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Impact of the Large-Scale Renewable Energy Target on Wholesale Market Prices and Emissions Level

NERA
Economic Consulting

Addendum Report – Additional Sensitivities

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CONFIDENTIAL

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Contents

1. Introduction 1

2. Methodology and Assumptions 2
2.1. Approach to market modelling 2
2.2. Modelling sensitivities considered 2
2.3. Summary of modelling scenarios considered 4

3. Results of the Demand Sensitivity 5
3.1. Key findings from the Interim Report 5
3.2. Overview of treasury demand sensitivity 5
3.3. Forecast spot market prices 5
3.4. Implications for generation investment and emissions 9
3.5. Scope to satisfy the LRET by FY2020 12
3.6. Supply and demand balance and unserved energy 15
3.7. Conclusions 18

4. Results of Relaxing the No New Coal Generation Investment Assumption 19
4.1. Key results from the Interim Report 19
4.2. Overview 19
4.3. SWIS prices 20
4.4. Implications for generation capacity and emissions 21
4.5. Achievement of the LRET in WA 24
4.6. Conclusions 25

5. Implications of Removing the Pro-rating of the LRET 26

Appendix A. Detailed Modelling Assumptions 27

Appendix B. Detailed Results for Treasury Demand Sensitivity 33

Appendix C. Detailed Results for Relaxing No New Coal Generation Investment Assumption 44

List of Tables

Table A.1: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Carbon Case 27
Table A.2: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Reference Case 28
Table A.3: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Carbon Case 29
Table A.4: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Reference Case 30
Table A.5: NEM Sent Out Energy (GWh) Net of Non-Scheduled Generation – Final Report Carbon Case 31
Table A.6: NEM Sent Out Energy (GWh) Net of Non-Scheduled Generation – Final Report Reference Case 32
Table B.1: NEM Weighted Average Prices ($/MWh) – Final Report Reference Case 33
Table B.2: NEM Weighted Average Prices($/MWh) – Final Report Counterfactual Case 34
Table B.3: NEM Weighted Average Prices($/MWh) – Final Report Carbon Case 35
Table B.4: NEM Installed Capacity (MW) – Final Report Reference Case 36
Table B.5: NEM Installed Capacity (MW) – Final Report Counterfactual Case 37
Table B.6: NEM Installed Capacity (MW) – Final Report Carbon Case 38
Table B.7: NEM Energy (GWh) – Final Report Reference Case 40
Table B.8: NEM Energy (GWh) – Final Report Counterfactual Case 41
Table B.9: NEM Energy (GWh) – Final Report Carbon Case 42
Table C.1: SWIS Weighted Average Prices($/MWh) – Final Report Reference and Carbon Case with New Coal Investment 44
Table C.2: SWIS Installed Capacity (MW) – Final Report Reference Case with New Coal Investment 45
Table C.3: SWIS Installed Capacity (MW) – Final Report Carbon Case with New Coal Investment 46
Table C.4: SWIS Energy (GWh) – Final Report Reference Case with New Coal Investment 47
Table C.5: SWIS Energy (GWh) – Final Report Carbon Case with New Coal Investment 48

List of Figures

Figure 2.1 Revised NEM Demand Outputs Compared with Draft Interim Report 3
Figure 3.1 NEM Price Forecast - Reference Case 6
Figure 3.2 NEM Price Forecast - Counterfactual 6
Figure 3.3 Difference in NEM Price Forecasts – Reference Case 7
Figure 3.4 NEM Price Forecast – Carbon Case 8
Figure 3.5 Difference in NEM Price Forecasts – Carbon Case 9
Figure 3.6 Difference in NEM Generation Capacity – Reference Case 10
Figure 3.7 Difference in NEM Generation Capacity – Carbon Case 10
Figure 3.8 Difference in NEM Generation Emissions – Reference Case 11
Figure 3.9 National Cost of Abatement 12
Figure 3.10 Forecast Level of Renewable Generation Compared to the LRET – Revised Demand Assumptions 13
Figure 3.11 Forecast Level of Renewable Generation Compared to the LRET – Initial Demand Assumptions 14
Figure 3.12 NEM and National LRET Compliance Costs 15
Figure 3.13 Proportion of Unserved Energy – Final Report Reference case 16
Figure 3.14 Proportion of Unserved Energy – Final report Counterfactual 17
Figure 3.15 Proportion of Unserved Energy – Final Report Carbon Case 17
Figure 4.1 SWIS Price Forecasts – All Cases 20
Figure 4.2 Difference in SWIS Price Forecasts – All Cases 21
Figure 4.3 Difference in Scheduled and Semi-Scheduled Installed Capacity – SWIS Reference Case 22
Figure 4.4 Scheduled and Semi-Scheduled Installed Capacity – SWIS Carbon Case 23
Figure 4.5 Difference in Scheduled and Semi-Scheduled Installed Capacity – SWIS Carbon Case 23
Figure 4.6 Emissions from Electricity Generation – SWIS 24
Figure 4.7 Forecast Level of Renewable Generation Compared to the LRET – Initial Demand Assumptions 25

1. Introduction

In June 2011, NERA Economic Consulting (NERA) and Oakley Greenwood (OGW) undertook an analysis of the wholesale electricity price impact of the large-scale renewable energy target (LRET) in the National Electricity Market (NEM), the Western Australian Electricity Market (WEM) and the Northern Territory's Darwin-Katherine system (DKIS). The Australian Energy Market Commission (the Commission) has since asked for an analysis of the sensitivity of the results to changes in a number of key assumptions made as part of the earlier analysis.

The sensitivities that have been considered include:

- Analysis of the impact in the NEM arising from revised demand assumptions based on specifications provided to the Commission by the Commonwealth Treasury [1]; and
- the impact of relaxing the assumed restriction on allowing new coal plants to be constructed in the SWIS.

In addition, we have qualitatively considered the implications of removing the pro-rated LRET assumptions across energy markets that we made in the initial report.

This report sets out our modelling methodology, assumptions used and modelling results in detail. It is structured as follows:

- section 2 provides a brief explanation of the changes to the assumptions that have been examined as part of this study;
- section 3 presents the modelling results relating to the revised demand assumptions in the NEM;
- section 4 sets out the modelling results from relaxing the restriction on new coal plant investment in the SWIS; and
- section 5 provides a qualitative discussion of the implications of removing the pro-rated LRET assumptions across each of the energy markets.

In addition, Appendix A, B and C provide more detailed modelling results.

[1] Our previous report used demand forecasts developed by the Australian Energy Market Operator (AEMO), see AEMO, (2010), *National Transmission Network Development Plan*, http://wwww.aemo.com.au/planning/2010ntndp_cd/home.htm

2. Methodology and Assumptions

This chapter provides a brief description of the market modelling approach and assumptions used for the additional analysis. For a more detailed explanation of the modelling methodology employed and key assumptions, see chapter 2 of our earlier report.[2]

2.1. Approach to market modelling

To investigate wholesale market impacts of the LRET, we have used a market optimisation model that:

- assesses generation entry and exit to ensure there is sufficient capacity to satisfy energy demand, given minimum reserve requirements and any other constraints; and
- determines the least cost dispatch of generation plants to satisfy energy demand requirements.

The profitability of the generation investments is investigated using an iterative approach of comparing market prices to investment returns for representative levels of demand, and making adjustments until the investment returns are sufficient to support the new entrant generation. This approach is in contrast to some alternative modelling approaches, which simply make generation investment decisions based on market requirements to satisfy energy demand, given minimum reserved levels, without investigation the profitability of the subsequent profile of investment.

2.2. Modelling sensitivities considered

The sensitivities that have been considered include:

- revised NEM demand assumptions derived from national specifications provided to the Commission by the Commonwealth Treasury; and
- the impact of relaxing the assumed restriction on allowing new coal plants to be constructed in the SWIS.

In addition, we have qualitatively considered the implications of removing the pro-rated LRET assumptions across energy markets.

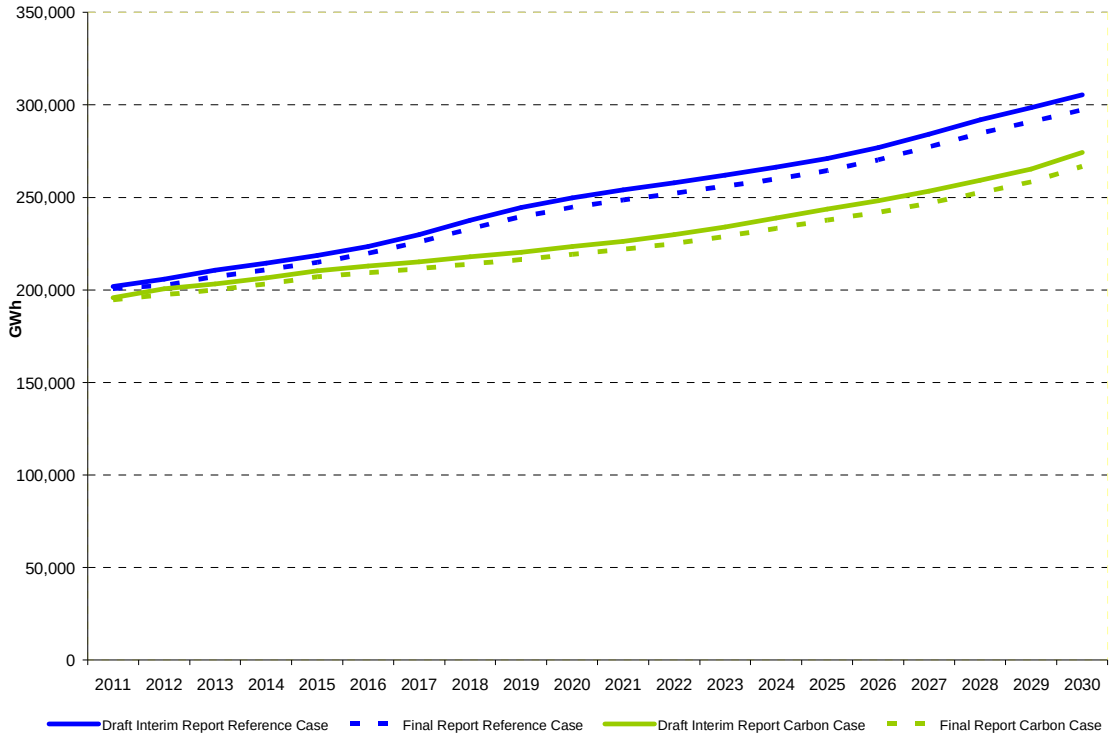
This section describes the sensitivities in greater detail.

2.2.1. Sensitivity on demand assumptions

Figure 2.1 provide a comparison of the revised demand assumptions as compared against the assumptions used in our previous analysis.

[2] See Thorpe, G., Kemp, A., and Narducci, J., (2011), *Impact of the Large-Scale Renewable Energy Target on Wholesale Market Prices*, June.

Figure 2.1 Revised NEM Demand Outputs Compared with Draft Interim Report



The key point of difference in the demand assumptions is that the revised demand is lower than the demand used in our earlier analysis[3]. For example, the revised demand in 2015 demand is approximately 4 per cent lower than previously assumed in the NEM for both the reference and carbon case. This increases to approximately 11 per cent lower for both cases when compared against the previously assumed demand in 2020.

2.2.2. Restrictions on new coal plants in the SWIS

In our earlier analysis we assumed that no new coal plants would be constructed anywhere in the NEM or the SWIS. This reflects the opinion that given uncertainties about the approach to introducing a price on carbon at that time, governments would be reluctant to approve new coal plants. Additionally, it reflects investor uncertainty about the economic viability of those plants given uncertainties about the governments' approach to pricing carbon.

The second modelling sensitivity considers the relaxation of the restriction on the construction of new coal plants in the SWIS to examine how the results change by removing this restriction.

[3] Which was based on forecasts published by the Australian Energy Market Operator – AEMO and the Western Australian Independent Market Operator - IMO

2.3. Summary of modelling scenarios considered

In line with our earlier analysis, we have considered how the sensitivities affect the wholesale market outcomes across a number of scenarios. These scenarios were current and existing as at late June 2011 (ie when there was no formal announcement of a carbon price or tax) and did not take into account the Commonwealth Government's contract for closure program. The scenarios represent differing combinations of the application of the LRET, with and without a formal carbon price:

- Reference case – LRET no carbon price – which principally assumes the continuation of the current LRET policy settings with no formal carbon tax or emissions trading scheme;
- Counterfactual – No LRET and no carbon price – which assumes that renewable generation is capped at the existing amount and committed investments and any additional renewable investment would only occur if it was economic in its own right; and
- Carbon Case – LRET and a carbon price – which assumes that a carbon price is introduced from FY2012, with the carbon price trajectory reflecting the CPRS-5% modelling undertaken by the Commonwealth Treasury in relation to the previous CPRS.

Results from the early analysis are referred to as Draft Interim Report whereas findings from this report are referred to as Final Report in the diagrams presented in this report.

3. Results of the Demand Sensitivity

This chapter sets out key findings from the previous study, and the results of the demand sensitivity for wholesale market prices, generation capacity and dispatch, and the achievement of the LRET.

3.1. Key findings from the Draft Interim Report

A key conclusion of our earlier study was that given our modelling assumptions, the previous results suggested that:

- under the reference case the proportion of renewable generation energy likely to enter on the basis of economic returns from energy and REC revenue alone by FY2020 will be approximately 30 to 40 per cent lower than the LRET target;
- the LRET reduces wholesale market prices and so lowers revenues for fossil fuel generation compared to the case if there was no LRET; and
- given forecast wholesale market prices, and limitations created by the market price cap, cumulative price threshold and the REC penalty price, there is insufficient overall generation investment to meet the reliability standard in some NEM regions in some years. In the earlier report we emphasised that this last outcome should be regarded as indicative rather than a definitive conclusion warranting further examination.

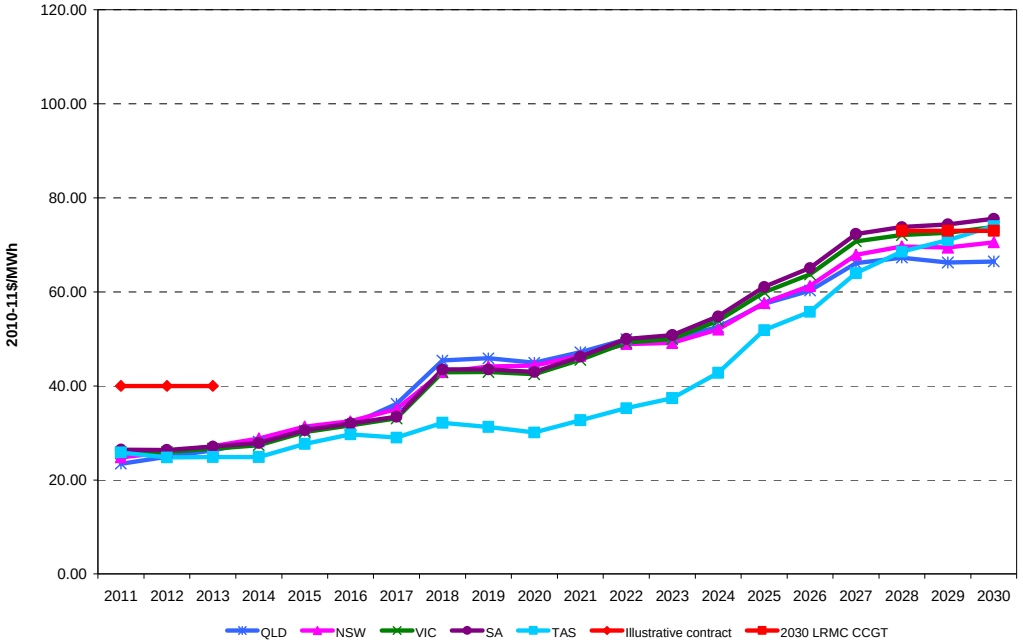
3.2. Overview of treasury demand sensitivity

The treasury demand sensitivity considered as part of this analysis do not affect these broad conclusions, except for increasing the size of the shortfall for the achievement of the LRET target by FY2020. Indeed, the shortfall with the revised demand is between 50 and 60 per cent of the LRET target in the NEM, reflecting less opportunity for renewable generation investment, and lower overall wholesale market prices meaning that the LRET penalty price is achieved sooner as compared to the previous results.

3.3. Forecast spot market prices

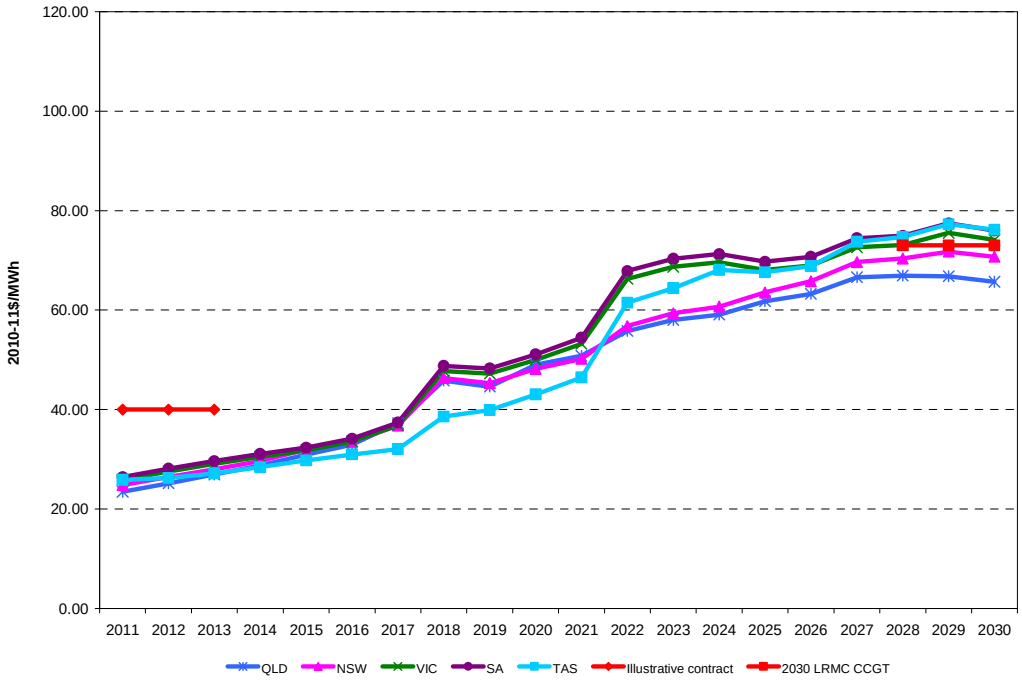
Figures 3.1 and 3.2 set out the forecast spot market prices based on the new demand assumptions for the reference case and counterfactual scenarios. As in our previous analysis, the effect of the LRET (as demonstrated by comparing the reference case to the counterfactual) is to dampen wholesale market prices for a number of years, with a peak reduction around 2020. Indeed, in 2020 wholesale market prices are approximately 8 to 15 per cent lower in New South Wales, Queensland, Victoria and South Australia and 30 per cent lower in Tasmania when the LRET is in place.

Figure 3.1 NEM Price Forecast - Reference Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

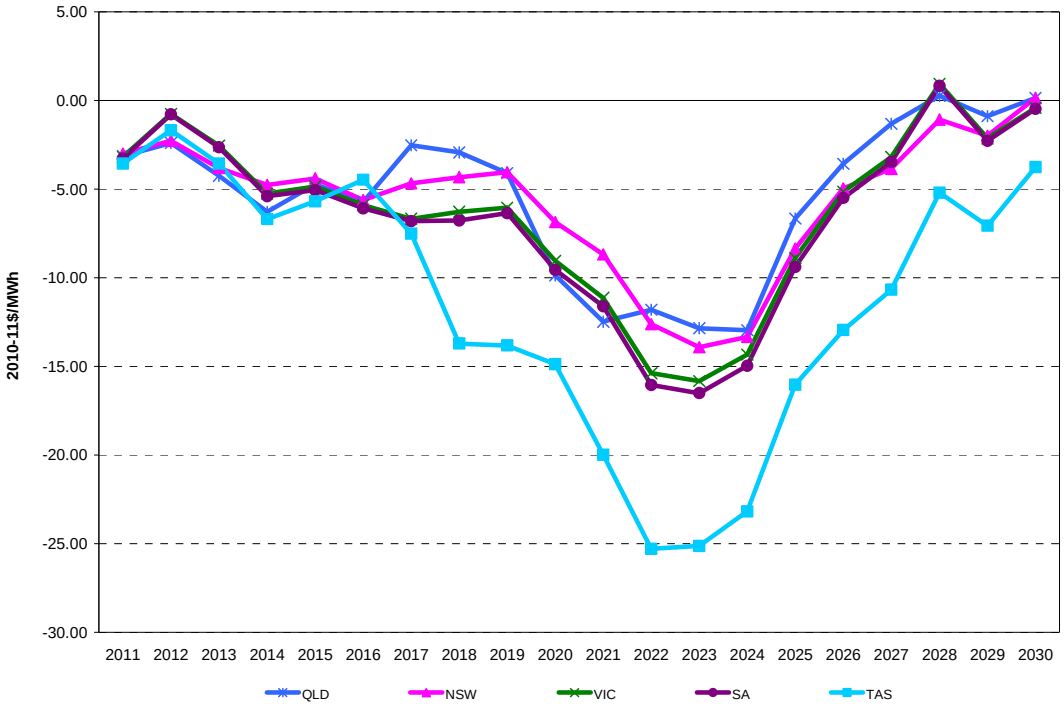
Figure 3.2 NEM Price Forecast - Counterfactual



Note: Data represents financial years (eg, FY2011 is 2011/12)

Figure 3.3 demonstrates the implications of the change in demand for wholesale market prices under the reference case scenario. Forecast prices for the start of the period in the NEM are well below prevailing contract prices (an indicative $40/MWh level is shown) but a little under annual average actual spot prices: a similar effect was seen in our earlier study. This outcome indicated a significant contract premium and also that the modelling methodology, by design, did not examine very short term (sub 30 minute) volatility in price that can occur at times and push 30 minute prices up. Volatility of this nature is highly uncertain and increases with the presence of intermittent generation technology. Our methodology assumed investors would not presume such technology would be present when making investment decisions, especially for peaking plants that need to be started and brought on line to capture the benefit of high prices. The chart also shows how prices converge to new entrant prices towards the end of the horizon suggesting the suppression of prices "washes" out" of the market by this time.

Figure 3.3 Difference in NEM Price Forecasts – Reference Case

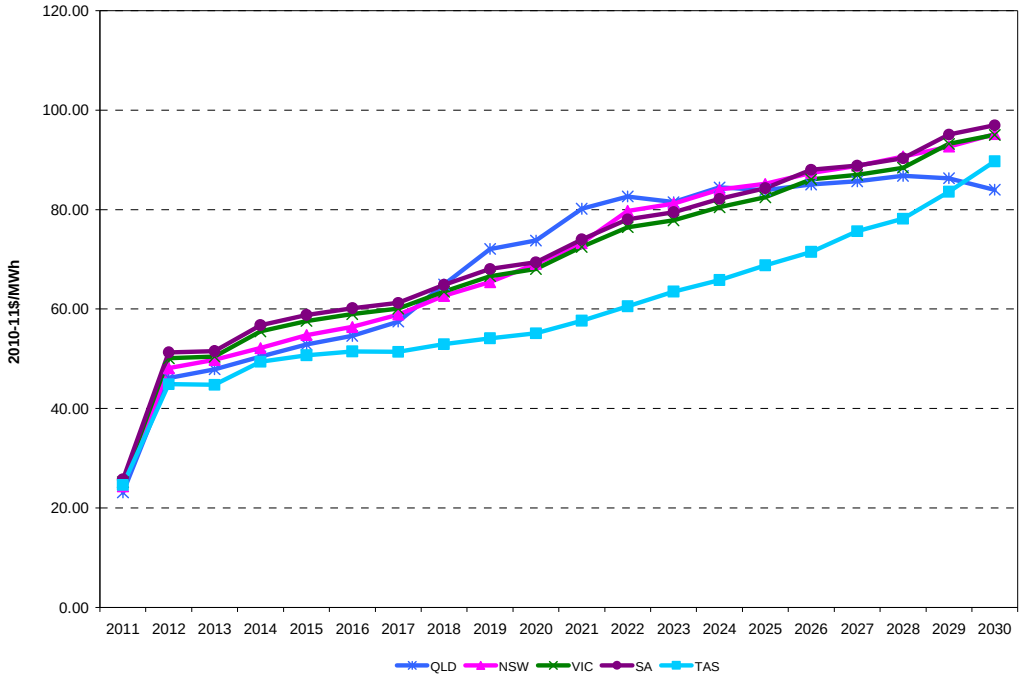


Note: Data represents financial years (eg, FY2011 is 2011/12)

Finally, as in the previous analysis, the imposition of a carbon price increases the wholesale market prices compared to the reference case – Figure 3.4. Interestingly the price forecast for the Tasmanian region diverges from the other regional price results from around FY2016 but trends back towards the other regions by the end of the study horizon. This is due to ongoing investment in renewable technology in Tasmania identified by the model even though the demand in Tasmania is reduced (in line with a general reduction across the NEM) to the point that Tasmania exports more energy up to the limit of Basslink more often resulting in price separation between Tasmania and Victoria. Towards 2030 demand has grown to the point where Basslink is congested less often and price aligns with the Victorian price. The ongoing investment in Tasmania is in effect the least-worst location for the renewable investment that

does occur. In practice investors may be wary about the risk of even greater price separation and choose another location or simply not invest, which will exacerbate the shortfall from the LRET target.

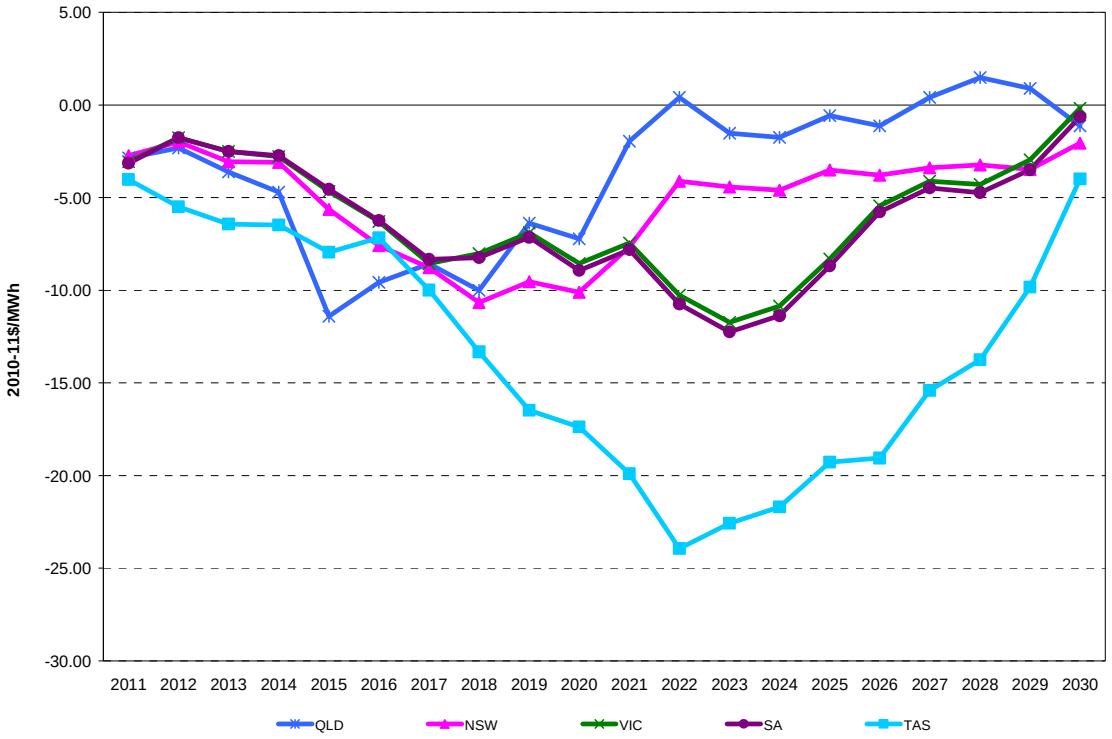
Figure 3.4 NEM Price Forecast – Carbon Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

Figure 3.5 illustrates how the change in demand affects the wholesale market prices under the carbon case scenario. The reduction in demand causes the wholesale market price to fall until the end of the study period. Indeed, in 2020 wholesale market prices are approximately 9 to 13 per cent lower in New South Wales, Queensland, Victoria and South Australia and 24 per cent lower in Tasmania when the LRET is in place. The wholesale market prices then converge to new entrant prices towards the end of the horizon.

Figure 3.5 Difference in NEM Price Forecasts – Carbon Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

3.4. Implications for generation investment and emissions

Under the reference case, the effect of lower energy demand is that less generation investment is required in order to satisfy demand, with associated reductions in generation dispatch and emissions. Indeed, generation capacity is 14 per cent lower in 2020 in the reference case when compared to the previous demand assumptions. Initially the capacity reductions are mostly OCGT, wind and, in the later years, CCGT generation in the NEM – figure 3.6.

Similarly for the carbon case, the lower demand leads to lower generation investment and emissions. Indeed, generation capacity is 9 per cent lower in 2020 when compared to previous demand assumptions. Capacity reduction occurs mostly in OCGT after 2014 and CCGT after 2019 – Figure 3.7.

Figure 3.6 Difference in NEM Generation Capacity – Reference Case

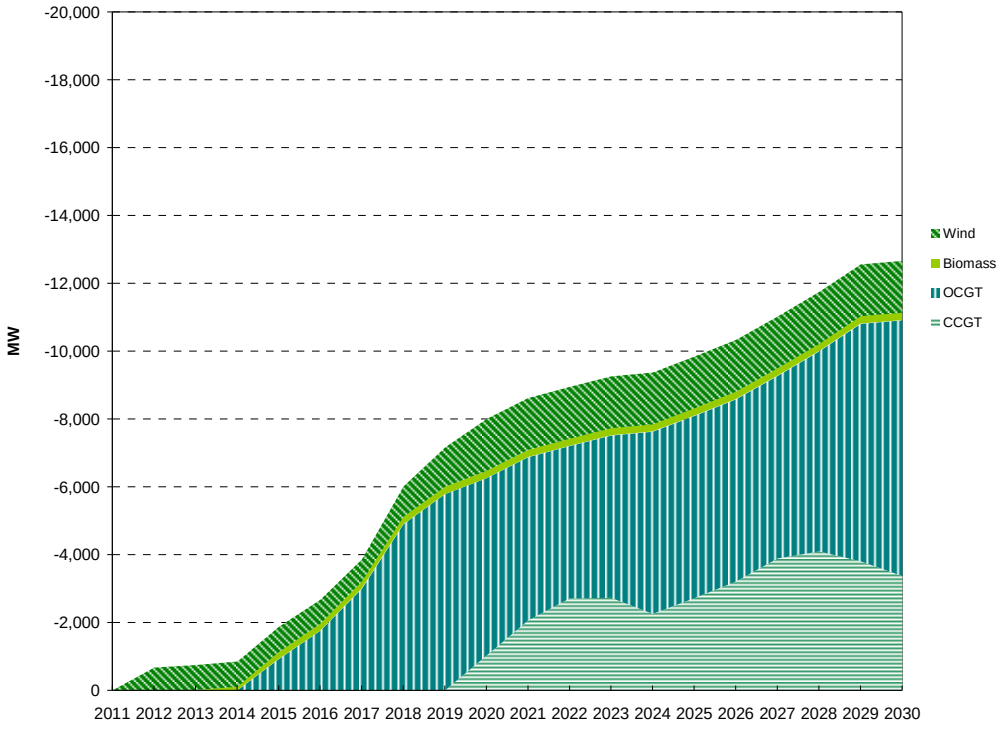
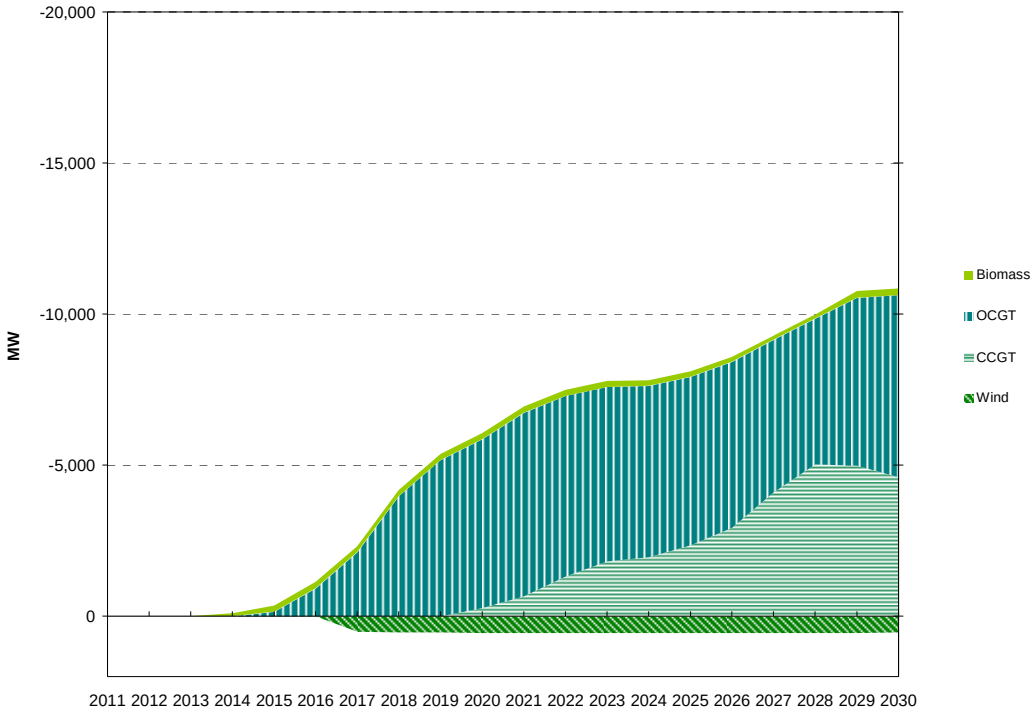


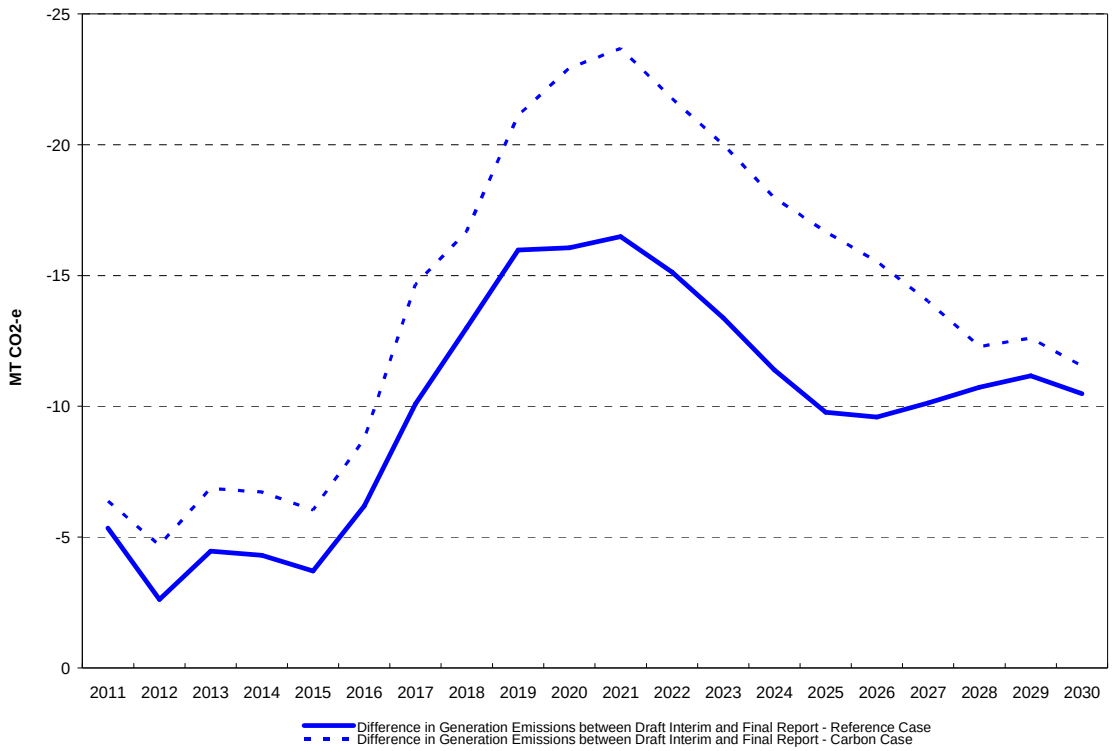
Figure 3.7 Difference in NEM Generation Capacity – Carbon Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

The difference in combustion and fugitive emissions for the reference case under the two demand scenarios is set out in Figure 3.8. The results indicate that total emissions are approximately 7 to 11 per cent lower by 2020 for the reference case and carbon case respectively.

Figure 3.8 Difference in NEM Generation Emissions – Reference Case

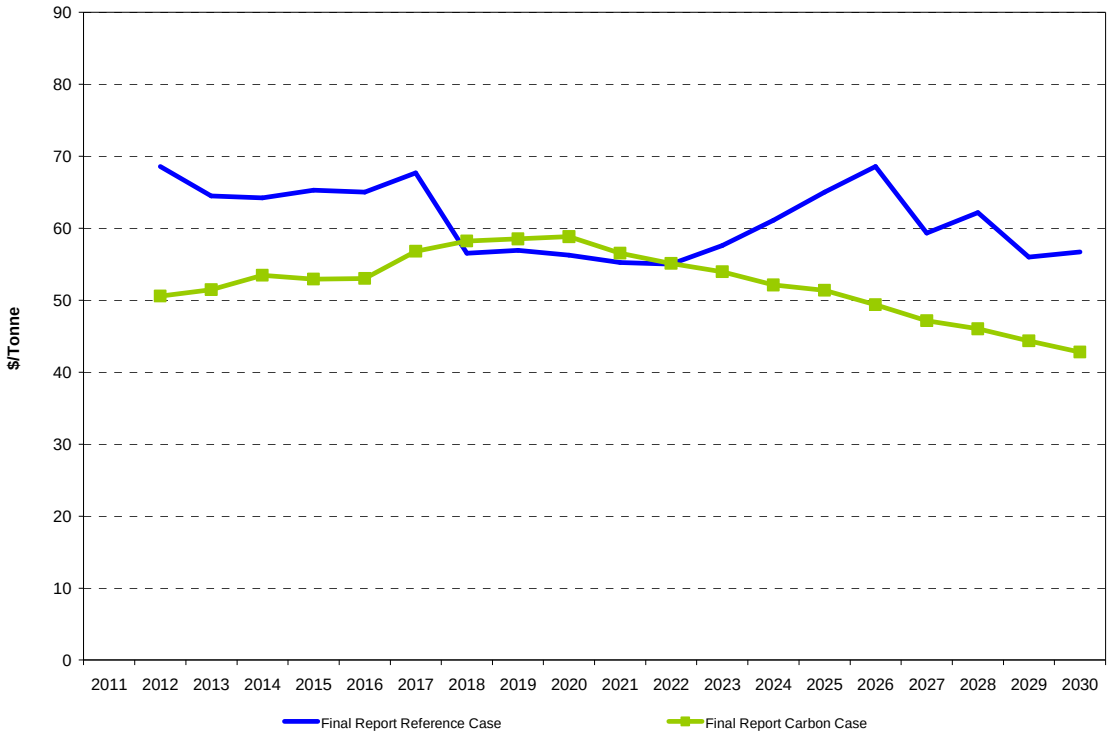


Note: Data represents financial years (eg, FY2011 is 2011/12)

Figure 3.9 sets out the implied national abatement costs associated with the LRET. The abatement costs represent the incremental operating and capital costs for the industry to reduce emissions in the reference and carbon cases compared to the counterfactual case. The cost of abatement is calculated as the additional annualised capital and operating costs relative to the counterfactual divided by the change in emissions in each case.[4]

[4] Notably, operating costs exclude the cost of carbon taxes/permits but includes all other taxes and royalties paid by the industry to operate.

Figure 3.9 National Cost of Abatement



Note: Data represents financial years (eg, FY2011 is 2011/12)

The cost of abatement is generally lower as compared to the previous study in the reference case, but high under the carbon case. The carbon case has higher abatement cost as the percentage increase in cost of abatement (the numerator) outweighs the percentage increase in emission reductions (the denominator). For example, the total reduction in emissions is approximately 30 per cent higher when compared to our earlier study, but the cost of abatement is approximately 50 per cent higher in 2020. This outcome highlights the reason why such ratios should be used with some caution and is due to the relative differences in the degree and timing of reduction in demands in the two cases impact the capital and operating cost (the numerator) and reduction in emissions (the denominator) in the two cases over the period of the study which covers only part of a period of major transition in the industry.

3.5. Scope to satisfy the LRET by FY2020

As in the previous analysis, the LRET in the NEM (see Figure 3.10) is not satisfied under the reference case for either demand level. Indeed, the shortfall reflects the effect of lower demand on wholesale market prices, decreasing the revenue obtained from the wholesale market for renewable generation investments. This in turn means that the penalty price becomes a cheaper alternative to constructing new renewable energy capacity earlier.

Comparing Figure 3.10 with 3.11 indicates the size of the shortfall difference in the NEM for the reference case. In FY2020, with lower energy demand the shortfall in satisfying the LRET under the final report reference case is over 50 per cent, compared with approximately

30-40 per cent from the previous results from the Draft Interim Report. It can therefore be concluded that lower energy demand reduces the scope for the achievement of the LRET further in the NEM for the conditions assessed in the analysis.

Under the carbon case the level of renewable generation is similar to the Interim Report. Indeed, the difference by 2020 is less than 1 per cent when compared to the previous results. This is reasonable as the majority of the capacity reduction occurs in OCGT and CCGT generation investment.

Figure 3.10 Forecast Level of Renewable Generation Compared to the LRET – Revised Demand Assumptions

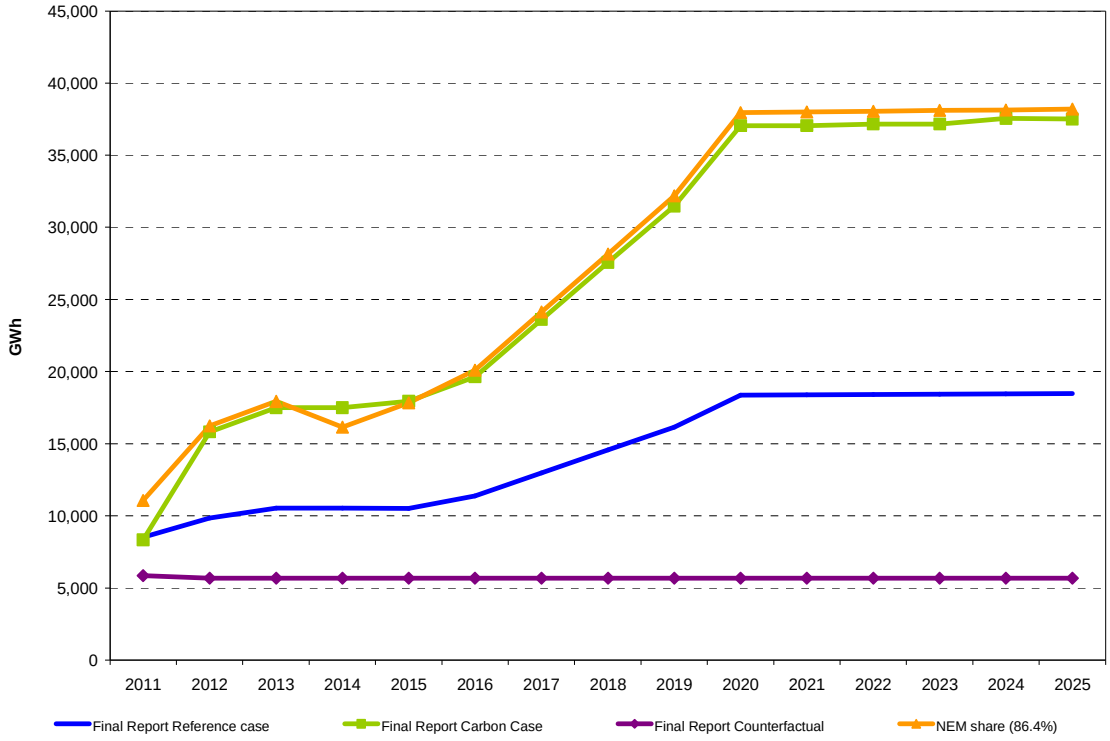
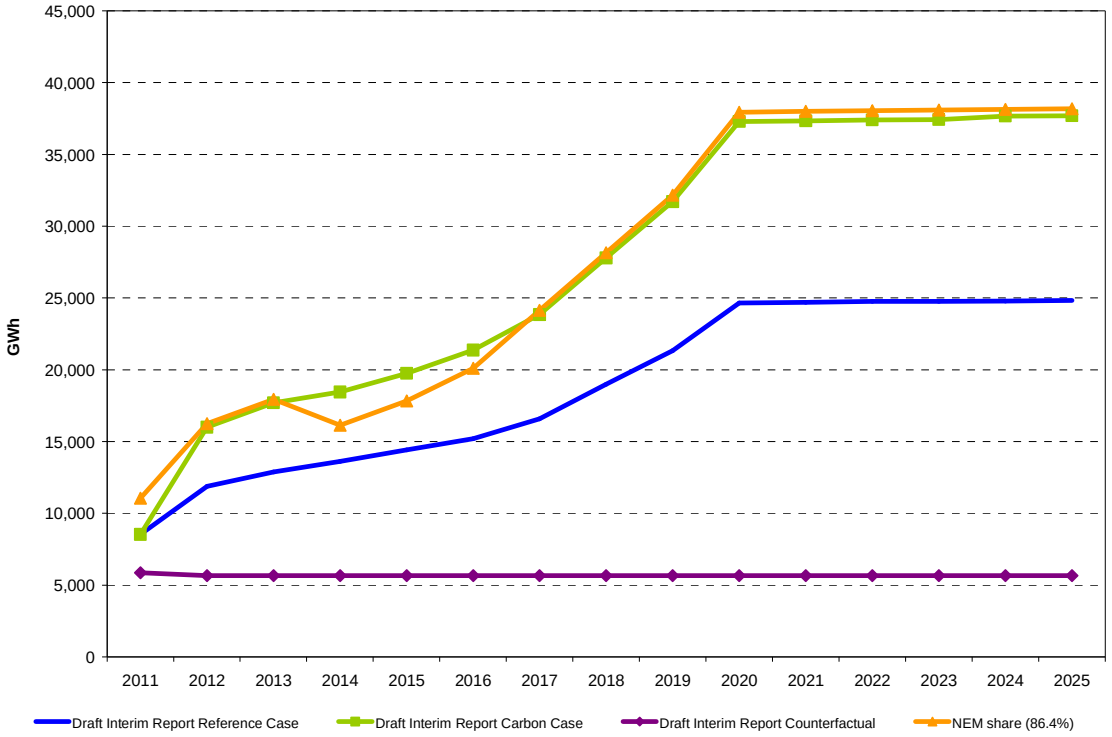


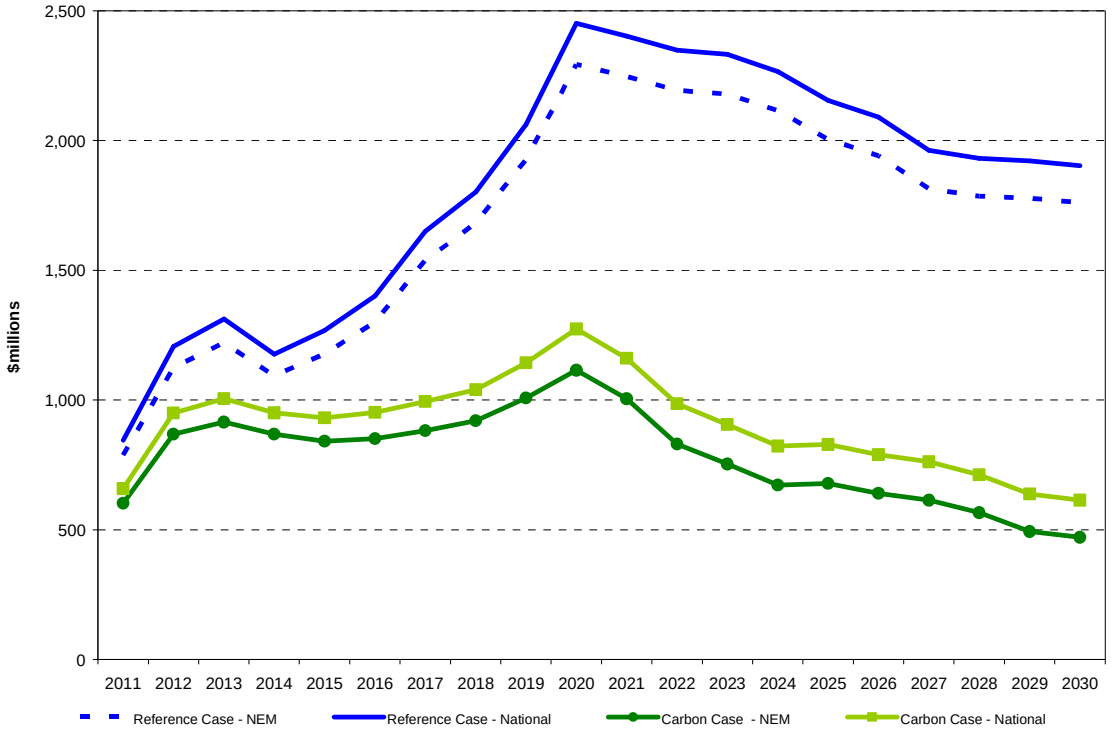
Figure 3.11 Forecast Level of Renewable Generation Compared to the LRET – Initial Demand Assumptions



Note: Data represents financial years (eg, FY2011 is 2011/12)

The implied cost of complying with the LRET requirements is set out in Figure 3.12. In light of the lower wholesale market prices, the cost of satisfying the LRET is higher under the lower demand sensitivity. Indeed at its peak in 2020, the lower demand results in an increase in the cost of complying with the LRET by 10.2 per cent for the NEM, and 9.5 per cent nationally for the reference case.

Figure 3.12
NEM and National LRET Compliance Costs



Note: Data represents financial years (eg, FY2011 is 2011/12)

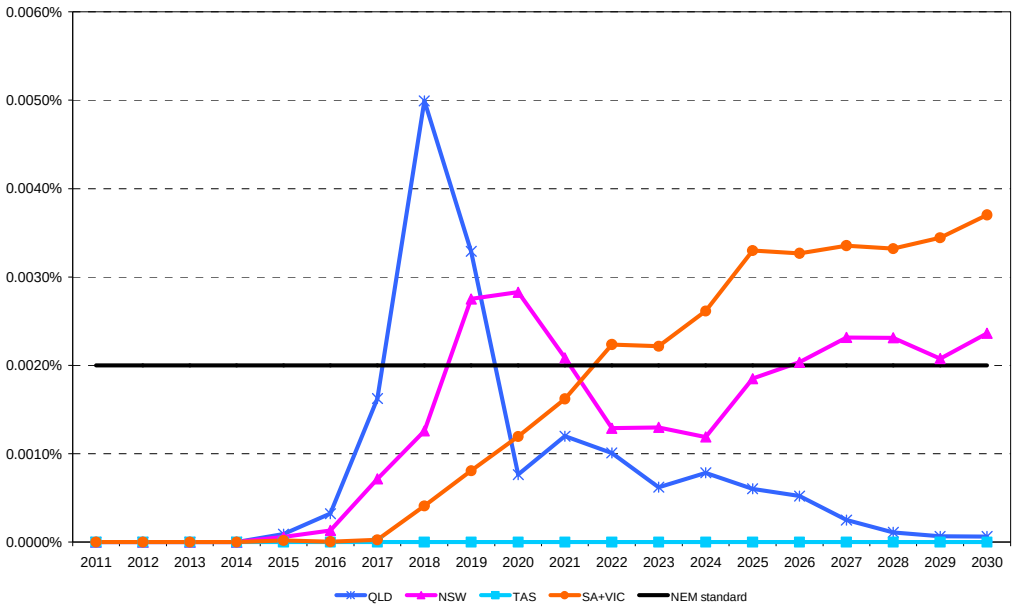
3.6. Supply and demand balance and unserved energy

A key concern identified in the previous study was that there was no combination of generation investments that could ensure that the reliability standard was satisfied for all NEM regions under each of the scenarios considered. While the lower demand results in a reduction in the pressure on the reliability standard, it is still breached in some regions over the modelling time horizon.

In the earlier study we emphasised that as the study was not designed to assess reliability in detail more work would be warranted on this point. This further examination would need to look more closely at short term market outcomes and the location of investment between regions which would have the effect of levelising unserved energy to some degree. These additional studies may then conclude that regions with reliability outcomes exceeding the standard see additional peaking investment and other regions that currently satisfy the reliability standard have less. While this will change the location and possibly overall magnitude of unserved energy it is unlikely to change the level of renewable investment that was the focus of this work. The additional work should also take account of other factors affecting peaking investment and noted in the earlier report including the risk profile and discount rate individual investors might apply to peaking investment in practice. It is also relevant to note that these more strategic business factors may have shifted since the earlier work given the passage of the carbon pricing legislation through federal parliament.

Overall the lower demand in the treasury sensitivity reduces the level of unserved energy and reduces the pressure on the reliability standard. Figures 3.13 to 3.15 sets out the estimated levels of unserved energy compared to the NEM reliability standard of 0.002 per cent for the reference case, counterfactual case and carbon case, respectively seen in these studies.

Figure 3.13 Proportion of Unserved Energy – Final Report Reference case



Note: Data represents financial years (eg, FY2011 is 2011/12)

Figure 3.14 Proportion of Unserved Energy – Final report Counterfactual

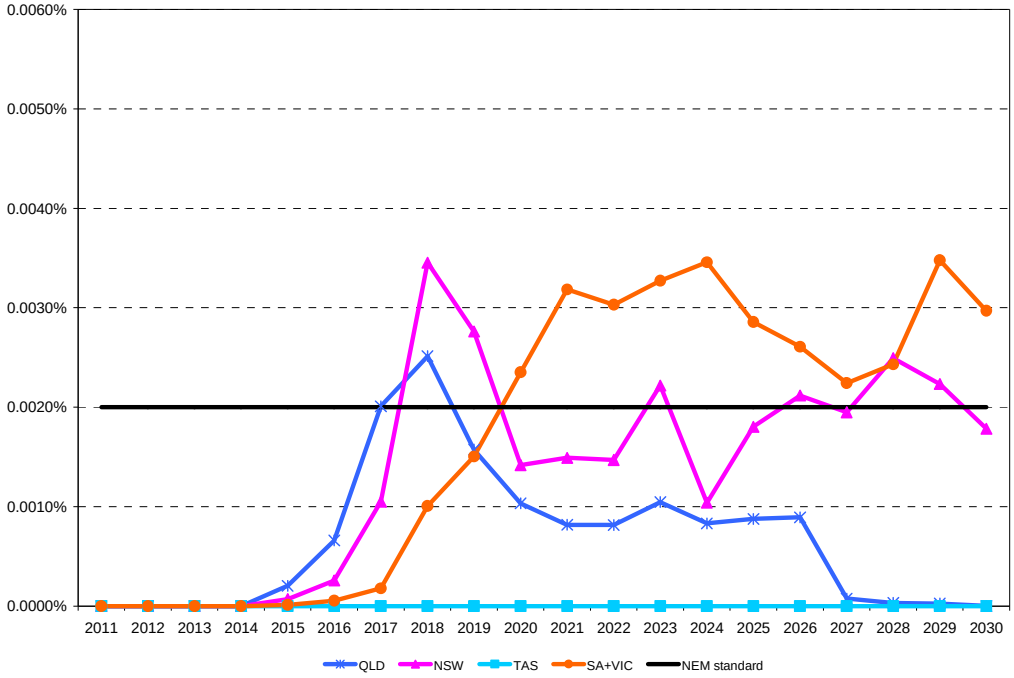
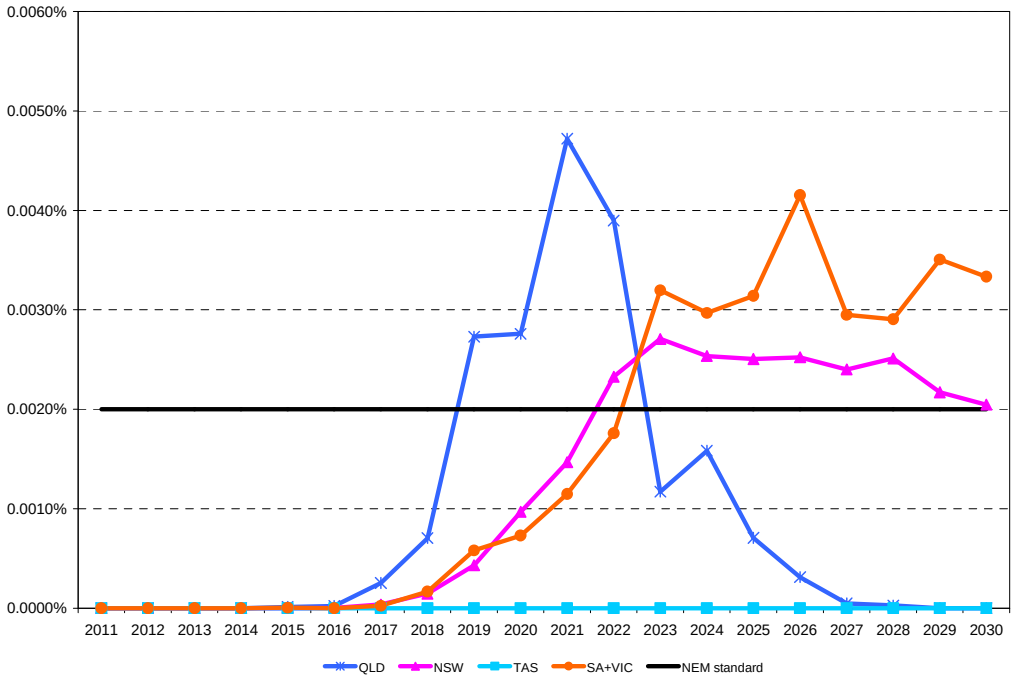


Figure 3.15 Proportion of Unserved Energy – Final Report Carbon Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

3.7. Conclusions

Our examination of the wholesale market implications of revising down demand assumptions indicates that for the reference case:

- wholesale market prices remain lower with the LRET as compared against the no LRET counterfactual;
- compared to the carbon case results from our earlier study, there are lower OCGT, CCGT and wind generation investments, with associated lower dispatch and emissions;
- the shortfall on the achievement of the LRET in NEM is significantly higher, because the penalty price becomes the more cost effective alternative to investment sooner; and
- the cost of complying with the LRET is also higher, because of the reduced wholesale market prices dampening the revenue to be obtained from new renewable generation investments from the market.

Key conclusions for the carbon case include:

- wholesale market prices are higher in the carbon case when compared to the no LRET counterfactual;
- compared to the carbon case results from our earlier study there are lower OCGT, CCGT and to a lesser extent, biomass generation investment, and moderate increase in wind generation investment;
- the change in generation investment is associated with lower dispatch and both combustion and fugitive emissions; and
- the level of renewable energy is similar when compared to the previous study.

4. Results of Relaxing the No New Coal Generation Investment Assumption

This section sets out the results when the assumption that no new coal can be built is removed from the modelling results.

4.1. Key results for the SWIS from the Draft Interim Report

Based on our previous modelling assumption, the previous results for the SWIS suggested that:

- prices in the SWIS exhibit a flatter profile for both the reference case and carbon case driven primarily by the earlier increase in gas prices;
- under the reference case, the combination of existing and committed renewable plants will approximately satisfy a pro rata share of the LRET by 2020 and later in the modelling period; and
- there are no concerns for unserved energy in the SWIS given the design of the market and more directly managed reserve margin.

4.2. Overview

Relaxing the assumption that no new coal can be built in the SWIS, results in significant new investment in coal generation capacity later in the modelling time horizon in the absence of a carbon price but no increase when a carbon price is imposed. Specifically for the reference case:

- an additional 900 MW of coal capacity is constructed from 2020, which substitutes mostly for CCGT generation capacity in the no carbon price scenario;
- SWIS prices are approximately 2 per cent lower in 2020 reflecting the lower overall cost of coal plant at the costs assumed for gas and coal;
- the effect of the LRET on emissions from generation capacity in the SWIS is limited; and
- additional coal investment reduces the level of renewable energy in the later years of the analysis and leads to a shortfall in the achievement of the LRET

For the carbon case:

- effectively no change in coal capacity was found;
- consequently there is effectively no impact on price under the carbon case;
- there is no change in the level of renewable energy generation investment and effectively no change in the level of emissions; and
- renewable generation in the SWIS exceeds the pro rata share of the national LRET with additional investment seen to be economic after 2020.

4.3. SWIS prices

The effect of relaxing the no new coal generation investment assumption on SWIS prices is set out in Figures 4.1 and 4.2. In the reference case, the effect of removing the restriction on no new coal is to decrease the SWIS prices if no carbon price is applied but has effectively no impact if a carbon price is applied as no new coal enters. Indeed, SWIS price forecasts without carbon price are approximately 2 per cent lower in 2020 as a consequence of removing the restriction. This is consistent with the lower overall cost of a coal plant (at the coal prices assumed at the time of the study) when compared against a new entrant gas plant (also at the gas prices assumed in the study).

Figure 4.1 SWIS Price Forecasts – All Cases

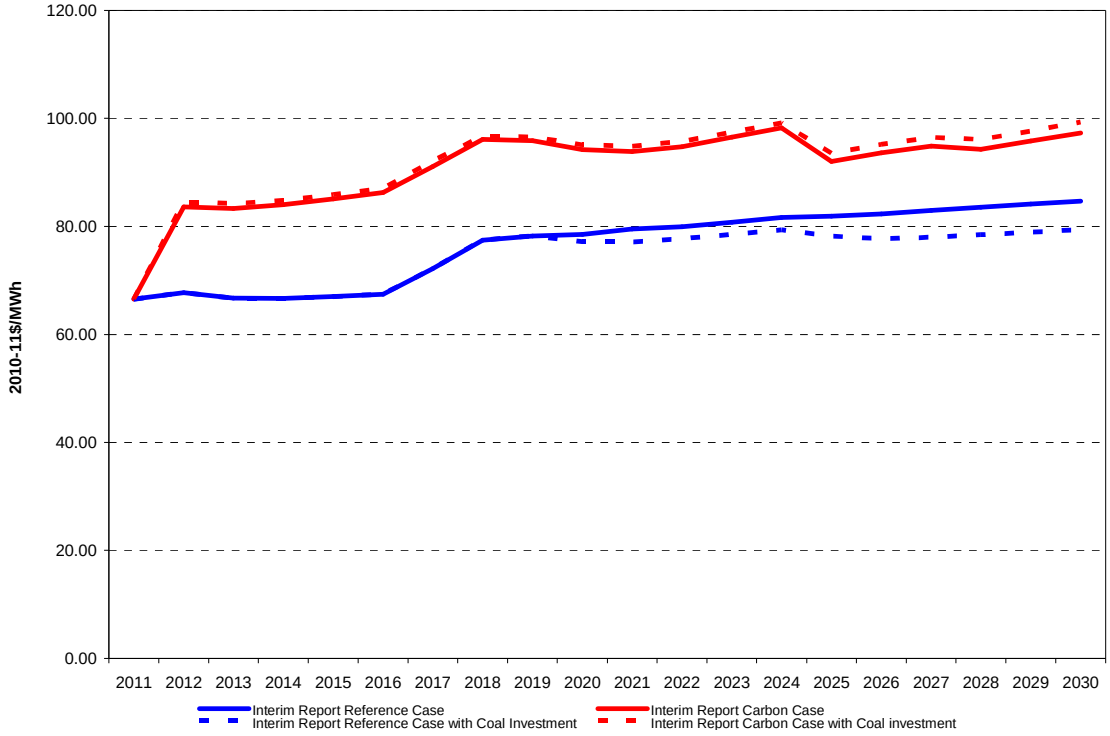
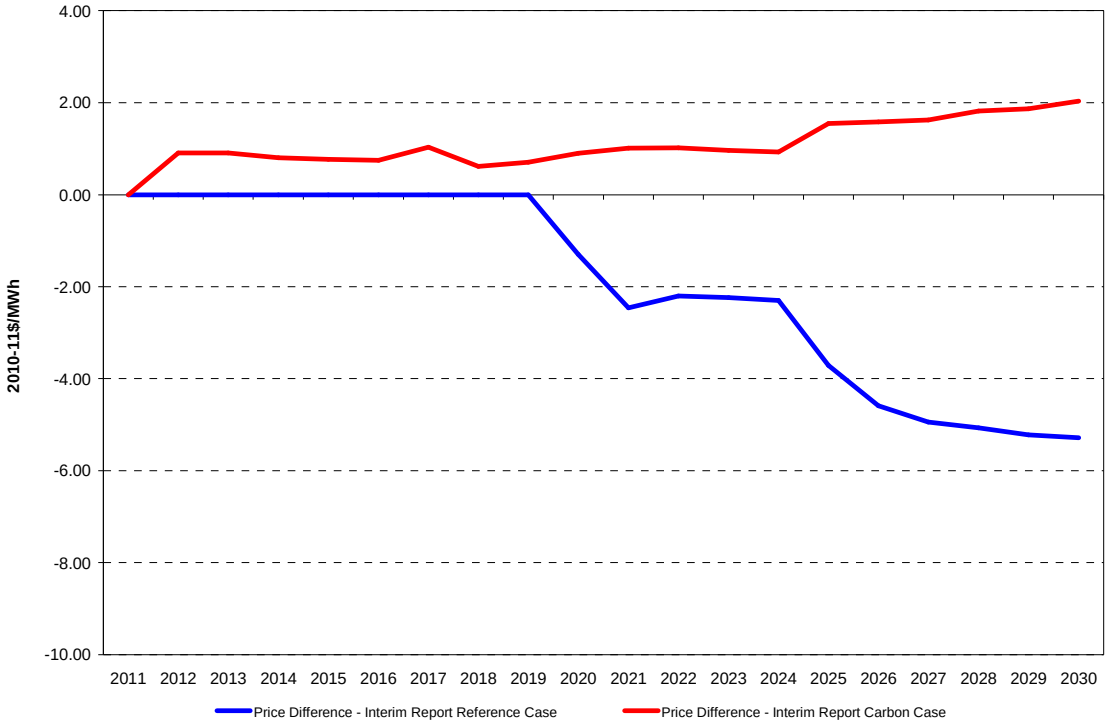


Figure 4.2 Difference in SWIS Price Forecasts – All Cases



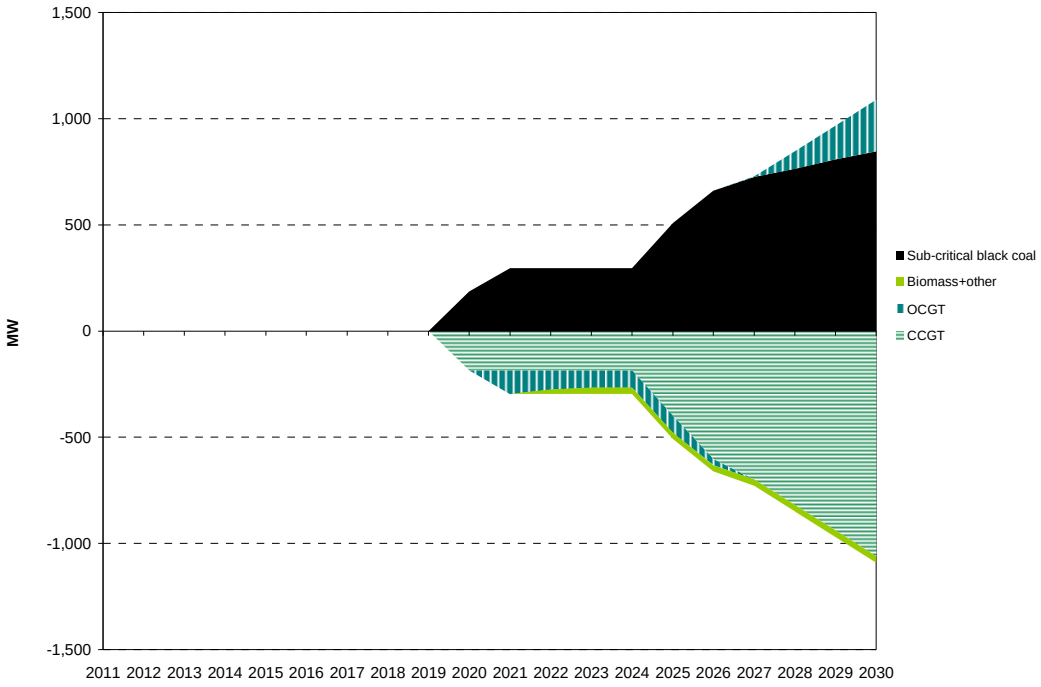
Note: Data represents financial years (eg, FY2011 is 2011/12)

4.4. Implications for generation capacity and emissions

In the reference case, the key effect of removing the restriction on no new coal generation investment is that approximately 900 MW of coal generation capacity enters to satisfy demand and reserve margin in the absence of a carbon price. New coal generation capacity enters in the period 2020 and 2025 – Figures 4.3 and 4.4. The additional capacity substitutes for CCGT and OCGT investment that is constructed if coal generation was unavailable.

In contrast, the removal of the no new coal generation has effectively no effect on installed capacity in the carbon case. The very minor 20MW in coal investment was built in the model but this is due to "noise" in the modelling rather than being indicative of likely outcomes.

Figure 4.3 Difference in Scheduled and Semi-Scheduled Installed Capacity – SWIS Reference Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

Figure 4.4 Scheduled and Semi-Scheduled Installed Capacity – SWIS Carbon Case

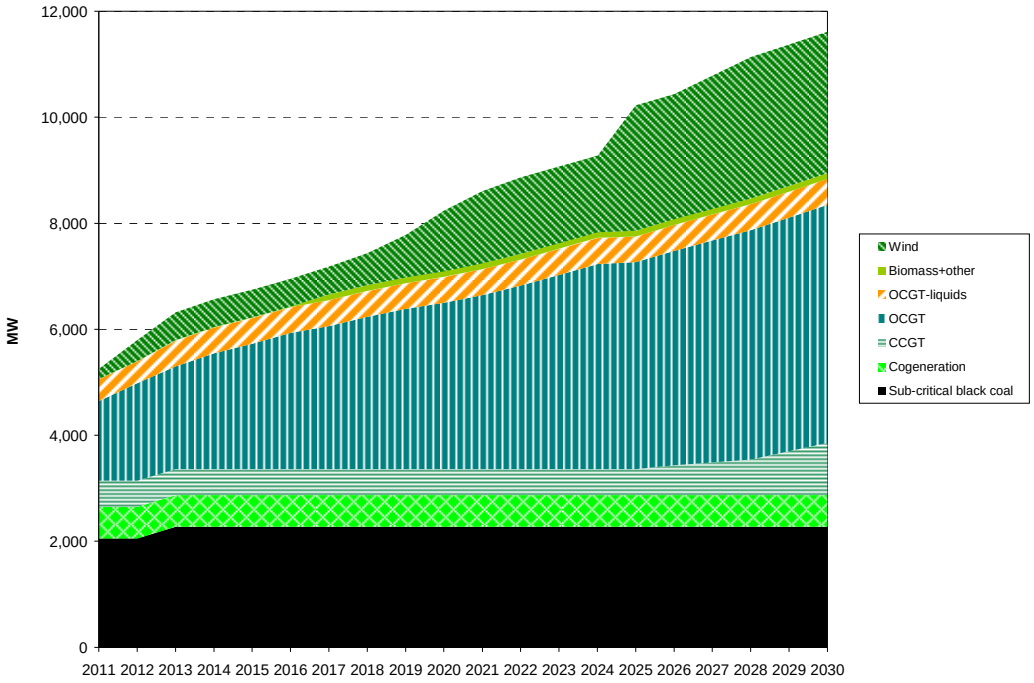
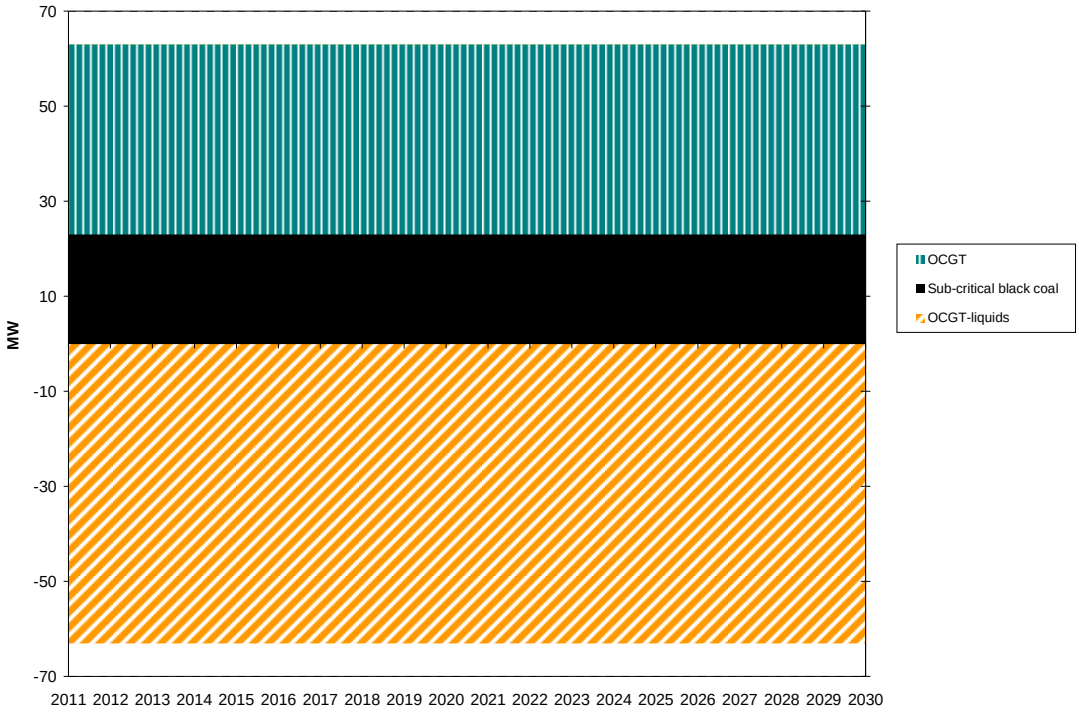


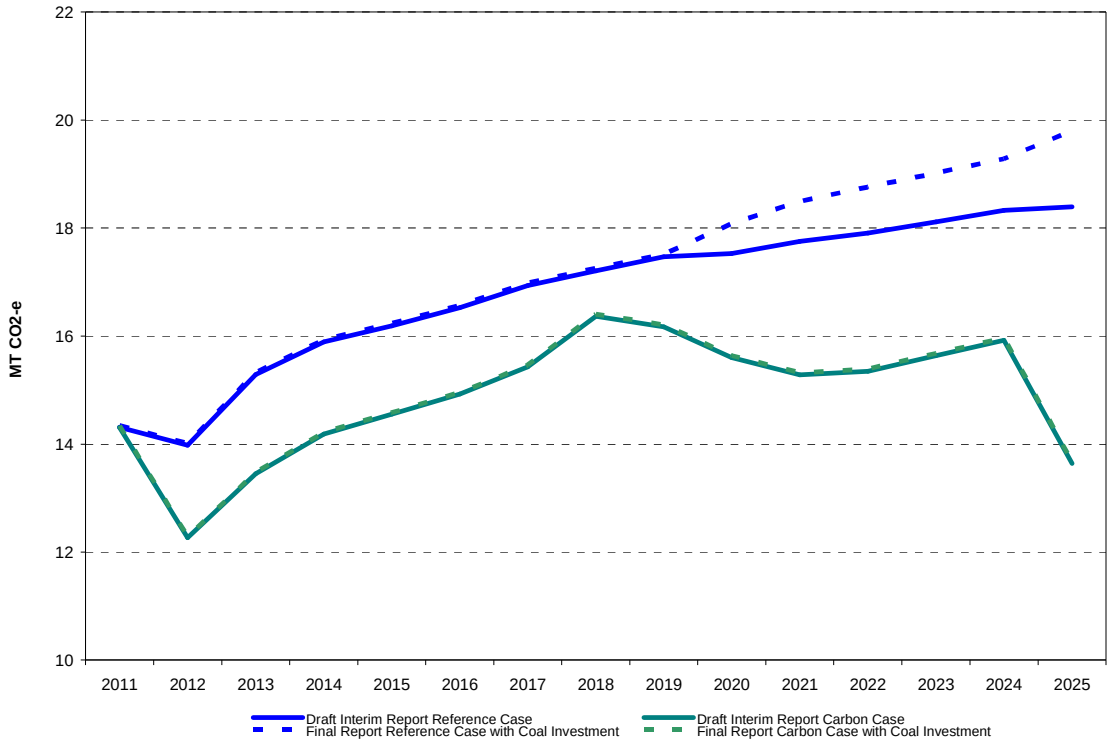
Figure 4.5 Difference in Scheduled and Semi-Scheduled Installed Capacity – SWIS Carbon Case



Note: Data represents financial years (eg, FY2011 is 2011/12)

The implications for emissions in the SWIS are set out in Figure 4.6. Importantly, overall emissions from the SWIS are higher in the reference case than would have been the case with the restriction, but are still lower with the introduction of the LRET. Relaxing the restriction on new coal generation investment therefore results in SWIS emissions (fugitive and combustion) being 10 per cent higher by 2025 in the reference or no carbon price scenario but no change in the with carbon price case.

Figure 4.6
Emissions from Electricity Generation – SWIS

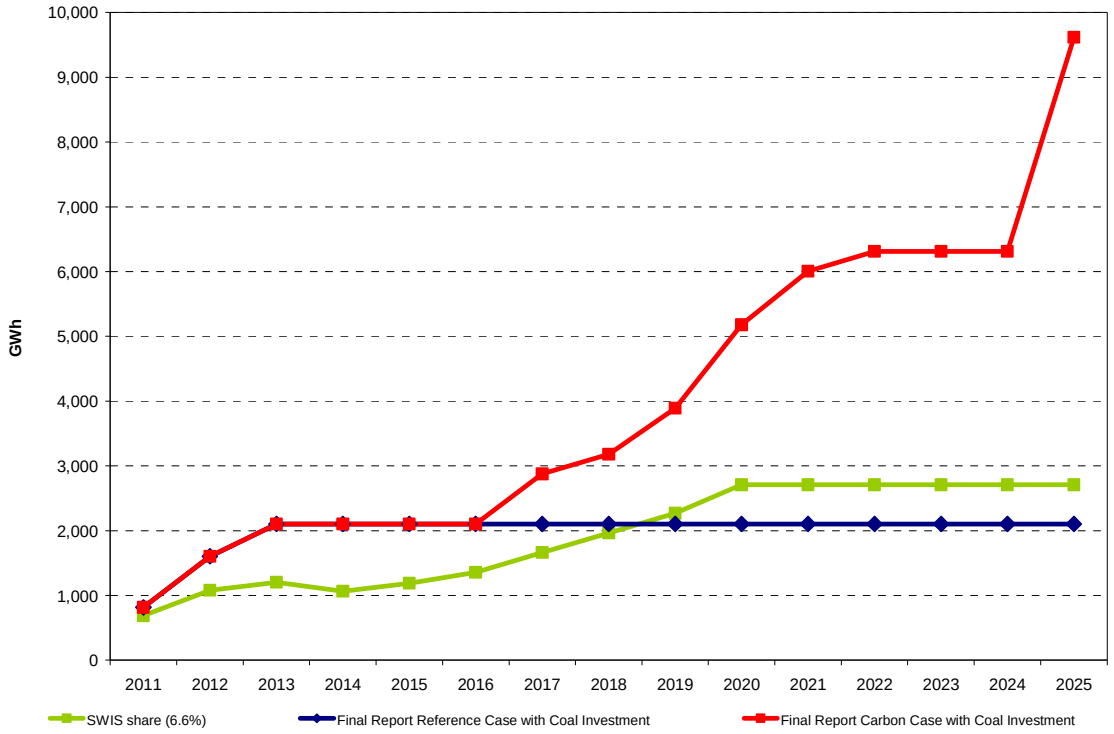


Note: Data represents financial years (eg, FY2011 is 2011/12)

4.5. Achievement of the LRET in WA

The methodology adopted to determine LRET allocations between different markets relied information about demand in the SWIS (available from the IMO) and elsewhere in the SWIS. There is uncertainty about both of these factors in the data available to us for this study. The core (but uncertain) assumption was that the SWIS represents 6.6 per cent of national demand. The effect of the additional coal generation is that there is a reduction in the level of renewable energy in the later years of the study, as economic investment in coal displaces economic investment in biomass – Figure 4.7. This reduces the level of renewable energy in the later years of the study and creates a shortfall in the achievement of the LRET. This is the result of very finely differences in forecast cost between coal and biomass in the later years. This highlights that caution should be exercised as assumptions about the relative costs in different technologies in the later years of the analysis will impact on the results.

Figure 4.7
Forecast Level of Renewable Generation Compared to the LRET – Initial Demand Assumptions



4.6. Conclusions

Under the reference case, the effect of a relaxation of the no new coal generation investment is investment in approximately 900 MW of coal generation capacity over the modelling time horizon. This in turn has the effect, compared against the previous results, of:

- lowering SWIS prices if no carbon price is applied but increasing wholesale price when a carbon price is present;
- increasing carbon emissions from installed generation capacity; and
- creating a shortfall in the achievement of the LRET.

Under the carbon case, the relaxation of the no new coal generation suggests::

- there is no significant difference in wholesale prices;
- there is a similar level of emissions when compared to the carbon case without coal investment as coal investment only increases marginally; and
- there is no impact on the achievement of the LRET as the level of investment in wind and biomass generation does not change

5. Implications of Removing the Pro-rating of the LRET

The final element we have considered is a qualitative assessment of implications for our results of removing the assumption of pro-rating of the LRET between the NEM and the SWIS.

In the previous study we found that in the SWIS the existing and planned renewable generating plant would mean the SWIS would approximately meet its pro rata share of the national LRET in the absence of a carbon price. As noted the nature of the available data about existing renewable plant and demand growth in Western Australia outside the SWIS meant that we needed to understand the ratio of demand in the SWIS relative to demand in WA as a whole – in effect a forecast of demand growth outside the SWIS. This is very dependent on resource project developments and so is uncertain. In the earlier study we found that if non SWIS demand grew more aggressively the SWIS was more likely to meet its pro rata share of the LRET and conversely if non SWIS demand was less aggressive the SWIS would fall short of a pro rata share.

For a situation where the SWIS fell below a pro rata share from existing and planned new plants, the NEM was found to already be below its (larger) share. As a result additional investment in the SWIS to increase the level of renewable plant would, in principle, be possible to lift the level of renewable generation overall.

However, in the previous analysis we did not investigate the potential for additional renewable investment in the SWIS as we understand there is also uncertainty about the cost and indeed technical ability of the SWIS to accommodate additional intermittent generation until the system is, as a minimum, considerably larger. Indeed, we would anticipate that if the additional costs of network connections and ancillary services that would be needed to accommodate intermittency were taken into account, combined with the suppressing impact on balancing market prices, the impact on the commercial returns of wind investments would all be negative.

Accordingly, we concluded that the amount of (any) additional investment in the SWIS would most likely make little difference to the overall national shortfall in achieving the LRET in the absence of a carbon price. When a carbon price is considered the national target can be met – subject to any technical or material cost impediments. Detailed study of network and ancillary service costs would be required to understand whether it was economic to install new plant to meet the LRET gap or whether it would have been rational to pay the penalty price; both of which were beyond the scope of our study.

Appendix A. Detailed Modelling Assumptions

The peak demand and energy (sent out) forecasts (less non-scheduled generation) used in this study are set out in the tables below.

Table A.1: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Carbon Case

	10% POE Medium Growth MD (MW)					
	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	9,957	15,180	10,675	3,421	1,743	N/A
FY2012	10,435	15,140	10,800	3,418	1,696	N/A
FY2013	10,874	15,252	10,887	3,442	1,691	N/A
FY2014	11,456	15,479	11,030	3,496	1,692	N/A
FY2015	11,830	15,741	11,171	3,517	1,716	N/A
FY2016	12,057	15,948	11,305	3,542	1,722	N/A
FY2017	12,353	16,223	11,488	3,542	1,737	N/A
FY2018	12,625	16,492	11,691	3,591	1,757	N/A
FY2019	12,870	16,725	11,883	3,620	1,773	N/A
FY2020	13,016	16,953	12,070	3,668	1,804	N/A
FY2021	13,236	17,072	12,154	3,694	1,810	N/A
FY2022	13,501	17,245	12,277	3,732	1,822	N/A
FY2023	13,806	17,464	12,432	3,781	1,839	N/A
FY2024	14,141	17,716	12,610	3,836	1,859	N/A
FY2025	14,484	17,970	12,789	3,892	1,880	N/A
FY2026	14,817	18,205	12,955	3,944	1,898	N/A
FY2027	15,198	18,493	13,159	4,007	1,922	N/A
FY2028	15,627	18,832	13,398	4,081	1,951	N/A
FY2029	16,057	19,160	13,630	4,154	1,979	N/A
FY2030	16,654	19,678	13,997	4,268	2,028	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Table A.2: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Reference Case

	10% POE Medium Growth MD (MW)					
	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	10,001	15,305	10,680	3,448	1,763	N/A
FY2012	10,549	15,450	10,812	3,484	1,744	N/A
FY2013	11,001	15,576	10,899	3,512	1,741	N/A
FY2014	11,597	15,822	11,043	3,570	1,743	N/A
FY2015	11,982	16,108	11,185	3,595	1,770	N/A
FY2016	12,219	16,336	11,320	3,625	1,781	N/A
FY2017	12,524	16,634	11,503	3,629	1,799	N/A
FY2018	12,806	16,926	11,706	3,682	1,822	N/A
FY2019	13,061	17,181	11,899	3,716	1,840	N/A
FY2020	13,217	17,434	12,087	3,769	1,874	N/A
FY2021	13,450	17,577	12,172	3,801	1,883	N/A
FY2022	13,730	17,780	12,295	3,845	1,898	N/A
FY2023	14,050	18,030	12,451	3,899	1,919	N/A
FY2024	14,403	18,315	12,630	3,962	1,945	N/A
FY2025	14,763	18,602	12,810	4,025	1,971	N/A
FY2026	15,114	18,871	12,978	4,084	1,994	N/A
FY2027	15,514	19,196	13,182	4,154	2,021	N/A
FY2028	15,964	19,576	13,423	4,236	2,054	N/A
FY2029	16,415	19,945	13,655	4,316	2,085	N/A
FY2030	17,046	20,530	14,024	4,444	2,142	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Table A.3: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Carbon Case

	50% POE Medium Growth MD (MW)					
	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	14,175	9,468	9,993	3,086	1,721	N/A
FY2012	14,109	9,931	10,098	3,087	1,673	N/A
FY2013	14,205	10,358	10,165	3,125	1,669	N/A
FY2014	14,400	10,923	10,290	3,152	1,670	N/A
FY2015	14,629	11,286	10,411	3,165	1,693	N/A
FY2016	14,815	11,502	10,524	3,174	1,699	N/A
FY2017	15,058	11,781	10,684	3,194	1,714	N/A
FY2018	15,304	12,038	10,869	3,254	1,733	N/A
FY2019	15,508	12,267	11,038	3,286	1,750	N/A
FY2020	15,707	12,406	11,208	3,299	1,781	N/A
FY2021	15,818	12,616	11,286	3,323	1,786	N/A
FY2022	15,979	12,869	11,400	3,357	1,798	N/A
FY2023	16,182	13,160	11,544	3,401	1,815	N/A
FY2024	16,416	13,480	11,710	3,451	1,835	N/A
FY2025	16,652	13,806	11,877	3,501	1,855	N/A
FY2026	16,871	14,124	12,032	3,548	1,873	N/A
FY2027	17,138	14,487	12,221	3,605	1,897	N/A
FY2028	17,453	14,896	12,444	3,673	1,926	N/A
FY2029	17,757	15,306	12,659	3,738	1,953	N/A
FY2030	18,239	15,876	13,001	3,841	2,001	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Table A.4: NEM Peak Demand Forecasts Net of Non-Scheduled Generation – Final Report Reference Case

	50% POE Medium Growth MD (MW)					
	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	14,291	9,510	9,998	3,111	1,740	N/A
FY2012	14,399	10,040	10,109	3,148	1,721	N/A
FY2013	14,508	10,479	10,177	3,188	1,718	N/A
FY2014	14,721	11,058	10,302	3,219	1,721	N/A
FY2015	14,970	11,432	10,424	3,236	1,747	N/A
FY2016	15,177	11,656	10,537	3,249	1,758	N/A
FY2017	15,440	11,944	10,697	3,273	1,776	N/A
FY2018	15,707	12,211	10,884	3,337	1,798	N/A
FY2019	15,932	12,450	11,053	3,373	1,816	N/A
FY2020	16,154	12,598	11,224	3,390	1,850	N/A
FY2021	16,287	12,820	11,303	3,419	1,858	N/A
FY2022	16,475	13,087	11,418	3,459	1,873	N/A
FY2023	16,707	13,393	11,563	3,508	1,894	N/A
FY2024	16,972	13,729	11,729	3,564	1,919	N/A
FY2025	17,238	14,072	11,897	3,621	1,945	N/A
FY2026	17,489	14,407	12,052	3,674	1,967	N/A
FY2027	17,790	14,789	12,242	3,738	1,994	N/A
FY2028	18,143	15,218	12,466	3,813	2,027	N/A
FY2029	18,486	15,648	12,683	3,885	2,057	N/A
FY2030	19,029	16,250	13,026	4,000	2,114	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Table A.5: NEM Sent Out Energy (GWh) Net of Non-Scheduled Generation – Final Report Carbon Case

	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	49,562	73,398	46,921	14,079	9,760	N/A
FY2012	51,908	73,859	47,521	14,113	9,616	N/A
FY2013	54,238	73,670	47,815	14,233	9,538	N/A
FY2014	57,241	74,070	47,695	14,194	9,517	N/A
FY2015	59,311	75,565	47,946	14,271	9,513	N/A
FY2016	60,189	76,103	48,567	14,385	9,603	N/A
FY2017	61,308	76,814	48,917	14,381	9,623	N/A
FY2018	62,407	77,538	49,331	14,650	9,642	N/A
FY2019	63,388	78,370	49,810	14,662	9,656	N/A
FY2020	64,442	79,421	50,478	14,797	9,685	N/A
FY2021	65,543	80,375	50,827	14,902	9,717	N/A
FY2022	66,868	81,591	51,337	15,055	9,782	N/A
FY2023	68,387	83,033	51,979	15,246	9,872	N/A
FY2024	70,063	84,640	52,721	15,469	9,990	N/A
FY2025	71,768	86,268	53,466	15,693	10,103	N/A
FY2026	73,430	87,827	54,159	15,900	10,205	N/A
FY2027	75,323	89,647	55,003	16,152	10,333	N/A
FY2028	77,461	91,730	56,001	16,452	10,500	N/A
FY2029	79,584	93,777	56,964	16,740	10,655	N/A
FY2030	82,534	96,772	58,489	17,197	10,926	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Table A.6: NEM Sent Out Energy (GWh) Net of Non-Scheduled Generation – Final Report Reference Case

	QLD	NSW	VIC	SA	TAS	WA SWIS
FY2011	49,779	73,993	46,944	14,189	9,873	N/A
FY2012	52,473	75,344	47,572	14,383	9,899	N/A
FY2013	54,864	75,207	47,868	14,518	9,828	N/A
FY2014	57,940	75,681	47,750	14,491	9,816	N/A
FY2015	60,067	77,286	48,003	14,583	9,827	N/A
FY2016	60,987	77,916	48,628	14,716	9,941	N/A
FY2017	62,149	78,719	48,980	14,730	9,982	N/A
FY2018	63,292	79,532	49,396	15,018	10,010	N/A
FY2019	64,320	80,460	49,878	15,043	10,032	N/A
FY2020	65,427	81,626	50,548	15,198	10,071	N/A
FY2021	66,590	82,705	50,901	15,323	10,118	N/A
FY2022	67,986	84,067	51,414	15,500	10,203	N/A
FY2023	69,582	85,665	52,060	15,716	10,316	N/A
FY2024	71,342	87,442	52,806	15,967	10,463	N/A
FY2025	73,131	89,240	53,554	16,219	10,607	N/A
FY2026	74,881	90,973	54,251	16,455	10,733	N/A
FY2027	76,869	92,984	55,098	16,735	10,881	N/A
FY2028	79,108	95,280	56,100	17,066	11,066	N/A
FY2029	81,343	97,561	57,067	17,389	11,248	N/A
FY2030	84,461	100,893	58,601	17,901	11,566	N/A

Source: Revised demand figures based on specifications provided to the Australian Energy Market Commission by the Commonwealth Treasury
Note: Data represents financial years (eg, FY2011 is 2011/12)

Appendix B. Detailed Results for Treasury Demand Sensitivity

This Appendix provides the annual weighted average prices, installed capacity (MW) and energy sent out (MWh) for each of the scenarios considered in the NEM.

Table B.1: NEM Weighted Average Prices ($/MWh) – Final Report Reference Case

	Illustrative contract	QLD	NSW	VIC	SA	TAS	2030 LRMC CCGT
FY2011	40.0	23.5	24.8	25.9	26.4	25.8	
FY2012	40.0	25.0	25.9	25.9	26.4	24.8	
FY2013	40.0	26.3	27.2	26.7	27.1	24.9	
FY2014		28.2	28.9	27.4	27.9	24.9	
FY2015		30.5	31.3	30.1	30.6	27.7	
FY2016		31.8	32.5	31.6	32.0	29.7	
FY2017		36.2	35.1	33.1	33.4	29.0	
FY2018		45.4	42.9	42.9	43.5	32.2	
FY2019		45.9	44.1	42.9	43.5	31.3	
FY2020		44.9	44.3	42.5	42.9	30.1	
FY2021		47.2	46.4	45.6	46.2	32.7	
FY2022		49.9	48.9	49.2	50.0	35.3	
FY2023		50.1	49.2	50.0	50.8	37.4	
FY2024		52.5	52.0	53.8	54.8	42.8	

FY2025	57.5	57.6	59.9	61.0	51.8	
FY2026	60.3	61.2	63.7	65.1	55.7	
FY2027	66.1	67.9	70.7	72.3	64.0	
FY2028	67.3	69.6	72.1	73.8	68.5	73.0
FY2029	66.3	69.4	72.6	74.3	71.0	73.0
FY2030	66.5	70.5	73.8	75.5	74.0	73.0

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.2: NEM Weighted Average Prices($/MWh) – Final Report Counterfactual Case

	Illustrative contract	QLD	NSW	VIC	SA	TAS	2030 LRMC CCGT
FY2011	40.0	23.5	24.8	25.9	26.4	25.8	
FY2012	40.0	25.2	26.4	27.5	28.1	26.2	
FY2013	40.0	26.9	28.0	29.1	29.7	27.2	
FY2014		28.8	29.7	30.5	31.1	28.4	
FY2015		31.0	32.0	31.8	32.3	29.8	
FY2016		32.9	33.6	33.6	34.1	31.0	
FY2017		37.3	36.7	36.9	37.4	32.0	
FY2018		45.8	46.3	47.8	48.8	38.6	
FY2019		44.6	45.3	47.3	48.3	39.9	
FY2020		49.0	48.2	50.0	51.1	43.1	
FY2021		50.8	50.2	53.2	54.4	46.5	
FY2022		55.8	56.8	66.3	67.9	61.5	

FY2023	58.0	59.4	68.7	70.3	64.4	
FY2024	59.1	60.7	69.6	71.3	68.1	
FY2025	61.8	63.6	68.1	69.7	67.6	
FY2026	63.3	65.8	69.0	70.7	68.9	
FY2027	66.6	69.7	72.7	74.5	73.7	
FY2028	66.9	70.4	73.1	75.0	74.7	73.0
FY2029	66.8	71.8	75.5	77.4	77.3	73.0
FY2030	65.7	70.7	74.1	76.0	76.2	73.0

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.3: NEM Weighted Average Prices($/MWh) – Final Report Carbon Case

	QLD	NSW	VIC	SA	TAS
FY2011	23.1	24.3	25.2	25.7	24.6
FY2012	46.1	48.1	50.1	51.3	44.9
FY2013	47.9	49.8	50.4	51.5	44.8
FY2014	50.4	52.2	55.5	56.8	49.4
FY2015	52.9	54.8	57.6	58.8	50.7
FY2016	54.6	56.4	59.0	60.2	51.5
FY2017	57.5	58.9	60.1	61.2	51.4
FY2018	64.9	62.6	63.5	64.9	52.9
FY2019	72.1	65.4	66.6	68.0	54.1
FY2020	73.8	69.1	68.0	69.4	55.1
FY2021	80.2	73.3	72.5	74.0	57.6

FY2022	82.6	79.7	76.5	78.0	60.5
FY2023	81.5	81.2	77.8	79.5	63.5
FY2024	84.5	84.0	80.5	82.2	65.8
FY2025	83.9	85.2	82.5	84.3	68.8
FY2026	85.1	87.4	86.1	88.0	71.5
FY2027	85.7	88.8	87.0	88.9	75.6
FY2028	86.8	90.7	88.4	90.3	78.1
FY2029	86.3	92.7	93.2	95.1	83.6
FY2030	84.0	95.2	95.0	97.0	89.7

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.4: NEM Installed Capacity (MW) – Final Report Reference Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Biomass	Wind	Total
FY2011	2,853	17,538	7,490	524	1,780	7,792	2,305	5,743	688	0	763	47,476
FY2012	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	100	996	47,771
FY2013	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	188	996	47,859
FY2014	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	188	996	47,859
FY2015	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	188	996	47,259
FY2016	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	288	1,026	47,388
FY2017	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	388	1,274	47,737
FY2018	2,853	16,900	7,250	524	1,780	7,792	2,305	5,776	688	488	1,523	47,879

FY2019	2,853	16,900	7,250	524	1,780	7,792	2,305	6,414	688	588	1,772	48,865
FY2020	2,853	16,900	7,250	524	1,780	7,792	2,305	6,976	688	688	2,243	49,999
FY2021	2,853	16,900	7,250	524	1,780	7,792	2,305	7,469	688	690	2,243	50,495
FY2022	2,853	16,900	7,250	524	1,780	7,792	2,305	8,124	688	693	2,243	51,152
FY2023	2,853	16,900	7,250	524	1,780	7,792	2,720	8,498	688	695	2,243	51,944
FY2024	2,853	16,900	7,250	524	1,780	7,792	3,196	8,915	688	698	2,243	52,839
FY2025	2,853	16,900	7,250	524	1,780	7,792	3,851	8,915	688	701	2,243	53,496
FY2026	2,853	16,900	7,250	524	1,780	7,792	4,704	8,915	688	703	2,243	54,352
FY2027	2,853	16,900	7,250	524	1,780	7,792	5,710	8,915	688	706	2,243	55,361
FY2028	2,853	16,900	7,250	524	1,780	7,792	6,874	8,915	688	708	2,243	56,528
FY2029	2,853	16,900	7,250	524	1,780	7,792	7,995	8,936	688	711	2,243	57,672
FY2030	2,853	16,900	7,250	524	1,780	7,792	9,394	9,275	688	714	2,243	59,413

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.5: NEM Installed Capacity (MW) – Final Report Counterfactual Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Wind	Total
FY2011	2,853	17,538	7,490	524	1,780	7,792	2,305	5,743	688	763	47476
FY2012	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	816	47,491
FY2013	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	816	47,491
FY2014	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	816	47,491
FY2015	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	816	46,891

FY2016	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	816	46,891
FY2017	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	816	46,891
FY2018	2,853	16,900	7,250	524	1,780	7,792	2,305	6,173	688	816	47,081
FY2019	2,853	16,900	7,250	524	1,780	7,792	2,305	6,917	688	816	47,825
FY2020	2,853	16,900	7,250	524	1,780	7,792	2,305	7,591	688	816	48,499
FY2021	2,853	16,900	7,250	524	1,780	7,792	2,597	7,794	688	816	48,994
FY2022	2,853	16,900	7,250	524	1,780	7,792	3,065	7,981	688	816	49,650
FY2023	2,853	16,900	7,250	524	1,780	7,792	3,613	8,224	688	816	50,439
FY2024	2,853	16,900	7,250	524	1,780	7,792	4,259	8,470	688	816	51,333
FY2025	2,853	16,900	7,250	524	1,780	7,792	5,163	8,470	688	816	52,236
FY2026	2,853	16,900	7,250	524	1,780	7,792	6,020	8,470	688	816	53,094
FY2027	2,853	16,900	7,250	524	1,780	7,792	7,032	8,470	688	816	54,105
FY2028	2,853	16,900	7,250	524	1,780	7,792	8,201	8,470	688	816	55,275
FY2029	2,853	16,900	7,250	524	1,780	7,792	9,224	8,594	688	816	56,421
FY2030	2,853	16,900	7,250	524	1,780	7,792	10,648	8,915	688	816	58,167

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.6: NEM Installed Capacity (MW) – Final Report Carbon Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Biomass	Wind	Total
FY2011	2,853	17,538	7,490	524	1,780	7,792	2,305	5,743	688	0	763	47,476

FY2012	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	100	3,087	49,862
FY2013	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	200	3,361	50,236
FY2014	2,853	17,500	7,490	524	1,780	7,792	2,305	5,743	688	200	3,361	50,236
FY2015	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	200	3,511	49,786
FY2016	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	300	3,782	50,157
FY2017	2,853	16,900	7,490	524	1,780	7,792	2,305	5,743	688	400	4,810	51,285
FY2018	2,853	16,900	7,250	524	1,780	7,792	2,305	5,743	688	500	5,860	52,195
FY2019	2,853	16,900	7,250	524	1,780	7,792	2,305	5,743	688	600	6,926	53,361
FY2020	2,853	16,900	7,250	524	1,780	7,792	2,305	5,743	688	700	8,555	55,090
FY2021	2,853	16,900	7,250	524	1,780	7,792	2,305	5,895	688	706	8,555	55,249
FY2022	2,853	16,900	7,250	524	1,780	7,792	2,305	6,256	688	713	8,555	55,616
FY2023	2,853	16,900	7,250	524	1,780	7,792	2,305	6,975	688	719	8,555	56,341
FY2024	2,853	16,900	7,250	524	1,780	7,792	2,305	7,750	688	762	8,555	57,159
FY2025	2,853	16,900	7,250	524	1,780	7,792	3,035	7,850	688	762	8,555	57,989
FY2026	2,853	16,900	7,250	524	1,780	7,792	3,701	7,940	688	789	8,555	58,772
FY2027	2,853	16,900	7,250	524	1,780	7,792	4,346	8,381	688	889	8,555	59,958
FY2028	2,853	16,900	7,250	524	1,780	7,792	5,112	8,601	688	989	8,555	61,044
FY2029	2,853	16,900	7,250	524	1,780	7,792	6,180	8,601	688	989	8,555	62,111
FY2030	2,853	16,900	7,250	524	1,780	7,792	7,609	8,781	688	989	8,555	63,721

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.7: NEM Energy (GWh) – Final Report Reference Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Biomass	Wind	Total
FY2011	20,937	93,165	54,366	230	295	16,333	7,338	703	8	0	2,483	195,858
FY2012	21,162	95,507	54,343	252	310	16,333	7,919	810	9	770	3,229	200,645
FY2013	21,204	96,673	54,353	252	299	16,333	8,539	861	9	1,442	3,228	203,194
FY2014	21,216	99,490	54,337	280	348	16,333	8,766	1,058	11	1,445	3,233	206,518
FY2015	20,805	102,725	54,520	311	462	16,333	9,395	1,220	13	1,445	3,220	210,447
FY2016	21,000	103,615	54,491	1,429	502	16,333	7,833	2,174	13	2,213	3,325	212,929
FY2017	20,635	104,466	54,415	1,476	539	16,333	7,777	2,436	15	2,985	4,133	215,211
FY2018	21,237	113,669	53,235	422	489	16,333	2,368	1,470	18	3,755	4,962	217,959
FY2019	21,231	114,024	53,150	481	498	16,333	2,447	1,858	17	4,520	5,764	220,324
FY2020	21,201	114,954	52,971	538	543	16,333	2,618	1,738	17	5,293	7,231	223,438
FY2021	21,220	116,769	53,167	627	562	16,333	2,903	2,094	17	5,315	7,224	226,233
FY2022	21,204	119,130	53,365	701	621	16,333	3,158	2,691	17	5,338	7,222	229,780
FY2023	21,207	122,012	53,412	740	643	16,333	4,104	2,965	17	5,353	7,230	234,016
FY2024	21,208	125,223	53,413	823	688	16,333	5,369	3,178	17	5,379	7,216	238,848
FY2025	21,249	127,130	53,409	1,198	701	16,333	7,661	3,321	17	5,397	7,233	243,649
FY2026	21,236	127,905	53,410	1,402	693	16,333	11,328	3,220	17	5,417	7,215	248,176
FY2027	21,212	127,917	53,412	1,778	728	16,333	16,289	3,002	18	5,435	7,261	253,384
FY2028	21,230	127,903	53,410	1,789	682	16,333	22,444	2,867	18	5,458	7,220	259,355

FY2029	21,215	127,919	53,406	1,769	629	16,333	28,634	2,780	18	5,476	7,218	265,396
FY2030	21,221	127,910	53,410	1,762	598	16,333	37,352	2,909	17	5,494	7,232	274,237

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.8: NEM Energy (GWh) – Final Report Counterfactual Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Wind	Total
FY2011	20,937	93,165	54,366	230	295	16,333	7,338	703	8	2,483	195,858
FY2012	21,194	96,704	54,508	252	333	16,333	7,948	822	9	2,663	200,766
FY2013	21,225	98,560	54,577	252	328	16,333	8,578	887	9	2,663	203,412
FY2014	21,223	101,305	54,590	294	400	16,333	8,832	1,036	12	2,663	206,689
FY2015	21,141	104,456	54,582	324	511	16,333	9,436	1,251	13	2,663	210,711
FY2016	21,225	106,256	54,607	1,425	561	16,333	8,034	2,088	13	2,663	213,205
FY2017	21,208	108,226	54,613	1,495	696	16,333	7,813	2,538	15	2,663	215,601
FY2018	21,184	118,819	53,388	511	672	16,333	2,913	1,921	18	2,663	218,423
FY2019	21,217	120,549	53,404	551	724	16,333	3,202	2,282	18	2,663	220,944
FY2020	21,208	122,838	53,410	755	880	16,333	3,559	2,483	18	2,663	224,148
FY2021	21,217	124,508	53,407	756	885	16,333	4,573	2,613	17	2,664	226,973
FY2022	21,215	125,959	53,411	1,158	861	16,333	6,009	2,802	17	2,664	230,427
FY2023	21,228	126,930	53,409	1,327	848	16,333	8,828	2,975	18	2,664	234,558
FY2024	21,232	127,613	53,411	1,490	939	16,333	12,637	3,043	17	2,664	239,378
FY2025	21,227	127,914	53,410	1,686	824	16,333	16,711	3,092	18	2,664	243,877

FY2026	21,196	127,919	53,412	1,618	793	16,333	21,320	3,044	18	2,664	248,317
FY2027	21,213	127,903	53,387	1,788	863	16,333	26,517	2,792	17	2,664	253,476
FY2028	21,228	127,906	53,414	1,789	806	16,333	32,751	2,629	18	2,664	259,537
FY2029	21,220	127,909	53,411	1,771	752	16,333	39,231	2,600	16	2,664	265,907
FY2030	21,215	127,901	53,406	1,783	696	16,333	47,887	2,745	16	2,664	274,646

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table B.9: NEM Energy (GWh) – Final Report Carbon Case

	Super-critical black coal	Sub-critical black coal	Sub-critical brown coal	Cogeneration	Steam gas	Hydro	CCGT	OCGT	OCGT-liquids	Biomass	Wind	Total
FY2011	20,685	92,448	54,317	225	287	16,333	7,326	655	7	0	2,484	194,770
FY2012	20,048	87,391	50,275	231	208	16,333	12,354	459	8	765	9,397	197,469
FY2013	20,589	87,475	49,775	293	205	16,333	12,929	566	9	1,531	10,299	200,005
FY2014	20,624	89,894	51,588	354	240	16,333	11,556	764	9	1,533	10,289	203,183
FY2015	20,772	92,656	51,356	428	279	16,333	12,017	944	12	1,536	10,740	207,073
FY2016	20,832	92,780	51,293	865	302	16,333	11,807	1,141	13	2,305	11,658	209,329
FY2017	20,793	93,179	48,958	1,235	302	16,333	11,658	1,093	13	3,076	14,860	211,500
FY2018	20,818	100,207	47,885	342	260	16,333	5,351	914	14	3,840	18,055	214,021
FY2019	20,745	98,526	47,552	336	277	16,333	5,802	982	16	4,611	21,186	216,366
FY2020	20,642	98,343	46,076	415	281	16,333	5,051	771	15	5,382	26,010	219,321
FY2021	20,680	99,897	46,533	679	291	16,333	5,154	896	18	5,427	25,963	221,870
FY2022	20,875	103,437	47,250	999	315	16,333	3,282	1,096	17	5,487	26,005	225,095

FY2023	20,983	104,746	48,001	1,023	360	16,333	4,554	1,458	17	5,538	25,960	228,974
FY2024	21,142	106,800	48,685	1,038	367	16,333	5,198	1,835	17	5,879	26,008	233,303
FY2025	20,626	105,089	49,558	1,040	416	16,333	11,137	1,670	17	5,867	25,981	237,735
FY2026	20,554	103,647	50,130	1,059	452	16,333	16,078	1,592	17	6,074	26,020	241,955
FY2027	20,427	105,025	50,581	935	449	16,333	18,587	1,657	16	6,838	26,052	246,898
FY2028	20,486	105,731	50,321	924	432	16,333	22,994	1,715	16	7,624	26,043	252,620
FY2029	20,307	102,319	50,828	912	435	16,333	32,018	1,594	14	7,621	26,027	258,409
FY2030	20,197	100,847	49,331	937	406	16,333	43,442	1,655	13	7,629	25,996	266,786

Note: Data represents financial years (eg, FY2011 is 2011/12)

Appendix C. Detailed Results for Relaxing No New Coal Generation Investment Assumption

This Appendix provides the annual weighted average prices, installed capacity (MW) and energy sent out (MWh) for each of the scenarios considered in the sensitivity testing of relaxing no new coal generation investment assumption in the SWIS.

Table C.1: SWIS Weighted Average Prices($/MWh) – Final Report Reference and Carbon Case with New Coal Investment

	Reference case	Carbon case
FY2011	66.5	66.5
FY2012	67.7	84.5
FY2013	66.7	84.2
FY2014	66.7	84.8
FY2015	67.0	85.9
FY2016	67.5	87.0
FY2017	72.2	92.2
FY2018	77.5	96.8
FY2019	78.2	96.6
FY2020	77.2	95.1
FY2021	77.1	94.9
FY2022	77.7	95.8
FY2023	78.5	97.5
FY2024	79.3	99.2
FY2025	78.2	93.6

FY2026	77.7	95.2
FY2027	78.0	96.5
FY2028	78.5	96.1
FY2029	78.9	97.7
FY2030	79.4	99.4

Table C.2: SWIS Installed Capacity (MW) – Final Report Reference Case with New Coal Investment

	Sub-critical black coal	Cogeneration	CCGT	OCGT	OCGT-liquids	Biomass+other	Wind	Total
FY2011	2,033	598	491	1,464	475	9	191	5,261
FY2012	2,033	598	491	1,799	475	9	397	5,802
FY2013	2,253	598	491	1,895	549	9	527	6,322
FY2014	2,253	598	491	2,145	549	9	527	6,572
FY2015	2,253	598	491	2,324	549	9	527	6,751
FY2016	2,253	598	491	2,528	549	9	527	6,955
FY2017	2,253	598	491	2,758	549	9	527	7,185
FY2018	2,253	598	491	2,948	549	9	527	7,375
FY2019	2,253	598	491	3,136	549	9	527	7,563
FY2020	2,439	598	491	3,136	549	9	527	7,749
FY2021	2,549	598	491	3,217	549	9	527	7,940
FY2022	2,549	598	491	3,413	549	9	527	8,136
FY2023	2,549	598	491	3,614	549	9	527	8,337

FY2024	2,549	598	491	3,821	549	9	527	8,544
FY2025	2,761	598	491	3,821	549	9	527	8,756
FY2026	2,914	598	491	3,886	549	9	527	8,974
FY2027	2,979	598	491	4,044	549	9	527	9,197
FY2028	3,018	598	491	4,234	549	9	527	9,426
FY2029	3,062	598	491	4,426	549	9	527	9,661
FY2030	3,100	598	491	4,629	549	9	527	9,903

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table C.3: SWIS Installed Capacity (MW) – Final Report Carbon Case with New Coal Investment

	Sub-critical black coal	Cogeneration	CCGT	OCGT	OCGT-liquids	Biomass+other	Wind	Total
FY2011	2,056	598	491	1,504	412	9	191	5,261
FY2012	2,056	598	491	1,839	412	9	397	5,802
FY2013	2,276	598	491	1,935	486	9	527	6,322
FY2014	2,276	598	491	2,185	486	9	527	6,572
FY2015	2,276	598	491	2,364	486	9	527	6,751
FY2016	2,276	598	491	2,568	486	9	527	6,955
FY2017	2,276	598	491	2,698	486	109	527	7,185
FY2018	2,276	598	491	2,872	486	109	608	7,439
FY2019	2,276	598	491	3,022	486	109	798	7,780
FY2020	2,276	598	491	3,139	486	109	1,142	8,241
FY2021	2,276	598	491	3,286	486	109	1,363	8,609

FY2022	2,276	598	491	3,466	486	109	1,445	8,871
FY2023	2,276	598	491	3,667	486	109	1,445	9,072
FY2024	2,276	598	491	3,873	486	109	1,445	9,278
FY2025	2,276	598	491	3,902	486	109	2,363	10,225
FY2026	2,276	598	564	4,046	486	109	2,363	10,442
FY2027	2,276	598	617	4,189	486	109	2,516	10,791
FY2028	2,276	598	670	4,332	486	109	2,669	11,140
FY2029	2,276	598	826	4,411	486	109	2,669	11,375
FY2030	2,276	598	984	4,495	486	109	2,669	11,616

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table C.4: SWIS Energy (GWh) – Final Report Reference Case with New Coal Investment

	Black coal	Cogeneration	CCGT	OCGT	OCGT-liquids	Biomass+other	Wind	Total
FY2011	12,054	3,072	2,131	899	2	75	740	18,958
FY2012	11,839	3,014	1,661	1,231	0	75	1,529	19,341
FY2013	13,196	3,016	1,549	1,211	1	75	2,027	21,067
FY2014	13,474	3,035	1,862	1,569	2	75	2,027	22,036
FY2015	13,624	3,079	2,276	1,431	3	75	2,027	22,506
FY2016	13,771	3,092	2,112	1,957	4	75	2,027	23,032
FY2017	13,892	3,388	2,364	2,025	51	75	2,027	23,818
FY2018	13,995	3,936	2,129	1,949	146	75	2,027	24,250

FY2019	14,111	3,956	2,239	2,115	146	75	2,027	24,662
FY2020	15,213	3,868	1,796	1,967	138	75	2,027	25,057
FY2021	15,900	3,831	1,700	1,928	37	75	2,027	25,459
FY2022	16,015	3,859	1,769	2,107	51	75	2,027	25,866
FY2023	16,120	3,901	1,748	2,394	51	75	2,027	26,281
FY2024	16,228	3,931	2,091	2,332	51	75	2,027	26,697
FY2025	17,449	3,820	1,542	2,236	37	75	2,027	27,126
FY2026	18,345	3,781	1,414	1,958	37	75	2,027	27,558
FY2027	18,792	3,763	1,366	2,025	37	75	2,027	28,000
FY2028	19,107	3,762	1,437	2,090	37	75	2,027	28,446
FY2029	19,453	3,758	1,384	2,262	37	75	2,027	28,902
FY2030	19,776	3,757	1,414	2,377	37	75	2,027	29,364

Note: Data represents financial years (eg, FY2011 is 2011/12)

Table C.5: SWIS Energy (GWh) – Final Report Carbon Case with New Coal Investment

	Black coal	Cogeneration	CCGT	OCGT	OCGT-liquids	Biomass+other	Wind	Total
FY2011	12,054	3,072	2,131	899	2	75	740	18,972
FY2012	8,683	3,397	3,583	2,062	4	75	1,529	19,334
FY2013	9,820	3,455	3,680	1,997	5	75	2,027	21,059
FY2014	10,375	3,556	3,704	2,282	7	75	2,027	22,026
FY2015	10,636	3,572	3,788	2,395	7	75	2,027	22,500

FY2016	10,849	3,594	3,841	2,625	10	75	2,027	23,022
FY2017	11,881	3,460	3,074	2,452	51	848	2,027	23,794
FY2018	13,496	3,879	1,897	1,659	129	848	2,330	24,238
FY2019	13,388	3,850	1,761	1,631	129	848	3,043	24,649
FY2020	13,075	3,824	1,306	1,539	120	848	4,330	25,041
FY2021	12,861	3,850	1,115	1,573	37	848	5,158	25,441
FY2022	12,886	3,850	1,338	1,424	37	848	5,464	25,847
FY2023	13,052	3,850	1,077	1,932	37	848	5,464	26,260
FY2024	13,211	3,850	1,520	1,749	37	848	5,464	26,679
FY2025	11,431	3,787	935	1,305	25	848	8,768	27,099
FY2026	11,410	3,785	1,210	1,490	25	848	8,768	27,536
FY2027	11,238	3,785	1,833	1,365	25	848	8,887	27,981
FY2028	10,663	3,770	1,839	1,368	25	847	9,914	28,427
FY2029	10,408	3,759	2,594	1,340	25	847	9,914	28,888
FY2030	9,605	3,748	3,898	1,321	25	847	9,914	29,358

Note: Data represents financial years (eg, FY2011 is 2011/12)

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