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Review of Progress to Achieving Targets Under Section 7 Of The Climate Change And Greenhouse Emissions Reduction Act 2007

Prepared by CSIRO

for The Department of the Premier and Cabinet of South Australia

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1 EXECUTIVE SUMMARY

1.1 Introduction

The Government of South Australia 'Climate Change and Greenhouse Emissions Reduction Act 2007' includes as one of its requirement under Section 7 (5) that a report be prepared by the end of 2009, to assess the extent to which any determination or target made or set under section 5 of the act is being achieved and, if it appears relevant, should be revised. The report that follows is CSIRO's independent assessment to meet this requirement. It has been prepared in collaboration with McLennan Magasanik Associates (MMA).

1.2 Scope of the report

Part 2 of the Climate Change and Greenhouse Emissions Reduction Act 2007 (the Act) specifies a principal target to achieve a reduction in greenhouse gas emissions within the

State of South Australia, as well as two related targets that promote the generation and use of renewable sources of energy. The Act also instructs the Minister for Climate Change (the Minister) on the operation of these targets. Specifically:

Part 2—Targets

5—Targets

(1) The principal target under this Act is to reduce by 31 December 2050 greenhouse gas emissions within this State by at least 60% to an amount that is equal to or less than 40% of 1990 levels.

(2) Two related targets under this Act are—

(a) to increase the proportion of renewable electricity generated so that it comprises at least 20% of electricity generated in the State by 31 December 2014;

(b) to increase the proportion of renewable electricity consumed so that it comprises at least 20% of electricity consumed in the State by 31 December 2014.

(3) The Minister may, in connection with the operation of subsections (1) and (2) for the purposes of any other provision of this Act—

(a) determine the method for calculating greenhouse gas emissions for the purposes of setting relevant 1990 levels (the ***baseline***), and then determine a figure that represents that baseline;

(b) determine the method for calculating any reduction in greenhouse gas emissions;

(c) set sector-based targets and additional interim targets;

(d) set specific baselines for particular areas of activity (as components of the overall baseline);

(e) make other determinations that assist in measuring greenhouse gas emissions within the State.

An additional target was made by the Minister under Part 2 of the Act for '33.3% of South Australia's electricity generation to come from renewable energy by 2020'.

The Minister is required, on a two-yearly basis, to prepare a report on the operation of the Act. The first report, and thereafter every alternate report, must incorporate a report from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) that:

- Summarises the CSIRO's assessment of the extent to which any determination or target made or set under Part 2 of the Act is being achieved and, if it appears relevant, should be revised; and
- Provides advice on the method for calculating the 1990 baseline for the greenhouse gas target consistent with Sections 5 (4) (b) and Section 5 (4) (c) of the Act.

This document reports the assessment of the CSIRO in relation to the first of these two-yearly reports.

1.3 Key findings

1.3.1 1990 Baseline Methodology

- The CSIRO recognises that the current methodologies used in the development and maintenance of the State and Territory Greenhouse Gas Inventory are consistent with best national and international practices and accord with the methodologies prescribed by the International Panel on Climate Change.
- The CSIRO is satisfied that while the South Australia Greenhouse Gas Inventory is calculated using Commonwealth Department of Climate Change (DCC) methods and associated data, and routinely updated in response to DCC evaluation processes, that South Australia will have a sufficiently reliable baseline to provide for the assessment of progress towards its greenhouse gas emissions target.
- The CSIRO is comfortable that the South Australia Greenhouse Gas Inventory is determined using the sum of scope 1 emissions as defined by the National Greenhouse and Energy Reporting (NGER) Regulations, plus emissions associated with net interconnector flows (imports less exports). The target therefore explicitly includes indirect greenhouse gas emissions associated with purchased electricity that is generated outside South Australia and imported into South Australia via the interconnectors.

1.3.2 Renewable Electricity Target Methodology

- The South Australia Government have noted a discrepancy between generated energy estimated from customer sales data and historical generation data. CSIRO have evaluated the average error as 0.6% and recommend that the discrepancy be re-evaluated following a change in methodology described below and in section 3.1.1

- CSIRO concurs with previous South Australian Government deliberations in recognising the value of taking measurements for the renewable electricity generation and consumption targets at the interconnection point between the transmission and distribution system, using the NEM regional reference node (RRN) as the locational proxy. This will give the generation and consumption targets a similar locational basis, so they should yield similar results when net imports are zero. This treatment will then be directly compatible with the Federal Government Expanded RET scheme (RET). Details of the revised methodology are provided in section 3.1.1
- The CSIRO notes that the NGER Technical Guidelines recognise the difficulty of identifying the physical source of electricity received by each customer. In light of these difficulties the CSIRO supports using a 'physical' basis for defining the consumption of renewable electricity.
- The CSIRO is satisfied that: renewable electricity generation data found in the ESIPC 2009 Annual Planning Review (2009 APR) and as published by the Commonwealth Department of Environment, Water, Heritage and the Arts; statistics in the 'Solar Homes and Communities Plan' published by the Department of Climate Change; and the Marginal Loss Factors and average Distribution Loss Factors obtained from AEMO data; provide an acceptable basis for evaluating the renewable electricity values used for the consumption and generation targets.

1.3.3 Greenhouse Gas Emissions Target (2050)

Assessing progress towards South Australia's 2050 greenhouse gas emission target is subject to considerable estimation risk given the uncertainties associated with technological change, policy decisions, investment behaviour, and consumer demand. However, electricity generation makes up a substantial proportion of these emissions and if the current progress towards meeting South Australia's renewable electricity targets is sustained this will significantly enhance the probability of achieving the target.

1.3.4 Renewable Electricity Targets (2014 and 2020)

Based on current installed renewable generation capacity and assuming all announced wind projects go ahead as scheduled, the CSIRO expects that South Australia will achieve its 2014 and 2020 Renewable Electricity Generation Targets, whether the existing South Australian Strategic Plan Methodology or the recommended methodology is used.

2 THE GREENHOUSE GAS EMISSIONS TARGET

2.1 Calculating a Greenhouse Gas Inventory for South Australia

The principal target under the Act is to reduce by 31 December 2050 greenhouse gas emissions within South Australia by at least 60% to an amount that is equal to or less than 40% of 1990 levels (SA GHG Target). This requires the establishment and maintenance of a Greenhouse Gas Inventory for South Australia in the form of a time series having a base year of 1990.

Section 5(3)(a) of the Act refers to the "…method for calculating greenhouse gas emissions for the purposes of setting relevant 1990 levels (the baseline), and then determine a figure that represents that baseline".

In determining this method, including a method for calculating reductions in greenhouse gas emissions or the use of renewable electricity, section 5(4)(c) of the Act requires that the Minister seek to provide consistency with the best national and international practices.

The best international practices will continue to evolve over time. The Intergovernmental Panel of Climate Change (IPCC) is a leading international body for the assessment of climate change, established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). As a scientific body, the IPCC reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. IPCC have recommended methodologies for the establishment of national greenhouse gas inventories; these are reviewed and updated as scientific knowledge progresses. In particular, current international practice is guided by the:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997);
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000);
- IPCC Good Practice Guidance for Land Use, Land-Use Change, and Forestry (IPCC 2003); and the
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006).

Australia is one of 192 countries that have joined the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty that sets general goals and rules for confronting climate change. The UNFCCC requires precise and regularly updated inventories of greenhouse gas emissions from industrialized countries. Apart from a few exceptions, the base year for assessing greenhouse gas emissions has been set as 1990. UNFCCC parties have agreed to use comparable methodologies, and it has been agreed that Annex I countries such as Australia, should use methods that are consistent with IPCC guidelines for estimating and reporting their national greenhouse gas inventories.

The CSIRO notes that the Commonwealth Department of Climate Change (DCC) compiles a State and Territory Greenhouse Gas Inventory that is part of Australia's National Greenhouse Gas Accounts.

The State and Territory Greenhouse Gas Inventory is prepared in accordance with the IPCC Revised 1996 Guidelines for National Greenhouse Gas Inventories and the principles of the IPCC (2000) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and the IPCC (2003) Good Practice Guidance for Land Use, Land Use Change and Forestry. Where appropriate, elements of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories are being progressively implemented.

The CSIRO also notes that the State and Territory Greenhouse Gas Inventory has been prepared in consultation with the States and Territories, under the guidance of the National Greenhouse Gas Inventory Committee of representatives of the Australian, State and Territory Governments.

The CSIRO is therefore of the view that the methodologies used by the DCC in the development and maintenance of the State and Territory Greenhouse Gas Inventory are consistent with the best national and international practices.

The science of climate change is continuing to develop however, and the methodologies used to estimate greenhouse gas emissions are similarly developing. Although the IPCC captures and disseminates changes in the state of the art, the calculation and maintenance of a reliable greenhouse gas emissions baseline remains a challenge. Indeed, the currency of an estimated baseline is short given that inputs, assumptions and methods evolve, requiring ongoing recalculation and therefore historical revision back to 1990 to maintain the integrity of the time-series.

UNFCCC parties have agreed that "As part of its inventory planning, each Party included in Annex I should consider ways to improve the quality of activity data, emission factors, methods and other relevant technical elements of inventories".[1] In Australia's submission to the UNFCCC Secretariat[2], the DCC reports on page 5:

> *The DCC has instituted an annual cycle of evaluation through the preparation of an Evaluation of Outcomes document, providing a process for quality assurance and feedback for improvement to the National Greenhouse Accounts. The Accounts are assessed against explicit quality objectives which take into account, inter alia, detailed estimates of uncertainty surrounding Australia's emissions data; UNFCCC Expert Review processes, which aim to review and improve the quality of all Annex I inventories in an open and facilitative manner on an annual basis; and an assessment of Australia's estimation methodologies against IPCC guidelines, international practice and available data.*

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1 Decision 19/CMP.1 Annex (reported in FCCC/KP/CMP/2005/8/Add.3)

2 Department of Climate Change (2008), The Australian Government's Initial Report under the Kyoto Protocol: Report to facilitate the calculation of the assigned amount of Australia pursuant to Article 3, paragraphs 7 and 8 of the Kyoto Protocol, Department of Climate Change, Canberra.

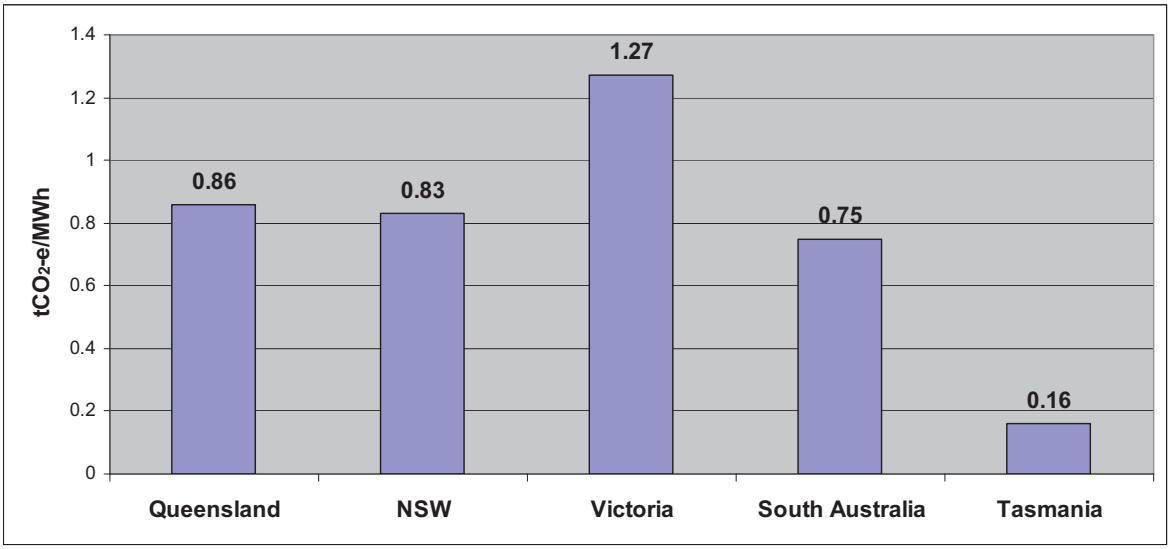
The CSIRO is satisfied that should the South Australia Greenhouse Gas Inventory be calculated using DCC methods and associated data, and routinely updated in response to DCC evaluation processes, that South Australia will have a sufficiently reliable baseline to provide for the assessment of progress of the SA GHG Target.

The State and Territory Greenhouse Gas Inventory provides time series data for South Australia that represents total emissions including net emissions from Land Use, Land Use Change and Forestry (LULUCF). This is analogous to Scope 1 emissions, as defined by the Commonwealth National Greenhouse and Energy Reporting Regulations 2008 (NGER Regulations), where South Australia is defined as a greenhouse gas emitting facility that uses electricity that is generated outside the facility boundaries.

Electricity is supplied in South Australia via a transmission grid that supports the National Electricity Market (NEM). South Australia is directly linked with Victoria via the Heywood and Murraylink interconnectors, and is indirectly linked to New South Wales and Queensland that also share the interconnected transmission grid. Power stations that are connected to the grid have a range of greenhouse gas emission intensities.

A greenhouse gas inventory that is appropriate for measuring progress against the SA GHG Target must include those emissions that are related to electricity that is imported. Given that South Australia has typically been a net importer of electricity, the inclusion of interconnector related greenhouse gas emissions makes the SA target more stringent. This is evident from Figure 2-1 that shows the average emissions intensity for each region in the NEM; average Victorian emissions are significantly greater than those from South Australia due to the large contribution of brown-coal fired power stations in Victoria. Unlike Victoria, South Australia's indigenous supply of electricity is mostly sourced from either natural gas or low quality black-coal, each producing electricity with lower associated emissions than does brown–coal.

Figure 2-1: Average emission intensity in each region of the NEM, t CO_2/MWh



Source: MMA analysis based on generation data published by the Australia Energy Market Operator (AEMO) and its predecessor organisation, and the National Greenhouse Gas Inventory methodology workbooks published by the Department of Climate Change.

The CSIRO is satisfied that a valid and robust greenhouse gas inventory for South Australia is determined as the sum of scope 1 emissions as defined by the NGER Regulations, plus emissions associated with net interconnector flows (imports less exports), therefore explicitly including indirect greenhouse gas emissions associated with purchased electricity that is generated outside South Australia and that is imported into South Australia via the interconnectors.

Data in support of this methodology is collected by the DCC as part of its process to prepare Australia's National Greenhouse Gas Accounts:

- Scope 1 Emissions - published directly as part of the State & Territory Greenhouse Gas Inventory by the DCC
- Interconnector Emissions - embedded in the data contained in the National Inventory by Economic Sector

The *Australian Greenhouse Emissions Inventory System* (AGEIS)[3] retains greenhouse gas emissions data from 1990 to 2007 that is used to prepare Australia's National Greenhouse Gas Accounts, including the National and State and Territory inventories and the National Inventory by Economic Sector. AGEIS therefore features the data that is necessary to calculate and maintain the South Australia Greenhouse Gas Inventory[4].

In accordance with IPCC guidelines, it is noted that data in AGEIS will be revised as inventory methods improve and more relevant data become available[5]. For this reason, historical greenhouse gas emissions data may change. The re-calculation of the South Australia Greenhouse Gas Inventory will therefore be required from time to time to ensure that progress against the SA GHG Target is measured using the latest information available.

2.2 Summary of current progress

Using the latest published data from AGEIS, and a definition for the South Australia Greenhouse Gas Inventory that is based on the sum of scope 1 emissions (as defined by the NGER Regulations), plus emissions associated with net interconnector flows (imports less exports), the following is calculated.

Table 2-1 presents total greenhouse gas emissions (Gg (1000 tonnes) CO_2e) for South Australia for the year 2007 relative to the 1990 baseline. The data is extracted from AEGIS using the recommended methodology; the calculations include net scope 2 emissions related to purchased electricity that is imported from interstate via the Heywood and Murraylink interconnectors, and distinguish between those emissions associated with Land Use, Land Use Change and Forestry.

Table 2-1: SA GHG Emissions 1990-2007

SA GHG Emissions [Gg CO2-e]	1990	2007
Total GHG emissions including LULUCF and interconnector	32,984.4	30,877.9
Change since 1990		-6.4%
Total GHG emissions excluding LULUCF and including interconnector	31,725.0	33,995.1
Change since 1990		7.2%

Source: The Australian Greenhouse Emissions Inventory System (AGEIS)
http://ageis.climatechange.gov.au

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3 http://www.ageis.climatechange.gov.au/

4 For Scope 1 Emissions (EM) –Emissions data can be extracted from AEGIS by submitting a query using the following filters: Location = SA; Accounting Framework = Kyoto; Sector = Total Kyoto; and Gas = Carbon Dioxide Equivalent
For Interconnector Emissions (EI) –Data will need to be calculated as the difference between emissions associated with electricity production (E_Elect_P) and electricity consumption (E_Elect_C) such that net interconnector related emissions: EI = E_Elect_C - E_Elect_P
- Emissions data for E_Elect_C can be extracted from AEGIS by submitting a query using the following filters: Location = SA; Sector = Total of all Economic (ANZSIC) sectors
- Emissions data for E_Elect_P can be extracted from AEGIS by submitting a query using the following filters: Location = SA; Sector = Stationary Energy ->Energy Industries ->Public Electricity and Heat Production.

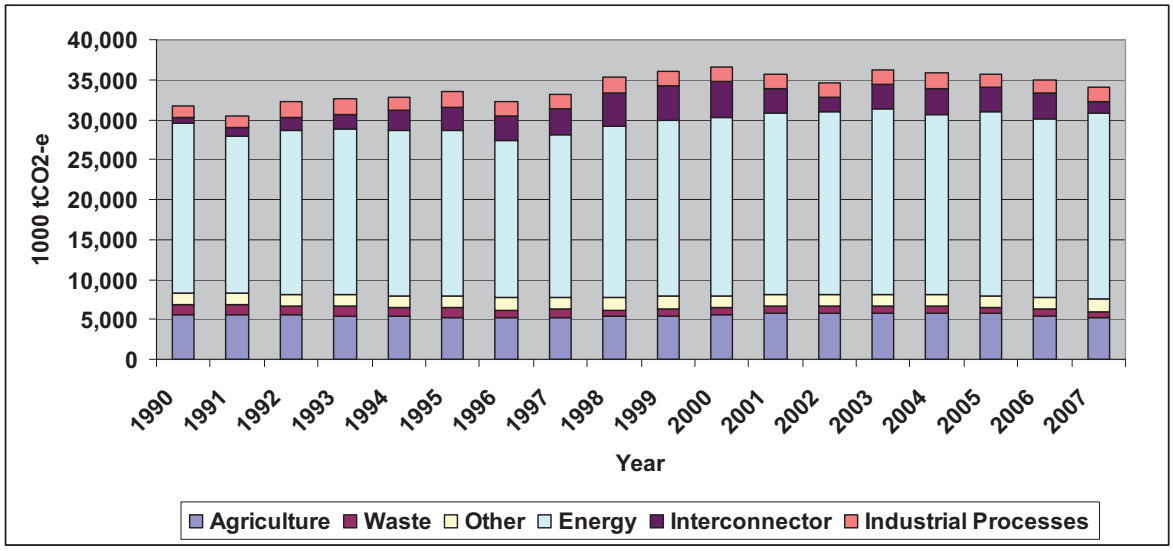
SA GHG Inventory – Equals (EM + EI) for each year

5 As an example, emissions data in AEGIS related to interconnector flows use emissions factors that are calculated as a three-year moving average. These emissions factors with therefore change from year to year.

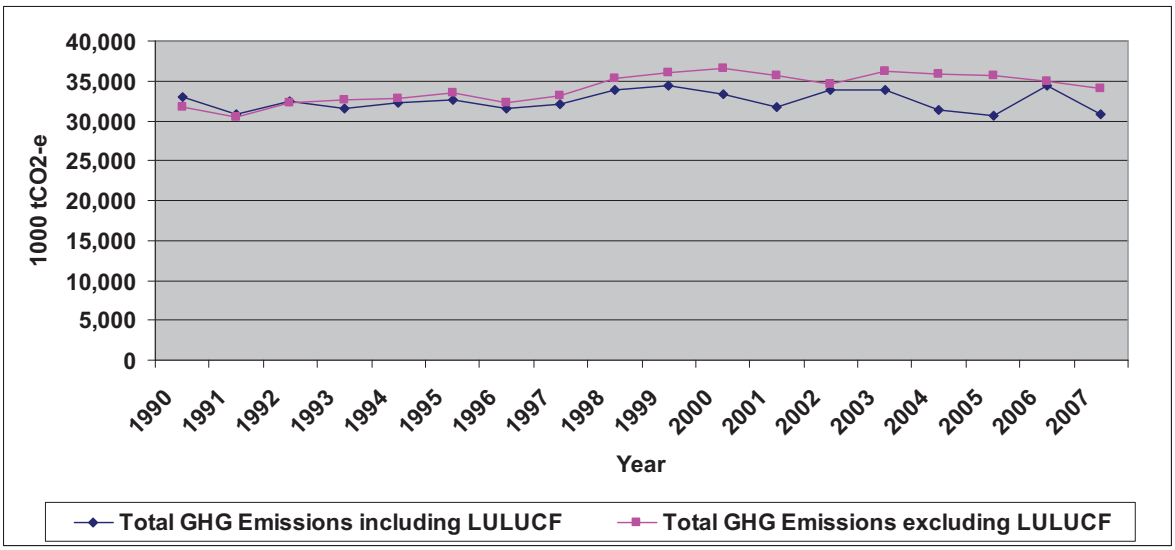
Figure 2-2a presents total greenhouse gas emissions excluding LULUCF emissions for South Australia since 1990; Figure 22b compares the total emissions with and without LULUCF and Table 2-2 presents the calculated data.

Figure 2-2: SA GHG Emissions since 1990

(a)



(b)



Source: MMA analysis

Table 2-2: SA GHG Emissions since 1990

SA GHG Emissions [Gg CO_2-e]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy	21,241	19,566	20,629	20,742	20,708	20,727	19,657	20,370	21,467	22,061	22,336	22,717	22,955	23,194	22,562	22,998	22,268	23,273
Industrial Processes	1,511	1,472	2,054	1,967	1,793	1,852	1,772	1,807	1,876	1,825	1,848	1,847	1,840	1,885	1,854	1,662	1,613	1,768
Agriculture	5,569	5,581	5,525	5,463	5,345	5,255	5,201	5,284	5,341	5,468	5,578	5,720	5,726	5,799	5,740	5,695	5,451	5,,189
Waste	1,346	1,344	1,207	1,230	1,084	1,250	1014	977	864	885	856	869	927	893	862	808	812	833
Other	1,457	1,350	1,291	1,330	1,540	1,467	1475	1,459	1,510	1,505	1,474	1,450	1,462	1,489	1,470	1,484	1,560	1,570
Land Use, Land Use Change and Forestry	1,259	366	123	-1062	-636	-880	-681	-1,111	-1,301	-1,628	-3,321	-3,896	-868	-2,366	-4,511	5,009	-383	-3,117
Total, excluding interconnector related emissions	32,384	29,679	30,829	29,670	29,883	29,671	28,438	28,785	29,758	30,115	28,771	28,708	32,042	30,894	27,977	27,638	31,321	29,515
Interconnector	601	1,093	1,568	1,929	2,405	2,917	3,088	3,241	4,198	4,347	4,516	3,054	1,766	3,027	3,305	3,022	3,182	1,363
Total, including interconnector related emissions	32,984	30,772	32,397	31,598	32,239	32,588	31,525	32,025	33,956	34,463	33,287	31,762	33,808	33,922	31,282	30,660	34,503	30,878

Source: MMA analysis

2.3 Progress towards the 2050 target

Assessing progress towards the 2050 SA GHG Target is difficult and subject to considerable estimation risk given uncertainties regarding technological change, policy decisions, investment behaviour, and the impact of the foregoing on consumer demand. The 2050 SA GHG Target has been set in the context of broader national and interstate policy developments, and typically complements general efforts around Australia to manage greenhouse gas emissions. Although these broader efforts will combine with the SA GHG Target to deliver lower emissions for Australia, the regulatory detail and commercial response is continuing to evolve and will affect the pattern and schedule of investments in each jurisdiction.

The following summarises a range of developments that will affect South Australia's progress towards the 2050 GHG Target, and the related renewable electricity targets.

2.3.1 Policy developments affecting renewable generation

Energy is the inventory sector with the largest emissions, of which power generation is a major contributor, and therefore an area of significant policy attention. Emissions from electricity generation are projected to grow faster than emissions from other activities. With no policy to curb emissions, emissions from electricity generation are projected to grow at a national level by an average of 1.7% per annum, compared to 1.3% per annum for direct combustion activities and 1.6% for transport activities[6]. Indeed, the South Australian Renewable Electricity Targets (2014 and 2020) have been designed to address the emissions of this sector, and to assist the achievement of the SA GHG Target. In Australia, there are several renewable energy and carbon markets for which a renewable energy generator can source revenue additional to their electricity sales. In particular, the Federal Government's Mandatory Renewable Energy Target and the State and Federal Green Power Scheme, whereby customers pay a premium for accredited renewable energy.

The Australian Government has recently passed legislation to enact the RET Scheme. This will involve expanding the existing renewable generation target from 9,500 GWh to 45,000 GWh in 2020. This expanded target will replace all legislated and proposed state based target schemes. Second, the Federal Government has announced the targets and structure of the Carbon Pollution Reduction Scheme (CPRS. Legislation underpinning this policy is currently being considered by the Australian Senate. If enacted, the NSW Greenhouse Gas Abatement Scheme will expire when the CPRS commences. The National RET Scheme and the CPRS will have a significant influence on the achievement of the SA GHG Target, on South Australia's related renewable electricity targets, and on the distribution of greenhouse gas emissions-relevant investments between South Australia and competing jurisdictions.

[6] MMA analysis based on data provided in DCC (2009),

The Renewable Energy (Electricity) Amendment Bill 2009 specifies that the mandatory renewable energy target scheme applies to electricity sales in all grids above a specified threshold of 100 MW. Based on this threshold, grids included are:

- The National Electricity Market (NEM), covering the interconnected grids of Queensland, New South Wales, Victoria, South Australia and Tasmania.
- The South West Interconnected System of Western Australia.
- The North West Interconnected System.
- The Darwin - Katherine grid.
- The Mt Isa and north west mining grid system.

Although, customers supplied by smaller grids are not liable under the scheme to source electricity from renewable generation options, renewable energy in those systems can still contribute towards meeting the target in other grids.

2.3.1.1 National Renewable Energy Targets

Targets for the level of renewable generation in each year under the RET scheme have been set in the legislation. These interim targets are designed to discourage liable parties from delaying investment, with the risk that such delays would make it difficult to meet the target. The interim targets were also set to allow the industry to build capacity to respond in a timely manner.

The interim targets for the RET Scheme are included in the Act, and stipulate a target of 12,500 GWh of renewable generation in 2010 expanding to 45,000 GWh in 2020. The target will increase from 2010 to the ultimate 45,000 GWh target in 2020 and remain at this level until 2030 as shown in Table 2-3 and Figure 2 3 below.

The RET Scheme will replace the MRET Scheme and state based schemes. Already the NSW and WA Governments have abandoned their proposed state based schemes. Under the legislation underpinning the RET Scheme, the Victorian Renewable Energy Target (VRET) Scheme will transition during 2010 into the RET Scheme and after November 2010 will no longer be in existence.

In addition, there is a component of 850 GWh added to the targets in the years from 2012 to 2020 inclusive to cater for the inclusion of existing waste coal mine gas based generation as an eligible generation option under the RET Scheme. Only existing waste coal mine generators are eligible under this additional component at a level equal to their generation levels in 2007.

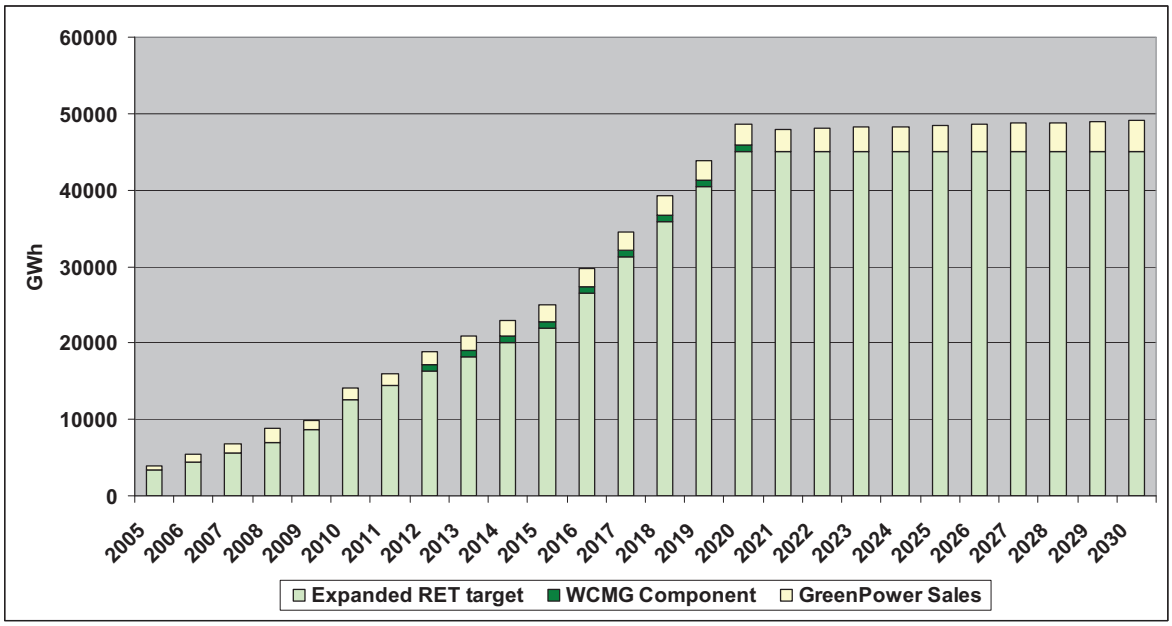
Excluded are recent announcements for the supply of renewable energy to supply new desalination facilities, where the contracts to supply exclude this renewable energy from being part of the RET scheme.

Table 2-3: Interim Targets under the MRET Scheme

Year	Target GWh	Actual certificate creation (generation) GWh	Cumulative surplus to target GWh
2001	300	1,663	1,363
2002	1,100	2,779	3,042
2003	1,800	4,356	5,598
2004	2,600	3,403	5,685
2005	3,400	4,822	6,707
2006	4,500	5,194	7,004
2007	5,600	6,290	6,811
2008	6,800	8,595	6,964
2009	8,100	9,893	8,753
2010	12,500		
2011	14,400		
2012	16,300		
2013	18,200		
2014	20,100		
2015	22,000		
2016	26,600		
2017	31,200		
2018	35,800		
2019	40,400		
2020 to 2030	45,000		

Source: MMA database and Office of the Renewable Energy Regulator (REC Registry). Annual certificate creation data for 2008 and 2009 are as of July 18 2009. Creation for these years is likely to increase in the coming months.

Figure 2-3: RET target



Note: Green Power is a voluntary scheme set up by the State Governments that allows retail customers to purchase, at a premium, electricity sourced from renewable energy only. RECs can be acquitted against GreenPower or the RET, but not both, Green Power data is based on extrapolations of historical sales.

Source: ORER (2009), *RET: The Basics*, available at http://www.orer.gov.au/publications/pubs/ret-thebasics-0909.pdf; GreenPower sales to 2008 supplied by the NSW Department of Water and Energy.

2.3.1.2 Creation of certificates

Accredited generators are allowed to create RECs (in electronic form) for renewable electricity supplied to an agreed measurement point. Certificates created must be registered with the Office of Renewable Energy Regulator (ORER).

Each certificate represents 1 MWh of renewable electricity generated. Fractions of a certificate will not be issued. A generator producing between 0.5 per annum and 1 MWh per annum would create one certificate with its generation rounded up to the nearest MWh. To maintain confidence in the system, provision is made in the legislation for the auditing of the creation of RECs by accredited renewable generators.

Liable parties are required to acquire and surrender renewable certificates equivalent to the target proportion of their sales or consumption in each accounting period. In any period, liable parties can purchase more certificates than required to achieve their target, with the surplus traded to other liable or third parties or banked to be surrendered in a future accounting period.

Generators will have the option of trading their certificates to a liable party or through a third party, and will achieve the price premium that supports the development of the project, through the sale of certificates. The price that is likely to be obtained for the certificates will influence any decision to invest in renewable energy generation.

2.3.1.3 Penalty for non-compliance

The RET Scheme will place a legal liability on wholesale purchasers of electricity, defined as liable parties under the Renewable Energy (Electricity) Amendment Act 2009, to proportionately contribute towards the generation of additional renewable electricity. Liable parties are entities that are required to purchase and surrender certificates to show they have met their obligations under the RET Scheme. Liable parties are wholesale customers (retailers, large industrial loads) who purchase electricity from grids with generation capacity greater than 100 MW. Each liable party has to surrender a number of certificates to the Office of Renewable Energy Regulator (ORER) each year equivalent to their obligations in the previous year. The obligation, in terms of number of certificates required to be surrendered to ORER, is calculated as the Renewable Power Percentage (RPP), which is set by ORER, multiplied by their share of sales in the eligible grids.

Liable parties who fail to submit the required number of certificates in each accounting period will be required to pay a penalty for the shortfall. This penalty, called the shortfall charge, is set at $65/MWh under the RET Scheme, with this penalty adjusted annually for movements in the CPI. The penalty is not tax deductible meaning that under current company tax rates a liable party would be indifferent between paying the penalty and purchasing certificates up to a price of $92.86/MWh.

A 10% leeway is available to liable parties who fail to comply fully with the requirements. Shortfalls of more than 10% will be penalised for the full quantum of the shortfall, although this penalty may be redeemed by surrendering additional RECs in the following three years. Shortfalls within the 10% leeway must also be made up in the following three years.

Compliance with the liabilities has been strong. By the end of 2007, 98.9% of liabilities (that is, number of certificates required to be surrendered) have been met[7]. Of the 70 entities that were liable parties at the end of 2007, only three had a shortfall in 2007, with an effective shortfall of 6,333 certificates (equivalent to 6.3 GWh of generation compared with a target in 2007 equivalent to 5,600 GWh). For the period from 2001 to 2006, there were 9 parties with a shortfall with the total shortfall for this period being 1,543 certificates (equivalent to 1.5 GWh of generation).

2.3.1.4 Review

Under the legislation, the Government will undertake a review of the RET scheme in 2014. A similar review was undertaken in 2002 for the prior MRET scheme (the Tambling Review).

A key risk is that the review could recommend a lowering of the target. This is unlikely to occur for the following reasons:

- Sovereign risk issues that would occur with a lowering of the target.

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[7] Source of compliance information is Office of Renewable Energy Regulator (2009), *Increasing Australia's Renewable Electricity Generation: Annual Report 2008*, Commonwealth of Australia, Canberra.

- One possibility is that problems in having investments being constrained by transmission issues or other structural issues which makes the target difficult to achieve leading up to the review. This is not the most likely outcome at this point in time. There are already enough projects under development to meet the target. Most are located within the existing network system. Moreover, there may be sufficient certificates banked at the end of 2009 to supply three years worth of growth in the target from 2010. As other generators will come on line in 2010, the potential to exhaust the banked certificates could to carry over into 2014, so the probability of there being not enough certificates through constrained generation investment is likely to be low.

One possibility is that the carbon price may increase to such a high level (due to say an international agreement for deep cuts in emissions) that the RET scheme becomes superfluous as electricity prices are high enough to support renewable generation. In this case, the revenue stream to a renewable generator would still be the same.

2.3.1.5 Other features

Other features of the MRET scheme which will carry over to the new RET Scheme include:

- Allowing all models of solar water heaters (SWH) to be eligible. Treatment of eligible sources will be the same as the current MRET. Solar water heaters remain eligible with a 10-year deeming period through to the end of the scheme (2030). Analysis indicates this, in combination with recent changes to Federal and State based planning laws and rebate schemes encouraging the use of solar water heaters, could result in a significant contribution to meeting the renewable energy target from this source.
- Limits on the timing of creation of certificates. Once a renewable electricity plant generates a unit of electricity, the certificate on that generation has to be created by the end of the year following the year of generation. For example, certificates on generation of renewable electricity occurring in 2009 will need to be created (that is, be deemed to be created by ORER) by the end of 2010.
- Providing a deemed level of RECs for small scale photovoltaic generators to improve the rate of adoption of these technologies. The maximum capacity for photovoltaic (PV) units to be eligible for deeming has been increased to 100kW and PV units installed after 31 July 2005 will have an option to create 15 years worth of RECs in a single up-front transaction or three tranches of 5 years worth of RECs. The Government provides owners of small scale systems with an upfront payment of RECs equal to the estimated generation levels over a 15 year period.
- Providing for provisional accreditation of proposed generation projects, establishing timeframes for determining the eligibility of proposed projects by the Renewable Energy Regulator and clarifying the components of a power station.
- Allowing for the publication of data on baselines for each accredited renewable electricity generator.

- Providing the Renewable Energy Regulator with information gathering powers to enable the effective monitoring and compliance with the provisions of the legislation.
- Allowing for the suspension of an accredited power station under a number of circumstances including where gaming is suspected.

In addition the Renewable Energy Target Scheme will have a number of additional features (based on the legislation passed by the Australian Senate):

- Native forest wood waste remains eligible subject to the current MRET restrictions.
- Maintaining the same treatment of banking of Renewable Energy Certificates (RECs) as under the current MRET scheme. RECs created or purchased by liable parties to meet annual targets can be 'banked' by the owners for sale or surrender in later years of the scheme. Banking is permitted for the life of the scheme without restriction
- Renewable generators can create RECs on all generation occurring in the time period from installation to 2030. That is, all renewable power plants once accredited will be able to create RECs on their generation until the scheme expires. All existing projects eligible under MRET and the Victorian Renewable Energy Target scheme will be eligible to participate in the RET for the life of the scheme. Current generation baselines above which existing projects are able to create RECs would be extended to the end of the new scheme.
- Multiple RECs can be earned by small scale generation units from 2009-2010 to 2014-2015 according to
- Table 2-4. The design includes a multiplier to be applied for RECs created by micro-generation units (including rooftop solar PV systems, small wind turbine systems and micro-hydro systems). For each micro generation system, the multiplier would apply only to the first 1.5 kilowatts of system capacity.

Creation of RECs from solar water heaters has been a major component of the REC market. Between 2004 and 2007, around 20% of RECs created came from solar water heaters. This was increased to about 38% in 2008 when there was a boost based on heat pump uptake, which may not recur due to new regulations passed as part of the legislation.

Creation of RECs from small scale generation units, apart from solar water heaters, has been a minor component of total REC creation. At the end of 2008, less than 2% of the RECs have been created from small scale generating units eligible for deemed RECs (see

Figure 2-4).

However, the allowance of multipliers could see the proportion of REC creation from small scale generation units increase in the period from 2010 to 2014. The additional income that can be earned from the multiplier adds a subsidy of the order of $4,000 to $7,000 for a REC price of $50/certificate. This level of subsidy is not generous relative to the rebate

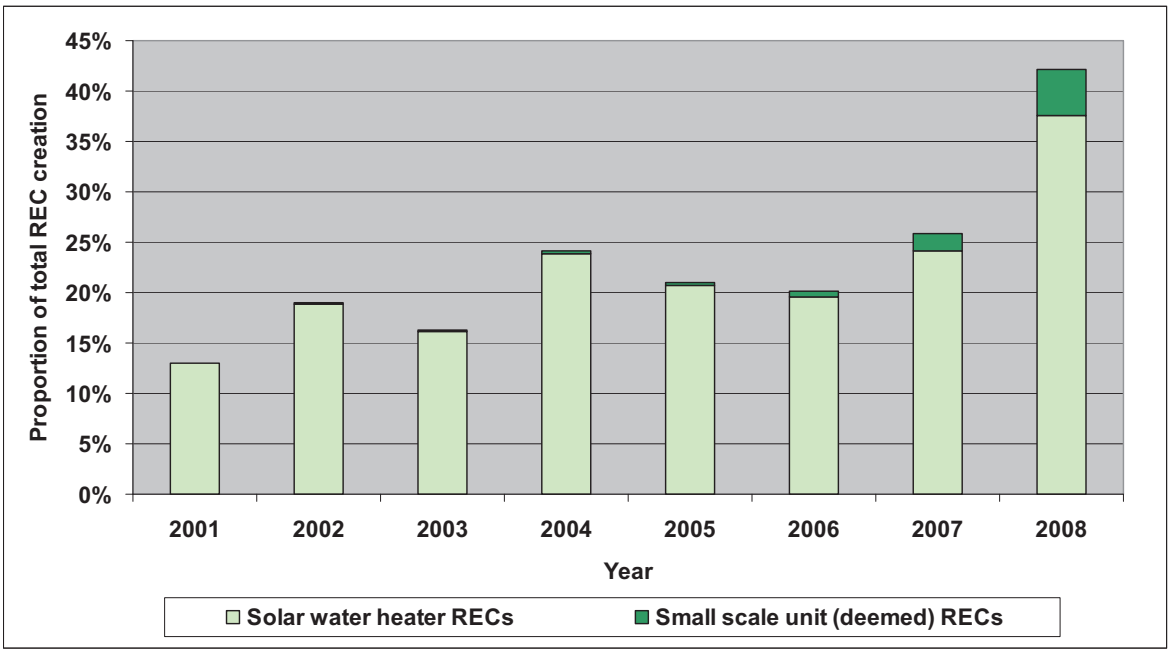
($8,000) that it replaced so the level of demand should be lower than has occurred in 2008, despite falling prices for PV systems. The level of subsidy will fall over time as the multipliers reduce.

Table 2-4: Multiplier for certificates for small generation units

Period during which system installed	Number of RECs per MWh of Generation
1 July 2009 to 30 June 2010	5
1 July 2010 to 30 June 2011	5
1 July 2011 to 30 June 2012	5
1 July 2012 to 30 June 2013	4
1 July 2013 to 30 June 2014	3
1 July 2014 to 30 June 2015	2

DCC Renewable Energy (Electricity) Act 2009, Amendments

Figure 2-4: RECs created by solar water heaters and small scale generation units



Source: MMA analysis based on data obtained from ORER's REC Registry.

Three other major amendments enacted to allow passage of the legislation. The first amendment involved the inclusion of existing (not new) coal waste gas as an eligible resource under the RET, but the target has been boosted to account for the likely certificate creation under this source[8]. The second amendment involved removing liability

[8] The target is around 850 GWh higher until 2020. Thereafter, coal waste gas is no longer eligible.

from energy intensive loads for paying for purchases of certificates. The third amendment involved imposing tougher eligibility criteria for heat pumps to claim RECs.

It is worth noting that the large increase in the proportion of RECs created by solar hot water heaters has had the effect of significantly reducing REC prices. With respect to the achievement of South Australia's renewable electricity targets, this may have the effect of delaying investment in other renewable generation. It is unlikely that this will challenge the achievement of the targets however, due to the large quantum of existing and proposed wind generation in South Australia. Indeed, the estimated average annual output from all wind generation plants in South Australia that are either existing, or proposed for commissioning prior to 2015, makes up 34% of the sent-out energy requirement that is forecast (median) by ESIPC to supply customers in 2014/15. This significantly exceeds the 20% renewable electricity generation and consumption targets for 2014 and will act as a buffer to support the achievement of these targets.

In terms of existing renewable generation in South Australia, the lower REC prices are not expected to affect generation performance given that these units have a very low marginal cost, making them price takers in most NEM dispatch scenarios. Unit commitment is therefore not sensitive to REC prices.

Considering the large uptake of SHW as part of the RET Scheme, there may be value in considering whether this renewable resource should be explicitly recognised as part of South Australia's renewable electricity targets.

2.3.2 Emissions trading

2.3.2.1 Policy initiatives

In January 2004, the First Ministers of State and Territory Governments established the National Emissions Trading Taskforce (NETT) to develop a model for a national emissions trading scheme (NETS). In August 2006, the NETT released a discussion paper detailing the possible design for a NETS, entitled 'Possible Design for a National Greenhouse Gas Emissions Trading Scheme'. With the election of the Federal Labor Government in November 2007 and its promise of implementing an emission trading scheme, the NETT was replaced by a federal program called the Carbon Pollution Reduction Scheme. Details of the scheme were outlined in a white paper released in December 2008 and legislation underpinning the scheme is currently being considered by the Australian Senate.

The proposed scheme would be a cap and trade emissions trading scheme. As proposed, the scheme is expected to commence in July 2011. All six types of greenhouse gas covered by the Kyoto Protocol are proposed to be covered by the CPRS.

The scheme cap sets limits on the amount of greenhouse gas emissions allowed to be emitted by the covered sectors without incurring a penalty. The scheme cap would be in line with Australia's long-term reduction target and a proposed target is to reduce

emissions by around 60% compared with 2000 levels by 2050. It is proposed that firm annual caps would be set for the first 10 years of the scheme and every year, the firm cap would be extended by another year. The legislation being considered calls for an unconditional target of a 5% cut on 2000 levels by 2020. If an extensive international agreement binding most countries with a target is negotiated at the COPS meeting in Copenhagen in December 2009, the Government may elect to decrease the target to 15% below 2000 levels by 2020, thereby making it more stringent. If an international agreement to achieve a global concentration target of 450 ppm CO_2e is achieved at Copenhagen then the Government will adopt a target with a 25% cut on 2000 levels by 2020.

The scheme is based on a tradable permit to emit such that each permit would allow the holder the right to emit 1 t CO_2e.

Permits can be sourced from eligible international sources of abatement. It is proposed that the rules governing the creating of offsets will be consistent with the Joint Implementation (JI) and Clean Development Mechanisms (CDM) allowed for under the Kyoto Protocol.

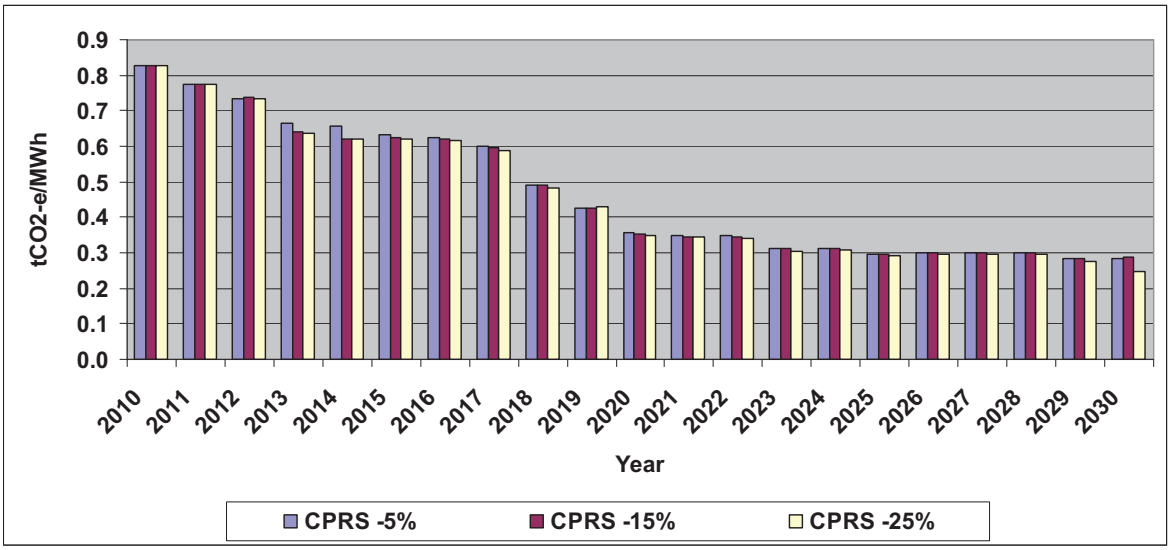
Other details of the proposed scheme include:

- All sectors except agriculture and land use change will be included, although these latter sectors may be included at a later date (to be decided after a review in 2013).
- Compliance with emission trading could be confined to large emitters only. It is proposed that only sites with direct emissions greater than 25 kt CO_2e be covered (about 1000 sites), with smaller sites possibly included under offset arrangements. In some cases, smaller sites are covered by application of the liability on upstream supply sites (i.e. gas retailer and oil refiners). Coverage could eventually be extended to all users once monitoring and compliance costs are reduced.
- A price cap will apply in the first 5 years of the scheme to limit liability. This would enable a soft start to occur. The price is set at $10/t CO_2e in 2011, then increasing to $45/t CO_2e in 2012 and increasing by 5% per annum until 2015.
- Trade exposed industrial customers will be compensated, with eligibility for compensation based on threshold levels of emissions per $M revenue or per $M value added. Coal-fired generators will also be compensated in part under an adjustment assistance package worth $3.5 billion in mid 2008 dollar terms.

Figure 2-5 shows emission intensity projections for South Australian electricity under alternative CPRS scenarios[9] .

[9] This is based on analysis conducted by McLennan Magasanik Associates (MMA). MMA's projections on emissions intensity are based on market simulations using Strategist, a probabilistic market modelling software package. The model represents the major thermal, hydro and pumped storage resources as well as the interconnections between the NEM regions. The three scenarios modelled were the CPRS-5%, CPRS-15% and CPRS-25% carbon price trajectories. Demand projections used for the modelling were those of the 2009 SOO, although they were adjusted for demand response to the carbon price through demand elasticity coefficients.

Figure 2-5: Average emissions intensity for the SA region of the NEM, 2007-08



Source: MMA analysis[10]

2.3.2.2 Impact on electricity prices

Under the CPRS, electricity prices are likely to increase for two reasons. First, purchasing permits will increase the costs of generation. Second, over the next decade, low emission generation options will no longer obtain subsidies for generation under the NSW Greenhouse Gas Abatement Scheme (NGGAS), which helped lower the cost of gas-fired generation and put downward pressure on electricity prices.

Achieving deep cuts will likely see electricity prices more than double[11]. The increases will vary by state. Prices would increase more in Victoria in the short-term (to 2020) due to the high emission intensity of some of the generating plant in that state[12]. However, Victoria has some of the lowest cost emission abatement options which will tend to limit price increases and could provide Victoria with a comparative advantage in electricity generation in the long term. This could affect the pattern of interconnector flows with South Australia depending on how this affects relative prices. In the NEM, price increases are also likely to be high in New South Wales due to the high cost of low emission generation in that state and limited opportunities for switching away from coal-fired generation in the short-term.

[10] Average annual emissions intensities were calculated by NEM region at the sent-out level excluding exported energy and including energy imported from neighbouring regions. The formula underlying the calculation is simply total emissions for the year divided by total generation. This differs from Department of Climate Change estimation methodology but is included to provide an indication of the decrease in the emissions intensity of South Australian electricity.

[11] MMA report 2008, Impacts of an emissions trading scheme on Australian Electricity Markets, report to Department of the Treasury, Canberra, Dec 2008

[12] Currently it is expected that assistance for coal fired generators (with emission intensity >0.86t $C0_2$e/MWh) will conclude in June 2016. The conclusion of compensation is not likely to lead to higher prices of itself as the compensation is in the form of free permits to the generators. The permits still have an opportunity cost (they can be sold to some other party). If the compensated generator cannot recover short term operating costs with the permit priced at is opportunity cost, they would be better off to sell the permit and stop generating. Thus, the provision of free permits will not change the dispatch decisions and therefore will not impact on electricity prices.

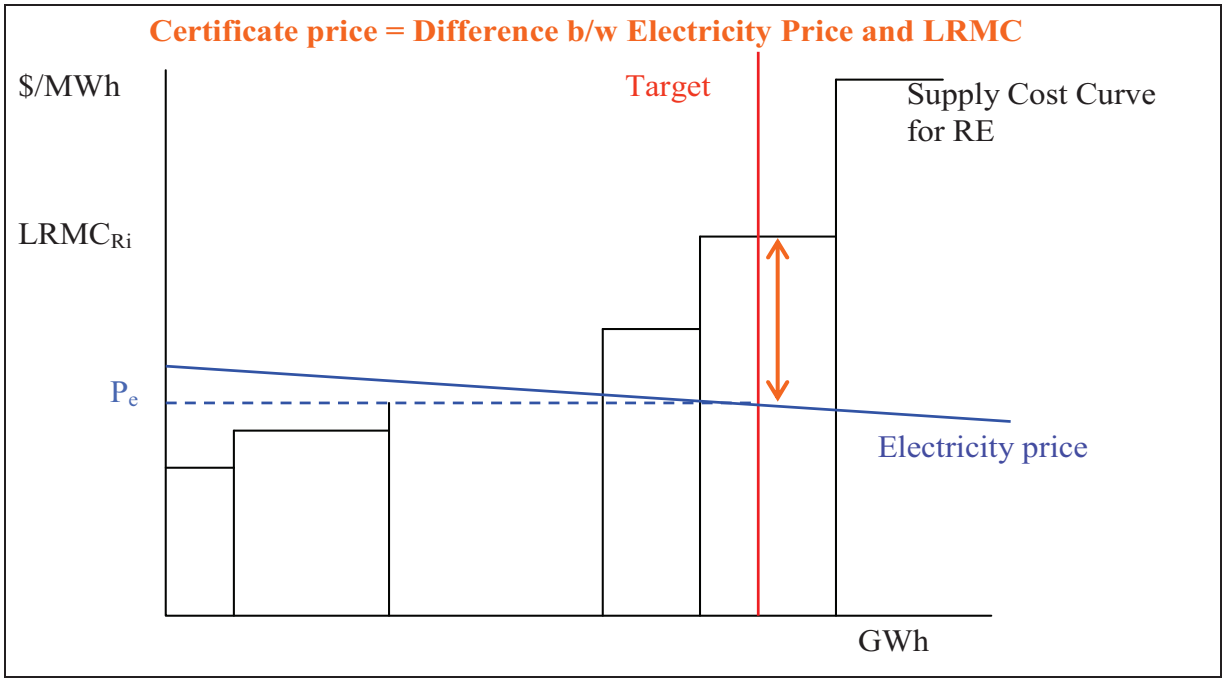
Price increases in South Australia will be muted due to the relatively low emission intensity of generation.

Furthermore, the CPRS will reduce electricity demand as people may give more attention to energy efficiency. These energy savings will have more impact on peak loads than on base loads. Additionally, emission trading will also tend to increase off-peak prices (when coal plants typically set the price) more than peak prices (when gas plants more often set the price). Intermittent renewable generation, such as solar power and wind power at some locations, can generate more of their generation during hours of peak demand, which will also tend to dampen prices in peak periods.

2.3.2.3 Impacts on the RET Scheme

The impacts on the RET scheme regarding the REC price are illustrated in Figure 2-6. It shows the relationship between REC price, electricity price and the long run marginal cost (LRMC) of renewable energy generation. The bars in this graph show, that with an increasing renewable energy target, generators with higher LRMC enter the market. For example, the first 1,000 GWh of a renewable energy target are generated by renewable power plants with low LRMC, like hydro or bagasse generators. As the target increases, the amount of low cost generation may not be enough and generation technologies with higher LRMC enter the market. The last generator that enters the market to just fulfil the renewable energy target is called marginal generator. The certificate price reflects the difference between the electricity price and the LRMC of the marginal generator. For a given LRMC, the REC price decreases with increasing electricity prices and vice versa.

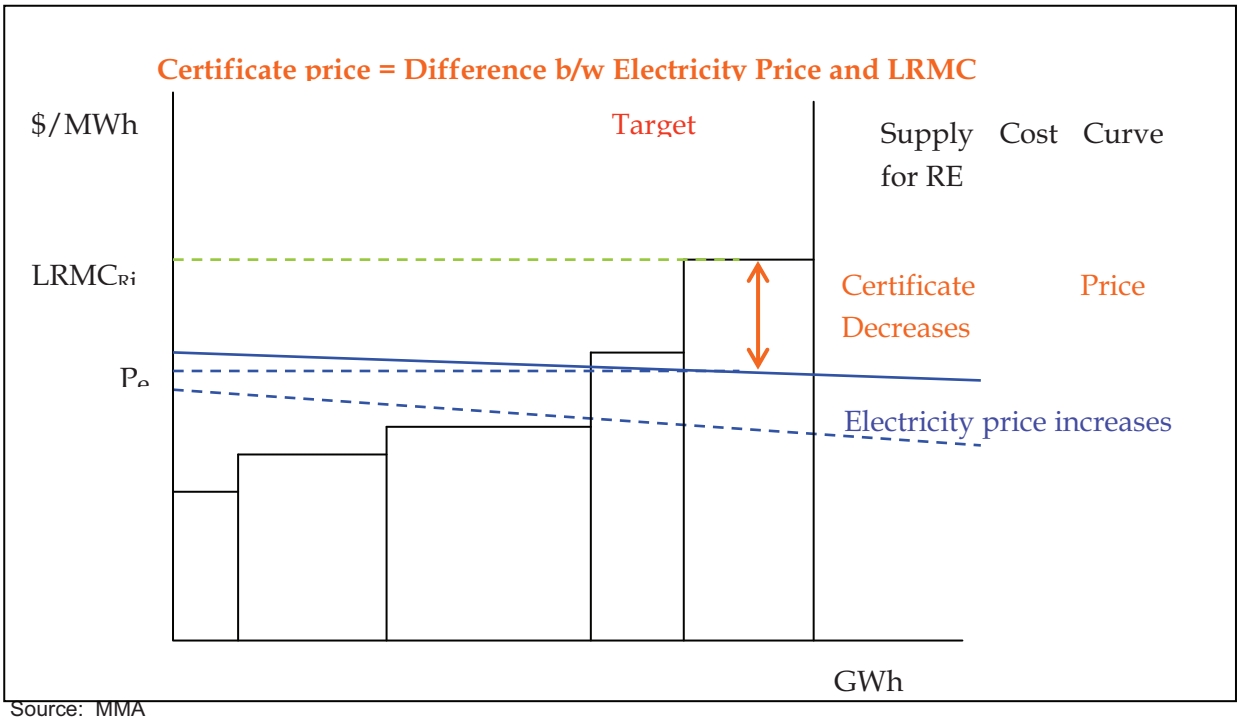
Figure 2-6: Certificate Price



Source: MMA

With the introduction of an emission trading scheme, it is likely that the electricity prices will increase over time due to rising generation costs of conventional generators. From this it follows that the margin from REC sales needed for a renewable generator to enter the market decreases as well. It follows that depending on the renewable energy target, the REC price should decrease, as shown in Figure 2-77.

Figure 2-7: Certificate price under increasing electricity price



Source: MMA

2.3.3 Transmission investment and remote renewable generation

National and state level energy policies, including the South Australian renewable electricity targets and related policy initiatives, will lead to a significant shift in the locations where electricity is generated from areas with large coal resources to areas with renewable energy resources, and areas around significant gas infrastructure. The areas with excellent renewable energy resources are along the southern and west facing coasts of South-east Australia and in the outback where solar and geothermal energy is more prospective.

A key challenge for transmission investment under these changes is to provide for an efficient pattern of infrastructure investment, with respect to time, location and with regard to trade-offs between alternative investment options. This challenge is affected by economy of scale issues that relate to large lumpy investments, free-rider effects, particularly when transmission expansion is in part funded by generation connection costs, and other system objectives that may have social good characteristics that are not fully reflective in market prices. The latter can include certain aspects associated with reliability or environmental objectives.

Generators setting up in remote locations need to be able to share deep connection costs and to obtain firm access for their financial commitment to transmission capacity. The

current piecemeal bilateral planning processes will not necessarily lead to efficient outcomes. Additional measures are needed to provide better information for planning purposes on the long-run marginal cost of transmission capacity related to the transmission projects that are prospective. In additional demand side providers and embedded generators need relevant information on the value of their capacity in deferring network investment. This would enable them to bring forward competitive options well before the network projects enter the regulatory approval phase.

To improve the efficiency of transmission development and to provide for the transformation to a low emission generation sector, a number of key issues will need to be progressed, including:

- The provision of information on the long-run marginal cost of alleviating the inter-regional and the main intra-regional constraints based on the cost of prospective augmentations and the impact of their need in relation to regional generating capacity and peak demand
- The provision of information on the value of the capacity of additional embedded generation at each major transmission node where local generation or demand side response is prospective.
- A regulatory approval process that values the benefits of a remote grid extension among local generators and local and remote customers having regard to the projected impact of the project on REC and energy prices.
- An inter-regional TUoS charging regime so that these benefits can be reflected in charges to customers across the regional networks according to the distribution of benefits, including through the impact of REC prices.

In order to provide investor confidence to continue with the current resource development and commercialisation of new technologies, it may be necessary to upgrade the planning and risk analysis processes so that sound plans can be laid out for network developments in time for connection of the new large scale resources. In some cases higher voltage levels will be necessary to realise the full potential in the long-term and this necessarily involves financial risk due to the potential for under-utilised assets for longer than might be expected under foreseeable scenarios.

The major opportunities for large scale development in South Australia involve:

- Network strategy for connection of new large scale renewable energy resources in NSW and South Australia. This would involve:
  - Augmentation of the Victoria-South Australia interconnection to allow large exports from South Australia to Victoria.
  - Direct connection of geothermal resources to Olympic Dam, Port Augusta and/or Adelaide with export of surplus power via the Heywood interconnection.
- Augmentation of the Victoria and South Australia to NSW connections to allow surplus renewable energy to flow north and displace coal fired generation in NSW and Queensland.

2.3.4 GreenPower

GreenPower sales have being growing strongly in recent years. Over the last two years growth in sales has increased by around 50% per annum.

The growth in GreenPower sales is a function of a number of factors including:

- Growth in consumer income over time.
- Price of renewable energy generation (GreenPower) relative to the delivered price of electricity from conventional generation sources
- Willingness to pay for renewable generation by niche consumers.

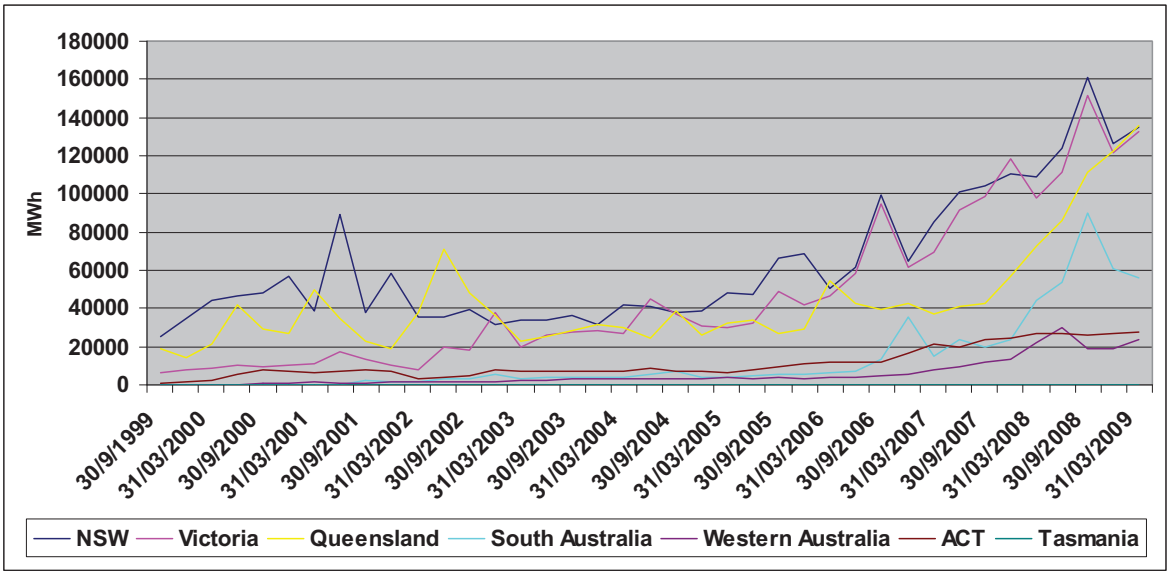
With the implementation of the CPRS and the RET scheme, additional renewable energy generation will come on stream over the next ten years to the point where renewable energy generation under these two measures will comprise around 20% of total electricity consumption in Australia. By 2020 South Australia's Renewable Electricity Generation Target will deliver sufficient renewable generation to contribute about a third of total electricity consumption, depending on the level of interconnector imports. GreenPower sales will add to this overall contribution.

However, the implementation of these additional measures may hamper growth in GreenPower sales. Those customers wishing to support renewable energy generation may now feel that the two measures, combined with South Australia's renewable electricity targets, provides enough support to replace the need for individuals to support renewable energy generation. Second, customers wishing to reduce emissions may feel that voluntary action through the purchase of GreenPower may not lead to a net reduction in emissions and therefore it would not be worthwhile to join in a GreenPower scheme. Lower income growth due to the global financial crises may also hamper GreenPower sales in the near future.

On the other hand the gap between the cost of conventional electricity generation and the cost renewable energy generation (under a GreenPower scheme) is likely to reduce, encouraging additional customers to join GreenPower schemes.

The trend in sales has been consistent across most of the states suggesting common factors behind the recent growth. Growth in South Australia has followed trends in the other states. Victoria and NSW sales have consistently had the highest sales, but sales in Queensland have grown strongly over the past year to reach the levels of the other two states. Proportional to total load, South Australia has one of the highest rates of uptake of Green Power.

Figure 2-8: Sales of Green Power by States



Source: MMA analysis

Major customers of Green Power are the State Governments themselves. For instance South Australia has purchased 20% of its electricity as GreenPower since 1 January 2008.

2.3.5 Premium Feed-In Tariffs

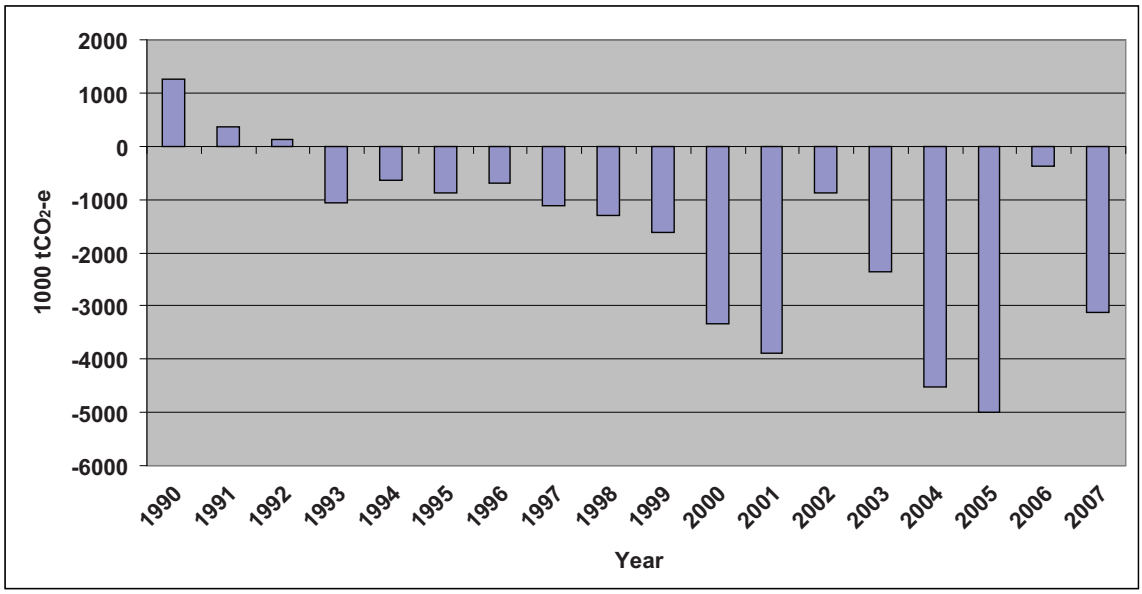
State Governments other than Western Australia, Northern Territory and Tasmania have enacted a feed-in-tariff to support small scale PV installations and, in some cases, other small scale renewable generation. Limits on the maximum size of system supported vary by state with the maximum size in any one State being 10 kW. Tariffs range from about $440/MWh to $660/MWh. Some State Governments have placed limits on the level of uptake, either on the basis of installed power, or on the basis of energy produced per annum.

Adding the impact of the proposed multipliers under the RET scheme (where small scale PV installations can earn multiples of up to 5 RECs per MWh), will likely see large uptake of these systems in the period to 2015.

2.3.6 SA Land Use Patterns

From 1990 to 2007, South Australia's greenhouse gas emissions dropped from 6.7% from almost 33,000 tonnes to less than 30,900 tonnes of CO_2-e. All of this reduction can be attributed to Land Use, Land Use Change and Forestry (LULUCF). Indeed, in 2005 reductions in this sector approximated 15% of South Australia's total 1990 greenhouse gas emissions (Figure 2-9). Much of this decrease has been achieved by moving from net vegetation clearance in 1990 to revegetation and new forestry plantings in the more recent period.

Figure 2-9: SA GHG Emissions from LULUCF 1990-2007



Source: The Australian Greenhouse Emissions Inventory System (AGEIS)
http://ageis.climatechange.gov.au

A growing contribution from LULUCF could be maintained, but would require continued and significant change in SA land-use patterns.

It is unclear to what extent the CPRS will impact this growing contribution to emission reductions in South Australia. It is acknowledged that the CPRS is proposed to apply to all IPCC sectors except Agriculture and LULUCF, although these sectors may be included as part of an offset arrangement (to be decided after are review in 2013).

3 THE RENEWABLE ELECTRICITY TARGETS

3.1 Calculating the Renewable Energy Targets

The Climate Change and Greenhouse Emissions Reduction Act (2007) also sets two related renewable electricity targets, and enables the Minister to set additional interim and sector-based targets. Together with the principal SA GHG Target, these targets seek to deliver the object of the Act which is to assist "the achievement of ecologically sustainable development in the State by addressing issues associated with climate change"[13].

The related renewable electricity targets are:

1. *to increase the proportion of* ***renewable electricity generated*** *so that it comprises at least 20% of electricity generated in the State by 31 December 2014*

   [hereafter referred to as the 2014 Renewable Electricity Generation Target];

2. *to increase the proportion of* ***renewable electricity consumed*** *so that it comprises at least 20% of electricity consumed in the State by 31 December 2014*

   [hereafter referred to as the 2014 Renewable Electricity Consumption Target].

An additional interim and sector based target was made by the Minister under Part 2 of the Act for:

3. *33.3% of South Australia's* ***electricity generation*** *to come from renewable energy by 2020*

   [hereafter referred to as the 2020 Renewable Electricity Generation Target].

The distinction between generation and consumption that is a feature of these additional renewable electricity targets addresses the role of the state's two electricity interconnectors, Heywood and Murraylink. In the absence of the renewable electricity consumption target, it would be possible to move towards the achievement of the renewable electricity generation target by increasing electricity imports. The inclusion of the consumption target therefore addresses this, ensuring that the state's performance is effectively independent of interconnector performance in any given year.

South Australia's Strategic Plan 2007[14] specifies that the data sources for these renewable electricity targets are the Electricity Supply Industry Planning Council (ESIPC) and the Australian Greenhouse Office (AGO).

On 1 July 2009 ESIPC became part of the Australian Energy Market Operator (AEMO). The AGO is now the DCC.

The renewable electricity targets can be calculated as ratios and expressed as a percentage. The calculation of the targets therefore requires the determination of both the

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13 Section 3(1)(a)(ii) of the *Climate Change and Greenhouse Emissions Reduction Act (2007).*

14 Page 25.

numerator and the denominator. The following considers a methodology for each of these renewable electricity targets.

3.2 The revised methodology

CSIRO concurs with previous South Australian Government deliberations in recognising the value of taking measurements for the renewable electricity generation and consumption targets at the interconnection point between the transmission and distribution system, using the NEM regional reference node (RRN) as the locational proxy. The rationale for this revision is summarised as follows:

1. The decision to include both a generation and a consumption target is in part to address the State's imports of electricity from outside of South Australia, and therefore to assist a measure of progress that has some independence from interconnector performance in any given year. This logic suggests that the generation and consumption targets should converge when interconnector flows are nil. In this respect the generation and consumption targets are therefore useful when compared. The approach of the SA Methodology Statement does not adopt a common locational basis between measures of the consumption and generation targets, therefore causing transportation losses to introduce a wedge between these targets. This wedge makes a comparison in progress between the two classes of target less intuitive and immediate than is the case in the recommended methodology, which adopts a common locational basis. Insofar that the wedge has the effect of indicating that the generation target is lagging the consumption target, the approach in the SA Methodology Statement may give rise to incorrect perceptions that the State's renewable electricity generation performance is inferior to it's renewable electricity consumption performance; the recommended approach mitigates this.

2. The CSIRO notes that it is a requirement of the Act that the Minister seeks to provide consistency with best national and international practices with respect to methods for measuring progress in relation to renewable electricity, and further, that the Minister takes into account the relevant methodologies and principles that apply within other Australian jurisdictions. For this reason the CSIRO acknowledges the benefit of measuring the renewable electricity targets on a locational basis that is consistent with that adopted for use in the enhanced RET scheme. The CSIRO therefore suggests that the locational basis for the measurement of the targets be the regional reference node used in the National Electricity Market (NEM) for South Australia. This also brings the measurement of the targets in line with the reporting practices in the NEM that reports much data at the location of the regional reference nodes.

3.2.1 2014 Renewable Electricity Generation Target

The numerator of this target must measure the total amount of renewable electricity generation in South Australia for each assessment year. The denominator must measure the total amount of electricity generation in South Australia for each assessment year.

As mentioned earlier, the inclusion of both a consumption-based and a generation-based renewable electricity target accommodates the interconnection of South Australia with the transmission grid of the NEM, and the effect that this can have on the achievement of the generation-based target; in particular the effect that imports can have in assisting the achievement of the generation-based targets. The use of both a consumption-based and generation-based target therefore provides a basis for the state's performance to be assessed with some independence from interconnector performance. The implied logic is that both targets can be similarly achieved, and are effectively the same, when there are no net imports of electricity. This suggests that each target should have a comparable measurement basis, therefore requiring a consideration of system losses as part of the methodology.

System losses occur between the point of generation and the point of consumption and are specific to power flows along the length of the transmission and distribution systems. Measures of generation therefore occur prior to system losses, and measures of end-use occur after system losses. For the generation target to have a comparable measurement basis with the consumption target, thereby ensuring consistency when there is no net trade in electricity, the targets will need to share a similar locational basis.

The CSIRO notes that under the MRET and RET schemes, the liability and the amount of certificates created for each renewable generator is measured at the point of delivery from the transmission system to the distribution system, usually measured for convenience at the regional reference node. For symmetry between the implementation of State and Federal methodologies therefore, it would seem reasonable for the renewable electricity targets to be measured at this same location. It will also reduce a propensity for transportation losses to introduce a wedge between the targets, caused by the distance between sources of generation and sources of consumption.

For this reason the CSIRO suggests that each of the renewable electricity targets are measured at the location of the South Australian regional reference node (Torrens Island) that is part of the NEM.

In practice, this will mean adjusting the data for the numerator and denominator of each target for transportation losses:

- data having a locational source within the transmission system should be adjusted by multiplying the data by the square root of the appropriate Marginal Loss Factor (MLF) that is published by AEMO[15];

[15] http://www.aemo.com.au/electricityops/lossfactors.html. By calculating the square root of the MLF, the average loss factor can be determined.

- data having a locational source within the distribution system should be adjusted by multiplying the data by the appropriate average Network Loss Factor that is published by AEMO[16].

With respect to the renewable electricity generation target, data for the numerator can be found in the ESIPC 2009 Annual Planning Review (2009 APR) and as published by the Commonwealth Department of Environment, Water, Heritage and the Arts:

- Table 2-6 of the 2009 APR summarises *Other Renewable* generation on a 'sent-out' measurement basis; the historical actuals summarise non-scheduled biomass and hydro generation. This table also includes generation projections through to 2018-19. The projections are based in part on estimates produced by KPMG Econtech; the CSIRO has not reviewed the assumptions and methodology used by KPMG Econtech, so does not have a position on the robustness of the projected series. The actual historical outcomes presented in this table should however provide a reliable and appropriate data source for assessing actual progress.
- Estimates for each assessment year should be multiplied by the average distribution loss factor (HV) published by AEMO[17].
- Table 3-16 of the 2009 APR summarises the actual generation output of all wind generation (scheduled and non-scheduled), on a sent out basis.
- Estimates for each assessment year and each generation unit should be multiplied by the square root of the relevant MLF for the unit, as published by AEMO[18]. For most generation sites this will have the effect of reducing the generation estimate, reflecting the effect of transportation losses in dissipating some of the sent-out energy by the time it is delivered at the regional reference node. Intuitively, this reflects the fact that some of the sent-out renewable electricity generation is not realised at the point of consumption.
- ESIPC states on page 62 of its 2009 APR that solar generation from sub 1 MW installations has been treated as a reduction to customer demand rather than as addition to supply. Therefore the numerator will also need to include a measure of this embedded solar generation. A time-series measure of installed grid-watts is collected and published as part of the Solar Homes and Communities Plan (SHCP) of the Commonwealth Department of Environment, Water, Heritage and the Arts[19]; the SHCP was formerly the Photovoltaic Rebate Program that commenced in 2000. SHCP statistics summarise data related to installations under the Photovoltaic Rebate Program (PVRP). It is noted that the PVRP is only available for residential

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[16] It is noted that the Regional Reference Node (RRN) for South Australia sits outside the distribution system; in practice there will be some small transportation loss for flows between the distribution system and the RRN. For the purpose of the methodology these small losses are ignored. The size of these losses may average about 1% of affected flows.

[17] The High Voltage (HV) DLF should be used. See page 17 of http://www.aemo.com.au/electricityops/171-0021.pdf

[18] For scheduled generation, published MLF's for the respective generation units were used. For non-scheduled generation in aggregate form, an estimated loss factor was calculated by determining by calculating the square root of an average annual output-weighted MLF based on the published MLFs that apply for each non-scheduled wind generator (0.88377 was the computed MLF); the square root of this was then applied to the aggregated estimate.

[19] See http://www.environment.gov.au/settlements/renewable/pv/pubs/wattsbymonth-sep09.xls

and community projects, and therefore SHCP statistics do not include data relating to commercial installations.

The CSIRO is of the view that SHCP statistics can provide an acceptable basis for approximating a time series of solar generation from sub 1 MW installations. Using the assumptions that all installed grid-watts are operational and that no capacity losses occur over time, the measure of installed grid-watts can be multiplied by an appropriate solar zone rating[20] to deem an estimate of annual generation.

The Zone Rating for Adelaide is 1.382, meaning that a 1KW PV installation is deemed to generate 1.382MWh per annum. The methodology supplied by the South Australian Government relating to South Australian Strategic Plan Target 3.12 'Renewable energy' [21] suggests a value of 1.5 as an approximation for all SA systems. The figure is somewhat higher than the zone rating for Adelaide, SA's major population centre. CSIRO notes that the difference in the zone rating, when applied to PV installations as at June 30 2009, amounts to 0.01% of ESIPC'S 2009 APR estimate of total customer sales for the year 2008/09. In light of this very low value and consistent with maintaining compatibility between the South Australian Government and Federal Government methodologies, it would be useful to continue to use the Zone Rating for Adelaide of 1.382.

Given that solar PV installations are typically located in the distribution system, estimates should be multiplied by the average Distribution Loss Factor (Low Voltage Demand DLF published by AEMO) to approximate the additional amount of energy that would otherwise need to be supplied to source the energy via the regional reference node. This effectively adds a factor to the actual generation value to reflect the savings in distribution losses that are directly attributable to the embedded generation.

The denominator requires the summation of renewable electricity generation as defined above, plus a measure of all other generation in South Australia, thereby providing a measure of total electricity generation in South Australia for the assessment year. Data inputs for the denominator include the following:

- Data inputs used to calculate the numerator, plus
- Total SA Generation for year (from Table 3-16 of the 2009APR: Historical Generation for SA Generators, excluding wind which is already captured in the numerator above).
- Estimates should be multiplied by the square root of the appropriate MLF for the generation unit.
- Other non-scheduled generation (Table 2-6 of the 2009 APR).

[20] Renewable Energy (Electricity) Regulations 2001
[21] Climate Change and Greenhouse Emissions Reduction Act 2007 Section 5–Targets: Methodology Statements & Report of Historical Performance, September 2009

- Estimates of other non-scheduled generation should be multiplied by the average DLF (High Voltage) that is published by AEMO.

3.2.2 2020 Renewable Electricity Generation Target

The methodology and data sources for the 2020 Renewable Electricity Generation Target should be the same as for the 2014 Renewable Electricity Generation Target.

3.2.3 2014 Renewable Electricity Consumption Target

The numerator of this target must measure the total amount of renewable electricity that is consumed in South Australia for each assessment year. The denominator must measure the total amount of electricity that is consumed in South Australia for each assessment year.

With respect to the numerator, consideration must be given to whether it should be measured on a physical or contractual basis:

- A contractual basis defines the consumption of renewable electricity based on what is contracted at the customer level, for example, via contracted MRET or Green Power requirements;
- A physical basis defines consumption of renewable electricity based on flows that are physically attributed to the sent-out energy of renewable electricity generators in the state, using the assumption that what is generated in the state is consumed in the state.

The CSIRO notes that the DCC has considered this issue in the Technical Guidelines that accompany the NGER[22]. In particular, the DCC recognises that "within an electricity grid it is impossible to physically trace or control the actual physical source of electricity received by each customer." Moreover, to attempt such, the DCC acknowledges the consequences of complexity and a propensity for double-counting.

The CSIRO supports the use of a physical basis for defining the consumption of renewable electricity.

Although a proportion of renewable electricity may be supplied into South Australia from renewable generation sources located in other jurisdictions, the means for deeming the quantum of this renewable content at the regional reference node is complex, involving calculations encompassing all NEM generators, interconnector flows and loss factors, and likely to be relatively insignificant given that interconnector performance has recently moved in the direction of net exports, a trend that may continue based on expected price differentials between South Australia and Victoria. The CSIRO advises that the consumption target methodology ignores the calculation of deemed renewable electricity

[22] http://climatechange.gov.au/reporting/publications/pubs/draft_nger_technical_guidelines.doc, p366.

from the interconnectors as a result of the complexity of the calculation and the likely insignificance of the result.

The numerator should therefore be calculated on the same basis as for the numerator of the renewable electricity generation target.

Whereas, the numerator requires a physical measure of consumption based on the sent-out energy of renewable electricity generators that are indigenous to the state, thereby excluding imported renewable power, the denominator requires a measure of the total consumption of electricity, including that which is imported via the interconnectors. Again, this measure of consumption should include the associated system losses that are associated with its delivery to the location of the regional reference node. The denominator also requires an estimate of the generation of embedded solar PV installations, reflecting the extent that this generation offsets customer demand for alternatively supplied power.

The denominator should be calculated as the sum of the following:

- Total Customer Sales (from Table 2-6 ESIPC APR2009:). The data should be multiplied by the average Distribution Loss Factor (Low Voltage Residential) published by AEMO to approximate the additional amount of energy that would otherwise need to be supplied to source the energy via the regional reference node.
- Solar generation (SHCP Statistics) multiplied by the solar zone rating of 1.382. The estimate should also be multiplied by the average Distribution Loss Factor (Low Voltage Demand DLF) published by AEMO.

While it may reduce the impact of some discrepancies, the revised method should not hide discrepancies between base consumption and generation data so that the revised method continues to provide information for the SA Government to identify and correct discrepancies, and so improve the estimation.

The driver trees in figure 3-1 describe the revised methodology for both targets while figure 3-2 describes the location of the generator and consumption loss factors with respect to the transmission and distribution networks and the South Australian regional reference node.

Figure 3-1: Calculating the Renewable Electricity Generation and Consumption

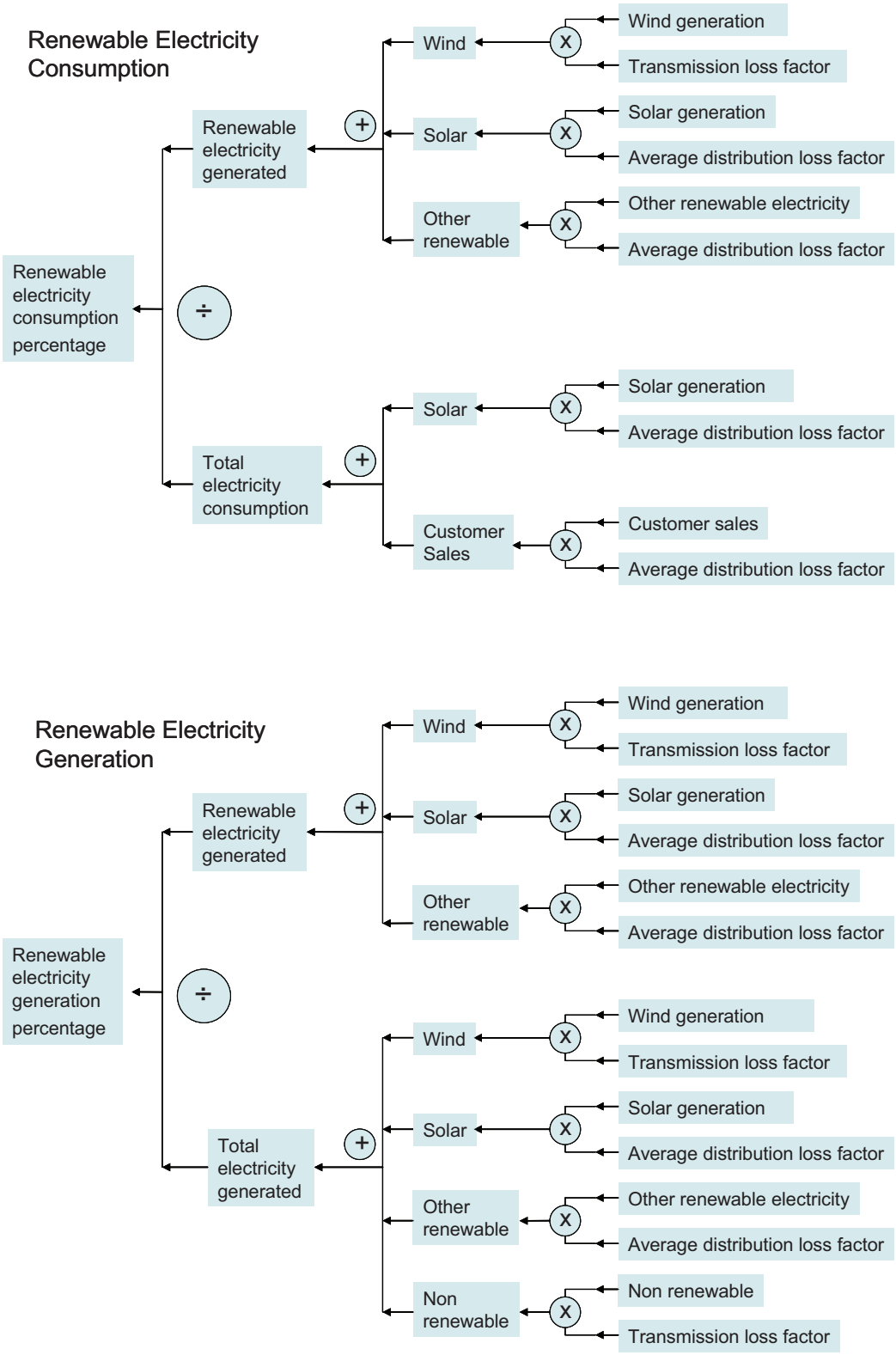
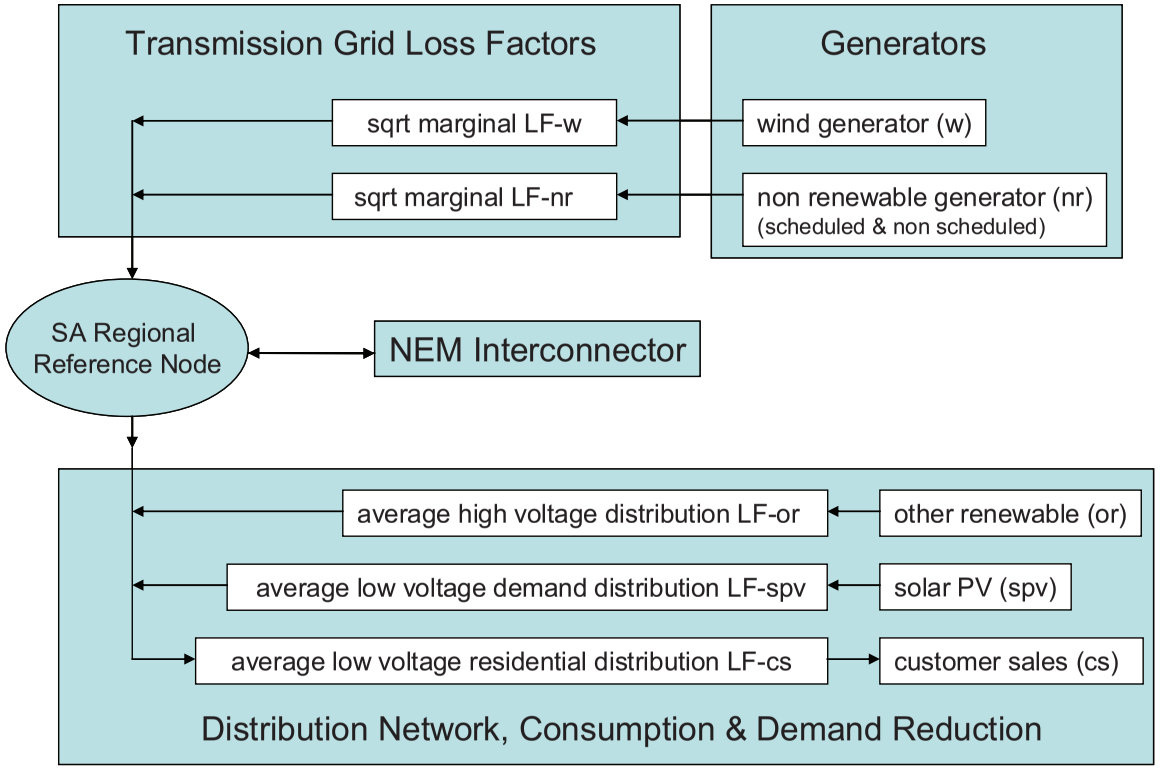


Figure 3-2: Location of the Generator and Consumption Loss Factors (LF)

Renewable electricity generation target
(wind + solar + other renewable) / (non renewable + wind + solar + other renewable)

Renewable electricity consumption target
(wind + solar + other renewable) / (customer sales + solar)



3.3 Progress Towards the Renewable Electricity Target

3.3.1 Renewable Electricity Generation Targets

The data shows that South Australia is well progressed in terms of achieving the 2014 generation target of 20%, and similarly the 2020 target of 33.3%. Indeed, the estimated average annual output from all wind generation plants in South Australia that are either existing, or proposed for commissioning prior to 2015, makes up 34% of the sent-out energy requirement that is forecast (median) by ESIPC to supply customers in 2014/15.

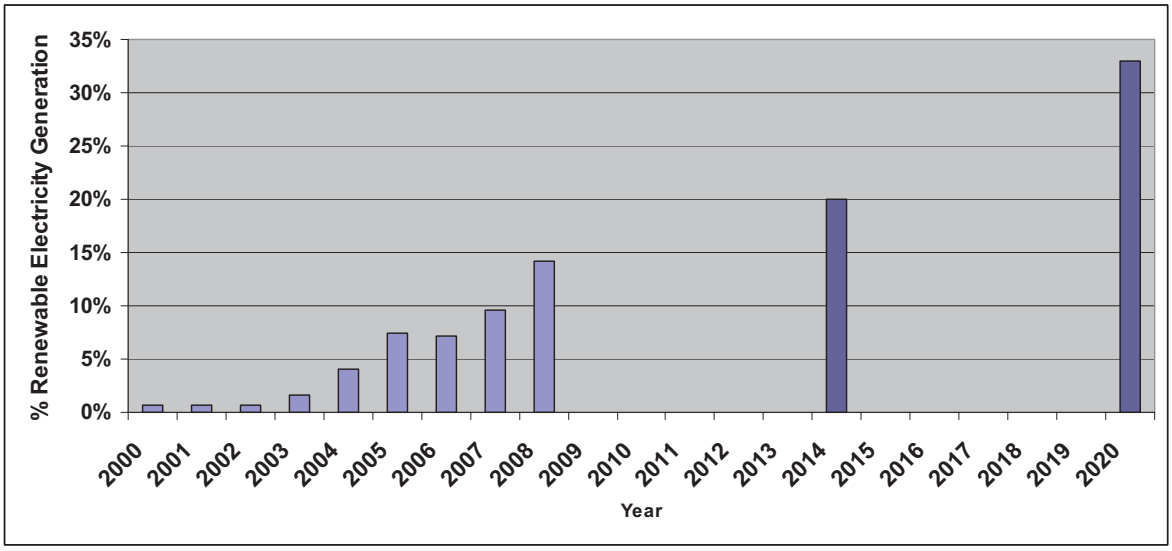
- Average annual output of existing SA wind units[23]:
  - 2,556 GWh
- Average annual output of wind units that are existing and proposed for commissioning prior to 2015:
  - 5,366 GWh (33.9% of 2014 estimated sent out generation if no net imports[24])
- Average annual output of wind units that are existing and proposed for commissioning prior to 2020:
  - 7,566 GWh (44.1% of 2020 estimated sent out generation[25] if no net imports)

Based on current installed renewable generation capacity and assuming all announced wind projects go ahead as scheduled, the CSIRO expects that South Australia will achieve its 2014 and 2020 Renewable Electricity Generation Targets.

Figure 3-3 summarises current progress towards the 2014 and 2020 Renewable Electricity Generation Targets.

[23] The average annual output of existing and proposed wind units is based on a combination of information from the 2009 AEMO Electricity Statement of Opportunities and supporting data obtained from McLennan Magasanik Associates.
[24] ESIPC estimated sent-out energy 2014/15 (50%PoE) from 2009 APR.
[25] ESIPC estimated sent-out energy 2018/19 (50%PoE) from 2009 APR increased by an estimated growth factor of 1.2%.

Figure 3-3: Progress towards the Renewable Electricity Generation Targets



Source: MMA analysis - revised method

Table **3-1** shows this recent performance in tabular form

Table 3-1: Progress towards the Renewable Electricity Generation Targets

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Revised method	0.71%	0.66%	0.73%	1.56%	4.00%	7.44%	7.11%	9.56%	14.21%
Current method	0.68%	0.63%	0.74%	1.81%	4.10%	7.72%	7.38%	9.69%	14.76%

Source: MMA analysis

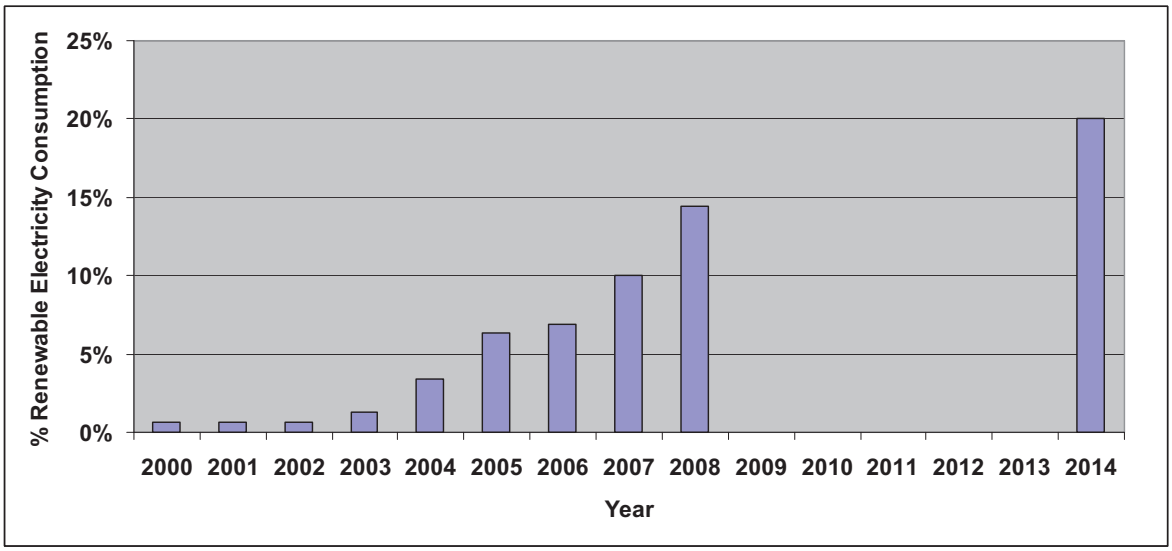
It can be observed from Table 3.1 that the SA Methodology Statement (the current method) initially measures a lower percentage of progress than does the revised method, until the financial year 2002/03, from which point the current method measures a higher percentage of progress towards the targets. This feature in the time series is in part influenced by the quantum of measured wind generation, which is low prior to 2003/04 and thereafter increases to significant levels. Wind generation, due to the location of the generators, incurs greater transportation losses than conventional thermal generation, meaning that a lower proportion of sent-out generation is deliverable to the load centre near Adelaide. Given that the revised method explicitly adjusts for transportation losses to the point of the regional reference node, the revised method measures a lower proportion of delivered wind generation (relative to what is sent out) at this node than it does for conventional thermal generation. The effect is that when wind generation is significant in amount, the revised method may report a slightly lower percentage of progress than the current method.

With both methods, the data shows that South Australia is well progressed in terms of achieving the 2014 and 2020 Renewable Electricity Generation Targets.

3.3.2 Renewable Electricity Consumption Targets

Figure 3-4 summarises current progress against the 2014 Renewable Electricity Consumption Target.

Figure 3-4: Progress towards the Renewable Electricity Consumption Target



Source: MMA analysis - revised method

Table 3-2 shows this recent performance in tabular form.

Table 3-2: Progress towards the Renewable Electricity Consumption Target

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Revised method	0.61%	0.61%	0.63%	1.31%	3.44%	6.33%	6.93%	10.00%	14.42%
Current method	0.63%	0.64%	0.69%	1.65%	3.84%	7.16%	7.85%	11.05%	16.35%

Source: MMA analysis

The SA Methodology Statement (the current method) typically measures a higher percentage of progress than does the proposed approach, attributable in the main to the denominator of the measure (Total Customer Sales). In the case of the SA Methodology Statement approach, the denominator does not include the transportation losses that must be incurred in delivering the electricity to the point of metered consumption. This makes the denominator significantly smaller in quantum than is the case with the proposed methodology that explicitly adjusts for transportation losses.

With both methods, the data shows that South Australia is well progressed in terms of achieving the 2014 consumption target of 20%. As noted in the case of the renewable electricity generation targets, the estimated average annual output from all wind generation plants in South Australia that are either existing, or proposed for commissioning prior to 2015, makes up 34% of the sent-out energy requirement that is forecast (median) by ESIPC to supply customers in 2014/15. This well exceeds the determined target.

It is interesting to note that when using the revised method to compare the performance of the generation and consumption targets for like years, the direction of the interconnector performance can be approximated by considering the difference in the measured progress between each target. In the time series South Australia was a net importer of electricity until 2007/08 when it became a net exporter. Interim progress towards the generation target was therefore superior relative to the consumption target until 2007/08 when the opposite becomes true.

Based on current installed renewable generation capacity and assuming all announced wind projects go ahead as scheduled, the CSIRO expects that South Australia will achieve its 2014 Renewable Electricity Consumption Target.

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