau of Statistics, *Mining Commodities in Australia, 2001-02 to 2006-07* (Catalogue #8415.0), [www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/1B81F726E2167049CA2574F1000EB0A8/\\$File/84150_mining%20commodities_2001-02%20to%202006-07.xls](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/1B81F726E2167049CA2574F1000EB0A8/$File/84150_mining%20commodities_2001-02%20to%202006-07.xls)



Electricity prices

Table 1: Average annual wholesale (spot) prices (per financial year) from 1998-99 to 2008-09 (A\$/MWh)⁴

| Year | NSW | QLD | SA | TAS | VIC |
|-----------|-------|-------|--------|--------|-------|
| 1998-1999 | 33.13 | 51.65 | 156.02 | Na | 36.33 |
| 1999-2000 | 28.27 | 44.11 | 59.27 | Na | 26.35 |
| 2000-2001 | 37.69 | 41.33 | 56.39 | Na | 44.57 |
| 2001-2002 | 34.76 | 35.34 | 31.61 | Na | 30.97 |
| 2002-2003 | 32.91 | 37.79 | 30.11 | Na | 27.56 |
| 2003-2004 | 32.37 | 28.18 | 34.86 | Na | 25.38 |
| 2004-2005 | 39.33 | 28.96 | 36.07 | 190.38 | 27.62 |
| 2005-2006 | 37.24 | 28.12 | 37.76 | 56.76 | 32.47 |
| 2006-2007 | 58.72 | 52.14 | 51.61 | 49.56 | 54.80 |
| 2007-2008 | 41.72 | 52.59 | 74.02 | 54.99 | 46.92 |
| 2008-2009 | 38.85 | 25.09 | 50.98 | 58.48 | 41.82 |

The introduction of an emission trading scheme is proposed from 1 July 2013 is expected to increase electricity prices. Potential large industrial electricity consumers need to discuss future electricity prices with generators and retailers to ensure that carbon costs are not double counted in modelling through inclusion in quoted electricity prices and future projections in carbon models.

Meeting peak electricity demand

From 1995-2005, significant new electricity generation capacity was commissioned in the eastern Australian States to meet demand. This has assisted the establishment of many major projects associated with the resources sector. There are still many new large power using projects being planned along with expansions to existing network infrastructure. Growth in electricity demand, along with the availability of mining resources in Australia, will encourage further investment in power generation and create opportunities for new entrants.

Australia's peak electricity demand has grown significantly, and the solar power generation profile complements the peak electricity demand profile. There is a particularly strong opportunity for solar in eastern States if storage of around 2-4 hours can be economically integrated into solar power generation systems. This would match solar electricity supply much closer to peak demand. Whilst renewable energy technologies are not yet cost competitive with large scale fossil fuelled power stations in Australia, solar power systems are recognised as one of several mechanisms to ease demand on electricity supply infrastructure.

The Australian Energy Market Operator (AEMO) manages our National Electricity Market and the retail and wholesale gas markets of eastern and southern Australia. The AEMO annual *Statement of Opportunities*⁵ provides forecasts for supply and demand growth in electricity and gas markets, including reserve generation shortfall forecasts and grid (network) developments.

Electricity Grid Connection

Connecting solar power systems to the electricity grid is a relatively new development in Australia, and a growing number of electricity utilities are supporting grid-interactive systems, paying customers for electricity if the electricity the customer's solar generation exceeds their electricity consumption over the billing period.

Prices for grid interactive systems start from as little as A\$2000 for a pair of solar panels and inverter. Chiefly 1kW systems have been installed around Australia in recent years ranging in price from around A\$8000 up to A\$16,000. The variation reflects a range of factors, including technology (supplier) chosen, international price movements and the degree of difficulty of installation. Government rebates, such as Solar Credits, of around A\$7500 for a 1.5kW system, reduce the upfront capital costs considerably. A system capable of running an average suburban home could cost up to A\$25,000 for a 1.5-2kW solar array, inverter and storage unit to suit.

⁴ AEMO Australian Electricity Market Data of Average Price Table, www.aemo.com.au/data/avg_price/averageprice_main.shtml

⁵ Annual Electricity Statement of Opportunities can be ordered through the AEMO website www.aemo.com.au



Increasing Market Awareness

A suite of Australian, State and Territory Government initiatives are raising public awareness of the importance of addressing climate change and investing in renewable energy power generation technologies, such as solar. The Mandatory Renewable Energy Target, Solar Cities program, Remote Renewable Power Generation Program and Solar Homes and Communities Plan have all played an important role in deploying solar technologies both in urban and remote communities. New initiatives such as the Expanded National Renewable Energy Target, Solar Flagships and Solar Credits scheme will maintain growth in solar technology deployment at the residential, commercial and utility scale.

Green Power is a government accredited program for renewable energy established in 1997 to drive investment in renewable energy and decrease greenhouse gas emissions from the generation of electricity. As of March 2005, any organisation (including non-licensed energy providers) that is eligible to purchase Renewable Energy Certificates is eligible to develop a product for accreditation as a GreenPower Product. The National GreenPower Accreditation Program is an independent test for products offered by GreenPower Providers. Those that meet the Accreditation Criteria earn the right to use the GreenPower Product logo, providing customers assurance that their products adhere to these requirements and that monies will be put towards the purposes expected. Over 900,000 Australian households and businesses support GreenPower. Consumers have a choice to request that their electricity retailer supply their business or household with electricity sourced from renewable sources. Renewable energy supplies range from 10% to 100% and are priced from A\$1-8 per week or from A\$0.05-0.075/kWh for households. Plans and prices vary between providers.⁶

Another market approach is a retailer voluntarily offering to buy back surplus electricity generated from solar systems. For example, *Energy Australia* has offered A\$0.324/kWh buy-back tariff for net export between 2pm and 8pm. This encourages the installation of west facing solar arrays in *Energy Australia's* Sydney retail area.⁷

Renewable Energy Certificates (RECs)

RECs are an electronic form of currency initiated by the *Renewable Energy (Electricity) Act 2000* (the Act). The sale of RECs in the energy market provides an additional income stream for renewable energy generators, thereby improving the return on investment.

The Office of the Renewable Energy Regulator (ORER) oversees the implementation of the Act, which sets the national Renewable Energy Target 45,000GWh of electricity by 2020, to be sourced from renewable energy generators.⁸ Accredited generators earn one REC for each mega watt hour (MWh) of renewable electricity produced. Except for small scale solar systems (1.5kW), which can currently earn 5 RECs for each MWh under the Solar Credits scheme.

RECs are traded on the spot market⁹, being purchased by wholesalers who are liable for their electricity generation under the Act. If a liable wholesaler does not surrender enough RECs to meet its obligation to the MRET, it is required to pay a penalty. Where the market price is higher than the penalty figure, the penalty rate is charged at market price.

Remote Area Power Supply (RAPS)

Many remote communities across Australia are not connected to a main electricity grid, supplied by large scale coal, gas or hydro generation plants. With government support for communities to displace diesel fuel electricity generators with renewable power sources, more photovoltaic and solar hot water systems have been installed.

RAPS systems can cost up to A\$50,000 to meet the power requirements of a family home, with a typical range of appliances. On the other hand, the cost to connect to an electricity grid can cost A\$10,000/km of power lines, making the cost of a RAPS system a viable alternative.

⁶ A full list of accredited products is available from the GreenPower website www.greenpower.gov.au/home.aspx

⁷ Energy Australia, Solar Power webpage www.energyaustralia.com.au/energy/ea.nsf/Content/NSW+Solar+Energy+Save

⁸ Australian Government Department of Climate Change

⁹ Green Energy Trading (Oct-08) www.greenenergytrading.com.au



Solar Products Installation and Maintenance

Clean Energy Council plays a key role in improving the quality of renewable energy systems installations across Australia. Customers seeking government rebates must order a system that is designed and installed by a Clean Energy Council accredited designer and installer. Over 600 designers and installers are registered with the Clean Energy Council and most are accredited. Installers must provide evidence that their panels meet the relevant standards. The installer must personally sign off on the installation report at the time of commissioning of each system. For example, for PV systems, to be eligible for a government rebate, PV panels installed must be certified to international standards, IEC61215 or IEC61646. Grid-connected inverters must comply with AS4777 (Australian Standard) and have a current Certificate of Suitability as evidence for the consumer.

Population Concentration and Growth

The resident population of Australia is estimated to be over 22 million.¹⁰ By 2056, Australia's population is expected to increase to between 30–43 million people.¹¹

Table 3: Population Changes by Remoteness Structure, 2008-09^{(a)12}

| State/ Territory | Estimated Resident Population as at 30 June 2009 ^(c) | Major Cities % change from 30 June 2008 | Inner Regional | Outer Regional | Remote | Very Remote |
|------------------|-----------------------------------------------------------------|-----------------------------------------|----------------|----------------|--------|-------------|
| NSW | 7 134 421 | 1.9 | 1.4 | 0.9 | 0.3 | - |
| Vic | 5 443 228 | 2.4 | 1.8 | 1.1 | -0.1 | (b) |
| Qld | 4 425 103 | 2.8 | 2.9 | 2.7 | 0.4 | - |
| SA | 1 623 590 | 1.3 | 1.6 | 0.6 | 0.8 | 0.4 |
| WA | 2 245 057 | 3.1 | 4.7 | 2.0 | 1.5 | 1.9 |
| Tasmania | 503 292 | (b) | 1.0 | 1.2 | 1.0 | -1.0 |
| NT | 225 938 | (b) | 3.1 | 1.2 | 2.2 | 2.5 |
| ACT | 352 189 | 1.7 | 4.8 | (b) | (b) | (b) |
| Total | 21 995 256 | 2.2 | 2.1 | 1.7 | 0.9 | 1.2 |

^(a) Population growth rates are average annual growth rates. Population estimates for 2009 are preliminary.

^(b) For the purposes of ABS Remoteness Structure, there are no regions in this category for this state.

- nil or rounded to zero

¹⁰ Australian Bureau of Statistics, *Population Clock* (10 June 2010),

www.abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63?OpenDocument

¹¹ Australian Bureau of Statistics, *Regional Population Growth, Australia 2008-09* (Cat. 3218.0)

www.abs.gov.au/ausstats/abs@.nsf/Products/3218.0~2008-09~Main+Features~Main+Features?OpenDocument#PARALINK2

¹² Bureau of Transport and Regional Economics (BTRE), *About Australia's Regions June 2008*

www.bitre.gov.au/publications/38/Files/RegStats_2008.pdf, citing Australian Bureau of Statistics *Regional Population Growth, Australia 2006-07* (Cat. 3218.0)



Feed-in Tariffs

Feed-in tariffs are available to households, community organisations and small businesses with low energy consumptions. All State and Territory Governments have announced feed-in tariffs (refer Table 2). The Australian Government, through the Council of Australian Governments (COAG), has considered the appropriateness of a harmonized national approach to feed-in tariffs.

At its meeting on 29 November 2008, COAG agreed to a set of four national principles to apply to feed-in tariff schemes across Australia¹³:

- that micro-renewable generation system owners are to receive fair and reasonable value for exported energy;
- that any premium rate for exported energy is to be jurisdictionally determined, transitional and considered for public funding;
- that the Ministerial Council on Energy should continue to implement the regulatory arrangements to advance fair treatment of small renewable energy generators; and
- that Feed-in Tariff policy is to be consistent with previous COAG agreements, particularly the Australian Energy Market Agreement.

¹³ Council of Australian Governments, *Meeting 29 November 2008 Communique*, www.coag.gov.au/coag_meeting_outcomes/2008-11-29/index.cfm#climate



Table 2: Summary of announced feed-in tariff schemes in Australian states and territories¹⁴

| Location | Size Limits to individual installations | Limits of caps to scheme | Net or Gross | New or Existing | Value of FIT (A\$/kWh) | Eligible Sources |
|----------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------|--------------|-----------------|--------------------------------|-----------------------------|
| Western Australia ¹⁵ | <5kW (Synergy) <10kW per phase (30kW maximum, Horizon Power) | From 1 August 2010; review every 10MW or 3 years | Net | Both | 0.40 | PV, wind, micro-hydro |
| New South Wales ¹⁶ | <10kW (total capacity limit of 300MW) | From 28 Oct 2010, with a review in 2012 | Gross | New | 0.20 | PV and Wind |
| New South Wales | <10kW | Prior to 28 Oct 2010 | Gross | Existing | 0.60 | PV and Wind |
| South Australia ¹⁷ | <10kVA single phase or <30kVA 3-phase | Review at 10MW installed ¹⁸ | Net | Both | 0.44 | PV only |
| Victoria ¹⁹ | 5kW | Review at 100MW installed | Net | Both | 0.60 | PV only |
| Victoria | <100kW | Review at 100MW installed | Net | Both | 0.60 ²⁰ | Wind, hydro, biomass and PV |
| Queensland ²¹ | <10kVA single phase or <30kVA 3-phase | Review at 8MW installed | Net | Both | 0.44 | PV only |
| ACT ²² | 30kW | Review 2012 | Gross | Both | 0.457 | PV & wind |
| Tasmania ²³ | <3kW | N/A | Net | Both | 0.20 | PV, wind and micro hydro |
| Northern Territory – Alice Springs only ²⁴ | Unknown | | Gross | New | 0.5128 (capped at \$5 per day) | PV only |
| Northern Territory – Power and Water Corporation ²⁵ | Unknown | | Gross | New | 0.1923 | PV only |

¹⁴ Senate Environment, Communications and the Arts Committee, *Renewable Energy (Electricity) Amendment (Feed-in-Tariff) Bill 2008* inquiry final report, Canberra (p5); www.aph.gov.au/senate/committee/eca_ctte/renewable_energy/report/index.htm

¹⁵ Western Australia Government, Office of Energy (27/05/2010) www.clean.energy.wa.gov.au/pages/re_feed-in_tariff.asp

¹⁶ NSW Government, Solar Bonus Scheme (Nov- 2009) www.industry.nsw.gov.au/energy/sustainable/renewable/solar/solar-scheme

¹⁷ Electricity Act 1996 Division 3AB inserted by *Electricity (Feed-In Scheme—Solar Systems) Amendment Act 2008* commenced 1/07/2008. www.legislation.sa.gov.au/LZ/C/A/ELECTRICITY%20ACT%201996.aspx

¹⁸ In May 2009, South Australia reached the 10 MW capacity, www.climatechange.sa.gov.au/index.php?page=feed-in-scheme

¹⁹ Victoria Department of Primary Industries, www.dpi.vic.gov.au/dpi/dpinenergy.nsf/LinkView/47D19C1C08345367CA25736A001FCDF7866B51F390263BA1CA2572B2001634F9#premium; and www.dpi.vic.gov.au/dpi/dpinenergy.nsf/LinkView/47D19C1C08345367CA25736A001FCDF7866B51F390263BA1CA2572B2001634F9#standard

²⁰ “While electricity companies are only obliged to offer the A\$0.60 rate and as only a 12 month credit, some are now offering cash payments at higher rates”, extract from Energy Matters (08/06/10), www.energymatters.com.au/government-rebates/feedintariff.php#victoria

²¹ Queensland Premier media release, *Queenslanders’ receive cash incentive to tackle climate change* (11/03/2008) <http://statements.cabinet.qld.gov.au/MMS/StatementDisplaySingle.aspx?id=56973>. The Queensland Government has passed legislation to introduce the Solar Credit Scheme from 1/06/2008.

²² ACT Legislation Register, *Electricity Feed-in (Renewable Energy Premium) Act 2008*, www.legislation.act.gov.au/a/2008-21/default.asp

²³ The feed-in-tariff scheme available in Tasmania is a voluntary offering from Aurora Energy and is currently under review by the Tasmanian Government.

²⁴ NT Feed-in Tariffs <http://www.aph.gov.au/library/pubs/climatechange/governance/domestic/national/feed.htm>

²⁵ NT Feed-in Tariffs <http://www.aph.gov.au/library/pubs/climatechange/governance/domestic/national/feed.htm>



Building Activity and Key Players

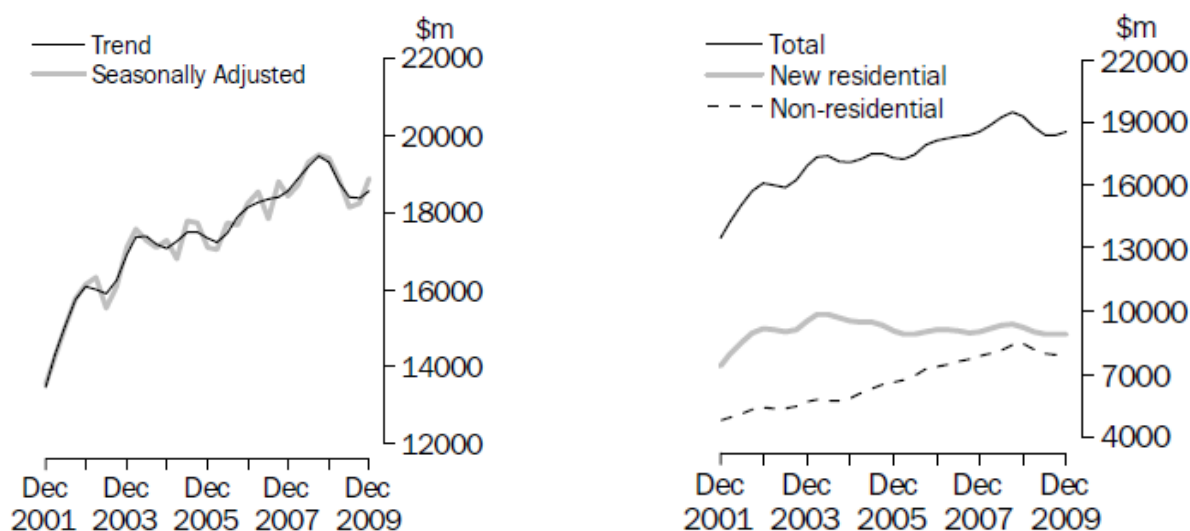
Many houses in Australia have north-facing roofs, with space (5-30m²) to support a solar system. In 2005, the **UNSW Centre for a Sustainable Built Environment** in partnership with the Australian Government published *Best Practice Guidelines for Solar Power Building Projects in Australia*.²⁶

A report of retail and industrial roof areas and construction activity can be purchased from the Property Council of Australia.²⁷ The Master Builders Association of Australia represents over 23,000 members across the country.

The 'Victorian Building Code' requires that new homes meet a five star energy and water efficiency standard, including featuring either a solar hot water system or rainwater tank. Similarly in Queensland, under the 'Standard Building Regulations' new homes must include a greenhouse efficient hot water system that produces between 14 and 22 RECs.²⁸ And in South Australia, all new homes or homes undergoing major renovations, in areas where gas is available, must have solar, gas or heat pump hot water systems.

In New South Wales, the BASIX (Building Sustainability Index) sets a water and energy efficiency standard for new homes (40% usage reduction on the average home). New housing developments and renovations require a BASIX Certificate to be lodged with the Development Application to the local government authority.

Figures 1 & 2: Value of Building Activity (work done, value chain measures, A\$)²⁹



²⁶ Guidelines can be viewed at www.re-systems.ee.unsw.edu.au/documents/BiPV%20Best%20Practice%20guidelines.pdf

²⁷ Australian Property Council, April 2006 Quarterly Development Survey

²⁸ Copies of the Queensland sustainable building standard are available at www.lqp.qld.gov.au/?id=247.

²⁹ Australian Bureau of Statistics, *Building Activity Australia December 2009* (Cat 8752.0)

[www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/AB757F30A03C19F5CA257704001886B1/\\$File/87520_dec%202009.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/AB757F30A03C19F5CA257704001886B1/$File/87520_dec%202009.pdf)



Photovoltaic

Research and Development

Australia has a strong and broad based solar research and development tradition and its climate makes it ideal for developing and testing solar technologies. As domestic capacity grows, Australia's expertise and competitive business operating costs will provide a valuable opportunity for the establishment of plants to design, manufacture and export the machinery needed to build high technology solar products.

University of New South Wales (UNSW), Centre of Excellence in Advanced Silicon Photovoltaic and Photonics, mission is to advance silicon photovoltaic research on three fronts, and to apply these advances to the related field of silicon photonics. The Centre has a world-leading program with "first-generation" devices, holding international records for the highest-performing silicon cells in most major categories. A key goal is to develop technology which allows silicon wafers doped with boron to be replaced by phosphorus-doped wafers. The Centre's experimental program is concentrating on "all-silicon" tandem solar cells, where high energy-band-gap cells are stacked on top of lower-band-gap devices. The silicon band-gap is controlled by quantum confinement of carriers in small silicon quantum-dots dispersed in an amorphous matrix of silicon oxide, nitride or carbide. Progress with this approach was recognised by the award of substantial complementary funding under the Global Climate and Energy Project managed by Stanford University and funded by a large international consortium. Cells based on "hot" carriers are also of great interest since they offer the potential for very high efficiency from simple device structures.

UNSW researchers are world leaders in the development of cheap, light sensitive materials from special titanium oxide ceramics – to produce hydrogen fuel from water using solar energy. By altering the oxygen content and adding dopants (slight amounts of impurities) to titanium oxide, the UNSW team can control the electrical properties of the material, which range from insulating to semi-conducting and metallically conducting. The concept is similar to those used in the doping of silicon to produce conventional semiconductors, but the researchers say titanium oxide has cost and stability advantages over silicon. The equipment designed at the UNSW allows the researchers to understand what is going on during the materials manufacturing process. By contrast, researchers in Japan, Europe and the US study the material after it is altered after the manufacturing process.³⁰

CSG Solar has developed Crystalline Silicon on Glass, a thin-film PV technology, based on initial research at the UNSW. Whilst research and development will remain in Australia, the company is manufacturing the CSG cells and modules in Germany. CSG Solar manufactures its own inverters, rooftop mounting systems and associated equipment for its 'plug and power' rooftop PV system.

Australian National University (ANU), Centre for Sustainable Energy Systems has developed a number of commercial solar technologies including the 'Sliver Cell', now being commercialised by Origin Energy; a Combined Heat and Power Solar (CHAPS) system, which uses concentrating solar collectors to simultaneously produce solar hot water and electricity; parabolic trough and paraboloidal dish PV concentrator systems, and associated concentrator cells, trackers, controllers and mirrors; and multi-crystalline silicon solar cells. 'Sliver' cells are micro-machined to less than 70 microns thick, using 90% less silicon than conventional solar cells to make PV panels. Cutting the quantity of silicon in each cell significantly reduces production costs. Research is now focussing on making the manufacturing process cheaper and faster, bringing next generation sliver cell technology to be cost competitive with clean coal.

Research Institute for Sustainable Energy (RISE) at Murdoch University examines methods of producing low cost silicon from new sources for both wafer based and thin-film solar cells; and supports the development of new battery technology and testing of systems. RISE was awarded A\$5.5 million under the Australian Government Remote Renewable Power Generation Program to support its remote power industry support components research and development. Researchers are also working to improve cell designs, using a combination of nano-crystalline and amorphous silicon alloys, and improved methods of producing solar grade silicon directly from metallurgical grade material.

³⁰ Extract from The Australian, Features, *Scientists power into the future* (15/11/06, p7)



Dyesol listed on the Australian Stock Exchange in 2005, is commercialising a dye-solar cell (DSC) technology that utilises nanotechnology and bio mimetic activity to mimic photosynthesis to absorb light. Its DSC technology was originally developed by Sustainable Technologies International. Dyesol is now developing third generation DSC products at its 500kW research and manufacturing facility at Queanbeyan, New South Wales.

Dye solar cell research is also underway at **Flinders University, University of Wollongong, University of Sydney** and the **University of Western Australia**.

Silicon Sands Pty Ltd, a spin-off company from Flinders University, is commercialising an energy-efficient method for producing silicon. The process reduces silicon production costs by chemically controlling colloidal nanostructures, resulting in high yield synthesis of key silicon compounds.

Curtin University and the **University of Tasmania** undertake PV systems research, focussing on central and diesel grid integration.

Queensland University of Technology, Faculty of Built Environment & Engineering is developing organic dye sensitised solar PV technology, using a mixture of “poly (3-hexythiophene) and carbon nanotubes sandwiched between two different metal contacts”. The group still needs to improve the electrical efficiency of the solar cell, and is working to unveil the microscopic mechanisms that control the light-electricity conversion and modify fabrication processes. QUT researchers are also developing a low-cost alternative to PV that is constructed from a thin film of composite material, a mixture of carbon nanotubes and a conductive polymer. Research and development of a liquid dessicant solar air-conditioning system is also progressing.

University of South Australia, Sustainable Energy Centre is developing a suite of solar transport and built environment integrated technologies, including solar air conditioning systems, energy efficient air conditioning, alternative fuels, energy efficient motors and drives, and energy storage.

Ian Wark Research Institute (The Wark) is located at the University of South Australia. The Wark has worked on industry funded projects to identify surface and bulk defects with photovoltaic cells and assisted with the development with new technologies.

University of Queensland, Centre for Organic Photonics and Electronics works on organic photovoltaic's with the International Consortium for Organic Solar Cells was supported by the Australian Government International Science Linkages program. The Australian Institute for Bioengineering and Nanotechnology, based at the University of Queensland is developing Titania nano-crystals for low cost solar cells and photo-catalysis,

Spark Solar has formed R&D collaborations with the ANU and international companies to improve silicon thin film solar PV cells through incorporating a ‘spray on’ anti-reflective coating technology and etching the surface of solar PV wafers to produce ‘Angled Buried Contact’ cells. The R&D projects will receive Australian Research Council grants totalling A\$1.85 million over the next four years.³¹

University of Melbourne, with partners at Monash University, Sunergy, BP Solar, Merck, Bluescope Steel and NanoVic are researching organic ‘plastic’ PV cells with potential production of flexible solar cells, or coatings that function as conductive paints on roofs or integrated into fabrics.

Swinburne University of Technology, Centre for Micro-Photonics is developing a new technology for the third generation solar cells, jointly initiated with Suntech Power Holdings Co Ltd in China. The new technology called NANAPLAS can potentially provide low cost and high efficiency solar panels.

³¹ Spark Solar news webpage www.sparksolar.com.au/news.html (05/02/09); extract from Environmental Management News, *CleanTech: Research into cheaper solar cell technologies* www.EnvironmentalManagementNews.net (05/02/09)



James Cook University, [School of Engineering](#) is conducting research into the economics of solar PV systems and characterisation of solar radiation; “solar thermal applications and experimental and numerical methods in heat transfer”.

PV systems manufacturing

Silex Systems Ltd has purchased the BP Solar production facility at Olympic Park, NSW. Silex is producing photovoltaic cells and modules using an optimised form of conventional mono-silicon processing, with a conversion efficiency of approximately 17%. Silex Solar has a strong technology focus and plan to increase the conversion efficiency of its solar cells by implementing advanced processing technology and novel Materials, such as those being developed by Silex's US-based subsidiary Translucent Inc. Silex NSW solar manufacturing facility is the largest in the Southern Hemisphere, with annual capacity of over 50MW of solar cell production and 15MW of module production. It is estimated that the potential future capacity of the plant could be expanded to 200MW.³²

Origin Energy is a leading energy provider and green power retailer in Australia, and new solar PV manufacturer, from its A\$20 million plant in Adelaide, South Australia. Origin Energy produces ‘sliver’ cell PV panels, and assembles modules, frames and kits including junction box and electronic components. The Adelaide plant was commissioned in 2005, with a maximum production capacity of 7MW per annum and employing 32 full time equivalent staff. Origin Energy is planning to expand the plant capacity to 25MW per annum and is seeking engineering skills and partners to accelerate large-scale production.

Three cell manufacturing start-ups have been announced but are yet to make a final investment decision – **Spark Solar Australia**, **Regency Media** and **Solarcell Technologies**.

Spark Solar Australia has been granted Major Project Facilitation status by the Australian Government for its proposed A\$60 million Angled Buried Contact cell production facility. Spark Solar is the first solar company to be given the status by the government. Although the status does not come with funding, MPF status can speed up approvals processes at the State and Federal Government levels for private sector enterprises. In its MPF application, Spark Solar's facility plans to produce more than 10 million solar cells each year that can produce 40MW of electricity, which could be expanded to 30 million cells producing more than 120MW. The company plans to start building late this year and produce the first cells in late 2010.

BT Imaging Pty Ltd is developing a luminescence imaging system to reduce the cost and improve efficiencies of solar cell manufacturing.

Glass and coatings suppliers

Dyesol was granted a European patent for its technology and plans to manufacture in Germany, with Swiss technology partner EPFL. Patents are also pending in Singapore, South Africa, Australia, the United States, China, Japan, Korea and Canada. Dyesol has announced a partnership with international metal producer Corus to produce a DSC laminated steel PV sheet designed to provide the most cost-effective solution to meet the market demand on Corus for energy efficient construction products.³³

Sungrid Limited

Sungrid Ltd³⁴ is a Western Australian company that designs, manufactures, imports and distributes solar photovoltaic products. These products include a range of monocrystalline, polycrystalline and amorphous panels, grid-interactive inverters, balance of system components and various mounting solutions for a range of installation needs.

³² Silex media release (10/04/2010)
[www.silex.com.au/public/uploads/announce/\(e\)%20Silex%20Solar%20Official%20Opening%20and%20speech%2014-4-10.pdf](http://www.silex.com.au/public/uploads/announce/(e)%20Silex%20Solar%20Official%20Opening%20and%20speech%2014-4-10.pdf)

³³ Extract from Environmental Management News, *DSC technology to be used in construction* (8/12/06)

³⁴ Sungrid Limited, www.sungridcorp.com/company.php



Viridian (Australia)

In November 2007, Pilkington Australia (now Viridian Australia) announced A\$130 million investment to upgrade its glass manufacturing plant in Dandenong, Victoria, for the production of environmentally efficient glass products. The upgrade incorporated a five beam chemical vapour deposition (CVD) coater that enables production of: energy saving glass products for buildings; self-cleaning glass that virtually eliminates water use; and glass that will be used in solar energy production.³⁵

G. James Australia operates Australia's only glass-coating facility where large-area nano-scale metal and metal-oxide coatings are applied to glass destined for projects where the control of heat flow is required. The G. James Glass division is actively involved in product development using nano-scale materials in its own laboratory as well as working collaboratively with external research organisations. The company manufactures and markets a range of laminated products that incorporates a 'bonding' inter-layer that contains nano-particles of lanthanum hexa-boride. These nano-particles have the unique ability to selectively reject heat while still allowing visible light to pass through, making these products ideal for commercial and residential glazing applications. An example of this type of glass features on the western façade of the recently completed Deutsche Bank Place in Sydney.

Very Small Particle Company manufactures nano-scale, complex metal oxides with optimised architectures and nano-scale features using its patented processing technology. These materials can be used in industries as diverse as vehicle exhaust catalysts, solid oxide fuel cells, gas separation membranes, batteries, industrial catalysts, opto-electronics, sensors, solar, pigments, structural ceramics and magnetises.

Xerocoat have based their R&D at the University of Queensland and established its manufacturing base in California, USA. Xerocoat use nanotechnology to create anti-reflective technologies that improve the efficiency of solar thermal and PV technologies.

Inverter suppliers

Latronics design and manufacture Pure Sine wave DC to AC Power Converters from its A\$3 million facility in Caloundra, Queensland. The company employs 14 full time equivalent staff and exports to South-East Asia, South America and European markets.

Selectronic manufactures each year some 25,000 units of 200–2600 watt sine wave inverters, 3-20kW interactive inverter chargers and 3-phase interactive inverter chargers, from its A\$4 million facility in Wooroolbark, Victoria. The company has reported annual sales of A\$6 million, including exports worth A\$1.5 million, to clients in Malaysia, Philippines and Fiji. Selectronic employs 50 full time equivalent employees.

Xantrex Technology Inc supply DR and SW range of inverter/chargers for boats, motor homes, heavy duty trucks, off-grid, grid-feed and back-up power applications. The SW range includes 24 and 48V models, with output of 3300-4500W of pure sine wave power and 40-100A of battery charging capacity.

YK sine wave inverters (1000-1500W, 12 VDC – 230 VAC) are marketed as being ideal for powering larger electronic appliances such as entertainment units, whitegoods, laptop computers, power tools and lighting.

Pacific Solar Pty Limited is a research, design, manufacturing, supply and retail company of solar PV systems, including module components and inverters. Its Plug&Power™ product is a rooftop mounted modular solar power system for grid-connected applications.

Advanced Energy Systems Ltd manufacture, wholesale, retail and export DC to AC power inverters for PV systems, remote home power systems and telecommunications applications.

³⁵ Extract from Environmental Management News, *Pilkington commits to \$130m glass plant upgrade* (22/11/07)



Enertec Australia Pty Ltd based in Brisbane, Queensland, retails, wholesales and exports DC to AC power inverters and converters, LED lighting and solar outdoor lighting systems. The company offers consulting, design, project development and research services.

Power Solutions Australia manufacture and export DC to AC sine wave power inverters sized from 3kW single phase to 75kW triple phase units, for remote and grid connected renewable power systems. The company works with local power authorities and renewable energy specialists to develop alternative power supply systems.

Sunsine Australia, a joint venture between Victorian based companies Digital Device Development and Wiltronics Research, manufactures and distributes a range of products to the alternative energy industry. Its products are especially suited to the RAPS (Remote Area Power Systems) market. The Sunsine® Plus is a Generator Interactive Inverter-Charger-Booster providing mains quality power using the company's patented sinewave technology.

Battery Suppliers

CAP-XX (energy storage) develops high power, high energy super-capacitors in thin, flat, prismatic packages. They enable smaller, lighter, more functional and longer-running electronic products by providing peak power support to pulsed loads and short-term power support during interruptions to the primary source.

Redflow Energy Pty Ltd, based in Queensland, has developed a zinc-bromine battery for use in remote area power systems (direct substitute for lead-acid batteries), using a novel technology to bond the polymer battery components.

Smart Storage Pty Ltd is developing 'UltraBattery Storage for Cyclical Renewable Energy Systems'.

Other suppliers

PV Solar Energy Pty Ltd has developed a PV solar interlocking roof tile array that can create a watertight system to cover either the full roof or be set within a standard structure similar to a skylight. The company is working to commercialise the PV solar tile technology, targeting grid-connected buildings as its greatest potential market. Joint ventures with solar panel manufacturers, building product manufacturers and suppliers, energy retailers or housing development companies can potentially make the technology widely available in the marketplace.

Solenergy manufacture and assemble solar trackers, at its plant in Reservoir, Victoria, producing about 280 units per years, generating annual sales of A\$830,000. The company exports to Europe, New Zealand and USA, and employs 5 full time equivalent staff. The company also distributes internationally certified batteries, solar modules and inverters.

Refer **Attachment C** for Australian Solar PV industry capability matrix by State and Territory.



Solar Hot Water

Research and Development

Solahart Industries is a significant developer of new solar thermal products, accredited under a range of national and international schemes. Solahart has developed a revolutionary closed circuit system that operates in temperature ranges of +35°C to -30°C.

Institute for Sustainable Systems and Technologies (ISST) at the University of South Australia carries out research, development, prototyping, testing, monitoring and educational projects in the renewable energy and energy efficiency areas. ISST's Sustainable Energy Industry Support Centre (SEISC) focuses on supporting solar hot water applications through testing and product development. The Centre actively develops new innovations with industry, including current developments to commercialise solar heating and solar cooling systems. ISST's Regional Sustainability Centre will build a solar demonstration plant in Whyalla that will deliver base-load electricity through integration of thermo-chemical solar energy storage technology

Queensland University Technology is developing a solar hot water system that uses a new curved reflector onto finned absorber tubes, eliminating the need for a large water tank on the roof. Researchers are also developing a liquid desiccant solar air-conditioner for commercial sector application. The system utilises a "cross-flow type Plate Heat Exchanger as the dehumidifier removes moisture from the air without the application of Chlorofluorocarbon. Low grade heat (from cogeneration or solar energy) can be used for the liquid desiccant regeneration.

University of Sydney offers world-leading research in solar thermal electricity, particularly solar materials and solar ray development, such as designs for evacuated absorber tubes, the first solar steam cooker with storage, a solar selective coating and solar hot water designs. In a partnership agreement with [Shandong Himin Solar Energy Company](#) of China, the evacuated solar absorber tubes and solar selective coating technologies have been patented and commercialised in China.

Cogen Microsystems Pty Ltd is developing a combined solar hot water and electricity generation system for household and small scale commercial use.

Manufacturers

Aquamax Pty Ltd manufactures at Moorabbin, Victoria and retails through Origin Energy.

Beasley Hot Water Solutions based in South Australia, sells solar hot water systems throughout Australia and to about 15 export markets.

Dux Hot Water designs, develops and manufactures a range of solar hot water systems from its facility in New South Wales; including the hybrid SunPro products, which combine Dux twin element electric water heater with a leading European solar technology. Dux is part of GWA International Limited.

Edwards Hot Water is a subsidiary of Paloma and manufactures and supplies one in four solar hot water systems installed in Australian homes. Edwards' products are also exporting to over 40 countries. Edwards operates from Cannington, Western Australia, has reported annual sales of A\$30 million (doubled over 3 years) and employing 50 full time equivalent staff.

Quantum Energy Technologies based in Adamstown, New South Wales manufactures and distributes each year some 15,000 of its patented heat pump hot water systems that draw heat energy from the ambient air, as well as central heating systems and swimming pool heaters. Historic production growth is around 50% per annum. Total reported sales are A\$20 million from domestic and export markets. Quantum employs 70 full time equivalent staff. In 2003, Quantum listed on the stock exchange and commenced manufacturing and distribution with Chinese partners in Shandong and Yunnan provinces.



Solahart Industries is a world leader in solar thermosiphon and split system water heaters, including tanks, collectors and components. Solahart, a subsidiary of Rheem Australasia, services about 40% of the Australian market, and exports to over 70 countries. Solahart is based at Welshpool, Western Australia. The plant includes sales, distribution, service and administrative functions. Solahart produces 100,000 water heaters and 400,000m² of collectors each year, generating annual sales of A\$50-100 million of which A\$20-50 million generated from exporting revenues. Solahart employs about 160 full time equivalent staff.

Rheem Australasia Pty Ltd is a subsidiary of Rheem Manufacturing, USA (a wholly owned subsidiary of Paloma Industries Ltd, Japan). From its manufacturing and sales headquarters in Sydney, Rheem services a reported 10% of Australia's solar hot water market.

Solco Ltd manufactures polymer-based solar hot water systems, solar water pumps, photovoltaic panel integration equipment, battery savers, solar micro lighting, solar powered water desalination units and water tanks. Solco can produce some 6000 hot water systems, 2000 solar pumps and other equipment (per demand), from its A\$4 million facility at Welshpool, Western Australia. In 2004-05, Solco reported annual sales of A\$20 million and annual exports of A\$3 million, with production growth reported to be around 50% per annum. Solco employs 70 full time equivalent staff and plans to open additional manufacturing facilities in Australia as more technology partners come on board through licensing agreements.

Solar Thermal

Research and Development

The **Commonwealth Scientific Industrial Research Organisation (CSIRO)** [National Solar Energy Centre \(NSEC\)](#) opened in March 2006, demonstrating the only multi-collector facility of its type in Australia, and largest high concentration solar array in the Southern Hemisphere. The NSEC is supported by: the Australian Government's International Science Linkages program; the New South Wales Government's [Sustainable Energy Research and Development Fund](#); DLR from Germany; and the ANU.

NSEC is used to research and demonstrate high and low concentration solar technologies in collaboration with other national and international research institutes. The high concentration array (200 panels with 500kW capacity, which can generate temperatures over 1000°C) can produce solar gas that contains over 25% more energy than the natural gas feeding into the system. The solar gas can then be processed to solar hydrogen, enabling solar energy to be stored and transported. The low concentration array (generating hot fluids around 250°C) provides thermal energy that drives a small, high-speed turbine designed for use in remote power applications and distributed generation markets.

CSIRO is also developing technology to use solar radiation in conjunction with an absorbent material, or desiccant, to dehumidify and cool air more cheaply and efficiently. To date, solar cooling technologies have utilised heat from solar thermal collectors to generate cooling for building air-conditioning. The project is funded by the Australian Government under the Asia-Pacific Partnership on Clean Development and Climate.

Royal Melbourne Institute of Technology is demonstrating the commercial viability of electricity generation from Solar Pond technology. Its 55m² pond at Bundoora East campus, can store heat up to 80°C, available over a 24-hour period. Research suggests solar ponds in climates similar to northern Victoria can produce process heat (40-80°C) at an average cost of between A\$10-15 per giga joule. The results from the current trials will provide actual data on cost of energy delivered for the demonstration pond, but also commercial systems for prospective users for industrial process heating and other applications in regional and rural areas remote from the natural gas distribution system.

Australian National University is demonstrating ammonia based thermo-chemical energy storage systems in conjunction with 20m² and 400m² parabolic dish solar concentrators. Wizard Power is working with ANU to commercialise this 'big dish' technology and develop a large scale installation of arrays to produce super-heated steam for electric power generation.



Control Technologies International is commercialising a combined solar, thermal energy storage cell to produce electric power, hot water, air conditioning and dry heat for central heating and cooking. The patented technology is licensed from the CSIRO and GHEKO Constructions for world wide use, sub-licensing and manufacture. The focus of CTI for the future is the development of a number of products which have been under research at our Brisbane facility and are now ready for commercialisation.

Solexus Pty Ltd is a start-up company, with patent applications for a novel solar thermal collector design. In 2008, the company received a COMET grant from the Australian Government.

Chimera Innovations Pty Ltd is a start-up company commercialising a modular solar air heating technology for domestic and light industry use.

Nano-Nouvelle Pty Ltd is developing semiconductor materials for thin film applications and solar thermal power. Technology is patented through IP Australia.

Project Developers & Announcements

AREVA has purchased **Ausra** Pty Ltd and its Compact Linear Fresnel (CLFR) solar thermal technology. CLFR systems produce super heated steam (up to 350°C), offering an efficient supplementary feed water for heating systems in large scale rankine cycle plant. Ausra commissioned a 40MW CLFR concentrator to Macquarie Generation for Phase 1 of the Liddell Power Station project in Newcastle, New South Wales. The CLFR system produces steam at 285°C. The project is the first full-scale demonstration of CLFR technology. Based on the success of the CLFR system at Liddell, Ausra successfully attracted venture capital and support in California and Nevada, USA to develop a commercial scale CLFR system and establish a manufacturing plant.

Phoenix Solar Pty Ltd, the Australian subsidiary of Phoenix Solar AG (a leading European photovoltaic solar systems integrator), plans, builds and operates large photovoltaic plants and is a specialist wholesaler for complete power plants, solar modules and accessories and has recently established an office in Adelaide, South Australia.

SunEnergy is a global manufacturer and distributor of solar power stations. The company has an engineering centre in Perth developing generation projects in the range of 100kW to 10MW. Their annual capacity will be 20MW from 2009.

NEP Solar is part of the Australian New Energy Partners (NEP) Group of companies. NEP Group develops wind and solar energy projects and solar thermal technology in the South Pacific Region and in Europe through its companies NEP WIND, NEP SOLAR and NEP Europe. NEP Solar projects produce heat up to 220°C for industrial processes, high efficiency cooling and cogeneration applications.

Other players include **Ingenero**, **Solar Shop**, **Going Solar**, **Vemtec** and **Cogent Energy**.

Acquasol has announced plans for a A\$270 million staged development of Australia's third largest desalination plant at Point Paterson, 7km south of Port Augusta in South Australia. The project proposes combining solar energy based power generation, desalination and commercial salt production processes in a single industrial complex. The solar field will be laid out over a 2km² area with each solar mirror standing 3 metres tall. The captured heat will be used to create steam for electricity and desalination, with any excess heat going into thermal storage.

WorleyParsons, with backing from Rio Tinto, BHP Billiton and Woodside Energy announced it undertook a feasibility study to construct a 250MW solar thermal power station in Australia. The estimated cost to build the plant was A\$1 billion. WorleyParsons considered the economics of large scale solar thermal can be a competitive electricity supply during the day and early evening in Australia following the Australian Government announcements to expand the national Renewable Energy Target as well as ongoing high peak load electricity prices.³⁶

³⁶ The Australian Financial Review (13 August 2008) *Worley Parsons heralds solar power dawn* (p10)



Wizard Power intends to commercially demonstrate the ANU 'big dish' solar concentrator technology. The project proposes to build 20 'big dishes' to feed steam into a highly efficient single central power block, using conventional turbine and engine technology. The array would, in a moderate solar location such as Canberra, generate about 2GWh per annum of electricity and 4GWh per annum of heat. Sale of the "Green Power" along with the integration of thermal energy delivery such as water treatment and town heating will enhance the viability of a long-term facility.

Lloyd Energy and **Ergon Energy** will develop a 10MW solar thermal project at Cloncurry, utilizing heated granite as a thermal storage, enabling steam and electricity generation after dark. The Queensland Government is investing A\$7 million in the estimated A\$30 million project. The announcement has generated strong international interest from companies in South Africa, Canada, the United States and Germany.³⁷

Ergon Energy is investing A\$4 million in Queensland's first solar farm at Windorah, a remote town in Queensland's south-west. The town's existing diesel-fired power station and solar power station will be integrated to minimise the use of diesel generators.

Horizon Power plans to build two solar power stations valued at A\$25 million in Marble Bar and Nullagine, in the east Pilbara region of Western Australia. The projects are the first high penetration hybrid solar photovoltaic diesel power stations in the State; will generate over 1GWh per annum, supplying about 60% of the annual electricity demand for both towns, and will save about 412,000 litres of fuel and 1100 tonnes of greenhouse gas emissions each year. .

Other Solar Technology Announcements

Lehmann Pacific Solar Pty Ltd has launched 'SkyCool', a solar reflective, paint like substance for metal roofs, particularly in large commercial and industrial markets. The product reflects roof heat and can reduce air conditioning and insulation costs by up to 50%. Recent trials on a Queensland shopping centre and a New South Wales school portable classroom have been highly successful, demonstrating that climate control costs can be significantly reduced using SkyCool.

Solectair³⁸ is a low cost solar heating system that uses the roof of a building as a solar collector and a unique microprocessor based controller to measure the temperature in the living space and also in the roof space. As the sun shines on the roof cladding, the temperature builds up in the roof space (for example on a 21°C day, the roof space temperature can exceed 30°C). When heating is required in the living space, and the roof space is warmer than the living space, the controller automatically activates a fan that 'harvests' the free solar heated warm air and transfers it into the living space, heating the building. Tests of the Solectair HTS by Murdoch University have shown reductions in home heating energy usage by 50% and a reduction in CO₂ emissions of half a tonne to three tonnes per annum at a 14m² home. Some versions of Solectair also provide night air cooling and can reduce conventional cooling usage by 20%. The Solectair Heat Transfer System is a Western Australian invention with US, Australian and other international patents issued.

CSIRO has developed 'Smart Fridges' that run on renewable electricity and are capable of negotiating the most energy efficient way to keep food cold. The fridge is capable of maintaining its average temperature while regulating power consumption from renewable-energy generators, such as solar panels or wind turbines. CSIRO is currently seeking commercial partners to further develop the technology.³⁹

World Solar Challenge promotes educational and technical excellence, showcasing sustainable transport. The challenge involves building a solar car capable of travelling the 3000km from Darwin to Adelaide. It attracts teams from corporate, research and educational institutions from around the world. The 10th World Solar Challenge event will be held in October 2009.

³⁷ Queensland Minister for Mines and Energy, press release (15/11/2007) *Solar thermal power station sparks international interest* www.cabinet.qld.gov.au/MMS/StatementDisplaySingle.aspx?id=55182

³⁸ www.solectair.com

³⁹ Environmental Management News (19/01/2009) www.environmentalmanagementnews.net/StoryView.asp?StoryID=448066



Australian Government Initiatives

The Australian Government is committed to help individuals, communities and businesses meet the challenges of climate change.⁴⁰ A number of programs offer support to expand renewable energy research, manufacturing capacity and deployment, through a suite of technology innovation and market demand measures. Key initiatives are:

- Ratifying the Kyoto Protocol and setting a target to reduce Australia's greenhouse gas emissions by 5% to 25% by 2020 and 60% by 2050;
- Setting a national renewable energy target of 20% of electricity consumption to be supplied by renewable energy generators by 2020 (an additional 45,000GWh);⁴¹
- Increasing the A\$4.5 billion Clean Energy Initiative (CEI) to A\$5.1 billion, announced in Budget 2010. The Clean Energy Initiative consists of:
 - Australian Centre for Renewable Energy (ACRE): more than A\$690 million of funding to help commercialize renewable energy. ACRE's objective is to promote the development, commercialization and deployment of renewable energy and enabling technologies and to improve their competitiveness in Australia. The Australian Centre for Renewable Energy is establishing a \$100 million Renewable Energy Venture Capital (REVC) fund to make critical early-stage equity investments that leverage private funds to help commercialise renewable technologies.
 - Renewable Energy Future Fund: A\$652 million for the development and deployment of large and small scale renewable energy projects through partnership with the private sector; and to promote the take-up of energy efficiency and help businesses and households reduce their energy consumption.
 - Solar Flagships Program: A\$1.5 billion of funding over 6 years to support construction and demonstration of large-scale, grid connected, solar power stations in Australia, using solar thermal and photovoltaic technologies. The target size is to establish up to 1000MW of solar power generation capacity.

In addition, the Government has provided A\$100 million to the Australian Solar Institute, which aims to increase the cost-effectiveness of solar technology and accelerate the capacity of solar industries in Australia.

- CCS Flagships Program: A\$2 billion of funding over 9 years to support construction and demonstration of large-scale integrated carbon capture and storage projects in Australia, which may include gasification, post-combustion capture, oxy-firing, transport and storage technologies. The target is to create 1000MW of low emission fossil fuel generation.

Complementing the CCS Flagship Program is the A\$385 million National Low Emissions Coal Initiative that aims to accelerate the development and deployment of technologies to reduce emissions from coal use; and

- Maintaining a range of duty and tax concession programs aimed to facilitate investment in research, manufacturing and export facilities in Australia.

Kyoto Protocol

The Australian Government has ratified the Kyoto Protocol, committing to ensure national greenhouse gas emissions over the period 2008-2012 are capped at 108% of 1990 levels. The Australian Government will continue to work with many countries through the UNFCCC negotiations to contribute to a global solution for climate change.

⁴⁰ Australian Government, Department of Climate Change, *Climate Change Budget Overview 2008-09*, p3

⁴¹ Australian Government, Department of Climate Change www.climatechange.gov.au/renewabletarget/consultation/pubs/ret-designoptions.pdf



Renewable Energy Target

The Australian Government has expanded the Renewable Energy Target (RET) to reach 20% of electricity generation in Australia by 2020, which increases the current Renewable Energy Target by more than four times, reaching 45,000 gigawatt-hours in 2020.

To further drive investment in renewable energy, the Australian Government enhanced the RET by splitting it into two parts: the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET).⁴² The LRET will cover commercial generation-scale renewable energy projects and will deliver the majority of the 2020 target. The SRES will cover household-scale technologies such as domestic solar panels and solar hot water systems and deliver the remainder of the target. The enhanced RET will commence 1 January 2011.

Solar Flagships Program

Solar Flagships⁴³ supports construction and demonstration of large scale solar power stations in Australia to help position Australia as a world leader in solar technology. The program is expected to comprise up to four solar power stations operating within the energy market. The total capacity of the power stations will be 1000MW of electricity generation, equivalent to an average Australian coal fired power station. Project funding under the Solar Flagships Program is subject to a competitive process, with applications assessed by an expert committee. Solar Flagships Program guidelines have been developed and the first round of applications has closed. The Government announced short-listed projects for Round 1 on 11 May 2010⁴⁴:

- AGL in collaboration with First Solar and Bovis Lend Lease propose to develop up to five solar photovoltaic projects with a total capacity of up to 200MW across five states and territories.
- BP Solar, leading a consortium including Fotowatio, propose to develop a 150MW solar photovoltaic facility in the NSW Tablelands.
- Infigen Energy, Suntech Power Holdings, University of New South Wales, Phoenix Solar and Tenix have formed a consortia to build three solar photovoltaic projects across three sites in Victoria or New South Wales, with a capacity of between 150-195MW.
- TRUenergy in collaboration with First Solar, Bovis Lend Lease, CSIRO and Worley Parsons, propose to build a 180MW solar photovoltaic project near Mildura in Victoria
- ACCIONA Energy in collaboration with Mitsubishi Corporation, ACCIONA Infrastructures, BMD Constructions, GHD and CSIRO, propose to build a 200MW solar thermal parabolic trough project in either Queensland or South Australia.
- Parsons Brinkerhoff is leading the Solar Flair Alliance, including Siemens (Solel), John Holland, CS Energy, Infrastructure Capital Group, Queensland University of Technology, and Curtin University, propose to develop a 150MW solar thermal parabolic trough project at the existing Kogan Creek coal fired power station near Chinchilla, Queensland.
- Transfield Holdings, Transfield Services, Transfield Services Infrastructure Fund and Novatec (a subsidiary of Transfield Holdings) propose to build a 150MW solar thermal project at a existing Collinsville coal fired power station in Queensland.
- Wind Prospect CWP has partnered with CS Energy, AREVA Solar, Mitsui & Co (Australia), and University of Queensland, to develop a 250MW solar thermal project at the existing Kogan Creek coal fired power station near Chinchilla, Queensland.

⁴² Australian Government, Department of Climate Change, Energy Efficiency and Water (May 2010) www.climatechange.gov.au/~media/Files/minister/wong/2010/media-releases/May/mr20100512.ashx

⁴³ Australian Government, Department of Resources, Energy and Tourism, www.ret.gov.au/energy/energy%20programs/cei/sfp/Pages/default.aspx

⁴⁴ Australian Government, Department of Resources, Energy & Tourism website, Media Release, Martin Ferguson: www.ret.gov.au/Department/Documents/FactSheets%20-%20Budget%20night%2010-11/FACT%20SHEET%203%20-%20SOLAR%20FLAGSHIPS%20PROJECTS%20SHORTLISTED.pdf



Australian Solar Institute

The Australian Solar Institute (ASI), based in Newcastle, was officially launched on 15 January 2009. The ASI will support Australian researchers in solar photovoltaic and concentrating solar technologies, by helping to retain expertise and develop the next generation of researchers and technologies within Australia. The ASI will foster greater collaboration between universities, research institutions and industry, and help forge strong link with peak overseas research organisations.

The ASI was allocated A\$100 million under the Energy Innovation Fund to support the Australian solar community through a competitive grants program. A smaller proportion of research funding will be provided to core Institute projects and activities. Guidelines and eligibility criteria for the competitive grants program have been published. Allocation of grants is made through an open, competitive and transparent process.

Australian Centre for Renewable Energy

Australian Centre for Renewable Energy (ACRE) will be overseen by a specialist board with expertise in research, venture capital, intellectual property and commercialisation. ACRE's objective is to promote the development, commercialisation and deployment of renewable technologies. It will seek to achieve this through applying a more comprehensive and commercial investment approach to government expenditures in this field.

ACRE will have the flexibility to operate along the full innovation chain, including through incubating promising technologies in a 'venture capital' style model. Activities under the initiative would be expected to include:

- Supporting focused, collaborative, high-priority technology research with the ultimate aim of progressing new technologies and lowering the cost of existing technologies in the market place;
- Supporting and advising government, industry and the community in the promotion, development and implementation of renewable technologies and relevant research and development in essential renewable-related systems; and
- Supporting growth in skills and capacity in renewable technologies for the domestic and international markets.

Asia-Pacific Partnership on Clean Development & Climate Change

The Asia-Pacific Partnership on Clean Development and Climate (APP) brings together Australia, Canada, China, India, Japan, Republic of Korea and the United States of America to address the challenges of climate change, energy security and air pollution in a way that encourages economic development and reduces poverty. The APP members are large, fast growing economies that represent around half the world's emissions, energy use, gross domestic product, and population.

In March 2008, the Australian Government committed an additional A\$50 million in funding beyond the initial commitment of A\$100 million over five years for the partnership. In recognition of the significant commitment to the development of renewable resources, 25% of the funds have been specifically earmarked for renewable energy. Currently Australia has allocated over A\$100 million to over 62 APP projects. These projects are drawn from across all eight Task Forces with a focus on cleaner fossil and renewable energy.⁴⁵

Environmental Protection and Biodiversity Act 1999 (EPBC Act)

The EPBC Act may apply to large scale solar generation projects in Australia, if the "project, development, undertaking, activity, or series of activities that will have, or are likely to have, a significant impact on a matter of national environmental significance, it will require approval from the Commonwealth Environment Minister under the EPBC Act." The EPBC Act protects the environment, streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places. Whether an impact on a protected matter is significant or not depends on the particular location, scope, timing and other circumstances of the proposed action.⁴⁶

⁴⁵ Asia-Pacific Partnership Project Roster can be downloaded at: www.asiapacificpartnership.org/english/default.aspx

⁴⁶ EPBC Administrative Guidelines on Significance can be viewed at: www.deh.gov.au/epbc/policy/index.html



Other Programs (open to new applications)

For further details about these programs and links to guidelines, please refer to **Attachment B**.

R&D, proof-of-concept and demonstration

- R&D Tax Credit
- Commercialising Emerging Technologies (COMET)
- Innovation Investment Fund (IIF)

Manufacturing through assembly facilities

- Enhanced Project By Laws Scheme
- Certain Inputs to Manufacture
- Major Project Facilitation

Commercial technology deployment

- Remote Renewable Power Generation Program (now open to Western Australia applicants only)
- Solar Credits
- Solar Hot Water Rebate

Goods and Services import and export

- Tradex Scheme
- Export Market Development Grants
- Export Finance and Insurance

Other Programs (closed to new applications)

Solar Cities is a A\$94 million program administered by the Department of the Environment, Water, Heritage and the Arts. The seven Solar Cities are Adelaide, Townsville, Blacktown, Alice Springs, Central Victoria, Perth and Moreland. Consortia that successfully bid for a Solar Cities project are now working with industry, businesses and the communities to trial a range of new technology options, such as energy efficiency measures for homes and businesses, pricing trials to reward people who use energy wisely, the wide spread integration of solar technologies in distribution networks, and community education. No additional Solar Cities are expected. The program continues until 2013.⁴⁷

Under the **Photovoltaic Rebate Program**, over 8000 residential systems were installed between 2000-2006, totalling 10MWp and rebates of over A\$40 million. In 2006, 1230 systems were installed, amounting to 1.85MWp, of which 75% were grid connected.

The **Solar Homes and Communities Plan** was allocated A\$150 million in 2007 (over 5 years) to provide rebates of up to A\$8000 for the installation of solar photovoltaic systems on up to 3000 homes each year. Demand for the rebate was so strong that 34,000 solar systems had been installed by the end of May 2009, and a further 63,000 installations registered for the rebate. This resulted in a four-fold increase in budget; closure of this program and the immediate introduction of **Solar Credits**.

The **Low Emissions Technology Demonstration Fund (LETDF)** provided grants totalling A\$335 million to six projects, to demonstrate the commercial potential of new energy technologies or processes or the application of overseas technologies or processes to Australian circumstances to deliver long-term large-scale greenhouse gas emission reductions.⁴⁸

⁴⁷ Australian Government, Department of Environment, Water, Heritage and the Arts, www.environment.gov.au/settlements/solarcities/publications/solarise/index.html

⁴⁸ Australian Government, Department of Resources, Energy & Tourism, LETDF Round 1 projects: www.ret.gov.au/energy/Documents/energy%20programs/letdf-round-1-funded-projects.pdf



The **Renewable Energy Demonstration Program** was a A\$435 million commitment by the Australian Government in Budget 2008.⁴⁹ Applications for REDP grants closed on 15 April 2009. On 6 November 2009, grants totalling of A\$235 million were offered to four projects, promoted to deliver ~A\$810 million in renewable energy investment and ~80 MW of new renewable generation capacity⁵⁰ On 11 May 2010, additional grants totalling A\$92 million were announced for two additional solar thermal projects⁵¹:

- CS Energy, A\$32 million, to build a 23MW solar boost to coal-fired turbines at Kogan Creek, near Chinchilla, Queensland; and
- N.P. Power Pty Ltd, A\$60 million, to build a 40MW concentrated solar thermal demonstration plant at Whyalla, South Australia.

The **Renewable Energy Development Initiative's** solar projects are:

- Origin Energy Solar Pty Ltd (SA), A\$5 million, to develop the solar PV SLIVER technology;
- Solar Heat and Power Pty Ltd (now called Areva) (NSW), A\$3,254,028, to build a 5MW proof-of-concept solar-concentrating array (linear Fresnel technology);
- Solco Ltd (WA), A\$197,623, to enhance a low-cost, plastic, high-pressure solar hot water system suitable for frost and corrosive locations, providing pressurised or pump-boosted hot water;
- Wizard Power Pty Ltd (ACT), A\$3,478,876, to develop a 2nd generation Big Dish with a 50% solar-to-electricity conversion performance improvement and potentially a threefold reduction in overall manufacturing and maintenance costs;
- Katrix Pty Ltd (Vic), A\$811,252, to develop a new high-efficiency fluid expander to enable small-scale residential and commercial solar thermal power and heat systems;
- New Energy Partners Pty Ltd (NSW), A\$258,800, to complete development of a polymer based parabolic trough collector designed for roof mounted, medium temperature applications, such as solar thermal air-conditioning for commercial buildings.
- BP Solar Pty Ltd (NSW), A\$1,581,411, for cell process engineering developments for improved yield from available silicon

The **Advanced Electricity Storage Technologies Program**⁵² aims to reduce barriers to the uptake of all renewable energy technologies, not just solar. However of the A\$20.4 million allocated by the Australian Government to the program, four of the five successful projects are solar related. Advanced storage technologies for electricity applications include, but are not limited to, batteries, electro-mechanical, chemical and thermal storage technologies in either on-grid or off-grid situations. The four projects are:

- Wizard Power (SA), A\$7.4 million, to demonstrate a solar energy storage system based on ammonia dissociation and re-association into hydrogen and nitrogen;
- Lloyd Energy Systems (NSW), A\$5 million, to demonstrate a solar thermal energy storage system involving concentrated solar energy and graphite blocks;
- ZBB Technologies (NSW), A\$3.1 million, to demonstrate an integrated zinc-bromine flow battery at CSIRO's National Solar Energy Centre in Newcastle; and
- RedFlow Pty Ltd (QLD), A\$1.113 million, to demonstrate the viability of zinc-bromine batteries in maximising on grid and fringe of grid solar photovoltaic systems.

⁴⁹ Australian Government, Department of Resources, Energy & Tourism, www.ret.gov.au/energy/energy%20programs/cei/acre/redp/Pages/default.aspx

⁵⁰ Australian Government, Minister for Resources, Energy and Tourism, Media Release [http://minister.ret.gov.au/TheHonMartinFergusonMP/Pages/RENEWABLEENERGYDEMONSTRATIONPROGRAMFOURINNOVATIVEPROJECTSRECEIVE\\$235MILLION.aspx.html](http://minister.ret.gov.au/TheHonMartinFergusonMP/Pages/RENEWABLEENERGYDEMONSTRATIONPROGRAMFOURINNOVATIVEPROJECTSRECEIVE$235MILLION.aspx.html)

⁵¹ Australian Government, Minister for Resources, Energy and Tourism, Media Release http://minister.ret.gov.au/TheHonMartinFergusonMP/Pages/budget_renewable.aspx.html

⁵² Australian Government, Department of Resources, Energy & Tourism AEST website: www.ret.gov.au/energy/energy%20programs/advanced_electricity_storage_technologies_program/Pages/AdvancedElectricityStorageTechnologies.aspx



The **Climate Ready** program was allocated A\$75 million by the Australian Government, to provide competitive grants from A\$50,000 up to A\$5 million to Australian industry. Four rounds of Climate Ready were called and grants have been offered to support research and development, proof-of-concept and early-stage commercialisation activities to develop solutions to climate change challenges. Solar energy related recipients are:

- Smart Storage Pty Ltd (NSW), A4345,000, for UltraBattery Storage for Cyclic Renewable Energy;
- BT Imaging Pty Ltd (NSW), A\$3,624,897, for the development of a luminescence imaging system to revolutionise solar cell manufacture; reduce costs, increasing performance and foster widespread consumer adoption of solar energy;
- Nano-Nouvelle Pty Ltd (Qld), A\$276,833, for Nanostructured Semiconductor Thin Films
- Cogen Microsystems Pty Ltd (SA), A\$814,471, to develop a combined solar hot water and electricity generation system for household and small commercial use;
- Xerocoat Pty Ltd (Qld), A\$964,394, for an anti-soiling coating to increase solar energy generation efficiency; and
- Selectronic Australia Pty Ltd (Vic), A\$492,835, to develop a new generation of interactive inverter/chargers which will enhance the reliability and performance of renewable power systems such as wind and solar.

You may also like to read about four older programs and the projects funded by clicking on the hyperlinks:

- [Low Emissions Technology and Abatement](#)
- [Renewable Energy Industry Development Program](#) (REID)
- [Renewable Energy Commercialisation Program](#) (RECP)
- [Renewable Energy Industry Program](#) (REIP)
- [Renewable Energy Showcase](#)



State and Territory Governments' Initiatives

Clean Energy Targets

The **Australian Government** is working with relevant Ministers in each State and Territory through the Council of Australian Governments to bring the national Renewable Energy Target (20% by 2020) and the following existing State-based targets into a single national scheme.

The **Victorian** Government has introduced to State Parliament the *Victorian Renewable Energy Target Act 2006* that sets a target of 10% (approximately 3274GWh) of the State's energy supply to be sourced from renewable sourced by 2016. This policy is expected to attract some A\$2 billion of investment in renewable energy generation to Victoria.⁵³

The **South Australian** Government's *Climate Change and Greenhouse Emissions Reduction Act* commenced in July 2007.⁵⁴ The principal target under this Act is to reduce by 2050 greenhouse gas emissions within South Australia by at least 60% to an amount that is equal to or less than 40% of 1990 levels. The government is reaching this target ahead of its 2014 deadline. In June 2009, the South Australian Government outlined plans to increase the states renewable energy production target to 33% by 2020.

The **New South Wales** Government under its Greenhouse Plan requires electricity retailers to offer at least 10% Green Power to all new (or moving) residential customers.⁵⁵ From July 2009, the New South Wales Government Energy Savings Scheme came into effect with an energy efficiency target of 0.4% of total electricity sales which will increase to 4% in 2014.⁵⁶

The **Queensland** Government has signed up to the national Renewable Energy Target of 20% of Australia's electricity supply to come from renewable energy sources by 2020. The *Queensland Renewable Energy Plan* outlines the State's aim to achieve at least 20% of investment generated through the national Renewable Energy Target. The plan will help leverage up to A\$3.5 billion in new investment, create some 3500 new jobs and reduce greenhouse gas emissions by more than 40 million tonnes by 2020.

The **Australian Capital Territory** Government currently purchases 23% of energy requirements from green sources. There are plans to increase this percentage to 30% and will be further raised by 10% for each subsequent year. The Government is currently developing an energy policy that will include a renewable energy target of at least 15% by 2012 and 25% by 2020.⁵⁷

The **Western Australia** Government is working with the Federal Government to develop a scheme to deliver national target of 20% of electricity is generated from renewable sources by 2020.⁵⁸

The **Northern Territory** Government has mandated that by 2010 an additional 61500MWh of electricity must come from renewable energy sources.⁵⁹

In **Tasmania**, hydro and wind currently represents 87% of installed electricity generation capacity. Tasmania's aspires to generate 100% of its electricity needs from renewable resources.

⁵³ Sustainability Victoria, www.resourcesmart.vic.gov.au/for_government/renewable_energy_2143.html

⁵⁴ South Australia Government,

www.legislation.sa.gov.au/LZ/C/A/CLIMATE%20CHANGE%20AND%20GREENHOUSE%20EMISSIONS%20REDUCTION%20ACT%202007.aspx

⁵⁵ New South Wales Government, www.deus.nsw.gov.au/Publications/NRET%20Explanatory%20Paper%20FINAL.pdf

⁵⁶ New South Wales Government Solar Bonus Scheme: www.industry.nsw.gov.au/energy/sustainable/renewable/solar/solar-scheme

⁵⁷ ACT Government, *Weathering the Change: Action Plan 1 2007-2011*

www.environment.act.gov.au/climate_change/weathering_the_change

⁵⁸ WA Government, Sustainable Energy Development Office: www.sedo.energy.wa.gov.au/pages/renewable_energy_target_wa.asp

⁵⁹ NT Power and Water Corporation: www.powerwater.com.au/business/renewable_energy/solar_hot_water_rebate



Research and Development Funds

Queensland

- The A\$115 million Solar Package, announced in Budget 2010-11, aims to build a solar industry and double solar energy generation capacity in Queensland. Solar initiatives funded include:
 - A\$35.4 million for CS Energy's Carbon Reduction Program - supporting the development of major renewable energy projects at Kogan Creek
 - A\$29.5 million for the A\$60 million Solar Rebate Scheme - providing residents with rebates of A\$600 and A\$1000 for the installation of solar heat pump or solar hot water systems
 - A\$5.8 million for the Solar Kindergartens Program - funding the installation of solar PV panels on the roofs of new and existing kindergarten buildings, built or upgraded over the next four years
- A\$50 million Queensland Renewable Energy Fund (QREF) supports the development and deployment of renewable energy technologies. One Round was announced, and is closed to new applications.⁶⁰
- Queensland Sustainable Energy Innovation Fund (QSEIF) focuses on the development and commercialization of sustainable technologies, rather than pure research. Since 1999, QSEIF has committed over A\$8.9 million in funding to over 77 projects in Queensland. Grants of up to A\$200,000 are available, through a competitive merit based process. There are two funding rounds per year.⁶¹
- The Clean Energy Strategy for Queensland's Isolated Communities program will change the way electricity is supplied and used within 33 isolated electricity networks across Western Queensland, Cape York and Torres Strait Islands. Initial funding of A\$5 million will be provided to Ergon Energy to undertake a one year trial of energy efficiency and conservation initiatives at select locations. The program aims to reduce household electricity consumption by 20% at each of the trial centres, translating into savings of up to A\$200 per customer each year.⁶²
- Queensland Solar Hot Water Program, commenced on 1 July 2009, will deliver up to 200,000 solar and heat pump hot water systems by 2012. Eligible participants will have access to a standard installed and warranted, solar or heat pump hot water system for a payment of up to A\$500.⁶³
- *Queensland Solar Homes Program* aims to make solar power systems more accessible to Queenslanders by reducing up-front costs. The Government has an agreement with the contractor, eco-Kinetics, to secure a "guaranteed bulk purchase" price for up to 1000 one-kilowatt solar power systems. These systems are being installed in up to 1000 homes in south-east Queensland, Toowoomba, Cairns, Rockhampton and the Fraser Coast.⁶⁴
- The Smart Energy Savings Fund (SESF) is an A\$50 million funding program to assist Queensland businesses to invest in commercial energy saving projects.⁶⁵
- Queensland Energy Efficient Street Lighting Trial is a three year trial will involve a world-first monitoring device that measures the performance of 400 new types of energy efficient lighting in "real world" climatic and network conditions. To demonstrate its support, the Australian Government has now committed A\$240,000 to the trial. In September 2008, deployment of all lighting technologies was completed in South East Queensland.⁶⁶

⁶⁰ Queensland Renewable Energy Fund http://svc196.wic512d.server-web.com/queensland_renewable.cfm

⁶¹ Queensland Environmental Protection Agency, www.epa.qld.gov.au/environmental_management/sustainability/energy/queensland_sustainable_energy_innovation_fund_qseif/

⁶² Queensland Government, Renewable Energy Plan: www.cleanenergy.qld.gov.au

⁶³ *ibid*

⁶⁴ Queensland Government, Department of Environment and Resource Management, www.epa.qld.gov.au

⁶⁵ Queensland Government, Office of Clean Energy www.cleanenergy.qld.gov.au

⁶⁶ *ibid*



South Australia

- Remote Areas Energy Supplies (RAES) subsidy scheme aims to increase the availability and reliability of power generation and distribution in remote areas of the state. The Scheme consists of nine power stations overseen by Energy Division using contracted service providers. The District Council of Coorber Pedy and two private operators (Andamooka and Yunta) receive a subsidy under the Scheme based on their annual reporting.⁶⁷
- The A\$20 million Renewable Energy Fund announced in the 2009 Budget will be used over two years to support strategic investments in the renewable energy industry.⁶⁸
- The South Australian Government offers low income owner occupiers a rebate of A\$500 towards the cost of installing a new solar hot water system (electric or gas boosted) or a heat pump water heater. The scheme is targeted at assisting low income households.⁶⁹
- Under the Residential Energy Efficiency Scheme (REES), commenced on 1 January 2009, providers of electricity and gas in South Australia are required to meet customer (household) energy efficiency targets. Energy providers, and their contractors, offer incentives to adopt [energy saving measures](#); such as installing more efficient lighting and showerheads, draught proofing, retiring second fridges, and upgrading to more efficient appliances. Energy providers are required to make sure they meet at least one third of their targets in low income households. They must also deliver 13,000 energy audits to low income households by 2011.⁷⁰
- The Centre for Innovation is offering merit-based Innovation Development Grants to assist in small to medium businesses with developmental costs and/or to position themselves to attract further investment (such as grants and equity) that will lead to the commercialisation of innovative products and services⁷¹.

Victoria

- A\$72 million is allocated for sustainable energy technologies under the Energy Technology Innovation Strategy.⁷²
- The A\$100 million Victorian Large Scale Solar fund will help develop a new large-scale solar power station in Victoria, with the final power station being capable of delivering 330GWh of electricity to the National Electricity Market.⁷³
- The Victorian Science Agenda provides up to A\$41 million for collaborative projects between business and research organisations that strengthen Victoria's science and technology capabilities. Grants from A\$300,000 to A\$3 million will be offered.⁷⁴
- The Victorian Energy Efficiency Target scheme, which commenced on 1 January 2009, aims to encourage the uptake of energy efficient technology, initially in the residential sector.⁷⁵
- Environment and Resource Efficiency Plans (EREP) is an innovative regulatory program to help Victorian businesses meet climate change and resource scarcity challenges. Through EREP, industry can realise the business opportunities presented by resource efficiency by implementing actions that achieve environmental benefits and direct cost savings in a short timeframe. Participating businesses

⁶⁷ South Australia Government, Department of Transport, Utilities & Infrastructure, www.dtei.sa.gov.au/energy/rebates_and_grants/remote_areas_energy_supplies

⁶⁸ South Australia Government, www.treasury.sa.gov.au/public/download.jsp?id=2849&page=/dtf/budget/publications_and_downloads/current_budget.jsp

⁶⁹ South Australia Government, www.sa.gov.au/energysmart

⁷⁰ The Essential Services Commission of South Australia, www.energy.sa.gov.au/rees

⁷¹ South Australian Biz, www.southaustralia.biz/Grants/Innovation-Development-Grant.aspx

⁷² Victorian Department of Primary Industries' Energy Technology Innovation Strategy www.dpi.vic.gov.au/DPI/dpinenergy.nsf/LinkView/916FB089198CC145CA2572BB000985B4AFE5D9442E22210ACA2572BB00096717

⁷³ Victorian Department of Primary Industries, www.dpi.vic.gov.au/DPI/dpinenergy.nsf/childdocs/-384C1AC0F3D5716CCA25729D00102547-4F62928B9AF1A8F9CA25757E00108747-0E0AF54433E832C4CA25757C0008CB49?open

⁷⁴ Business Victoria, Innovation and Commercialisation, Science Agenda Investment Fund www.business.vic.gov.au/BUSVIC/STANDARD.HTML/pc=pc=pc=PC_63087.html

⁷⁵ Victorian Govt Energy Saving Incentive Scheme, www.dpi.vic.gov.au/DPI/dpinenergy.nsf/childdocs/-3F827E74C37E0836CA25729D00101EB0-25F3A72717ED1F21CA2572B2001BF39D?open



need to register with EPA, prepare and implement a plan that identifies actions to reduce energy and water use, and waste generation.⁷⁶

- The Victorian Government's Sustainability Fund⁷⁷, managed by Sustainability Victoria, provides funding for projects that drive more sustainable resource use in Victoria. There is approximately A\$4.5 million available in the 2009 Funding Round, and two categories to apply for:
 - Sustainable solutions that directly assist Victorian households to address climate change (A\$3.5 million).
 - Capacity building in community organisations and local government to assist low income Victorian households to address climate change (A\$1 million).

Western Australia

- A\$36.5 million Low Emissions Energy Development (LEED) fund supports renewable energy research;⁷⁸
- Sustainable Energy Development Office Grants Program provides funding up to A\$50,000 for community-based sustainable energy projects and sustainable energy research and development projects in Western Australia.⁷⁹
- Remote Area Power Supply Program provides rebates for renewable energy power systems used instead of fossil fuel generation in off-grid areas.⁸⁰

Australian Capital Territory

- A\$34.9 million has been budgeted for strategic environment and climate change initiatives in 2009-10.⁸¹ Additionally, the ACT Government has pledged A\$30 million towards the construction of a solar power plant capable of powering approximately 10,000 homes.⁸²
- Australian National University A\$2.5 million grant to establish the Climate Change Institute to foster interdisciplinary and innovative research on climate change issues.
- A\$242 million (2007-08 to 2012-13) is budgeted for climate change initiatives, of which A\$100 million is allocated to implement the ACT Climate Change Strategy.⁸³

New South Wales

- A\$40 million Renewable Energy Development Program supports emission savings in NSW by demonstrating and supporting the early commercialisation of renewable energy technologies in NSW.⁸⁴
- The A\$100 million Residential Rebate Program helps households to become more water and energy efficient. The [hot water system rebate](#) under the Program provides up to A\$1200 per household to switch from electric to solar, heat pump or gas hot water systems.
- [NSW Energy Challenge Prize](#), announced July 2009, is a A\$5 million international research prize to keep NSW at the forefront of clean energy provision. The aim of the prize is to encourage innovative solutions in the provision of clean energy. To be eligible for the prize, research teams must have two essential partners – a NSW university and a company with its headquarters in NSW.

⁷⁶ Victorian Govt, Environment Protection Authority, www.epa.vic.gov.au/bus/erep/default.asp

⁷⁷ Victorian Government, Sustainability Victoria, www.sustainability.vic.gov.au/www/html/1361-sustainability-fund.asp

⁷⁸ Western Australia Premier media release (29 June 2008)

⁷⁹ www.mediastatements.wa.gov.au/Pages/Results.aspx?ItemId=130444&search=solar&admin=&minister=&portfolio=®ion=

⁸⁰ Western Australia Sustainable Energy Development Office www.sedo.energy.wa.gov.au/pages/grants.asp

⁸¹ Western Australia Remote Area Power Supply Program, www.sedo.energy.wa.gov.au/pages/raps.asp

⁸² ACT Government Budget 2009-2010, Media Release, www.treasury.act.gov.au/budget/budget_2009/files/press/16_press.pdf

⁸³ ACT Government, Solar Power Facility Fact Sheet,

www.environment.act.gov.au/_data/assets/pdf_file/0008/151982/Solar_FacilityFactsheet_290509.pdf

⁸⁴ ACT Treasury, Budget 2008 announcement, www.treasury.act.gov.au/budget/budget_2008/html/paper3.htm

⁸⁵ NSW Government, Department of Environment and Climate Change, Renewable Energy Development Fund website www.environment.nsw.gov.au/grants/ccfred.htm



Northern Territory

- The [Solar Hot Water Retrofit Rebate](#) provides up to A\$1000 per household for installation of solar hot water systems that replace electric systems and earn Renewable Energy Certificates.⁸⁵

Tasmania

- A\$3 million Climate Futures for Tasmania Project will provide detailed (10-15km resolution) climate change projections through to 2100 for Tasmania, under a range of accepted greenhouse emission scenarios.
- Climate Connect⁸⁶ grants provide funding for community based programs that deliver clever climate change solutions. Eligible community groups can apply for grants of up to A\$50,000 each to undertake projects that reduce emissions or conserve energy in their community.

⁸⁵ NT Power and Water Corporation www.powerwater.com.au/environment/renewable_energy_products/solar_hot_water_retrofit_rebate

⁸⁶ Climate Connect, Tasmania, www.climatechange.tas.gov.au



ATTACHMENT A

Electricity generation industry structure in Australia

Since the 1990's, Australia's electricity industry has been significantly restructured, through the dis-aggregation of many government owned utilities into separate generation, transmission, distribution and retail supply businesses and, in some cases, privatisation of state-owned electricity assets. The electricity generation sector is now horizontally segregated into numerous competing businesses and these are subject to fair trade and competition regulations.

The International Energy Agency reports Australia has "one of the most transparent and competitive electricity markets in the world. New entrants face relatively minor barriers to entry and there is robust third party access to transmission and distribution lines. For the most part, there is sufficient diversity of suppliers to mitigate market power abuse"⁸⁷.

National Electricity Market

Governments' market-based reforms culminated in the establishment of the National Electricity Market (NEM), which links the Australian Capital Territory, South Australia, New South Wales, Victoria, Queensland and Tasmania to a competitive wholesale electricity market and retail sector for the supply and purchase of electricity. Thirty-five different companies bid their electricity generation output to the National Electricity Market (NEM) and thirteen major retailers.

Western Australia is not connected to the NEM but has established a State-wide electricity market and reform program. Under the reforms, Western Power Corporation was divided into four separate Government owned utilities: Verve Energy (generation); Western Power (networks); Synergy (retail) and Horizon Power (regional power supply).⁸⁸

The operation of the NEM relies on the forecast of expected demand for electricity. Demand varies across State borders, depending on factors such as population, climate and industrial and commercial needs for power. Demand also varies throughout the day (peak and off-peak times). Price is determined by a designated region reference node, where the spot price of electricity for that region is set. High-voltage transmission lines (inter-connectors) transport power between the six electricity regions.

An important feature of the NEM is the clear separation of the physical and financial functions. While the physical market is a common pool or spot market for trading wholesale electricity, the financial market enables contracts between market participants.

Physical Market

All electricity produced by market generators must be traded through the pool. A single, central dispatch process determines a merit order for the dispatch of generation (with the lowest priced generator dispatched first subject to system and other operating constraints) based on a 5 minute dispatch cycle and 30 minute trading intervals to balance supply and demand and system security.⁸⁹ Electricity is traded through a pool because it cannot be stored for future use, so supply varies according to demand. It is difficult to determine which generator produced what unit of electricity.⁹⁰

Financial Market

There is risk caused by volatility of the spot market especially for retailers who on-sell at fixed prices to consumers and purchase from the spot market, called "Value of Lost Load". The value varies from an average of A\$30/MWh⁹¹ to a maximum of A\$10,000/MWh until 30 June 2010 and A\$12,500/MWh thereafter.⁹² Market participants reduce risk by entering into long term Power Purchase Agreements and

⁸⁷ International Energy Agency (2006) *Energy Policies of IEA Countries: Australia 2005 Review*, France (p116)

⁸⁸ Western Australia Office of Energy www.energy.wa.gov.au/2/3189/64/electricity_ref.pm

⁸⁹ Australian Electricity Market Operator (July 2009) *An Introduction to Australia's National Electricity Market*, (p17)

⁹⁰ Australian Electricity Market Operator, www.aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html

⁹¹ Australian Electricity Market Operator, Week In Review Graphs, August 2009; www.aemo.com.au/reports/review/bulletin_graphs.html

⁹² Australian Electricity Market Operator (July 2009) *An Introduction to Australia's National Electricity Market*, (p7)



short-term wholesale bilateral contracts. These may be traded 'Over-the-Counter' (OTC) between counter parties, through brokers or by using exchange-trade instruments. While contracts provide a hedging facility they do not carry with them any rights to the physical supply of electricity.

NEM Access

Third party access arrangements and economic regulation have been established for all transmission and distribution networks within the NEM.

The Australian Energy Market Operator (AEMO) manages the NEM and eastern seaboard gas markets. AEMO's core functions are: Electricity Market – Power System and Market Operator; Gas Markets Operator; National Transmission Planner; Transmission Services; and Energy Market Development.⁹³ To supply into the NEM, applications are made to the Australian Energy Market Operator (AEMO). An explanation of the process to connect including: enquiry, agreement and construction phases; performance, technical and access standards; and a compliance program is outlined at www.aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html and www.aemo.com.au/registration/genreg.html.

Connection of generators to the transmission and distribution network is by negotiation and arbitration. This entails:

- Network service providers are required to submit negotiating frameworks to the regulator for approval;
- Parties negotiate commercial for access to services; and
- If agreement cannot be reached, the regulatory framework provides for arbitration by reference to principles for determining an administered price for that service.

The connection of generators to either the transmission or distribution network may impose both shallow and/or deep connection costs. Shallow connection costs, include a network extension to the generation site, transformers, circuit breakers, and metering equipment, dedicated to the connection of a generator and possibly also other equipment that may be required for the generator to meet the relevant access standards. Deep connection costs are caused by any upstream network augmentation that may be required to increase the energy transfer capability from a particular generator's connection point to load.

Transmission rules to require generators to pay only shallow connection costs, with deep connection costs being:

- Paid for by the consumers where the expansion of transfer capability satisfies the regulatory test; or
- Paid for by the generator, to the extent that the augmentation does not satisfy the regulatory test (albeit with no firm property right to the resultant additional transfer capacity); or
- Not incurred, because the generator chooses not to fund the non-regulatory test, satisfying expansion and instead, taking the risk of being constrained in its energy output via the applicable AEMO network constraint algorithm, applied to its generation bids.

The AEMC reasoning for this approach reflects its view that the transmission network is primarily built to serve the needs of load (consumers), and that the user pays principle, therefore, requires that consumers pay for shared network augmentations where these are of the benefit to the market. On the basis of this user pays principle, where the expansion of transfer capability is primarily for the benefit of the generator (and does not therefore satisfy the regulatory test), the AEMC specifies that the generator must fund such augmentations (or face dispatch constraint).

National electricity industry regulators

- Australian Energy Market Operator (www.aemo.com.au) manages the operation of the wholesale electricity market;
- The Australian Energy Market Commission (www.aemc.gov.au) has responsibility for rule changes, rule making and market development.

⁹³ Australian Energy Market Operator, www.aemo.com.au/index.html



- The Australian Energy Regulator (www.aer.gov.au) enforces economic regulation of the wholesale electricity market and electricity transmission networks and the National Electricity Law and National Electricity Rules. From 1 July 2007, the AER is also responsible for economic regulation of electricity distribution as well as gas transmission and distribution.
- The Office of Renewable Energy Regulator (www.orer.gov.au) manages the *Renewable Energy (Electricity) Act 2000* and the registering and transferring of Renewable Energy Certificates;
- The National Electricity Tribunal was established under the National Electricity Law to hear and determine applications that Code Participants have breached the code;
- The Australian Competition and Consumer Commission (www.accc.gov.au) is an independent authority that administers the Trade Practices Act, including its competition and access provisions;
- The Australian Securities and Investments Commission (www.asic.gov.au/asic/asic.nsf) regulates the financial instruments used by participants to manage the risk of trading in the National Electricity Market.

State and Territory Government electricity industry regulators

- Queensland Mines and Energy (www.dme.qld.gov.au)
- Queensland Competition Authority (www.qca.org.au)
- Independent Pricing and Regulatory Tribunal (New South Wales) (www.ipart.nsw.gov.au)
- Independent Competition and Regulation Commission (Australian Capital Territory) (www.icrc.act.gov.au)
- Essential Services Commission (Victoria) (www.esc.vic.gov.au)
- Essential Services Commission of South Australia (www.escosa.sa.gov.au)
- Government of Western Australia, Office of Energy (www.energy.wa.gov.au)
- The Economic Regulations Authority (Western Australia) (www.era.wa.gov.au)
- Utilities Commission (Northern Territory) (www.utilicom.nt.gov.au)
- Office of the Tasmanian Economic Regulator (www.economicregulator.tas.gov.au)

National electricity industry representative bodies

- The National Generators Forum (www.ngf.com.au/html) represents the 22 major power generators in the National Electricity Market.
- The Clean Energy Council (www.cleanenergycouncil.org.au) is a member based organisation with over 400 businesses, covering a quarter of Australia's total electricity production including gas, wind, hydro and bioenergy and a range of business in the low-emissions energy and energy efficiency sectors; including solar PV, solar hot water, biomass, geothermal and cogeneration.
- The Energy Supply Association of Australia (www.esaa.com.au) is a national body representing members involved in electricity generation, transmission, distribution and retailing.
- The Energy Retailers Association of Australia (www.eraa.com.au) is an independent association lobbying in the interests of retailers of electricity and gas throughout the National Electricity Market the National Gas Market.
- The Energy Users Association Australia (www.euaa.com.au) represents business users of energy with activities across all states and many sectors of the economy.
- The Energy Networks Association (www.ena.asn.au) is the peak national body representing gas and electricity distribution businesses in Australia.
- Australian Institute of Energy (AIE) (www.aie.org.au) promotes understanding and awareness of energy issues and the development of responsible energy policies in Australia.



- Retail Energy Market Company Ltd (REMCo) (www.remco.net.au) is the Retail Market Administrator for the contestable gas retail markets in Western Australia. REMCo's role is to administer the business processes between the gas market businesses in Western Australia that allow gas retailers to cost effectively compete for the supply of gas to over 620,000 customers.

Principal electricity generation businesses in Australia 2008-09⁹⁴

| | Generation – output (GWh) | Share of NEM generation (%) |
|-------------------------------------------|---------------------------|-----------------------------|
| New South Wales^a | | |
| Macquarie Generation | 28,542 | 12.58 |
| Delta Electricity | 25,422 | 11.21 |
| Eraring Energy | 15,527 | 6.85 |
| Snowy Hydro | 1,406 | 0.62 |
| Redbank Project Pty Ltd | 772 | 0.34 |
| Marubeni | 1,043 | 0.46 |
| Victoria | | |
| Loy Yang Power | 16,705 | 7.36 |
| International Power & Transfield Services | 12,220 | 5.39 |
| TRUenergy | 12,024 | 5.30 |
| International Power & Mitsui | 8,618 | 3.80 |
| Prime Infrastructure & Babcock Brown | 1,382 | 0.61 |
| Energy Brix | 1,228 | 0.54 |
| Alcoa | 1,195 | 0.53 |
| AGL | 336 | 0.15 |
| Snowy Hydro | 380 | 0.17 |
| Alinta | 199 | 0.09 |
| Eraring Energy | 31 | 0.01 |
| Queensland | | |
| CS Energy | 13,308 | 5.87 |
| Stanwell | 9,251 | 4.08 |
| Transfield Services & Comalco | 7,975 | 3.52 |
| Tarong Energy | 7,766 | 3.42 |
| OxGen & Marubeni | 6,199 | 2.73 |
| CS Energy & OzGen | 5,929 | 2.61 |
| Tarong, TEPCO and Mitsui | 3,233 | 1.43 |
| Wambo Power | 1,875 | 0.83 |
| Transfield Services | 1,687 | 0.74 |
| Origin Energy | 262 | 0.12 |
| Contact Energy, ERM & Babcock Brown | 30 | 0.01 |
| Enertrade | 2 | 0.00 |
| Other | 2,231 | 0.98 |
| South Australia | | |
| Babcock and Brown | 4,920 | 2.17 |
| International Power | 3,303 | 1.46 |
| TRUenergy | 2,491 | 1.10 |
| Origin Energy & ATCO Power | 1,241 | 0.55 |
| Origin Energy | 251 | 0.11 |
| AGL | 22 | 0.01 |
| Infratil | 2 | 0.00 |
| Tasmania | | |
| Hydro Tasmania | 6,851 | 3.02 |
| Bell Bay Power | 661 | 0.29 |
| Western Australia^b | | |
| SWIS | 16,226 | 7.15 |
| NWIS | 426 | 0.19 |
| Horizon Power | 463 | 0.20 |
| Northern Territory^b | | |
| Power and Water Corporation | 1,631 | 0.72 |

^(a) Including the Australian Capital Territory. ^(b) Not part of the national electricity market

Sources: Global Roam, NEM Review; WA Office of Energy; NT Power and Water Corporation, *Annual Report 2009*

⁹⁴ Australian Government, Bureau of Agriculture Research Economics (ABARE) (2010) *Energy in Australia 2010* (p29) www.ret.gov.au/energy/Documents/facts%20statistics%20publications/Energy%20in%20Aust_2010_FINAL.pdf



ATTACHMENT B

Other Australian Government Programs

Research and development, proof-of-concept and demonstration

R&D Tax Credit⁹⁵

R&D Tax Credit is a broad-based, market-driven package to replace the R&D Tax Concession. Key elements of the package are:

- a 45% refundable tax credit (the equivalent to a 150% concession) will be provided to small firms with a turnover of less than A\$20 million per annum;
- a 40% tax credit cent (the equivalent of a 133% deduction) will be provided to foreign-owned firms, and firms with a turnover of more than A\$20 million per annum;
- the Credit is decoupled from the corporate tax rate and thereby creates certainty in the level of assistance; and
- the increased benefits to companies are balanced by removal of the complex R&D Tax Concession Premium and tightening definitions to support genuine R&D.

Commercialising Emerging Technologies (COMET)

COMET provides innovators with advice, services and financial assistance to plan their commercialisation, to attract capital for their project and to establish strategic partnerships to take the innovation to market. Advice is provided through a network of private sector business advisers and financial assistance is available to subsidise access to service providers in marketing, commercialisation, intellectual property and business planning. COMET was substantially expanded in 2004 when a further A\$100 million to June 2011 was provided to expand the program. COMET grants offered to solar project proponents in 2008-09 are:

- Portasol Trackers Pty Ltd (Qld) A\$64,000 to develop its thermal hydraulic driven tracking device for solar energy systems
- Solexus Pty Ltd (Vic) A\$64,000 to develop its solar thermal collector technology
- Chimera Innovations Pty Ltd (Vic) A\$64,000 to further develop its modular solar air heating system
- Sunengy Pty Ltd (NSW) A\$64,000 to develop a low cost, waterborne solar power generator.

Innovation Investment Fund (IIF)

IIF promotes the commercialisation of Australia's research, through the establishment of new fund managers to provide equity finance to small, early stage Australian companies. The Australian Government invested A\$221 million in rounds one and two of the IIF program, matched by the private sector up to a maximum ratio of two to one. The total funding available to support the commercialisation of early-stage Australian research and development under rounds one and two of the IIF program is A\$354 million. Funds Managers licensed under the Innovation Investment Fund (rounds 1 and 2) with solar technology companies in their portfolio are:

- Allen and Buckeridge Investment Management Pty Ltd (www.a-b.com.au/Portfolio.aspx?i=7); and
- Cleantech Australia Fund Management Partnership, LP (www.cleantechventures.com.au).

⁹⁵ Minister for Innovation, Media Release

<http://minister.innovation.gov.au/Carr/Pages/RDTAXCREDITTOBOOSTBUSINESSINVESTMENT.aspx>

Information on the Government's Innovation Agenda, www.innovation.gov.au/innovationreview/Pages/home.aspx



Manufacturing through assembly facilities

Enhanced Project By-Laws Scheme (EPBS)

A project to develop plants to manufacture and assemble solar photovoltaic cells is likely to be eligible under the EPBS. In short, if the project proponent develops and implements an approved Australian Industry Participation Plan it would be able to import eligible goods that are not available from Australian production duty free. The application process has two parts:

- project acceptance, where the applicant sets out its Australian Industry Participation Plan and detail of the project. The Plan is reviewed and a decision taken on whether it is satisfactory. Once all information is available assessment is complete within 30 days; and
- implementation report, where the applicant demonstrates that the Plan has been implemented satisfactorily and provides details of eligible goods it intends to procure and evidence that they are not available from Australian production where a concession is sought. Once all information is available assessment is complete within 60 days.

If eligibility criteria are met then a concession determination is issued to allow duty free importation of specified goods. Both applications must be lodged before goods are imported but the implementation report can be lodged before assessment of the project acceptance application is complete. The amount of assistance varies with the amount of dutiable eligible goods imported for which a concession can be given but as a rough guide savings under the EPBS are about A\$1 million for a project investing A\$150 million.⁹⁶

Major Project Facilitation (MPF)

MPF is administered by the Department of Infrastructure, Transport, Regional Development and Local Government to assist prospective investors in large, strategically significant projects in Australia to obtain necessary Australian Government approvals and to provide information and advice on any impediments to the project proceeding. The MPF program is open to all industry sectors, not just the infrastructure sector and demonstrates the Australian Government's commitment to support major new investments.⁹⁷

Commercial technology deployment

Remote Renewable Power Generation Program (RRPGP)⁹⁸

The RRPGP is open to applicants from Western Australia only. Rebates (of up to 50% of the CAPEX, capped at A\$200,000) are available for households, communities, not-for-profit, business, government and other organisations. Across Australia, over 7000 projects up to 20kW in size have been installed. In addition, over 10,600kWe of solar, wind and micro-hydro water pumps have been installed.

Solar Credits are available to install solar PV systems up to 1.5kW. Owners can earn 5 Renewable Energy Certificates (REC) for each megawatt hour (MWh) output, which can be traded to earn around A\$7750 (based on A\$50 REC price, 15-years system operation), which offsets the up front cost of a system. Solar generation units over 1.5kW are still eligible for one REC for each additional MWh output.⁹⁹

Renewable Energy Bonus Scheme is available to help eligible home-owners, landlords or tenants to replace their electric storage hot water systems with solar or heat pump hot water systems. The Scheme replaces the Solar Hot Water Rebate Program. Eligible households can claim a rebate of A\$1000 for a solar hot water system or A\$600 for a heat pump hot water system.¹⁰⁰

⁹⁶ Application forms are available from the AusIndustry web site at [www.ausindustry.gov.au/ImportandExport/EnhancedProjectBy-lawSchemeEPBS/Pages/EnhancedProjectBy-lawScheme\(EPBS\).aspx](http://www.ausindustry.gov.au/ImportandExport/EnhancedProjectBy-lawSchemeEPBS/Pages/EnhancedProjectBy-lawScheme(EPBS).aspx)

⁹⁷ Major Project Facilitation website, with application form www.majorprojectfacilitation.gov.au

⁹⁸ Remote Renewable Power Generation Program website: www.environment.gov.au/settlements/renewable/rrpgp

⁹⁹ Australian Government, Department of Climate Change and Energy Efficiency, Solar Credits, www.climatechange.gov.au/renewabletarget

¹⁰⁰ Australian Government, Department of Environment, Water, Heritage and the Arts, Solar Hot Water Rebate: www.environment.gov.au/energyefficiency/solarhotwater/index.html



Goods and services import and export

Certain Inputs to Manufacture (CIM) provides import duty concessions on certain imported raw materials, intermediate goods as well as prescribed metal materials and goods.¹⁰¹ The eligibility criteria used to assess an application under the CIM Scheme are:

- Prospective in nature- applications must be lodged before the goods, which are the subject of the application, are imported;
- Enhances competitiveness- goods that are the subject of the application must be intended for use in export enhancement or import replacement activities that would generate a quantifiable and significant benefit to Australia; and
- Eligibility of goods - is restricted to chemical, plastic and paper raw materials and intermediate goods and certain food packaging that has a substantial and demonstrable performance advantage over those produced in Australia.

Tradex Scheme

The Tradex Scheme provides up-front exemptions from customs duty and GST on imported goods that are intended for direct export or imported goods that are used, lost or wasted in the manufacture of other goods that are exported later. For example, if goods normally attract 5% customs duty and 10% GST, a Tradex order means an up-front saving of 15% on the value of the imported goods when they first arrive in Australia.

Tradex aims to strengthen the international competitiveness of Australian business in export markets. To be eligible for Tradex you must comply with certain requirements:

- The goods you intend to import under Tradex must be exported or incorporated in other goods or used in manufacturing other goods that are exported.
- Export of imported goods should take place within one year of importation, or within a further period of time approved by AusIndustry.
- Records must be kept of all goods imported and exported under Tradex, including any manufacturing records that show that the imported goods were incorporated in other goods that were exported. Keeping your normal Australia Taxation Office and customs records would be sufficient for the purposes of Tradex.

If, rather than exporting, you sell, use or dispose of any of your imported goods in Australia, you will be liable to pay Tradex duty (equivalent to the customs duty that you were exempted from paying under Tradex). You should account for any outstanding GST in your normal Business Activity Statement.

Export Market Development Grants (EMDG)

EMDG encourages small and medium sized Australian businesses to develop export markets. It reimburses up to 50% of eligible export promotion expenses above the threshold of A\$10,000 per financial year. You spend the money first and then you claim a grant from Austrade from the beginning of the next financial year. You can claim up to eight grants. For more information visit: www.austrade.gov.au/exportgrants/howtoapply or email emdg.help@austrade.gov.au or call 13 28 78 from within Australia.

Export Finance and Insurance

Export Finance and Insurance Corporation (EFIC), Australia's export credit agency, provides specialist finance and insurance services to Australian companies exporting and investing overseas.

EFIC provides the support needed when financial, country, or industry risks exceed the capacity available in financial markets. EFIC does not compete with the commercial market, but collaborates with it to improve the competitiveness of Australian companies. EFIC's network extends beyond traditional commercial sources to

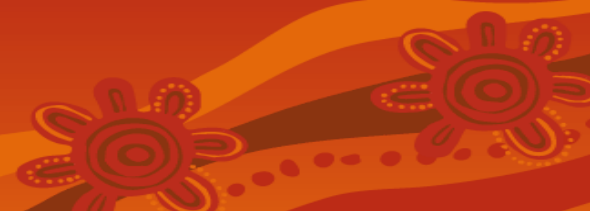
¹⁰¹ AusIndustry is the point of contact for all aspects of the CIM Scheme. Policy and Administrative Guidelines, which include details of how to apply, are available from www.ausindustry.gov.au.



other export credit agencies, multilateral bodies and Australian government agencies. This can give you a competitive advantage in growing your international business.

Before EFIC confirms any commitment it will verify that all eligibility criteria are satisfied. These criteria are product specific, but overall EFIC must be satisfied that all parties to a transaction are acceptable and capable of fulfilling their respective obligations.

EFIC will make an offer of finance or insurance following a complete assessment of the transaction. Consideration will also be given to our policies on [Australian content](#), Australian benefit and [environmental protection](#). Any offer of finance or insurance will comply with the [Organisation for Economic Co-operation and Development \(OECD\) Arrangement](#). For further information on eligibility, email finance@efic.gov.au or call 1800 887 588 or if outside Australia call +61 2 9201 2111.

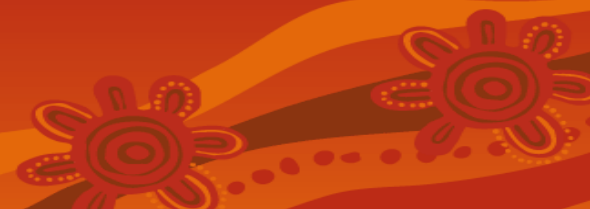


Attachment C: Australia PV capability matrix by State/ Territory

| State/ Territory | Silica Sand & Quartz Mining | Silicon Refining | Wafers | System design, cell manufacture assembly | Balance of System Manufacturers | Research & Development | Sales & services |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Victoria | <ul style="list-style-type: none"> TGS Industrial Sands | | | <ul style="list-style-type: none"> Regency Media (proposed) | <ul style="list-style-type: none"> Selectronics SunRaz Solar Sunsine Australia P/L Power Solutions Australia Plasmatronics Telepower Australia Tek Trek P/L Sunlight Solar Systems Australia P/L Solenergy Power Solutions Australia | <ul style="list-style-type: none"> Elab Telepower Australia Monash University CSIRO Swinburne | <ul style="list-style-type: none"> Solar Charge P/L Tek Trek P/L Going Solar Retail M+H Power Systems Radiant Energy Systems Siddons Solarstream Sun Real Renewable Energy Systems |
| New South Wales | <ul style="list-style-type: none"> Unimin Australia Ltd PB White Minerals Glenella Aggregates P/L TJ Bryant P/L | | <ul style="list-style-type: none"> Peregrine Semiconductor Australia P/L (electronics grade) | <ul style="list-style-type: none"> Ausra Pty Ltd. Tindoz (proposed) BT Imaging P/L (cell production quality control) | <ul style="list-style-type: none"> M& H Power Systems PV Solar Tiles Solar Energy Australia Smart Storage Pty Ltd Quantum Energy Technologies | <ul style="list-style-type: none"> CSG Solar UNSW Centre of Excellence in Advanced Silicon Photovoltaic's & Photonics Uni Western Sydney National Solar Energy Centre (CSIRO) Dyesol Australia Solar Institute | <ul style="list-style-type: none"> Artasolar Pty Ltd Associated Controls (Aust) P/L Aussie Solar Barker Electrical Wholesalers Barraba Solar BP Solar Conergy P/L North Coast Power & Water Punchline Energy P/L Pyramid Power Co. Rainbow Power Co. R F Industries P/L Solarcom (Aust) P/L Solar Online Solar Technology Australia All Natural Energy Andy Colvin Solar Ark Energy Armada Solar Australia Wide Solar Bluesky Energy Eastland Energy EcoSmart Hot Water Endless Solar Energy & Space Solutions Energywise Living EP&T |



| State/ Territory | Silica Sand & Quartz Mining | Silicon Refining | Wafers | System design, cell manufacture assembly | Balance of System Manufacturers | Research & Development | Sales & services |
|--------------------|-----------------------------------------------------------------------------------------------------------------------|------------------|--------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | | | | | | <ul style="list-style-type: none"> • Ethical Energy • Green Solar Solutions • Inland Solar • Kyocera Solar • Lavo's Electrical • Living Clean • Mackie Electric Refrigeration and Air Conditioning • Major Electrics • MAN Ferrostaal AG • Midwest Solar and Electric • Nathan Ross Electronics • North Coast Power System • Northern Rivers Solar • Pure Solar • SCHOTT Solar Australia • Seymour Solar • Solarhart • Solar Inverters • Solar Farm • Urban Energy Australasia • Watershed West • Wise Living |
| Northern Territory | | | | | | | <ul style="list-style-type: none"> • Bushlight • Delta Electronics P/L • PowerCorp |
| Queensland | <ul style="list-style-type: none"> • Cape Flattery Silica Mines P/L • North Stradbroke Island | | | | <ul style="list-style-type: none"> • Redflow Energy Pty Ltd (energy storage) • Latronics (inverters) • EnerTech Australia • CAP-XX (energy storage) • Ceramic Fuel Cells (energy storage) • Hydrexia (energy storage) • Very Small Particle Company (materials) • XeroCoat (glass coatings) • G.James Australia (glass coatings) • Lehmann Pacific Solar P/L (coatings) • Portasol Trackers P/L | <ul style="list-style-type: none"> • University of Queensland • Qld University of Technology • James Cook University • Nano-Nouvelle P/L | <ul style="list-style-type: none"> • Alphatron Australia • Alternative Solar Energy Sales & Design • Cairns Solar Equipment • Central Solar Systems • Choice Electrical Co. • Free Heat Industries • Kyocera Solar Pty • Photowatt Australasia • Raintree Electronics • RF Electronics P/L • Zane Solar Centre |



| State/ Territory | Silica Sand & Quartz Mining | Silicon Refining | Wafers | System design, cell manufacture assembly | Balance of System Manufacturers | Research & Development | Sales & services |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Western Australia | <ul style="list-style-type: none"> • Kemerton Silica Sand P/L • Boral Quarries • Rocla Quarry Products | <ul style="list-style-type: none"> • Simcoa (99.4%) | | | <ul style="list-style-type: none"> • Solco • Advanced Energy Systems | <ul style="list-style-type: none"> • University of Western Australia • Murdoch University, Research Institute for Sustainable Energy | <ul style="list-style-type: none"> • E-Solar P/L • Orientation Homes • Siomar Battery Industries • Solar Advice • Solar Sales P/L • Solco Industries P/L • The Twelve Volt Shop • WD Moore & Co. |
| Tasmania | <ul style="list-style-type: none"> • Maydena Sands P/L • Tasmania Advanced Minerals P/L | | | | | | |
| South Australia | <ul style="list-style-type: none"> • Unimin Australia Ltd • OneSteel Manufacturing P/L | <ul style="list-style-type: none"> • Silicon Sands P/L (proposed) | Hendon Semiconductors | <ul style="list-style-type: none"> • Origin Energy | <ul style="list-style-type: none"> • Neuplex • REDARC Electronics • Swiss-Electric Solar | <ul style="list-style-type: none"> • Flinders University • University of Adelaide Centre for Energy Technology • University of Adelaide – Centre of Expertise in Photonics • University of South Australia – Institute for Sustainable Systems and Technologies • University of South Australia, Sustainable Energy Centre • Univeristy College London (UCL) – School of energy and resources Australia • Cogen Microsystems P/L | <ul style="list-style-type: none"> • Aquaculture Advantage • Aqua Heat Australia • Natural Technology Systems • Oxford St Agencies • Planetary Power • Solar Shop • Solaris • SUNTEG Australia |
| Australian Capital Territory | | | | <ul style="list-style-type: none"> • Spark Solar (proposed) | | <ul style="list-style-type: none"> • ANU | <ul style="list-style-type: none"> • Armada Solar |
| National | | | | | | <ul style="list-style-type: none"> • ARC Photovoltaics Centre of Excellence • CRC for Polymers • ARC Centre of Excellence in Functional Nanomaterials | Industry associations <ul style="list-style-type: none"> • Australia New Zealand Solar Energy Society • Clean Energy Council |