Report to

Department of Climate Change and Energy Efficiency

Impacts of Changes to the Design of the Expanded Renewable Energy Target

May 2010

McLennan Magasanik Associates

Project Team

Walter Gerardi

Melbourne Office
242 Ferrars Street
South Melbourne Vic 3205
Tel: +61 3 9699 3977
Fax: +61 3 9690 9881

Brisbane Office
GPO Box 2421
Brisbane Qld 4001
Tel: +61 7 3100 8064
Fax: +61 7 3100 8067

Email: mma@mmassociates.com.au
Website: www.mmassociates.com.au

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CoPS	Centre of Policy Studies
CPI	Consumer Price Index
CPRS	Carbon Pollution Reduction Scheme
DKIS	Darwin Katherine Interconnected System
ERET	Expanded Renewable Energy Target
GDP	Gross Domestic Product
GHG	National Greenhouse Gas
GNP	Gross National Product
IGCC	Integrated Gasification Combined Cycle Plants
IMO	Independent Market Operator
MMA	McLennan Magasanik Associates
MRET	Mandatory Renewable Energy Target
NEM	National Electricity Market
NGGI	National Greenhouse Gas Inventory
REC	Renewable Energy Certificate
REMMA	Renewable Energy Market Model Australia
RET	Renewable Energy Target
SHW	Solar Hot Water
SWIS	South West Interconnected System
TWA	Time Weighted Average
VOLL	Value of Lost Load
VREC	Victorian Renewable Energy Certificates
VRET	Victorian Renewable Energy Target

1 INTRODUCTION

The Department of Climate Change and Energy Efficiency has engaged McLennan Magasanik Associates to conduct economic and electricity market modelling of the changes to the expanded Renewable Energy Target (RET) scheme announced on 26 February 2010 (known as the enhanced RET). The changes involve splitting the RET into a Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES).

The modelling and analysis is designed to provide information on national and state impacts of the changes, including:

- Investment profile.
- Investment cost.
- Technology mix.
- Electricity prices.

In this report, monetary values are in mid 2009 dollar terms, unless otherwise stated, and stated years refer to financial year ending June.

2 METHOD AND ASSUMPTIONS

2.1 Overview

The same method and underlying assumptions used in the modelling of the expanded RET for the Department of Climate Change and Energy Efficiency (formerly the Department of Climate Change) in early 2009 has been used in this study (a report outlining this approach is on the department's website). Essentially there are three steps to the modelling:

- Step 1: Renewable energy market modelling, using MMA's REMMA model. This model determines the mix of renewable energy technologies that meets the cumulative target over the life of the LRET at least cost to the market, subject to any restrictions contained in the scheme design. Outputs from this modelling include the mix of renewable energy generation by technology by State and the certificate price required to allow the target to be met. The certificate price is set by the long run marginal cost (minus the electricity price received for its output) of the last generator required to meet the target.
- Step 2: In conjunction with Step 1, modelling of the uptake of small-scale electricity generation and displacement technologies under the SRES is undertaken. This includes solar water heater, heat pump water heater, small scale photovoltaic and other deemed generation technologies.
- Step 3: Electricity market model simulations. Using the outputs of the renewable energy capacity by State (from the REMMA model) in MMA's Strategist model of the major electricity markets in Australia, simulations of the wholesale electricity market are undertaken to determine impacts on electricity price, investments in new conventional generation technologies and resource costs.

The process is repeated in an iterative fashion until stable results are achieved.

The economic impacts of the enhanced RET on the electricity market have been modelled above the impact of the current RET and the proposed Carbon Pollution Reduction Scheme (CPRS) minus 5 scenario.

2.2 Modelling Impacts on the Electricity Market

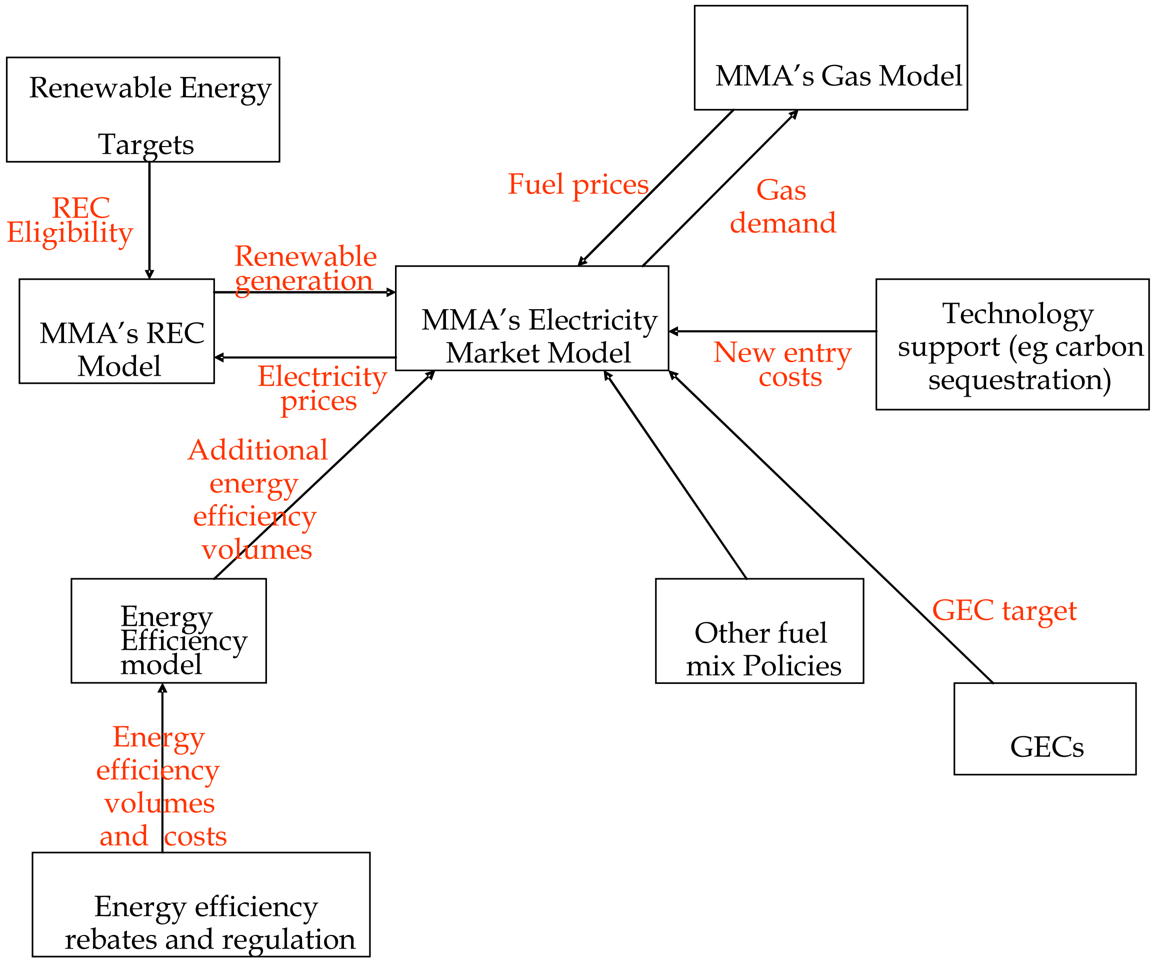
The third stage involved detailed modelling of the electricity markets over the timeframe of the study using MMA bottom up models of these markets. MMA's model of the National Electricity Market (NEM), South West Interconnected System (SWIS) and the Darwin Katherine Interconnected System (DKIS) simulates the market to determine:

- Dispatch of generating plant and electricity supply costs arising from this dispatch for each year.
- Timing and type of new investments in electricity generation and for each region.
- Impact of schemes such as Queensland's Gas Electricity Scheme on dispatch and electricity prices.

Modelling the impact of the expanded RET on the electricity market is a complex process. It requires iteration between a number of models to determine both the direct impacts and interactions between the electricity market and various Government schemes.

Figure 2-1 shows the interactions between the MMA models used, and how the abatement policies were incorporated into the analysis. The key modelling processes are discussed in more detail below.

Figure 2-1: Diagram of MMA's suite of models for assessing impact on energy sector



Our approach to modelling the electricity market, associated fuel combustion and emissions was to utilise published electricity demand forecasts in our STRATEGIST model of the major electricity systems in Australia. The model accounts for the economic relationships between generating plant in the system. In particular, the model calculated production of each power station given the generation availability of the station, the availability of other power stations and the relative costs of each generating plant in the system.

Modelling of the electricity markets was conducted using a multi-area probabilistic dispatch algorithm. The algorithm incorporates:

- Chronological hourly electricity loads representing a typical week in each month of the year. The hourly load for the typical week is consistent with the hourly pattern of demand and the load duration curve over the corresponding month.
- Chronological dispatches of hydro and pumped storage resources either within regions or across selected regions (hydro-electric plant is assumed to shadow price to maximise revenue at times of peak demand).
- A range of bidding options for thermal plant to maximise profit from trading in the spot market is assumed up to the time new plant are needed. After new plant are needed, all new base load plants follow Bertrand bidding with the remaining plants bid at short run marginal cost plus an additive factor in all regions. For existing plants, bids were formulated based on Cournot bidding which allowed generators to adjust plant availability to maximise profits subject to the level of competition in the market.
- Chronological dispatch of demand side programs, including interruptible loads.
- Estimated inter-regional trading based on average hourly market prices derived from bids and the merit order and performance of thermal plant, and quadratic inter-regional loss functions.
- Scheduled and forced outage characteristics of thermal plant.

By projecting expected levels of generation for each generating unit in the system, the model projected spot market prices, emissions, costs and returns. The level of utilisation of each plant depends on plant availability, their cost structure relative to other plant in the system and bidding strategies of the generators.

New plant, whether to meet load growth or to replace uneconomic plant, were chosen by the algorithm on two criteria:

- To ensure electricity supply requirements are met under most contingencies. We used a maximum energy not served of 0.002%, which is in line with the planning criteria used by AEMO. Minimum reserve margins were also respected for each region. Plant will always be installed in the model to meet these criteria.
- Revenues earned by the new plant equal or exceed the long-run average cost of the new generator. Additional plant could be installed according to this criterion above that required satisfying the first criterion.

Each power plant is considered separately in the model. The plants are divided into generating units, with each unit defined by minimum and maximum operating capacity, heat rates, planned and unplanned outages, fuel costs and operating and maintenance costs.

Information required to project generation, emissions and system costs, include:

- Forecasts of load growth (peak demand, electricity consumption and the load profile throughout the year).
- Operating parameters for each plant including heat rate as a function of capacity utilisation, rated capacity, internal energy requirements, planned and unforeseen outage time.

- Data on fuel costs for each plant including mine-mouth prices (or well-head prices in the case of gas), rail freights (or transmission costs in the case of gas), royalty arrangements, take-or-pay components, escalation rates, quantity limits and energy content of the fuel.
- Variable unit operating and maintenance costs for each plant (which may also vary according to plant utilisation).
- Fixed operating and maintenance costs.
- Emissions production rates by fuel type.
- Annual hydro energy and allocation of generation on monthly basis.
- Capital costs for new generating plant.

2.3 Modelling of the uptake of renewable energy generation

2.3.1 Basis

Under the current RET scheme wholesale market customers are required to purchase Renewable Energy Certificates (RECs) equivalent to their liabilities under the scheme. The price of the certificates is primarily a function of the cost of supply of renewable generation, the actual level of the generation required to meet the renewable energy target and the structure of the wholesale market and the market for certificates. In this section, we describe the methodology employed to project renewable energy certificate prices and the key underlying assumptions.

The price of renewable energy certificates is affected by a number of factors:

- The nature, cost and available resource of renewable energy.
- Prices received for renewable energy generation in wholesale electricity markets.
- Revenue earned from other potential services provided by renewable generation, such as the ancillary services, avoidance of network costs, avoidance of waste disposal costs and green premiums.
- Short-term factors, such as variation in climate from year-to-year.

Renewable energy technologies are generally characterised by a number of features that will ultimately impact on the price of the certificates. Apart from the capital and operating costs, other factors affecting the choice of renewable generation options and, therefore, the price of certificates include:

- Constraints on fuel resource availability. This particularly impacts on the costs of biomass options, which may need guarantees of long-term fuel supplies. It also affects intermittent generation options, particularly the reliability of supply of the fuel (e.g., wind regimes and solar insolation levels).
- Changes over time in the capital costs of renewable energy technologies. The long-term trend has been for a decline in the capital cost of renewable energy

technologies as a result of technological enhancements and increasing scale of production.

- Lag times in developing renewable generation projects (including the time required to obtain approvals).
- Community concerns over the visual amenity or other pollution issues associated with renewable generation.
- Strategic factors that may cause investments in options that are not the least cost options.

Because of the dearth of site-specific information on renewable energy options, some retailers may contract with options with higher cost than would have been chosen on the basis of least cost for the system as a whole. A competitive market for renewable energy with well-informed participants would result in choices converging to least cost outcomes. Prices of certificates would be bound by the entry cost of the next highest cost option required to meet the target. Retailers who contract with higher cost options will face the risk of earning lower profits on their sales of electricity.

Output from renewable generation will either be sold on wholesale markets or will displace purchases from the wholesale market by end-use customers. Thus, renewable generators will receive revenue from electricity sales to wholesale customers.

The value of output for the renewable energy generators will be equal to the prices received in the pool market minus a loss factor covering losses in transmitting the electricity from the generator to the market. In some cases, renewable generators may confer an advantage to customers in lowering the network losses. The renewable generator could also capture part of the value of reduced losses.

Due to the operation of the NEM, the price of electricity varies significantly throughout the day. The highest prices occur at periods of high demand, primarily the morning and evening peaks, and low prices occur overnight as demand reduces. This diurnal cycle of wholesale prices has a large impact on the sales revenue earned by a renewable generator and the certificate price required to support the projects. Some renewable generators may have higher levels of generation during peak periods resulting in a higher average price for sales than a simple daily average. On the other hand, some other renewable generators such as solar hot water systems commonly replace off-peak electric systems, resulting in these generators receiving a much lower average electricity price.

Some renewable generator options, particularly embedded and distributed generators, can provide other market services. Examples include avoided network costs, lower losses, provision of steam from renewable based cogeneration and provision of other products or services (such as waste management).

Of course, intermittent renewable generation options will be less successful in obtaining such additional benefits.

To the extent that renewable generation may confer additional benefits to electricity customers, the value of these benefits will impact on the REC price outcomes assuming a competitive market. The value of these services should fall in the range between the marginal cost of providing the service through renewable generation and cost of the alternative option for providing similar services. However, these additional benefits have not been considered in the modelling.

2.3.2 Method

Projecting renewable energy certificate prices and the technology mix likely under the RET requires the use of a sophisticated model of the Australian electricity system. Our approach is to account for the interrelationships between the wholesale electricity market and the renewable energy market over the study period. Future REC prices are dependent on wholesale electricity market prices and the cost of renewable generation. In turn, the entry into the market of additional renewable generation will impact on wholesale electricity prices.

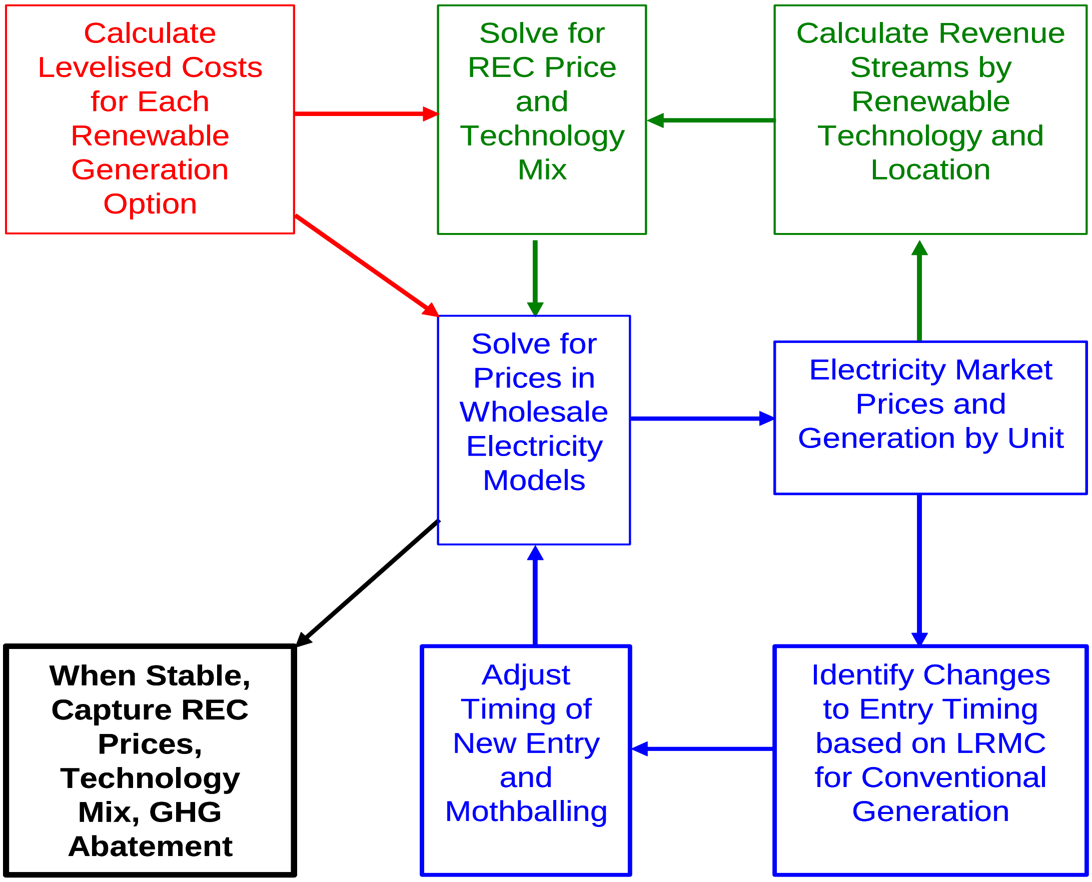
Geographical differences are also considered. Wholesale electricity market prices may vary by location, depending on local supply and demand factors and limits on transmission capacity. A region may have the potential for a large amount of renewable generation, but this potential may be thwarted by the lack of demand for electricity nearby. For the same technology, the costs also vary by location due to differences in fuel costs and transmission upgrade costs.

MMA’s REMMA model is based on the premise that a renewable energy certificate will trade at a value that will enable the marginal generator to operate economically, while meeting the mandatory interim targets. The value of a certificate may be determined from the difference between the levelised cost of generation of the marginal renewable generation unit and the electricity price obtained in the market for the thermal generation it displaces. Thus, the basis of the projections of the price of renewable energy certificates is that the certificate price will relate directly to the cost of renewable electricity generation. The renewable certificate will equate to the difference between the cost of the lowest cost renewable energy required to meet the mandatory target and the price for the electricity that can be obtained in the wholesale market. The cost of the last renewable option dispatched to meet each of the interim targets sets the market clearing price and the certificate price.

The prices forecast with this method represent an average price for contracted sales of RECs. Most RECs will be sold under bilateral contracts, with up to 20% of sales traded on the spot market.

An overview of the modelling process is shown in Figure 2-2. The approach is iterative since the timing and selection of renewable generation impacts on wholesale market prices and vice versa. The electricity prices that are produced as an output of the wholesale electricity market simulation model, Strategist, are used as inputs into the REC model. After running the REC model, any changes to the renewable generation options selected are inputted back into Strategist. The process may be repeated if it is deemed that substantial changes in REC price and technology mix are possible.

Figure 2-2: Overview of method for projecting REC prices and technology mix



The approach is based on the assumption that the REC price provides the revenue, in addition to the electricity price, that is required to make the last required (marginal) renewable energy generator to meet the REC target viable. This takes into account an acceptable commercial rate of return to the project developer.

In a simple system the REC price would be determined by identifying the marginal generator and performing a simple subtraction of these two values. However, the following complications arise:

- Introduction of new renewable generators impacts on the electricity price paths, which may require iteration of the market price forecast and the REC estimation.
- The allowance of banking in the REC market results in the requirement for an inter-temporal optimisation. Under the RET, there is no limit on banking so more RECs can be created in a year than required to meet the target to be banked and surrendered at a later date. This makes economic sense if the cost of creating the REC earlier than required is lower than the projected cost of purchasing a REC at a future date. The potential for banking means that the demand for renewable generation can be higher than the interim targets in the earlier years and lower than the target in the latter years. The effect of banking in terms of REC prices will depend on the level of banking and the costs avoided from creating surplus RECs.

- Currently, installed and committed generators remain/enter the market regardless of the estimated economics. Because capital costs are sunk, these plants are assumed to be operating with just the marginal cost of generation considered in the modelling. Typically, these marginal costs are lower than the levelised costs for new units, so that committed plant are not likely to set the price in RECs in any year[1].
- Generation resulting from the upgrade of large hydro units is treated in our hydro dispatch model to account for the additional dispatch that could be achieved with refurbishment to achieve higher efficiency in generation. This means that the additional capacity is treated as new generation capacity in the model, with full accounting of all costs incurred in the upgrade.
- Resource and other constraints limit the uptake of renewable generation. Resource constraints, for example fuel availability, are modelled by increasing the marginal cost of the resource.

The certificate price path is set by the net cost of the marginal generators, which enables the above conditions to be met and result in positive returns to the investments in each of the projects.

MMA has a detailed database of renewable energy projects covering existing, committed and proposed projects that supports our modelling of the REC price path. The database includes estimates of capital costs, likely reductions in capital costs over time, operating and fuel costs, connection costs, and other variable costs for individual projects that are operating, committed or planned[2].

Project costs have been obtained from published estimates of costs (usually capital costs) plus estimates of costs inferred from equipment suppliers, market data (for biomass fuel costs) and reports to Government. The costs are believed to be accurate to +/- 10% for existing and committed projects and +/- 20% for planned projects.

MMA has also developed a separate model for forecasting REC creation from solar water heaters and small-scale generation systems (roof-top PV and wind and micro hydro) taking into account the impact of a range of support policies.

The MMA REMMA Model determines the future price path of RECs in the following steps:

- The costs of a range of renewable energy generation options have been determined as the levelised cost of generation using a 9.8%[3] real pre-tax weighted average cost of capital over at most a 20-year investment horizon. The model considers the time from the commencement of generation to the end of 2030 for REC revenue but only considers energy (electricity) revenue beyond 2030 earned by the project if its

[1] The marginal cost of an existing plant typically comprises only fuel and non-fuel operating costs (capital costs are sunk). For new plant that is not as yet in the market, the marginal cost includes the cost of capital because the plant would need to recover capital costs to enter the REC market.

[2] Committed plant means projects that are either under construction or have achieved financial closure. Planned projects are those being actively investigated.

[3] Based on debt to equity ratio of 75:25, real pre-tax interest on debt of 7.3% (9.0% in nominal terms) and real pre-tax return to equity of 17%. A premium of 1% applies to biomass projects to account for fuel supply risk.

operating life goes beyond 2030. Where data has been available, the costs include the costs of connection to the grid, which can form a significant proportion of the capital costs of a project, particularly where no local transmission wires are available (up to $15/MWh for remote projects).

- The spot market price or wholesale electricity cost in each of the regions of NEM, SWIS or the Darwin-Katherine Grid has been used as the price that a generator could obtain for the power generated in the market. Wholesale electricity prices are determined on an hourly basis for each week of the study period, using Strategist model.
- Assign regional wholesale electricity prices to all renewable projects in the data base according to location and start date. Weight wholesale electricity prices according to the generation profile of the renewable technology. For example, waste process generation would operate 24 hours per day and would therefore be represented by the average time-weighted pool price. Whereas, photovoltaic would only operate through daylight hours, achieving the prevailing market price for these hours only. Solar hot water systems although using solar energy during daylight hours, actually replace off-peak electricity usage so the surrogate price for this option is the off-peak price for the replaced energy.
- For each project, estimate any revenue from other sources such as fees for avoided landfill charges.
- Potential revenues from wholesale market transactions and other sources for each project are levelised for the life of the project.
- Subtract levelised revenue from corresponding renewable project levelised cost and then determine the merit order of the projects by ascending net costs (apart from those generators flagged as committed). The generation meeting the interim targets plus demand for banked credits in each year will determine which projects in the merit order will come on-line in a particular year.
- The generation output from each project is calculated from the MW and capacity factor for each project.
- For each selected new project the REC values over the remaining term of the RET scheme are discounted with the electricity sales income. The discounted cash flow compared with the levelised cost indicates whether a given REC price path will justify the construction of a project.
- The REC path is optimised over the years of the program subject to the constraints indicated above.
- The plant installed in each year is determined by the economic viability subject to the REC price path, REC creation and surrender constraints.
- The resulting installed capacity and generation levels are then input into wholesale electricity market model to determine the resultant pool price changes that in turn impact the REC prices.

- The process may be repeated until stable outcomes result.

In this analysis banking of certificates over periods is allowed to occur where economic. This allows generators to hold their certificates until a later date when a more attractive price may be available. Banking of certificates may also reduce the total cost of the scheme by delaying the introduction of more expensive generation. It also means that all targets could be met by a group of renewable generators creating less than overall target as long as there are sufficient banked RECs to meet the shortfall in any year.

2.4 General assumptions

A number of high level assumptions are employed in the modelling of all indicative policy scenarios.

2.4.1 Market structure

The market is assumed to operate to maximise efficiency and is made up of informed, rational participants.

Capacity is installed to meet the target reserve margin for the NEM, SWIS and the DKIS as long as new entrants recover all costs.

Any changes in wholesale prices will flow through to retail prices. Price changes are therefore borne by the broad customer base.

Availability, heat rates and capacity factors of all plants in the NEM, SWIS and DKIS (including non-renewable generators) are based on historical trends and other published data.

2.4.2 Renewable Technologies

The capacity factor for existing hydro generators is assumed to be based on normal inflow conditions, with assumptions for Tasmania updated to current Hydro Tasmania predictions. Capacity factors for wind generation vary by state and location and vary from 25% to 43%.

Penetration into the market of intermittent technologies such as wind is dependent on the ability of the system to absorb such generation. The amount of installed wind capacity in each region was capped at 25% of that region's peak demand, with the exception of South Australia where this cap was allowed to be exceeded if the transmission network to Victoria was upgraded (by the model).

Both existing (hydro, wind, biomass, SHW) and predicted technologies (geothermal, high temperature solar thermal and wave) were considered, with capacity limitations as determined by previous MMA research. There are limited new hydro-electric and biomass resources, with the latter limited by host industry expansion and fuel transportation costs. Aside from the constraint of above, wind resources will eventually be limited by the unsuitability of sites. A conservative approach is adopted for the likely success of geothermal. Aside from a small demonstration project at 10 MW in 2013, geothermal is assumed not to become available on a large scale until 2015.

2.4.3 Technology Costs and Availability

Non-fuel operating costs are estimated based on published data and bid information.

Capital costs for thermal generation options are based on published data and industry knowledge. IGCC plant fitted with pre-combustion carbon capture and storage is considered.

Costs for renewable generation projects are derived from published sources of information. MMA maintains a database of renewable energy projects, which contains information on capacity, generation levels, operating costs, capital costs and other costs for each renewable generation project - operating, committed or planned. The location by sub-state region is also known, and incorporated into the model.

Real capital costs for all technologies are assumed to fall over time. A capital cost reduction factor is included for each technology in the analysis to model this effect, with the reduction factor specific to the technologies.

Future transmission and distribution prices are estimated from historical trends in prices and recent regulatory decisions on allowable movements in prices. Network charges were assumed to increase by 5% real per annum until 2019, with this rate declining by 1% per annum until 2024 and then held constant.

Network upgrade costs are based on the Annual Planning Statements published by the state and territory governments and planning bodies. The data was used to make assumptions on the costs of both committed and planned interregional network upgrades.

2.4.4 Fuel prices

Projected fuel prices for both existing and new thermal generation were based upon MMA's database of current prices and movements in the international energy prices for each scenario. The former is based upon published data on prices (such as ABARE's export coal price projections) and published data on contract quantities.

Key features of the assumptions are:

- Brown coal and mine mouth black coal prices were held constant at the current values in real terms.
- For existing black coal generators not at mine mouth, black coal prices were modelled as per contract prices until around 2017 when current contracts are due to expire. From this time there was allowance for new coal contracts to be influenced by international energy prices subject to a discount premium.
- New black coal plant fuel prices were aligned with the international coal price index.
- East coast gas prices were determined from MMA's gas model assuming moderate LNG penetration in Queensland. Prices at the Gladstone port were predicted to reach export parity in 2025 with the southern state prices converging with the Queensland price by around 2030.
- West cost gas prices were influenced by international price shifts from the beginning of the projection period.

Projected gas and fuel prices for new plant are given in Figure 2-3 and Figure 2-4.

Figure 2-3: Trends in city node gas prices for base load gas demand, 2007 dollars

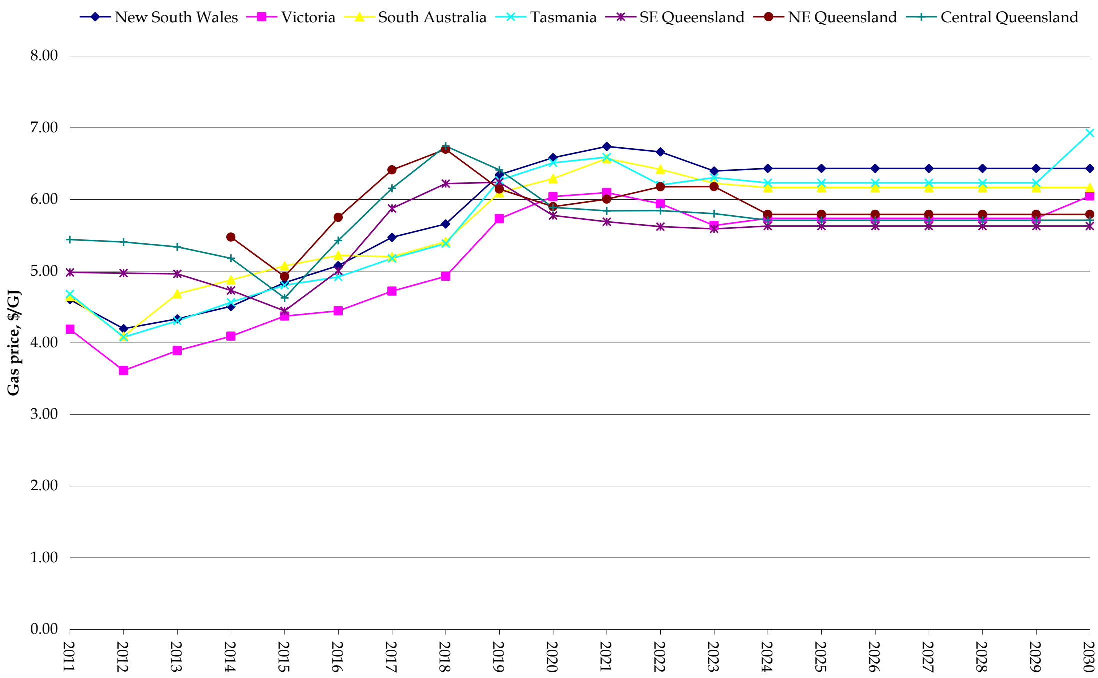


Figure 2-4: Trends in coal prices, 2007 dollars

2.4.5 New generation costs – renewable generation

Renewable generation costs were based on data published in previous MMA reports.

The total amount of commercially accessible new renewable generation resource was limited to 130,000 GWh above current levels by 2030. Limitations on new renewable capacity were similar to previous analysis undertaken by MMA and take into consideration system constraints in absorbing intermittent technology such as wind. A conservative constraint on the success on geothermal was employed, with the total capacity restricted to approximately 1,500 MW by 2020.

As with fossil fuel technologies, the long-run marginal cost of renewable energy generation increases as more of each technology is required. For example, less windy sites will be accessed as more wind generation is required. Fuel costs will increase as more biomass options are required. Assumptions on the marginal cost curve as a function of level of generation required are shown in Figure 2-5.

Figure 2-5: Long-run marginal cost for renewable energy generation in Australia

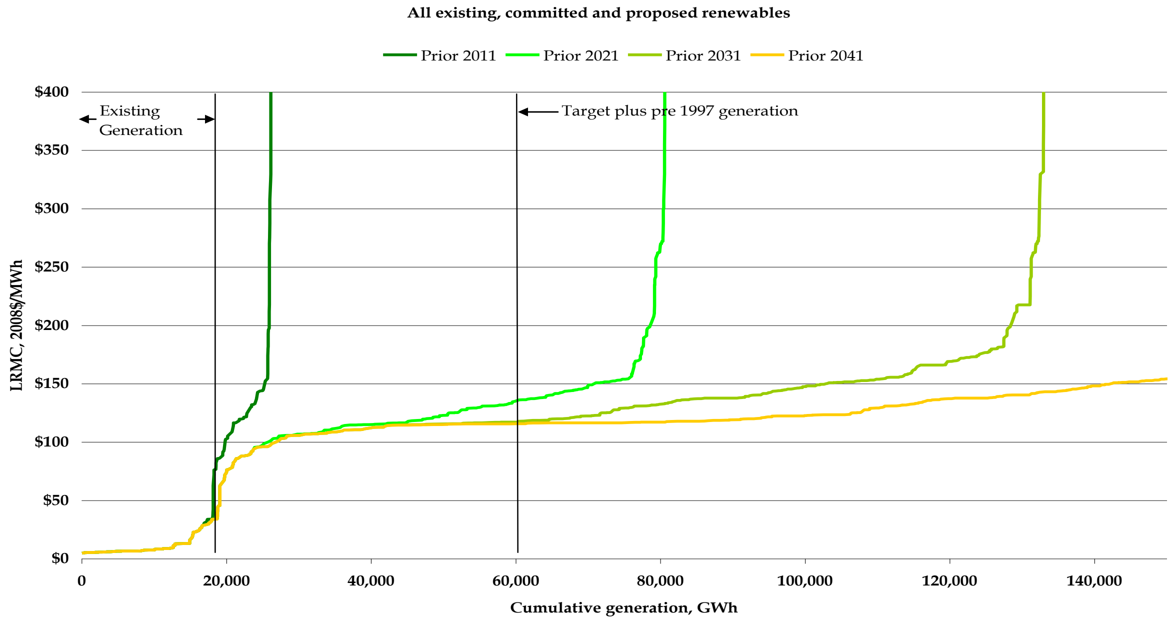
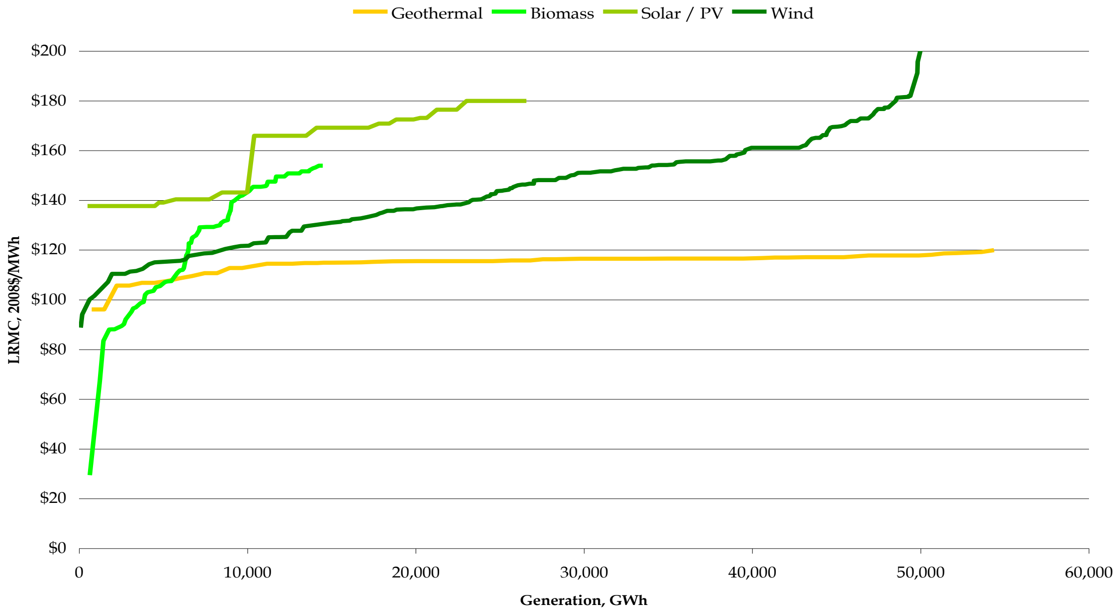


Figure 2-6: Long run marginal cost by technology



2.4.6 Assumptions – water heaters

At the state and Commonwealth level there are a number of incentives available to support a switch towards more energy efficient forms of water heating.

At the Commonwealth level, from 3 February 2009, rebates have been available for the replacement of existing electric water heaters at the level of $1,600 for the installation of solar water heaters and $1,600 dollars for the installation of air-sourced heat pumps. The rebate for air-sourced heat pumps was reduced to $1,000 from 5 September, 2009. On 26 February 2010, the rebate was reduced further to $1,000 for solar water heaters and $600 for heat pump water heaters. The program runs until 30 June 2012 or until the date when program funds have been fully allocated, whichever occurs first.

In addition to rebates, Renewable Energy Certificates can be created for the installation of solar water heaters and air-sourced heat pumps. The number of RECs created varies by system type and the location of the installation. Data from the Office of the Renewable Energy Regulator suggests that in 2008/09, an average of 31 RECs were created for each unit installed.

Details of state government rebates are shown in Table 2-1 below.

Information on the duration of rebate schemes was not available for every State, although, where it is available it demonstrates that these schemes are expected to be short term in nature. For example the NSW rebate scheme is due to end in June 2011 and the NT rebate is provided for one financial year only (2009/10).

In addition to state rebate schemes, changes to building codes have been made at both the national and state levels. These changes are phased in over time and limit the installation of inefficient forms of hot water heating such as electric heating particularly where reticulated gas is available.

At the national level, electric water heaters will be banned from 2010 in gas reticulated areas and from 2012 in non reticulated areas. Three star gas water heaters will be banned from October 2010. At the state level, there is a move away from electric and 3 star gas water heaters in new homes. In particular, South Australia has banned 3 star gas systems in Adelaide from July 2008 and electric systems from July 2009. Queensland has banned electric and 3 star gas systems in gas reticulated areas from 2010.

Table 2-1: State government rebates for switching to energy efficient water heaters

State	Rebate/Incentive amount	Basic eligibility criteria
Victoria	\$400 - \$1,600 \$300 - \$1,500 \$400	Switching from gas, electric or solar to solar water heaters in regional areas Switching from gas, electric or solar to solar water heaters in metropolitan areas Switching from electric to gas water heaters
New South Wales	\$300 \$600 - \$1,200	Switching from electric to gas water heaters Switching from electric to solar or heat pump water heaters (based on number of RECs). To be discontinued from mid 2010.
Queensland	\$600 (\$1000)	For the installation of a solar hot water system or heat pump (for pensioners and low income earners)
ACT	n/a	
South Australia	\$500	Low income households installing a new solar or heat pump water heating system
Northern Territory	\$400 - \$1000	Switching from electric to solar water heating in homes built before 2000
Western Australia	\$500 - \$700	Funding for the rebate scheme for gas-boosted solar water heaters has been extended to 2013.
Tasmania	n/a	

Using the policy developments discussed above, a set of assumptions on uptake of solar water heaters and heat pump water heaters were developed. Key assumptions behind the estimates of uptake of RECs for solar water heaters are as follows:

- Market for residential solar water heaters were broken down into markets for water heaters for new homes and replacement water heaters.
- The prime driver affecting uptake in new homes is regulatory bans of electric water heater installations, building codes favouring the installation of solar water heaters and rebates for solar water heaters (by state and Commonwealth Governments, all of which expire by 2014).
- Uptake of solar water heaters in new homes is shown in the following table. In each state, the uptake reaches saturation levels equal to either the number of homes not connected to gas mains or the model imposed limits on the upper level of uptake (due to roof alignments and the availability of gas based continuous flow heaters).

- Uptake of solar water heaters in the replacement market is also affected by the general ban on electric water heaters.
- Average number of RECs earnt (deemed) by a solar water heater is 31 RECs. REC price is set either at the market price under the current design of the RET scheme or at $40/certificate in nominal terms under the proposed SRES.

Table 2-2: Solar and heat pump water heater uptake assumptions – new homes

	NSW	Victoria	Qld	SA	WA	Tas	NT	ACT
2008/09	49%	58%	52%	49%	37%	2%	60%	30%
2009/10	62%	64%	67%	62%	49%	2%	63%	46%
2010/11	65%	61%	72%	64%	61%	2%	67%	62%
2011/12	58%	49%	68%	54%	48%	2%	60%	52%
2012/13	50%	35%	63%	44%	35%	2%	53%	41%
2013/14	43%	25%	59%	35%	23%	2%	47%	32%
2014/15	36%	14%	55%	26%	13%	2%	41%	23%
2015/16	31%	6%	52%	19%	5%	2%	36%	15%
2016/17	30%	6%	52%	18%	5%	2%	35%	14%
2017/18	29%	6%	52%	17%	5%	2%	34%	14%
2018/19	29%	6%	51%	17%	5%	2%	33%	13%
2019/20	28%	5%	51%	16%	5%	2%	32%	12%

Table 2-3: Solar and heat pump water heater uptake assumptions – replacement water heater market

	NSW	Victoria	Qld	SA	WA	Tas	NT	ACT
2008/09	3%	2%	7%	12%	9%	2%	53%	3%
2009/10	23%	24%	33%	25%	8%	2%	49%	8%
2010/11	33%	26%	48%	28%	8%	2%	44%	13%
2011/12	33%	7%	53%	21%	7%	2%	40%	18%
2012/13	33%	7%	53%	21%	6%	2%	39%	17%
2013/14	32%	7%	53%	20%	5%	2%	38%	17%
2014/15	31%	7%	53%	19%	5%	2%	37%	16%
2015/16	31%	6%	52%	19%	5%	2%	36%	15%
2016/17	30%	6%	52%	18%	5%	2%	35%	14%
2017/18	29%	6%	52%	17%	5%	3%	34%	14%
2018/19	29%	6%	51%	17%	5%	3%	33%	13%
2019/20	28%	5%	51%	16%	5%	3%	32%	12%

2.4.7 Assumptions – small scale PV systems

Assumptions on the uptake of small scale PV installations include:

- PV system cost of $7,000/kW in 2010, then falling by 3% per annum in real terms thereafter. No allowance is made for bulk purchase or any other discount. Twenty-five year life assumed.
- 15% capacity factor for PV systems for Victoria and Tasmania. Higher for other states and territories but not exceeding 20%. The PV model (called DOGMMA for

Distributed and On-site Generation Market Model Australia) predicts uptake by comparing costs of electricity supply from the grid and costs of supply (after rebates and subsidies are deducted) from PV systems.

- No saving for avoided roof tile cost (especially since the system will be angled to optimize energy generation).
- Rebates (including FIT payments) and/or REC multipliers as per announced policy. In particular that these support measures end as announced.
- Certificate prices and electricity prices as determined by MMA modelling under the current design and $40/certificate in nominal terms under the proposed SRES.

2.5 The enhanced RET and scheme coverage

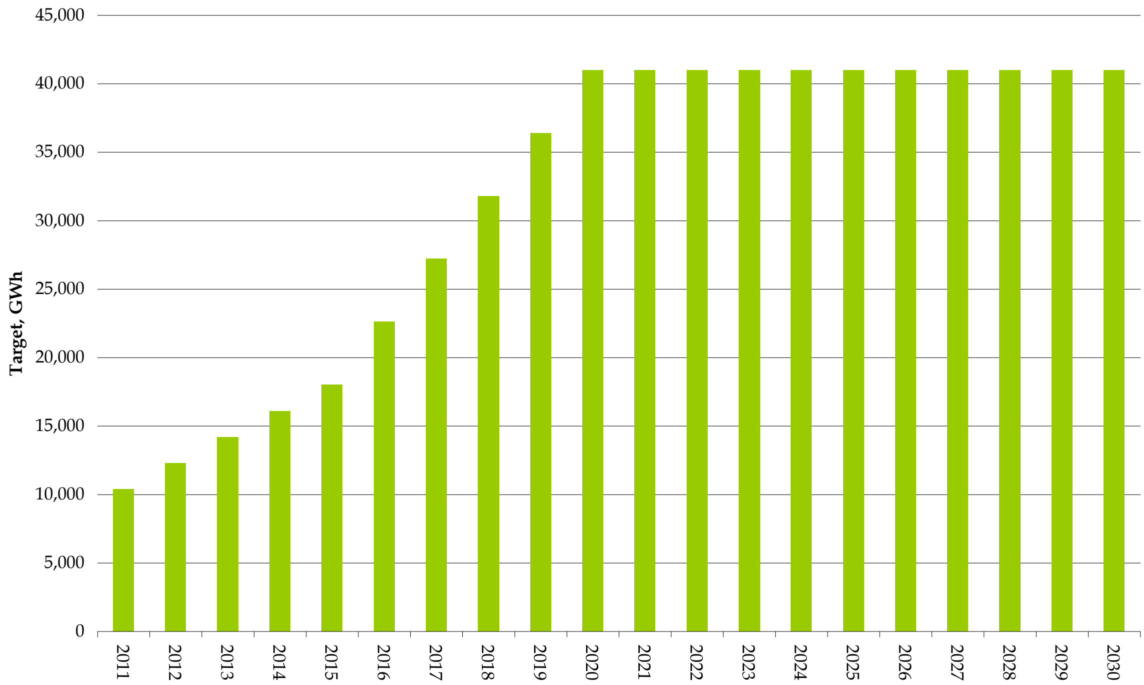
Targets for the level of renewable generation in each year under the current RET scheme have been set in the legislation.

The targets for the current design of 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 proposed changes to the scheme design announced by the Commonwealth Government on 26 February 2010 will split the RET scheme into two separate mechanisms, with a new target for large-scale renewable energy generation and a scheme supporting the uptake of small-scale systems with the provision of a fixed price for certificates. The changes include:

- Small-scale Renewable Energy Scheme (SRES), which covers renewable energy generation systems, defined in existing legislation as small generation units such as household rooftop solar PV systems and electricity displacement technologies such as solar water heaters and heat pumps. Eligible renewable energy options under this scheme can earn a fixed price of $40/certificate.
- Large-scale Renewable Energy Target (LRET), applying to renewable energy power stations using eligible sources including wind, large-scale solar, hydro-electric and in the future geothermal power. The annual targets are 4,000 GWh less than the current design. The targets commence at 10,400 GWh in 2011, increasing to 41,000 GWh in 2020. The targets remain at 41,000 GWh until 2030 (see Figure 2-7).

Figure 2-7: New Large-scale Renewable Energy Target



As per existing RET legislation a statutory review of the arrangements is to be conducted in 2014. If it appears that combined renewable energy generation under the LRET and SRES is not likely to ensure the overall 45,000 GWh target is met, then the annual targets under the LRET scheme will be increased from 2015 to a level to ensure this will occur.

Table 2-4 shows the certificates created (in the year of generation) as sourced from REC Registry. In most years, more certificates have been generated than has been required to meet the target in those years. The surplus to target indicates that each year's surplus is a high proportion (and in many years exceeded) the target of the following year. Another trend evident is that despite the large increase in the level of certificate creation from solar water heaters and heat pumps, the proportion of the surplus as a function of the following year's target has fallen since 2005, although this trend was reversed in 2009 due to an upswing in the creation of RECs from small scale systems.

Table 2-4: Targets under the MRET Scheme and LRET Scheme

Year	Target under LRET(GWh)	Actual certificate creation (GWh)	Surplus to target (GWh)	Surplus - % of target in following year
2001	300	1,663	1,363	123%
2002	1,100	2,779	3,042	169%
2003	1,800	4,356	5,598	215%
2004	2,600	3,403	5,685	167%
2005	3,400	4,822	6,707	149%
2006	4,500	5,194	7,004	125%
2007	5,600	6,288	6,809	100%
2008	6,800	8,685	8,694	107%
2009	8,100	16,115	16,709	133%
2010	12,500			
2011 (LRET begins)	10,400			
2012	12,300			
2013	14,200			
2014	16,100			
2015	18,000			
2016	22,600			
2017	27,200			
2018	31,800			
2019	36,400			
2020 to 2030	41,000			

Source: MMA database and Office of the Renewable Energy Regulator (REC Registry). Annual certificate creation data for 2009 as of March 30 2010.

3 IMPACTS OF CHANGES TO SCHEME DESIGN

The Government has decided that it will not move to legislate the Carbon Pollution Reduction Scheme (CPRS) before the end of the current period of the Kyoto Protocol in 2012 and will only introduce the scheme when there is sufficient international action. For the purposes of this modelling report, impacts of the changes to the RET design were estimated using the following scenarios:

- Reference case 1, which includes the impacts of the expanded RET scheme based on the RET legislation passed in August 2009 and the CPRS -5 scenario commencing 1 July 2013.
- Reference case 2, which includes the impacts of the expanded RET scheme based on the RET legislation passed in August 2009 and the CPRS -5 scenario commencing 1 July 2014.
- The enhanced RET case (LRET/SRES), which includes the changes to the scheme design as announced in February 2010 to commence 1 January 2011.

The results are not significantly different between Reference case 1 and Reference case 2 as the short-term delay in the CPRS does not significantly impact on total revenue received by renewable energy producers over the life of the relevant project.

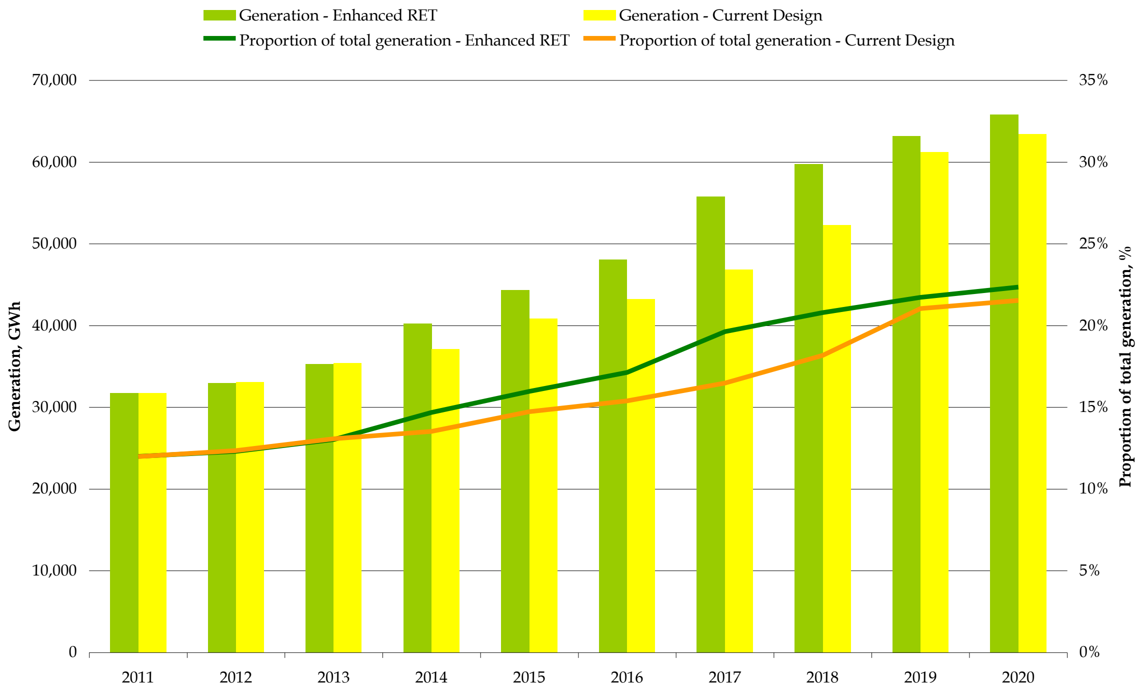
3.1 Scheme Impacts with a 1 July 2013 CPRS start date

3.1.1 Total renewable energy generation under the enhanced scheme

Total renewable energy generation, including the contribution from small scale generators and from electricity displacement technologies, is expected to grow from around 27,000 GWh in 2010 to around 66,000 GWh in 2020. In 2020, the LRET is expected to contribute 39,000 GWh and the SRES 11,000 GWh[4]. The level of renewable energy generation as a proportion of total electricity generation is expected to be around 22% in 2020. The remaining 16,000 GWh is from generation in existence before the MRET scheme commenced operation in 2001.

[4] Rather than the number of RECs from small –scale technologies, the estimate of 11,000 GWh represents the energy generated or displaced by small scale reenwable energy technologies operating in 2020.

Figure 3-1: Total renewable energy generation



The modelling illustrates the proportion of total generation contributed by renewable generation is higher under the proposed design changes as both large and small scale generation will benefit from higher certificate prices and higher effective targets over the life of the scheme.

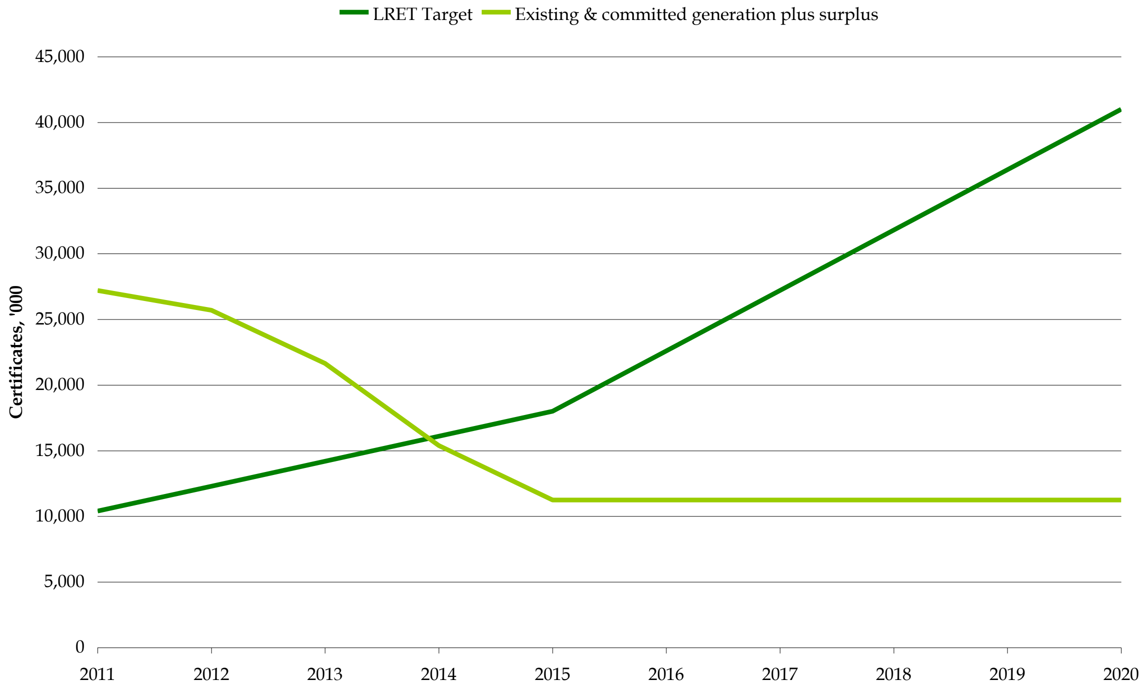
3.1.2 Stocks of certificates at end of 2010

The stock of certificates at the end of the 2009 generation year is estimated to be around 10.8 million certificates. Based on the modelling results, the stock of certificates is projected to be 16.2 million following the February 2011 surrender period.

Assuming current and committed[5] levels of large scale renewable generation (after GreenPower sales are deducted), the level of stocks falls below the target from 2014. However, RET liable entities tend to manage their liability over the long term and would be expected to utilise the existing surplus of certificates to manage their obligations over the life of the scheme, rather than the short term.

[5] Includes plant that have commenced construction or reached financial close since the passing of the RET legislation in August 2009. Another three projects have reached financial close in the past month and are expected to commence the construction phase shortly.

Figure 3-2: Supply and demand balance for certificates in the LRET



3.1.3 REC prices

Certificate prices are shown in Figure 3-3. The price in each year reflects long term contract prices for certificates that are required to support the renewable energy generation that enters the market in each year. Each year's certificate price reflects the prices a renewable generator could obtain under a long term contract in the year of entry into the market.

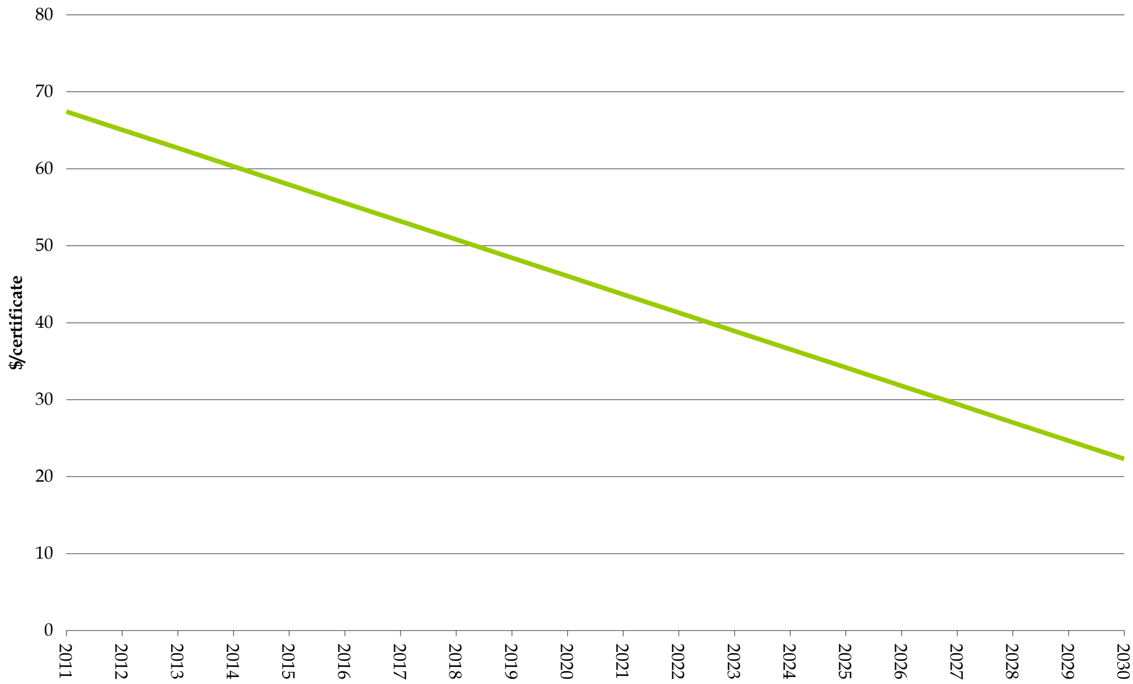
Prices are set to ensure all renewable generators that enter the market recover their costs including return to capital over their economic life. That is, the certificate price is set in such a way that the marginal plant coming into the market earns enough from electricity market and certificate transactions to recover the long run marginal cost of generation.

Under the LRET, contract prices start off at around $67/MWh and then decrease over time. The high initial price occurs because this is the price required to get the additional renewable generation in the early years of the scheme when the outlook is for decreasing certificate prices over time. Electricity prices are also expected to increase slowly over time, so that the revenue required under the RET to recover investment costs decreases over time. This is partly offset by the increasing cost of renewable energy as the target increases, but this cost increases at a slower rate than the price of electricity.

Under the proposed LRET, certificate prices are slightly higher than the current RET (by around $3/MWh) as more large scale renewable energy generation will be required because the high proportion of small scale RECs created to meet targets under the expanded RET over the next few years is now gone. This will more than offset the reduction of the annual targets by 4,000 GWh in the early years.

In later years, under the current RET scheme, small scale generation was expected to create on average around 5.4 million certificates per annum for the life of the scheme, resulting in a net annual target for large scale generation of less than 40 million certificates in 2020. This compares to a mandated target for large scale generation under the LRET scheme of 41,000 GWh or 41 million RECs (from 2020 onwards).

Figure 3-3: Certificate prices under the LRET Scheme



3.1.4 Certificate creation under the SRES

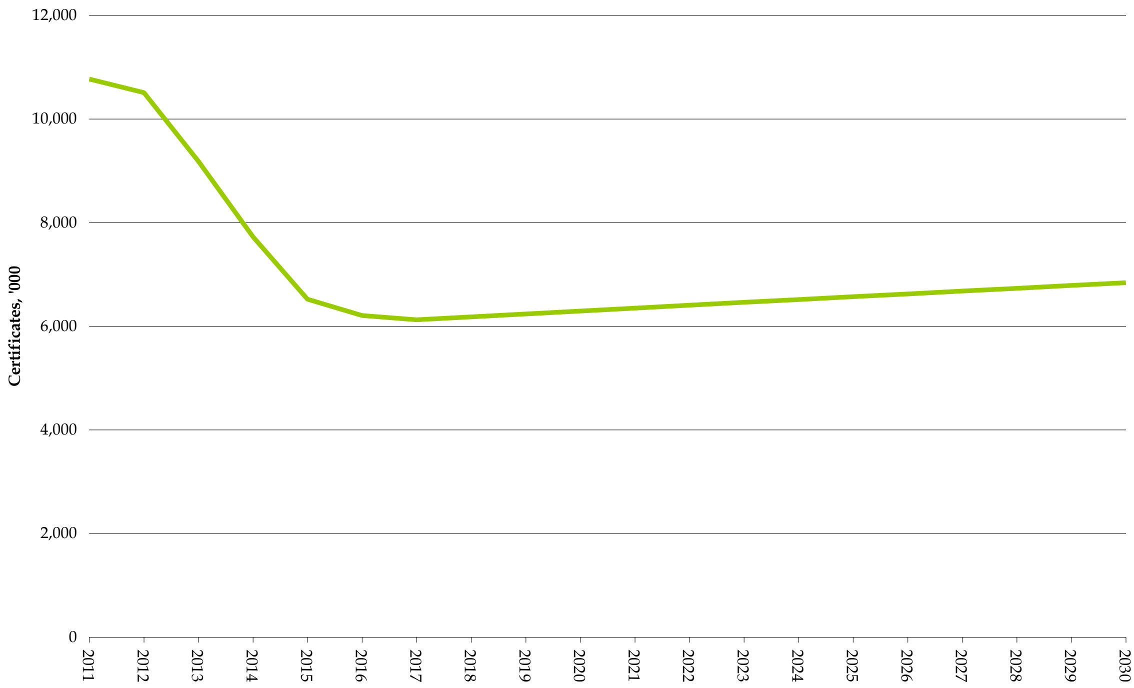
Under the enhanced RET, solar and heat pump water heaters and small scale deemed generation will be treated separately from the large scale sector with the establishment of the SRES. The REC price is not the only driver for uptake (that is, a combination of REC price and other factors such as rebates and other incentives as well as regulatory changes in building codes are important determinants of uptake). The amount of certificates created by these technologies will differ between the current design and the proposed SRES due to differences in the certificate price received. Certificate creation under the SRES will be lower in the initial period (estimated until around 2019), but then higher over the long term. This result occurs because the certificate price received under the SRES (fixed at $40/certificate in nominal terms) is lower than the contract certificate price modelled under the current scheme design until around 2019.

Over the period to 2030, total certificate creation by small scale technologies is slightly greater than under the current RET design.

The projected uptake and hence certificate creation for small scale systems should be interpreted with care. The estimation procedure is largely based on rational economic decisions and may not fully consider other factors that may influence uptake. The predictions are sensitive to capital cost reductions, which are highly uncertain as it is driven by global supply and demand factors. The predictions also do not consider product availability and limitations on capacity to meet installation demand.

The number of certificates created is expected to fall off over the next three to five years as the multiplier applying to small scale deemed generation reduces and as rebates applying to sales of solar and heat pump water heaters expire. This fall off in uptake of these technologies is predicated on no major decrease in the cost of these systems to compensate for the loss in revenue from certificate sales and rebates.

Figure 3-4: Certificates created by small scale generation and solar/heat pump water heaters under the SRES



3.1.5 Large scale renewable energy generation

Large-scale renewable energy generation is set to expand markedly as a result of the enhanced RET. Generation from eligible renewable energy generation sources increases three-fold under the LRET scheme. Although renewable energy generation increases in all States, the bulk of the increase occurs in NSW and Victoria. South Australia only experiences a modest increase despite its good wind resource, as higher levels of renewable energy generation in that state are likely to cause wholesale market prices to fall. The level of renewable energy generation in Western Australia also increases but is constrained by the limited amount of wind capacity the system can handle and the inability to transport excess renewable energy generation to other markets. Renewable energy generation in Tasmania is similarly limited by the amount of power that can be exported to the mainland.

More large scale generation is likely to be required under the proposed LRET scheme (see Figure 3-5 and Figure 3-6). The additional amount of generation peaks in the period to 2017 before dropping off, but the average additional generation is around 1,500 GWh over the 20 years to 2030, just under 3% higher than under the current design. This additional annual generation is equivalent to a wind farm of about 550 MW capacity.

Victoria and New South Wales are the states that are predicted to experience higher levels of generation from large scale renewable energy generation as a result of the change of scheme design. Tasmania and Queensland also benefit from higher levels of generation in the near term, but to a lesser extent. Western Australia, Northern Territory and South Australia are not expected to significantly benefit from the change to scheme design, probably due to system constraints limiting the amount of further uptake in these regions.

Figure 3-5: Total renewable energy generation from large scale generators in Australia under LRET

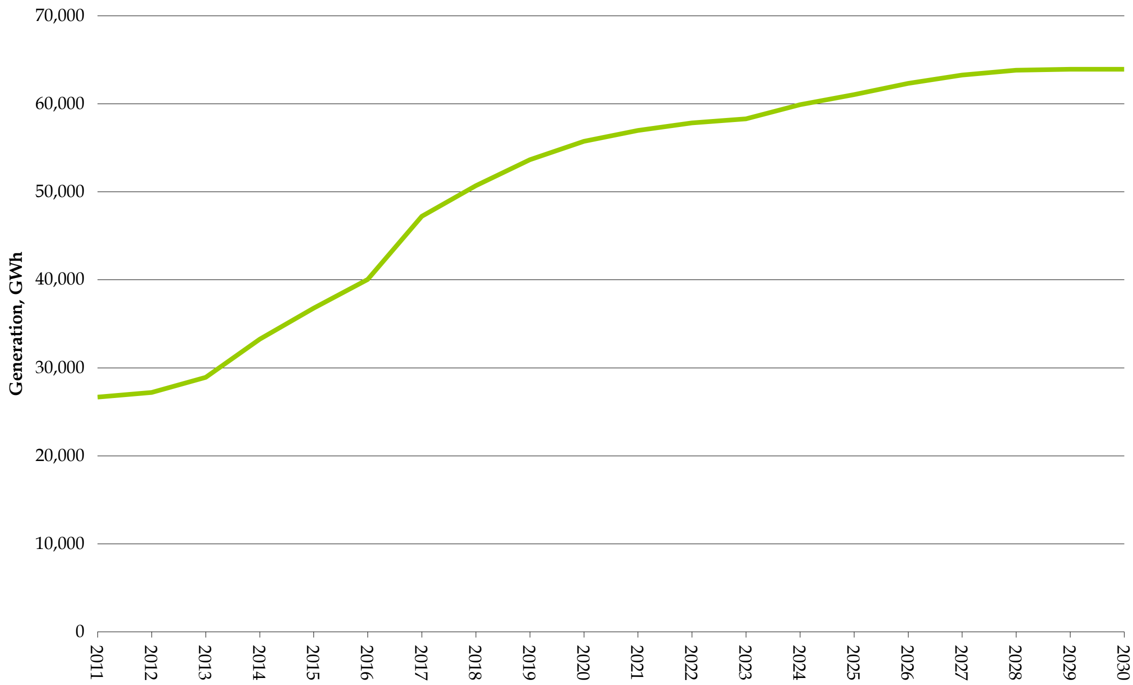


Figure 3-6: Change in large scale renewable energy generation

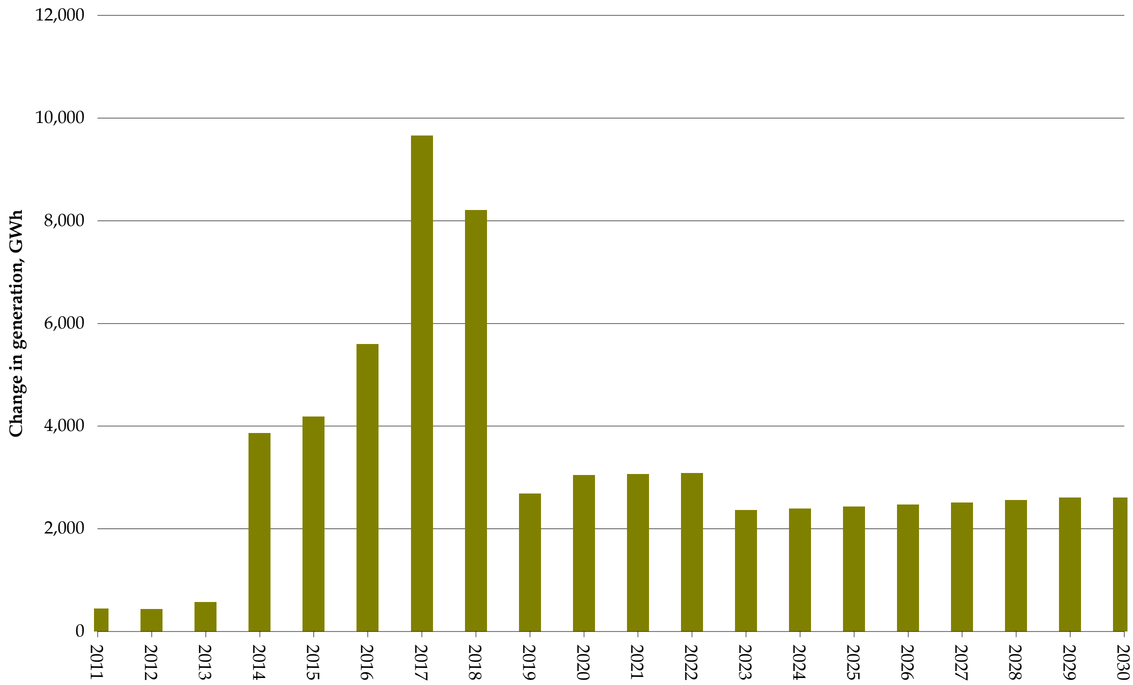
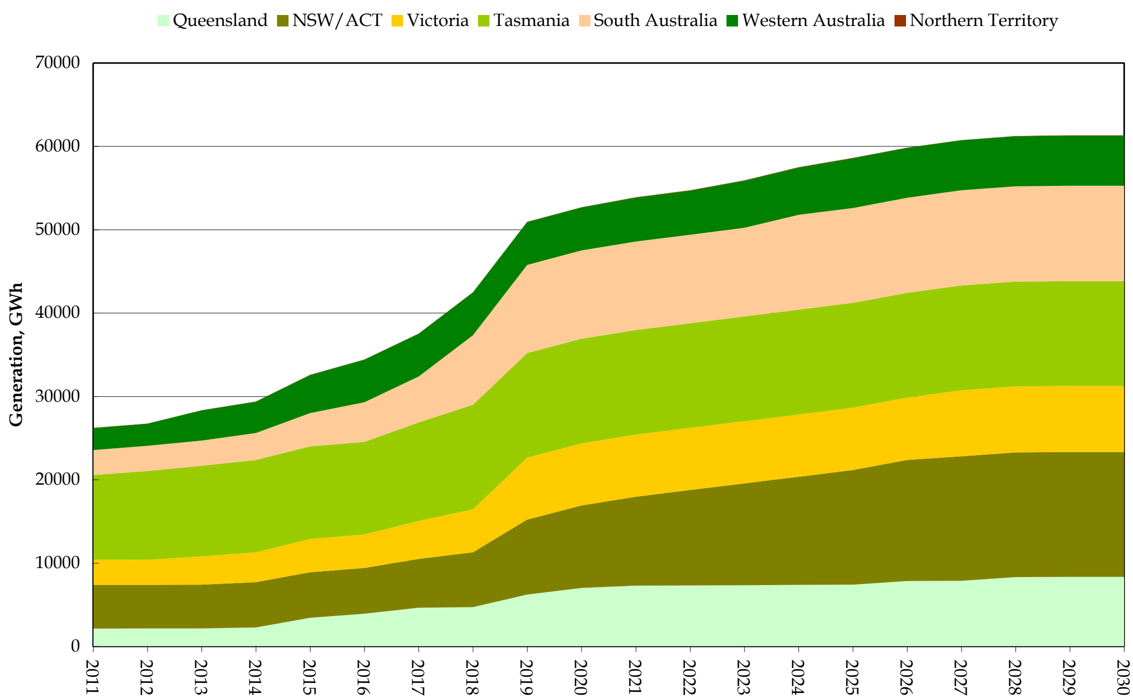
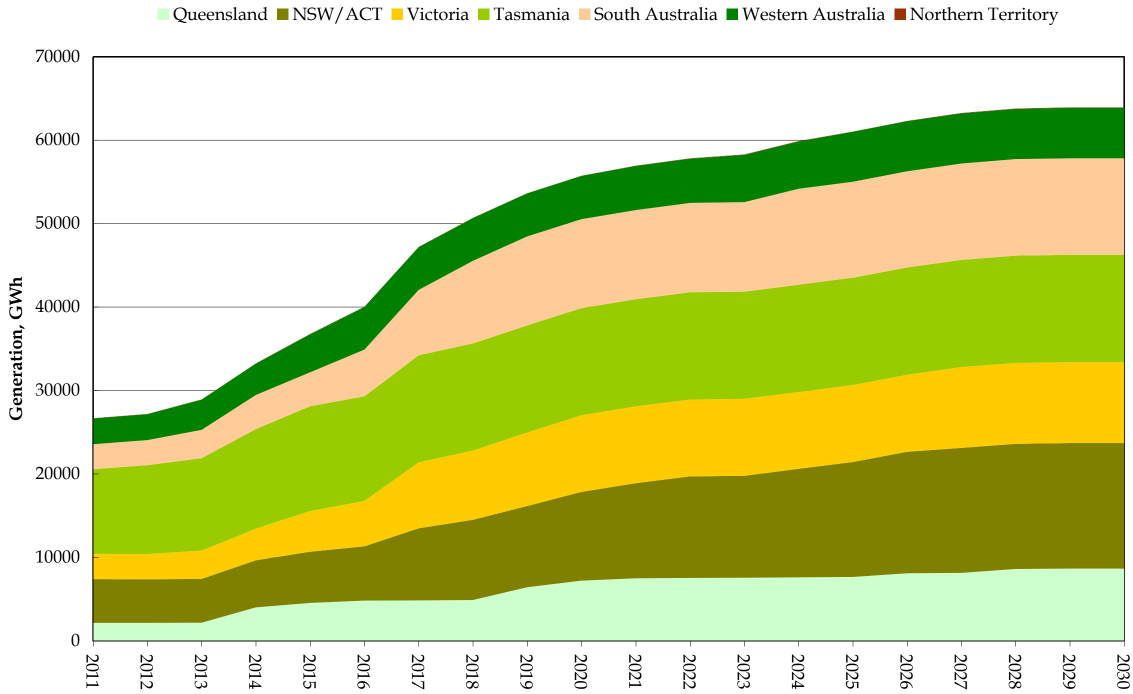


Figure 3-7: Renewable energy generation by State, current RET design



Note: includes small generation units but excludes solar water heater generation and eligible generation not supplying the major grids (NEM, SWIS and DKIS).

Figure 3-8: Renewable Energy Generation by State, LRET Scheme



Note: includes small generation units but excludes solar water heater generation and eligible generation not supplying the major grids (NEM, SWIS and DKIS).

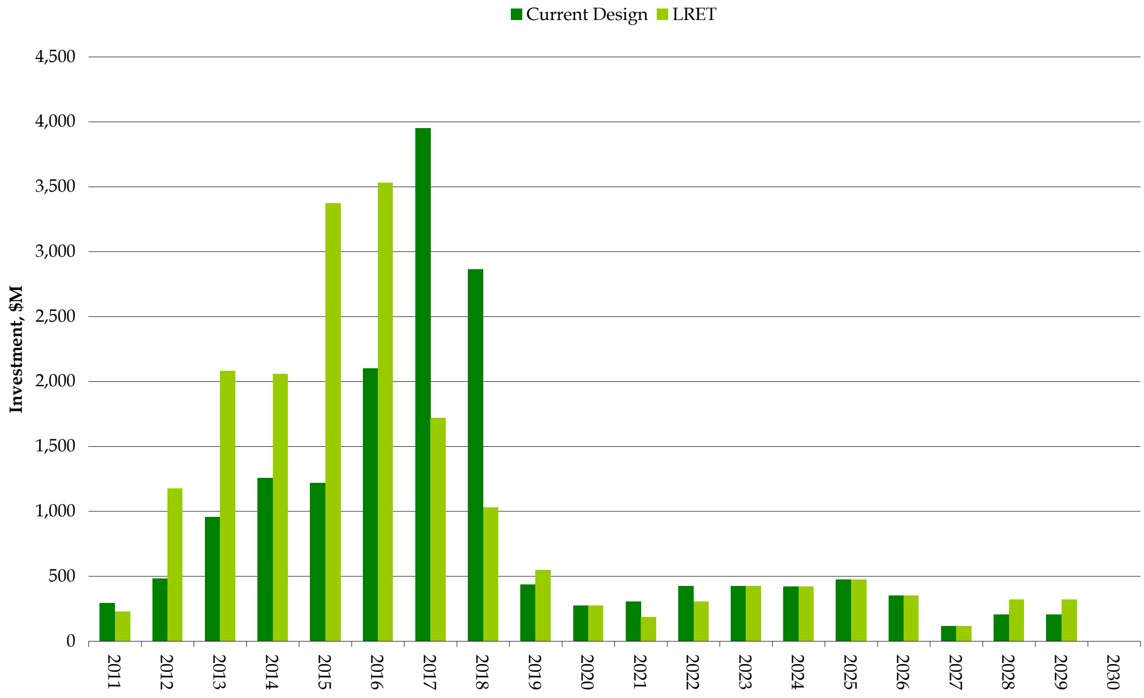
3.1.6 Investment profile

All generation technologies are deployed to meet the target, but over 70% of the increase in capacity comprises additional wind generation and geothermal (hot dry rocks) generation. Increased biomass and expansions at existing hydro-electric (as well as some mini-hydro facilities) also occur but growth in these technologies is limited either by their high cost or their limited opportunities.

Investment is spread over the period to 2020, but there tends to be a higher level of investment around the period 2013 to 2017. Investment in the period to 2020 is estimated to be around $14 billion to $16 billion in total, with a present value of around $10 billion to $12 billion (assuming a 6% discount rate).

Investment is brought forward under the LRET proposal, with higher levels of investment in the period to 2016. The total level of investment in large scale generation is also higher, with the present value of total capital expenditure to 2020 being some $2.1 billion higher. Total investment in the period to 2030 is $17 billion to $19 billion under both scenarios, with investment from 2020 to 2030 being similar under both designs. The present value of investment over the period to 2030 is estimated to be $2.3 billion higher for the LRET proposal.

Figure 3-9: Investment in large scale renewable energy capacity with the LRET



3.1.7 Technology mix – large scale

As the RET acts to push renewable generation into the electricity market faster than would have occurred under the CPRS alone, the technologies captured by the RET primarily favour those that are market-ready, such as wind and biomass. By 2020, almost half the extra renewable generation induced by the RET is taken up by wind generation. Although there is some uncertainty as to when the technology will be developed, geothermal is expected to contribute around 30% of the additional renewable energy generation required.

Figure 3-10: Generation mix (large scale plant) – current RET design

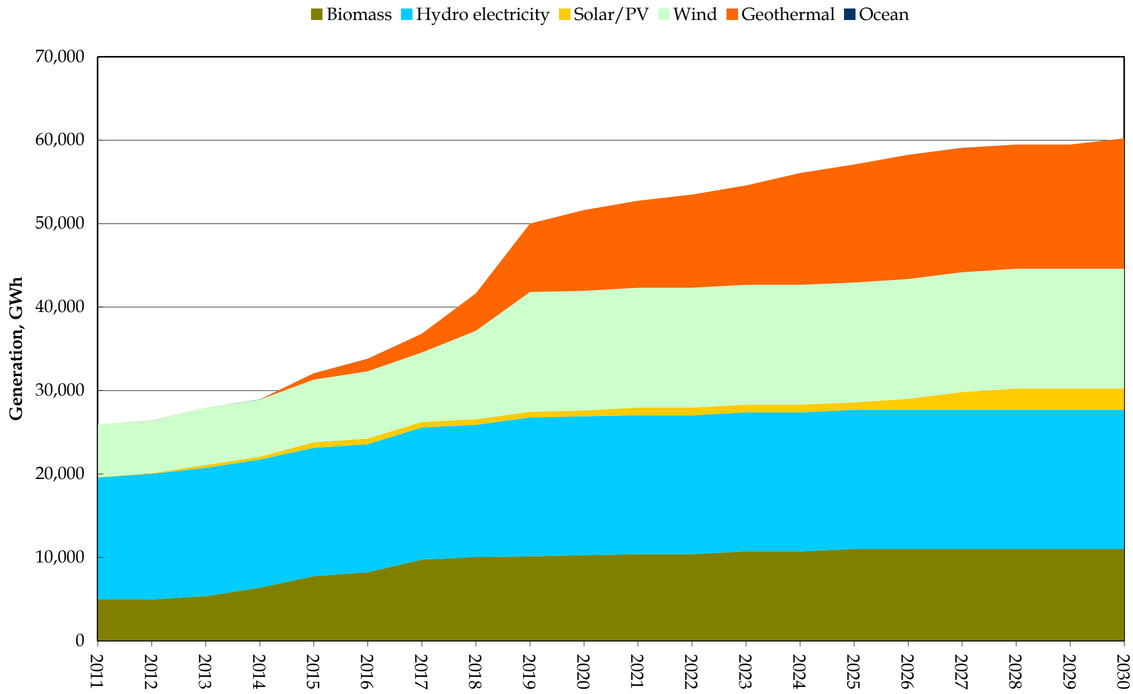
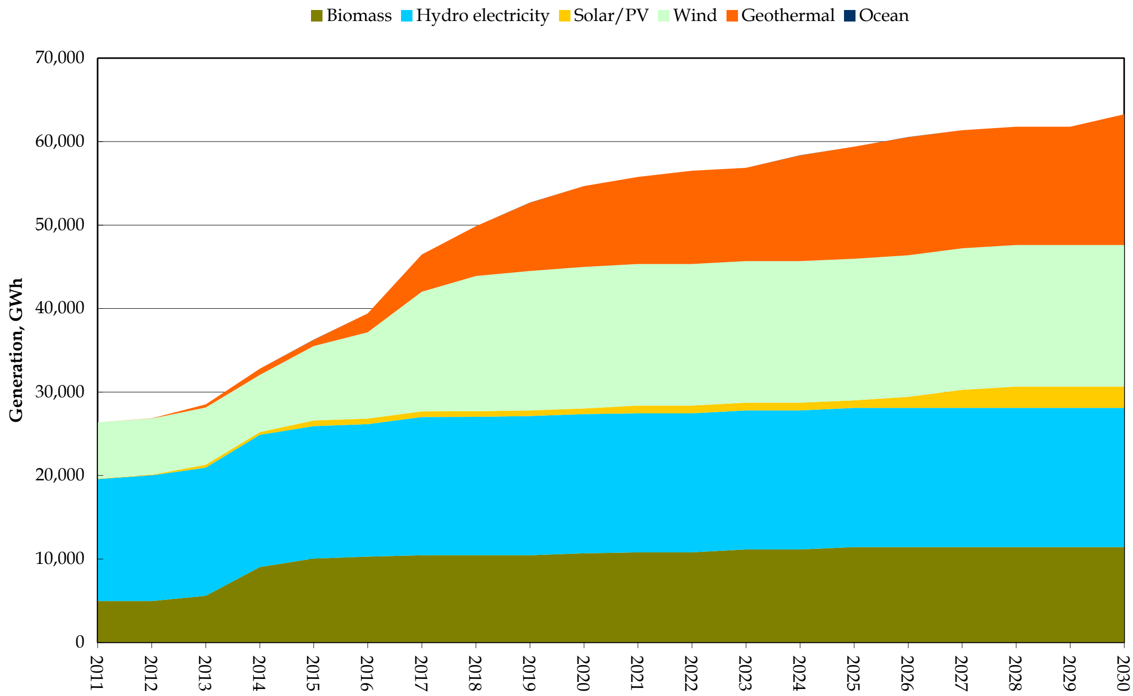


Figure 3-11: Generation mix (large scale plant) – LRET design



3.1.8 Small scale generation uptake under the SRES

Small scale generation is projected to decrease in the early years under the proposed SRES compared with the current scheme design. As certificate prices received for these technologies are expected to be lower under the SRES proposal until 2017 than the modelled contract price, then uptake of these technologies will be lower. The level of uptake is approximately the same by 2030.

Figure 3-12: Energy displaced by solar and heat pump water heaters under SRES

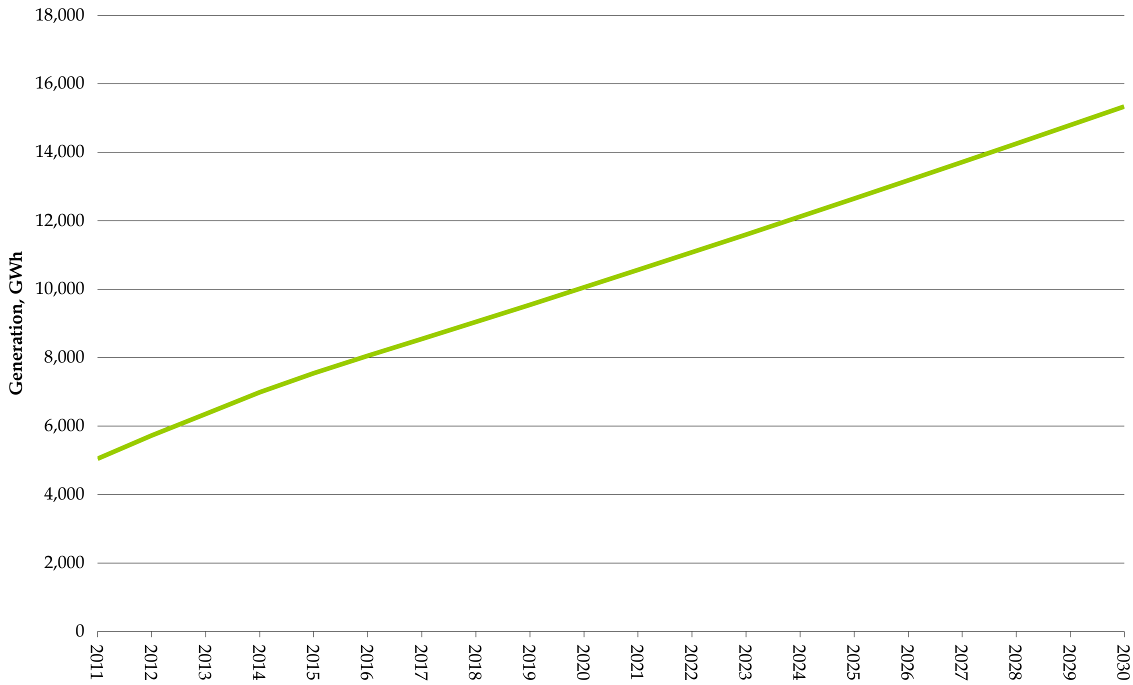
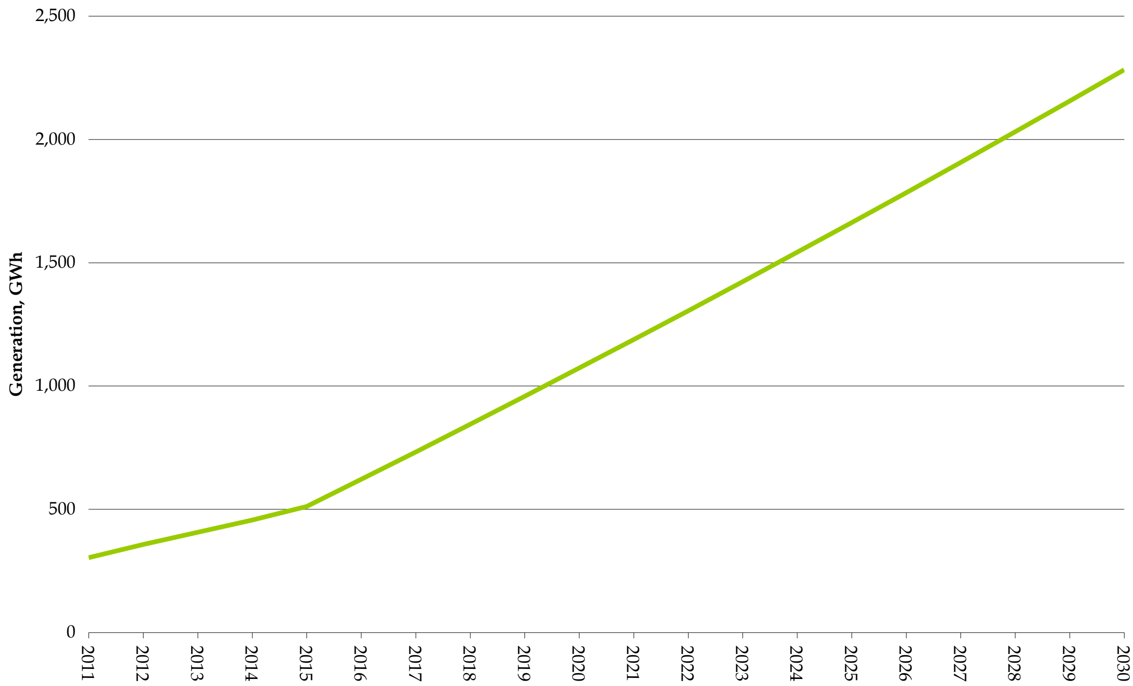


Figure 3-13: Generation by small scale (deemed) systems under SRES



3.1.9 Electricity Markets

The Current RET

The current RET scheme increases retail electricity prices due to the cost of purchasing certificates to cover liabilities. Retail electricity prices in Australia for non emission-intensive, trade-exposed customers, are expected to increase by around 4.0% in the period to 2015, 5.1% in the period from 2016-2020 and 3.3% in the period from 2021 to 2030.

For the average household, the additional cost for purchasing electricity amounts to $39 per year over the period from 2010 to 2015, $61 per year in the period from 2016 to 2020 and $44 per year for the period from 2021 to 2030.

Table 3-1: Impact of the current RET on retail electricity prices

	2010 -2015	2016-2020	2021-2030
Price (no RET), $/MWh	117	144	165
Cost impact of the current RET, $/MWh	4.69	7.41	5.40
Proportional change in price due to the current RET, %	4.0%	5.1%	3.3%

Note: additional costs of purchasing RECs are assumed to be borne by customers other than energy intensive trade exposed industrial customers.

The Enhanced RET

Wholesale prices

Wholesale prices are projected to increase due to the assumed implementation of the CPRS in 2013 and rising fuel and capital costs. In the wholesale market, changing the scheme design to the LRET reduces prices by less than 1% in the period to 2020, due mainly to more large scale generation entering the market - and therefore creating a small and temporary overhang of capacity – and the ability of this capacity to bid into the wholesale market at a low marginal cost. The price decrease is relatively small being less than 1% on a time-weighted average basis due to the fact that the additional capacity entering the market is less than 10% of the additional renewable energy capacity required and under 2% of total generation capacity.

Table 3-2: Change in wholesale price due to enhanced RET changes

	2010 -2015	2016-2020	2021-2030
Price, reference case, $/MWh	60.00	81.00	94.00
Change in price from reference case, $/MWh	-0.12	-0.19	0.00
Proportional change in price, %	-0.22%	-0.24%	0.00%

Retail prices

The expanded RET scheme increases retail electricity prices due to the cost of purchasing certificates to cover liabilities. Retail prices are expected to increase by less than 1% in the period to 2030 as a result in the change in design. The increase is due to the added cost of purchasing certificates, which can add up to $1/MWh to retail prices. This is partly offset by average wholesale prices decreasing slightly so that price increases at the retail level are less than $1/MWh.

Table 3-3: Change in average retail prices due to enhanced RET changes

	2010 -2015	2016-2020	2021-2030
Price, reference case, $/MWh	121.00	151.00	170.00
Change in price from reference case, $/MWh	0.23	0.31	0.64
Proportional change in price, %	0.19%	0.20%	0.37%

Note: additional costs of purchasing RECs are assumed to be borne by customers other than energy intensive trade exposed industrial customers.

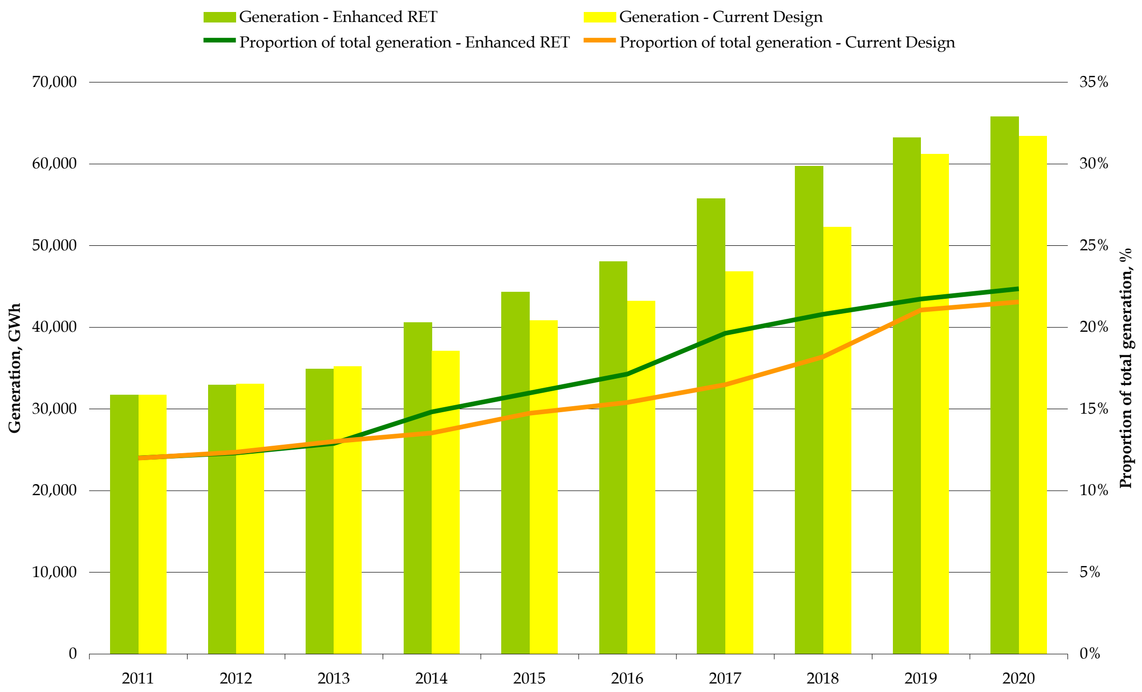
For residential customers, the increase in retail prices due to the changes to the scheme (including impacts on wholesale prices), amount to around $1.90 per year in the period to 2015, $2.50 per year in the period from 2016 to 2020, and $5.20 per year in the period from 2021 to 2030.

3.2 Scheme Impacts with a 1 July 2014 CPRS start date

3.2.1 Total renewable energy generation under the enhanced scheme

Total renewable energy generation, including the contribution from small scale generators and from electricity displacement technologies, is expected to grow from around 27,000 GWh in 2010 to around 66,000 GWh in 2020. The level of renewable energy generation as a proportion of total electricity generation is expected to be around 22% in 2020, similar to the proportion with the earlier start date for the CPRS.

Figure 3-14: Total renewable energy generation

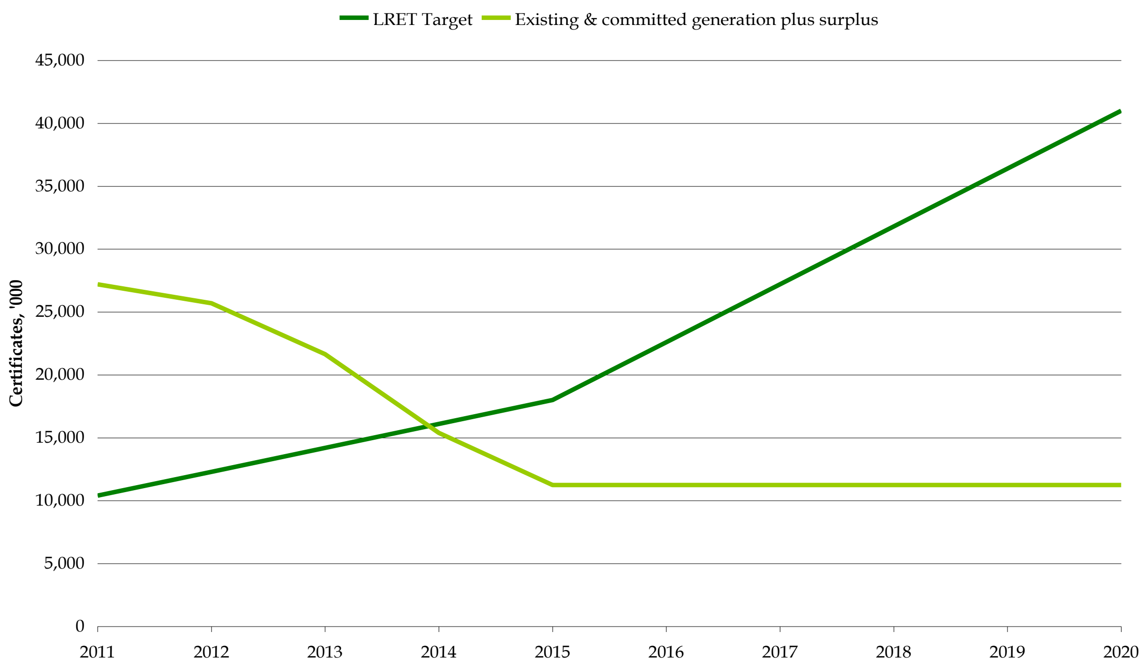


3.2.2 Stocks of certificates at end of 2010

The stock of certificates at the end of the 2009 generation year is estimated to be around 10.8 million certificates. Based on the modelling results, the stock of certificates is projected to be 16 million following the February 2011 surrender period.

Assuming current and committed[6] levels of large scale renewable generation (after GreenPower sales are deducted), the level of stocks falls below the target from 2014. However, RET liable entities tend to manage their liability over the long term and would be expected to utilise the existing surplus of certificates to manage their obligations over the life of the scheme, rather than the short term.

Figure 3-15: Supply and demand balance for certificates in the LRET



3.2.3 REC prices

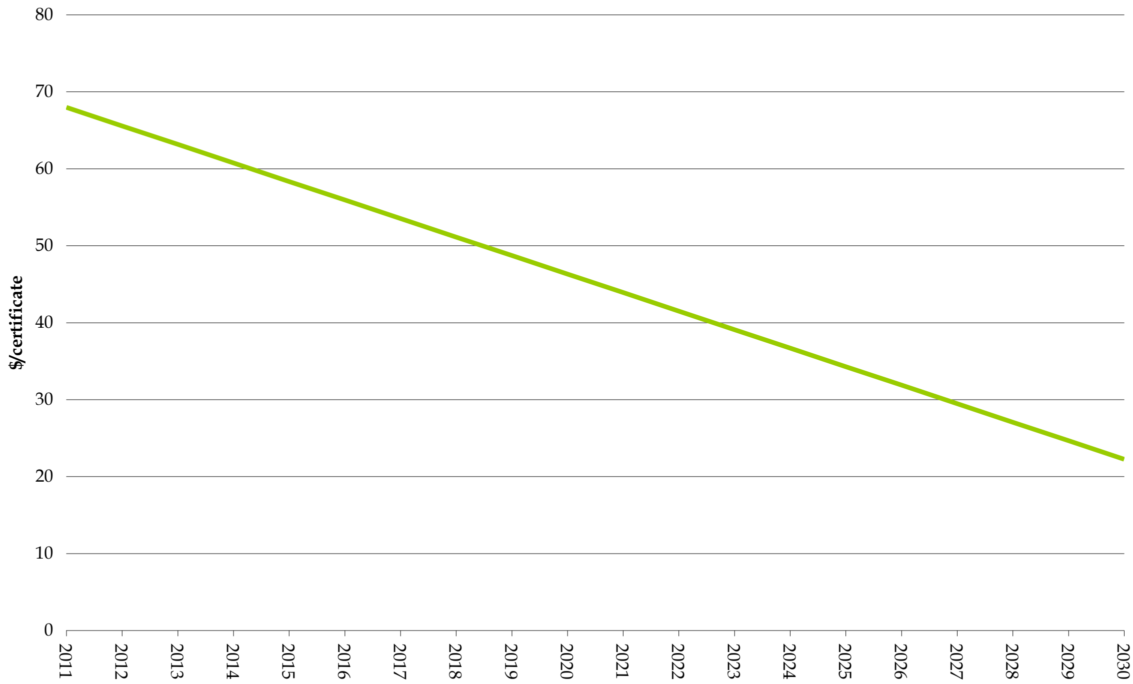
Certificate prices are shown in Figure 3-16. Under the LRET and a later start date for the CPRS, contract prices start off at around $68/MWh and then decrease over time. The high initial price occurs because this is the price required to get the additional renewable generation in the early years of the scheme when the outlook is for decreasing certificate prices over time. Electricity prices are also expected to increase slowly over time, so that the revenue required under the RET to recover investment costs decreases over time. This is partly offset by the increasing cost of renewable energy as the target increases, but this cost increases at a slower rate than the price of electricity.

---

6 Includes plant that have commenced construction or reached financial close since the passing of the RET legislation in August 2009. Another three projects have reached financial close in the past month and are expected to commence the construction phase shortly.

Under the LRET, certificate prices are slightly higher than the current RET (by around $3/MWh) as more large scale renewable energy generation will be required because the high proportion of small scale RECs created to meet targets under the expanded RET over the next few years is now gone. This will more than offset the reduction of the annual targets by 4,000 GWh in the early years.

Figure 3-16: Certificate prices under the LRET Scheme, 2014 start date for the CPRS

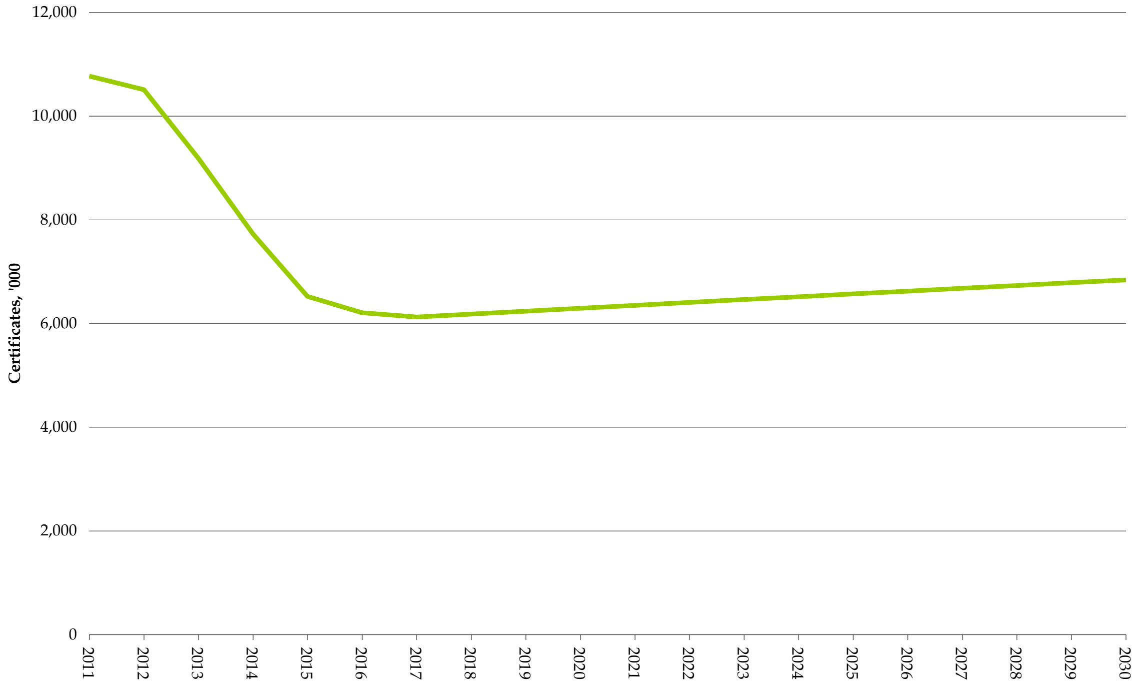


3.2.4 Certificate creation under the SRES

Certificate creation under the SRES will be lower in the initial period (estimated until around 2019) than under the current design, but then higher over the long term. This result occurs because the certificate price received under the SRES (fixed at $40/certificate in nominal terms) is lower than the contract certificate price modelled under the current scheme design until around 2019. Over the period to 2030, total certificate creation by small scale technologies is slightly greater than under the current RET design.

Delaying the implementation of the CPRS by one year did not have an impact on uptake of small scale systems and hence certificate creation was similar with a 2013 and 2014 start date for the CPRS.

Figure 3-17: Certificates created by small scale generation and solar/heat pump water heaters under the SRES



3.2.5 Level of large scale generation under the LRET

More large scale generation is likely to be required under the proposed LRET scheme (see Figure 3-18 and Figure 3-19) even with a later start date for the CPRS. The additional amount of generation peaks in the period to 2017 before dropping off, but the average additional generation is around 1,500 GWh over the 20 years to 2030, just under 3% higher than under the current design. This additional annual generation is equivalent to a wind farm of about 550 MW capacity.

Victoria and New South Wales are the states that are predicted to experience higher levels of generation from large scale renewable energy generation as a result of the change of scheme design. Tasmania and Queensland also benefit from higher levels of generation in the near term, but to a lesser extent. Western Australia, Northern Territory and South Australia are not expected to significantly benefit from the change to scheme design, probably due to system constraints limiting the amount of further uptake in these regions.

Figure 3-18: Total renewable energy generation from large scale generators in Australia under LRET

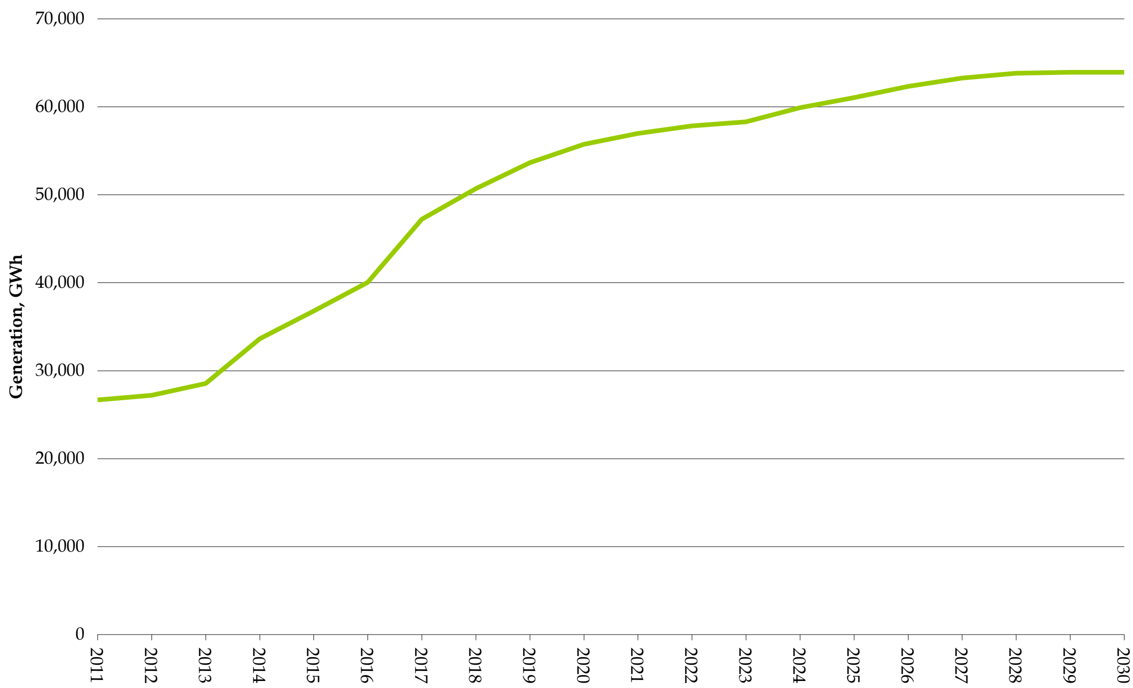


Figure 3-19: Change in large scale renewable energy generation

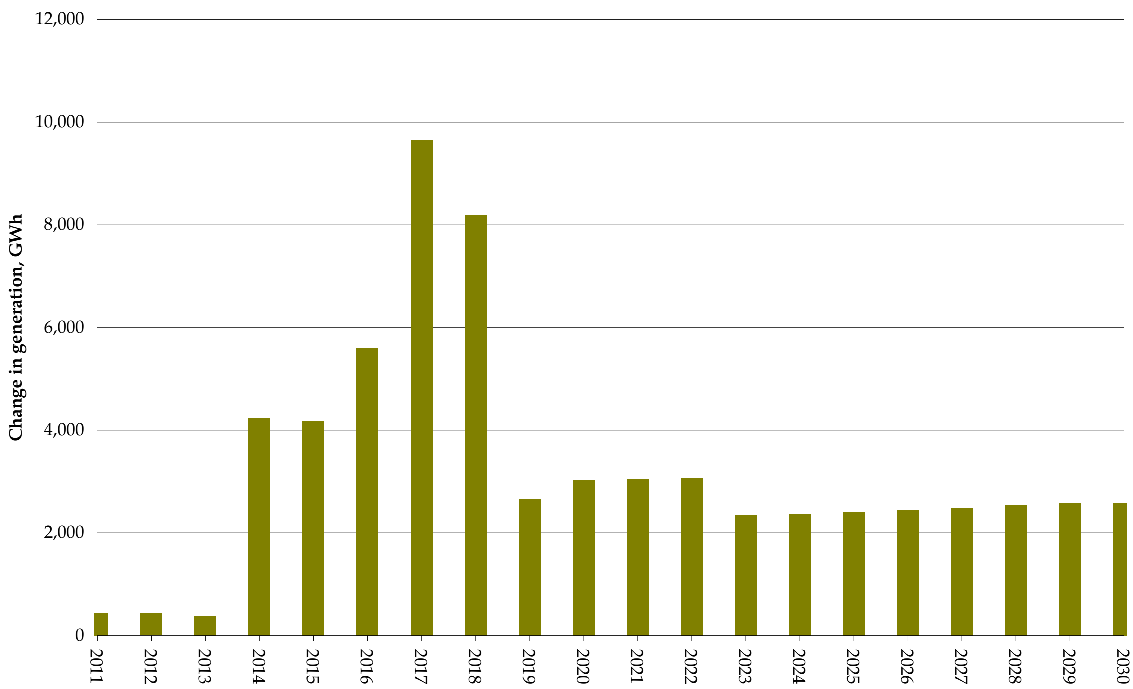
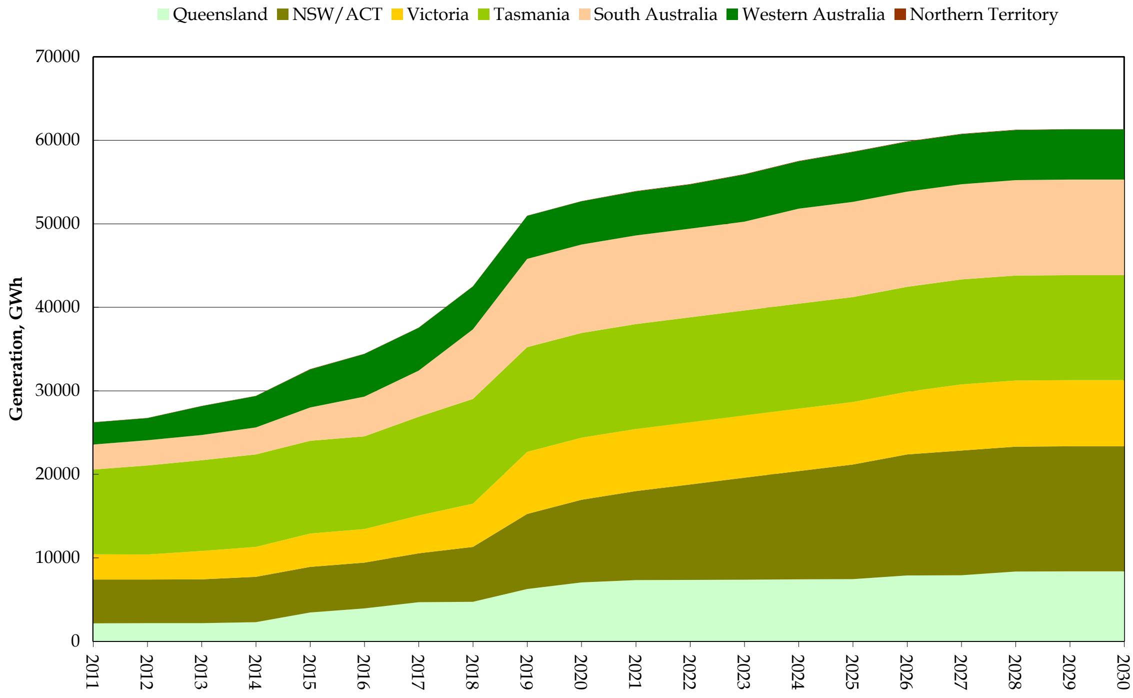
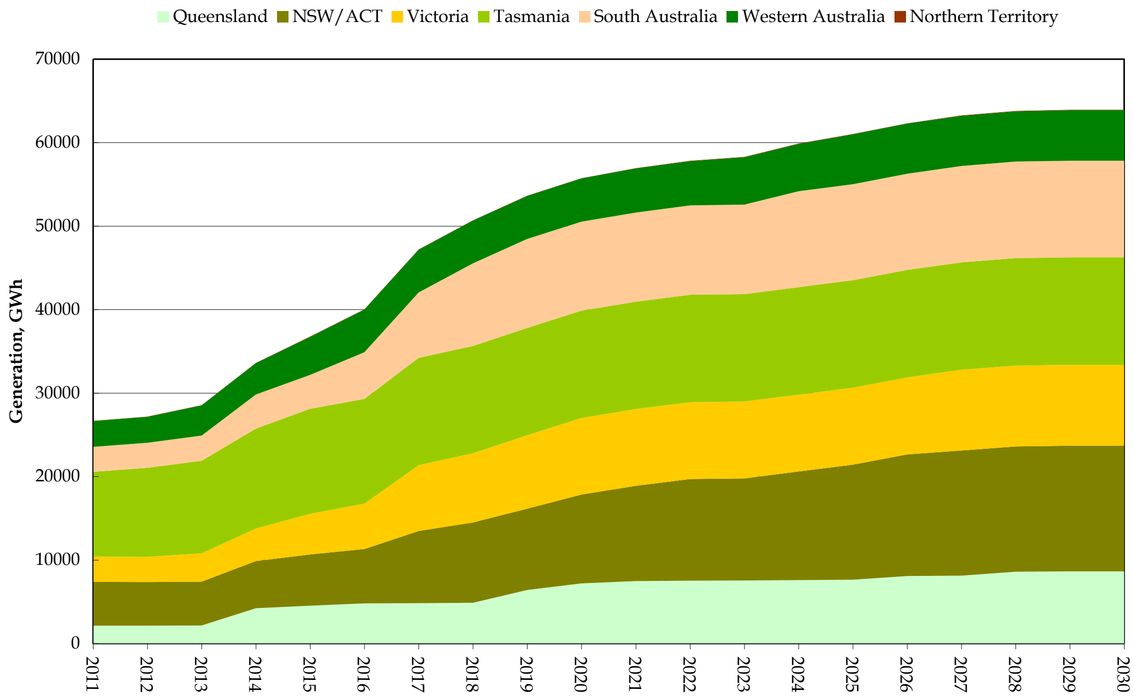


Figure 3-20: Renewable energy generation by State, current RET design



Note: includes small generation units but excludes solar water heater generation and eligible generation not supplying the major grids (NEM, SWIS and DKIS).

Figure 3-21: Renewable Energy Generation by State, LRET Scheme



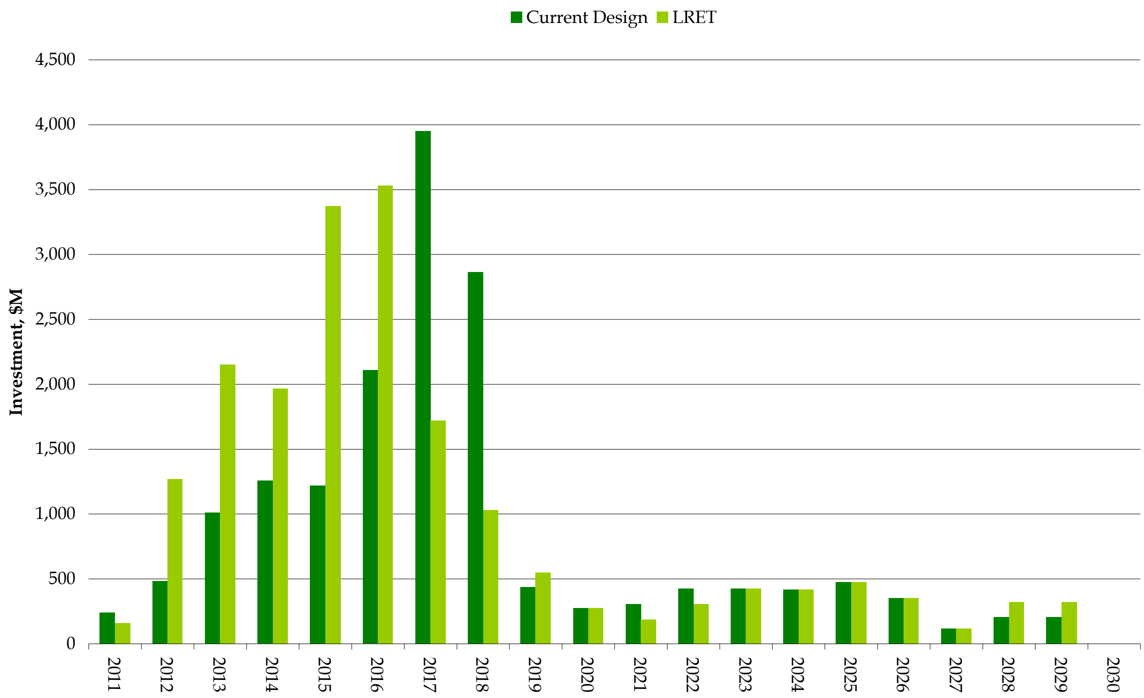
Note: includes small generation units but excludes solar water heater generation and eligible generation not supplying the major grids (NEM, SWIS and DKIS).

3.2.6 Investment profile

Investment is spread over the period to 2020, but there tends to be a higher level of investment around the period 2013 to 2017. Investment in the period to 2020 is estimated to be around $14 billion to $16 billion in total, with a present value of around $10 billion to $12 billion (assuming a 6% discount rate).

Investment is brought forward under the LRET proposal even with a later start date for the CPRS, with higher levels of investment in the period to 2016. The total level of investment in large scale generation is also higher, with the present value of total capital expenditure to 2020 being some $2.1 billion higher. Total investment in the period to 2030 is $17 billion to $19 billion under both design scenarios, with investment from 2020 to 2030 being similar under both designs. The present value of investment over the period to 2030 is estimated to be $2.3 billion higher for the LRET proposal.

Figure 3-22: Investment in large scale renewable energy capacity with the LRET



3.2.7 Technology mix – large scale generation

As the RET acts to push renewable generation into the electricity market faster than would have occurred under the CPRS alone, the technologies captured by the RET primarily favour those that are market-ready, such as wind and biomass. By 2020, almost half the extra renewable generation induced by the RET is taken up by wind generation. Geothermal could contribute around 30% of the additional renewable energy generation required. In total, but over 70% of the increase in capacity comprises additional wind generation and geothermal (hot dry rocks) generation. Increased biomass and expansions at existing hydro-electric (as well as some mini-hydro facilities) also occur but growth in these technologies is limited either by their high cost or their limited opportunities.

Figure 3-23: Generation mix (large scale plant) – current RET design

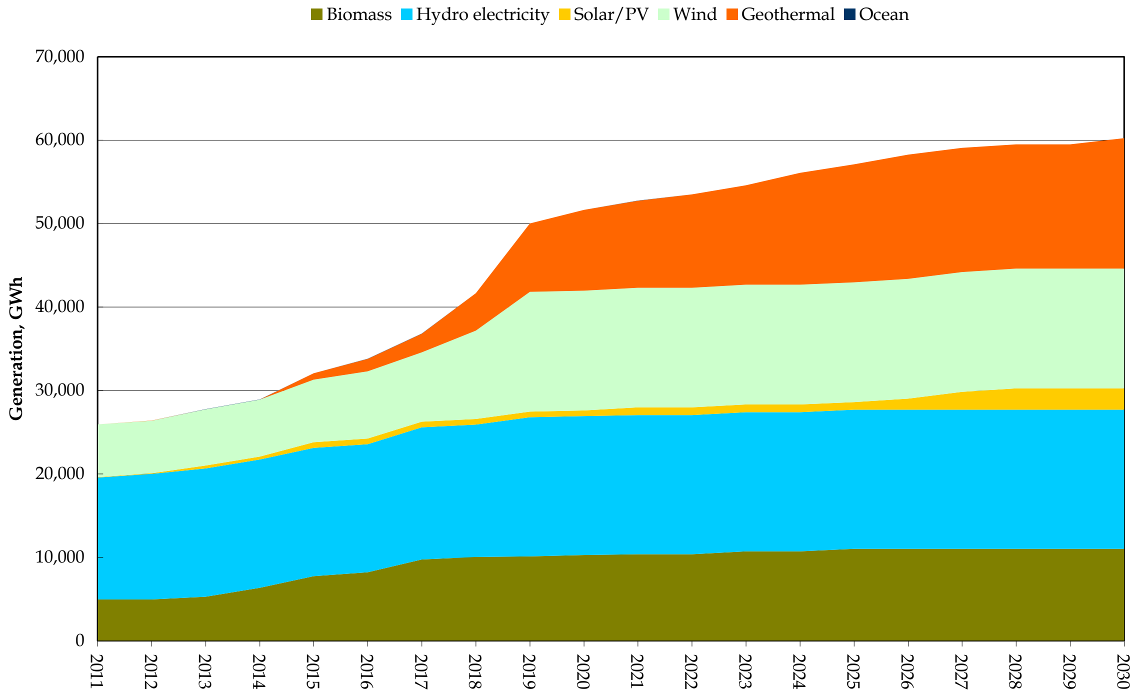
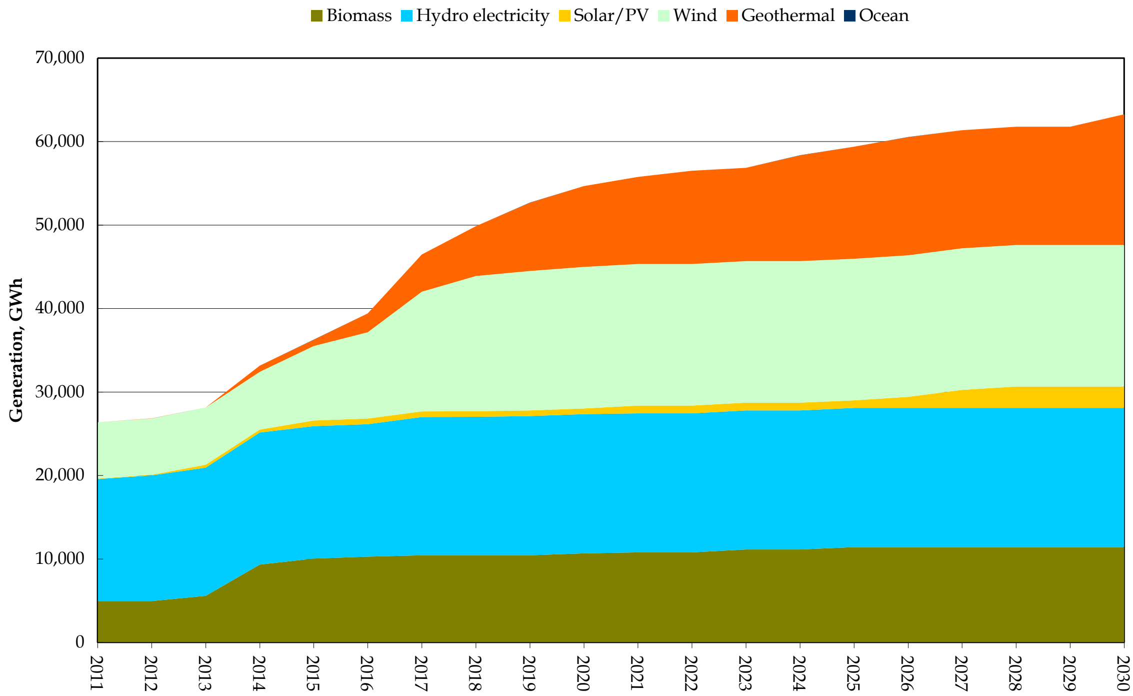


Figure 3-24: Generation mix (large scale plant) – LRET design



3.2.8 Small scale generation uptake under the SRES

Small scale generation is projected to decrease in the early years under the proposed SRES compared with the current scheme design. As certificate prices received for these technologies are expected to be lower under the SRES proposal until 2017 than the modelled contract price, then uptake of these technologies will be lower. The level of uptake is approximately the same by 2030. Delaying the CPRS by one year did not have any impact on generation levels.

Figure 3-25: Energy displaced by solar and heat pump water heaters under SRES

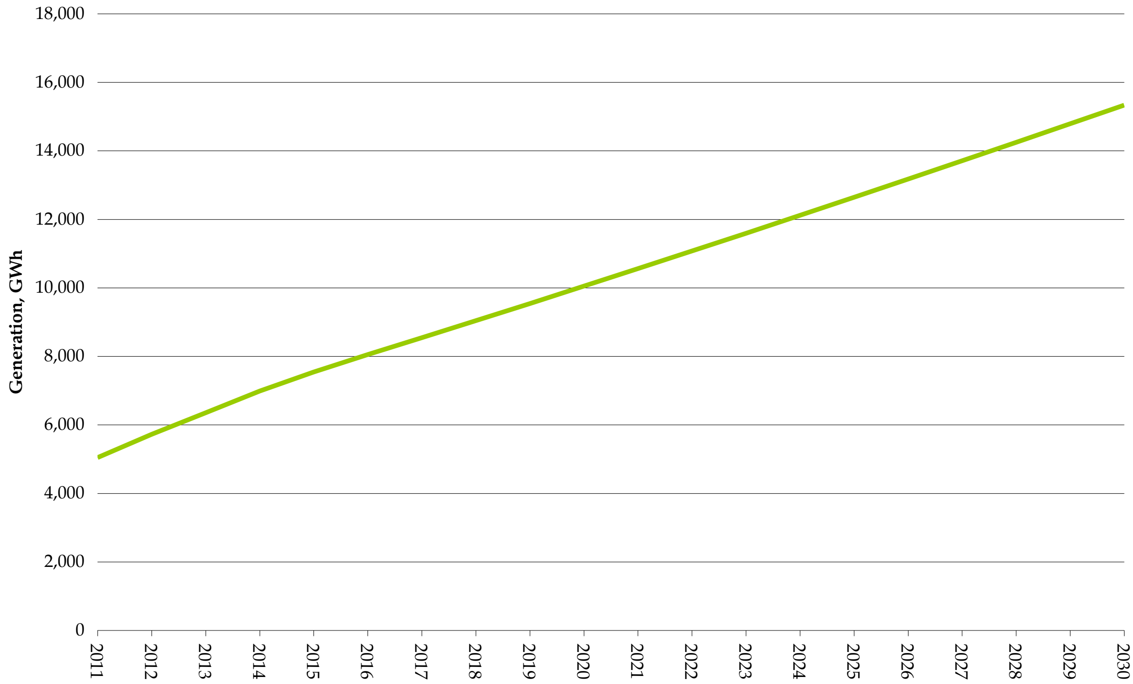
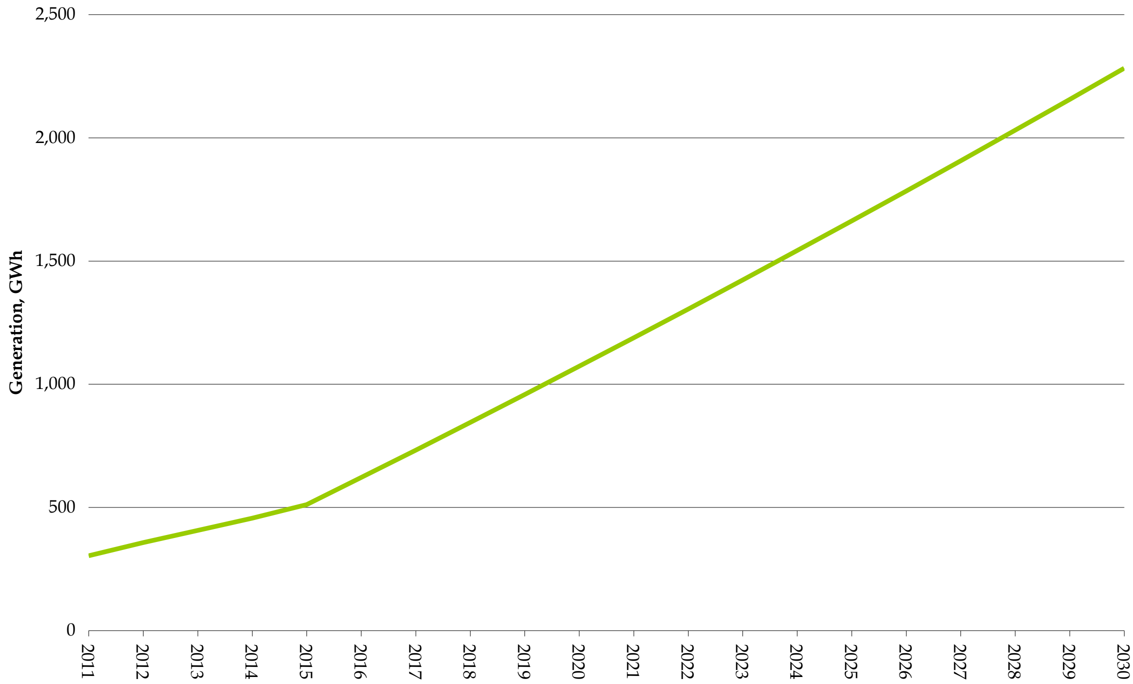


Figure 3-26: Generation by small scale (deemed) systems under SRES



3.2.9 Electricity Markets

The Current RET

The current RET scheme increases retail electricity prices due to the cost of purchasing certificates to cover liabilities. Retail electricity prices in Australia for non emission-intensive, trade-exposed customers, are expected to increase by around 4.2% in the period to 2015, 5.2% in the period from 2016-2020 and 3.3% in the period from 2021 to 2030.

For the average household, the additional cost for purchasing electricity amounts to $39 per year over the period from 2010 to 2015, $61 per year in the period from 2016 to 2020 and $44 per year for the period from 2021 to 2030.

Table 3-4: Impact of the current RET on retail electricity prices

	2010 -2015	2016-2020	2021-2030
Price (no RET), $/MWh	114	144	165
Cost impact of the current RET, $/MWh	4.73	7.47	5.42
Proportional change in price due to the current RET, %	4.2%	5.2%	3.3%

Note: additional costs of purchasing RECs are assumed to be borne by customers other than energy intensive trade exposed industrial customers.

The Enhanced RET

Wholesale prices

Wholesale prices are projected to increase due to the RET and implementation of the CPRS. Changing the scheme design to the LRET reduces prices by less than 1% in the period to 2020, due mainly to more large scale generation entering the market - and therefore creating a small and temporary overhang of capacity – and the ability of this capacity to bid into the wholesale market at a low marginal cost.. The price decrease is relatively small being less than 1% on a time-weighted average basis due to the fact that the additional capacity entering the market is less than 10% of the additional renewable energy capacity required and under 2% of total generation capacity.

Table 3-5: Change in wholesale price due to enhanced RET changes

	2010 -2015	2016-2020	2021-2030
Price, reference case, $/MWh	57.00	81.00	94.00
Change in price from reference case, $/MWh	-0.11	-0.19	0.00
Proportional change in price, %	-0.22%	-0.24%	0.00%

Retail prices

Retail prices are expected to increase by less than 1% in the period to 2030 as a result in the change in design and with a 2014 start date for the CPRS. The increase is due to the added cost of purchasing certificates, which can add up to $1/MWh to retail prices. This is partly offset by average wholesale prices decreasing slightly so that price increases at the retail level are less than $1/MWh.

Table 3-6: Change in average retail prices due to enhanced RET changes

	2010 -2015	2016-2020	2021-2030
Price, reference case, $/MWh	118.00	151.00	170.00
Change in price from reference case, $/MWh	0.26	0.31	0.64
Proportional change in price, %	0.22%	0.20%	0.37%

Note: additional costs of purchasing RECs are assumed to be borne by customers other than energy intensive trade exposed industrial customers.

For residential customers, the increase in retail prices due to the changes to the scheme, amount to around $2.10 per annum in the period to 2015, $2.50 per annum in the period from 2016 to 2020, and $5.20 per annum in the period from 2021 to 2030.