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Renewable electricity in Australia: outcomes and prospects

October 2011

A Report for

EUAA
ENERGY USERS ASSOCIATION OF AUSTRALIA

EXECUTIVE SUMMARY

Since 2002, Australian governments have implemented policies to subsidise renewable energy. The Australian Government is in the process of legislating a number of new policies to promote the development of renewable electricity generation. This means that significant additional funds are likely to be directed at the subsidy of renewables.

To date, some of the renewables subsidy has been provided through government budgets although it is electricity users, through their bills, that have so far paid the greatest share. The main subsidy mechanisms are federally administered mandatory obligations to purchase renewable energy (which was introduced in 2002) and state government feed-in tariffs which were generally introduced from 2009 onwards and are now being wound back.

The subsidies provided through these schemes have grown rapidly over the last decade so that they are now having a significant effect on electricity prices. Electricity users are concerned about this. The Energy Users Association of Australia (EUAA) commissioned this report to examine what has been achieved, what it has cost, and what lies ahead.

Renewables subsidy policies led to average retail electricity prices in 2010 being around 2% higher than they otherwise would be. However the price impact is expected to rise significantly following the implementation of the Small Scale Renewable Energy Scheme (SRES) from 1 January 2011, and the expanding Large Scale Renewable Energy Target (LRET). It is impossible to be certain how these will affect average electricity prices in future but it is plausible that these policies will lead to average electricity prices in 2012 being 10% higher than they otherwise would be, with further significant increases in the period to 2020.

Our estimate is that around $12bn of subsidy has been paid or is payable for renewable capacity that was added between 2001 and the end of 2010. Electricity consumers will bear around 87% of this amount with the remainder borne by governments.

A conclusion of the analysis in this report is that in the period to the end of 2010, in terms of emission reduction or renewable energy production, there is little to show for subsidies that have been paid. In other words, the greenhouse gas abatement that will be achieved through renewable subsidies has so far come at considerable expense. Specifically, we estimate that for renewable plant commissioned by the end of 2010, each tonne of CO2-e emission abatement that that plant will achieve over its life has required $76 of subsidy. This can be compared to a proposed emission tax of $23/tonne.

The high abatement cost is largely attributable to the fact that the least efficient technologies have attracted a disproportionate share of the subsidy. Around 30% of the total renewables subsidy paid (and payable) for plant commissioned between 2002 and 2010 has been allocated to photovoltaics (PV). Yet over its useful life, this PV will deliver less than 5% of the total renewable energy that will be produced from renewable generation commissioned between 2002 and 2010.

This misallocation of subsidies has also crowded out the development of more efficient renewable generation. This is a loss for energy users who are bearing most of the subsidy, and also for prospective developers of more efficient renewable plant.

The report suggests four reasons for these failures: unresolved conflict between the goals of industry development and lowest cost emission reduction; insufficient policy development; failure to allow market forces to determine the allocation of subsidies; and state government / Commonwealth Government co-ordination difficulties.

Looking ahead, mandatory renewable energy targets are rising sharply. The average annual Large scale Renewable Energy Targets (LRET) for the next decade – 23 million Large scale Generation Certificates (LGCs) – is almost 10 times higher than the average annual Renewable Energy Certificate (REC) creation (from LRET-eligible generation sources) in the decade just ended. For the decade from 2020 the average annual number of LGCs that are required to be surrendered will need to almost double again from the level of the previous 10 years, to 41 million LGCs per year.

Will this target be met under the LRET incentive? Our modelling suggests an LGC price of $53 dollars in real terms over the period to 2030 will be needed to ensure that the LRET target is met. Our model estimates that wind generation could contribute 79% of the total LGC supply to 2030. This will require total additional investment in wind generation capacity of 9,950 MW. To put this in context, the current installed electricity generation capacity in Australia is 49,000 MW, of which 12,000 MW was added over the twelve years from 1998 to 2010.

It is possible to hold different views on LGC creation from biomass, solar, geothermal and hydro. But, based on current information, there is limited scope for radical differences on the growth of generation from these sources: the technical and economic potential of these renewable generation resources in Australia seems to be limited at least to 2020, and probably to 2030. This means that based on currently known technologies, wind generation is likely to need to expand to produce 70% to 90% of the total volume of renewable generation in order for the LRET target to be met.

On the basis of this analysis, the question of whether the target will be met seems to depend on whether the wind generation industry will be able to expand from its current size of 1,870 MW to around 11,800 MW by 2020. This would require a six-fold increase in less than 10 years. The capital required to achieve this – around $30bn – is about four times the total capital that has been invested in generation capacity in the National Electricity Market over the last decade.

There will be considerable demand for supporting infrastructure and logistics including transportation and handling equipment, tower and blade constructors, civil and electrical contractors. Many environmental and development approvals will need to be obtained, and hundreds of community consultations will need to be successfully negotiated to address local objections to supposed or real loss of amenity, noise pollution and so on. Moreover, significant transmission grid expansion and extension may be needed to meet the needs of this capacity, with concomitant need for planning, environmental and economic regulatory approvals. It should be obvious from this, that even if the economics for renewables expansion are favourable, developing the industry at this rate will be an extraordinary achievement in a market economy with a community that has a sophisticated understanding of its civil and environmental rights.

Looking ahead, the Government's Climate Change Action Plan has proposed changes that could significantly affect the development of renewables:

- The Clean Energy Finance Corporation (CEFC) will invest in renewable generators, enabling technologies, energy efficiency and low-emission technologies. The Government has committed $10bn to fund it, although it is not yet clear what form this funding will take. Half the funding will be set aside for renewable energy generators, while the other half is set aside for enabling technologies, energy efficiency and low-emission technologies, although some part of this other half may also be directed to renewable generators. The CEFC will provide funding through commercial loans, concessional loans, loan guarantees and equity. Capital will be reinvested in the CEFC although dividends may also be used to fund the Australian Renewable Energy Agency.

- The Australian Renewable Energy Agency (ARENA) will be a statutory authority whose main task will be to provide grants supporting research, development, demonstration and commercialisation of renewable energy technologies. It combines a number of programs and organisations that together are able to provide $3.2bn in funding. It may also receive dividends from the CEFC and possibly some of the funds currently allocated to the Jobs and Competitiveness Program.

The CEFC is a major announcement not least in terms of the significant financial contribution ($10bn over five years) that has been made to it. It will be very important that there is careful consideration of the purpose of the CEFC, and how it will decide between the conflicting objectives (e.g. least cost emission reduction versus industry development) that it is likely to be presented with. It will also need to be clear on what the problem is to which the CEFC is the best solution.

From a more narrow perspective of the best interests of energy users, what is to be made of the Government's renewables policies in general and the ARENA and CEFC proposals in particular? The starting point in addressing this question is to recognise that there are different views on whether Australian energy users should be subsidising renewables at all. From the perspective of least cost greenhouse gas abatement, most economists suggest that economy-wide measures such as broad-based taxes or emissions trading schemes are likely to be more efficient than sector-specific subsidies[1]. The Garnaut Review and Productivity Commission have both suggested that renewables subsidies should be directed at overcoming market failures in research and development, rather than in subsidising the production of renewable electricity from market-ready technologies.

These views on the appropriate role of renewables subsidies are not new. They have been expressed in various forms frequently in the past, and seem to be well-founded in policy circles in Australia and elsewhere.

However, subsidies for the production of renewables are well established and growing in many countries. A typical argument for such sector-specific subsidies is that broad-based emission reduction policies have proven to be politically untenable and so governments have no option than to resort to sector-specific "complementary measures" in order to achieve their emission reduction goals, notwithstanding that these are generally agreed to involve higher costs. In some cases, this is in addition to what are widely considered to be relatively ineffective broad-based emission reduction policies.

Substantial renewable production subsidies such as provided through the RET, feed-in tariffs and now possibly also by the CEFC are, by comparison with the approach adopted in other countries, not unusual.

[1] For example a survey of 140 Australian economists by the Economics Society of Australia showed overwhelming support for the Labor Government's proposed tax and subsequent tradable scheme, rather than the Federal Opposition's sector-specific policies.

In this context, where does the best interest of electricity users lie? This report does not purport to present a consensus (or even majority) view of energy users on this issue. The community of energy users has widely differing views on the wisdom of renewables subsidies. They find common ground in their opposition to poorly designed and implemented policies whose costs they are forced to bear.

Our view is that while there are well-founded concerns about the inefficiency of sector-specific subsidies, such subsidies are not *necessarily* contrary to the interest of electricity users. If the benefits that users derive from the renewables subsidy (such as reduced exposure to volatile and rising fossil fuel and emission prices) exceeds the costs that users bear in acquiring those benefits, then renewables subsidies are in energy users' interests. For example, the Department of Energy and Climate Change in Britain has estimated that the U.K. power industry (and by extension its customers) will save 8.9 billion pounds because so-called contracts-for-difference-feed-in tariffs will encourage new renewable energy generation that will cut the need for carbon permits.[2]

While the analysis in this paper has concluded that up to the end of 2010 Australia's renewables subsidy policies have been costly and at users' expense, the point is that this need not always be the case. With different policy settings, users could, possibly, be net beneficiaries from the subsidy of renewables. At the least, energy users' best interest is that governments pay for those benefits that arise from the subsidy of renewable generation, but which energy users are not able to capture (such as subsidised job creation and industry development).

Finally, where energy users are asked to bear subsidies for renewables, government should be encouraged to design subsidies that maximise efficiency (i.e. that maximise the production of renewable electricity/greenhouse gas abatement per dollar of subsidy provided).

[2] Reported in Bloomberg New Energy Finance, 14 July 2011.

Table of Contents

Table of Figures

Table of Tables

1 Introduction

Since 2001, Australian governments have implemented policies to provide budgetary and energy user support for renewable energy. Through mandatory obligations to purchase renewable energy and the introduction of feed-in tariffs, these subsidies have grown rapidly over the last decade so that they are now having a significant effect on electricity prices. The level of subsidy of renewable energy sources is projected to continue to rise sharply in the coming years. Electricity users are concerned about this.

It is in this context that the Energy Users Association of Australia (EUAA) has commissioned Carbon Market Economics (CME) to examine what outcomes Australia's renewable energy policies have delivered. The report also examines future prospects for the development of renewables and finally examines renewable energy announcements in the Government's Climate Change Action Plan from the perspective of energy users.

The report starts with an examination of how much subsidy has been paid to renewable energy producers and who has paid it. It also examines where the money has gone, and what it has delivered in terms of new renewable generation capacity, electricity production from that new capacity and greenhouse gas abatement. This analysis provides the basis for conclusions on where policy has succeeded and failed. The last section examines the prospects for the development of renewables and considers energy users perspectives on this.

2 Outcomes to-date

This chapter describes the outcomes of Australia's renewable energy subsidies, as at the end of 2010. The chapter begins by summarising relevant details of the main renewable energy subsidies. It then presents a calculation of the source and application of renewable subsidies for plant that has been commissioned by the end of 2010. The next section analyses what these subsidies have delivered in terms of additional renewable energy capacity and energy and greenhouse gases abatement. The sections after this examine how renewable energy subsidies are likely to affect future electricity prices and whether the main policies will achieve the stated objective that 20% of Australia's electricity supply should come from renewable electricity by 2020.

The main subsidies

Subsidy schemes can be distinguished between those that provide capital grants and rebates, and those that provide on-going subsidies based on actual renewable energy production.

The capital grant and rebate schemes include:

- Jurisdictional governments (and the Commonwealth Government) provide rebates for the installation of solar water heaters. Such rebates are contingent on many factors but are mostly to incentivise the replacement of electrical (or inefficient gas) water heaters with heat pumps or solar water heaters. The cost of the rebates is borne by the jurisdictional governments.
- The Commonwealth Government has a variety of research, development and deployment grant programs, projects initiatives and institutions, although limited funding has been provided through these so far.[3]
- The Small Scale Renewable Energy Scheme (SRES), which provides a grant of $40 per unit of renewable energy that small scale technologies (mainly photovoltaics, solar water heaters and heat pumps) are deemed to produce over their useful life. The production of electricity by a small scale generating units is multiplied by a variable factor, in order to magnify the subsidy provided. This factor is 3 from 1 July 2011 and reduces to 2 in 2012 and 1 from 2013. There is no limit to the aggregate subsidy provided under this scheme. The costs of the scheme are collected from energy users (through their retailers). Although the government does not describe this subsidy as a rebate, it has all the characteristics of a rebate and so is described as such in this paper.

[3] Garnaut Climate Change Review – Update 2011. "*Low emissions technology and the innovation challenge*"

The production subsidy schemes include:

- The Large Scale Renewable Electricity Target (LRET). This is a mandatory tradable obligation quota. Energy retailers and other large electricity users are required to procure a specified volume of Large Scale Generation Certificates (LGCs) every year to 2030, and surrender these to the Commonwealth Government. Some emission-intensive trade-exposed industries are given partial relief from this obligation. LGC's can be banked and are freely tradable not just by the entities that are required to surrender them.

- Feed-in Tariffs (FiTs): Most jurisdictional governments provide operational subsidies through FiTs to small scale PV plant. The funds for this are collected from energy retailers and the costs – including the costs of changes to the distribution network and for the administration of the subsidy scheme – are recovered from electricity users. The rate and type of subsidy varies by jurisdiction. At the time of writing, several jurisdictional governments are reducing the subsidy provided through their feed-in tariffs.

2.1 Source and application of funds

The calculation of the subsidy that has been paid (and is yet to be paid) to renewable energy developers is unavoidably complex and subjective. The subsidies provided through the LRET and feed-in tariffs are paid over many years. The future level of subsidies provided to plant developed before the end of 2010, is not certain because the price of LGCs and continuity of feed-in tariffs in uncertain. The calculation of the subsidy requires an analysis of future outcomes of many uncertain variables including LGC prices, conventional electricity prices, production volumes and so on. Our analysis of this reflects our collection of detailed information on the various schemes and is informed further by our professional judgment on many of these uncertain variables. This has been supported through the use of analytical models that we have used in other consulting assignments, to understand the future of Australia's renewable energy market. In the interests of transparency, the notes in Appendix A describe the data sources, assumptions and analytical approach used in the calculations.

The outcome of the analysis in Table 1 shows which renewable technologies have received what amount of subsidy so far, and how governments and energy users are funding those subsidies. A highlight of the main points are set out in Figures 1 to 3.

Figure 1 shows the source of renewables subsidies as between electricity users and government.

Figure 1. Subsidy allocation between electricity users and government ($million)

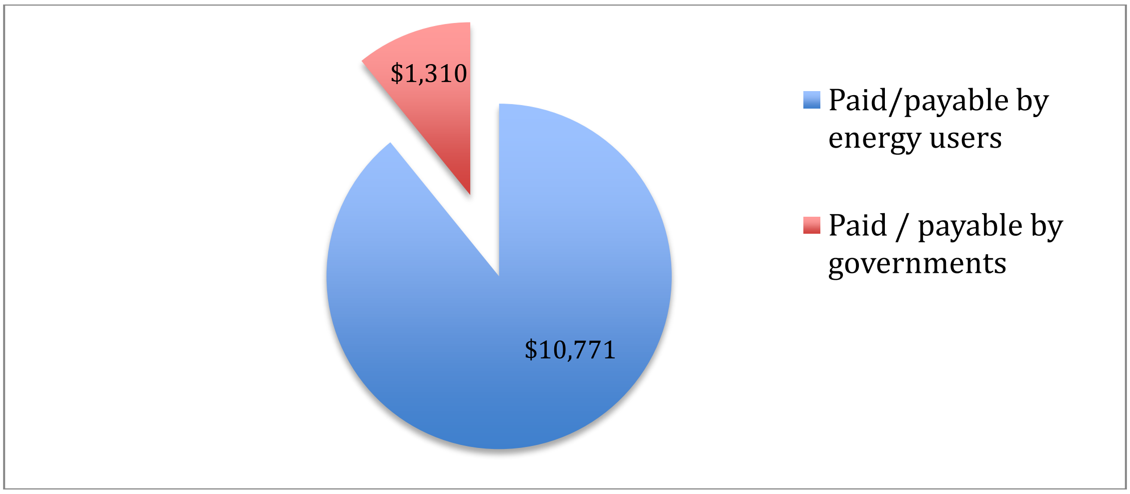


Figure 2 shows what proportion of the total subsidy available to plant commissioned between 2001 and 2010 has already been received, and what amounts are yet to be received through feed-in tariff payments or the sale of LGCs to be produced in future.

Figure 2. Subsidies already received and yet to be received ($million)

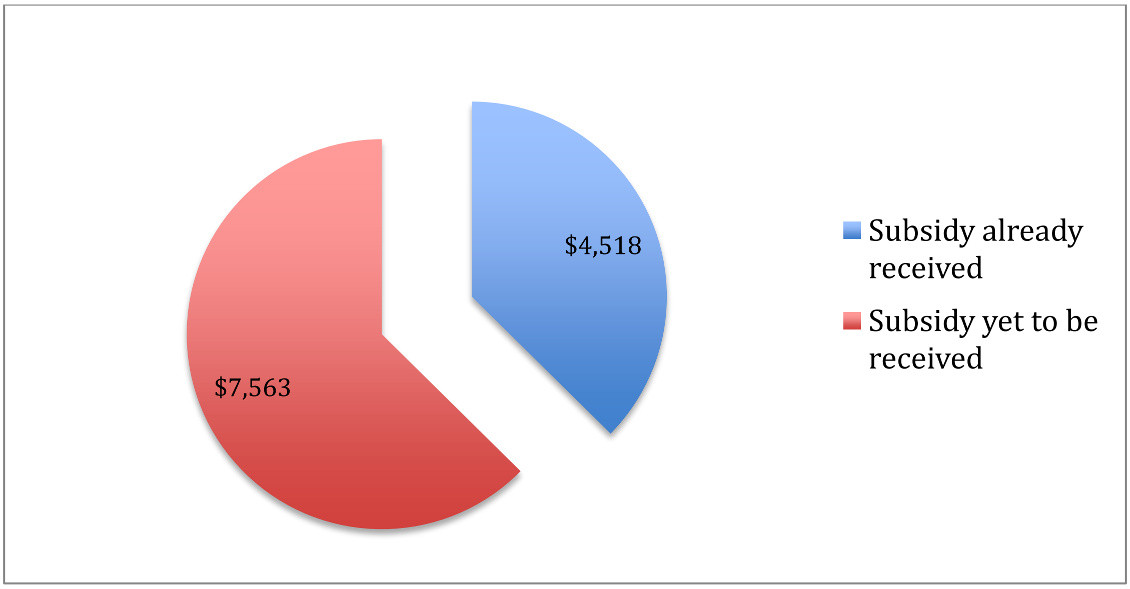
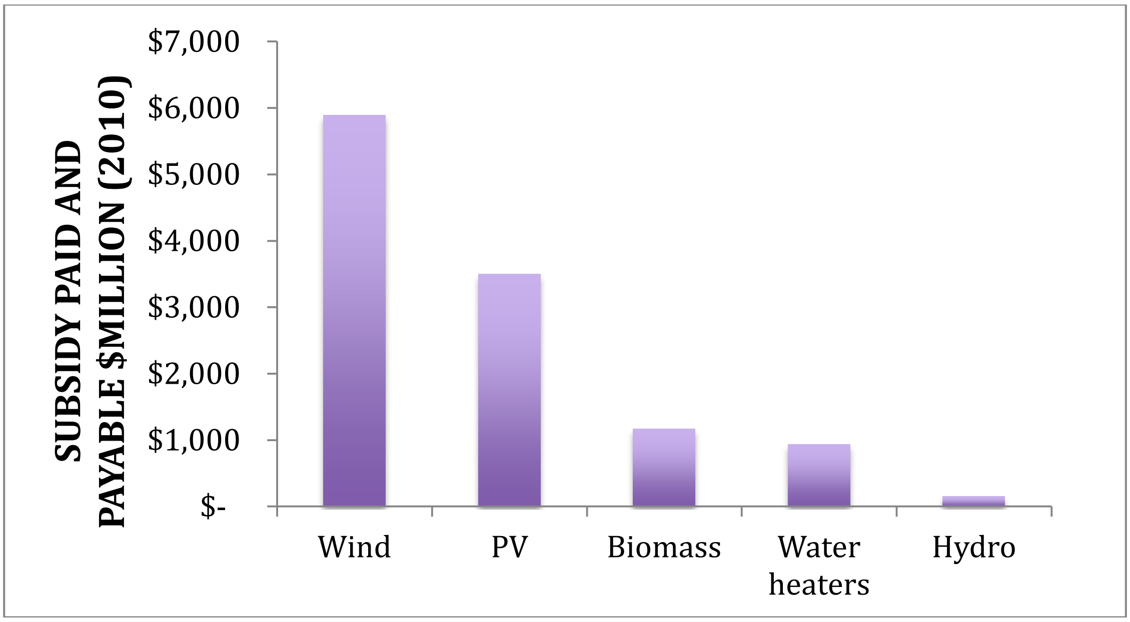


Figure 3 shows how the subsidy for plant commissioned between 2001 and the end of 2010 is divided amongst renewable technologies.

Figure 3. Subsidy allocation among renewable technologies



The rows of Table 1 show the source of funds distinguishing between energy users and governments:

> The first row of the Table shows the subsidies that energy users have already accrued for plant that has been installed by the end of 2010. In other words this is the amount of the subsidy that renewable energy producers have already received for the renewable energy production in the period to the end of 2010. Not all of this amount has yet been recovered from electricity users.
>
> The second row shows the present value of the subsidies that energy users have yet to be charged for subsidies provided under feed-in tariff schemes and the large scale RET.
>
> The third and fourth rows of the table show the subsidies that the Commonwealth and jurisdictional governments have already incurred for plant operational by the end of 2010. Since governments are not exposed to any further future subsidies for plant brought into operation after the end of 2010, the present value of such future subsidies is zero.

The columns of the table show the application of funds to different renewable energy technologies under the RET, feed-in tariff and rebate subsidy schemes.

Table 1. Source and application of subsidies for renewable plant commissioned between 2001 and the end of 2010

Source of funds (rows) / Application of funds (columns). All 2010 $millions.	Renewable Energy Target					Feed-in tariffs	Rebates			Sub-TOTAL	TOTAL
	Hydro	Wind	Water heaters	PV	Biomass	PV	Jurisd-ictional water heaters	Cwlth - water heaters	Cwlth - small generators		
Already accrued to energy users	$ 16	$ 828	$ 933	$ 1,003	$ 244	$ 185				**$ 3,208**	
To be charged to energy users	$ 135	$ 5,062	$ -	$ -	$ 927	$ 1,440				**$ 7,563**	**$ 10,771**
Paid by Commonwealth Government								$ 264	$ 868	**$ 1,132**	**$ 1,310**
Paid by jurisdictional governments							$ 178			**$ 178**	
TOTAL	$ 151	$ 5,889	$ 933	$ 1,003	$ 1,170	$ 1,625	$ 178	$ 264	$ 868	**$ 12,082**	**$ 12,082**

The main observations from Figures 1 to 3 and Table 1 are as follows:

1. The level of subsidy paid and payable for plant installed by the end of 2010 is very significant. The total - $12.1bn - is about 50% more than the average annual value of electricity produced and sold in the National Electricity Market (NEM).
2. Energy users are bearing by far the greatest portion of the subsidy, compared to governments. They have paid or will pay a total subsidy of $10.8 bn ($3.2 bn already received and a further $7.6 bn to be paid), compared to only $1.3 bn for all Governments. Hence, about 87% of the total subsidy to renewable energy will be paid for by energy users.
3. The greatest volume of subsidy so far has been directed at PV, but wind and biomass are expected to receive a greater amount of subsidy from their future production than PV. A significantly greater proportion of the subsidies due to wind, biomass and hydro plant installed by the end of 2010, will be paid between 2011 and 2030, compared to the amounts that have already been paid. By contrast, PV and particularly solar water heaters have received the greatest amount of their subsidy already.

2.2 Impact on electricity prices

Up to the end of 2010, the impact of the RET on electricity prices has been relatively benign. In 2010, the Renewable Power Percentage (RPP) was 5.98% - in other words liable entities needed to surrender RECs corresponding to 5.98% of the electricity that they retailed (or purchased). At an average price of $35 per REC, this added around $400m to the nation’s electricity bills. This is equivalent to around 5% of the wholesale price and a little over 2% of the average retail price.

However it is important to understand that there is a significant difference between the amount that electricity users have already paid for renewable electricity and the amount that they are yet to pay for renewable plant commissioned between 2001 and 2010. Figure 1 and Table 1 showed that electricity users have so far accrued charges for renewable electricity that are worth around $3.2bn, and that a further $7.6bn (present value) of subsidy will be payable over the next 20 years for renewable plant that had been commissioned by the end of 2010.

Our calculation is that electricity consumers have so far paid $2.13bn of the $3.2bn that has already been awarded to renewable energy plant between 2001 and 2010. The accumulated REC surplus at the end of 2010 – around 33 million RECs, valued at a price of $35 per REC accounts for most the difference that renewable generators have been awarded and the amount that energy users have been charged. REC-eligible renewable plants commissioned before the end of 2010 have created this surplus and either hold it as an asset or have sold it to others. The ability to bank RECs has deferred the payment (by electricity users) for this surplus REC production. It will be charged to energy users as the surplus is consumed as a result of the rising mandatory (LRET) target.

Other reasons for the differences in the costs calculated in Table 1 and the revenues that have so far been recovered from users, include delays in the recovery of feed-in tariff premia. Table 1 shows that energy users will be charged another $1.44bn (in present value) under PV feed-in tariffs for plant commissioned by the end of 2010.

In addition, there are other administrative and network related costs related particularly to feed-in tariffs that users will be required to bear through their regulated network charges. These costs are likely to rise to several hundred million dollars, although a precise calculation at this point in time is impossible.

Finally, the actual cost of RECs that has been recovered from users is not clear. Competing retailers - where retail price caps do not apply - may seek to recover more than the costs that they pay for RECs if they find this to be a commercially advantageous strategy. The opportunity for this to occur would arise where there is less competition in retail markets and/or where consumers are not as informed about the operations of the REC market. As such, the actual cost of RECs and the feed-in tariff premium that energy users are paying may be substantially more than the wholesale price of RECs and feed-in tariffs that renewable energy producers are receiving.

Future price impacts

Table 1 showed the subsidies for renewable plant that had been commissioned by the end of 2010. This showed that around $7.6bn has yet to be recovered from energy users over the next 20 years, for that plant. In addition to the recovery of this, the subsidy of renewable energy (and hence impact on electricity bills) can be expected to rise substantially for the foreseeable future. There are several reasons for this:

- The creation of the SRES with a fixed price and no banking means that users will pay for the subsidies provided to small scale renewable energy sources much closer to the time that these subsidies are paid to the producers. For example, the introduction of the SRES in 2011 will result in the recovery of around $1.2bn from energy users in 2011 for the subsidy of water heaters and residential PV alone. This is around 40% more than the total amount that was recovered from electricity users in 2010 under the RET.
- The LRET will continue to increase significantly. The Renewable Power Percentage (RPP) in 2012 can be expected to be around 8.8%, compared with 3.6% in 2010. The RPP is scheduled to continue to rise to at least 16% by 2020.

- The LGC price can be expected to increase since the annual supply of LGC is likely to fall well short of the annual LRET and Green Power demand for LGCs.[4]

While the increase in the LRET demand is known, it is difficult to be certain on the rate of increase in electricity prices since this will also depend on the price of LGCs and the rate of growth of small-scale renewable technologies subsidised under the SRES.

Our analysis is that the price of LGCs will need to rise significantly from their current spot price levels around $40/LGC to more than $53 per LGC and be maintained at this level in real terms for the life of the RET in order to provide sufficient incentive for renewable energy investment needed to meet the LRET target.

If LGC prices reach this level, the impact of this, combined with the impact of a significantly larger LRET target and continued high demand for SRECs will lead to significantly higher electricity prices. For example if SRES demand in 2012 is the same as it was in 2010 and LGC prices rise to $53 then the total subsidy provided by the LRET and SRES in 2012 will equal $2.1bn, about five times more than was raised through the RET in 2010. Assuming liable electricity demand of 200 TWh in 2012, this is equivalent to an average cost of the subsidy to electricity users of around $10.50/MWh. This would add around 25% to the current average wholesale price or 10% to the average retail price of electricity.

2.3 Outcomes

This subsection examines what the subsidies have delivered (and will deliver) in terms of additional renewable generation capacity, renewable energy production and greenhouse gas abatement.

[4] For example in 2010 the supply of RECs from sources other than water heaters and PV was 10.8 million. This compares to an LRET of 16.3 million LGCs in 2012 and additional Green Power demand that can be expected to be exceed around 2.5million LGCs. In other words to meet the LRET and Green Power demand the supply of LGCs will need to approximately double in two years. This must surely be highly unlikely.

2.3.1 Capacity

Table 2 shows the additional renewable capacity installed between 2001 and 2010.

Table 2. Additional renewable capacity installed between 2001 and 2010

Renewable generation	MW installed by end 2010
Wind generation	1878
Photovoltaics	373
Biomass	245
Hydro	180

The total additional capacity (2,676 MW) compares to installed capacity of renewable generation in 2000 of around 8,300 MW. Some of this renewable capacity – such as the 140 MW Capital wind farm - has actually been developed to meet Green Power demand, and as such should not be counted as investment that has been incentivised by the Governments' renewable energy policies.

In addition to renewable electricity generators, between 2001 and 2010 more than 599,000 solar water heaters and heat pumps have been installed. Most of these have been installed in new homes pursuant to building regulations. All eligible solar water heaters and heat pumps are able to create RECs, but only some – generally replacement water heaters – also receive rebates.

The Department of Climate Change and Energy Efficiency informed us that between September 2007 and February 2011, $264m of rebate had been paid to 193,000 households for the installation of solar water heaters or heat pumps, an average of $1,386 per household. Sustainability Victoria informed us that in 2009, $12.1m of subsidy was paid to 6,810 households in Victoria for the installation of solar water heaters or heat pumps, an average of $1,777 per household. Data for the water heater rebates for other years was not available and neither was data for the rebates paid in other jurisdictions. However extrapolating the Victorian rebates (based on the percentage of water heaters that were eligible to receive rebates in Victoria as a percentage of total water heaters installed) produces an estimate of total water heater rebates paid by jurisdictional governments between 2001 and 2010 of $173m. However this figure should be considered to be a rough estimate and so is not used in further analysis in this section.

By comparing the subsidies accrued and payable (in Table 1) with the figures on the capacity additions (in Table 2), the subsidy dollars per capacity addition ($/MW) can be derived. These are shown in Table 3.

Table 3. Subsidy dollars per MW added between 2001 and 2010

Renewable generation	MW installed by end 2010	Total subsidy paid and payable ($million)	Subsidy dollar per MW added ($million/MW)
Wind generation	1878	$ 5,889	$ 3
Photovoltaics	373	$ 3,496	$ 9
Biomass	245	$ 1,170	$ 5
Hydro	180	$ 151	$ 1

Table 3 shows that the subsidy calculated per MW of capacity added is the lowest for the small hydro additions, and the highest for PV. PV has nevertheless been allocated the second highest amount of subsidy. Furthermore the subsidy to PV, unlike the subsidies to wind, biomass and hydro have mostly (other than feed-in tariff payments) been paid upfront. To put these numbers in contact, the capital cost of an open cycle gas turbine is around $0.6m per MW.

While the calculation of subsidy per MW installed is important, so is understanding the efficiency of the allocation of subsidies. This is because generators' useful output is energy: their ability to produce energy (their capacity) is much less valuable than their actual production. Therefore the calculation of subsidy per MWh produced – set out in Section 2.3.2 below - is a more significant indicator of efficient allocation than subsidy per MW installed.

2.3.2 Energy

Table 4 shows the total electricity produced and to be produced from renewable energy plant commissioned between 2001 and the end of 2010. The total electricity generation from this plant over its useful life – around 216 TWh - is approximately equivalent to the total electricity currently produced in Australia in one year. The assumptions underlying this calculation are set out in Appendix B.

Table 4 also shows the subsidy paid and payable for this plant, and then expresses the subsidy per MWh produced over the life of the plant. This ratio is a reliable indicator of the relative efficiency of the use of subsidies in delivering renewable electricity. The results in this table suggest that hydro is the most efficient, followed by wind and biomass, in terms of converting subsidies into renewable energy.. To put this level of subsidy into context of current wholesale electricity prices in Australia, the average spot price in the National Electricity Market in the period from 1998 to 2010 was $34/MWh.

PV has required approximately 10 times as much subsidy per MWh produced as the other renewable technologies. In addition it has been allocated around 30% of the total subsidy. This will produced just 5% of the renewable electricity that will be produced for plant commissioned under the RET up to the end of 2010. By comparison, wind generators have attracted around 50% of the subsidy but will produce more than 80% of the renewable energy.

Table 4. Subsidy per MWh of additional renewable energy production for plant commissioned between 2001 and 2010

Renewable generation	Total subsidy paid and payable ($million)	Lifetime electricity production (TWh)	Subsidy dollar per MWh produced
Wind generation	$ 5,889	170	$ 35
Photovoltaics	$ 3,496	10	$ 367
Biomass	$ 1,170	30	$ 39
Hydro	$ 151	6	$ 26

As noted in the previous sub-section, unavailable data has meant that we are not able to include solar water heaters and air source heat pumps in the calculation of subsidy dollar per MWh-equivalent produced.

2.3.3 Greenhouse gas emissions abated

The estimates of greenhouse gas emissions abated largely mirror the estimates of electricity produced. However the subsidy per tonne of greenhouse gas emissions abated is higher than the subsidy per MWh produced since the power system is assumed to progressively decarbonise. This decarbonisation is partly attributed to the higher penetration of renewable energy, but mostly to replacement of coal generation with gas fired generation.

Table 5 shows the subsidy per tonne of greenhouse gas abated for plant commissioned between 2001 and 2010. The most efficient renewable technology in terms of greenhouse gas abatement is hydro, followed by biomass, and wind.

Table 5. Subsidy per tonne of greenhouse gas abatement for plant commissioned between 2001 and 2010

Renewable generation	Total subsidy paid and payable ($million)	Lifetime GHG abatement (MtCO2-e)	Subsidy dollar per lifetime tCO2-e abatement
Wind generation	$ 5,889	103	$ 57
Photovoltaics	$ 3,496	8	$ 435
Biomass	$ 1,170	25	$ 47
Hydro	$ 151	4	$ 36

The weighted average subsidy dollar per tonne of CO2-e abated is $76/tCO2-e.

Again, as noted earlier, unavailable data has meant that we are not able to include solar water heaters and air source heat pumps in the calculation of subsidy dollar per tonne of greenhouse gas abated. The actual abatement cost of water heaters depends on several factors. The most efficient abatement will be achieved when a solar water heater or heat pumps replaces an electric resistance water heater. In this case abatement of around three tonnes C02-e can be expected per year. Such water heaters can be expected to typically receive around $1,000 in subsidy through RECs and an additional $1,000 in rebate payment. In this case, the subsidy dollar per tonne of CO2-e abated is around $56/tonne.

2.3.4 Summary

This section has examined the outcomes that have so far been achieved from Australia's renewable energy policies. The main points of this analysis are as follows:

- Subsidies with a present value of around $12bn have been paid (in part) and are payable in future for renewable generation plant commissioned between 2001 and 2010.
- Energy users are responsible for paying around 87% of this subsidy. The Commonwealth Government has historically funded a significant proportion of the subsidy of PV water heaters. However in future both the Commonwealth and jurisdictional governments will have a much diminished role in funding PV as they have shifted this expense off-budget and onto energy consumers. Government's only remaining contribution will be in respect of funding rebates for water heaters. The Commonwealth has also committed to provide capital grants to large scale solar plants. Besides this, energy users will fund almost the entire renewable energy subsidy.

- The Commonwealth and jurisdictional governments have allocated large subsidies to the most inefficient renewable energy producers. Around 30% of the total subsidy paid and payable has been allocated to PV which is expected to deliver less than 5% of the renewable energy that will be produced from plant commissioned between 2001 and 2010. This is contrary to the objective of least cost emission reduction.

- The price impact to end users of renewable energy subsidies has so far been relatively muted – around 2% increases on what they would otherwise be. But this is expected to rise significantly partly as a consequence of the creation of the SRES (and the inability to bank RECs under that scheme), partly as a result of a rapidly expanding LRET target and partly as a result of LGC prices which will need to rise significantly from current levels if there is to be any hope of attracting sufficient investment to meet the expanded LRET targets. On various assumptions, average wholesale electricity price increases of around 20% and retail electricity price rises of around 8% can be expected in the short term.

2.4 Why are the outcomes inefficient?

This subsection suggests possible reasons for the inefficient outcomes that have been delivered.

Uncertain objectives

Australia's renewable energy policies began under the Howard Government following the introduction of the RET and rebates for PV and water heaters. The stated aim of renewable energy subsidies put in place by that Government was to develop Australia's capacity in renewable technologies so that Australian businesses would be equipped to export goods and services in this nascent industry. In addition to the policies of the Commonwealth, a number of jurisdictional governments also adopted subsidies for water heaters reflecting a desire, we surmise, to promote renewable energies and reduce emissions.

The change of the Federal Government in the 2007 election brought much stronger focus on the promotion of renewable technologies as a contribution to energy efficiency (through use of renewable energy in water heaters) and as a "complementary measure" to promote lower greenhouse gas emission electricity generation. We understand that the term "complementary measure" is meant to convey that the policy works in a complementary way to an emission trading scheme, presumably to achieve things that the emission trading scheme would not, but not in way that assists or complements them.

Industry development and low cost emission reduction are generally mutually exclusive or only weakly linked (at least for the foreseeable future). The pursuit of industry development requires the allocation of subsidies to nascent, early stage technologies to address market failures in the funding of research, demonstration and early development. By definition these early stage technologies are more expensive than market-ready technologies.

The objective of maximising emission reduction through renewable electricity generation is achieved by allocating subsidies to those technologies that have the lowest emission abatement costs. This means allocating subsidy to well-established technologies such as wind generation, that do not require significant research and development funding.

Ultimately, Australia's renewable policies have achieved neither industry development nor emission reduction objectives to any meaningful extent. Instead, as Section 2 showed, PV which has by far the highest cost per tonne of emission abated and which is also a fully developed technology, has received disproportionately more funding than much more efficient technologies like wind. This has provided no meaningful benefit in industry development: none of the subsidy has been directed at overcoming market failures in the research of leading edge technologies. To the contrary, almost all the PV equipment has been imported from Germany or China who have very well developed manufacturing capacity of standard and widely available products. There has been limited domestic economic benefit – mainly through jobs for installers and related service providers in Australia, but to what public purpose? Would such misallocation of subsidies have occurred if conflicting policy objectives had been more clearly resolved?

Insufficient policy development

Renewable energy and job creation enjoys widespread community support in Australia, and even more so when these outcomes can be achieved without raising electricity prices or taxes significantly. The structure of renewable energy subsidies (and specifically the ability to defer the recovery of subsidies from users) have allowed substantial monies to flow to PV thereby creating jobs while also creating a perception that action is being taken on climate change and renewable energy. By banking RECs and through the adoption of jurisdictional feed-in tariffs it has been possible to delay the recovery of the subsidy from electricity users. This was described in Section 2 which showed that renewable technologies have allocated subsidies - that users are required to bear - with a present cost of around $10.7bn, and yet consumers have so far only paid around $2.1bn of this amount, with the remainder to be recovered through future mandatory LGC obligations and feed-in tariff payments. This ability to defer impacts on electricity prices has, until recently, provided little pressure on governments to seriously consider their renewables policies.

The Labor Party's 2007 election commitment to expand renewable electricity to 20% by 2020 (which was largely supported by the Liberal Party, although in a somewhat different format) was a very significant commitment. By any reckoning, achieving it would cost many billions and require great effort from government and industry. The implementation of this significant commitment raised numerous questions: What will it cost and who should bear the cost? What policy instruments should be used to achieve the target most efficiently? How do mandatory obligation schemes like the RET, feed-in tariffs, grants, rebates, tax concessions or guaranteed loans compare? If combinations of subsidy schemes are to be used, how should they work together and which will produce the most efficient outcomes?

These are the sorts of questions that might have been considered in the implementation of this major policy. There is little evidence to suggest they have been given sufficient attention. Major changes to the RET, first to expand the targets in 2008, and subsequently in 2010 to split the scheme into separate large and small technology schemes, were not supported by detailed analysis and there was limited public consultation.

In view of the size of the subsidies, their impact on electricity prices, the economic significance of the energy industry and of greenhouse gas mitigation, perhaps more effort in policy analysis, consideration of different options and greater consultation could have prevented the outcomes that have been delivered and are now expected in future.

Mis-directed markets

As Section 2.1 showed, by far the most significant renewable energy subsidy mechanism in Australia is the Commonwealth Government's mandatory tradable obligation scheme (the LRET), which now only applies to large-scale renewable electricity producers. One of the *apparent* attractions of this subsidy mechanism is that government avoids having to "pick winners" amongst the competing technologies. This is because, through tradable obligation schemes, renewable energy developers ostensibly compete with each other to create LGCs and the technology that does this most efficiently creates the greatest number of LGCs and therefore attracts the greatest volume of subsidy. In this way, in theory, the subsidy is directed to the lowest cost technology. But this is not how it has worked in practice as Section 2.1 has shown. This is because the market has been distorted in a number of ways:

- Water heaters and PV were able to receive all the RECs that they were "deemed" to be able to create over their lives, upfront at the time the water heater or PV was installed. This turned an operating subsidy into a capital subsidy for these technologies, thereby giving them much greater competitive

advantage relative to other renewable technologies (wind, biomass, hydro) that could not do this;
- PV was allowed to earn a multiple of the number of RECs for the renewable electricity that they are deemed to create over their useful lives. Through the multiplier it has been possible to provide a far higher level of subsidy for what is obviously a much more expensive technology;
- Various Commonwealth and jurisdictional rebate, feed-in tariff and grant schemes have distorted the economics of competing technologies and given them a competitive advantage in REC creation relative to technologies that do not receive rebates, grants and so on.

The recent decision to exclude small-scale technologies from a tradable obligation scheme and instead provide fixed rebates, has rectified one of the major distortions affecting the development of more efficient large scale renewable technologies. However, distortions from the most efficient allocation of subsidies remain:

- Large scale solar plant (under the Solar Flagships Program) will receive capital grants in addition to LGCs;
- There will continue to be pressure from nascent (and more expensive) renewable technologies (such as large scale solar, geothermal, some biomass) for preferential treatment and greater subsidy to compensate for the market failures in research and development funding that they face. Their claim could be seen as quite reasonable if the objective of subsidies is to address market failures in research and development funding. But their claims are not reasonable if the purpose of the funding is to achieve abatement at the lowest cost.

The main argument for tradable obligation schemes – that through this approach government does not pick winners – has proved in practice to be unsustainable. Certain types of renewable technologies have enjoyed preferential access to the market, and this has been at the expense of the successful development of other more efficient technologies. It is inevitable that this will continue in future in response to political pressures and also in response to the (understandable) desire to address research and development market failures for nascent technologies. This is an insurmountable problem and suggests that perseverance with a tradable obligation scheme as the centre-piece of the subsidy policy should be seriously questioned.

State / federal co-ordination problems

As Section 2.1 showed, PV has received most funding from Commonwealth subsidy schemes but jurisdictional schemes have also become more significant. The combination of the PV multiplier through the RET and jurisdictional feed-in tariff schemes has boosted growth in PV installation. The quick cancellation and adjustment of jurisdictional schemes, suggests that this outcome was unintended. In this sense, co-ordination failures between the jurisdictions and Commonwealth seem to be at least part of the problem.

3 Prospects

The previous section analysed the outcomes that renewable energy policies have delivered so far. This section looks forward to consider future prospects. It starts by defining the renewable electricity targets. It then analyses investment needed to meet the target. Finally it examines changes to the renewables subsidy arrangements in the Australian Government's recently announced "Climate Change Action Plan".

3.1 What are the renewable electricity targets?

The Government's stated renewable electricity target is that 20% of Australia's electricity will be produced from renewable sources by 2020. However inspection of the targets in the subsidy mechanisms which are meant to deliver this outcome, suggests that the actual targets are less clear.

Jurisdictional government policies

Dealing firstly with the jurisdictions, almost all have feed-in tariffs (FiTs) to encourage the up-take of PV. Most of these FiTs do not have specified volume targets, but there are commitments to review or close access to FiTs once specific quantity levels have been met. In the case of New South Wales, the quantity levels were met (and then far exceeded) much sooner than the Government had expected and the scheme was then closed to new entrants. Further changes are currently being considered.

Jurisdictional government's also contribute relatively small sums to provide rebates for the installation of efficient water heaters when less efficient (mainly electrical resistance) water heaters are replaced in existing dwellings. These subsidy arrangements appear relatively stable and in the broader context are minor.

Finally at a jurisdictional level, most Australian Governments have building standards that are increasingly mandating the installation of solar water heater or air-source heat pumps in new homes. These water heaters are not awarded rebates (other than in Western Australia). Of all the jurisdictional renewable energy policies, it is this mandated building standard requirement that is likely to be having the greatest impact (from the perspective of jurisdictional government policies) on renewable energy development.

Commonwealth Government policies

The actual renewable energy targets in these policies are not entirely clear. The SRES is essentially a rebate scheme with no upper limit on volumes. As such there is no "target" that can be determined from this.

The target for the LRET is clear, and established through legislation and regulation. Following the most recent changes to the target, the total volume of LGCs that must be surrendered over the next 20 years is 607 million (after accounting for a carried-forward surplus of around 33 million RECs at the end of 2010), compared to 46.7 million RECs that were required to be surrendered over the last 10 years.

The conclusion from this is that it is not possible to be sure just how much renewable electricity the Commonwealth Government (and state governments) are seeking to achieve. This uncertainty has developed as a result of policy changes over time:

- First the Labor Party made an election commitment (in the 2007 elections) that 20% of Australia's electricity was to be come from renewable sources by 2020. This was then translated into a demand for RECs – which was calculated to be 45 million in 2020 (on the basis of the assumption that 20% of Australia's electricity supply in 2020 would be 60 TWh and that 15 TWh of renewable generation would be produced from then existing renewable plant, leaving additional demand for 45 TWh of renewable electricity).
- Changes to the RET were made in 2009 to grant PV multiple RECs. The effect of this was to "print" RECs, and thus one REC could no longer be associated with 1 MWh of renewable electricity production as had previously always been the case.
- Then changes to the RET were again made in 2010 to split the small scale sources (principally photovoltaics and water heaters) from other renewable generators. In the process, a downward adjustment was made to the remaining LRET target on the assumption that the small scale rebate scheme would produce an equivalent of roughly 4 million RECs per year. But this has been a drastic under-forecast: in 2010 more than 29 million small scale RECs were produced. In the first six months of 2011 a similar total number of small scale RECs has been created.

The net effect of these changes is that it is now impossible to define Australian's renewable electricity target. The best that can be said with certainty is that the renewable energy policies are targeting a very rapid expansion in renewable energy sources so that at least 607 TWh of electricity will be produced from large scale renewable sources in the period between 2011 and 2030, and an indeterminate amount of small scale renewable energy capacity will be added.

3.2 Investment requirement

The previous section concluded that there is now no target for small scale renewable energy producers and hence the question of whether the target will be met for these is not relevant. For large scale renewable electricity producers, the questions are whether:

- the target of producing 607 TWh of renewable electricity between 2011 and 2030 will be met; and
- whether the annual profile of this target will be met.

The Australian Government's renewable electricity targets have so far been met – so much so that a surplus of 33 million RECs - equivalent to around three times the mandated REC demand for 2010 has been built up. However, after deducting the RECs created by water heaters and PV, the cumulative surplus of RECs created by the end of 2010 (33 million) becomes a cumulative deficit at that date, of 21 million. This deficit is almost half the total number of RECs that were required to be surrendered between 2001 and 2010. Furthermore, the size of the deficit has been growing rapidly – more than doubling between 2009 and 2010. The conclusion to draw from this is clear: the RET has failed to stimulate large-scale (more efficient) renewable electricity development, as it is intended to do. These technologies have been crowded-out mainly by PV and less so, solar water heaters.

This historic under-performance has been in the context of relatively low mandatory targets. The average annual REC creation from 2001 to 2010 from sources eligible for RECs under the LRET scheme, has been 2.56 million RECs per year. By comparison, the average number of RECs that these eligible technologies will be required to produce for the next 10 years (2011 to 2020) is 23 million RECs per year – almost 10 times higher. For the ten years after that (2020 to 2030) the average annual number of RECs that are required to be surrendered will need to almost double again to 41 million RECs per year.

Will this target be met under the LRET incentive? To model LGC creation in future we have developed an equilibrium model that uses an economic criterion to decide whether investment in wind generators would be financially viable (i.e. whether the discounted present value of future revenues from the sale of LGCs and electricity production exceeds the present cost of the wind farm). Adding assumptions on LGC creation that is likely from large scale solar, geothermal and hydro it is possible to calculate the LGC price needed to ensure that the aggregate supply of RECs between 2011 and 2030 will match the aggregate demand for LGCs (from LRET and Green Power) over this period. Appendix C describes the model in further detail.

The result of this modelling is that an LGC price of $53 dollars in real terms over the period to 2030 will be needed to ensure that the LRET target is met. Other important outputs from this analysis are that:

1. Biomass based electricity generation is calculated to contribute 5% of total LGC production. This relies on the assumption that annual LGC creation from biomass rises about three fold from 2 million RECs per year in 2010 to 7 million LGCs per year in 2030.
2. Geothermal and large scale solar contributes 1% of the total LGC production. This relies on the assumption that the Commonwealth Government's Solar Flagship project succeeds. The low contribution from geothermal reflects the fact that there is not even one hot fractured rock geothermal project that is close to demonstration project status, despite the high hopes that geothermal developers have had for many years. As the incentive provided through the LRET declines over time (there are fewer remaining years to earn LGCs) it must surely be unlikely that geothermal will be able to make a meaningful contribution to the LRET unless major technology and cost challenges are overcome in the next few years. On the evidence available to us, this seems unlikely.
3. Hydro generation contributes 5% of aggregate LGC supply. This assumes that average hydro LGC creation in the period from 2011 to 2030 – 1.5m LGCs per year – is equivalent to its average annual output in the period from 2001 to 2010.
4. Wind generation contributes 79% of the total LGC supply to 2030. This will require total additional investment in wind generation capacity of 9,950 MW. To put this in context, the current installed generation capacity in Australia is 49,000 MW, of which 12,000 MW was added over the twelve years 1998 to 2010.

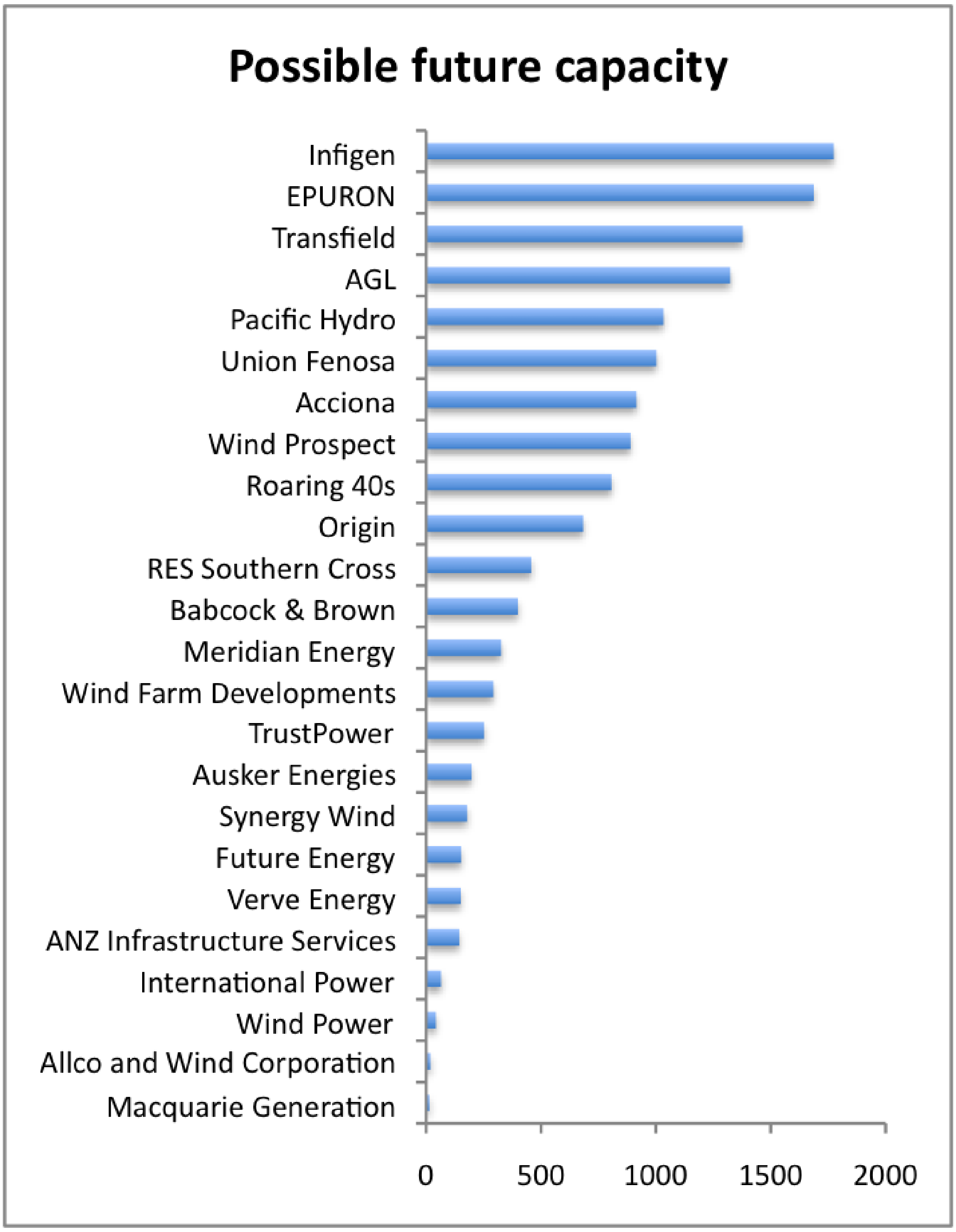
It is possible to hold different views on LGC creation from biomass, solar, geothermal and hydro. But there is limited scope for radical differences on these assumptions: the technical potential of these renewable generation resources in Australia seems to be limited at least to 2020, and probably to 2030. This means that based on technologies that known about today, wind generation is likely to need to expand to produce 70% to 90% of the total volume of renewable generation in order for the LRET target to be met.

On the basis of this analysis, the question of whether the target will be met seems to depend on whether the wind generation industry will be able to expand from its current size of 1,870 MW to 11,800 MW by 2020. The capital required to achieve this – around $30bn – is about four times the total capital that has been invested in generation capacity in the National Electricity Market over the last decade.

There will also be an enormous demand for supporting infrastructure and logistics including transportation and handling equipment, tower and blade constructors, civil and electrical contractors. Many environmental and development approvals will need to be obtained, and hundreds of community consultations will need to be successfully negotiated to address local objections to supposed or real loss of amenity, noise pollution and so on. Moreover, significant transmission grid expansion and extension may be needed to meet the needs of this capacity, with concomitant need for planning, environmental and economic regulatory approvals.

Is there any evidence that the Australian wind industry is prepared for this rate of expansion? Our project database lists more than 19,000 MW of possible future wind developments. These have been ranked by plant developer in Figure 4.

Figure 4. Prospective capacity (MW) ranked by known prospective wind developers



If such a long list of prospective developers is taken to be indicative of possible future supply then there may be little to worry about: supply should easily rise to meet demand. However, the majority of these are highly speculative projects from under-capitalised, opportunistic developers. Many of the named developers have little intention of actually developing plant, but rather intend to on-sell development opportunities, or may act as contractors, service providers or suppliers to other developers. Amongst the list of prospective developers it is hard to identify many that would have the financial capacity and resources to actually develop significant tranches of new capacity.

Furthermore, the economics of wind development has yet to become attractive. Average spot prices in the electricity market are currently around $40/MWh. Even after adjusting for higher spot prices, a $25/tonne emission price may bring, LGC prices would need to rise to at least $53 and be sustained at this level in real terms for the next 20 years to make investment in wind generation financially attractive. With spot REC prices currently around $40 per LGC, there is likely to be a reasonable gap to be bridged for many wind farms.

This analysis pre-dates the recent announcement of the Clean Energy Financing Corporation and the re-organisation of the delivery of government funded research, development and deployment through the Australian Renewable Energy Agency. These significant developments are discussed in further detail below.

3.3 Developments announced in the Climate Change Action Plan

3.3.1 The Clean Energy Finance Corporation

The CEFC will invest in renewable generators, enabling technologies, energy efficiency and low-emission technologies. The Government has committed $10bn to fund it, although it is not yet clear what form this funding (eg, debt and equity) will take. Half the funding will be set aside for renewable energy generators, while the other half is set aside for enabling technologies, energy efficiency and low-emission technologies, although some part of the funding may also be directed to renewable generators.

The CEFC will provide funding through commercial loans, concessional loans, loan guarantees and equity. Capital will be reinvested in the CEFC although dividends on investments may also be used to fund the Australian Renewable Energy Agency.

The CEFC is a major announcement not least in terms of the significant financial contribution ($10bn over five years) that has been allocated to it. It will be very important that there is careful consideration of the purpose of the CEFC, and how it will decide between the conflicting objectives (e.g. least cost emission reduction versus industry development) that it is likely to be presented with. Most importantly it will need to be clear on what the problem is to which the CEFC is the best solution.

3.3.2 The Australian Renewable Energy Agency

The Australian Renewable Energy Agency (ARENA) will be a statutory authority whose main task will be to provide grants supporting research, development, demonstration and commercialisation of renewable energy technologies. It combines a number of programs and organisations that together are able to provide $3.2bn in funding. It may also receive dividends from the CEFC and possibly some of the funds currently allocated to the Jobs and Competitiveness Program.

3.4 Energy users' interests

There are different views on whether Australian energy users should be subsidising renewables at all. From the perspective of least cost greenhouse gas abatement, most economists suggest that economy wide measures such as broad based taxes or emission trading schemes are likely to be more efficient than sector-specific subsidies[5]. The Garnaut Review and Productivity Commission have both suggested that renewables subsidies should be directed at overcoming market failures in research and development, rather than in subsidising the production of renewable electricity from market-ready technologies. These views on the economics of renewables subsidies are not new. They have been expressed in various forms frequently in the past, and seem to be well-founded in the economics establishment in Australia and elsewhere.

However, subsidies for the production of renewables are well established and growing in many countries. Substantial production subsidies such as provided through the RET, feed-in tariffs and now possibly also by the CEFC are, by comparison with the approach adopted in other countries, certainly not unusual. Evidently there is a dichotomy between the political economy of subsidising renewables and the first-best economics of emission reduction.

In this context, where does the best interest of electricity users lie? This report does not purport to present a consensus opinion on this issue. The community of energy users has widely differing views on the wisdom of renewables subsidies. They find common

[5] For example an informal survey at the Australian Conference of Economists in Canberra on 12 July 2011 showed that only 11% of attendees supported "direct action", while 80% favoured price-based mechanisms.

ground however, in their opposition to poorly designed and implemented policies whose costs they are forced to bear.

Our view is that while there are well-founded concerns about the inefficiency of sector-specific subsidies, such subsidies are not *necessarily* contrary to the interest of electricity users. If the benefits that users derive from the subsidy of renewables (such as reduced exposure to volatile and rising fossil fuel and emission prices) exceeds the costs that users bear in acquiring those benefits, then renewables subsidies are in energy users' interests. For example, the Department of Energy and Climate Change in Britain has estimated that the U.K. power industry (and by extension its customers) will save 8.9 billion pounds because so-called contracts-for-difference-feed-in tariffs will encourage new renewable energy generation that will cut the need for carbon permits.[6]

The analysis in this paper has concluded that up to the end of 2010 Australia's renewables subsidy policies have been costly and at users' expense. With different policy settings, users could be net beneficiaries from the subsidy of renewables. In general, electricity users' best interest is to encourage governments to pay for those benefits that the subsidy of renewable generation provides (such as jobs and industry development) but which do not accrue to energy users.

Second, where energy users are asked to bear subsidies for renewables, government should be encouraged to design subsidies that maximise efficiency (i.e. that maximise the production of renewable electricity/greenhouse gas abatement per dollar of subsidy provided).

[6] Reported in Bloomberg New Energy Finance, 14 July 2011.

Table 6 provides perspectives in relation to policies (the SRES and LRET) and institutions (ARENA and CEFC) that are consistent with these ideas.

Table 6. Perspectives on institutions and policies that could be in users' interests

Subsidy scheme / institution	**Perspective**
Small Scale Renewable Scheme (SRES) and jurisdictional government feed-in tariffs	The SRES is subsidising PV mainly and less-so water heaters. Subsidies provided under this scheme have been the main contributor to recent renewables-based electricity price increases. The level of subsidy through the SRES (and most jurisdictional government feed-in tariffs) has been reduced recently. It would be reasonable to suggest that it should be reduced further until the benefit that energy users derive from PV and water heaters is equivalent to the subsidy that they are being asked to pay.
Large Scale Renewable Energy Target (LRET)	The LRET encourages competition amongst competing renewable generators. In principle it is likely to allocate the greatest subsidy to the most efficient technologies. However, it is not clear that the scheme is providing investment certainty. This is at the expense of renewables developers and energy users (who will bear a higher subsidy to compensate for higher investment uncertainty). The review of the RET scheduled for 2012 should be used to assess outcomes and propose reforms.
Australian Renewable Energy Agency (ARENA)	The aggregation of a variety of renewable grant schemes in a single agency with stronger governance and commercial skills should promote more efficient disbursement of government grants relative to the current organisational arrangements. It is likely to be in users' interests that the greatest part of ARENA funding is allocated to overcome barriers to the successful deployment of market ready technologies, rather than in early-stage research or venture capital.
Clean Energy Finance Corporation (CEFC)	The CEFC is potentially beneficial to the interests of energy users, in that it will use public funds to promote renewables (thereby reducing the subsidy to be paid by users to meet renewables targets). It will be in users' interests that the main focus of the CEFC's efforts is on deployment of the most viable technologies, in this way obtaining the greatest volume of emission reduction and renewable electricity production for the least subsidy.

Appendix A: Data sources, assumptions and methodology for calculating subsidies

1. Feed-in tariff subsidies are payable over the remaining period of the feed-in tariff policy. The amount shown here is the present value of expected future feed-in tariff payments for PV systems installed by the end of 2010 i.e. the present value of the remaining subsidy over the life of the scheme for plant that was installed by the end of 2010. The data sources and key assumptions in this calculation are as follows:
    a. The life of the scheme is based on the jurisdictional scheme
    b. The weighted average duration of FiT tariffs is 1 year
    c. The feed-in tariff levels are as per jurisdictional schemes
    d. The status of the tariff as gross or net is as per the jurisdictional design
    e. Where net feed-in tariffs apply the expected feed-back is 70% of annual production per year.
    f. The average retail electricity is per CME database
    g. The Compound Annual Growth Rate of electricity prices is assumed to be 3% real over the period of the feed-in tariff.
    h. The discount rate is 5% real.
    i. Aggregated electricity production from PV from 2011 is adjusted downward by 20% to account for panel degradation over its life and to account for unit outages.
2. All data on historic REC creation by technology type is from the ORER database
3. In the electricity production analysis, the average life of:
    a. PV system is assumed to be 20 years.
    b. Wind is assumed to be 30 years.
    c. Biomass is 25 years.
    d. Hydro is 45 years
4. In the greenhouse gas analysis the assumptions in the electricity production analysis apply and in addition:
    a. Average greenhouse gas intensity in 2011 is assumed to be 1 tonneCO2-e per MWh. This declines by 2% per year.
5. Energy users are assumed to pay average spot market REC prices plus 10%.
6. The calculation of the REC price required to ensure that LRET target are met is calculated based on CME's RGE equilibrium model. Key assumptions in this model are as follows:
    a. All plant in CME's RED model with a probability ranking of greater than three is assumed to be eligible to be developed. Plant specific capacity factors are based on CME's RED model;
    b. Average wind generation installed capital cost including land and all ancillaries is $2.8m/MW,

   c. The weighted average cost of capital for a wind farm is 9% real pre tax.
   d. A $20/tonne emission price is assumed to be introduced in 2013
   e. Average wholesale electricity prices are assumed to be remain constant in real terms at $65/tonne from 2013.

7. The calculation of the subsidies paid under the Australian Government's Solar Homes and Communities Program is via on a series of calculations using REC data from the ORER and PV installation data provided by the Department of Water Heritage and the Arts.