

# Will-o'-the-ISP

## Estimating renewable energy employment under the Integrated System Plan

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*Between 18,000 and 59,000 construction and installation jobs could be created if the Energy Market Operator's Integrated System Plan 'fast scenario' on renewable transition is adopted. It would see around 53% of capacity from renewable energy by 2030.*

Rod Campbell  
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# Summary

The Australian Energy Market Operator’s (AEMO) Integrated System Plan (ISP) includes a ‘Fast Scenario’ that sees 42,895MW of new renewable energy capacity built by 2029-30, resulting in 53% of generation capacity from renewables.

Four studies present a range of estimates for employment generated by new renewable capacity constructed. Applying these estimates to the ISP Fast Scenario gives the following estimates of average employment in construction and installation:

## Construction and installation employment estimates

	Low	Mid	High
Average annual employment to 2029-30	18,535	38,136	58,554

These estimates vary due to different assumptions around technology and how much manufacturing and assembly takes place in Australia. While little renewable manufacturing currently occurs in Australia, some wind turbine manufacturing is being established, suggesting that well-designed policies could generate significant benefits.

Similar estimates can be made for ongoing maintenance and operation employment:

## Ongoing operation and maintenance employment estimates

Technology	Low	Mid	High
Wind	649	1,441	2,378
Utility Solar	1,719	2,234	5,156
Utility storage	1,155	1,155	1,155
Biomass	200	200	200
Distributed storage	NA	NA	NA
Rooftop PV	3,646	3,646	3,646
<b>Ongoing employment</b>	<b>7,368</b>	<b>8,677</b>	<b>12,536</b>

Given the focus on energy transition and jobs in Australia’s public debate, surprisingly little attention has been given to the potential employment benefits of a rapid transition to renewable energy. This is even more surprising as many of the benefits would be felt in regional areas where employment opportunities are often a social, political and economic priority. As more renewable energy is developed, researchers, decision makers and the public will hopefully gain a better understanding of these benefits.

# Introduction

The Australian Energy Market Operator’s (AEMO) Integrated System Plan (ISP) is a comprehensive infrastructure development plan for Australia’s energy system. It considers seven different scenarios, including a ‘Fast Scenario’ that sees 92,740 MW of generation capacity in 2029-30, around 53% of which is renewable.<sup>1</sup> The ISP details the total NEM installed capacity by technology that produces this result. The renewable energy elements of this scenario are presented below:

**Table 1: Total NEM Installed Capacity by Technology (MW)**

Technology	2018-19	2029-30	Total New Build
Wind	5,824	13,031	7,207
Utility Solar	2,212	19,400	17,188
Utility storage	2,681	8,455	5,774
Biomass	0	200	200
Distributed storage	312	3,723	3,411
Rooftop PV	7,324	16,439	9,115
<b>Total</b>	<b>18,353</b>	<b>61,248</b>	<b>42,895</b>

Source: AEMO (2018) Integrated System Plan, <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan>

From the ISP’s estimate of 42,895MW of new renewable energy capacity that will need to be built, an estimate can be made of the number of jobs created in this construction, installation and ongoing operation.

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<sup>1</sup> AEMO (2018) *Integrated System Plan*, <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan>

# Employment by capacity installed

Estimates of employment generated by renewable energy development are contained in four Australian reports:

- Green Energy Markets (2018) *Renewable Energy across Queensland's Regions*;<sup>2</sup>
- ROAM Consulting (2014) *RET policy analysis*;<sup>3</sup>
- The Climate Institute (2011) *Clean Energy Jobs in Regional Australia*;<sup>4</sup>
- Clean Energy Council/SKM (2012) *Wind Farm Investment, Employment and Carbon Abatement in Australia*.<sup>5</sup>

These reports present differing figures for the design, planning, and construction (referred to as installation) of the various forms of renewable energy generation and are set out in Table 2 below in terms of annual full time equivalent (FTE) hours per megawatt installed:

**Table 2: Estimated FTE job years per megawatt of capacity during installation**

Technology	Green Energy Markets 2018	CEC/ROAM 2014	TCI 2011 (construction only)	TCI 2011 (construction & manufacturing)	CEC 2012 local	CEC 2012 total
Wind	1.61	2.2	2.5	15	0.96	4.76
Utility Solar	2.2	2.4	6	10		
Utility storage	3					
Biomass	2		2	2.1		
Distributed storage						
Rooftop PV		15	29	38		

Sources: as above

The estimates in Table 2 vary widely depending on their approach to construction, installation, assembly and manufacturing of generation infrastructure. Most of the reports do not include any aspect of manufacturing in Australia. The exception to this

<sup>2</sup>[http://greenmarkets.com.au/images/uploads/GEM%20Reports/Industry%20Reports/Renewable\\_Energy\\_Across\\_Qld\\_Regions.pdf](http://greenmarkets.com.au/images/uploads/GEM%20Reports/Industry%20Reports/Renewable_Energy_Across_Qld_Regions.pdf)

<sup>3</sup>[http://www.roamconsulting.com.au/about\\_reports.php](http://www.roamconsulting.com.au/about_reports.php)

<sup>4</sup><http://www.climateinstitute.org.au/clean-energy-jobs.html>

<sup>5</sup><https://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/reports/2012/Wind-Farm-Investment-Employment-and-Carbon-Abatement-in-Australia/Wind%20Farm%20Investment%2C%20Employment%20and%20Carbon%20Abatement%20in%20Australia-1.pdf>

is the TCI (2011) report which includes an estimate of employment related to assembly and construction per megawatt of capacity installed. While little renewable manufacturing currently occurs in Australia, some wind turbine manufacturing is being set up in Australia. Danish company Vestas has established a manufacturing hub in Geelong, to provide components for two wind farms in Victoria.<sup>6</sup> With strong targets, stable energy policy and support for manufacturing it seems likely that substantial manufacturing could be carried out in Australia. The TCI (2011) estimates inform much of the high-end estimates below and should be considered an upper bound to employment, if renewable assembly and manufacturing is encouraged to establish in or relocate to Australia.

The CEC (2012) estimates vary between 0.96 at a local level and 4.76 at a nation-wide level, differentiating between on-site installation and overall planning, management and construction employment.

The Green Energy Market (2018) estimate of employment per capacity of utility storage refers to pumped hydro, rather than utility scale batteries. With only one major utility scale battery operating in Australia, little data exists on other utility scale storage technologies.

TCI (2011) estimate of utility scale solar is based on solar thermal generation, such as is planned in Port Augusta, South Australia.<sup>7</sup> It is based on older estimates so again represents a likely upper bound, although little other data exists.

Importantly, no estimates of employment in distributed storage exist. As household scale batteries become more popular this could become significant, although estimating separately from employment in rooftop solar could be difficult, as this often accompanies household storage.

Applying these various estimates to the required new build capacity under the ISP's fast scenario in the 11 years to 2029-30 above gives the following estimates:

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<sup>6</sup> Renewables Now (2018) *Vestas to set up hub in Victoria*, <https://renewablesnow.com/news/vestas-to-set-up-hub-in-victoria-629733/>

<sup>7</sup> Long (2018) *'Renewables capital of Australia'? Port Augusta shows off its green energy credentials*, <https://www.abc.net.au/news/2018-10-05/port-augusta-becomes-australian-renewable-energy-hub/10338812>

**Table 3: Construction and installation employment estimates**

<b>Technology</b>	<b>Low</b>	<b>Mid</b>	<b>High</b>
<b>Wind (job years)</b>	11,627	34,305	108,105
<b>Utility Solar (job years)</b>	37,814	103,128	171,880
<b>Utility storage (job years)</b>	17,322	17,322	17,322
<b>Biomass (job years)</b>	400	410	420
<b>Distributed storage</b>	NA	NA	NA
<b>Rooftop PV (job years)</b>	136,725	264,335	346,370
<b>Total annual FTE created</b>	203,888	419,500	644,097
<b>Timeframe (years)</b>	11	11	11
<b>Average annual employment</b>	18,535	38,136	58,554

Table 3 shows that at least 18,500 jobs per year would be created across the period to 2029-30. This could increase to nearly 60,000 if significant amounts of assembly and manufacturing take place in Australia. The mid estimate of 38,136 does not include significant amounts of assembly and manufacturing but does take into account off-site planning and management employment for wind energy, a similar factor to the TCI estimate for utility scale solar thermal, which does not include planning and management. In all cases, rooftop solar installation is the major employer on a per megawatt basis.

# Estimating ongoing employment in operations and maintenance

While most jobs in renewable energy occur during the construction and installation phase, a considerable workforce is required to operate and maintain the facilities. The reports discussed above also make a range of estimates relating to ongoing employment per megawatt of renewable generation capacity. These are shown in Table 5 below:

**Table 5: Estimated FTE per megawatt of capacity during operation**

Technology	Green Energy Markets 2018	CEC/ ROAM 2014	TCI 2011	CEC 2012 local	CEC 2012 total
Wind	0.1	0.1	0.2	0.09	0.33
Utility Solar	0.1	0.13	0.3		
Utility storage	0.2				
Biomass	1		1		
Distributed storage					
Rooftop PV			0.4		



Applying these estimates to the ISP capacity estimates in Table 1 above gives the following employment estimates:

**Table 6: Ongoing operation and maintenance employment estimates**

Technology	Low	Mid	High
Wind	649	1,441	2,378
Utility Solar	1,719	2,234	5,156
Utility storage	1,155	1,155	1,155
Biomass	200	200	200
Distributed storage	NA	NA	NA
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Table 6 suggests much less variation in operation and maintenance job estimates, however this is likely due to few estimates for ongoing maintenance employment in rooftop PV and distributed storage.

# Conclusion

Given the focus on energy transition and jobs in the coal industry in Australia's public debate in recent years, surprisingly little attention has been given to the potential employment benefits of a rapid transition to renewable energy. While the sector is capital intensive and so unlikely to ever employ as many people as major service industries such as education and health care, it can make a significant contribution, particularly in regional areas. As more renewable energy is developed, researchers, decision makers and the public will hopefully gain a better understanding of these benefits.