Market Briefing | November 2018

THE IMPACT OF VICTORIAN ELECTION POLICIES ON WHOLESALE ELECTRICITY PRICES

Modelling for Greenpeace Australia Pacific

RepuTex ENERGY

ABOUT THIS REPORT

THE IMPACT OF VICTORIAN ELECTION POLICY ON WHOLESALE PRICES

Contents

BACKGROUND

In the absence of a robust federal energy and climate policy framework, Australian states and territories continue to play an important role in shaping Australia's energy transition, with a number of jurisdictions adopting initiatives to address energy supply and affordability, and reduce greenhouse gas (GHG) emissions.

In Victoria, local policy will continue to be a key driver of investment in the energy system, with the Labor Government legislating a Victorian Renewable Energy Target (VRET) of 25 percent by 2020 and 40 percent by 2025, supported by a net zero GHG emissions target by 2050.

While Victoria has legislated its renewable energy and emissions reduction targets, the scheme does not enjoy bi-partisan support. Ahead of the state election on November 24, the future direction of the Victorian energy system therefore remains uncertain, with the Victorian Liberal and National parties (the Coalition) pledging to repeal the VRET, while the Victorian Greens have proposed to scale up the scheme to 100 per cent renewables by 2030.

As a result, the state election will have considerable implications for future energy supply, affordability and emissions reductions in Victoria, along with future investment in regional centres such as the Latrobe Valley, and the state's renewable energy zones (REZs).

ABOUT THIS REPORT

RepuTex has been engaged by Greenpeace Australia Pacific (Greenpeace) to analyse the impact of proposed state policy on Victorian energy supply and affordability, and GHG emissions reductions.

Specifically, analysis considers the potential impact of election policies of the three major political parties in Victoria:

» The Australian Labor Party (Victorian Branch),

» The Victorian Liberal and National parties (the Coalition); and

» The Victorian Greens.

Analysis presents three independent scenarios based on each party's announced policy platform, modelling the implications for regional fuel mix and renewable energy capacity, electricity emissions reductions, and wholesale electricity prices through to 2025.

Part One of this report provides an introduction to our modelling approach and policy assumptions. Parts Two to Four present the outcomes of each modelled policy scenario, and Part Five summarises our comparative outcomes.

KEY FINDINGS

THE IMPACT OF VICTORIAN ELECTION POLICY ON WHOLESALE PRICES

COMMITTED RENEWABLES CAPACITY TO DRIVE PRICE DECLINES TO 2021

» **Approximately 3,000 MW of large-scale renewables is expected to be added to the Victorian system by 2020**, with around 2,100 MW of large-scale wind and solar capacity currently committed and a further 928 MW of capacity contracted under the Victorian Renewable Energy Target (VRET).

» **Committed supply is projected to significantly increase competition, placing downward pressure on prices** as the market becomes less influenced by high priced gas. This is likely to see average Victorian wholesale prices fall from the high $90s in 2018 toward about $70 per MWh by 2021.

CONTINUATION OF VRET TO DRIVE INVESTMENT AND LOWER PRICES

» Should the VRET be continued under the ALP, modelling indicates that a **favourable policy environment is likely to drive over 2,200 MW of large-scale capacity beyond committed levels** as developers seek to capitalise on capacity withdrawals in other markets.

» Like the price decline to 2021, further **competitive pressure is modelled to keep wholesale prices lower through to 2025**, oscillating around $70 per MWh.

» Despite stronger competition, no coal closures are modelled to occur before 2025 in Victoria, with the exit of Liddell providing a lifeline for marginal brown-coal facilities such as Yallourn.

REPEAL OF VRET LIKELY TO DAMPEN INVESTMENT & TRIGGER PRICE RISES

» **The proposed repeal of the VRET under the Liberal and National parties is likely to trigger a significant regime change in Victoria**, with large-scale renewable energy investment to weaken - and effectively stop - similar to past periods of uncertainty under the federal LRET scheme.

» Should the VRET be repealed, modelling indicates the continuation of a coal-dominated market in Victoria, with a relatively static picture for large-scale renewables as existing gas and hydro provide flexibility to meet evening ramp ups and low-wind periods.

» **The Coalition's proposal to support 'at least 500 MW' of 'new' energy that could be available '24/7' at least-cost is modelled to be built as new solar and wind generation firmed by existing gas and hydro facilities.** No matter the technology built, however, any new capacity is likely to dampen the prospects for 'baseload' brown coal-fired generators.

» Under this scenario, **wholesale prices are projected to reverse their downward trend**, rising above $70 per MWh after the closure of Liddell, toward $90 per MWh by 2025 as lower levels of supply reduce competition relative to the modelled ALP scenario.

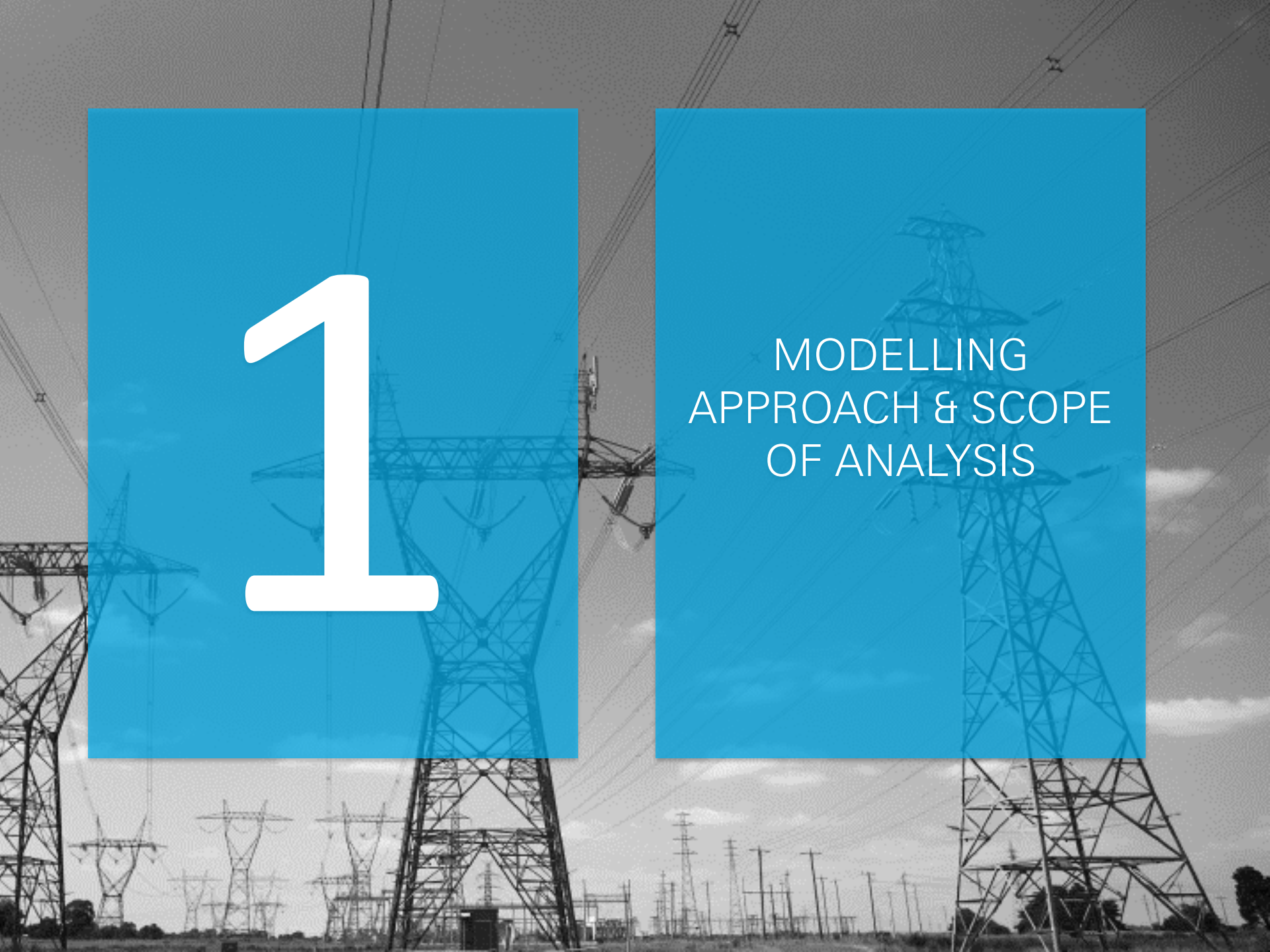
TRANSITION TO 100% RENEWABLES AT PRICES BELOW TODAYS LEVELS?

» Should the VRET be scaled up under Greens policy, **the transition to a wholly renewable powered system would necessitate an increased build out of around 500 – 600 MW of new capacity each year** – around 150 MW per annum more than the ALP scenario.

» New investment is modelled to encompass a wider variety of technologies, with modelled **electricity prices to progressively support hundreds of MW of firmed solar generation**, along with biomass-based plants when there is a low-cost fuel supply to provide reliable energy on seasonal basis. Additional peaking capacity would also be needed to provide earlier capacity for evening ramp ups and summer peak demand.

» Under such a scenario, the **Victorian electricity generation is projected to grow to almost 65 per cent renewables by 2025, at prices less than today's levels**, ranging between $70 and $84 per MWh to 2025 to support greater dispatchable capacity.

» This would require additional **coordination to support the orderly closure** of Victoria's major coal fired generators by the end of the decade. These considerations are not reflected in current modelling outcomes.



1

MODELLING APPROACH & SCOPE OF ANALYSIS

OUR ELECTRICITY MARKET MODEL

ANALYSIS OF THE NATIONAL ENERGY GUARANTEE BY 2030

OUR NEMRES ELECTRICITY MODEL

In delivering this project, we utilise our proprietary National Electricity Market Renewable Energy Simulator (NEMRES), which calculates annual generation and transmission expansion decisions in each region of the NEM as well as intra-hourly dispatch, replicating AEMO's dispatch engine.

Various rules, laws and policies govern the operation of the NEM, with the key elements being supply and demand, adjusted for constraints in the electricity network. The supply side is comprised of fossil fuel and renewable generators that offer capacity based on their own economic decisions, dispatched by AEMO from the cheapest to more costly offers, subject to system conditions, to meet forecast demand.

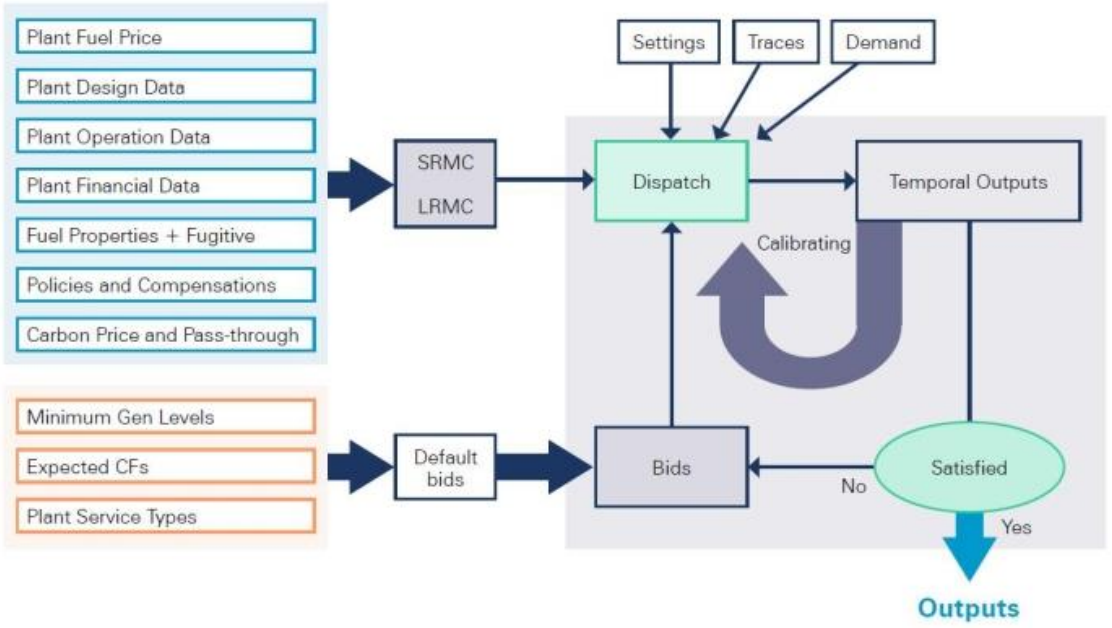
Demand is affected by several factors such as weather, economic activity, population, etc. Although demand for power has patterns, it is unplanned and highly inelastic. System operators rely on demand forecasting for the daily market operation and long-term planning. As such AEMO publishes forecast demand over different time frames, which we apply based on our analysis of annual investments or short-term energy dispatch.

NEMRES simulates the NEM least cost dispatch process and supply and demand conditions in the forecast periods, modelling the resulting generation and emissions from each of scheduled plant. Contracts impact the percentage of electricity subject to bidding behaviours and spot price revenue.

NEMRES explicitly models all scheduled power plants, while also allowing for non-market and non-scheduled plants.

Figure 1 outlines the main model components and model process flows. The central component of NEMRES is the least cost dispatch model, which dispatches the generation of plants based on default bids adjusted to each generators most recently observed patterns.

Figure 1 – RepuTex NEMRES modelling process



For each dispatch interval, bids are optimised for individual facility profitability. Hydro generation is allocated by model based on historical inflow and the proportion of run-of-river generation and storable hydro energy.

As shown, the input data preparation and model calibration are important blocks, supported by a number of criteria in checking the validity of model outputs, including cross checks against the closing facilities projected to be the least profitable, and the feasibility of new entrants in a given region.

OUR ELECTRICITY MARKET MODEL

ANALYSIS OF THE NATIONAL ENERGY GUARANTEE BY 2030

MERIT ORDER MODEL

A merit order is constructed via the bids offered by all fossil fuel plants. The algorithm orders the price bands offered by plants from the least to highest and accumulates the quantities of corresponding price bands accordingly.

BIDDING MODEL

The bidding model constructs four default price and quantity pairs. All the price and quantity pairs are in percentage of the cost and available capacity of each plant except the price in the first band, which is fixed at $0 per (MWh). The first band of a bid applies to plant-level minimum generation. The second band applies to short-run marginal cost (SRMC) and the third to long-run marginal cost (LRMC). The last band is related to the value of lost load (VOLL).

The quantity is the percentage that a plant is willing to offer to the market at above given prices. The quantity is incremental, in that the sum of the four quantity components must be 100 per cent. The quantity at the SRMC cost is related to the contract level, while the quantity at the LRMC may be allocated to the normal design level less the amount that has already been allocated in the previous price bands. The last band can be thought as opportunity or gaming bids.

There are two default bidding formats. Long-term forecasting calculates dispatch on annual demand duration curve. High precision forecasting uses half-hourly dispatch against half-hourly load..

COST MODEL

The cost of a generator depends on a number of factors: plant characteristics such as plant efficiency/heat rate, plant auxiliary usage, fuel cost, fuel combustion emission factor, variable operating & maintenance (VOM), fixed operating & maintenance cost (FOM), etc. The SRMC and LRMC are calculated by summing each cost components as shown in Figure 2.

To calculate per MWh cost of the fixed cost, a capacity factor is assumed for each plant. This may have impacts on dispatch outcomes. Bids may be adjusted based on plant profitability. Annual profit is calculated as total revenue from the sent-out energy + fixed subsidies less the variable cost associated with per MWh generation and less the annual fixed cost.

DEMAND TRACE MODEL

Annual forecast demand comes with three numbers for the NEM. One is for annual energy and the other two are for maximum load in the winter and summer seasons. Annual load is chosen to allocate forecast demand into finer time scales. RepuTex aims to mimic the operation of the NEM over 200 periods per year, equivalent to averaging demand over 1.8 days. Once the load shape in a particular historical period is chosen, the Demand Trace Generator can produce a demand trace matching the historical shape and forecasted energy target and the maximum load in the winter and summer season.

Weekends and public holidays load profiles are checked and matched as required. Forecasted demand for scheduled and semi-scheduled generation is used as only scheduled and semi-scheduled plants are modelled.

Figure 2 – Plant Level Generation Cost

	Cost Component		Factors in Cost Component
SRMC	Fuel cost	←	Heat rate + fuel price + CPI factor
	Fuel carbon cost	←	Fugitive emission pass through + permit price + CPI factor
	VOM	←	RepuTex data or as provided + CPI factor
	Emissions cost	←	Heat rate + fuel combustion emissions factor+ carbon capture + permit price
	Subsidies	←	
+			
Fixed cost	FOM	←	RepuTex data or as provided + expected capacity factor
	Capital cost	←	RepuTex data or as provided + expected capacity factor
	Subsidies	←	Free permits + permit price + expected capacity factor
= LRMC			

MODELLING SCOPE

SCOPE OF ANALYSIS AND MODELLING ASSUMPTIONS

MODELLING SCOPE

The scope of this report is the analysis of proposed election policy on greenhouse gas emissions and wholesale electricity prices in Victoria through to 2025.

Specifically, analysis considers the potential impact of election policies of the three major political parties in Victoria, modelling future renewable energy capacity, resultant electricity emissions reductions, and the annual wholesale electricity price trajectory.

Analysis presents three independent scenarios based on each party's announced policy platform:

1. The impact of Australian Labor Party policy (Victorian Branch) on Victorian electricity prices and emissions to 2025;
2. The impact of Victorian Liberal and National parties (the Coalition) on Victorian electricity prices and emissions to 2025;
3. The impact of Greens policy (Victorian Branch) on Victorian electricity prices and emissions to 2025;

KEY ASSUMPTIONS

A common set of market assumptions is applied in each scenario, with policy initiatives for each political party then overlayed (refer to next section) to provide a materially different outcome in each modelled case.

Common assumptions include:

- **Average fuel prices: 2018-2030 (real 2017 dollars)**
  - Biomass: $0.50/GJ
  - Brown Coal: $0.65/GJ
  - Export Coal: $3.95/GJ
  - Hydro: Average inflow each year
  - Victorian Gas $10/GJ
- **Capacity additions and retirements**: Announced retirement of capacity in other regions is considered, i.e. Liddell by 2022-23. Over 2,200 MW of new renewables capacity is assumed in Victoria, including contracted investment under the VRET (928MW).
- **Current federal policy**: The conclusion of growth in the Large-scale Renewable Energy Target (LRET) in 2020 (33 TWh to 2030). No further policy, such as the National Energy Guarantee is assumed to be implemented.
- **Current Victorian policy**: Contacts entered into at the first VRET auction are assumed to be maintained and projects built (928MW).
- **Demand**: AEMO Electricity Statement of Opportunities (ESOO) August 2018 - Neutral annual consumption scenario.
- **Reliability**: Brown coal units are assumed to operate with a de-rated capacity of 21 per cent for 14 per cent of the year. Full outages are assumed for 4 per cent of the year. Reliability is modelled to be met across the system.
- **Snowy 2.0**: The government's proposed 2 GW Snowy 2.0 pumped hydro project is assumed to be commissioned by 2025
- **Technology costs**: Accumulated based on in-house estimates derived from reported project costs, PPA prices, and internal modelling.
- **Wind and solar generation**: New Wind and Solar PV generators are assumed to submit offers and participate in the market clearance mechanism.

Please refer to the following slides for policy settings for each political party.

MODELLED POLICY SETTINGS

VICTORIAN ENERGY AND CLIMATE POLICY COMPARISON

Below we describe the core energy and climate policies of the three major parties in Victoria, specifically initiatives to address large and small-scale energy supply, reliability and affordability.

THE VICTORIAN ALP

The Andrews Labor government has developed a broad energy and climate policy framework, implementing a range of initiatives to support ongoing investment in large and small-scale renewable energy, and long-term energy reliability and affordability in the Victorian energy system.

The cornerstone of the government's policy framework is the **Victorian Renewable Energy Target (VRET)**, which legislates ambition to supply 25 percent of local electricity from renewable sources by 2020, growing to 40 percent by 2025. This is supported by a net zero GHG emissions target by 2050, adopted under the Victorian Climate Change Act, providing a pathway for the setting of targets every five years.

In September 2018, the government announced the results of its VRET reverse auction scheme, awarding long-term offtake agreements (contracts for difference) to **six new wind and solar farms, for 928 megawatts (MW) of capacity**, including:

- Berrybank wind farm (Union Fenosa) 180MW
- Cawarp solar farm (Canadian Solar) 121.6MW
- Cohuna solar farm (Leeson Group/Enel Green Power) 34.2MW
- Dundonnell wind farm (Tilt Renewables) 336MW
- Mortlake South wind farm (Acciona) 157.5MW
- Winton solar farm (FRV) 98.8MW

In addition, the Victorian government has announced a **$1.24 billion Solar Home Package**, which will support solar PV deployment via rebates and interest-free loans for rooftop solar systems. The program is expected to add solar panels to 650,000 households over 10 years, with a further a further $82 million over 10 years for 50,000 rebates set aside for rental properties. In addition, the scheme will include $40 million in funding to subsidise the installation of battery storage in 10,000 homes.

THE VICTORIAN LIBERAL AND NATIONAL PARTIES (COALITION)

The Victorian Liberal and National Parties (the Coalition) has pledged to **repeal the government's VRET scheme.** While it is unclear if the repeal will void awarded contracts, or apply only to the holding of future VRET auctions, for the purposes of this analysis we assume that September 2018 auction capacity is maintained, but no further auctions held.

The Coalition proposes to **contract at least 500 MW of new power capacity** to support the state's major public services via a competitive tender process. New capacity may be a combination of hydro, wind, solar, gas or coal - capable of being available '24/7' and meeting requirements like 'security of supply'.

In addition, other stated initiatives include:

- Proposal to **provide 700 Victorian public schools with solar and battery storage**.
- Proposal for 75 per cent of all labour, materials and supplies for the renewable energy industry (projects over $50 million) are locally sourced.

THE VICTORIAN GREENS

The Victorian Greens propose to transition the regional energy system to **100 per cent renewable energy by 2030**.

The proposal would increase the VRET to 30% by 2020, 50% by 2025 and 100 per cent by 2030, underpinned by a combination of building publicly-owned large-scale renewable energy, and supporting private and community projects through an expanded VRET.

The Greens' plan would build $9 billion worth of publicly-owned energy generation over ten years, along with **$500 million of investment large-scale battery storage and pumped hydro**, centred in the Latrobe valley. New supply would be supported by grid upgrades in the north and west to unlock additional resource potential.

The Greens support the Government's **Solar Home Package**, proposing to broaden the plan to include rental properties and apartments, however limited detail of scope and cost is disclosed.

The Greens have also proposed **solar panels and batteries for Victoria's 1,531 public schools**, connected through a Virtual Power Plant, increasing efficiency across the network.

CASE STUDY

SOLAR INSTALLATION UNDER THE ALP SOLAR HOMES INITIATIVE

The Victorian government has proposed an additional solar PV rebate to cut electricity bills via the "Solar Homes Package" (SHP). The package includes a 50 per cent rebate on the cost of solar PV systems, up to $2,225. This discount applies to all new systems installed from 19 August 2018.

Nine out of ten Victorians are assumed to be eligible, as eligibility applies to households with an income of less than $180,000 p.a., and homes valued at under $3 million. The ALP is also offering a 'no money up-front' offer via zero interest loans from July 2019.

The SHP is modeled to drive the uptake of approximately 2,700 MW of additional rooftop solar from 2018, with payback times found to approximately halve.

A 4-kW Solar System Example

A north facing solar system could generate around 5,485 kWh a year in Melbourne, however, given all systems do not face due north, a 5 per cent reduction is applied, to 5,210 kWh p.a. This is assumed to cost Melbourne homes around 25c per kWh after discounts. Exported energy is assumed to receive Victoria's minimum solar Feed-in tariff (FiT) of 9.9c per kWh.

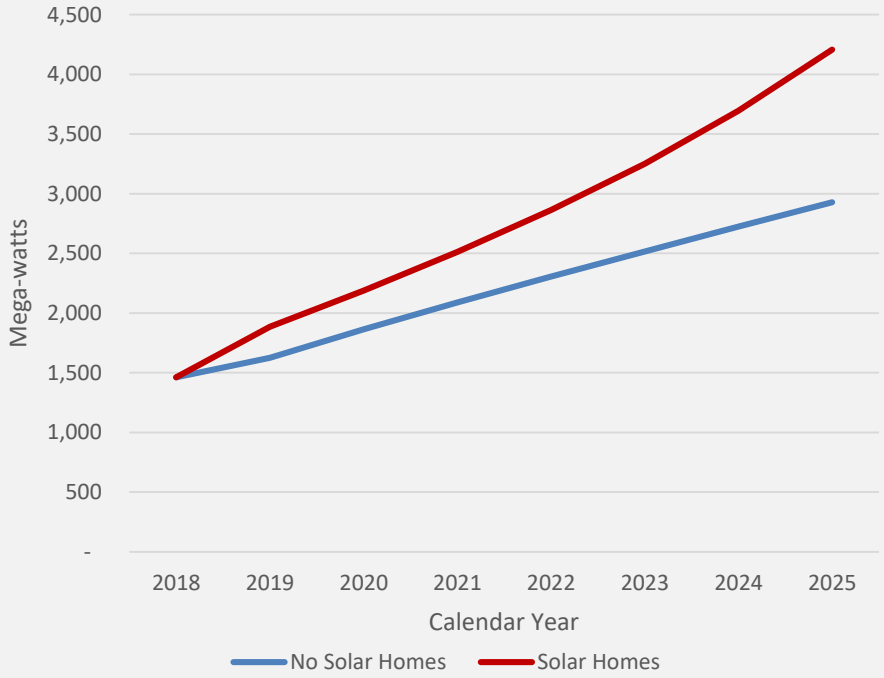
A typical Australian household is assumed to self-consume around 30 per cent of electricity generated by a 4 kW system. Offsetting 30 per cent of consumption at 25c and the remainder at 9.9c per kWh results in average savings of $750 per year.

Assuming a system cost of $6,700 for an average 4 kW system would represent a payback of 3 years. The same scenario without the $2,225 rebate would extend the payback period to 5.9 years.

A larger 6.5-kW system could attract the same absolute rebate, but with a longer payback.

Additional rooftop solar capacity is expected to result in GHG emissions reductions of over 5 million tonnes between 2019 and 2025.

Figure 3: Additional base capacity of rooftop solar in Victoria



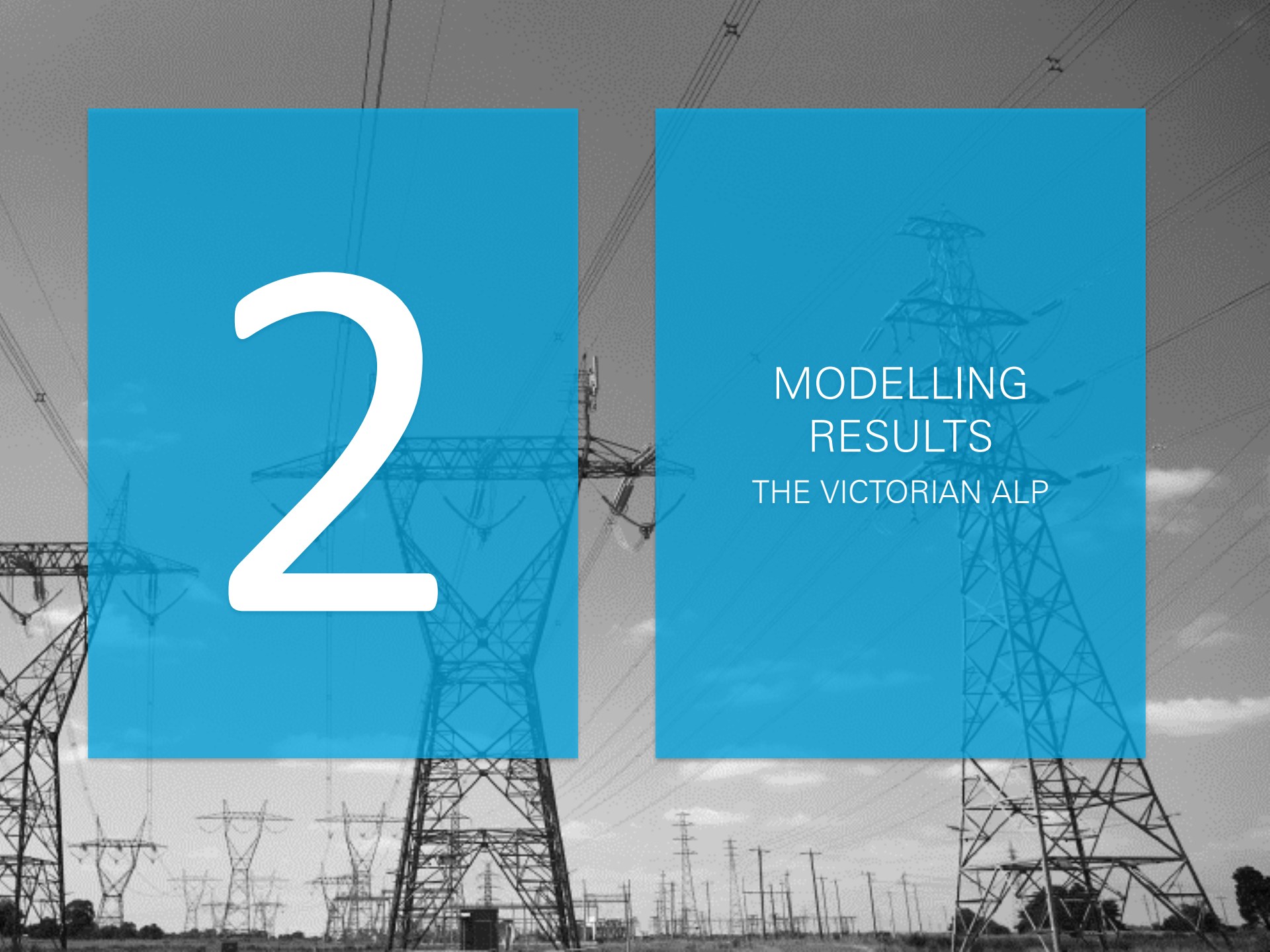
Size (kW)	Energy (kWh)	Avoided Cost (c/kWh)	FiT (c/kWh)	Self-consume (%)	Annual Savings ($)	Federal 'Rebate': STCs ($)	Victorian Rebate ($)	Payback (years)
4	5,210	25	9.9	30	750	2,240	2,225	3.0
4	5,210	25	9.9	30	750	2,240	0	5.9
6.5	8,466	25	9.9	20	1,090	3,640	2,225	4.4

MODELLED POLICY SETTINGS

VICTORIAN ENERGY AND CLIMATE POLICY COMPARISON

Figure 4: Comparative policy settings within modelled scenarios

POLICY MECHANISM	THE AUSTRALIAN LABOR PARTY (VICTORIAN BRANCH)	THE VICTORIAN LIBERAL NATIONAL PARTY COALITION	THE VICTORIAN GREENS
Victorian Renewable Energy Target (VRET)	VRET of 25% renewable energy by 2020, growing to 40% by 2025.	VRET is repealed.	VRET of 30% by 2020, 50% by 2025 and 100 per cent by 2030.
VRET auctions	September 2018 auction (928 megawatts of wind and solar capacity).	September 2018 auction (928 megawatts of capacity) is assumed to be maintained, but no further auctions held.	September 2018 auction (928 megawatts of wind and solar capacity).
Other power contracting	N/A	500MW of new energy generation – available 24/7 - to support the state's major public services.	$9 billion of generation over 10 years, along with $500 million of large-scale battery storage and pumped hydro. Total additional capacity of 15,900 MW to meet 100% target scenario.
$1.24 billion Solar Home initiative,	Addition of 700,000 solar panels to households over 10 years. Assumed to be at least 122 MW in FY 2018-19 and more than 275 MW annually thereafter.	N/A	Support for the Solar Home Initiative, broadened to include rental properties and apartments, which allows for higher 'rooftop' solar penetration.
Public school solar initiative	Assistance to selected schools in installing solar power via the Greener Government School buildings pilot program.	Provide 700 Victorian public schools with solar and battery storage, assumed to be about 70 MW controlled to manage demand at a grid level.	Extension of solar panels and batteries for Victoria's 1,531 public schools.
Network assumptions	Assumed to be upgraded to meet future supply needs in line with AEMO ISP.	Assumed to be upgraded to meet future supply needs in line with AEMO ISP.	New supply would be supported by grid upgrades to unlock additional resource potential.



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MODELLING RESULTS

THE VICTORIAN ALP

NEW CAPACITY ADDITIONS

VICTORIAN ALP POLICY SCENARIO

LRET DRIVING CURRENT CAPACITY BUILD IN VICTORIA

Investment in large-scale renewable energy in Victoria is currently underpinned by the existing large-scale renewable energy target (LRET).In addition to existing capacity of around 5,700 MW of large and small scale renewables, approximately 1,600 MW of wind capacity and approximately 500 MW of solar capacity is committed for development by 2020, driven by long-term power purchase agreements with retailers and corporate electricity consumers.

A further 670 MW of wind and more than 250 MW of solar capacity is probable by the end of 2020 after winning the September 2018 VRET auction. This suggests new large-scale capacity of over 3,000 MW will be added to the system by 2020.

As a consequence, no fossil fuel capacity (aside from a brown coal turbine upgrade) is projected to be built ahead of the planned closure of Liddell by 2022 in neighbouring New South Wales.

Although Liddell is not located in Victoria, this closure is expected to necessitate the replacement of annual energy generation and dispatchable capacity. While a mix of renewables, battery storage and demand response (coupled with an efficiency upgrade at Bayswater power station) is planned, modelling suggests that low-cost energy from Victoria remains one of the most cost-effective ways to fill the energy deficit left by Liddell's retirement.

In this scenario, the construction of Snowy 2.0's 2,000 MW is assumed to be built by 2025 in New South Wales. Note this is not reflected in Figure 6, which depicts only Victorian capacity.

CONTINUATION OF VRET TO DRIVE NEW RENEWABLES INVESTMENT

When the full extent of current committed capacity is considered in Victoria, along with future renewable energy support to meet the VRET, we estimate a significant increase in renewable energy capacity in the local system.

As noted, over 3,000 MW of new large-scale capacity is already committed to be added in Victoria by 2020 under the LRET and the September 2018 VRET auction. The continuation of the VRET is expected to reinforce additional investment in large-scale renewable energy capacity beyond current commitments, with modelling suggesting a further 1,700 MW of wind and 600 MW of large solar may be added due to a favourable policy environment, and opportunities for developers to substitute for capacity withdrawals in other markets.

In addition, rooftop PV is modelled to add an average of 350 MW each year or an average growth rate of 15 per cent annually, resulting in over 2,200 MW of new rooftop solar by 2025 or 9 per cent of generation relative to demand.

Modelling therefore suggests new renewable energy capacity additions may grow to over 7,500 MW by 2025, supported by a further 600 MW of additional capacity for managing reliability in the form distributed battery storage, peaking generators, and utility-scale storage.

The continuation of the VRET is therefore likely to provide a robust signal for renewable investment in Victoria, with 48 per cent of generation projected to be derived from renewable energy sources in 2025 (Figure 6), more than the 40 per cent currently legislated under the scheme.

RETIREMENTS

By 2025, 'merit order' pressure alone - from new investment in low-cost wind and solar generation - is not expected to trigger additional closures within Australia's coal-fired fleet beyond the announced retirement of Liddell by 2022-23. This is because of the potential for a return to current generation levels after Liddell suggests coal-fired facilities could chose to increase their offers and reduce generation (mothballing units as necessary) until the supply-demand balance tightens again.

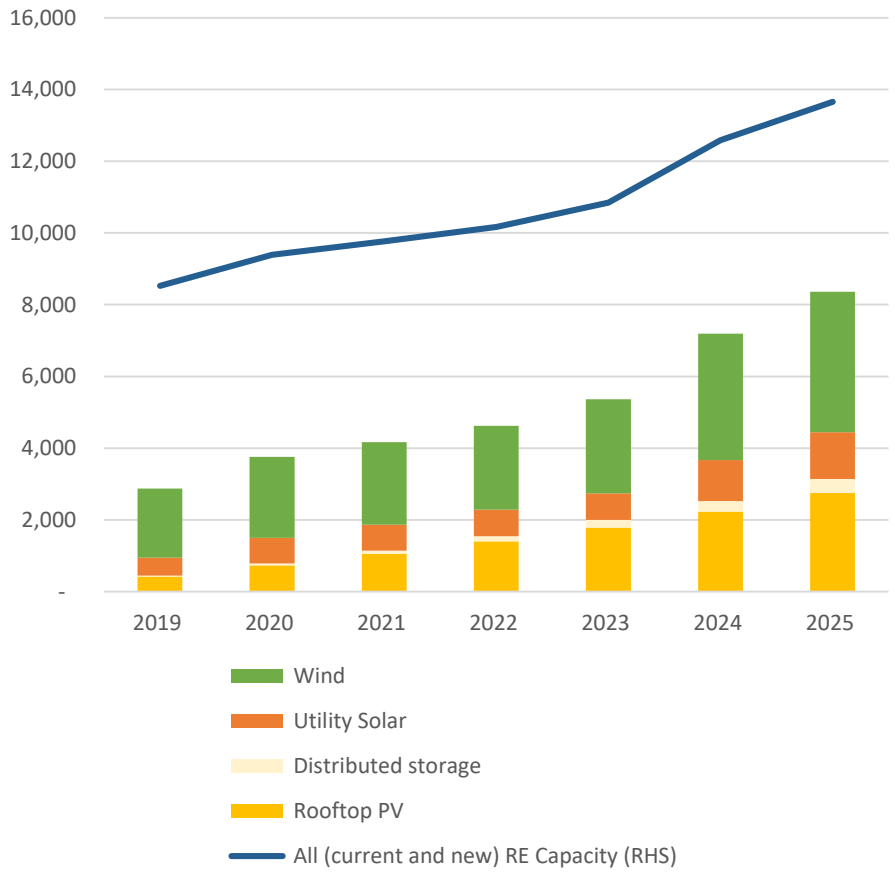
Increasing competition is modelled to limit dispatch of coal-fired energy to an increasingly smaller fraction of energy generation every year. This will impact the economics of brown coal in Victoria, however 'baseload' contracts are modelled to continue to cover operating costs to 2025, supported by increased profits after the closure of Liddell.

Almost all other forecast growth in gross electricity demand is expected to be met by increasing small-scale PV generation, with retiring coal plants replaced by a combination of dispatchable gas, solar and wind, made possible by an increase in capacity from demand response and other flexible storage like batteries and pumped hydro.

NEW CAPACITY ADDITIONS

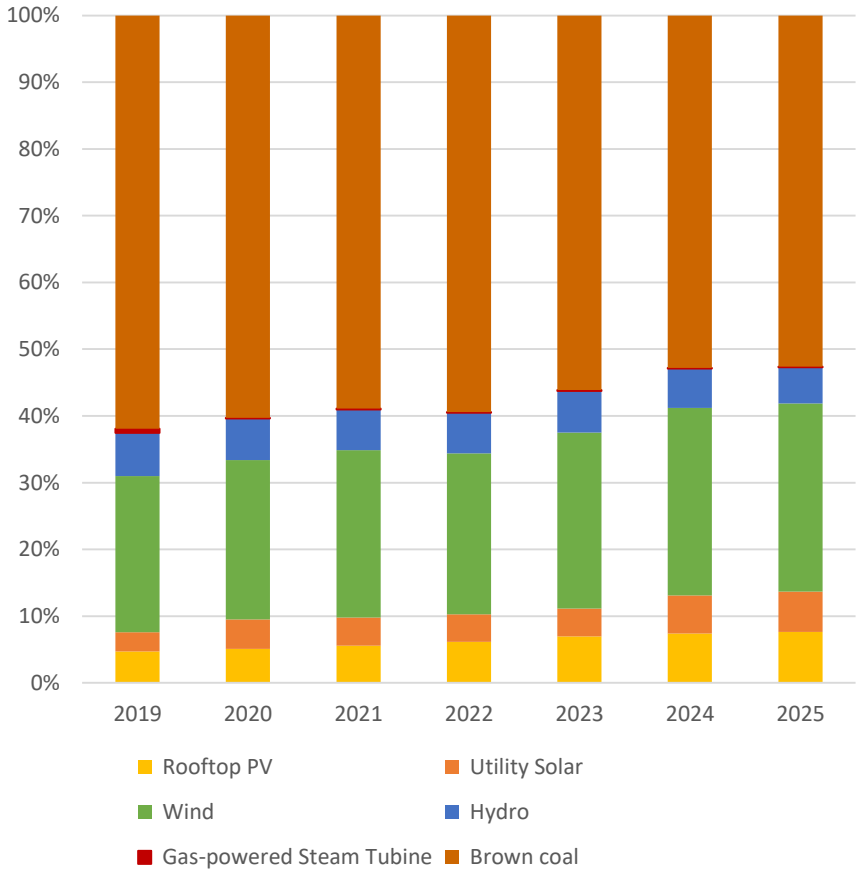
VICTORIAN ALP POLICY SCENARIO

Figure 5: Entry of Cumulative Capacity by Technology Type and Year in Victoria



Source: RepuTex Energy, 2018

Figure 6: Output of Generation by Technology Type and by Year in Victoria

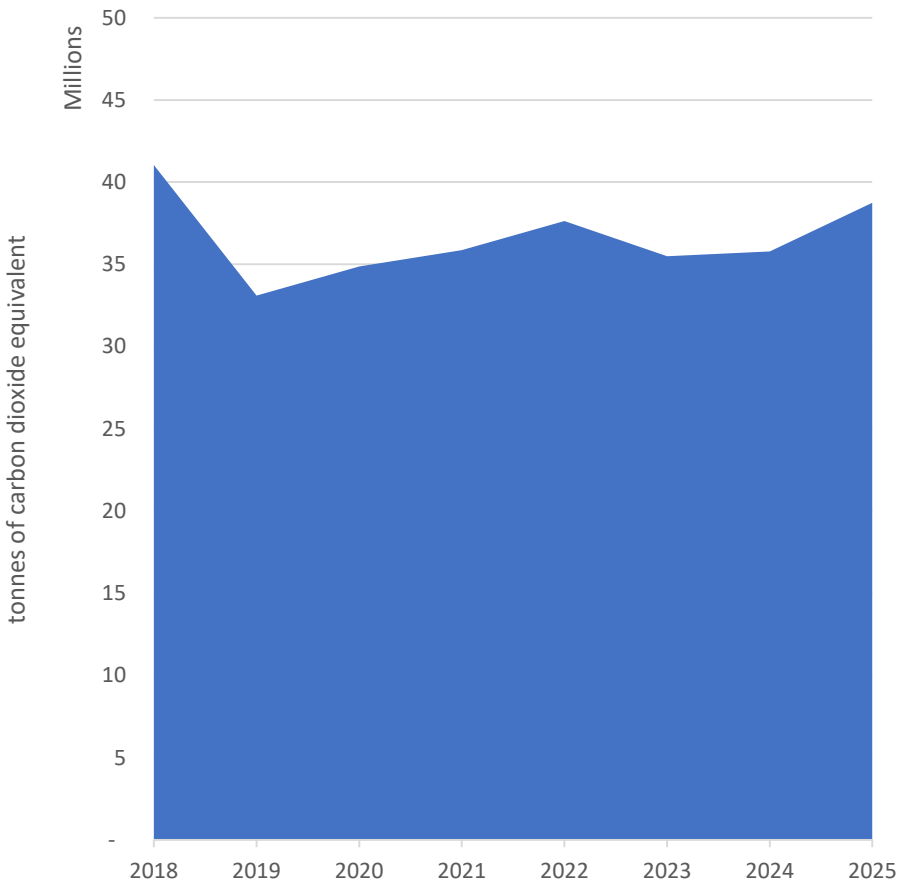


Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN ALP POLICY SCENARIO

Figure 7: Annual electricity sector GHG emissions in Victoria



Source: RepuTex Energy, 2018

Figure 8: ALP Electricity Price Projection Scenario, Victoria

Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN ALP POLICY SCENARIO

IMPACT ON EMISSIONS

As shown in Figure 7, we project electricity emissions in Victoria should drop sharply next year as a significant increase in new renewable capacity displaces fossil fuel generation. Part of this generation could be made up by existing capacity in Victoria's low-cost brown coal generators, however, as they increase their dispatch relative to black coal-fired facilities in New South Wales. The VRET should largely prevent Victorian electricity emissions from rising above current levels though to 2025. Even still the Victorian system will continue to be underpinned by brown coal fired output with excess capacity available to match 'baseload' demand that is not filled by renewables.

While modelling is highly sensitive to assumptions about electricity consumption, which is uncertain, analysis indicates that Victoria is likely to resume its traditional role of exporting electricity to neighbouring states in the 2020s. As new renewable capacity is built ahead of the closure of Liddell, this very low-cost energy is likely to displace higher cost coal- and gas-fired generation whenever possible. Additionally, more solar energy results in deeper demand minimums during daytime and summer periods, and the large energy storage capacity of Snowy 2.0 allows for the storage and availability of excess renewable energy.

IMPACT ON ELECTRICITY PRICES

As shown in Figure 8, current growth in renewable energy supply is expected to reverse the electricity price peak in 2018, predominately a consequence of coal-fired power plant withdrawals in South Australia and Victoria. In the lead up to these closures, additional large-scale renewable supply also slowed due to uncertainty over the federal LRET. By stalling development of both fossil fuel and renewable energy development, price increases were effectively 'baked in' to electricity contracts.

These higher prices have supported more renewable energy development since late 2016, with financing underpinned by higher electricity prices, rather than a reliance on revenue from green renewable energy certificates.

Major growth in renewable energy supply is projected to significantly increase competition in the National Electricity Market, placing downward pressure on electricity prices even before taking into account the almost zero variable cost of renewable generation on the merit order.

The large amount of new, low-cost electricity supply is therefore expected to supress prices, however, by 'how much' remains uncertain. Modelling suggests that new supply - now largely driven by market price signals - will see investment in large-scale renewables slow next year (from current record build out rates) as financers pause to reassess transmission constraints in Victoria and the settling point for contract prices in this newly completive regime.

As noted, the upcoming closure of Liddell is expected to create opportunities for new electricity supply in the mid-2020s. In a 'renewable friendly' scenario such as the ALP policy framework, this supply is likely to be derived from additional wind and solar development, underpinned by the expectation that the VRET will potentially support additional capacity to maintain at least 40 per cent renewable energy by 2025.

As noted, while new competition will create stronger competition for coal-fired power – the exit of Liddell may also create opportunities for coal-fired incumbents, supporting the prospect of increased profitability for brown-coal over the modelled period despite les and less dispatch each year. Resultantly, coal-fired power is modelled to continue to play a role in Victoria in this 'renewable friendly' scenario, contributing around 53 per cent of energy by 2025.

3

MODELLING RESULTS

THE VICTORIAN COALITION

NEW CAPACITY ADDITIONS

VICTORIAN COALITION POLICY SCENARIO

CURRENT CAPACITY UNDER THE LRET AND EXISTING VRET SCHEME

As noted under the ALP scenario, investment in large-scale renewable energy in Victoria is currently underpinned by the large-scale renewable energy target (LRET) and recent VRET auctions held in September 2018.

Committed projects suggest the addition of around 1,600 MW of wind capacity and approximately 500 MW of solar capacity by 2020, driven by investment in long-term power purchase agreements with electricity retailers and corporate electricity consumers.

Further supply of around 670 MW wind and more than 250 MW of solar is also expected to be developed under the VRET, assuming contracts entered into in September 2018 are honoured by a future Coalition government. This suggests new large-scale capacity of over 3,000 MW will be added to the system by 2020.

Similar to the ALP scenario, no fossil fuel capacity is therefore projected to be built ahead of the closure of Liddell by 2022-23 (New South Wales), aside from a turbine upgrade at Loy Yang B.

Although not located in Victoria, Liddell's closure will necessitate the need to replace both the bulk energy generation and dispatchable capacity of Liddell. Although a mix of renewables, battery storage and demand response (coupled with an efficiency upgrade at Bayswater power station) is planned, modelling suggests that low-cost energy from Victoria remains one of the least-cost ways to fill the energy deficit left by Liddell's retirement.

REPEAL OF VRET LIKELY TO STOP RENEWABLE INVESTMENT

While the VRET is likely to provide a robust signal for continued investment in Victoria under the ALP scenario, the proposed repeal of the scheme is likely to trigger a significant regime change for one of Australia's more favourable renewable investment states. As a result, new investment in large-scale renewable energy capacity is modelled to effectively stop under the Coalition, similar to the weak market for investment during periods of policy uncertainty under the federal LRET.

As noted, around 3,000 MW of new utility-scale solar and wind is committed in Victoria. Modelling indicates that this is likely to be supported by small-scale PV capacity growth of 10 per cent annually under the Coalition, adding nearly 1,500 MW of rooftop PV capacity to the market by 2025, or around 1,000 MW less than the ALP scenario.

In line with announced policy, a further 500 MW of new energy generation is modelled to be added to the local system by 2021, contracted by the Coalition government via a competitive tender process. This is modelled to be a combination of wind and solar firmed by gas and hydro, with this combination demonstrated to be lower cost than new gas or coal-fired energy only.

Including other capacity for managing reliability and upgrading existing generators (about 400 MW), this would represent a total of around 4,900 MW of new capacity, mostly from committed wind and solar under the existing LRET and VRET schemes (September 2018 auction), as well as growth in rooftop solar.

The Coalition's repeal of the VRET would therefore dampen clean energy investment relative to the ALP scenario, with a political regime change likely to provide a disruptive signal for new investment.

Assuming that new '24/7' contracts are supported by wind and solar capacity (firmed with gas and hydro), modelling indicates that around 40 per cent of generation will be derived from renewable energy sources in 2025 (Figure 10), in line with the 40 per cent legislated under the VRET.

RETIREMENTS

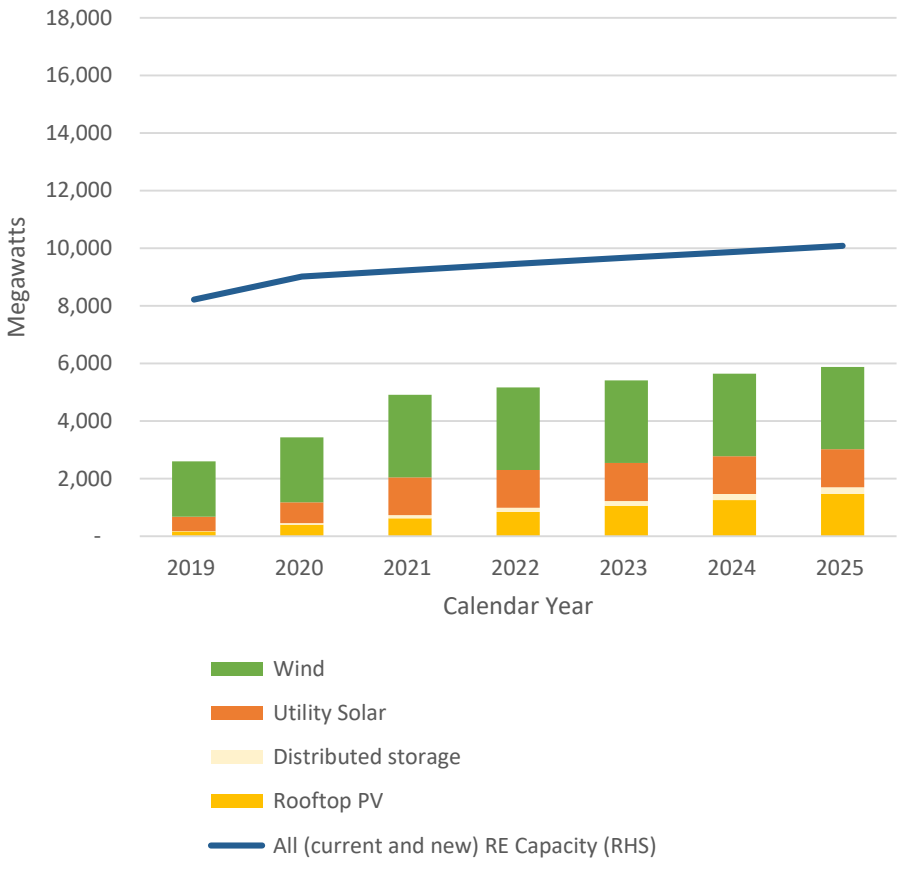
Similar to the ALP scenario, by 2025, 'merit order' pressure from new investment in low-cost wind and solar generation is not expected to trigger further retirements within Australia's coal fired fleet beyond the announced closure of Liddell.

Despite this, new competition (particularly from any new dispatchable contracting) will continue to create stronger headwinds for brown coal-fired power, even in a more 'fossil friendly' scenario as modelled here. By effectively capping the entry of new large-scale renewables in this scenario, however, the prospects for existing generators to increase their future sales appears favourable.

NEW CAPACITY ADDITIONS

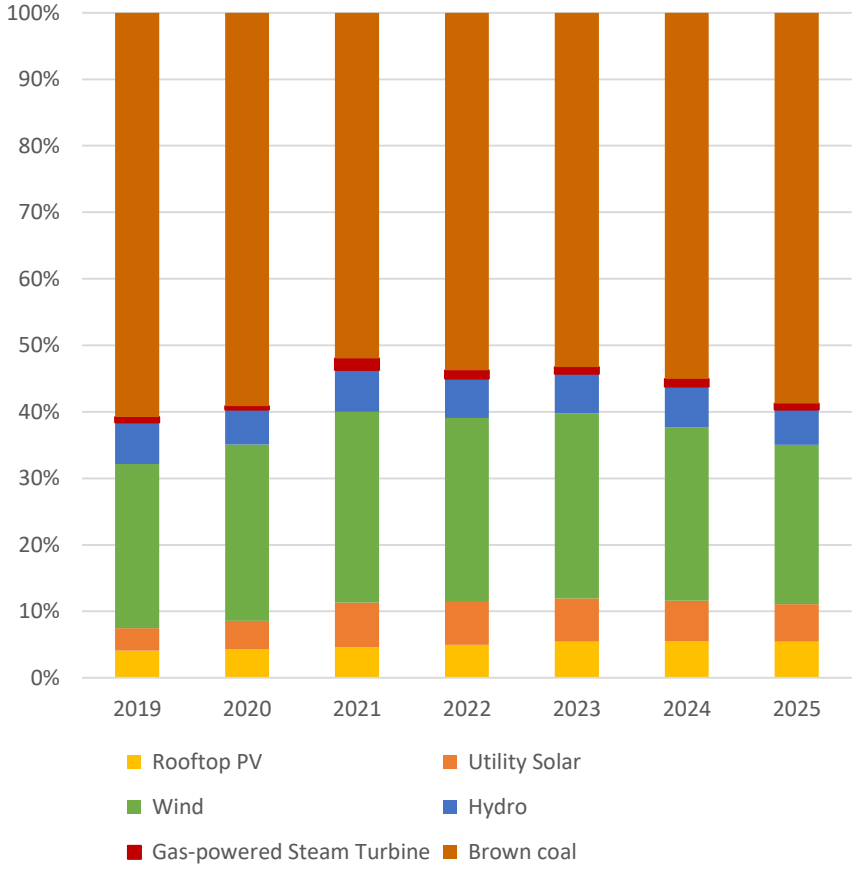
VICTORIAN COALITION POLICY SCENARIO

Figure 9: Entry of Cumulative Capacity by Technology Type and Year in Victoria



Source: RepuTex Energy, 2018

Figure 10: Output of Generation by Technology Type and by Year in Victoria

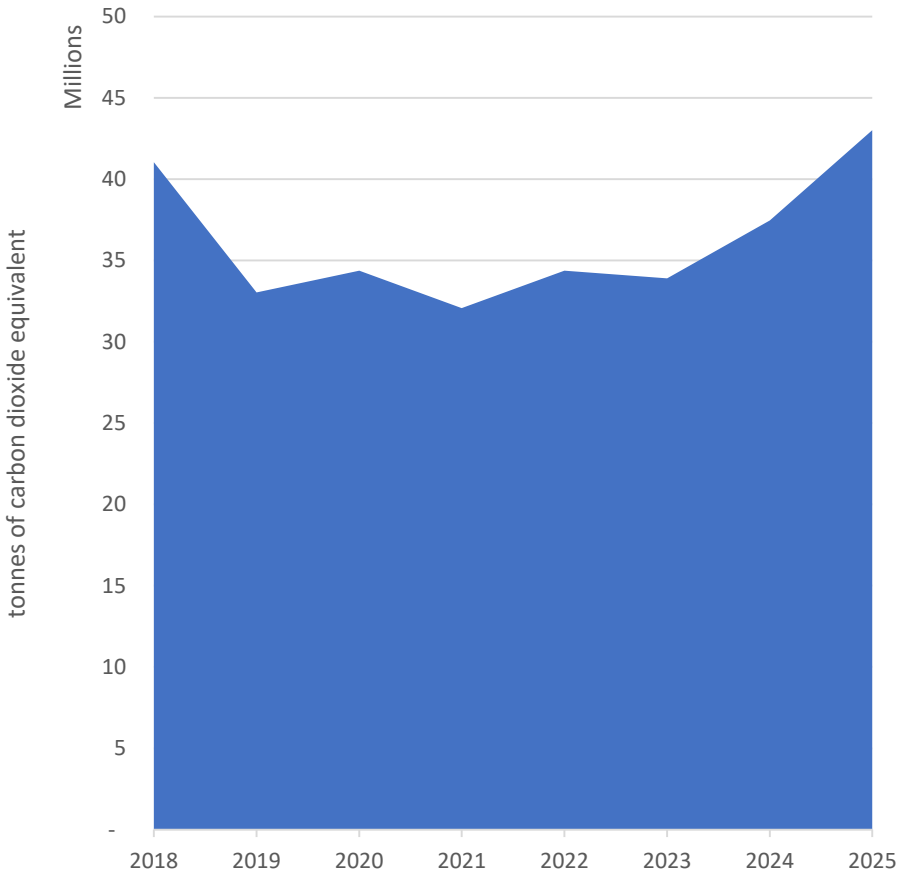


Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN COALITION POLICY SCENARIO

Figure 11: Annual electricity sector GHG emissions in Victoria



Source: RepuTex Energy, 2018

Figure 12: Coalition electricity price projection, Victoria

Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN COALITION POLICY SCENARIO

IMPACT ON EMISSIONS

In line with lower levels of projected renewables investment – relative to the ALP scenario - modelling indicates that emissions reductions could be completely displaced under the Coalition's policy platform. As shown in Figure 11, following the repeal of the VRET, electricity emissions in Victoria are projected to rise back to current levels by 2025, growing to around 43 Mt.

While modelling is highly sensitive to assumptions about electricity consumption, which is uncertain, analysis indicates that Victorian generation could again play a key role in exporting electricity to neighbouring states. Unless new capacity with low operating costs is built ahead of this period, spare capacity from brown coal is likely to be dispatched before higher cost black coal- and gas-fired generation. This will contribute to a higher emissions profile in Victoria.

In addition, reduced solar capacity will delay expected deeper electricity demand minimums during daytime and summer periods, while the large energy storage capacity of 'Snowy 2.0' will allow for more 'baseload' charging of reservoirs. Both of these factors could contribute to mitigating the disruptive 'ramping' that is causing additional 'wear and tear' on Victoria's baseload brown coal-fired power stations, potentially eroding future profitability though reduced capacity factors.

IMPACT ON ELECTRICITY PRICES

As shown in Figure 12, current growth in renewable energy supply is likely to reverse the electricity price spike in 2018, predominately underpinned by major coal-fired power plant withdrawals in South Australia and Victoria, and the slow down in large-scale renewable investment due to historical uncertainty over the Large-scale Renewable Energy Target.

In line with the ALP scenario, imminent increases in renewable energy supply are likely to significantly increase competition in the National Electricity Market, placing downward pressure on electricity prices even before taking into account the 'merit order effect', a consequence of the almost zero variable cost of renewable generation.

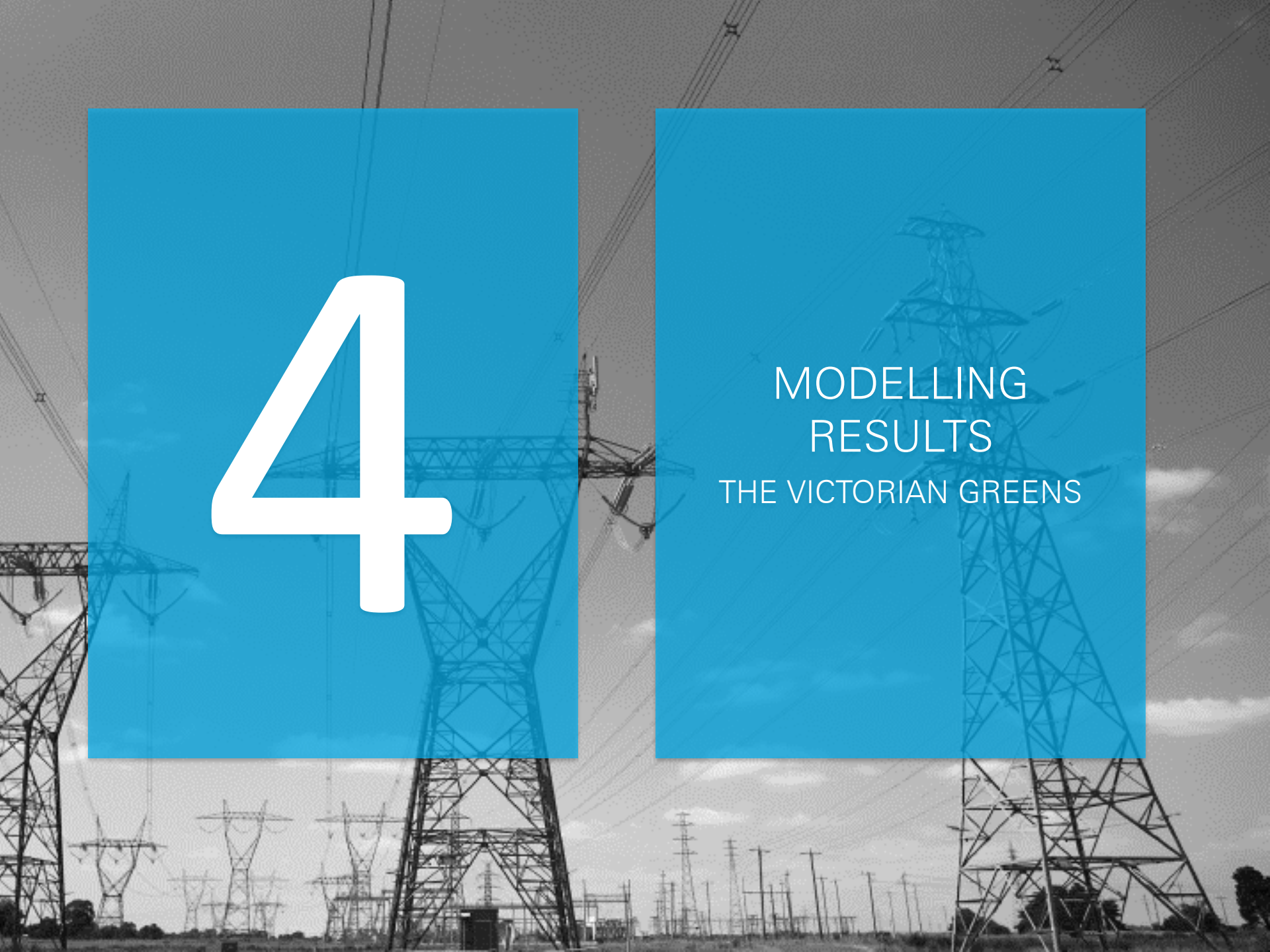
While prices decline to 2021 as new supply is commissioned, modelling indicates that the lack of new investment in renewable capacity – and a return to a policy environment similar to the historical uncertainty over the LRET – is likely to see prices again return to an upward trajectory as investors become more conservative in matching electricity contract price rises with the scale of new development.

Under this scenario, wholesale prices are projected to reverse their downward trend, rising above $70 per MWh after the closure of Liddell, toward $90 per MWh by 2025 as lower levels of supply reduce competition relative to the modelled ALP scenario.

Under this scenario, the upcoming closure of Liddell is expected create new opportunities for the ramp-up of the Latrobe Valley's under-utilised electricity capacity in the mid-2020s. In a 'fossil-fuel friendly' environment, this additional electricity is likely come from Victoria's three existing coal-fired generators, which would be assisted by the repeal of the VRET, in turn reducing competition to balance any increase in brown-coal fired generation.

However, as noted, new competition (particularly from new dispatchable contracting) will continue to create stronger headwinds for brown coal-fired power, even in a more 'fossil friendly' scenario as modelled here.

On the other hand, if new capacity is built, it is most likely to be renewable. Because of the near zero running costs of new renewables, any new renewable capacity would displace brown coal generation once the new capacity is built. The short-term advantage for brown coal to fill any new demand for electricity will therefore be limited, with price rises likely to trigger resumed investment in large-scale renewable energy, and increased competition for incumbents.



4

MODELLING RESULTS

THE VICTORIAN GREENS

NEW CAPACITY ADDITIONS

VICTORIAN GREENS SCENARIO

ZERO EMISSIONS TRAJECTORY BY 2030

Should the VRET be scaled up to align with a 1.5 degree ambition under the Paris Agreement, analysis considers the impact of a zero electricity emissions reduction target for Victoria by 2030.

In this scenario, we scale up the VRET to a 100 per cent emissions reduction target by 2030, underpinned by the minimum Victorian Greens targets of 30 per cent by 2020 and 50 per cent by 2025.

This would have an impact on the market, driving almost all investment into renewable energy to fill the closure horizon of coal fired generators (assuming no breakthroughs in carbon capture and storage technology). Accounting for full extent of current committed capacity and investment to meet the current VRET, we estimate a significant increase in renewable energy capacity in Victoria, growing to around 16,000 MW by 2025, shown in Figure 13.

Demand for more clean energy allows for the addition of hundreds of MW of utility-scale PV. Due to falling costs, more than 1,700 MW of large-scale PV is added by 2025 in this scenario, in addition to 2,400 MW of small-scale PV. Wind energy also sees major capacity additions, with about 5,800 MW of capacity added by 2025.

Additional investment in this scenario is attributed to about 170 MW of peaking capacity additions by 2021. In scenario these units are bio-fuel ready and can continue to be used even after a 100 per cent renewable target is imposed after 2030. This capacity is only necessary for back-up and super-peak demand periods.

Including other capacity for managing day-to-day reliability (about 1,800 MW), this represents a total new capacity investment of about 11,800 MW by 2025 on a trajectory toward 100 renewable energy.

RETIREMENTS

Rapidly rising competition from new capacity is modelled to significantly limit any future demand for coal-fired energy to an increasingly smaller fraction of energy purchases almost every year. This is assumed to result in the effective closure of over 1,100 MW of coal-fired capacity by 2025.

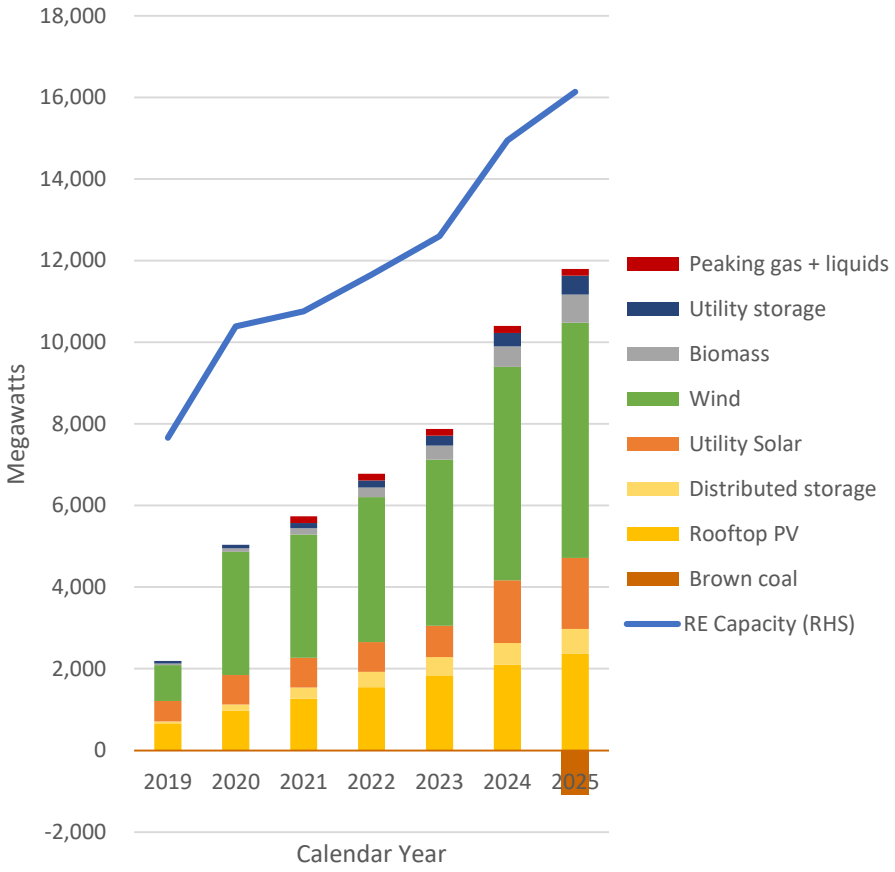
Under this scenario, a strong reliability requirement will be necessary to ensure there is enough energy available from non-coal sources and dispatchable capacity to meet demand with limited coal generator operation.

Even so, some degree of coordination will be required to safeguard the efficient dispatch of limited thermal coal generators that rely on continuous operation to minimise high unit shut-down and start-up costs. Additionally, as capacity is no longer needed, a mechanism should allow existing contracts to be transferred to the remaining generators in a planned way to avoid customers becoming stranded by the relatively rapid pace of retirements.

NEW CAPACITY ADDITIONS

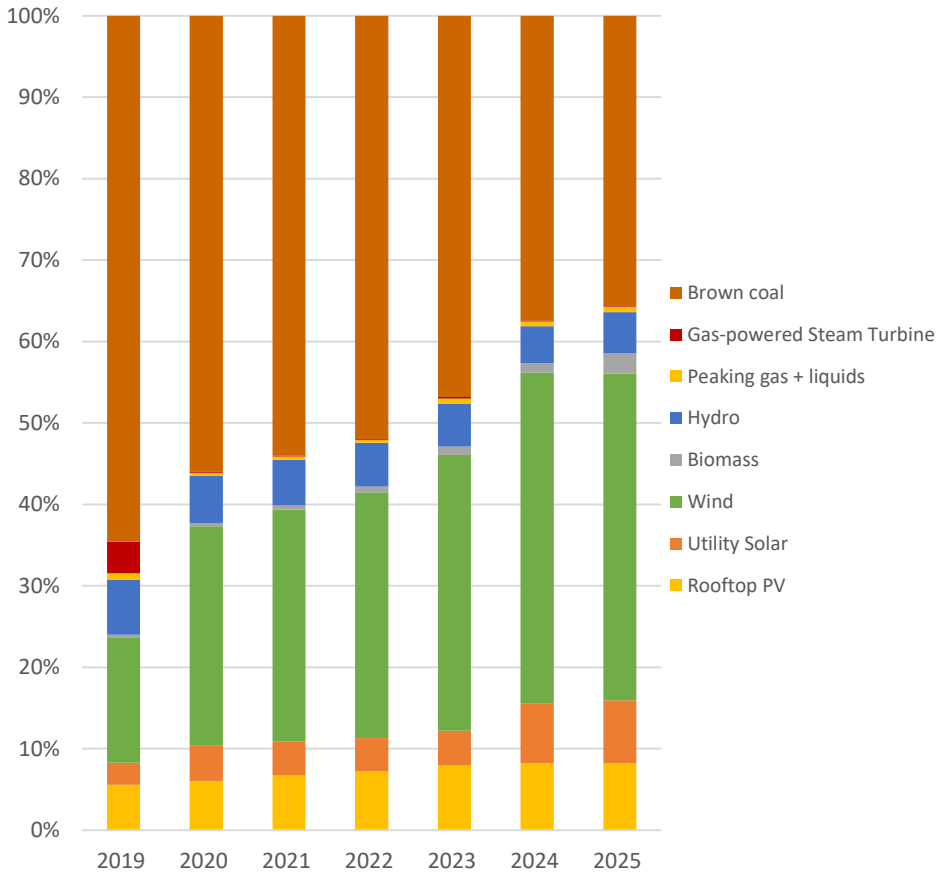
VICTORIAN GREENS SCENARIO

Figure 13: Entry and Exit of Cumulative Capacity by Technology Type and Year



Source: RepuTex Energy, 2018

Figure 14: NEM Output of Generation by Technology Type and by Year

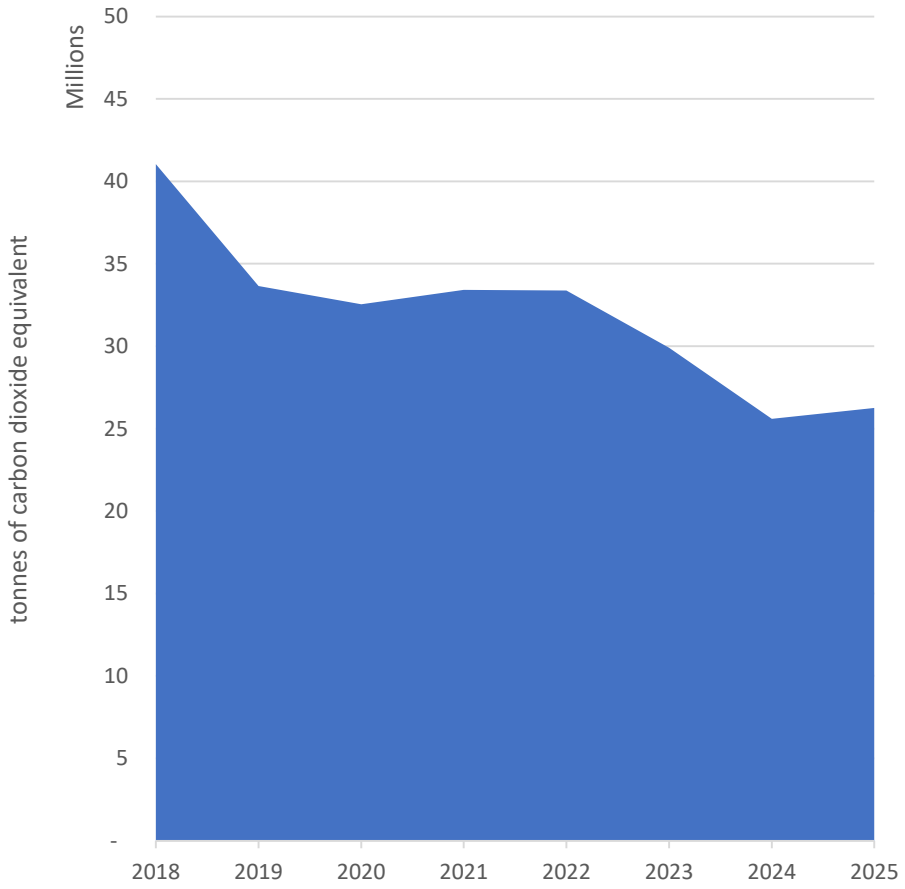


Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN GREENS SCENARIO

Figure 15: Greens Emissions Projection Scenario, Victoria



Source: RepuTex Energy, 2018

Figure 16: Greens Electricity Price Projection Scenario, Victoria

Source: RepuTex Energy, 2018

ELECTRICITY PRICES AND EMISSIONS

VICTORIAN GREENS SCENARIO

IMPACT ON EMISSIONS

Modelling indicates that renewable energy investment, and emissions reductions, are likely to be far more advanced under Greens policy than other major parties. As shown in Figure 15 we project electricity emissions from generators in Victoria will fall to around 26 Mt by 2025, as there is little to no opportunity for existing brown coal-fired generation to be able to return to current generation levels.

While modelling is highly sensitive to assumptions about electricity consumption, which are uncertain, analysis indicates that current committed wind and solar capacity to be built in the next few years would only need to approximately double over the remainder of the decade – a readily achievable build-rate.

IMPACT ON ELECTRICITY PRICES

A 100 per cent renewable powered system would necessitate an increased build out of around 500 – 600 MW of new capacity each year – about 150 MW per annum more renewables than the ALP scenario, but slightly less than the built rate we are currently witnessing.

While the pace of large-scale solar and wind development could be slightly less than the current boom, the building of distributed solar and energy storage may increase above current rates with targeted policy support.

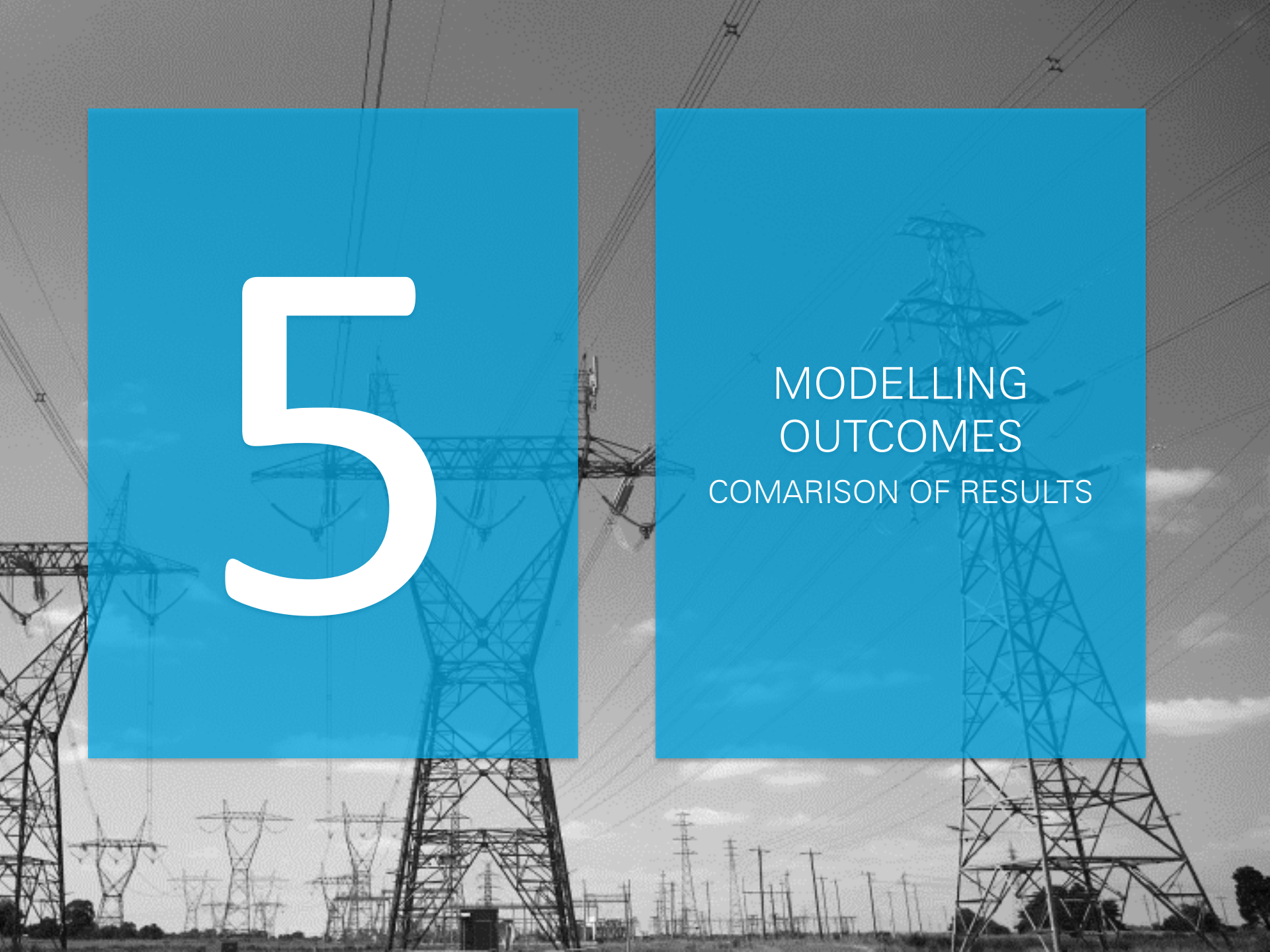
Additional peaking capacity would also be needed earlier to provide capacity support for morning and evening ramp ups and seasonal peak demand.

New investment should also encompass a wider variety of technologies - in addition to Victoria's strong onshore wind – with new opportunities for biomass-based plants - when there is a low-cost fuel supply – would provide dispatchable energy on seasonal basis, especially as coal capacity is mothballed and/or eventually closed.

Falling capital costs and/or public investments are also expected to support hundreds of MW of new dispatchable renewable generation, which our modelling implies is likely to shift toward firmed solar by 2025.

Under such a scenario, Victorian electricity generation is projected to grow to almost 65 per cent renewables by 2025, at prices less than today's levels, ranging between $70 and $84 per MWh to 2025. This is higher than the ALP scenario, with more dispatchable renewable capacity needed to replace closing brown coal-fired units. Alternatively, the Greens price projection compares favourably to the Coalition scenario, as a much higher portion of the energy comes from generation with lower fuel costs, and increasing competition enters the market due to a larger amount of power generating capacity.

Not reflected in this modelling is the need for detailed coordination to support the orderly closure of Victoria's three major coal fired generators by the end of the decade in the face of major public investments in generation. This would be required to provide developers with certainty about how much new capacity is required, and when, as coal-fired capacity closes.



5

MODELLING OUTCOMES

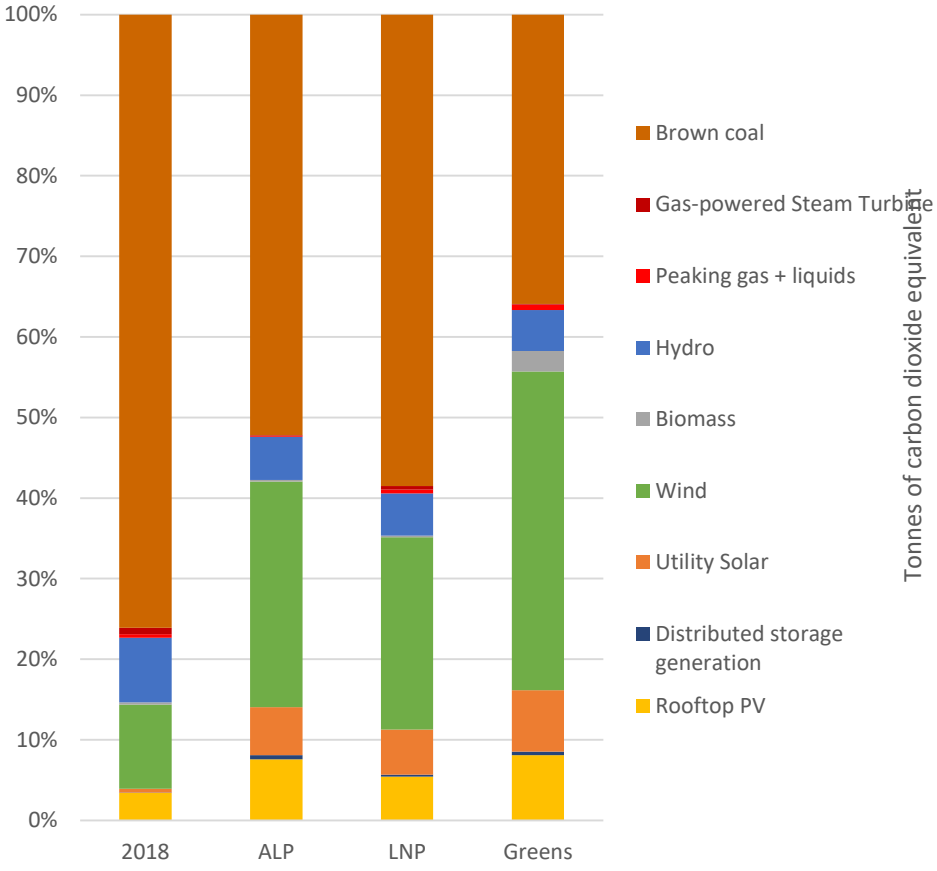
COMARISON OF RESULTS

ALL SCENARIOS

THE IMPACT OF ALL SCENARIOS ON NEM EMISSIONS

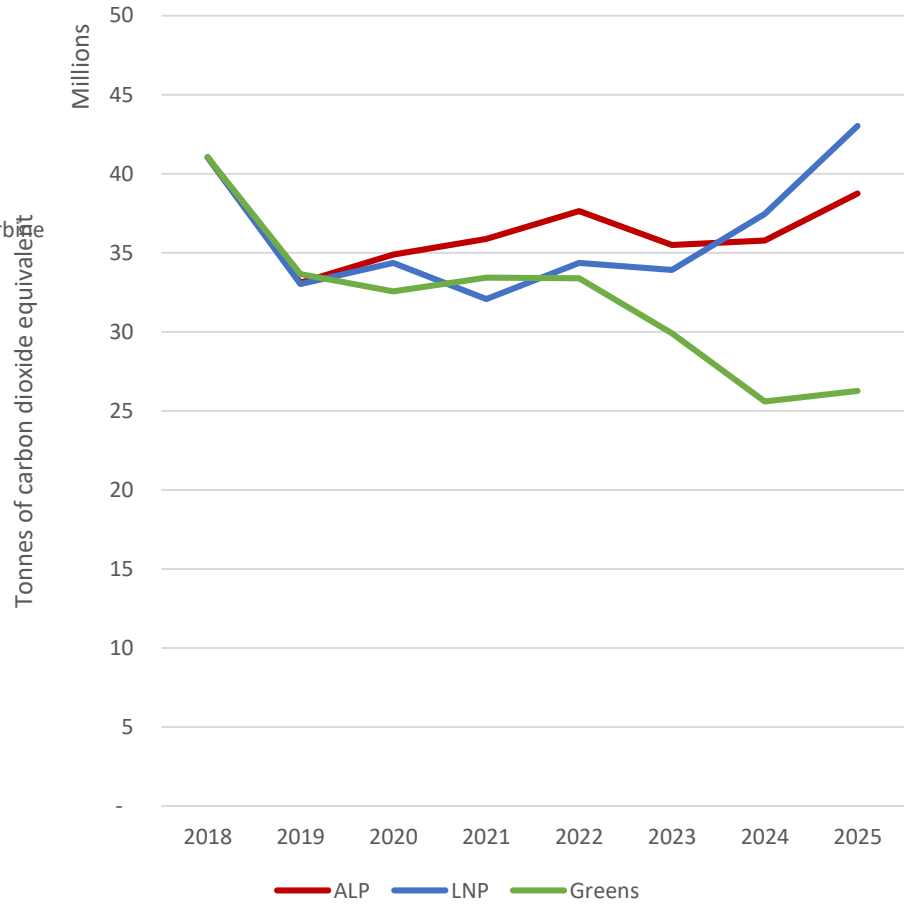
Figure 17: Victoria generation – ALP, Coalition, and Greens Scenarios in 2025.

Note: Victorian generation grows 35% over 2018, such that Victoria is modelled to be a stronger energy exporter by 2025.



Source: RepuTex Energy, 2018

Figure 18: NEM emissions – ALP, Coalition, and Greens Scenarios in 2025

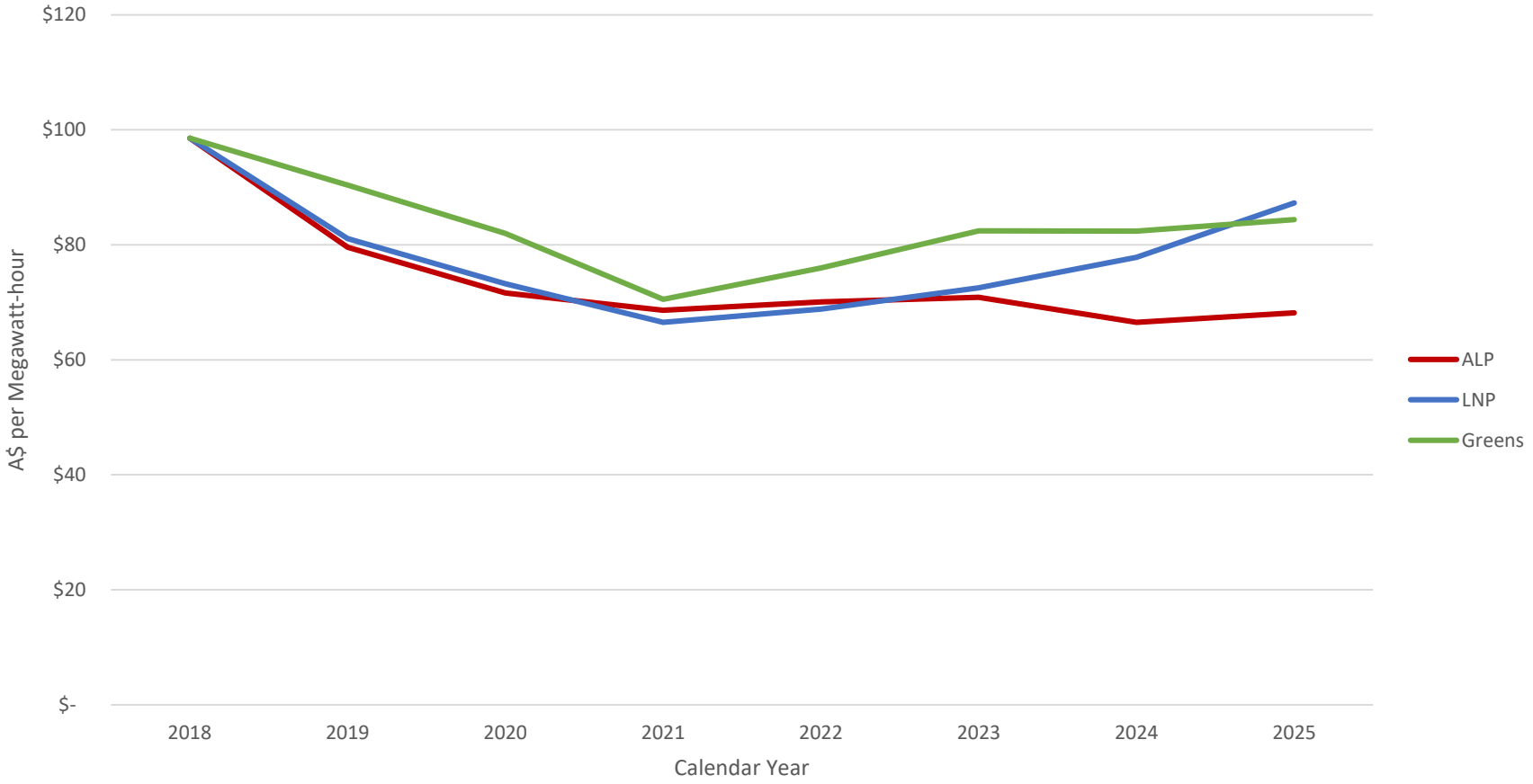


Source: RepuTex Energy, 2018

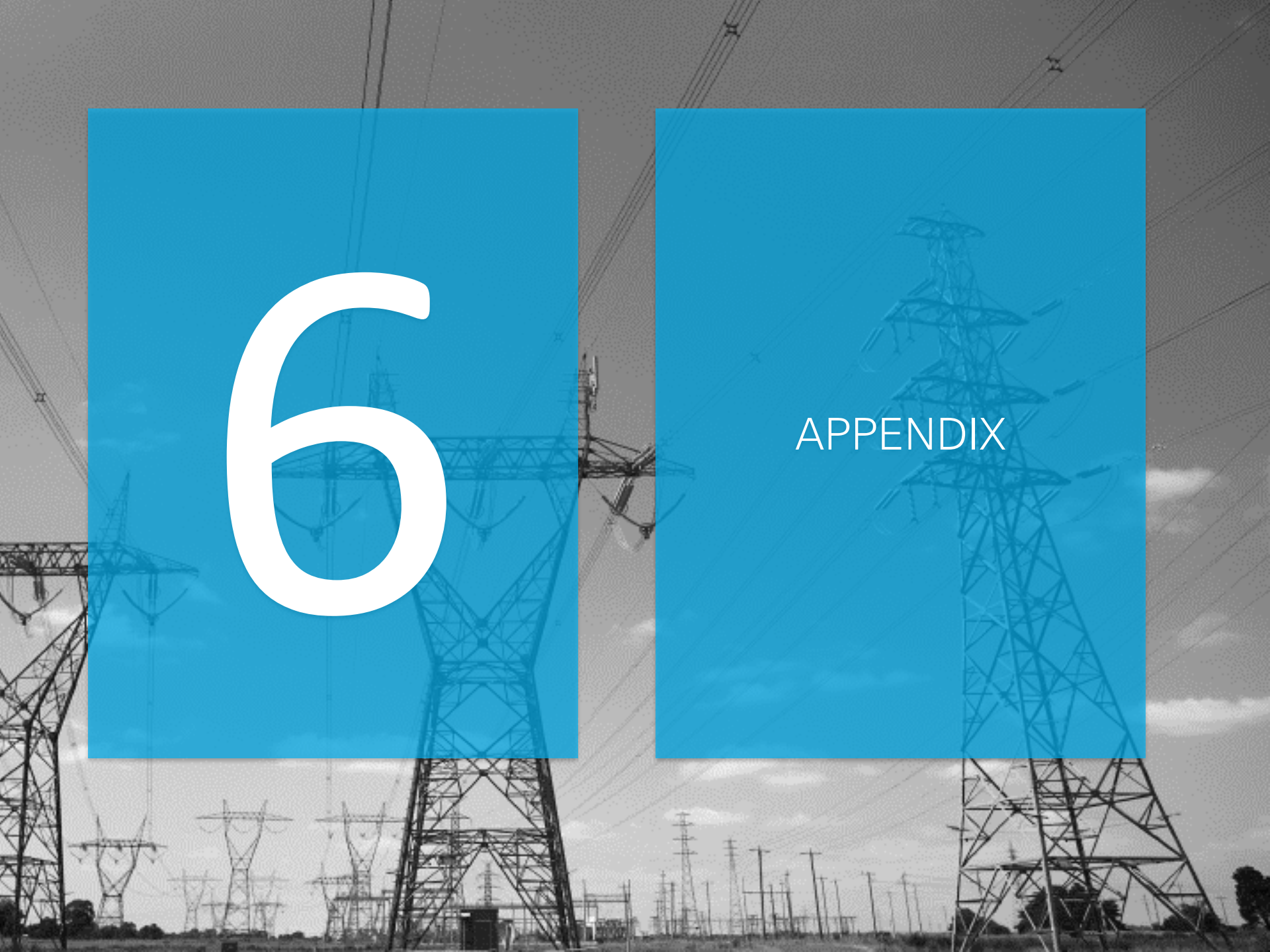
ELECTRICITY PRICE SCENARIOS

THE IMPACT OF EMISSIONS TARGET ON ELECTRICITY PRICES

Figure 19: Electricity price scenarios (Victoria) – ALP, LNP, and Greens Scenarios



Source: RepuTex Energy, 2018



6

APPENDIX

ABOUT REPUTEX

PRICING INSIGHTS FOR THE AUSTRALIAN ENERGY MARKET

COMPANY OVERVIEW

» RepuTex is a leading provider of independent analysis and pricing insights for the Australian renewable energy, power and emissions markets.

» We have worked with over 150 customers across Australia and the Asia-Pacific, including large energy users and emitters, offtakers and project developers, financials and government departments & agencies.

» Since 1999, our insights have become a key reference point for the market, providing our customers with an advanced perspective on the impact of new forces – such as renewable penetration, new energy storage technology and emissions contracting – on price formation and market development.

» Our focus is on data-driven insights: In doing so, we draw on our proprietary advanced analytics models to provide our customers with a deeper perspective on evolving market risk and pricing patterns.

» We have offices in Melbourne and Hong Kong, supported by a team of analysts with backgrounds in econometrics, statistics, commodities & policy.

» The company is a winner of the China Light and Power-Australia China Business Award for research across Asia-Pacific.

To learn more, please visit www.reputex.com

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