ACIL ALLEN CONSULTING

REPORT TO
DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING
AUGUST 2019

VICTORIAN RENEWABLE ENERGY TRANSITION

ECONOMIC IMPACTS MODELLING

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C O N T E N T S

C O N T E N T S

BOXES

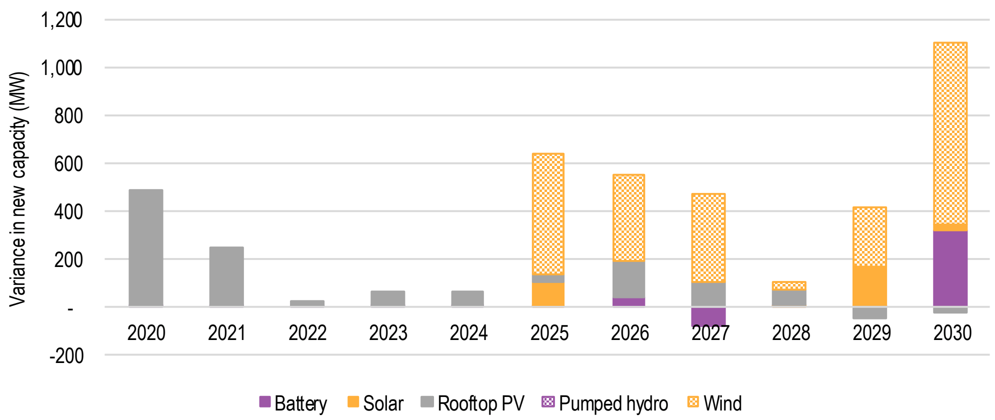
EXECUTIVE SUMMARY

ACIL Allen Consulting (ACIL Allen) has been engaged by the Department of Environment, Land, Water and Planning (the Department) to undertake Input-Output (I-O) modelling to estimate the economic impacts of investment in the transition of Victoria's electricity generation sector.

The Department has undertaken energy market modelling of two future pathways modelled for the transition – Business as Usual and the 50 per cent by 2030 Victorian Renewable Energy Target (VRET 2030). The projected investment in new energy generation capacity to 2030 under each of these scenarios is illustrated in Figure ES 2.

Figure ES 1 compares the investment in renewables under the two cases. It shows that, in the early years (2020-24), there is more investment in rooftop solar under the VRET 2030 case than under Business as Usual and in the later years there is more investment in wind. In aggregate, there is more investment in renewables under VRET 2030 (9,683 MW) than under Business as Usual (5,667 MW).

FIGURE ES 1 PROJECTED INVESTMENT IN NEW GENERATION CAPACITY TO 2030 – VARIANCE BETWEEN VRET 2030 AND BUSINESS AS USUAL

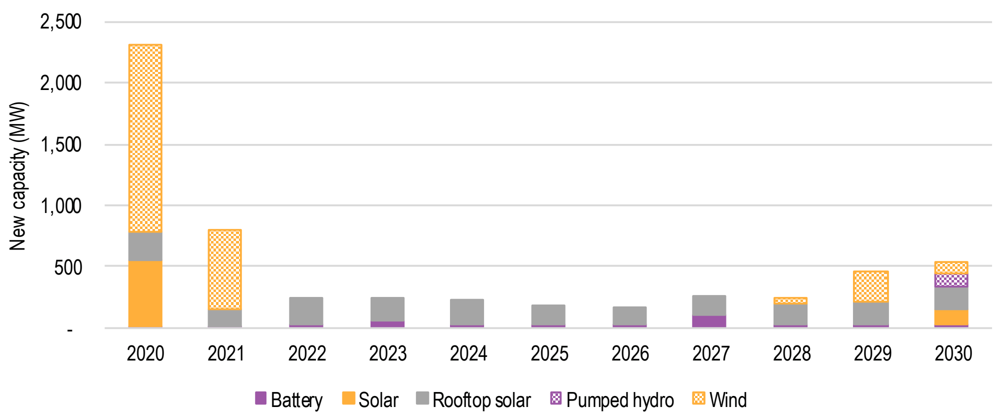


Note: While the energy market modelling and this economic modelling has been undertaken to 2050, the new generation capacity to 2030 only has been illustrated as this is the period under consideration for the 2030 Victorian renewable energy target.

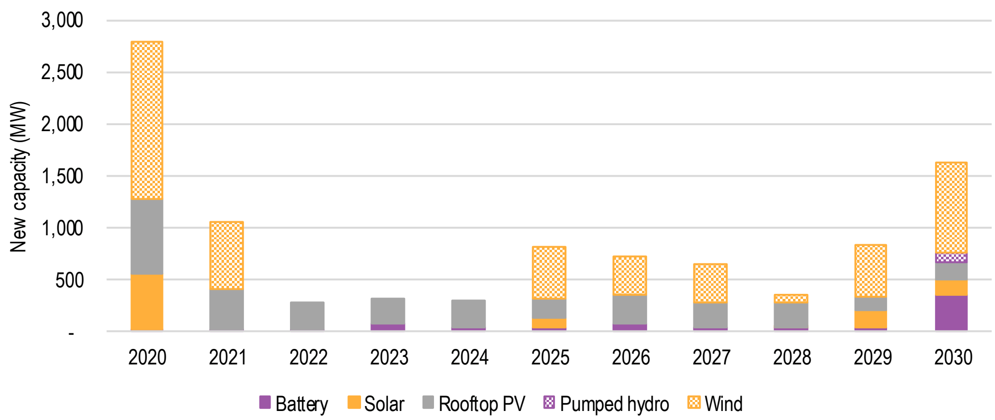
SOURCE: DEPARTMENT'S MODELLING

FIGURE ES 2 PROJECTED INVESTMENT IN NEW GENERATION CAPACITY TO 2030

A. Business as Usual



B. VRET 2030



SOURCE: DEPARTMENT'S MODELLING

Overview of I-O modelling

I-O modelling assesses the contribution a sector makes to the economy to analyse the potential impacts of a change in production of a particular sector, in this case, by the construction of renewable generation capacity in Victoria.

The standard measure of economic contribution is the extent to which it increases the value of goods and services generated by the economy as a whole – in other words, the extent to which it increases economic activity as measured by gross regional, state or domestic product (GRP, GSP or GDP). An economy has a range of factors of production (including labour and capital stock) and access to various intermediate inputs. By using the factors of production appropriately, industries add value to intermediate inputs by converting them into a range of goods and services more suited for use by consumers or other industries. An industry or business's contribution to GRP, GSP or GDP measures the total value added generated and is defined as the income that an industry or business generates, less the cost of the inputs that it uses to generate that income, plus certain taxes paid.

Indirect effects are a broader notion of the economic contribution. For example, when a transmission line is built, indirect effects are generated by the businesses supplying the component parts, the transporter who made deliveries to site, and the purchase of goods and services by the labour force. To fully measure the indirect effects, account should also be taken of changes in incomes which may feed through to further changes in domestic demand.

The intermediate inputs used by an industry can be sourced either from within the Australian economy or from foreign economies. If purchased from within the Australian economy, then the portion of value added embodied in the intermediate input is indirectly associated with the activity of the purchaser. The calculation of the indirect contribution quickly becomes difficult as one considers that value-added embodied in the intermediate inputs of the intermediate input.

Input-output tables and the associated 'input-output multipliers' can be used to estimate the indirect economic contributions. Input-output multipliers are summary measures generated from input-output tables that can be used to predict the total impact on all industries in the economy of changes in demand for the output of any one industry. The tables and multipliers can also be used to measure the relative importance of the production chain linkages to different parts of the economy.

Assumptions

The capital investment in renewables, other than rooftop PV, was provided to us by the Department and we estimated the capital cost of rooftop PV. We broke down the capital costs by labour, materials and overheads, and by local and imported content, based on information that we have for similar projects.

The Department provided fuel costs, fixed operating costs and variable operating costs by technology. In addition, ACIL Allen was provided with dispatch weighted average electricity prices which allowed for the calculation of the Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA).

ACIL Allen used this information to estimate the economic contribution that the renewable electricity generation industry will make to the Victorian economy over the period to 2030 in terms of both the new investment as well as their ongoing operations through their generation revenues.

The analysis used an updated version of the Economic Impact Analysis Tool (the Tool) built for the Department of Economic Development, Jobs, Transport and Resources in 2015. The Victorian input-output tables and multipliers in the Tool were updated to the 2017-18 financial year. All options associated with the cost of debt or opportunity cost of Federal or State government funding or subsidies were turned off. Hence, the Tool essentially operates like a standard Input Output model.

The I-O modelling results (economic contribution and jobs) are presented for Victoria.

Results from the I-O modelling

The impacts of the investment in new renewable generation capacity on the gross state product of Victoria and on employment (average annual full time equivalent (FTE) jobs) are summarised in Table ES 1 and illustrated in Figure ES 3.

TABLE ES 1 IMPACT OF THE INVESTMENT IN NEW GENERATION CAPACITY TO 2030 ON VICTORIA'S GSP AND JOBS

	Economic contribution (GSP)		Employment contribution	
	Lower	Upper	Lower	Upper
	NPV, $ million, $2019	NPV, $ million, $2019	Average annual FTEs	Average annual FTEs
Business as Usual				
Construction	4,361	7,215	2,935	4,656
Operation and maintenance (over period to 2030)	8,259	10,033	2,821	3,961
Total	**12,620**	**17,247**	**5,756**	**8,618**
VRET 2030				
Construction	7,404	12,254	5,098	8,092
Operation and maintenance (over period to 2030)	8,754	10.790	3,270	4.592
Total	**16,158**	**23,045**	**8,367**	**12,684**
Difference between Business as Usual and VRET 2030 cases				
Total	**3,537**	**5,797**	**2,612**	**4,067**

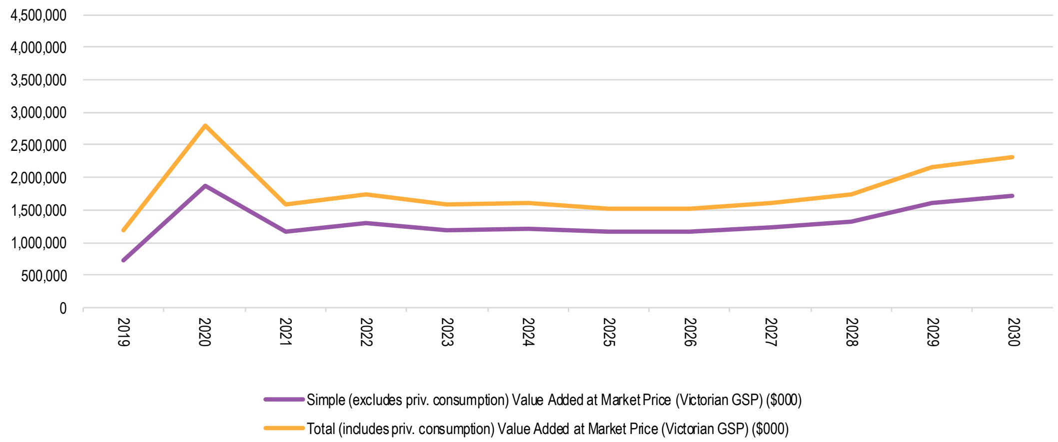
Notes:

1. Lower bound represents the simple I-O multiplier and upper bound represents the total I-O multiplier
2. NPV calculated using a 4 per cent discount rate
3. The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed
4. Totals may not add due to rounding

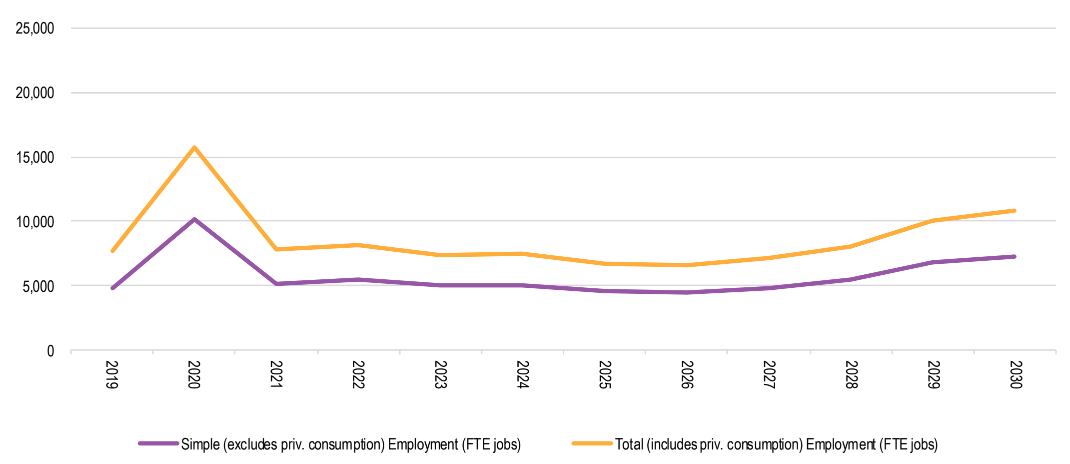
SOURCE: ACIL ALLEN MODELLING

FIGURE ES 3 IMPACT OF THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030

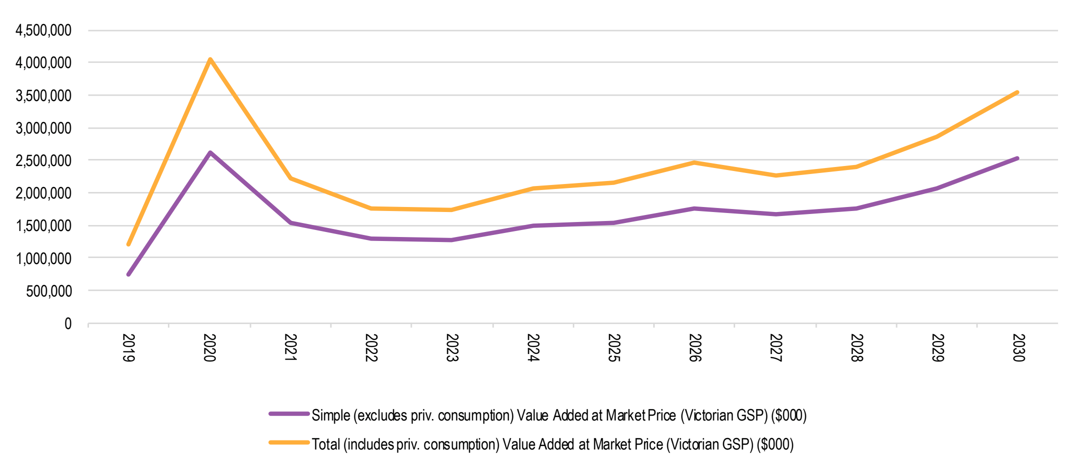
A. Economic contribution, Business as Usual



B. Employment contribution, Business as Usual



C. Economic contribution, VRET 2030



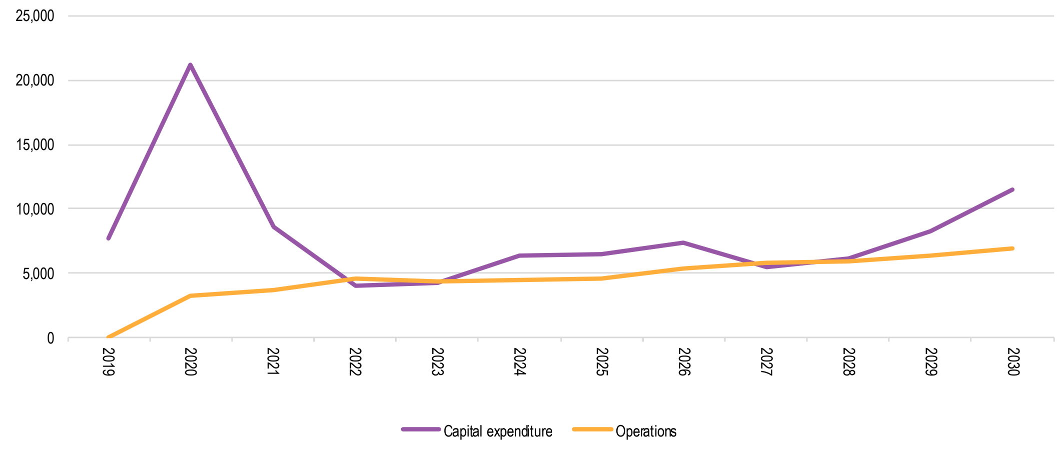
D. Employment contribution, VRET 2030

SOURCE: ACIL ALLEN MODELLING

The contribution of investment in new renewable energy capacity to the Victorian economy and jobs is greater under the VRET 2030 than Business as Usual, driven by the higher level of investment in renewables.

Figure ES 4 illustrates how the employment contribution (number of FTE jobs) varies over time for the upper bound (which represents the total I-O multiplier) of the VRET 2030 case. While the employment contribution from operations increases steadily over time, the employment contribution during the construction phase (from the capital expenditure) varies over time in line with the lumpiness of the investment profile. The employment contribution profile for the lower bound of the VRET 2030 case and for Business as Usual will be similar, albeit at a lower level.

FIGURE ES 4 EMPLOYMENT CONTRIBUTION (FTE JOBS), VRET 2030 CASE, UPPER BOUND, TO 2030



SOURCE: ACIL ALLEN MODELLING

While the employment contribution varies from year to year, the employment contribution in Table ES 1 is expressed in terms of the average number of FTEs per year.

If we assume that each person employed is employed for a period of two years, then the number of two year jobs created is equal to the total number of FTEs over the 12 year period from 2019 to 2030, divided by two. The number of two year jobs created is set out in Table ES 2.

TABLE ES 2 IMPACT OF THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030 ON VICTORIA'S JOBS (TWO YEAR JOBS)

	Lower	Upper
	Number of two year jobs	Number of two year jobs
Business as Usual		
Construction	17,608	27,939
Operation and maintenance (over period to 2030)	16,926	23,767
Total	**34,534**	**51,706**
VRET 2030		
Construction	30,586	48,554
Operation and maintenance (over period to 2030)	19,617	27,553
Total	**50,204**	**76,107**
Difference between Business as Usual and VRET 2030 cases		
Total	**15,669**	**24,400**

Notes:

1. Lower bound represents the simple I-O multiplier and upper bound represents the total I-O multiplier
2. The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed
3. Totals may not add due to rounding

SOURCE: ACIL ALLEN MODELLING

Limitations of I-O modelling

The key limitations of I-O modelling are:

1. Static modelling – the modelling is based on a snapshot of an economy in a given period, with the structure of the economy assumed to remain fixed over time – prices remain constant, technology is fixed in all industries, and import shares are fixed.
2. Resources, including labour and capital, are assumed to be unlimited – it is assumed that all required resources are available, regardless of the size of the development, and there is no competition between industries for these resources.
3. I-O analysis provides an estimate of the economic contribution of a facility or industry, not a measurement of economic impact if the facility or industry shut down or did not exist.
4. Impact of change in electricity prices – this modelling has not assessed the impact of additional renewable generation capacity in Victoria on electricity prices and the impact of any change in price on the economy. However, we note from the wholesale electricity prices provided to us by the Department that the wholesale electricity prices are projected to be lower under the VRET 2030 case than under Business as Usual.

1 INTRODUCTION

The Victorian Government is committed to increasing the proportion of renewable energy in the state's electricity generation mix. In June 2016, it committed to Victorian renewable energy targets of 25 per cent by 2020 and 40 per cent by 2025, which have been legislated through the *Renewable Energy (Jobs and Investment) Act 2017*.

In November 2018, the Victorian Government committed to increasing Victoria's renewable energy target to 50 per cent of Victoria's electricity generation.

In December 2018, the Victorian Government commissioned energy market modelling of alternative policy pathways for the transition of Victoria's electricity generation sector to 2030 to support government decision making in relation to Victoria's renewable energy targets. This energy market modelling assessed the impacts of these policy pathways on key energy market variables including electricity generation, electricity generation capacity, wholesale electricity prices and greenhouse gas emissions.

Purpose and structure of this report

ACIL Allen Consulting (ACIL Allen) has been engaged by the Department of Environment, Land, Water and Planning (the Department) to undertake Input-Output (I-O) modelling to estimate the economic impacts of achieving Victoria's 2025 and 2030 renewable energy targets. This work will help the Department understand the potential impacts of Victoria's renewable energy targets on jobs and investment in Victoria's energy sector over the period to 2030.

This report describes the methodology and assumptions for the I-O modelling in chapter 2, with the results from the modelling presented in chapter 3.

Further detail is provided in spreadsheets that accompany this report. While this report presents the results of the modelling to 2030, the spreadsheets provide the results to 2050.

2 METHODOLOGY AND ASSUMPTIONS

This chapter describes the I-O modelling and the key assumptions that have been used in the analysis.

2.1 Overview of I-O modelling

I-O modelling assesses the contribution a sector makes to the economy to analyse the potential impacts of a change in production of a particular sector, in this case, by the construction of renewable generation capacity in Victoria.

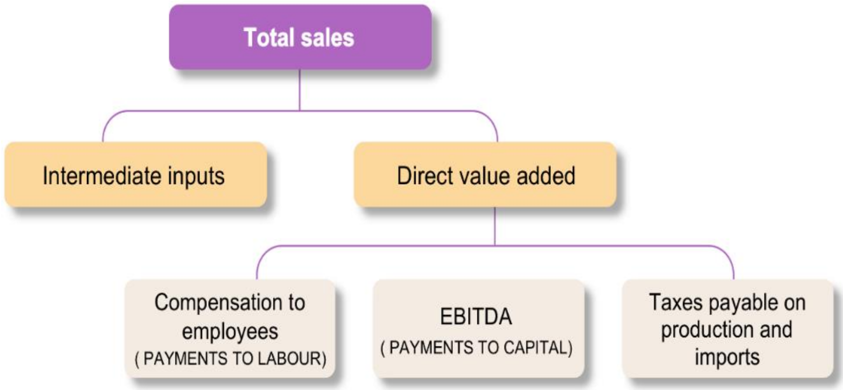
2.1.1 Direct economic contribution

The standard measure of economic contribution is the extent to which it increases the value of goods and services generated by the economy as a whole – in other words, the extent to which it increases economic activity as measured by gross regional, state or domestic product (GRP, GSP or GDP). An economy has a range of factors of production (including labour and capital stock) and access to various intermediate inputs. By using the factors of production appropriately industries add value to intermediate inputs by converting them into a range of goods and services more suited for use by consumers or other industries. An industry or business' contribution to GDP measures the total value added generated and is defined as the income that an industry or business generates, less the cost of the inputs that it uses to generate that income, plus certain taxes paid.

The direct contribution of an industry or a company to the Australian economy can therefore be estimated by determining their payments to the factors of production plus the taxes (less subsidies) payable on production and imports. This is shown graphically in Figure 2.1.

Box 2.1 provides a summary of the definitions used by the Australian Bureau of Statistics (ABS) as part of the System of National Accounts (SNA).

FIGURE 2.1 CALCULATION OF DIRECT VALUE ADDED



Note: EBITDA is equivalent to the SNA93 definition of gross operating surplus

SOURCE: ACIL ALLEN CONSULTING

BOX 2.1 ABS DEFINITIONS OF VALUE ADDED

An industry's direct contribution to Gross Domestic Product or Gross State Product is well defined under the standard national accounting framework used by the Australian Bureau of Statistics (ABS), which is known as the System of National Accounts (SNA). SNA recognises three different measures of value added:

a) Value added at Purchasers' Prices. This is defined as output valued at purchasers' prices, less intermediate consumption valued at producer prices. This measure is equivalent to the traditional measure of value added at market prices.
b) Value added at Basic Prices. In this measure, the output is valued at basic prices while intermediate consumption is valued at producer prices. In the case of beer production this measure excludes beer excise as they are viewed as production taxes levied on output.
c) Value added at factor Cost. This measure excludes all production taxes net of subsidies. In other words, it excludes all production taxes – such as payroll taxes, fringe benefit taxes etc – and not just those that are levied on output.

The measure of value added to be used depends on the nature of the analysis that is to be conducted. When presenting an industry view of GDP for example, the ABS uses value added at basic prices and adds an aggregate estimate of net taxes on products in question to give a total measure of GDP at purchasers' prices (ABS Cat no. 5216).

SOURCE: ACIL ALLEN CONSULTING

2.1.2 Indirect economic contribution

Indirect effects are a broader notion of the economic contribution. For example, when a transmission line is built, indirect effects are generated by the businesses supplying the component parts, the transporter who made deliveries to site, and the purchase of goods and services by the labour force. To fully measure the indirect effects, account should also be taken of changes in incomes which may feed through to further changes in domestic demand.

The intermediate inputs used by an industry can be sourced either from within the Australian economy or from foreign economies. If purchased from within the Australian economy, then the portion of value added embodied in the intermediate input is indirectly associated with the activity of the purchaser. The calculation of the indirect contribution quickly becomes difficult as one considers that value-added embodied in the intermediate inputs of the intermediate input.

Input-output tables and the associated 'input-output multipliers' can be used to estimate the indirect economic contributions. Input-output multipliers are summary measures generated from input-output tables that can be used for predicting the total impact on all industries in the economy of changes in demand for the output of any one industry. The tables and multipliers can also be used to measure the relative importance of the production chain linkages to different parts of the economy.

It should be noted that some of the assumptions underpinning input-output multipliers can be an impediment to credible analysis. Understanding these assumptions is necessary to prevent the inappropriate application of input-output multipliers – for example, in situations where economic constraints are present or when the profile of a business or project differs substantially from the industry average. We do not consider that these conditions apply for the purpose of this analysis and that the use of input-output multipliers to estimate the economic contribution of additional renewable generation capacity in Victoria is appropriate.

Further information on input-output tables and the calculation of multipliers can be found in ABS Catalogue number 5246.0.

2.1.3 Lower and upper bounds

In this report we have estimated the likely lower and upper bounds of the indirect economic contribution of additional renewable generation capacity in Victoria.

The lower bound estimate, derived from the 'Simple Multipliers', captures only the value added and employment associated with the supply chain of each purchase stream (see below for details). Consequently, they provide a conservative estimate – or lower level bound – of the indirect economic contribution of intermediate inputs. The difference between these estimates and the direct economic contribution are commonly referred to as the 'production induced' contribution. The estimates from simple multipliers indicates the embodied economic contribution of alternative production chains, which are additive and should sum to the national accounts estimates of gross state product and gross domestic product.

The upper bound estimate of the impact of additional renewable generation capacity in Victoria, derived using 'Total Multipliers', captures all of the effects of inter-industry interactions and also captures the impacts of the purchasing decisions made by workers employed throughout the construction and operation periods. This effect is commonly referred to as the 'consumption induced effect'.

When properly calculated[1], the lower bound estimates of a given project or industry are additive with the lower bound estimates for other non-overlapping projects or industries (such as beef, beverages, petroleum, aluminium, etc.) and will never add to more than Australia's total GDP, household income or employment. While the lower bound estimates of the footprint of the project are useful for many contexts, they are a conservative estimate of the total economic activity or employment that could be affected by the project, particularly at the regional level. In light of this, the upper bound estimates provide a useful upper bound on the total amount of economic activity or employment that is likely to be touched by the project in some manner.

2.2 Overview of I-O tables

Input-output tables provide a snapshot of an economy at a particular time. The tables used in this analysis were for the 2017-18 financial year.

Input-output tables can be used to derive input-output multipliers. These multipliers show how changes to a given part of an economy impact on the economy as a whole. A full set of input-output multipliers for Victoria were estimated for the purpose of this analysis.

The input-output multipliers allow rigorous and credible analysis of the economic footprint of a particular facility, industry or event for the region of interest. Although input-output multipliers may also

[1] In particular, it is important to avoid double counting related to the intra-sectoral purchases and vertical supply chain activities. For example, when adding the impact of related industries (where industry A supplies to industry B, for example) it is necessary to not include the value of A's sales to B when calculating industry B's contribution. In reality, ensuring that industries are completely non-overlapping is complex and certain simplifying assumptions would generally need to be made.

be suitable tools for analysing the impact of various types of economic change, caution needs to be adopted in their application for this purpose. Misuse of input-output multipliers for the purpose of impact analysis has led to scepticism of their general use in favour of other tools such as computable general equilibrium (CGE) modelling. Notwithstanding this, they are still eminently suitable for understanding the economic linkages between a given facility or industry to gain an appreciation of the wider interactions of the industry beyond its direct contribution.

2.3 Multiplier types

Input-output multipliers estimate the economic impact on a region's economy from a one dollar change in the final demand for the output of one of the region's industries. Generally, four types of multipliers are used:

- output – measures the impact on the output of all industries in the economy
- income – measures the effect on the wages and salaries paid to workers within the economy
- employment – measures the jobs creation impact
- value-added – measures the impact on wages and salaries, profits and indirect taxes.

The sum of wages and salaries, profits and indirect taxes for a given industry provides a measure of its contribution to the size of the local economy – its contribution to gross regional product (GRP). The value added multiplier can therefore also be considered to be the GRP multiplier.

Input-output multipliers are a flexible tool for economic analysis. Their flexibility stems from the different forms of each multiplier type. For each region, multipliers were estimated in the following forms:

- initial effects
- first round effects
- industrial support effects
- production induced effects
- consumption induced effects
- simple multipliers
- total multipliers
- type 1A multipliers
- type 1B multipliers
- type 2A multipliers
- type 2B multipliers.

The above multiplier types are defined in full in ABS Catalogue No. 5246 for output, income, employment and value-added multipliers; however, a brief overview of the different types of output multipliers is presented below.

2.3.1 Multiplier effects

When additional sales to final demand are made, for example through increased exports or sales to the public, production increases to meet the increased demand, and this is the initial effect. Since production increases to exactly match the increased final demand, the increase is always equal to one (noting that the multipliers are defined in terms of a one dollar increase in final demand).

The industry producing the additional output makes purchases to enable itself to increase production, these new purchases are met by production increases in other industries and these constitute the first round effect. These first round production increases cause other industries to also increase their purchases, and these purchases cause other industries to increase their production, and so on. These 'flow-on' effects eventually diminish, but when 'added together constitute the industrial support effect.

The industrial support effect added to the first round effect is known as the production induced effect. So far this chain of events has ignored one important factor, the effect on labour and its consumption. When output increases, employment increases, and increased employment translates to increased earnings and consumption by workers, and this translates to increased output to meet the increased consumption. This is the consumption effect.

2.3.2 Multipliers

The simple and total multipliers are derived by summing the effects. The simple multiplier is the sum of the initial and production induced effects. The total multiplier is larger, because it also adds in the consumption effect. So far all the effects and multipliers listed have had one thing in common, they all measure the impact on the economy of the initial increase in final demand.

The remaining multipliers take a different point of view, they are ratios of the above multiplier types to the initial effect. The type 1A multiplier is calculated as the ratio of the initial and first round effects to the initial effect, while the type 1B multiplier is the ratio of the simple multiplier to the initial effect. The type 2A multiplier is the ratio of the total multiplier to the initial effect, while the type 2B multiplier is the ratio of the total multiplier less the initial effect to the initial effect.

Given the large number of multiplier types to choose from, output, income, employment and value added multipliers, and each with numerous variations (simple, total, type 2A, etc) it is important that the analysis uses the most appropriate multipliers. Usually, the multipliers that include consumption effects (i.e. the added impact that comes from wage and salaries earners spending their income) are used. These are the total and type 2A multipliers. The total and type 2A multipliers will generally provide the biggest projected impact. Simple or type 1B (which omit the consumption effect) may be used to provide a more conservative result.

2.4 Limitations of input-output analysis

Although input-output analysis is valid for understanding the contribution a sector makes to the economy, when used for analysing the potential impacts of a change in production of a particular sector, input-output analysis is not without its limitations. Input-output tables are a snapshot of an economy in a given period, the multipliers derived from these tables are therefore based on the structure of the economy at that time, a structure that it is assumed remains fixed over time. When multipliers are applied, the following is assumed:

- prices remain constant
- technology is fixed in all industries
- import shares are fixed.

Therefore, the changes predicted by input-output multipliers proceed along a path consistent with the structure of the economy described by the input-output table. This precludes economies of scale. That is, no efficiency is gained by industries getting larger – rather they continue to consume resources (including labour and capital) at the rate described by the input-output table. Thus, if output doubles, the use of all inputs doubles as well.

One other assumption underpinning input-output analysis which is worth considering is that there are assumed to be unlimited supplies of all resources, including labour and capital. With input-output analysis, resource constraints are not a factor. It is thus assumed that no matter how large a development, all required resources are available, and that there is no competition between industries for these resources.

It is important to understand the limitations of input-output analysis, and to remember that the analysis provides an estimate of economic contribution of a facility or industry, not a measurement of economic impact if the facility or industry shut down or did not exist.

2.5 Assumptions

The Department has undertaken energy market modelling to 2050 of two future pathways – Business as Usual and the 50 per cent by 2030 Victorian Renewable Energy Target (VRET 2030). The projected investment in new energy generation capacity to 2030 under each of these scenarios is illustrated in Figure 2.2.

Pane C in Figure 2.2 compares the investment in renewables under the two cases. It shows that, in the early years (2020-24), there is more investment in rooftop solar under the VRET 2030 case than under Business as Usual, and in the later years there is more investment in wind. In aggregate, there is more investment in renewables under VRET 2030 (9,683 MW) than under Business as Usual (5,667 MW).

FIGURE 2.2 PROJECTED INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030

Note: While the energy market modelling and this economic modelling has been undertaken to 2050, the new generation capacity to 2030 only has been illustrated as this is the period under consideration for the 2030 Victorian renewable energy target.

SOURCE: DEPARTMENT'S MODELLING

The capital investment in renewables, other than rooftop PV, was provided to us by the Department. We estimated the capital cost of rooftop PV. The capital cost of solar, pumped hydro and wind are similar, with the capital cost of rooftop PV slightly higher and of battery technology significantly lower.

We broke down the capital costs by labour, materials and overheads, and by Victoria and non-Victorian content, based on information that we have for similar projects. A summary of the breakdown of the capital costs by technology is provided as Table 2.1.

TABLE 2.1 BREAKDOWN OF THE CAPITAL COSTS, BY TECHNOLOGY

Commodity / service	Battery	Solar	Rooftop PV	Pumped hydro	Wind
Victorian content					
Site acquisition cost	0.5%	2.8%	0.0%	0.5%	3.0%
On-site labour	7.4%	14.8%	27.6%	19.9%	12.3%
Other materials and services	30.4%	33.6%	40.7%	53.0%	30.0%
Total Victorian content	**38.3%**	**51.2%**	**68.3%**	**73.4%**	**45.3%**
Non-Victorian content					
Imported content (interstate and international)	61.7%	48.8%	31.7%	29.6%	54.7%

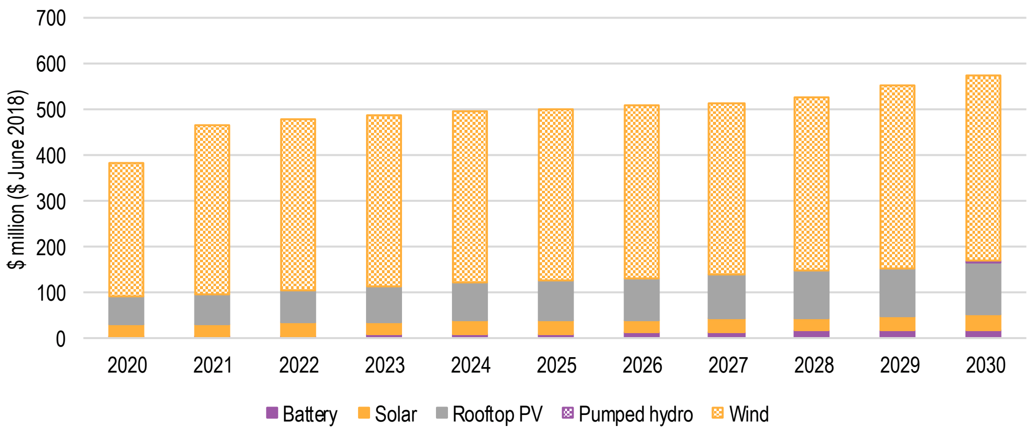
Note: Totals may not add due to rounding

SOURCE: ACIL ALLEN ANALYSIS

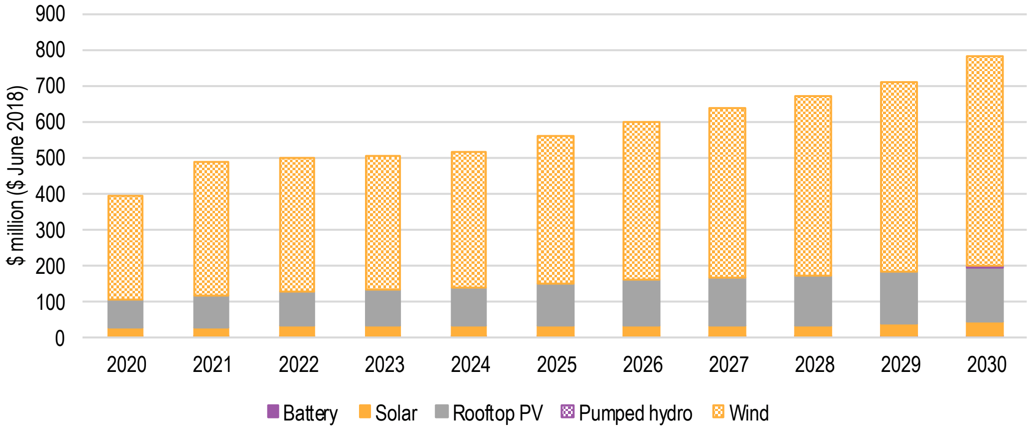
The Department provided the operating costs by technology for battery, solar, pumped hydro and wind. We assumed that the operating costs for rooftop PV are the same on a per MW basis as for large scale solar. The operating costs are illustrated by technology for the Business as Usual and VRET 2030 case in Figure 2.3.

FIGURE 2.3 OPERATING COSTS BY TECHNOLOGY, TO 2030

A. Business as Usual



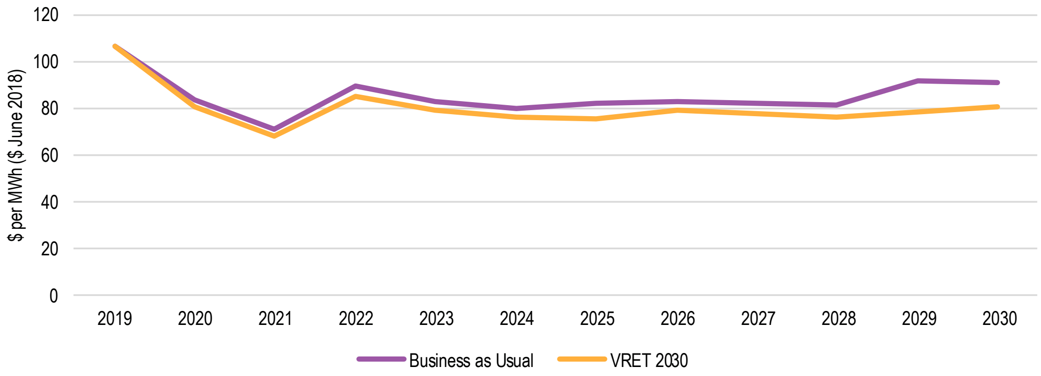
B. VRET 2030



SOURCE: ACIL ALLEN ANALYSIS BASED ON DEPARTMENT'S MODELLING

In addition, we were provided with time weighted and dispatch weighted average electricity prices which allowed for the calculation of the Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA) based on the output from the renewable generators. The time weighted prices for Business as Usual and the VRET 2030 case are illustrated in Figure 2.4 and the output from the renewable generators, by technology, is illustrated in Figure 2.5.

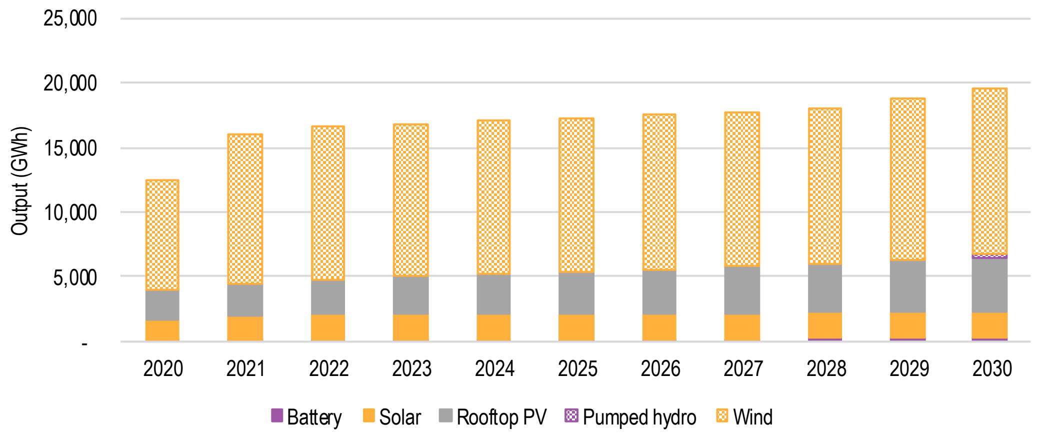
FIGURE 2.4 TIME WEIGHTED WHOLESALE ELECTRICITY PRICES, 2019-30



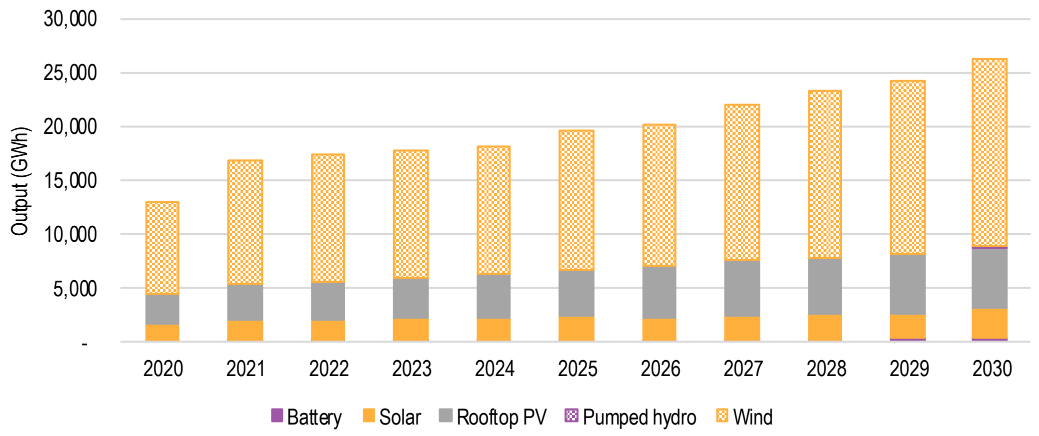
SOURCE: DEPARTMENT'S MODELLING

FIGURE 2.5 OUTPUT (AS GENERATED), BY TECHNOLOGY, 2020-30

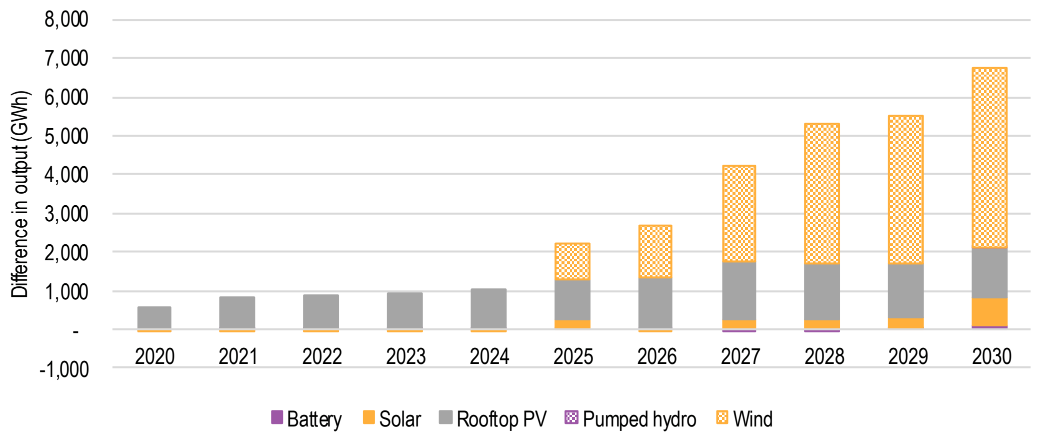
A. Business as Usual



B. VRET 2030



C. Variance between Business as Usual and VRET 2030



SOURCE: ACIL ALLEN ANALYSIS OF DEPARTMENT'S MODELLING

We used this information to estimate the economic contribution that the renewable electricity generation industry will make to the Victorian economy over the period to 2030 in terms of both the new investment as well as their ongoing operations through their generation revenues.

The analysis used an updated version of the Economic Impact Analysis Tool (the Tool) built for the Department of Economic Development, Jobs, Transport and Resources in 2015. The Victorian input-output tables and multipliers in the Tool were updated to the 2017-18 financial year. All options associated with the cost of debt or opportunity cost of Federal or State government funding or subsidies were turned off. Hence, the Tool essentially operates like a standard Input Output model.

The I-O modelling results (economic contribution and jobs) are presented for Victoria.

3 RESULTS

This chapter sets out the results of the I-O modelling. The economic contribution from the additional investment in renewable energy generation under Business as Usual and the VRET 2030 case is provided in section 3.1 and the employment contribution is provided in section 3.2.

3.1 Economic contribution

The contribution to the Victorian economy of the investment in new renewable generation capacity is summarised in Table 3.1 and illustrated in Figure 3.1.

TABLE 3.1 CONTRIBUTION TO THE VICTORIAN ECONOMY FROM THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030

	Lower	Upper
	NPV, $ million, $2019	NPV, $ million, $2019
Business as Usual		
Construction	4,361	7,215
Operation and maintenance (over period to 2030)	8,259	10,033
Total	**12,620**	**17,247**
VRET 2030		
Construction	7,404	12,254
Operation and maintenance (over period to 2030)	8,754	10,790
Total	**16,158**	**23,045**
Difference between Business as Usual and VRET 2030		
Total	**3,537**	**5,797**

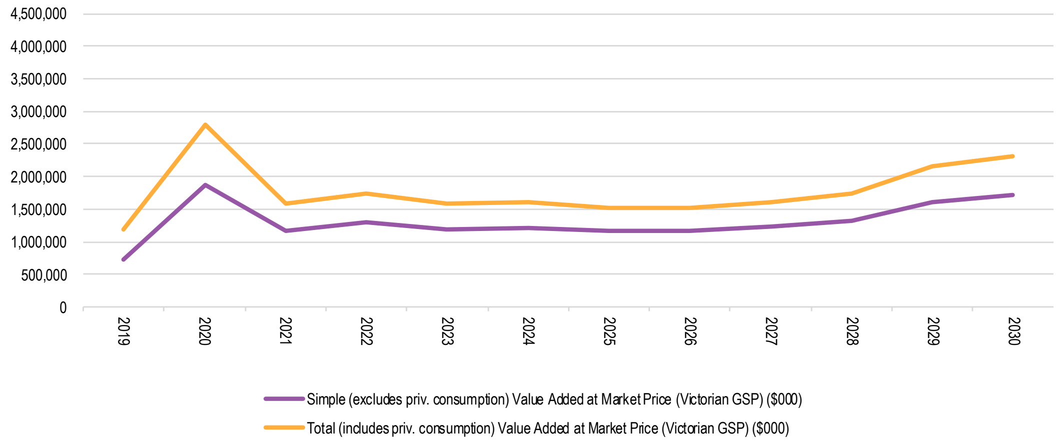
Notes:

1. Lower bound represents the simple I-O multiplier and upper bound represents the total I-O multiplier
2. NPV calculated using a 4 per cent discount rate
3. The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed
4. Totals may not add due to rounding

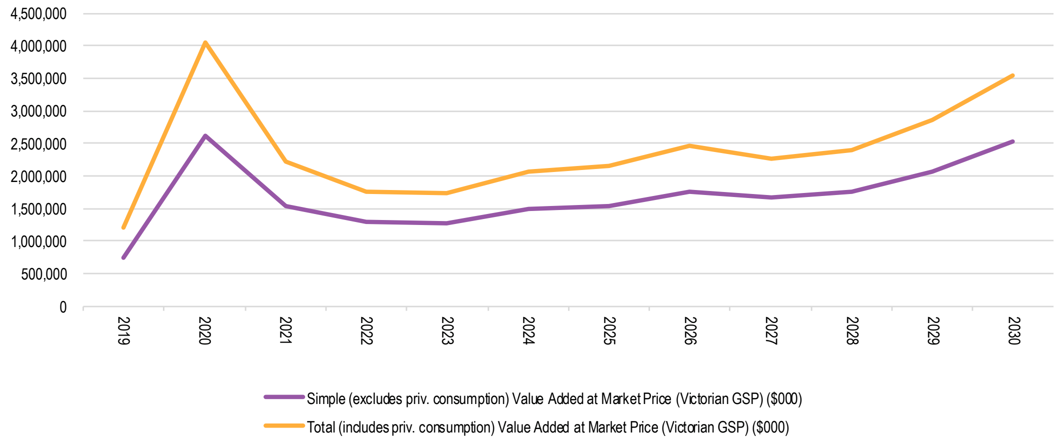
SOURCE: ACIL ALLEN MODELLING

FIGURE 3.1 CONTRIBUTION TO THE VICTORIAN ECONOMY FROM INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030

A. Business as Usual



B. VRET 2030



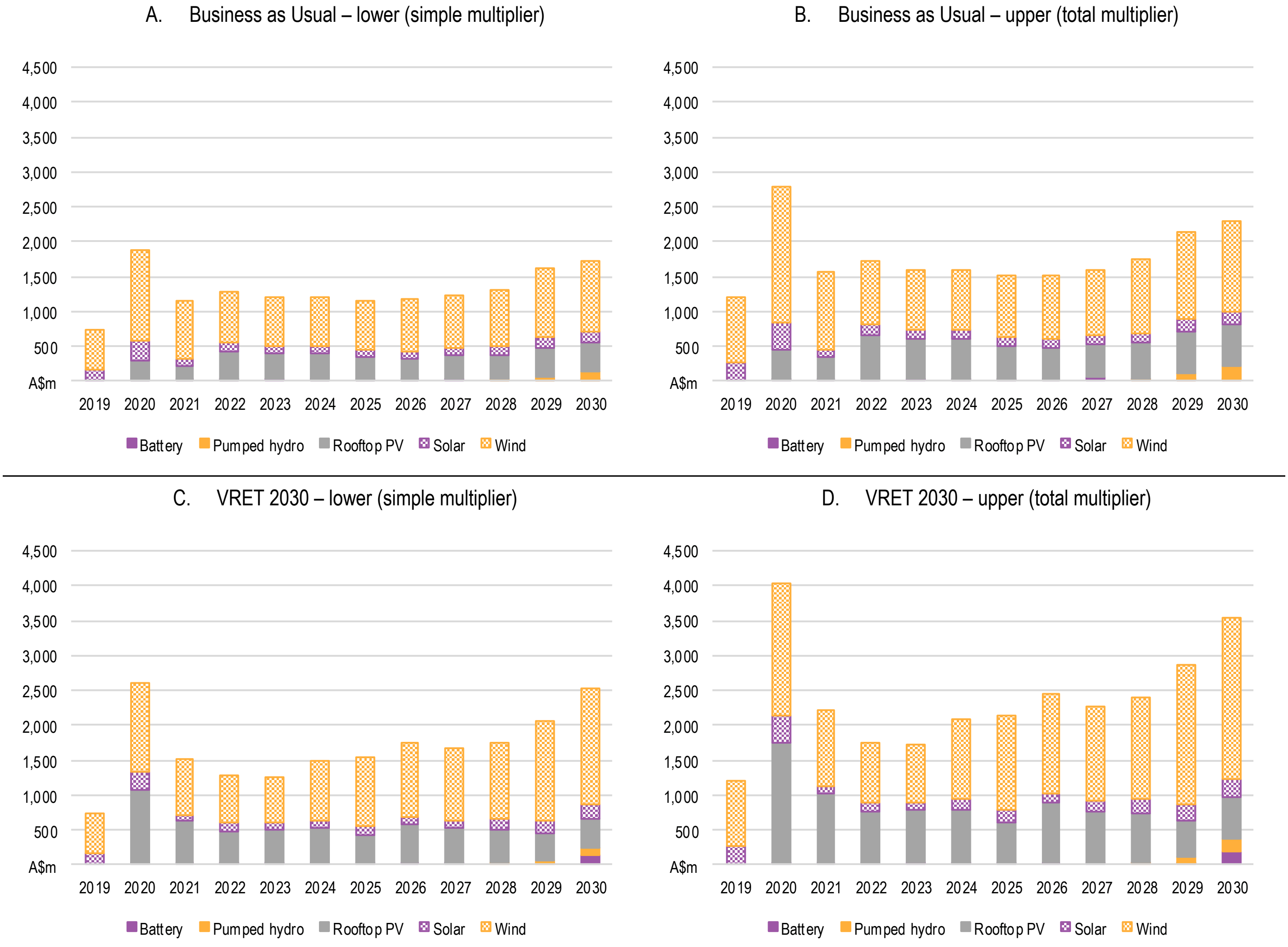
Note: The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed

SOURCE: ACIL ALLEN MODELLING

The contribution of investment in new renewable energy capacity to the Victorian economy is greater under the VRET 2030 case than Business as Usual, driven by the higher level of investment in renewables.

Figure 3.2 illustrates the contribution to the Victorian economy of the investment in new renewable generation capacity by technology. The contribution to the Victorian economy is in line with the additional capacity by technology. The contribution from wind and solar (large scale and rooftop PV) is significant throughout the period. The investment in pumped hydro and battery makes a relatively small contribution towards the end of the period.

FIGURE 3.2 CONTRIBUTION TO THE VICTORIAN ECONOMY FROM INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030, BY TECHNOLOGY



Note: The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed

SOURCE: ACIL ALLEN MODELLING

3.2 Employment contribution

The contribution to Victorian jobs of the investment in new renewable generation capacity is summarised in Table 3.2 and illustrated in Figure 3.3.

TABLE 3.2 IMPACT OF THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030 ON VICTORIA'S JOBS (AVERAGE NUMBER OF FTES)

	Lower	Upper
	Average annual FTEs	Average annual FTEs
Business as Usual		
Construction	2,935	4,656
Operation and maintenance (over period to 2030)	2,821	3,961
Total	**5,756**	**8,618**

	Lower	Upper
VRET 2030		
Construction	5,098	8,092
Operation and maintenance (over period to 2030)	3,270	4,592
Total	**8,367**	**12,684**
Difference between Business as Usual and VRET 2030		
Total	**2,612**	**4,067**

Notes:

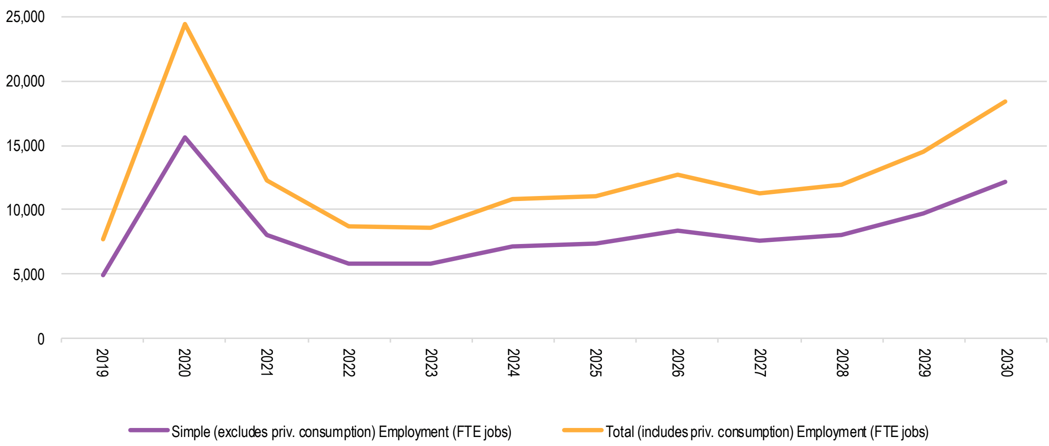
1. Lower bound represents the simple I-O multiplier and upper bound represents the total I-O multiplier
2. The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed
3. Totals may not add due to rounding

SOURCE: ACIL ALLEN MODELLING

FIGURE 3.3 VICTORIAN EMPLOYMENT CONTRIBUTION FROM THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030

A. Business as Usual

B. VRET 2030



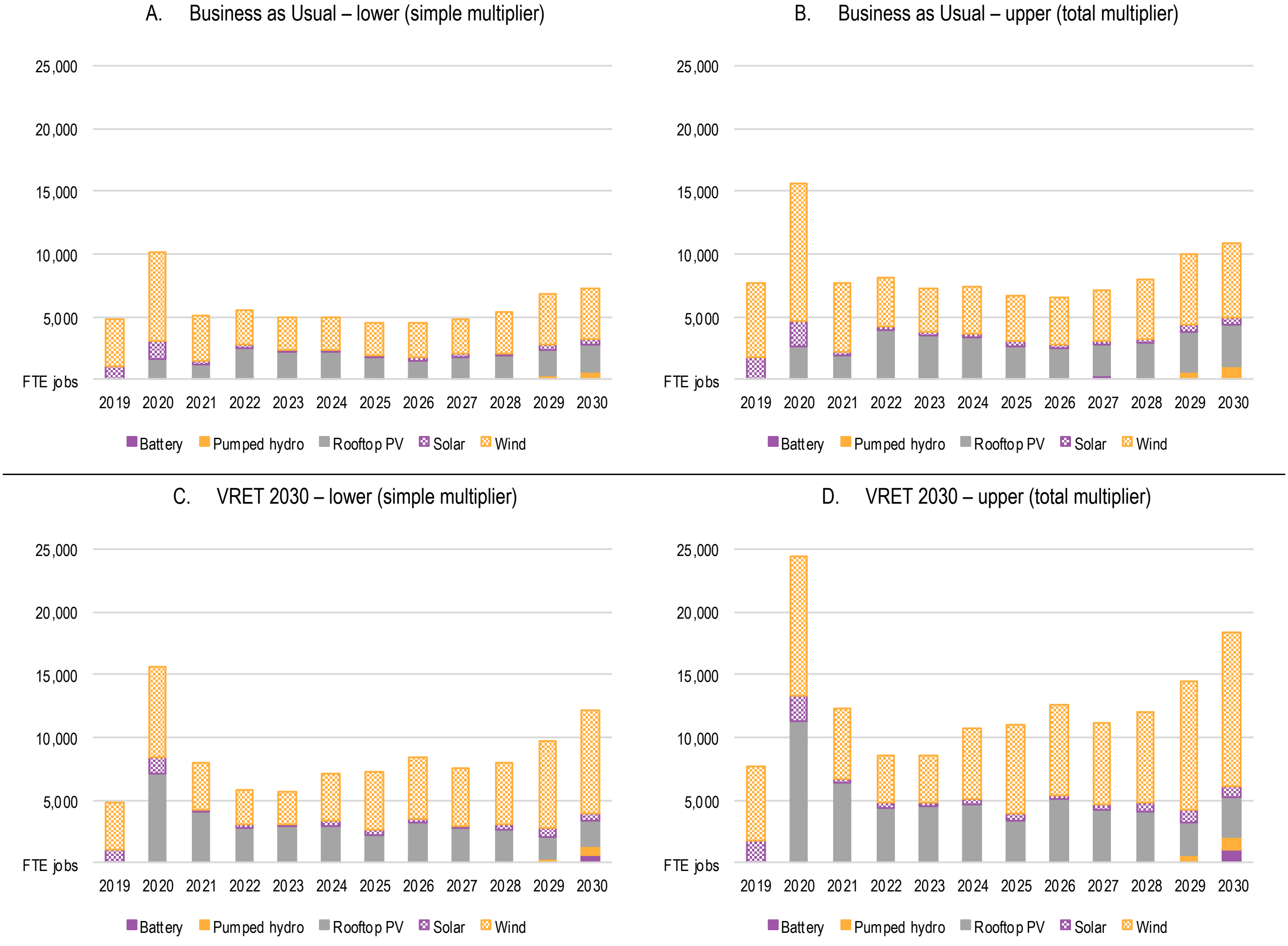
Note: The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed

SOURCE: ACIL ALLEN MODELLING

Consistent with the economic contribution, the contribution of the investment in new renewable generation capacity to Victorian employment is greater under the VRET 2030 case than under Business as Usual, driven by the higher level of investment in renewables.

Figure 3.4 illustrates the contribution to Victorian employment of the investment in new renewable generation capacity, by technology. Consistent with the contribution to the Victorian economy, the contribution to Victorian employment is in line with the additional capacity by technology. The employment contribution from wind and solar (large scale and rooftop PV) is significant throughout the period. The investment in pumped hydro and battery storage makes a relatively small contribution towards the end of the period.

FIGURE 3.4 VICTORIAN EMPLOYMENT CONTRIBUTION FROM INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030, BY TECHNOLOGY

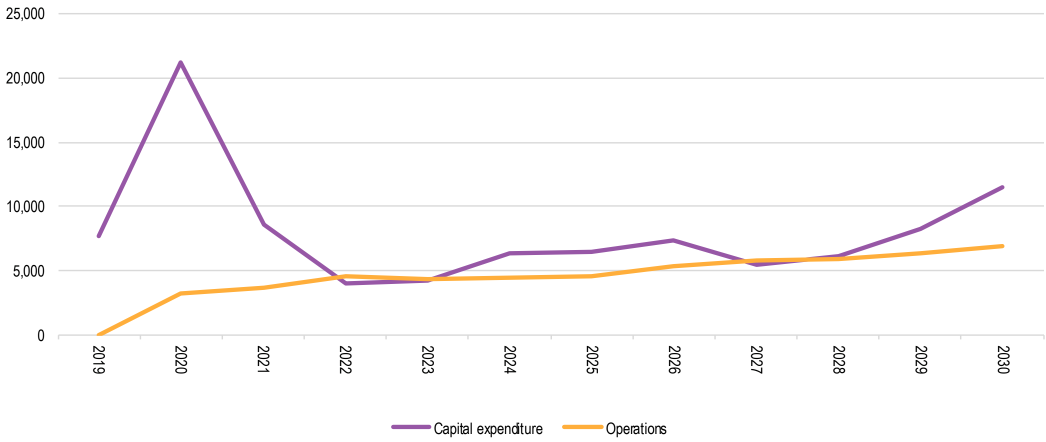


Note: The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed

SOURCE: ACIL ALLEN MODELLING

Figure 3.5 illustrates how the employment contribution (number of FTE jobs) varies over time for the upper bound (which represents the total I-O multiplier) of the VRET 2030 case. While the employment contribution from operations increases steadily over time, the employment contribution during the construction phase (from the capital expenditure) varies over time in line with the lumpiness of the investment profile. The employment contribution profile for the lower bound of the VRET 2030 case and for Business as Usual will be similar, albeit at a lower level.

FIGURE 3.5 EMPLOYMENT CONTRIBUTION (FTE JOBS), VRET 2030 CASE, UPPER BOUND, TO 2030



SOURCE: ACIL ALLEN MODELLING

While the employment contribution varies from year to year, the employment contribution in Table 3.2 is expressed in terms of the average number of FTEs per year.

If we assume that each person employed is employed for a period of two years, then the number of two year jobs created is equal to the total number of FTEs over the 12 year period from 2019 to 2030, divided by two. The number of two year jobs created is set out in Table 3.3.

TABLE 3.3 IMPACT OF THE INVESTMENT IN NEW RENEWABLE GENERATION CAPACITY TO 2030 ON VICTORIA'S JOBS (TWO YEAR JOBS)

	Lower	Upper
	Number of two year jobs	Number of two year jobs
Business as Usual		
Construction	17,608	27,939
Operation and maintenance (over period to 2030)	16,926	23,767
Total	**34,534**	**51,706**
VRET 2030		
Construction	30,586	48,554
Operation and maintenance (over period to 2030)	19,617	27,553
Total	**50,204**	**76,107**
Difference between Business as Usual and VRET 2030		
Total	**15,669**	**24,400**

Notes:

1. Lower bound represents the simple I-O multiplier and upper bound represents the total I-O multiplier
2. The contribution from operation and maintenance includes the operation and maintenance of the total renewable capacity installed
3. Totals may not add due to rounding

SOURCE: ACIL ALLEN MODELLING

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