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Learning the hard way: Australia's policies to reduce emissions

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Detailed Analysis

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1. Market mechanisms

1.1 Renewable Energy Target

The Renewable Energy Target provides a lesson in the virtues of market mechanisms. It has delivered large quantities of abatement at reasonable cost. It has been scaled up without substantial blow outs in cost. It has also improved Australia's capacity to reduce carbon emissions in the future by supporting industry investment in project development and skills and knowledge.

The Renewable Energy Target, which came into effect in 2001, sought to increase the share of renewable energy in Australia's electricity mix by 2% by 2010. This was expanded progressively to an electricity target of 45 million megawatt hours by 2010, roughly 20% of Australia's electricity.

Under the latest version of the scheme, electricity retailers are required to source a percentage of the electricity they produce from renewables by 2020. This is verified by issuing tradeable certificates to renewable electricity generators for each Megawatt hour of renewable energy they produce. Certificates are also issued to the installers of hot water heaters for each Megawatt hour of non-renewable electricity that the heater is expected to avoid. All retailers are required to produce certificates for a percentage of the total electricity they sell.

The RET delivered large quantities of abatement at reasonable cost. It was scaled up without substantial blow outs in cost. It has also improved Australia's capacity to reduce carbon emissions in the future. Abatement could probably be delivered at significantly lower cost by a market mechanism with a scope broader than just renewable energy.

By 2020 the RET is expected to reduce annual emissions by nearly 30 million tonnes,[1] almost 20% of the reduction target for 2020. It will reduce emissions more than any other single policy measure implemented to date. It has mostly done so at a moderate cost: from about $30 to about $70 per tonne of carbon.

The cost of purchasing renewable energy has turned out to be cheaper than forecast because the actual sources of renewable energy have been very different to that predicted by government and industry-commissioned experts. As a result, the RET has always produced more renewable energy certificates than are required and its interim targets have been reached with ease. It has also triggered substantial new wind generation, (which now supplies around 18% of South Australia's electricity demand[2] and will soon represent 8% of WA's main grid[3])– and large scale use of solar water heaters (with assistance from rebates as well).

More recently it supported a surge in installations of solar photovoltaic panels amounting to 325 megawatts in 2010 – greater than the entire capacity of solar panels that have been installed over the past 30 years.[4]

[1] DCCEE (2010b)
[2] Electricity Supply Industry Planning Council (2009)
[3] Office of Energy (2010) ; Collgar Wind Farm (2011)
[4] Watt and Wyder (2010)

However, most of the available options for abating carbon emissions are not eligible under the RET. For the purposes of meeting short-term 2020 targets (as opposed to fostering capacity to achieve longer-term abatement goals) a scheme that recognised a broader array of abatement options than just renewable energy would deliver lower costs of abatement.

1.1.1 Market design

The Renewable Energy Target was announced by the Howard Government in 1997 as part of its *Safeguarding the Future* policy statement, and came into effect in 2001. Its original goal was to increase the share of renewable energy in Australia's electricity mix by 2% by 2010 but this was subsequently converted to an electricity target of 9.5m MWh by 2010. In 2007 the Howard Government announced it would expand the target to 30m MWh by 2020 and the subsequent Labor Government expanded this further to 45m MWh by 2020. The target has since been restructured in 2010 into a large and small-scale scheme. Small-scale projects, predominantly solar photovoltaics and solar hot water, no longer operate under a fixed electricity target, but instead create certificates with a fixed value of $40 each, creating a support mechanism akin to a rebate.

Other sources of carbon abatement outside of renewable energy are not eligible to create certificates under this scheme.

The scheme achieves the target by requiring electricity retailers to obtain renewable energy certificates known as RECs. RECs are awarded by the regulator to renewable energy power plants for each MWh of electricity they generate (or are expected to avoid in the case of solar hot water).[5] The generators are then free to trade these RECs to retailers or indeed any other party. In terms of greenhouse abatement, one megawatt hour of renewable electricity is likely to avoid between 0.7tCO_2-e and 1.4tCO_2-e.

1.1.2 Emission reductions achieved

Up to 2010 the Renewable Energy Target will have delivered 8.8Mt of CO_2-e abatement, and out to 2020 it is expected to deliver reductions of 29.9 Mt CO_2-e.[6] It will deliver the largest amount of abatement of any single emissions reduction policy measure implemented to date in Australia.

The RET supported substantial new wind generation (which now supplies around 18% of South Australia's electricity demand[7] and will soon represent 8% of WA's main grid[8]), large scale usage of solar water heaters (also assisted by rebates) and more recently supported a growth surge in solar PV which installed 325MW in 2010[9] (capacity equivalent to a major gas-fired power station and greater than the entire combined installed capacity of Solar PV over the past 30 years[10]).

[5] Solar PV became an exception to this case in 2009, and is awarded 5 RECs for each MWh generated but these "bonus" RECs will be phased down over time
[6] DCCEE (2010b)
[7] Electricity Supply Industry Planning Council (2009)
[8] Office of Energy (2010); electricity generation estimates from Collgar Wind Farm (2011)
[9] Green Energy Markets (2010b)
[10] Watt and Wyder (2010)

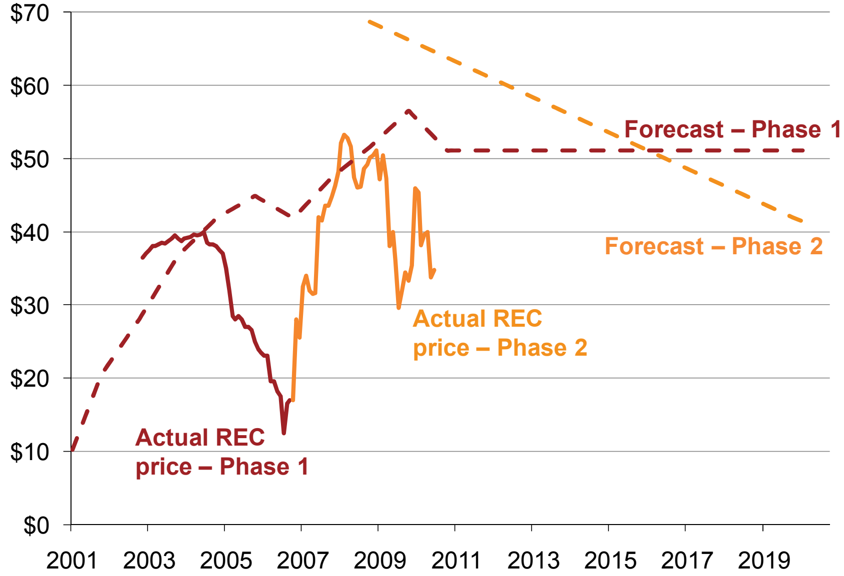
1.1.3 Cost-effectiveness

The cost per tonne of CO_2-e abated has ranged from a moderate cost close to that of switching from coal to natural gas power generation of around \$30-40tCO_2-e (when certificate prices have been low) to moderately expensive at around \$70tCO_2-e (when certificate prices have been high).

Prices initially began at close to \$40 but by 2005 the scheme was substantially over-supplied with renewable energy and prices collapsed (phase 1 of the RET). They revived in 2007 to a peak of \$50 when policy commitments were made to expand the target (illustrated as phase 2 of the RET). However since then they have stabilised at levels similar to those prevailing in 2003 and 2004, even though the renewable energy target is now much larger.

For much of the life of the RET prices remained below those forecast by experts, as shown in Figure 1.1. It has turned out to be substantially easier and cheaper than expected to achieve the targets.

Figure 1.1 REC prices and forecasts (\$/REC)



Note: Spot price data only available from 2003, once financial market conventions for trading had been developed.

Sources: McLennan Magasanik & Associates (MMA) (1999); McLennan Magasanik & Associates (MMA) (2009); REC price data from pers. comm. Green Energy Markets (2010a)

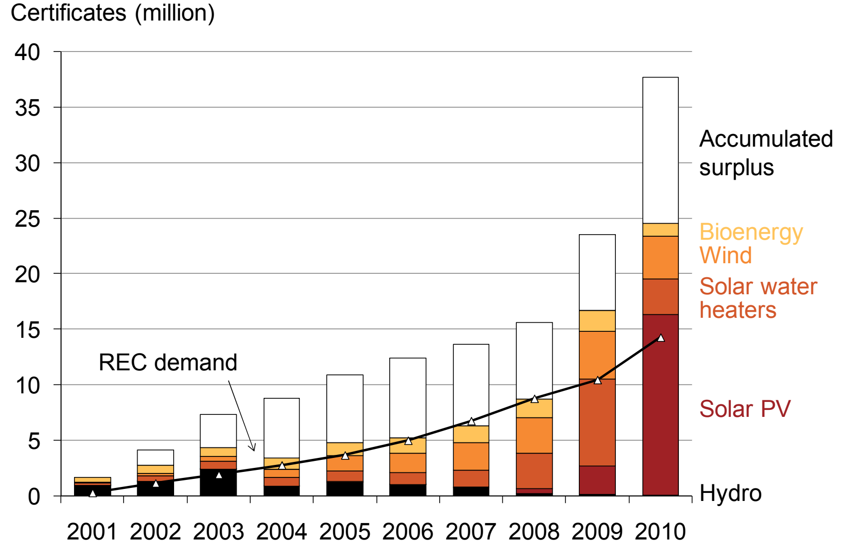
The RET probably provides an *upper* bound of the likely costs Australia to achieve a 5% abatement target using market-price incentive measures. While the RET has delivered the largest amount of abatement of any measure to date, it only recognises a small fraction of the available options for abating carbon emissions. A scheme with much wider scope that recognised abatement from less carbon intensive fossil fuelled power stations and abatement outside the power sector could be much cheaper, even if larger abatement targets were introduced.

1.1.4 Ability to scale up

The RET has always had substantially more renewable energy certificates than required, and there has been no difficulty meeting targets, as shown in Figure 1.2. According to the CEO's of the largest obligated companies under the RET – Origin Energy and AGL - they now have so many banked RECs that there is little need for new renewable energy projects for at least another three years.[11]

The RET illustrates the flexibility of market-mechanisms. The actual sources of certificates are very different to those predicted by government and industry-commissioned experts. Forecasts prior to commencement of the scheme in 2000 expected half of certificates to come from sugar cane biomass waste. Forecasts made in 2009 failed to anticipate large reductions in solar PV costs.[12] By providing for a wide range of abatement options and rewarding on the basis of delivery, government has avoided making what on reflection would have been a very bad bet on biomass power projects.

Figure 1.2 REC demand and sources of supply, 2001-2010



Note: RECs data for 2010 is incomplete (registry accessed 22 November 2010) and probably substantially understates RECs from wind, solar water heaters and solar PV: AGL (2010) estimates that solar PV and solar water heaters will create 30 million RECs for 2010

Sources: Green Energy Markets (2009); Office of the Renewable Energy Regulator (2011)

1.1.5 Potential to build industry capacity

At the same time that the RET delivered abatement, it also played an important role in expanding Australian capacity to reduce emissions in the future. However it has not had a noticeable impact in fostering any kind of major export industries.

[11] Parkinson, (2011a); Parkinson, (2011b)
[12] Daley and Edis (2010)

Within the space of five years from the introduction of the RET in 2001, a number of companies emerged with important capability in identifying, developing and exploiting Australia's high quality wind resources. This capability has also been developed within Australia's existing major incumbent electricity companies.

Australia now has a pipeline of over 10,000MW of wind projects either under development or operational which are capable of generating more than 10% of Australia's annual electricity demand with zero carbon emissions.[13] While this may not represent the most cost-effective option for achieving emissions reductions in the realm of 5% below 2000 levels by 2020, these projects are likely to be essential to delivering the more ambitious emission reductions required after 2020.

In addition the concentrated roll-out of wind power in South Australia provided an unintentional, but very important test-bed for how Australia might successfully integrate large proportions of weather-variable power. It has led to development of a number of important reforms to electricity market regulations, improved network planning skills and improved forecasting and generation dispatch systems.[14] The RET (in conjunction with generous rebates) also fostered greater capacity amongst the water heater industry to supply lower emission solar and heat pump water heaters. These now represent around 20-25% of water heater sales, compared to just 2%-5% prior to the commencement of the RET, and the industry has now scaled-up to a point where it can support a phase-out of carbon intensive conventional electric storage water heaters.[15]

The Solar Photovoltaic retail and installation industry is also starting to demonstrate a capability to supply substantial megawatts of power generation, and has substantially reduced installation costs in the past 2 years[16] (partly a function of generous rebates as well as the RET). However, this enhanced capacity has come at very high costs per tonne of CO_2-e.

1.1.6 Scheme design improvements

While the RET has delivered abatement quickly it provides some important lessons for how a market mechanism to deliver the 2020 target could be designed in the future.

Targets responsive to low prices

The fixed nature of the target, which was unresponsive to low prices, led to sudden price collapses. These have reduced investor confidence. The collapses were followed by difficult to predict government interventions (first the large expansion in the target in 2007 and then the separation of large-scale projects from small-scale projects in 2009) which led to further market uncertainty.

[13] Grattan Institute Australian power plant database (unpublished) built up from data sources including state governments' planning department planning applications; Australian Energy Market Operator (AEMO) (2010b); Copeland (2010)
[14] Pers. comm. Outhred (2010)
[15] Pers. comm. Brazzale (2010)
[16] AECOM (2010)

Larger markets

The small scale of the target in its initial years and the small number of obligated parties (just three companies hold the vast majority of the liability), has made the market for certificates relatively illiquid[17] and provides these three companies with substantial market power in the development of new renewable energy projects. Certificate prices can be influenced by relatively small volumes of trades due to a lack of liquidity. A larger market with more participants would improve trading efficiency and reduce market concentration which creates the potential for misuse of market power.

In addition, for the purposes of achieving the immediate term 2020 target (as opposed to fostering capacity to achieve longer-term abatement goals), a carbon trading scheme is required that recognises a broader array of abatement options than just renewable energy. This is because it is likely to deliver short-term abatement requirements at lower cost and with less risk.

Long time frames

Long time frames are very important – the RET when it was first developed was a measure with a 19 year life and the redesigned scheme has a life until 2030. This has been an important factor in supporting larger power projects, and it is unlikely the scheme would have as easily achieved its targets without these long time frames.

Appropriate baselines

The RET regulator encountered two major difficulties in setting baselines for assessing the amount of RECs hydro generators and heat pump suppliers were entitled to.

A very large proportion of Australia's renewable energy capacity was built decades before the RET – predominantly Tasmanian and Snowy hydro generators. These pre-existing generators argued for inclusion into the scheme on the basis that with new investments (underpinned by the additional revenue from RECs) they could substantially increase their generation. Their inclusion required baselines to be set which would determine the amount of generation deemed to be over and above their business as usual operation. The regulator set this annual baseline at the average of the generators' historical generation over a range of several years. But large variation in hydro output from year to year meant that in some years they would exceed their historical average generation that was the basis for the baselines. Yet in other years they would fall substantially short of the baseline. Overall electricity generation was probably no higher than what would have occurred anyway, but while they gained RECs in some years, they didn't have to give RECs back when they went substantially under their baseline. This led to windfall gains for hydro generators with little improvement in environmental outcomes.[18]

Heat pump systems also caused issues. The regulator chose to use tank size to estimate the expected energy savings of heat pumps. This resulted in some heat pump suppliers providing over-

[17] Pers. comm. Edwards (2007)

[18] Business Council for Sustainable Energy (BCSE) (2003)

sized heat pump systems to customers, particularly in the hotel sector, which maximised their REC generation but did not deliver anything close to the energy savings claimed on the basis of the regulatory formula.[19]

1.2 NSW and ACT Greenhouse Gas Abatement Scheme (GGAS)

The Greenhouse Gas Abatement Scheme, which began operation in 2003, was the first government-mandated carbon emissions trading scheme in the world.[20] It requires NSW and ACT electricity retailers and large wholesale electricity customers to purchase greenhouse abatement certificates in proportion to the electricity they have sold.

Like the RET, GGAS has reduced emissions relatively quickly. It is estimated to produce an annual 8.8 million tonnes of abatement by 2020.

By recognising a wide range of emissions reduction activities the scheme rewards flexibility and innovation and therefore was able to reduce emissions at relatively low cost between $15 and $40 a tonne of CO_2-e. However, its short time frame – it is scheduled to end in 2012 –- made it hard to justify long-term, capital-intensive projects on the basis of revenue from production of certificates. Even so, a number of companies outside the power sector have transformed the GGAS market by creating large volumes of certificates through the provision of energy efficient light bulbs and efficient showerheads. This triggered a surge in supply of certificates in 2006 and 2007, creating a large surplus and a price collapse in 2007. Prices have remained at levels substantially below expert forecasts,[21] suggesting once again that reducing carbon emissions is cheaper than expected.

1.2.1 Market design

The Scheme set a state-wide electricity emissions target of 7.27tCO_2-e per person. An NGAC is awarded for each tonne of CO_2-e abatement an activity is deemed to have contributed towards the target. In reality there are a range of complexities in setting baselines that mean the amount of abatement per certificate is substantially less than a tonne of CO_2-e. For each NGAC an obligated business is short of their target they must pay a penalty which equates to $13-$15 (incorporating tax impacts due to non-tax deductibility).

GGAS has recognised a wide variety of abatement activities not just restricted to NSW and ACT, including:

- Improved energy-efficiency of coal fired generators (across all states within the NEM);
- Generation from lower emission gas-fired generation (across all states within the NEM);
- Sequestration of carbon in trees;

[19] This was addressed by changes to RET legislation in 2010 which stipulate that air source heat pumps with a volumetric capacity over 425 litres are excluded from creating RECs

[20] Carr (2011)

[21] Daley and Edis (2010)

- Combustion of waste methane from coal mines, sewage treatment plants, and rubbish dumps (landfills), thereby converting it into CO_2 a less potent global warming gas.[22] This is also recognised across all NEM states if the methane is used for power generation;
- A variety of measures that improve energy efficiency in residential, commercial and industrial sectors including use of wasteheat in power generation (co-generation), water efficient shower-heads (which reduce water heating energy demand), and energy efficient light globes; and
- Switching to less carbon intensive fuels such as converting boilers from coal to natural gas, or converting from electric storage water heaters to gas water heaters.

However in 2009 the NSW Government significantly adjusted the scheme by removing a number of energy efficiency measures from eligibility to create NGACs from July that year. Instead these would be supported through a new market-price incentive called the NSW Energy Savings Target.[23] Also in late 2008 it reduced the amount of abatement certificates that could be created by energy efficient compact fluorescent light bulbs by 83% due to impending government regulations that would mandate them.[24]

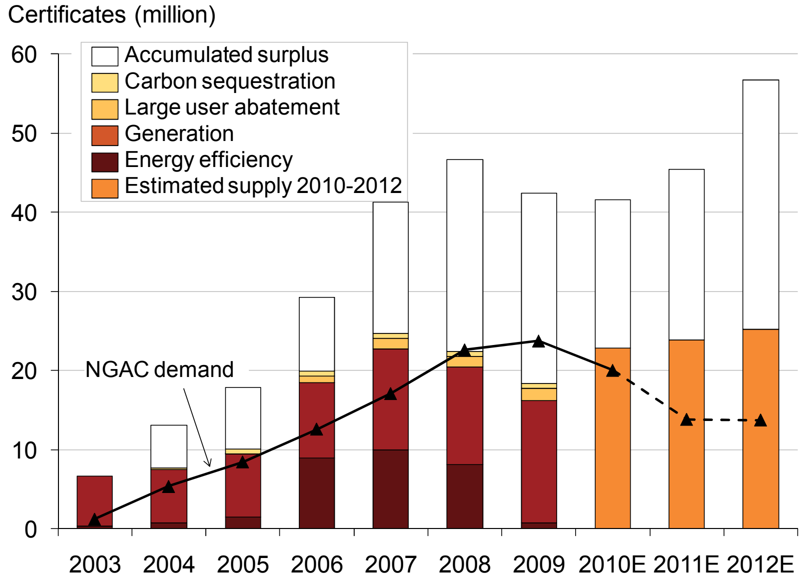
1.2.2 Emission reductions achieved

Like the RET, GGAS has reduced emissions relatively quickly. Before the RET was expanded, GGAS was estimated to deliver 4.7 million tonnes of CO_2-e abatement in 2010 and is the third largest single abatement policy measure, behind the RET and Minimum Energy Performance Standards (MEPS). Based on 2007 projections it was estimated to produce 8.8 million tonnes of abatement in 2020.[25]

Figure 1.3 illustrates supply of abatement certificates (NGACs) by broad type, and government set demand. It illustrates that the scheme has been in substantial surplus up to 2008. Supply dropped off in 2009 due to adjustments in eligibility of energy efficiency measures to create certificates, but it is expected to quickly return to substantial surplus for the remainder of the scheme's life to 2012, due to new abatement projects coming on-line replacing the lost supply from energy efficiency, and a reduction in demand for NGACs because the increase in the Renewable Energy Target will reduce the amount of emissions reductions required to achieve the emissions target.[26]

[22] Methane has a global warming potential assessed to be 21 times that of CO_2 under the Kyoto Protocol – see United Nations Framework Convention on Climate Change (UNFCCC) (undated)
[23] IPART (2010)
[24] IPART (2009a)
[25] DCC (2008)
[26] IPART (2010)

Figure 1.3 NSW GGAS certificate demand and sources of supply, 2003-2011



Source: IPART (2010)

1.2.3 Cost-effectiveness

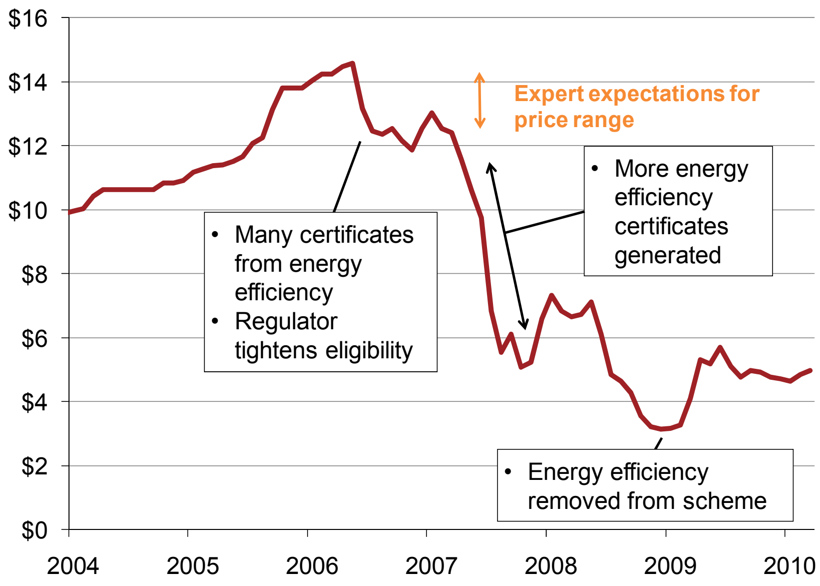
By recognising a wide range of emissions reduction activities the scheme rewards flexibility and innovation and therefore was able to reduce emissions at relatively low cost between $15 and $40 a tonne of CO_2-e, as shown in Figure 1.4 (depending on certificate prices and assumptions of abatement additionality). However costs could have been substantially lower if the baselines had been set more stringently. This would have reduced the windfall gains provided to a number of abatement certificate suppliers.

Consequently, future broad based market schemes are likely to be substantially less costly than the higher end abatement cost of $40t$CO_2$-e, provided they adopt a cap and trade model which is based on actual carbon emissions, rather than a forecast of abatement from business-as-usual activity.

NGAC prices were initially high in the first few years, a consequence of a concentrated market in which only a few companies could supply substantial volumes of NGACs (five organisations created almost 80% of NGACs in 2003).[27] Its short time frame – scheduled to end in 2012 –made it hard to justify long-term, capital-intensive projects on the basis of revenue from production of certificates.

[27] Passey et al. (2005)

Figure 1.4 NSW GGAS abatement certificate prices ($/NGAC)



Note: prices based on a 4 week rolling average of last spot market price
Source: www.nges.com.au cited in IPART (2010)

Nevertheless, a number of companies outside the power sector have transformed the GGAS market by creating large volumes of certificates through the provision of energy efficient light bulbs and efficient showerheads that did not require large upfront capital investments. This triggered a surge in supply of certificates in 2006 and 2007 creating a large surplus and a price collapse in 2007. Notably prices have remained at levels substantially below expert forecasts,[28] suggesting once again that reducing carbon emissions is cheaper than expected when market mechanisms are employed.

1.2.4 Ability to scale up

These low prices have been maintained even with the removal of large amounts of previously eligible supply (energy efficiency and power generators classified as “Category A Generators”), again suggesting that market mechanisms have substantial potential to be scaled up.

1.2.5 Scheme design improvements

Targets responsive to low prices

As experienced with the RET, the fixed target, which was unresponsive to low prices, led to sudden price collapses. Government subsequently responded with interventions to the scheme (by disqualifying energy efficiency and Category A Generators) that make the scheme more stringent, but these interventions were difficult to anticipate.

Larger markets

The small scale of the target and high concentration of suppliers in its initial years made the market for certificates relatively illiquid[29] and provided a few select companies with substantial market power. However this improved over time as other

[28] Daley and Edis (2010)
[29] Pers. comm. Edwards (2007)

companies established the ability to conduct projects that reduced emissions.

Long time frames

Alongside the surge in supply of energy efficiency NGACs, a shortened time frame for the scheme contributed to the price collapse over 2007. GGAS was expected to terminate once a national emissions trading scheme began. When the Howard Government announced in July 2007 that it would introduce an emissions trading scheme, it appeared that GGAS would end between 2010 and 2012 (rather than continue until 2020 as would have occurred without a national ETS). With a shortened lifetime the scheme was substantially over-supplied with NGACs.

Appropriate baselines

GGAS is a complex policy measure largely because it seeks to reward abatement rather than place a cost on pollution (known as a "baseline and credit" emissions trading scheme). This is not necessarily a straightforward measurement exercise. Energy researchers, Passey, MacGill and Outhred observe,

> *"An absence of emissions cannot be measured but must be estimated with respect to a projection of what would have happened in the scheme's absence. This is inherently counterfactual and cannot be independently verified"*[30]

GGAS depends on a range of assumptions about how emissions might unfold over time without the scheme in place, and therefore the extent of abatement delivered by various activities compared to business as usual. These assumptions are reflected in a wide range of baselines set for power generators, industrial plant, tree plantations, and energy consuming equipment which all rely on government's ability to forecast. The scheme has encountered major difficulties in setting parameters for recognition of abatement and eligibility to create NGACs in three situations. These increased costs for electricity consumers but did not materially improve environmental outcomes.

Generators classified as Category A under the scheme are entitled to produce NGACs for all of their generation, which has averaged 4m NGACs per annum. Yet much of this plant was built in the mid 1990's, well before GGAS commenced.[31] They were credited with emissions reductions even though there was no change in their behaviour.

Generators classified as Category C, also built and operational prior to the commencement of the scheme, could claim NGACs for generation above their average annual generation from 1997 to 2001. This additional generation entitled them to 4m NGACs per annum, yet the annual output of many of these generators increased merely because of growing electricity demand and would probably have occurred without GGAS. [32]

Lastly, the regulator found that the abatement delivered by energy efficient light globes was less than it originally thought, because householders often received them for free and stockpiled them rather than installing all of them immediately.

[30] Passey et al. (2009)

[31] Passey et al. (2005)

[32] Passey et al. (2005)

The NSW GGAS baseline and credit market design is not ideal and in some respects was an unavoidable feature of a scheme designed to operate within one state that is part of a much larger electricity market. Such a compromised model is not necessary for an Australia-wide carbon pricing scheme. An emissions cap and trade scheme or basic carbon tax avoid the need for baselines by controlling/pricing actual carbon emissions rather than crediting estimated reductions in carbon emissions from a forecast business-as-usual baseline.[33]

1.3 Queensland Gas Target

The Queensland Gas Electricity Target, which became operational in 2005, aims to encourage a switch from coal-fired to gas-fired electricity generation, thereby reducing carbon emissions and encouraging new sources of gas supply. Initially, the Queensland Government required at least 13 per cent of electricity to be produced by gas-fired generators in Queensland.

1.3.1 Market design

Gas Certificates were issued to producers of gas-fired electricity with one certificate equating to a megawatt-hour of generation.

1.3.2 Emission reductions achieved

The scheme is estimated to have reduced Queensland's annual emissions by 2.2 million tonnes of CO_2-e in 2010 and is projected to double that figure by 2020.[34] This is not a bad result considering the highly constrained scope of the scheme and its recent introduction.

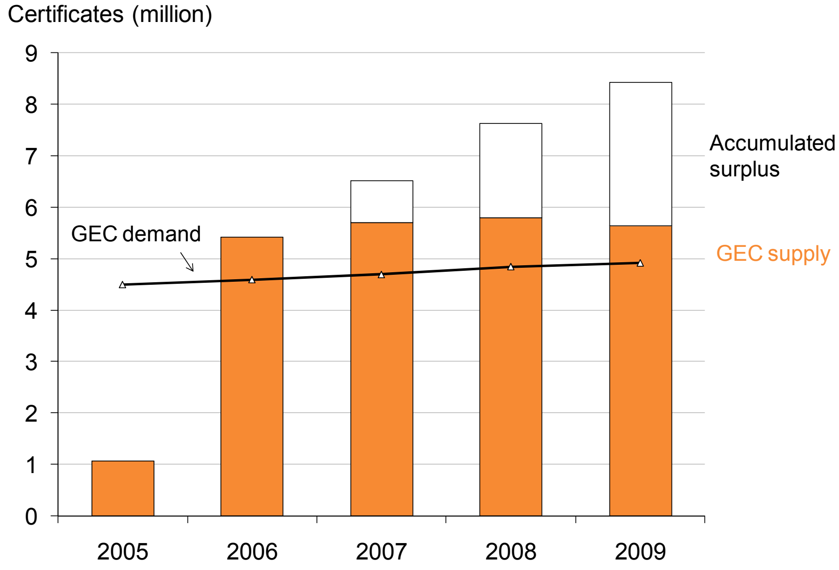
For every year except the first, the supply of gas certificates has outstripped demand. This is likely to continue even with the increase in the target from 13% to 15% in 2010 and even with the proposed increase to 18% in 2019. The large supply of certificates is due to the addition of two gas power plants that are expected to generate more than five million megawatt hours a year (equivalent to 5m GECs).[35]

[33] While an emissions cap and trade scheme or carbon tax may also choose to create baselines for entitlements to allocation of free permits, it is not an essential and inherent feature of these types of schemes. Also they avoid a problem of asymmetric incentives where a firm is rewarded for doing better than their baseline but not penalized when they do worse than the baseline. This means they are less open to distortions that reduce efficiency.

[34] DCC (2010)

[35] Australian Energy Market Operator (AEMO) (2009)

Figure 1.5 QLD Gas Electricity Target certificate (GEC) demand and supply, 2005-2009



Source: Queensland Government (2010); Queensland Government (undated)

1.3.3 Cost-effectiveness

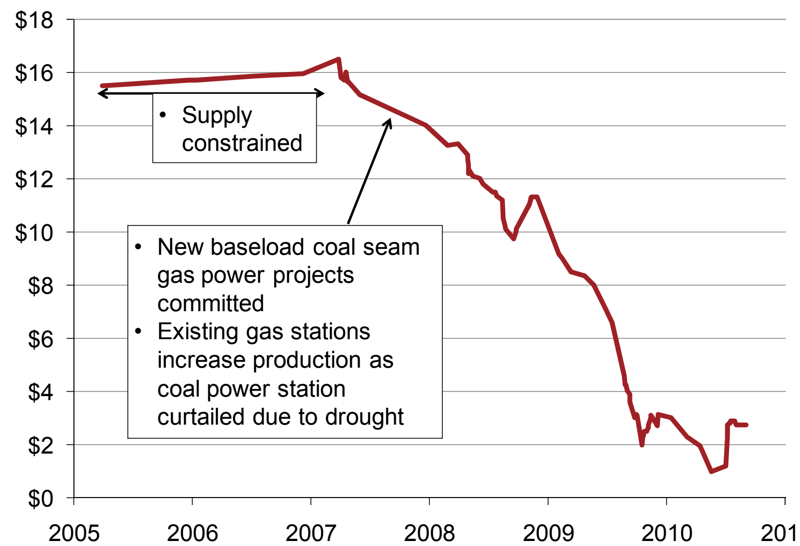
The Queensland scheme has reduced emissions at the reasonable cost of between $20 and $40 a tonne (depending upon assumptions of certificate prices).

Nonetheless costs per tonne of abatement would have been lower if the measure had confined support to projects that were only committed to construction after the scheme was announced (or changed to gas as their fuel).

Figure 1.6 illustrates how spot prices have unfolded under the scheme. Prices remained close to the penalty price in the first few years reflecting aggregate demand higher than supply. However prices collapsed beginning in 2007, in spite of a government announcement to expand the target to 18% by 2019.

In the end the small size and scope of the target was easily met, and it only took two new gas power projects (160MW Yarwun Co-generation plant; and 630MW Darling Downs Combined Cycle Gas Turbine Project), to tip the scheme into a state of substantial excess GEC supply.

Figure 1.6 Queensland Gas Electricity Certificate price ($/GEC)



Source: Tradition Financial Services (2010) and Grattan Institute analysis

Again illustrating the virtue of flexible market-price instruments, both Darling Downs and Yarwun were made possible by the emergence of a new source of gas supply that was largely unexpected and underestimated – coal seam methane. When the Gas Target policy was originally unveiled the government was quite specific that it expected this would help support a pipeline supplying gas from Papua New Guinea.[36] The flexibility of a market mechanism that can evolve differently from government forecasts will probably facilitate Queensland becoming a major exporter of gas rather than an importer, due to major innovation in the exploitation of coal seam methane.

1.3.4 Potential to build industry capacity

While not the only cause, the Gas Target has provided an important new market for development of coal seam methane. In just a five year period subsequent to the Queensland Government's institution of the gas target, coal seam gas reserves increased 10-fold as interest was sparked in exploring and developing this resource.[37]

The development of this energy resource, which has lower emissions intensity than coal, may well play an important role in reducing the emissions of Australia's electricity supply. The export of this gas will hopefully reduce net global emissions by assisting other countries to switch from coal to gas in electricity generation, although the extraction of the gas will add to *Australia's* carbon emissions.

1.3.5 Scheme design improvements

Targets responsive to low prices

Just as occurred with the RET and GGAS, the fixed nature of the target which was unresponsive to low prices, in combination with the relatively small size of the market led to a major price collapse when new supply was added.

Larger markets

The certificate market was illiquid because there are few buyers and few suppliers,[38] with just two companies representing 80% of supply until recently.[39] This creates the potential for market power. The narrow market also leads to price volatility because a single power project can tip the market from substantial shortfall to substantial over-supply. Ideally this would be avoided through a broader market with more options for compliance than just gas-fired electricity located within Queensland.

[36] Queensland Government (2000)
[37] Origin Energy (2005)
[38] Pers. comm. Edwards (2007)
[39] Edis and Morton (2007)

2. Grant tendering schemes

Over the past decade Federal and State Governments have announced around $7.1 billion dollars to grant tendering schemes aimed at reducing greenhouse gas emissions, as shown in Table 2.1.

Table 2.1 Grant program outcomes

Name	Gov't	Origin date	Total budget allocated ($m)	Name	Gov't	Origin date	Total budget allocated ($m)
R&D Start	FED	1996	$10	Queensland Clean Coal Special Agreement Act 2007	QLD	2007	$300
Renewable Energy Commercialisation Program (RECP) and Renewable Energy Showcase (RES)	FED	1997	$54	Renewable Energy Demonstration Program (REDP)	FED	2007	$435
Renewable Energy Equity Fund (REEF)	FED	1997	$21	Geothermal Drilling Program	FED	2007	$50
Greenhouse Gas Abatement Program (GGAP)	FED	1999	$400	Climate Ready	FED	2007	$75
Commercialising Emerging Technologies (COMET)	FED	1999	$1	Clean Coal Fund/National Low Emissions Coal Initiative	FED	2007	$400
Low Emission Technology Demonstration Program (LETDF)	FED	2004	$500	Renewable Energy Development Program (REDP)	NSW	2007	$40
Advanced Electricity Storage Technologies (AEST)	FED	2004	$20	NSW Clean Coal Fund	NSW	2008	$100
Solar Cities	FED	2004	$92	Carbon Capture and Storage Flagships	FED	2009	$2,000
Renewable Energy Development Initiative (REDI)	FED	2004	$100	Solar Flagships	FED	2009	$1,500
Energy Saving Fund (ESF)	NSW	2005	$200	Victorian Large-Scale Solar	Vic	2009	$100
Energy Technology Innovation Strategy (ETIS)	VIC	2005	$369	QLD Large-Scale Solar	QLD	2010	$100
Green Building Fund	FED	2007	$90	NSW Large Scale Solar	NSW	2010	$120
Total							**$7,077**

2.1 Greenhouse Gas Abatement Program (GGAP)

Australia's first major greenhouse grant tendering program, announced by the Federal Government in 1999, sought to purchase emissions reductions at lowest cost. This $400 million fund was expected to reduce emissions by more than 10 million tonnes of CO_2-e by 2010.[40] Latest Department of Climate Change and Energy Efficiency estimates are that it will provide less than a third of that figure.[41]

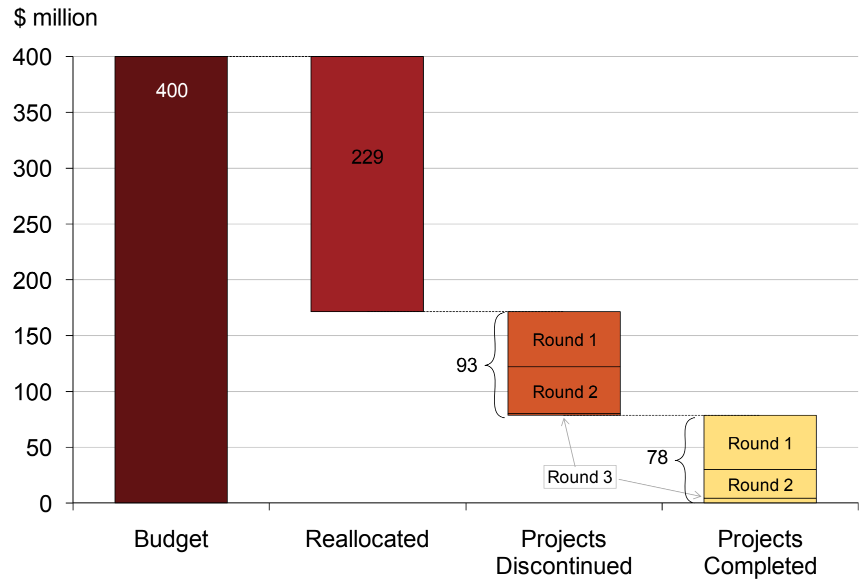
While the program is forecast to reduce emissions at the low cost of $4 to $10 a tonne, it would probably have great difficulty in reducing emissions at these costs at larger scale. The $400 million program took seven years to select projects and just $180 million -- less than half the allocated amount – was ever approved for expenditure. And less than half of that ultimately resulted in operational abatement projects.[42]

2.1.1 Emissions reductions achieved

GGAP was originally planned to reduce emissions by 10.35m tonnes of CO_2-e by 2010.[43] Latest DCC estimates are that the program will only reduce 3.4m tonnes of CO_2-e emissions per annum in 2010.[44]

Originally it was expected that GGAP would allocate its $400m budget to abatement projects within four years.[45] Yet it ultimately took seven years to complete the process of selecting projects, undertaking only 3 funding rounds, in which less than half the funds ($180.7m) were approved for expenditure on 23 projects.[46]

Figure 2.1 Funding outcomes for GGAP



Sources: As for Table 2.2.

[40] ANAO (2004)
[41] DCCEE (2010b)
[42] Australian Greenhouse Office (AGO) (2001); Australian Greenhouse Office (AGO) (2002); ANAO (2010b)
[43] ANAO (2004)
[44] DCCEE (2010b)
[45] Australian Greenhouse Office (AGO) (2000)
[46] Australian Greenhouse Office (AGO) (2000); Australian Greenhouse Office (AGO) (2002); Australian Greenhouse Office (AGO) (2001); ANAO (2010b)

Of the twenty-three projects approved for funding, we know of eight that did not proceed in any shape, three which are unlikely to have delivered any abatement, and two whose identity and status are unknown,[47] leaving a remaining ten projects that delivered meaningful results. Total funding to these ten projects was $73m or less than 20% of the total original policy commitment. This was not for a lack of applicants, with 228 project applications received.[48] Table 2.2 below provides further detail on the projects allocated funding and the development of those projects over time.

Not only did the program fall substantially short of its original aims, it also took many years to deliver its modest results. Although the program was announced in 1999, by mid 2005 only one project had managed to report any abatement.[49] In spite of the claims that have been made for tree planting as a cheap option for large scale abatement via carbon sequestration,[50] only one tree planting project qualified for funding and it ultimately did not deliver any abatement.

2.1.2 Cost effectiveness

While the program has achieved abatement of 3.4 million tonnes of CO_2-e at low cost of $4 - $10/t$CO_2$-e[51], it is clear that it would have had great difficulty maintaining these acquisition costs at larger scale.

2.1.3 Issues in delivery

The delays in selecting in delivering projects had a variety of causes.

It was typical for projects to take three to five years and sometimes longer after a grant was awarded until the project became operational, as Table 2.2 illustrates. In addition similar periods would transpire before many of the projects were confirmed as unviable and withdrawn, such that the allocated funds could be freed-up for other purposes. Proponents clearly had a number of important commercial and technical hurdles that remained after achieving success under the tender.

[47] The ANAO in their 2009-10 Audit of Climate Change Programs state that 23 projects were approved for funding but we could only manage to identify 21 with there being no public trace of the other two projects, indicating some serious flaws with the transparency of grant tendering initiatives (ANAO (2010b))
[48] ANAO (2010b)
[49] Commonwealth Senate Environment Communications and the Arts References Committee (2005)
[50] Liberal Party of Australia and National Party (2010)

[51] ANAO (2004)

Table 2.2 Projects allocated funding under Greenhouse Gas Abatement Program

Project type	Funds ($m)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Reduce refrigerant HFCs	3.7	PROGRAM ANNOUNCED										
Reduce refrigerant HFCs	0.3											
Ethanol production	8.8											
Reduce car use	6.5											
Alumina refinery energy efficiency	11											
Co-generation	10											
Co-generation	16											
Energy efficient rail	7.0											
Coal mine methane destruction	15											
Reduce livestock methane	13.5											
Coal mine methane destruction	15.5											
Coal mine methane destruction	13											
Energy efficient turbines	5											
Ethanol production	7.4											
Coal mine methane destruction	6											
Coal mine methane destruction	9											
Fuel switch to gas	7											
Brown Coal Drying	11.1											
Reduce car use	3											
Reduce refrigerant HFCs	2											
Tree carbon sequestration	10											
Unknown project												
Unknown project												
Total identified	**180.8**											

Key: Yellow: Project funding announced or approved; Orange: Project commenced operation; Red: Project cancelled or failed to deliver abatement.

Sources: AAP (2007); ANAO (2010b); Australian Greenhouse Office (AGO) (2002); Australian Greenhouse Office (AGO) (2001); BP Australia (2003);Commonwealth Senate (2005); Energy Developments Ltd (2005); Grattan Institute Australian power plant database (unpublished); Macquarie Generation (2006); Pers comm.Brazzale (2010); Pers comm. Envirogen (2010); QAL (2005); Wilson (2006).

Lengthy negotiation process

The complexity of projects made negotiation of funding agreements challenging. The ANAO observed,

> *"lengthy negotiations with proponents over agreements involved delays of up to two years for some projects. Delays in finalising agreements were attributed to many projects relying on approval or agreement by third parties, which had not been secured prior to the applicant applying for funding."*[52]

Under round 2, while all projects were approved for funding in October 2001, two of the winning projects were not actually formally confirmed until July 2003 due to an intervening election and changes in ministerial personnel.[53] The Round 3 process was especially drawn out. Calls for applications were made in May 2003, yet it took until March 2006 for the winning bids to be formally confirmed.[54]

Changing circumstances

Over the extended period of tender administration and grant agreement negotiation, market circumstances could change so that the financial assumptions embodied within the tender application became invalid. One example was Energy Development's coal mine waste methane project where the Australian government had to increase its funding from $11m to $15.5m. This was because of a drop in the value of the Australian dollar, which increased the cost of acquiring gas-fired engines from overseas.[55]

Complex grant criteria

In retrospect it appears there was considerable complexity hidden within the relatively simple objective of acquiring lowest-cost abatement via a tender. Implicitly the government was looking for a narrow range of projects that were close to being commercial, but not quite viable. Projects that were already commercial would make no difference to Australia's greenhouse gas emissions because they would have happened anyway. Projects that were a distance from being commercial tended to have higher cost abatement than competing projects. In addition, government tried to assess just how much money each project required make it commercially viable.

These judgments required substantial commercial due diligence to assess the fairness of the claims by project proponents about the costs and returns of their projects over the life of the project which could extend beyond a decade. These assessments were inevitably complex and slow, and ultimately many of the selected projects failed to materialise.

2.2 Low Emission Technology Demonstration Fund (incorporating VIC and QLD Gov't funding)

The $500 million Low Emission Technology Demonstration Fund was announced in mid 2004. It aimed to support technologies with the potential to lower Australia's emissions by at least 2% in

[52] ANAO (2010b)
[53] ANAO (2004)
[54] ANAO (2010b)
[55] ANAO (2004)

the long term, and that would be commercially available by 2020 to 2030. It aimed to be technology neutral and to support technologies beyond the pilot stage and at the commercial demonstration stage.

Seven years after the establishment of the program (and two supporting state programs), the results are lacklustre. Of a combined $665 million budget, just one small project is operating, worth $10 million. The Government's latest projections forecast no abatement from this program by 2020[56].

2.2.1 Fund scope

LETDF was aimed at supporting technologies at the commercial demonstration stage, and beyond pilot plant stage. These technologies needed to have the potential to lower Australia's emissions by at least 2 per cent in the long term at a realistic uptake rate, and be commercially available by 2020 to 2030.[57]

Around the same time that the LETDF was announced, the Victorian Government unveiled their Energy Technology Innovation Strategy (ETIS) program, which had largely similar intentions[58], and a substantial proportion of its initial funding was tied to projects successfully acquiring LETDF funding. The Queensland Government also established a Clean Coal Technology Fund which provided financial support to one of the projects selected under LETDF. Consequently we have assessed these programs as one combined program rather than in isolation. Combined these programs equated to an allocated budget of $665m.[59]

While LETDF documentation maintained that the program was technology neutral, it also explicitly stated a preference for *"technologies that could underpin Australia's resource base".*[60] From this statement it is hard to draw any other conclusion than a preference for supporting coal-based projects. Further complicating objectives, it also wished to promote leading-edge technology capacity in Australia.[61]

2.2.2 Emission reductions achieved

Seven projects were allocated $575m funding from these combined programs as detailed in Table 2.3 below.

Emissions reductions to date are minimal, and substantial reductions are only expected in 2014, all from a single project.

[56] DCCEE (2010b)
[57] Australian Government (2004); Australian Government (2005a)
[58] DSE and DPI (2004)

[59] This only incorporates the ETIS budget of $130m and QLD CleanCoal Fund budgeted funds of $35m that were allocated to projects which received LETDF funding as well. ETIS' and QLD Clean Coal Fund overall budget is greater than this
[60] Australian Government (2004)
[61] Australian Government (2005a)

Table 2.3 Projects awarded funding under LETDF, ETIS and QLD Coal Fund

Project	Original intention	Funding ($m)	
Santos - Fairview	Capture and sequestration of CO_2 from gas power plant	FED:	$75m
Chevron - Gorgon	Capture and sequestration of CO_2 released from oil and gas extraction	FED:	$60m
Solar Systems - Mildura	154MW concentrating solar PV power plant	FED:	$75m
		VIC:	$50m
International Power – Hazelwood Coal Drying	Drying of brown coal and upgrade boilers at Hazelwood Power Station	FED:	$45m
		VIC:	$25m
International Power – Hazelwood CO_2 Capture	Pilot plant to capture and separate CO_2 from Hazelwood power station exhaust gas	FED:	$5m
		VIC:	$5m
HRL - IDGCC	400MW power station fuelled by gasification of coal	FED:	$100m
		VIC:	$50m
CS Energy - Callide	Converting part of Callide power station to burn coal with pure oxygen	FED:	$50m
		QLD:	$35m
Total			**$575m**

Sources: DRET (2010); Ferguson and Wilson (2008); Macfarlane (2006)

Six years after the scheme was announced, just one small project is operational, reducing emissions by 0.01Mt per annum. This is a post combustion carbon capture pilot plant which is delivering almost inconsequential levels of abatement, reducing Hazelwood power station's greenhouse gas emissions by less than 0.1%.[62] Ironically, this project was inconsistent with the program guidelines, which excluded pilot projects.[63]

The Government's latest emission projections forecast no abatement to flow from the LETDF program by 2020[64], although this may be somewhat pessimistic. The first material reductions in emissions may flow in 2014 when Chevron's Gorgon project is likely to become operational. This project only reached financial commitment in October 2009,[65] three years after it was announced as one of the successful applicants, and five years after the fund was announced.

CS Energy's Callide oxyfuel power plant is the only other project that has made notable physical progress. It has restarted a previously mothballed coal-fired power station boiler, but this will not be delivering any reduction in greenhouse gas emissions.[66]

Two projects awarded funding have since been withdrawn representing $145m in the allocated funding. Santos' Fairview gas

[62] Innocenzei (2008)

[63] International Power, the owner of the power plant, and the Department of Climate Change and Energy Efficiency both refer to this post combustion carbon capture plant as a "pilot plant".

[64] DCCEE (2010b)

[65] Chevron Australia (2009)

[66] Callide Oxyfuel Project (2010)

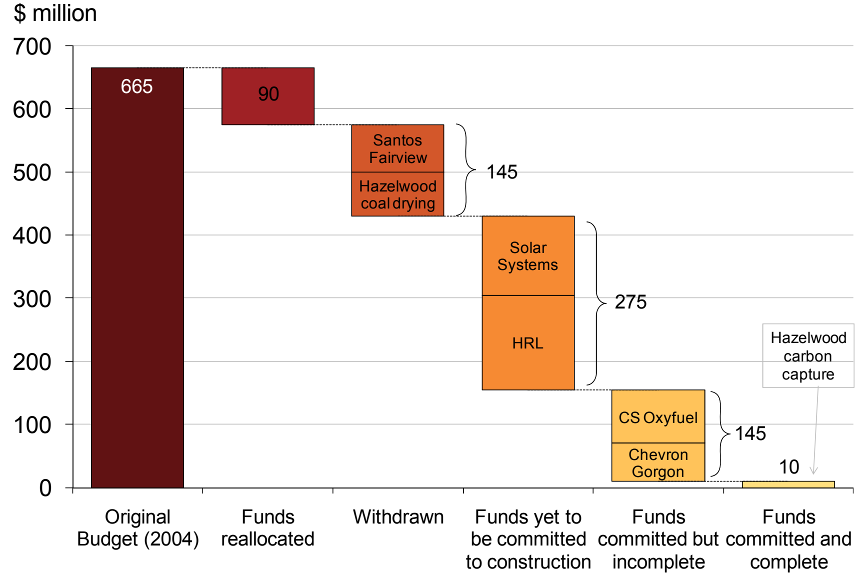
fired power plant with CCS was cancelled by the proponent two years after it was selected.[67] Hazelwood's coal drying project was reported as cancelled in November 2010[68] but a formal announcement is still pending. This is four years after it was announced as one of the successful bidders under LETDF and ETIS. This project was an addition to an earlier brown coal drying project also allocated funding under GGAP back in 2001 that also did not lead to implementation.

There is considerable uncertainty about whether another two projects will actually proceed. Both Solar Systems' (now Silex) and HRL's IDGCC power projects are still yet to reach financial commitment.[69] Even if they do obtain finance, construction would take several years.

2.2.3 Cost-effectiveness

Including the abatement from the Gorgon project then the budgetary cost per tonne of CO_2-e is relatively good value at less than \$20/tCO_2-e. However, it is unlikely that this figure could be replicated, as it is heavily skewed by this single project which faced special circumstances. The Gorgon project proponents were anxious to demonstrate green credentials in order to secure government development approval in a very environmentally sensitive location.[70] Excluding the Gorgon project, the budgetary cost per tonne is expensive at around \$100/tCO_2-e.

Figure 2.2 Funding outcomes for LETDF (plus VIC and QLD funds)



Sources: Australian Energy Market Operator (AEMO) (2010a); ANAO (2010b); Parkinson, G. (2010); Rose (2010)

[67] Rose (2010)
[68] Parkinson, G. (2010)
[69] Australian Energy Market Operator (AEMO) (2010a)

[70] Barrow Island is a Class A nature reserve because it contains a number of animal species extinct on the Australian mainland. By being able to develop their LNG project on this island which was closer to their gas fields, the proponents would have saved significant amounts of money.

2.2.4 Issues in delivery

Lengthy tender process

Just like GGAP, there were lengthy delays involved in delivering this program. While the program was announced in mid 2004, the tender process took two years. This required development of program and selection guidelines, provision of time for proponents to prepare their bids and assemble consortia, and then ultimately evaluate the bids.

Lengthy negotiation process

Winning bids were announced in October and November 2006[71]. After the winning bids were announced, there was an extensive period involved in negotiating funding agreements that set out the terms proponents would need to meet to obtain funding. ANAO (2010b) observed:

> *"The lengthy negotiation with the six successful proponents to finalise funding agreements was a particular problem for LETDF. Obtaining finance from third parties proved difficult and, in some cases, contributed to delays in the finalisation of agreements or, in some cases, to the termination of a project. Negotiations involved up to two years for one LETDF project."*

Changing circumstances

Many winning bids struggled with changes in market and regulatory circumstances. The inability of proponents to predict these and the future viability of the projects illustrates the inevitable challenges for government selection panels attempting to select projects, exacerbated because these panels often have limited knowledge of the industries and technologies concerned.

Santos' Fairview project, with a $75m grant, was cancelled in 2008 after further study by the proponent led to the realisation that the project was financially unviable.[72]

The Hazelwood coal drying project, with a $70m grant, was affected by the development of the general carbon pricing scheme embodied in the Carbon Pollution Reduction Scheme. In late 2008 the Australian Government released its White Paper for the design of an emissions cap and trade scheme. It planned that over the next decade emitters of CO_2-e would need to acquire permits at an expected cost of around $20 to $40 per tonne of CO_2-e.[73] International Power, the owner of Hazelwood, has claimed that the proposed CPRS would make Hazelwood financially unviable as soon as 2016, at which point closure was likely.[74] Irrespective of whether this is entirely true, the very large losses in profitability incurred by the CPRS, would make it difficult to justify investing $350m in coal drying technology for Hazelwood (as envisaged by the tender), that would only marginally reduce its emissions intensity, and still leave it as one of the most emissions intensive power stations in Australia.[75]

[71] Campbell (2006b); Campbell (2006a); Macfarlane (2006)

[72] ANAO (2010b)

[73] Australian Government Treasury (2008)

[74] International Power (2010)

[75] Innocenzei (2008); ACIL Tasman (2009)

The Hazelwood coal drying project was also affected by a number of other unforeseen factors, leading to delays in the project. As the Victorian Department of Primary Industries outlined to a parliamentary inquiry in 2009:

> *"International Power IP2030's coal drying and combustion component of the project has not commenced due to significant cost increases since the project was first announced. The project is also relying on the learning and success of a similar technology being applied in Germany. Negative impacts from the recent Global Financial Crisis and uncertainty associated with the introduction of the Commonwealth's Carbon Pollution Reduction Scheme have also contributed to the timing being revised."*[76]

Solar Systems was awarded $125m in LETDF and ETIS funds for its 154MW solar demonstration project. Yet it hadn't actually built a pilot plant of its tower-field proposal (again contrary to program guidelines).[77] Solar Systems subsequently obtained an additional $5m in funding separate to LETDF from the Asia Pacific Partnership for Clean Development to build the pilot plant.[78] However in 2008 one of its cornerstone investors and key customer for the Mildura project, TRUenergy withdrew its stake in the project[79] and shortly afterwards Solar Systems went into receivership[80] and was subsequently acquired by Silex Systems.[81] Interviews conducted by Grattan Institute suggest that the company struggled because it scaled-up too fast. It may be that this was in part encouraged because LETDF emphasised large projects.

HRL planned a lower emissions coal-fired power plant using gassified coal, expected to achieve an emissions intensity of 0.9tCO_2-e/MWh.[82] In 2008 the Australian Government emissions trading scheme white paper announced that projects not yet in operation or yet to reach financial commitment by mid 2007 would have to pay for their carbon emissions in full without any free permit assistance.[83] This would place the HRL power plant at a substantial disadvantage relative to new build combined cycle natural gas plants which have an emissions intensity less than half that of HRL's plant (around 0.4tCO_2-e/MWh). In addition the Victorian Government announced in July 2010 emission standards for newly constructed coal fired power plants which would disqualify the original design of HRL's plant.[84] HRL substantially adjusted its plant design to operate as a dual-fuel power station able to operate with a high proportion of natural gas. It also substantially increased the size of the plant from 400MW to 600MW which would have incurred additional capital costs in the realm of $200-$400m. In addition to these

[76] Public Accounts and Estimates Committee (2010)
[77] Confidential interviews with people close to the project highlighted the lack of a pilot project to us, although this was common knowledge amongst renewable energy industry participants. It is worth noting that solar systems did have a dish-based technology in field operation, but this is very different to the tower configuration it proposed under LETDF
[78] Renewable Energy and Distributed Generation Task Force (2009)
[79] Parkinson, Giles (2009)
[80] AAP (2009)
[81] Silex Systems (2010)
[82] Modern Power Systems (2007)
[83] Australian Government (2008a)
[84] Victorian DPC (2010)

government regulatory changes, HRL's major financial backer Harbin Power, withdrew its 50% stake in the project in 2009.[85]

Chevron's Gorgon LNG project originally planned to begin construction in late 2006, to produce LNG by mid 2010.[86] Yet it did not reach financial commitment until September 2009 and first LNG shipments aren't expected until mid 2014.[87] In the meantime the project design and cost underwent major revisions, experiencing a threefold blow-out in expected construction cost from \$11b[88] to \$43b and transforming from a 2 train 10mtpa LNG plant to a three train 15mtpa plant.[89] The original estimated cost of the CO_2 sequestration components of the project was \$841m[90], but in a November 2010 newsletter Chevron claims the investment will be \$2b.[91]

[85] Morton (2010)
[86] Chevron Australia (2006)
[87] Chevron Australia (2009)
[88] Chevron Australia (2005)
[89] Chevron Australia (2009)
[90] DRET (2011)
[91] Chevron Australia (2010)

2.3 NSW Energy Savings Fund

The NSW Energy Savings Fund, announced in 2005, sought to raise \$200 million over five years through a levy on electricity distribution companies. The funds were intended to fund energy efficiency abatement projects as well as projects that reduced electricity peak demand. [92] Yet the program never came close to allocating the budgeted funds and has reduced emissions by no more than 200,000 tonnes of CO_2-e a year, about the same as 10 days of output from a typical coal-fired power station.

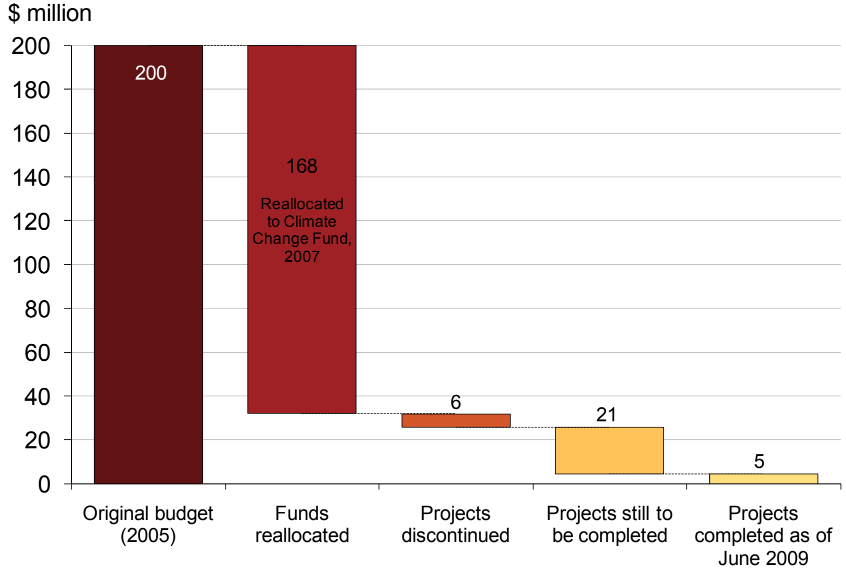
2.3.1 Emission reductions achieved

The NSW Energy Savings Fund never came close to allocating the budgeted funds and has had an inconsequential abatement impact, saving at best around 200kt CO_2-e per annum.[93] It was originally forecast to reduce emissions by 800kt of CO_2-e per annum.[94] The program conducted two funding rounds, which allocated \$33m of funding, before the NSW Government raided the fund to support a suite of other climate change commitments made in the 2007 state election.[95]

The ESF experienced similar problems to GGAP and LETDF, before its funds were reallocated to other programs. Of the grants that were awarded under the program, few of the projects have been completed five years after the program began.

[92] Sartor (2005)
[93] NSW DECCW (2010b)
[94] Sartor (2005)
[95] Business Council for Sustainable Energy (BCSE) (2007)

Figure 2.3 Funding outcomes for NSW Energy Savings Fund



Source: NSW DECCW (2010b); NSW DECCW (2008); Business Council for Sustainable Energy (BCSE) (2006); Business Council for Sustainable Energy (BCSE) (2007)

Of the $32.7m awarded to projects, $6.3m of projects have been withdrawn and $21.2m of projects are still yet to be completed,[96] as shown in Figure 2.3 above. Yet under the original guidelines it was expected that projects should be fully implemented within three years.[97] Projects costing $4.5m have actually been completed –15% of the funds awarded.

2.3.2 Issues in delivery

Just like GGAP and LETDF, the bespoke allocation of funding to projects before results were delivered created significant challenges.

Uncertain criteria

Government adopted non-standardised approaches to funding levels and engaged in active negotiation with many tenderers over the level of funding provided. For example, with 15 of the 29 projects awarded funding in the first tender round, the government sought to negotiate lower payments based on its own appraisal of these projects' commercial viability.[98] This type of administratively intensive process of trying to assess the counterfactual, similar to that under GGAP, rather than adopt standardised approaches, led the Business Council for Sustainable Energy (BCSE) to complain,

> *"It is extremely difficult to determine in an objective and consistent manner those projects that would not have gone ahead without funding and then determine the appropriate level of funding."*[99]

The administrative resources and uncertainty associated with this type of process led the Council to suggest that:

[96] NSW DECCW (2010b); NSW DECCW (2008); Business Council for Sustainable Energy (BCSE) (2006); Business Council for Sustainable Energy (BCSE) (2007)

[97] NSW DEUS (2005)

[98] Business Council for Sustainable Energy (BCSE) (2006)

[99] Business Council for Sustainable Energy (BCSE) (2006)

> *"Much more detailed guidelines with consistent approach, methodologies and assumptions [need to be] developed to determine energy, demand and greenhouse reductions attributed to each project."*[100]

Rushed tender process

Also the government-imposed timing around tendering also created problems. In the first round proponents were rushed to put in bid proposals. Government gave them only 6 weeks prepare bids for what in some cases were quite complex projects from a commercial perspective involving multiple parties.[101]

Elongated tender rounds

In addition, originally it was intended that tender rounds would be held twice to three times per year to provide ongoing, regular opportunities for funding and enable bidders to adjust their proposals in light of results in prior rounds.[102] However while Round 1 was established in a relatively short period of time by government standards for a new program (perhaps too quickly), the Round 2 process was not completed until well over a year after Round 1.[103] Many applicants found it difficult to maintain customer interest and projects alive when they were contingent on the outcomes of such a drawn out process. By the time winning bids were announced circumstances had changed that made it difficult for some projects to proceed.[104]

[100] Business Council for Sustainable Energy (BCSE) (2006)
[101] Business Council for Sustainable Energy (BCSE) (2006)
[102] Pers comm. Dunstan (2011)
[103] Business Council for Sustainable Energy (BCSE) (2007)
[104] Confidential interviews and discussions with ESF applicants

2.4 Solar Cities

The $94 million Solar Cities program seeks to fund several sites where solar and new electricity technologies would combine to trial new models for electricity supply and use. It has been characterised by slow and inconsequential results. Announcement of the winning bidders was not concluded until three years after the program was initially announced. Only 37% of funds have been spent to date.[105] According to the government's own projections it has produced negligible greenhouse gas abatement. Its cost of abatement is high – around $100 per tonne of CO_2-e. The program had little impact in developing the renewable energy industry because its aims relative to other programs were poorly defined.

2.4.1 Scope

Solar Cities was another grant tendering initiative of the Howard Government's 2004 Energy White Paper, involving an original funding allocation of $75m. This was subsequently increased to $94m as part of the Labor Party's 2007 election commitments.[106] Its intention was to fund several sites around Australia where:

> *"Distributed solar technologies (including solar thermal and photovoltaic technologies), energy efficiency, load management, smart meters and cost-reflective pricing will combine in large-scale grid-connected urban sites to trial new sustainable models for electricity supply and use."*[107]

2.4.2 Emissions reductions achieved

When the program was announced in 2004, critical infrastructure was expected to be in place by 2006 and interventions were to be fully implemented by 2008-09.[108] However, Grattan Institute analysis indicates that only 37% of budgeted funds have been spent to date.[109] According to the government's own emission projections the program has delivered negligible greenhouse gas abatement and is not expected to deliver noticeable levels of abatement in the future (less than 100kt CO_2-e/annum).[110]

2.4.3 Cost-effectiveness

The cost of abatement is high with a total fiscal cost of around $100 per tonne of CO_2-e.

2.4.4 Potential to build industry capacity

The Solar Cities initiative has had little impact in developing the renewable energy industry. Most of the solar capacity installed in Australia was supported by other programs, particularly the solar PV rebate programs.

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[105] ANAO (2010b) specified $19.8m spent to June 2009; Australian Government (2010) DCCEE portfolio statements - $15.5m over 2009-10 and 2010-11
[106] ANAO (2010b)
[107] DEH/AGO (2004)
[108] Australian Greenhouse Office (AGO) (2004)
[109] ANAO (2010b) specified $19.8m spent to June 2009; Australian Government (2010a) portfolio statements reported $15.5m over 2009-10 and 2010-11
[110] DCCEE (2010b)

While it is claimed that the program's primary aim is the *"collection and analysis of information and data on energy use patterns and behaviour change"* to inform future policy, rather than deliver immediate abatement,[111] it is unlikely that it will add much to the existing voluminous research in the areas targeted. Six years on from the announcement of the program, government has not published any research findings from the Solar Cities trials that suggest how we might enhance the design of policy interventions or markets associated with energy efficiency, distributed energy and demand management. While the Department of Environment's 2008-09 annual report notes that energy use data is being collected and stored centrally for each Solar City, none of it has been publicly released for researcher scrutiny. The 2008-09 annual report also claims that annual reviews of each of the selected cities would be undertaken and published on the solar cities website that would *"capture what has been learnt from the program and consolidate it into a progress report"*.[112] Yet the only material published is a newsletter that does not include rigorous research findings. Only the Townsville Solar City has published detailed results from its activities, and only in late 2010.

The Solar Cities program has not published substantial insights on more efficient management of energy infrastructure through greater customer participation seven years after it was announced. Nevertheless, in the 2008-09 budget the government unveiled another $100m program intended to do something similar – the *SmartGrid, Smart City Initiative*. While there is clearly an opportunity to make substantial savings in electricity infrastructure through better management of demand, it is questionable whether large site trials, testing a wide multitude of technologies and applications at once, will yield the best results.

2.4.5 Issues in delivery

Poorly defined, multiple, and unrealistic objectives

Solar Cities suffered from poorly defined, multiple, and unrealistic objectives.[113] It was inherently unlikely that these could be achieved.

Solar Cities sought bids that would test an array of practices and technologies. Most of these are well-understood technologies and practices that have been applied in the field for a decade or more, including:

- combined heat and power plants to heat community swimming pools;
- solar photovoltaic household electricity generation;
- ceiling insulation;
- handouts of compact fluorescent light bulbs;
- time of use pricing;
- in-house energy usage displays;
- energy audits; and

[111] DEWHA (2009a)
[112] DEWHA (2009a)
[113] DEH/AGO (2004)

- loans linked to energy efficiency products.

The need to "trial" these well-tested technologies and practices was never adequately explained. Many of the interventions have already been trialled in Australia and overseas, and there was no review of the existing literature to define what the Solar Cities initiative aimed to add.[114]

In addition it is difficult to understand why these interventions needed to be combined together in one large trial given that they operate perfectly well without active coordination. The requirement to test them in coordination necessitated the creation of complex consortia teaming-up local councils, electricity retailers, electricity network operators, product manufacturers, NGOs, energy auditors and other service providers. It also made it more difficult to isolate cause and effect critical to gaining improved understanding of what does and does not work.

Also the government did not need to use an elaborate and complex Solar Cities program to gain greater understanding of grid connection and integration issues associated with Solar PV. Firstly Solar Cities funding was completely inadequate to get a critical mass of PV installations (considering it also sought to fund multiple sites and a wide range of other initiatives). And secondly other PV subsidy programs are driving far larger numbers of PV installations, and government could have simply piggy-backed a research study off these existing programs in far less time and with lower administrative resources.

In addition because the program took so long to roll-out, some aspects of the trials ended-up being overtaken by other events. Its attempt to assess alternative methods of marketing energy efficiency and renewable energy products and services was overwhelmed by substantially increased government subsidies for Solar PV, Solar Hot Water and Insulation. These led to a huge surge in sales much larger than the relatively small expected impact of the Solar City initiatives.[115] The Government also introduced regulatory mandates which made voluntary persuasion and information programs redundant, such as the phase out of electric storage water heaters, the phase out of conventional light globes, and mandatory energy ratings of residential and commercial buildings.

Lengthy tendering and negotiating process

The Solar Cities program used a slow and complex tendering process that led to delays and problems similar to those encountered by the other grant tendering programs.

The winning bidders were not announced until three years after the program was unveiled. The budget papers reveal that the government had failed to appreciate how long and difficult it would be to select and implement the Solar Cities.

The budget papers from 2005-06 to 2007-08 show that the government expected to spend $53.2m by the conclusion of 2007-

[114] No review of existing research literature appears to have been conducted as part of the development of the program, with one of the selected cities (Alice Springs) actually doing this themselves – five years after the program was announced.

[115] See the Rebates section of this report for the extent of the large surge in sales of these products

08 financial year. However the 2008-09 budget papers reveal that by then only $19.8m had been spent.[116] They explain:

> *"delays in milestone payments for 2007–08 have been experienced due to grantees finalising their governance and formal consortia agreements."*[117]

In 2010 the ANAO observed similar problems with:

> *"[d]elays in negotiating and finalising funding agreements and problems with contractors for some cities going into voluntary administration have reduced the actual budget expenditure."*[118]

According to the ANAO,

> *"[c]onsistent with other programs (GGAP and LETDF) there were delays of up to nine months in implementing deeds of agreement for the Solar Cities Program. These delays again highlight the challenges of assessing projects with large consortia where project viability is contingent on contributions from third party financial providers."*[119]

[116] Australian Government (2005b); Australian Government (2006); Australian Government (2007); Australian Government (2008b)
[117] Australian Government (2008b)
[118] ANAO (2010b)
[119] ANAO (2010b)

2.5 Solar and Carbon Capture and Storage Flagships

2.5.1 Overview

The Solar and Carbon Capture and Storage Flagship programs were announced in May 2009.

Solar Flagships was allocated $1.5 billion to support the development of up to four large solar power stations with a combined capacity of 1000 megawatts.[120] State governments promised an additional $320 million.

Carbon Capture and Storage Flagship was allocated $2 billion to fund two to four industrial scale demonstrations of carbon capture and storage technology. State governments have promised an additional $510 million for similar objectives.

Both the Solar and CCS Flagship programs are already illustrating patterns of failure consistent with earlier grant tendering programs. There are lengthy and unexpected delays in implementation, and downward revisions in forecast outcomes. Solar Flagship's anticipated budget expenditure in 2009-10 was $144 million, but it had spent just $20 million as it was yet to even select the winning projects. Selecting winning tenders will require very complex evaluation decisions, and projects are withdrawing as changing circumstances and emerging knowledge of their projects invalidate tender assumptions. As with other grant-tendering programs, governments are raiding the funds to pay for other initiatives.

[120] AAP (2010)

Large scale solar demonstration plants could have been promoted better through a market mechanism rather than a grant mechanism to avoid many of these problems.

2.5.2 Program scope

Solar Flagships was allocated $1.5b by the federal government to support the development of up to 4 large-scale solar power stations with a combined capacity of 1000MW involving both photovoltaic and thermal technologies. In addition the Victorian government announced a further $100m,[121] NSW promised $120m[122] and the Queensland Government $100m.[123]

The CCS Flagship was allocated $2b to fund 2 to 4 industrial scale demonstrations of carbon capture and storage technology that will contribute to the overall target of 1000MW of low emission fossil fuel power generation.[124] In addition the Victorian Government provided $110m of additional funding under its ETIS program. The Queensland Government established a $300m fund to support clean coal projects, including supporting projects that were shortlisted for CCS Flagships. The NSW Government allocated $100m for clean coal research projects

[121] Brumby (2009)
[122] NSW Government (2010)
[123] AAP (2010)
[124] DRET (2009a)

2.5.3 Emerging issues

Both the Solar and CCS Flagship programs are still in their infancy, but they are already illustrating patterns of failure consistent with prior grant tendering programs.

The Solar Flagship program is encountering lengthy delays. Its anticipated budget expenditure in 2009-10 was $143.8m,[125] but it ultimately spent only $20m as it had not yet selected the winning projects (this remains to be finalised in April 2011).[126]

The original structure for Solar Flagship has a number of problems. Grattan Institute interviews with a number of solar industry participants indicate that the Government's original parameters for the program were highly unrealistic. Delivering the Program aim of 1000MW is not possible with the $1.5 billion of government funding on offer. The Program requires projects to be funded 2:1 for private:government contributions. Participants indicate that private funds cannot earn an adequate return on these terms.

Projects in the Solar Flagship program are struggling as changing circumstances and emerging knowledge of the details of projects invalidate tender assumptions. Acciona has announced the withdrawal of its solar thermal project.[127] Grattan Institute interviews with industry participants indicate that other short-listed solar projects are encountering serious difficulties that are likely to lead to withdrawal or substantial revisions in their projects. These

[125] Australian Government (2009)
[126] Australian Government (2010b)
[127] Government Grant Guru (2010)

problems are not surprising given that the tender guidelines were issued two days before Christmas in 2009 and effectively only gave bidders 6 weeks[128] including the summer holiday period to organise bids for highly complex projects.

Projects in the CCS Flagships program are also struggling with emerging knowledge of technology. The Queensland Government announced the withdrawal of its shortlisted ZeroGen project in December 2010. According to the Queensland Premier,

> *"We had hoped to have a clean coal power station up and running by 2015 but the fact is that the early research has shown us that this is not viable at this time on a commercial scale."*[129]

Government is reallocating funds out of these programs to pay for other initiatives, thereby undermining investor confidence. As part of funding its Cleaner Car Rebate (which itself has been subsequently scrapped) promise in the 2010 election, the Labour Party reduced funding to Solar Flagships by $220m and CCS Flagships by $150m.[130] As part of its flood reconstruction initiative, the Government announced that it would reduce funding for the CCS and Solar Flagship programs by a further $250m each over the period to 2014-15, although subsequent negotiations with the Greens restored $100 million to the Solar Flagship program.[131]

Also there are some major issues with the design of the Solar Flagship program as a support program for solar photovoltaics.

2.5.4 Market mechanism alternatives

Solar power technologies could have been promoted better through a market mechanism rather than a grant mechanism to avoid many of these problems.

In relation to solar photovoltaics, all of the shortlisted flagships projects involve minimal technology risk. They all plan to use existing, off-the-shelf solar panels, and the likely amount of electricity they are capable of producing is well understood.[132] There is little need to commit funds to projects in up-front grants when instead one could pay on the basis of delivered output and avoid the need to pre-commit to any individual party.

Also there seems to be little to be gained from explicitly preferencing large-scale projects. All other things being equal it is actually desirable for power plants to be located and sized as close as possible to customer demand, thereby minimising the need for expensive network capacity to distribute the power and minimise commercial risk. The fact that solar panels can be easily installed as small, modular installations next to customer loads is actually a major advantage of the technology. The modular nature of solar PV technology means there is relatively little difference in the design and installation of 1 MW versus a 250MW project. Thankfully the government revised its minimum project site criteria for PV technology down to 30MW, but it still

[128] DRET (2009b)
[129] Bligh (2010)
[130] Labor Party (2010)
[131] Wong (2011)

[132] Based on Grattan Institute interviews over 2010 and 2011 with members of the solar industry

requires each individual proponent to deliver a minimum capacity of 150MW across a combined number of sites.[133] This acts to substantially restrict the number of potential suppliers with minimal offsetting benefits. Rather than using grant tendering, which requires pre-commitment ahead of delivery of output, government could instead have set a target for a volume of electricity they were willing to purchase from solar photovoltaic projects and the maximum price they were willing to pay per MWh delivered (but with prices being ultimately determined through competition amongst suppliers to sell their electricity into the target). Government would not need to restrict entry, instead allowing developers to make their own decisions about whether to proceed with their project and the most appropriate scale for the project. Companies in Europe are building substantial solar PV capacity on a similar basis through use of feed-in tariffs.[134] They are able to obtain financing without government having to commit to specific individual projects and companies in advance of delivery. It is also worth noting that even less technologically mature solar thermal technologies are being financed on a similar basis via feed-in tariffs without the need for upfront grants.[135] A market mechanism could probably improve on feed-in tariffs by making prices more responsive to competition amongst suppliers however.

[133] DRET (2009b)
[134] Ernst & Young (2011)
[135] Melbourne Energy Institute (2010)

2.6 Other renewable energy research and commercialisation programs

2.6.1 Overview

An array of other programs aimed to support renewable energy generation and storage research, development, demonstration and commercialisation have allocated $700 million to date. Actual emission reductions are less than 0.5 million tonnes of CO_2-e, despite early forecasts that they would reduce emissions by 4.9 million tonnes of CO_2-e by 2010.

These once-off grant programs have generally not been designed appropriately for immature energy technologies that typically require a decade or more of development before approaching commercial viability.

Government support for energy technologies should not designed as once-off exercise but rather cater to a process involving a series of steps to reach commercial application. A Grattan Institute report in preparation will assess energy technologies against this criterion.

2.6.2 Program scope

The programs reviewed include RECP, REDI, Fed-REDP, NSW-REDP, Geothermal Drilling, AEST, Climate Ready, COMET, R&D START, and Asia-Pacific Partnership. These programs support one-off research, development, demonstration and commercialisation projects rather than large-scale deployment. Similar grant-tendering programs have also been instituted to support the development of Carbon Capture and Storage technologies.

2.6.3 Emissions reductions achieved

Total abatement expected from these programs for the 2010 and 2020 period are inconsequential – less than 0.5Mt CO_2-e by 2010 and less than 1Mt CO_2-e per annum by 2020. This contrasts with the forecast of the first inception of these programs – the Renewable Energy Commercialisation Program – which in 2003 forecast emissions reductions of between 4.9-6.1 Mt of CO_2-e in 2010.[136] The budgetary cost per tonne of CO_2-e saved is moderately high at around $60-$100.

These programs cannot be expected to directly deliver substantial levels of greenhouse gas abatement given that their primary objective is to improve understanding of a new technology's potential, performance, and opportunities for improvement.[137] However, they are not always communicated to the public in this way.

2.6.4 Potential to build industry capacity

However, these programs are only justified if they build industry capacity. Generally they have not done so.

14 years after RECP and REEF began in 1997, most of the companies and technologies funded under these original programs still rely on the drip-feed of Australian grant programs.

While cost breakthroughs may eventuate in the next few years, leading to rapid deployment of these technologies within this decade, this seems highly unlikely. This is true even with a carbon pricing scheme and the 20% Renewable Energy Target in place. Instead these companies and technologies will most likely require further additional deployment-oriented programs after their grant funded projects are concluded. We see no reason why this would not also be the case for CCS.

As with other grant tendering programs, many successful bidders did not ultimately proceed with their projects. However because there are a large number of grants, and outcomes are not transparently reported, it is not possible to identify ultimate outcomes across all grants.

Of more than 130 grants awarded under these programs since 1997 (which includes RRPGP and LETDF)[138], Grattan Institute identified four or five examples that appear to have self-sustaining positions without further Australian government support (although their viability inevitably depends on government policy to support renewable energy either through direct subsidies or carbon pricing). And these do not constitute major success stories whose pay-offs outweigh losses incurred on other projects.

2.6.5 Program design for immature energy technology

These grant-tendering programs have not been designed and resourced appropriately. Providing once-off grants to commercial

136 ANAO (2004)
137 ANAO (2010b)

138 We have assembled a database of grants awarded under these programs from: Australian Greenhouse Office (AGO) (2003); AusIndustry (2011); Industry Research and Development Board/ Innovation Australia (2002)annual report 2001-02 to 2008-09.

developers through short-lived programs is inconsistent with the long-term, capital-intensive, iterative nature of developing and commercialising new power generation technologies.

Power generation technologies usually take at least two decades or more to reach widespread commercial deployment. Typically this occurs with substantial government involvement and support over this entire period to provide support both R&D and improvement via learning by doing. This has been the case for the roll-out of nuclear power, gas turbines, wind turbines and most recently solar photovoltaics to multi-gigawatt scale of global annual installations (the scale which electricity technologies need to achieve to be worthwhile).[139]

Billions of dollars (in current dollar terms) of government support, either directly or via regulatory fiat, have been involved to supplant incumbent electricity generation technologies. Improvement has proceeded through in-field iterations of the technology, rather than fresh out-of-the-lab, market-ready revolutions. This is unlike pharmaceuticals or IT&T, where the end products tend to be more differentiated than electricity, which is perhaps the ultimate commodity.[140]

By contrast Australian renewable energy technology development grant tendering programs have short time-frames (at best they are designed to allocate funds within 5 years). There is little evidence of coherent programs to support the technology once the initial grant project has been completed. While grant programs have ultimately supported companies on multiple occasions as their technology progressed, this has been largely a product of accident rather than design.

Both government and proponents have been unrealistic about what could be achieved with a given amount of money and time. Predictions by some proponents that their technology would be competitive within a short-period with fossil fuels at a moderate carbon price or with wind have been found to be excessively optimistic. Notable examples including Geodynamics[141]; Solar Systems (now Silex)[142]; Oceanlinx[143]; and Ausra[144] (in its various iterations including now as part of AREVA) have instead continued to require repeated injections of grant funding to progress their technology since 1997.[145]

This is not to disparage the efforts of the technologists behind these companies, or suggest they are undeserving of support. However, Australian governments should become more realistic about what can be achieved, and this has implications for policy design. The reality is that a few million dollars of taxpayers' money provided to specific "strategic" projects will not deliver a painless fix.

Decades of experience in energy technology development suggests that progress with a relatively immature energy

[139] Alic et al. (2003); Foxon et al. (2007); Grubb (2004); IEA (2003)
[140] Alic et al. (2003); Foxon et al. (2007); Grubb (2004); Mowery et al. (2009)
[141] Geodynamics (2002)
[142] Solar Systems (undated)
[143] Australian Greenhouse Office (AGO) (2003)
[144] Australian Broadcasting Corporation (ABC) (2007)
[145] Based on a database of grants awarded under these programs from: Australian Greenhouse Office (AGO) (2003); DRET (2010); Ferguson, M. (2009a); Ferguson, M. (2009b); Industry Research and Development Board/ Innovation Australia annual reports 2001-02 to 2008-09.

technology requires a large investment over an extended period. Consequently, the appropriate design of government support for an energy technology depends on how close the technology is to commercial application. It should not be designed as once-off grant exercise, but rather cater to a process involving a series of steps to reach commercial application.[146] A Grattan Institute report in preparation will assess energy technologies against this criterion.

2.7 Green Building Fund

The Green Building Fund provides $90 million to support projects to improve energy efficiency in office buildings.

The Green Building Fund allocated funding far more quickly than other grant tendering programs. The Fund was announced in 2007, and by 2009 its budget was fully allocated to projects. This is because it avoided a bespoke approach to funding decisions. Instead it adopted a standardised methodology for evaluating tenders using a building energy efficiency rating scheme known as NABERS. In some respects it provides a better model for allocating grants than other tendering programs. However because there is no evidence provided by government about the effect of the program in reducing emissions, it is difficult to draw strong conclusions about its genuine effectiveness.

[146] Alic et al. (2003); Foxon et al. (2007); Grubb (2004); IEA (2003)

3. Rebate schemes

3.1 The Commonwealth Home Insulation Program (and smaller state programs)

3.1.1 Program purpose

Insulation reduces household heat losses and gains, thereby reducing, at relatively low cost, the amount of energy required to maintain a house at a comfortable temperature.

Heating and cooling of residential homes to maintain comfortable internal temperatures is responsible for 40% of household energy use, and 19% of implied carbon emissions.[147] However this varies substantially between regions of Australia depending on climate. For example in NSW it is estimated that heating and cooling represents 23% of household energy use.[148]

According to the Government's *Your Home* guide, ceiling insulation is expected to *"save up to 45 per cent on heating and cooling energy use with roof and ceiling insulation."* However the same guide suggests that the ceiling and roof space is responsible for around 25%-35% of heat gain and loss in the average home,[149] and CSR Bradford, major manufacturers of insulation, state that ceiling insulation has the potential to save 20-30% on heating and cooling bills.[150]

Australia has quite low levels of home insulation compared to other developed nations.[151] A 2008 ABS survey found that nearly 40% of households either did not have insulation or didn't know whether they had insulation.[152] While the proportion of homes insulated has increased since 1994 (when 47.8% of homes didn't have or didn't know whether they had insulation), this improvement has been slow. The most prevalent reason for no insulation having been installed is that the persons occupying the home were not the owner (i.e. renting).[153] This suggests that break-downs in incentives between renters and landlords have inhibited uptake of insulation, even where it might be cost-effective to install.

3.1.2 Program scope

The Home Insulation Program, introduced in February 2009, aimed to insulate up to 2.9 million Australian homes at a cost of $2.8 billion over two and half years (revised budget is now $2.4b).[154] It offered a rebate of $1600 per household and $1000 for rental properties. It was by far the largest insulation rebate program ever announced, dwarfing programs in Victoria and New

[147] Wilkenfeld (2009)
[148] DECC (2007)
[149] See: http://www.yourhome.gov.au/technical/fs47.html
[150] CSR Bradford Insulation (year unspecified)
[151] ICANZ (2009)
[152] ABS (2009)
[153] ABS (2009)
[154] ANAO (2010a)

South Wales, which offered $300 rebates, with a budget allocation of around $1m for Victoria[155] and $7.4m for NSW[156].

3.1.3 Emissions reductions

The Home Insulation Program led to 1.2m homes installing ceiling insulation.[157]

We estimate that the Home Insulation Program will reduce emissions by between 0.6 and 1.1 million tonnes CO_2-e per year. This estimate is substantially lower than Federal Government projections.

In 2010 the government estimated that the insulation program would reduce emissions in 2020 by 2.5 million tonnes a year.[158] In 2011, this forecast was reduced to 2 million tonnes CO_2-e per year for 2010,[159] but declining to 0.1 million tonnes CO_2-e per year by 2020.[160] It is unclear why the impact of ceiling insulation was forecast to dissipate so rapidly. With 1.2 million homes insulated under the program, this implies that each dwelling receiving insulation saved slightly more than 1.6 tonnes of CO_2-e a year in 2010.[161]

[155] Sustainability Victoria (2008); Sustainability Victoria (2009)
[156] Pers comm. NSW DECCW (2010a)
[157] DCCEE (2011a). ANAO (2010a) estimates 1.1m homes
[158] Treasury (2010) cited in DCCEE (2011a)
[159] DCCEE (2011a)
[160] DCCEE (2011a)
[161] DCCEE (2011a)

We believe that 0.5-0.9 tonnes of CO_2-e a year per household is a better estimate. Other government studies show that the *total* annual heating and cooling-related emissions for an average household amount to 1.6 tonnes of CO_2-e[162] – and that insulation is likely to reduce average heating requirements by 30%.[163] The NSW Government estimated that ceiling insulation saved between 0.5 and 0.9 tonnes of CO_2-e per house per year for its insulation rebate program.[164] This is a reasonable proxy for houses insulated under the Home Insulation Program as the majority of rebates were paid to households in NSW and Queensland[165] which both tend to have populations concentrated in mild climates with moderate energy consumption for heating and cooling.[166]

Assuming that these reductions persist over time – which we believe is a reasonable assumption – and with 1.2 million homes insulated, the annual abatement from the scheme is 0.6–1.1 million tonnes CO_2-e and cumulative abatement to 2020 is 6–10 million tonnes CO_2-e.

The State programs have only provided minimal emissions reductions. According to ICANZ the underlying insulation retrofit market is equal to 65,000-70,000 homes per annum.[167] By comparison the Victorian insulation rebate supported just 1,165

[162] DCC (2009); Energy Efficient Strategies (2008)
[163] For example see www.yourhome.gov.au; CSR Bradford Insulation (year unspecified)
[164] NSW DECCW (2008) NSW DECCW (2010b)
[165] DEWHA (2009b)
[166] Energy Efficient Strategies (2008)
[167] Commonwealth Senate Standing Committee on Environment Communications and the Arts (2010)

installations in 2007-08,[168] and the NSW rebate supported 7,740 installations in 2008-09[169] - part of which would have been inflated by the Federal Government rebate program. This is unlikely to be above business as usual installation levels.

3.1.4 Cost effectiveness

The cost to the budget of inducing these savings was particularly expensive at $200-$400/tCO$_2$-e.

The net cost to the community was between $50-$200/tCO$_2$-e. This takes into account monetary savings flowing to private households as a result of lower energy bills, offset by all government costs, including the inspection and remediation costs of the program.

3.1.5 Issues in delivery

While the insulation program was severely criticised,[170] many of its problems are shared by other rebate programs. It is unlikely that they would have been avoided by better management (although it might have reduced their severity). These problems are inherent to a program that relies on government being able to forecast how a market will respond to a financial inducement that does not automatically adjust to supply and demand.

168 Sustainability Victoria (2008)
169 NSW DECCW (2010b);
170 See, for example, ANAO (2010a); Hawke (2010)

Inability to set a sustainable price

The Home Insulation Program encountered significant problems because it could not forecast accurately how a given level of rebate might affect industry and consumer behaviour.

Take up of the Home Insulation Program was “extraordinary and unexpected”, according to the Hawke Review of the program.[171] At the Program’s peak, demand was two and half times the anticipated level.

As a consequence, the Government had to bring forward almost $1 billion from the budgets of later years and other programs.[172]

Sudden policy changes undermining industry capacity

The Federal Government insulation rebate program involved a massive boost to the rate of installation of insulation. This led many existing businesses to scale-up their operations rapidly in the anticipation that the program would spend $3.3 billion to insulate 2.7m homes, as outlined by the Government.

However, in February 2010 the government suddenly put the program on hold pending an investigation into a range of problems. In April, contrary to the assurances it made to industry representatives in February, it closed the program. About 1.2 million of a projected 2.7 million homes had been insulated.[173]

171 Hawke (2010)
172 ANAO (2010a)
173 Commonwealth Senate Standing Committee on Environment Communications and the Arts (2010)

The abrupt and unexpected end to the program left a number of businesses and employees in severe financial distress. The National Audit Office found that, *"The fallout from the program has caused reputational damage to the insulation industry, and financial difficulties for many Australian manufacturers and installers."*[174]

The Senate Inquiry noted that,

> *"There has been significant distress among affected businesses as a result of the negative consequences of HIP itself, including unjustified tarnishing of industry reputations from its unexpected closure, as well as the government's April 2010 decision to renege on its February 2010 promise to establish a replacement program."*[175]

Poor installation reducing effectiveness

A significant portion of the insulation under The Home Insulation Program was poorly installed and consequently did not reduce emissions as forecast. With insulation provided for free in the vast majority of cases, many consumers had little regard for the quality of what they were receiving. According to ANAO

> *"the department anticipated that householders would check the quality of the installation work. This expectation was unrealistic as there was generally no financial contribution by householders and there were difficulties associated with inspecting the installations."*[176]

As at March 2010, of the 13,808 roof inspections conducted, around 29% identified installations with some level of deficiency, ranging from minor quality issues to safety concerns. Also since the closure of the program, DCCEE advised that some 4,000 potential cases of fraud have been identified.[177]

The Program also relied on pre-existing standards, testing and enforcement regime that had issues. Prior to the institution of the Housing Insulation Program, the ACCC found repeated cases of insulation manufacturers claiming false energy performance levels.[178] Australia also currently lacks an independent scientific testing and research facility with the capability to thoroughly assess building thermal performance issues.[179]

Safety issues

Although safety issues with the Home Insulation Program were widely reported, these may not have been a consequence of the rebate program – although the program doubtless increased awareness of their consequences.

The house fires blamed on faulty home insulation installation were also due to the continued failure of Governments to act at State

174 ANAO (2010b)
175 Commonwealth Senate Standing Committee on Environment Communications and the Arts (2010)
176 ANAO (2010a)
177 ANAO (2010a)
178 ACCC (2007); ACCC (2005)
179 Commonwealth Senate Standing Committee on Environment Communications and the Arts (2010)

and Federal levels to regulate the installation and usage of low voltage halogen downlights. Low voltage halogen lights, because they are so energy inefficient, create large amounts of heat – up to 370 degrees Celsius at their base. In a large proportion of households these have been installed inappropriately and could easily come into contact with other materials ultimately setting these alight, such as insulation.[180] Back in July 2007, a year and half before the Federal Government's insulation rebate program The Sunday Age reported in an article entitled *Thousands at risk from halogen-light death traps,* that,

> *"Unless tougher regulations on the use and installation of halogen downlights are introduced, it is only a matter of time before someone is killed, the Metropolitan Fire brigade has told The Sunday Age."*[181]

According to the Melbourne Metropolitan Fire Brigade, low voltage halogens were causing 30 house fires every year in Melbourne alone well before the institution of the Home Insulation Program.[182]

Poor targeting

The Home Insulation Program was poorly targeted because it paid a lesser rebate in the situation where additional incentives were most required.

A key factor behind sub-optimal levels of ceiling insulation in Australia is that landlords and tenants in rental accommodation have split incentives.[183] Landlords bear the cost of upgrading the energy efficiency of the home, whereas renters obtain the benefit through reduced electricity and gas bills. Renters only inhabit the house temporarily and so cannot recoup the full benefits of efficiency improvements they pay for themselves. According to ABS surveys, the most common reason given by respondents for lacking ceiling insulation is that they are renting the property.[184]

Nevertheless, the government rebate for rental properties was less generous than that offered to owner occupiers. The program only paid 5,625 rebates for rental properties, less than 1% of the original target of 700,000 rental properties.

Poor choice of policy

Extremely low take up by landlords is surprising considering the rebate of $1000 would still have been sufficient to enable landlords to install insulation at low or no cost. It may be that rebates are ineffective to induce landlords to install insulation. The Tenants Union of Victoria has suggested that rebates are unlikely to overcome the institutional barriers to landlords installing insulation.[185] The absence of a house energy efficiency rating scheme, agreed to by State and Federal Governments in 2004,

180 Russell (2007)
181 Russell (2007)
182 ABC Four Corners program (2007)
183 IEA (2007)
184 ABS (2009)
185 Archer (2009)

but still yet to be implemented, has probably also been a contributing factor to this poor uptake.[186]

3.2 Solar Photovoltaics

3.2.1 Program scope

Solar photovoltaic panels use the sun's energy to produce electricity.

Rebates for solar PV were initiated in 2000. By 2015, total budget expenditure on these rebates is expected to be $1.9 billion.[187]

In 2000 the Commonwealth established two rebate programs:

- the Photovoltaic Rebate Program (PVRP), which largely supported solar PV installed in urban environments connected to the electricity grid, and
- the Remote Renewable Power Generation Program (RRPGP) which supported solar PV in remote areas, along with some other renewable off-grid technologies

The first program was established with a budget of $31 million and was expected to conclude in 2002-03.[188] In the end it received an estimated $1.1 billion over its nine years of life[189] -- an illustration of how much rebate programs can blow out. The second received $264 million and was expected to last for an extended period.[190] It ultimately expended $328 million over its lifetime.[191]

Both programs were regularly renewed and lasted until 2009[192], when they were replaced by support under the Renewable Energy Target.

A third program, National Solar Schools, offers eligible schools grants of up to $20,000 to install solar and other renewable power systems on school buildings (as well as additional funding of up to a further $50,000 for a range of energy and water efficiency measures). Funding was originally set at $489 million in 2008, for operation until 2014-15.[193] Available data suggest that the program will have spent $116m to June 2011,[194] with ongoing expenditure of around $50m per annum until 2014-15.[195]

3.2.2 Emissions reductions achieved

Photovoltaic Rebate Programme (PVRP) and Renewable Remote Power Generation (RRPGP) reduced emissions in 2010 by around 0.2MtCO_2-e.[196]

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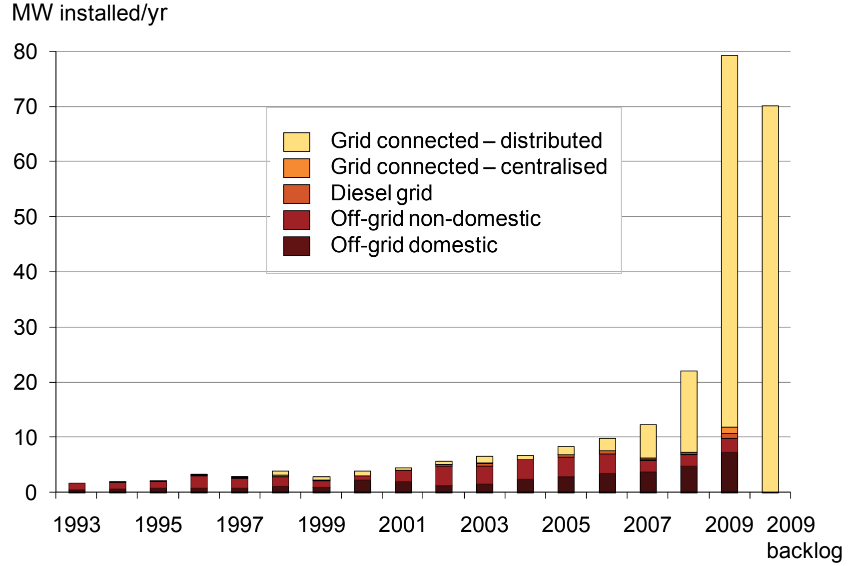
186 Ministerial Council on Energy (2004)
187 ANAO (2004); Garrett and Albanese (2007); Macintosh and Wilkinson (2010)
188 Australian Government (1999)
189 Macintosh and Wilkinson (2010)
190 ANAO (2004)
191 SKM and MMA (2011)
192 DCCEE (2010a)
193 Garrett and Albanese (2007)
194 DCCEE (2010a); DCCEE (2010c) – the budget papers are not entirely transparent on the Program's funding.
195 Green Energy Markets (2010b)
196 DCCEE (2010b)

From 2000 until 2007, annual installations of solar PV comprised less than 10 megawatts of new electricity generation, a tiny fraction of Australia's total electricity generation capacity of 49,000 megawatts. Changes to the programs in 2007 discussed below substantially increased the rebates paid, and installations began running at around 80 megawatts per year, as shown in Figure 3.1. Even at this rate, the rebate would need to operate for 30 years to install 5% of Australia's current electricity generation capacity.

Renewable Remote Power Generation (RRPGP) supported 9,000 rebates for small and medium scale renewable power installations (which are predominantly solar photovoltaic systems but also include small amounts of hydro and wind) over its lifetime. It also funded 31 larger-scale renewable power projects which are not the focus of this chapter.

Solar Schools is estimated to reduce emissions by a further 0.05 million tonnes per year in 2015.[197] The Program is expected to support a further 4-8 megawatts of new installations per annum over the next few years to 2015.[198]

Figure 3.1 Annual new solar PV capacity – megawatts (incorporates post 2009 capacity supported by PVRP/SHCP – "2009 Backlog")



Sources: Watt and Wyder (2010; DCCEE (2011c)

3.2.3 Cost effectiveness

It is very expensive to reduce emissions through solar PV rebates.

Although the Remote Renewable Power Generation Program is an effective program for individuals in remote areas, the cost to the Federal budget is large – over $400 per tonne of CO_2-e.

[197] Green Energy Markets (2010b)

[198] Estimated based on combination of Green Energy Markets (2010b); and DCCEE (2010c)

Emissions reductions under Photovoltaic Rebate Programme (PVRP) cost the Commonwealth budget over $400 per tonne CO_2-e according to ANAO.[199] After taking into account the benefits of reduced electricity costs from other sources, and the costs paid by households for installation, net costs of emissions reductions are between $200 and $300 per tonne CO_2-e.[200]

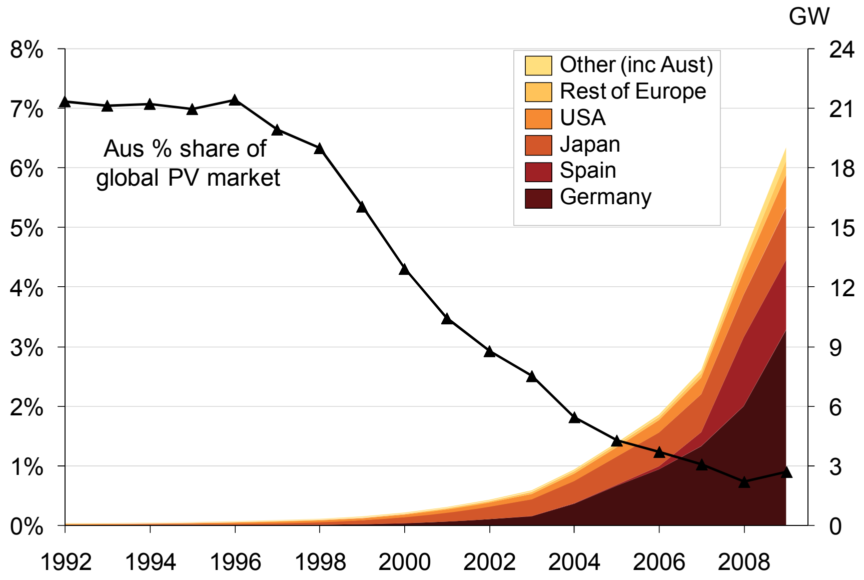
Solar Schools probably has similarly high abatement costs.

Renewable Remote Power Generation (RRPGP) has similar budgetary costs, but it has delivered a net benefit to the community in some circumstances. The program encourages new solar PV to replace expensive diesel fuelled generators in remote areas that produce power at costs substantially higher than main electricity grids. A solar PV or remote wind power system, taking into account capital and operating costs, can deliver power at lower cost in some locations, depending on remoteness and size of installation.[201]

3.2.4 Building industry capacity

Solar rebate programs were simply too small to enable Australia to maintain a prominent position within the global solar PV industry. While solar PV rebate programs were in place between 2000 and 2009, Australia's position in the global solar PV industry declined steadily, and probably irretrievably, as shown in Figure 3.2.

Figure 3.2 Global cumulative installed PV capacity and Australian share



Source: IEA (2010)

Australia was a significant market and industry player in the early 1990's with leading researchers and a notable manufacturing capability. However, aggressive promotion of solar PV by European and Japanese governments led the industry to grow to a scale and sophistication that bears little resemblance to that of the early 1990's. Australia's solar PV production capacity of a few tens of megawatts became sub-economic in scale and irrelevant in a global market installing 18.2 gigawatts in 2010 with $82 billion

[199] ANAO (2010b)
[200] Macintosh and Wilkinson (2010)
[201] Pers comm. Wyder (2011)

in annual sales[202]. The peak of annual sales in Australia in 2009 induced by the rebate is now only a single month's production from a modern PV manufacturing plant.[203]

Consequently Australia became a minnow in the industry. While Australian researchers have been at the forefront of photovoltaic technological advances, these have been commercialised by companies domiciled largely in Japan and Germany and more recently China.[204]

Between 2000 and 2007 Australia was unable to develop or attract significant domestic solar PV manufacturing. BP Solar's Homebush cell and module manufacturing plant in Sydney exported almost all of its production when the rebates were in place. It ultimately shut in 2008 because it was too small and too remote from key markets to remain viable.[205]

Australia's Solar PV installation sector operated largely as "cottage industry" dominated by small businesses that did not invest in automated and streamlined processes to reduce costs.[206]

This began to change in 2008 and 2009 after the rebate was doubled. As volumes grew, the market reached a critical mass that attracted many new installers. Accredited installers increased from 210 in 2006, to 1200 in 2009.[207] Some existing players could scale-up into professionalized, national businesses.[208]

3.2.5 Issues in delivery

Inability to set a sustainable price

Government repeatedly underestimated demand for solar rebates. This led to budget over-runs and frequent unexpected changes in rebate levels, and ultimately an abrupt cancellation of the program entirely in June 2009.

When the program began in 2000, the rebate was set at $5.50 per watt for systems of at least 450 watts up to a maximum of $8,250 per household. It was immediately oversubscribed, prompting the government to slightly reduce the rebate rate and the household limit in October 2000 to $5.00 per watt and $7,500.

By early 2003, over-subscription was again a problem. In February 2003 the government put a cap on total monthly approvals. In May of that year it extended the scheme until 2005 but further reduced the rebate rate and household limit to $4.00 per watt and $4,000 respectively.[209]

In the May 2007 budget, as part of the lead-up to the 2007 Federal election, the government sharply increased the rebate to $8 per watt up to a maximum of $8000 for a one kilowatt solar PV

[202] Solarbuzz (2011)
[203] Hsueh et al. (2010)
[204] Pers comm. Watt (2009)
[205] McDonald-Smith (2008). The plant has subsequently recommenced production under a new owner (Silex Systems) but with significantly reduced cell production.
[206] Ardron (2008)
[207] ANAO (2010b)
[208] Personal observations of author from several years of closely tracking the industry in Australia
[209] Macintosh and Wilkinson (2010)

system. The budget for the program was expanded to $150 million, which was expected to last for five years.[210]

This transformed the Australian solar PV sector. Applications for the rebate grew from an average of 1,000-1,200 per annum over the preceding years, to nearly 5,000 in 2007. With applications continuing to grow, the government introduced a means test in May 2008. This limited eligibility to households with annual taxable income below $100,000.[211] A surge of new entrants then applied innovative sales techniques, encouraging demand amongst lower income households.[212] Some even began offering fully installed PV systems at no charge to the customer,[213] which created the potential for low quality installation undisciplined by paying customers.

By 2009 the program was facing such an overrun of its budget that on 9 June the government announced it would close at midnight that day. By the end, the expanded program had paid around $1 billion in rebates for applications made between 2007 and its cancellation.[214] Yet the 2007-08 budget had provided the program with just $150 million, which was expected to last until 2012.[215]

[210] Turnbull (2007)
[211] Commonwealth Senate Standing Committee on Environment Communications and the Arts (2008)
[212] Pers comm. Brazzale (2010)
[213] Pers comm. Brazzale (2010)
[214] ANAO (2010b); ANAO (2004); Macintosh and Wilkinson (2010)
[215] Turnbull (2007)

The Remote Renewable Power Generation Program also suffered an abrupt end. In June 2009, the Department of the Environment, Water, Heritage and Arts announced that the program was closed to new pre-purchase applications as of 8:30am.[216]

Similarly, the Solar Schools initiative experienced unexpectedly high demand in its first year – nearly three times its budget of $27.8 million[217] – and was abruptly shut-down halfway through the year to stem the overspend. It was then restarted several months later after being significantly restructured so that PV installations had to be pre-approved. In effect it became a grant program rather than a traditional rebate program that pays on evidence of purchase.[218]

The experience of the PV rebate programs illustrates how much governments struggle to run programs that rely on their ability to predict and manage market demand. These issues arose even when the rebate applied to a single relatively small product market in which the government had several years of program experience.

This predictive ability has not improved over time. Back in 2004, the ANAO observed that,

[216] Watt and Wyder (2010)
[217] DCC (2010)
[218] DCC (2010)

> *"Evidence suggests that the AGO did not have sufficient initial understanding of the demand for program funds [from PVRP]"*[219]

In 2010, the ANAO in reviewing the PV Rebate programs concluded,

> *"Rebate programs with fixed appropriations and variable demand can be difficult to manage, particularly where an applicant has an entitlement to a rebate if their application is deemed as eligible. A significant risk for these types of rebate programs is that an unexpected acceleration in demand could exceed the funding limits specified in Budget appropriations".*[220]

The same problem was recreated in the program that replaced the household rebate - the Solar Credits Scheme. Although in form this was a sub-component of the Renewable Energy Target, it does not operate as a market mechanism where prices vary in response to changes in supply and demand. Instead, it is effectively a rebate with fixed prices for solar PV renewable energy certificates. Sales of Solar PV surged over 2009 and 2010 well above government forecasts, due to dramatic reductions in system costs. This forced the government to make an ad hoc intervention in December 2010 where it brought forward a reduction in the level of support by reducing the level of RECs it awarded solar PV systems.[221] The only difference is that under the Renewable Energy Target legislation, electricity retailers pay for the increasing payouts under the rebate, not government.

Sudden policy changes undermining industry capacity

The solar PV rebate programs have had short-term policy horizons that undermined business confidence critical to investments in industry capacity and expertise. PVRP was initially to end in 2003 after 4 years, but was then provided with a reprieve that extended the program for 2 years, and then a further 2 years in 2005 and then five years in 2007. Such short-term time horizons are incompatible with the very large capital investments involved in the solar PV industry (where new production plants cost hundreds of millions).[222] The climate of uncertainty has been exacerbated by the regular and abrupt changes in the level of rebate detailed above.

As the Senate Standing Committee on Environment Communications and the Arts concluded in 2008:

> *"The committee acknowledges the point, made by many industry players in their evidence, that repeated changes to the rebate scheme over a number of years have made it difficult for solar businesses to plan for growth. The rebate scheme has been intended to encourage householders to adopt renewable energy and to provide a platform from which the solar industry may grow and mature. The committee considers that, in the*

219 ANAO (2004)
220 ANAO (2010b)
221 Combet (2010)
222 Alberts and Tibi (2010)

long term, a rebate of this size is not likely to provide a sustainable footing for industry growth."[223]

High costs from policy duplication

In addition to the rebate for solar photovoltaics, State governments have concurrently adopted policies providing a price premium for electricity generated by solar photovoltaic systems up to 3 times the residential delivered price of electricity.

Solar PV systems have been eligible for renewable energy certificates since 2001, although these only had significant value after 2005 when RECs could be created for 15 years worth of expected generation in advance. This increased the value of a solar system by up to $900 per kilowatt.

Costs from free-riding

In the early years of the program, the rebate would have been substantially consumed supporting installations that would have happened anyway. Government tried to exclude a number of PV applications from eligibility to avoid free-riders (for example some telecommunications applications were excluded because solar PV was already an attractive option for them). The ANAO's evaluation of the PVRP in 2003 noted that half of respondents from a customer survey said they would have proceeded with the installation of a PV system irrespective of the rebate.[224]

Once the program expanded after 2007, sales increased well beyond any underlying natural demand for solar PV and free-riding as a proportion of the scheme became immaterial.

Poor choice of policy

The solar PV rebate was set at a fixed level per unit of rated electrical capacity of the system installed up to a fixed limit. However, this did not maximize the renewable electricity produced for each government dollar spent. Some of the problems with such a model are that:

- Larger systems are usually cheaper per unit of electricity generated, so capping support at 1kW sized systems fails to exploit these potential economies of scale; and
- The amount of electricity generated depends on many factors other than a system's rated capacity, including the amount of sunlight in the region, the orientation of the solar panels, any shading from trees or other buildings, the ventilation of the panels (output degrades as panels become hot), and the quality of the panels installed. While the government sought to manage quality by making the rebate conditional on use of accredited installers and panels which adhered to Australian standards, this is always an imperfect proxy for electrical output.

Many experienced PV industry participants indicated in interviews with Grattan Institute that they saw the rebate as an inherently flawed policy instrument. The strong consensus was that support would be better structured around paying a premium price for electricity actually generated by systems (commonly referred to as

[223] Commonwealth Senate Standing Committee on Environment Communications and the Arts (2008)
[224] ANAO (2004)

a "feed-in tariff"). This would encourage customers to care more about the quality and size of the system installed. While such a program has also had its problems[225], many of these could have been avoided with more thoughtful design.

Inadequate monitoring

The large growth in solar PV installations made it more difficult for the government to closely monitor the quality of PV systems and installations. The government reduced the proportion of systems audited from 5% down to 0.25%. Senior participants involved in standards and accreditation have publicly expressed concerns around quality and safety of installations.[226]

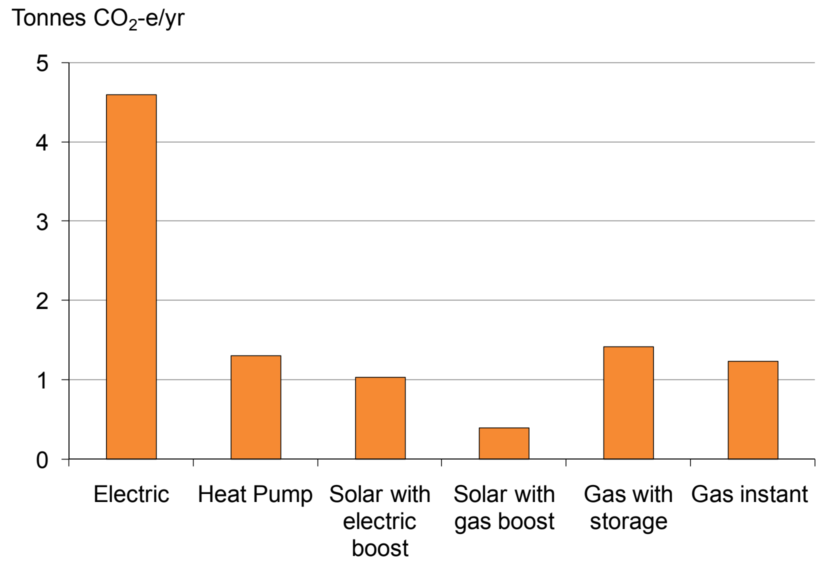
3.3 Solar and Heat Pump Water Heaters

3.3.1 Program purpose

Heating water comprises around 20% of all household emissions other than transport.[227] Solar collectors, heat-pump technologies or gas-fired water heaters can halve these water heating emissions, as shown in Figure 3.3.

[225] Garnaut (2011)
[226] Sydney Morning Herald (2010); ABC Lateline program (2010)
[227] Wilkenfeld (2009)

Figure 3.3 Annual average emissions of different water heater types



Source: Derived from Wilkenfeld (2009)

3.3.2 Program scope

After a number of inconsequential support schemes, the first material rebate for hot water heating was introduced in July 2007 when the Howard Federal Government offered a rebate of $1000 for households installing solar hot water or heat-pump systems.[228] There have been several changes in rebate level and eligibility.

[228] Edis and Morton (2007)

Over the period from September 2007 until June 2012 the Federal Government is expected to spend $572.7m on rebates for solar and heat pump water heaters[229] although the 2010-11 budget envisaged $722.7m.[230]

State governments have also provided rebates on and off over the past 10 years, costing around $200 million. In October 2007 NSW introduced a rebate of between $600 to $1200 for replacement of an electric storage system with solar or a heat pump. This was revised down to $300. Between 2005 and 2009 the WA government offered a rebate of $500-$700 for installation of gas-boosted solar hot water systems. Since 2008 SA has offered a rebate to low income households of $500 for solar and heat pump systems. Queensland has offered $600-$1000 since February 2010 to replace electric storage with solar or heat pumps. Victoria has had a long-running solar hot water rebate program although it was substantially increased in October 2007, to provide $900 to $1500 for solar water heater systems replacing electric storage in metropolitan Melbourne and $1900 to $2500 for homes in regional Victoria.[231] However this has been adjusted downward to provide $300-$1500 in metropolitan areas and $400-$1600 in regional areas.

A number of other programs also encourage greater uptake of less carbon intensive water heaters. Since 2001 solar water heaters and heat pumps have been eligible to generate Renewable Energy Certificates worth between $750 and $1200 per system.[232]

In addition the Federal Government has committed to phasing out electric storage water heaters (excluding Tasmania). This program was supposed to commence from 2010 in detached houses with access to reticulated gas and without reticulated gas from 2012. However, its impact to date is limited as it appears that State governments have lagged in implementing the necessary regulations.[233]

3.3.3 Emissions reductions

With so many different solar and heat pump system rebate programs, it is almost impossible to tell how much each has reduced emissions. The Federal Government's 2010 emissions projections do not include water heater rebate programs. Figures in the Australian Treasury's *Intergenerational Report 2010* indicate that 2020 emissions will be reduced by 0.5 million tonnes as a result of the Federal water heater rebate.[234]

While these programs have reduced emissions quickly, the result is small, and will be overwhelmed by the compulsory phase out of electric storage water heaters, which will reduce emissions by nearly five million tonnes a year by 2020.[235]

[229] DCCEE (2010a); DCCEE (2011b)
[230] Australian Government (2010a)
[231] IPART (2009b)
[232] Hot water systems generate around 25-30 RECS: Green Energy Markets (2010b). REC values vary over time, but have averaged between $30 and $40: Daley and Edis (2010)
[233] Green Energy Markets (2010b)
[234] Treasury (2010)
[235] Wilkenfeld (2009)

3.3.4 Cost-effectiveness

Estimating the cost per tonne of CO_2-e delivered by these programs is complicated by the various overlapping policies and programs.

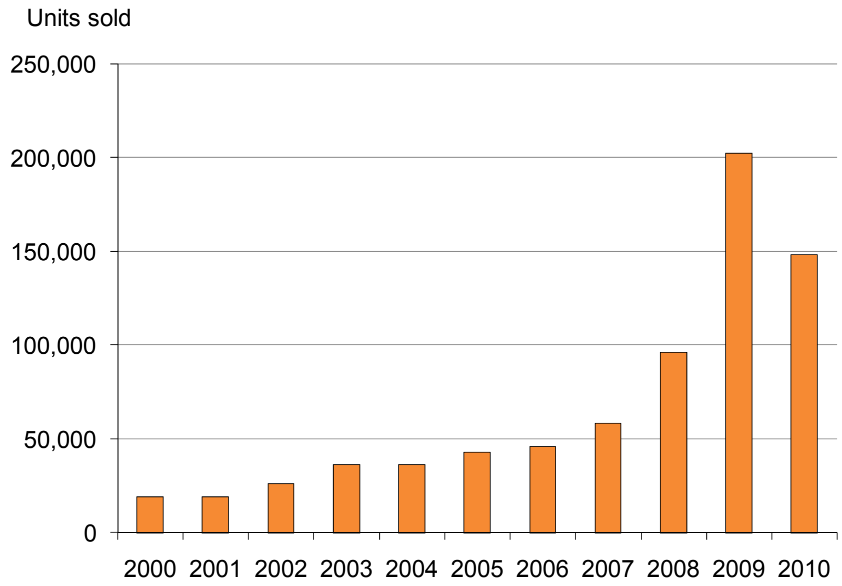
Taking into account both private and government costs and benefits, the cost of abating a tonne of CO_2-e through replacing a conventional electric water heater with a solar heater is relatively low between $0-$30. There are net savings when heat pumps are installed, so that CO_2-e costs less than nothing to reduce.[236] Where piped gas is available, switching from electric to conventional gas water heater system provides even greater net savings.

However the cost to the taxpayer of inducing this abatement is quite high at around $83 per tonne of CO_2-e (even though there are offsetting benefits flowing to private individuals). The federal rebate combined with renewable energy certificates add up to around $2500 of subsidy per system which will abate around 30tCO_2-e over its lifetime. Taking into account the State government rebates (which could often be obtained in addition to the Federal Government rebate) increases the cost of government subsidy to around $100 per tonne of CO_2-e.

3.3.5 Building industry capacity

Sales of solar and heat pump systems increased significantly from mid-2007 when rebate support became substantial. Sales tailed off in 2010 when rebate support was scaled back, as shown in Figure 3.4.

Figure 3.4 Annual solar and heat pump system installations



Sources: Data for 2000 to 2006: Business Council for Sustainable Energy (BCSE) (2007); 2007: Green Energy Markets (2009); 2008: Wilkenfeld (2009); 2009-2010: Green Energy Markets (2010b)

Solar and heat pump systems now comprise up to a quarter of annual water heater sales in Australia,[237] compared to just 5% in 2001. Systems are now offered by all the major hot water system suppliers. They have become a standard part of their business

[236] Wilkenfeld (2009)

[237] Green Energy Markets (2010b)

operations rather than a specialty item.[238] Plumbers have gained greater familiarity with their use and attributes, and their installation skills have improved, reducing barriers to their use. Several new entrants have established positions within the Australian water heater market, enhancing competition and choice for consumers.[239]

3.3.6 Issues in delivery

High cost to the taxpayer

Taking into account both private and public costs and benefits, solar and heat pump water heaters are a cost-effective abatement technology. The electricity cost savings are greater than the cost of the replacement system. However customers often baulk at the up front costs. Customers with a failed system may also be reluctant to wait to select and install a lower emissions system.[240]

Inducing customers to overcome these barriers has required large government subsidies for solar and heat pump water heaters.

Poor policy choice

Considering the substantial private benefits flowing from solar and heat pump systems, the compulsory phase-out of conventional electric systems is a better model for driving change than providing substantial taxpayer-funded subsidies.

To illustrate, phasing out the entire existing stock of 4.2 million conventional electric water heaters via a $2500 subsidy, would impose a cost on the taxpayer of over $10 billion between 2010 and 2020.

Inability to set a sustainable price

The Federal government rebate for hot water systems was originally set in 2007.

The Rudd Government subjected the rebate to a means test, then increased it to $1600 in February 2009 as part of its stimulus plan, and removed the means test.[241] In September of that year it changed tack again and reduced the rebate for both heat pump and solar hot water systems to $1000. In February 2010 it further cut the rebate for heat pump systems to $600.[242]

Sudden policy changes undermining industry capacity

Hot water heater rebates have changed abruptly, making it difficult for businesses to plan and invest. The total amount of rebate support per system taking into account federal and state government programs has varied by thousands of dollars over the space of a few months. This variance flowed through to system sales which grew by 64% from 2007 to 2008 and then by 110% in 2009 before crashing by 26% in 2010. Such abrupt changes both up and down make it difficult for businesses to make long-term commitments to hire and train new staff and invest in new production capacity.

[238] Pers comm. Rheem Pty Ltd (2009)
[239] Pers comm. Brazzale (2010)
[240] Wilkenfeld (2009)
[241] Commonwealth of Australia (2009)
[242] DCCEE (2010a)

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