Jacobs Word Template

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# 1 About

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## Jacobs Group (Australia) Pty Ltd

### Heading level 3

#### Heading level 4

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# 2 Executive summary

This report contains forecasts by Jacobs for the Clean Energy Regulator (CER) of the capacity and number of mid-scale photovoltaic (PV) installations for the calendar years 2022 up to and including 2027.

Key points:

* The CER has now recorded a total of 1,604 mid-scale PV installations accounting for a total capacity of 1,489.5 megawatts (MW). More than 90% have occurred since 2014.
* The top five industries installing mid-scale solar are: Commercial, Retail, Electricity, Industrial and Education.
* The annual average new installations are 186 with average installed capacity per site of 0.9 MW across all participating industries.
* For the years 2017-2022, there has been an average of 243.9 MW installed per year, which equates to 33.9% compound average growth rate.
* Jacobs forecasts a total installed mid-scale capacity of 2,839 MW by the end of 2027, with compound annual growth rate of 16%.

Mid-scale PV systems are defined by the capacity range of greater than 100 kilowatts (kW) and less than 30 MW. These systems are not eligible for federal rebates under the Small-scale Renewable Energy Scheme (SRES). However, they may be accredited under the Large-scale Renewable Energy Target (LRET) scheme to produce Large-scale Generation Certificates (LGCs) via the renewable energy generated. LGCs produced may then be sold to market participants, typically retailers who are required to surrender a determined number of LGCs to the CER. This has provided a financial incentive for the installation of larger sized PV systems.

High electricity prices coupled with plummeting capital costs of installation and high LGC prices saw a large growth rate in mid-scale PV installations during 2018, at over three times the capacity installed in 2017. Growth steadied in 2019. However, a reduction in growth occurred in 2020 due to factors relating to the global COVID pandemic including:

Reduced industrial and commercial demand.

Lower global oil and gas prices.

Market and policy uncertainty delaying investment decisions.

In 2021 the trend reversed, and growth returned to this market segment for both behind-the-meter installations and front-of-meter systems that export all energy to the grid. Part way through 2022, there is approximately 100 MW of new capacity in the mid-scale category.

Although mid-scale PV systems up to 30 MW are eligible to receive LGCs, generators less than 5 MW can be classified as ‘exempt generators’ in the National Electricity Market (NEM), which means they are not required to participate in the central dispatch process, are not constrained by the Australian Energy Market Operator (AEMO), and do not need to adhere to grid connection requirements. Systems of between 5 MW and 30 MW can be constrained at times of system need and have more stringent requirements to operate.

Mid-scale PV systems cover a broad range of applications. The majority of these are rooftop systems to help meet the energy requirements of business enterprises and government agencies. However, generators installed to power remote communities are commonly found in the mid-scale range and a growing number of single axis tracking systems1 are designed to participate in the wholesale market.

Incentives to take up mid-scale solar PV vary widely. Large differences exist in financial returns through the avoidance of retail electricity charges in behind-the-meter use versus selling energy to the wholesale market, due to varying electricity tariff and feed-in-tariff rates across Australia. There are also differing state-based programs targeting uptake in certain sectors and communities.

With a wide range in applications and incentives, it was deemed inappropriate to utilise an all-encompassing model to forecast mid-scale installations. Instead, a segmentation and market sizing exercise was conducted, and a bottom-up approach was used in combination with the fitting of recent trends in installation uptake to a mathematical function.

The dataset supplied by the CER containing the current and proposed mid-scale installations was segmented based primarily on the type of commercial organisation where the system is installed. This enabled an estimation of the total size of the mid-scale market to be established based upon 14 categories. Of the estimated market size of more than 11 thousand potential premises, only 1,1604 premises have been recorded as having a mid-scale system installed, indicating that there is still room for growth.

The net present value and payback periods of various cases were also calculated to help with the projections. Projected payback periods for behind-the-meter commercial systems have dropped steadily from over 12 years in 2012 to approximately 6 years currently. The payback period is expected to moderately reduce further for the remainder of the projection period, primarily driven by a reduction in capital cost. This indicates that despite the decreasing LGC prices and the lack of new federal incentives, the economic benefit of installing these systems continues to improve.

Systems designed to target the wholesale market were less financially rewarding. The successful Redmud business model based upon selling LGCs and energy to the South Australian wholesale market was determined not to be economically viable in states with lower wholesale prices. Systems sized at 5 MW with the ability to procure discounted PV panels based on scale also have the benefit of avoiding stringent AEMO connection requirements.

# 3 Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

## 3.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: # Hello world {#nice-label}.
   * Leave the label off if you like the automated heading generated based on your heading title: for example, # Hello world = # Hello world {#hello-world}.
   * To label an un-numbered heading, use: # Hello world {-#nice-label} or {# Hello world .unnumbered}.
2. Next, reference the labeled heading anywhere in the text using \@ref(nice-label); for example, please see Chapter 3.
   * If you prefer text as the link instead of a numbered reference use: [any text you want can go here](#cross).

## 3.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using \@ref(fig:chunk-label) and \@ref(tab:chunk-label), respectively.

See Figure 3.1.

par(mar = c(4, 4, .1, .1))  
plot(pressure, type = 'b', pch = 19)



Figure 3.1: Here is a nice figure!

Don’t miss Table 3.1.

knitr::kable(  
 head(pressure, 10), caption = 'Here is a nice table!',  
 booktabs = TRUE  
)

Table 3.1: Here is a nice table!

| temperature | pressure |
| --- | --- |
| 0 | 0.0002 |
| 20 | 0.0012 |
| 40 | 0.0060 |
| 60 | 0.0300 |
| 80 | 0.0900 |
| 100 | 0.2700 |
| 120 | 0.7500 |
| 140 | 1.8500 |
| 160 | 4.2000 |
| 180 | 8.8000 |

# 4 Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Add a numbered part: # (PART) Act one {-} (followed by # A chapter)

Add an unnumbered part: # (PART\\*) Act one {-} (followed by # A chapter)

Add an appendix as a special kind of un-numbered part: # (APPENDIX) Other stuff {-} (followed by # A chapter). Chapters in an appendix are prepended with letters instead of numbers.

# 5 Footnotes and citations

## 5.1 Footnotes

Footnotes are put inside the square brackets after a caret ^[]. Like this one [[1]](#footnote-1).

## 5.2 Citations

Reference items in your bibliography file(s) using @key.

For example, we are using the **bookdown** package ([Xie 2022](#ref-R-bookdown)) (check out the last code chunk in index.Rmd to see how this citation key was added) in this sample book, which was built on top of R Markdown and **knitr** ([Xie 2015](#ref-xie2015)) (this citation was added manually in an external file book.bib). Note that the .bib files need to be listed in the index.Rmd with the YAML bibliography key.

The RStudio Visual Markdown Editor can also make it easier to insert citations: <https://rstudio.github.io/visual-markdown-editing/#/citations>

# 6 Blocks

## 6.1 Equations

Here is an equation.

You may refer to using \@ref(eq:binom), like see Equation (6.1).

## 6.2 Theorems and proofs

Labeled theorems can be referenced in text using \@ref(thm:tri), for example, check out this smart theorem ??.

For a right triangle, if denotes the *length* of the hypotenuse and and denote the lengths of the **other** two sides, we have

Read more here <https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html>.

## 6.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: <https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html>

# 7 Sharing your book

## 7.1 Publishing

HTML books can be published online, see: <https://bookdown.org/yihui/bookdown/publishing.html>

## 7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you’d like to customize your 404 page instead of using the default, you may add either a \_404.Rmd or \_404.md file to your project root and use code and/or Markdown syntax.

## 7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the index.Rmd YAML. To setup, set the url for your book and the path to your cover-image file. Your book’s title and description are also used.

This gitbook uses the same social sharing data across all chapters in your book- all links shared will look the same.

Specify your book’s source repository on GitHub using the edit key under the configuration options in the \_output.yml file, which allows users to suggest an edit by linking to a chapter’s source file.

Read more about the features of this output format here:

<https://pkgs.rstudio.com/bookdown/reference/gitbook.html>

Or use:

?bookdown::gitbook

# 8 Heading 1

## 8.1 Heading 2

### 8.1.1 Heading 3

##### 8.1.1.0.1 Heading 4

Normal text

Xie, Yihui. 2015. *Dynamic Documents with R and Knitr*. 2nd ed. Boca Raton, Florida: Chapman; Hall/CRC. <http://yihui.org/knitr/>.

———. 2022. *Bookdown: Authoring Books and Technical Documents with r Markdown*. <https://CRAN.R-project.org/package=bookdown>.

1. This is a footnote. [↑](#footnote-ref-1)