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E3 Fast track

Electricity Sector Workforce Projections for the 2022 ISP: Focus on South Australia. Revision 1.

Final report

UTS Institute for Sustainable Futures
AEMO
Australian Government Department of Industry, Science and Resources
AusIndustry Cooperative Research Centres Program

RACE for Everyone
Research Theme E3: Future Energy Workforce

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Industry Report
Electricity Sector Workforce Projections for the 2022 ISP: Focus on South Australia

This report has been revised to correct an error in modelling offshore wind employment and the omission of some pumped hydro employment from the Slow Change scenario.

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Contributors

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What is RACE for 2030?

RACE for 2030 CRC is a 10-year co-operative research program with AUD350 million of resources to fund research towards a reliable, affordable, and clean energy future: https://www.racefor2030.com.au

Acknowledgement of Country

The authors of this report would like to respectfully acknowledge the Traditional Owners of the ancestral lands throughout Australia and their connection to land, sea and community. We recognise their continuing connection to the land, waters and culture and pay our respects to them, their cultures and to their Elders past, present, and emerging.

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List of Abbreviations

Acronym	Term
AEMO	Australian Energy Market Operator
GW/GWh	Gigawatt / Gigawatt Hours
ISF	Institute for Sustainable Futures
kW/kWh	Kilowatt / Kilowatt Hours
NEM	National Electricity Market
MW/MWh	Megawatt /Megawatt Hours
O&M	Operations & Maintenance
PV	Solar Photovoltaic

1 Introduction

This report provides electricity sector workforce projections for South Australia and is part of a wider project which provides projections for the National Electricity Market based on the 2022 Integrated System Plan (ISP) developed by the Australian Energy Market Operator (AEMO). Projections cover electricity generation and transmission construction.

The project was undertaken by the Institute for Sustainable Futures, University of Technology Sydney (ISF) in collaboration with the AEMO and was funded by the RACE for 2030 Co-operative Research Centre and by the NSW and Victorian State governments. The project has benefited from an Industry Reference Group made up of state government, industry, and university representatives.

The report provides electricity sector workforce projections for South Australia broken down by technology, occupation, and location for three ISP scenarios and one sensitivity:

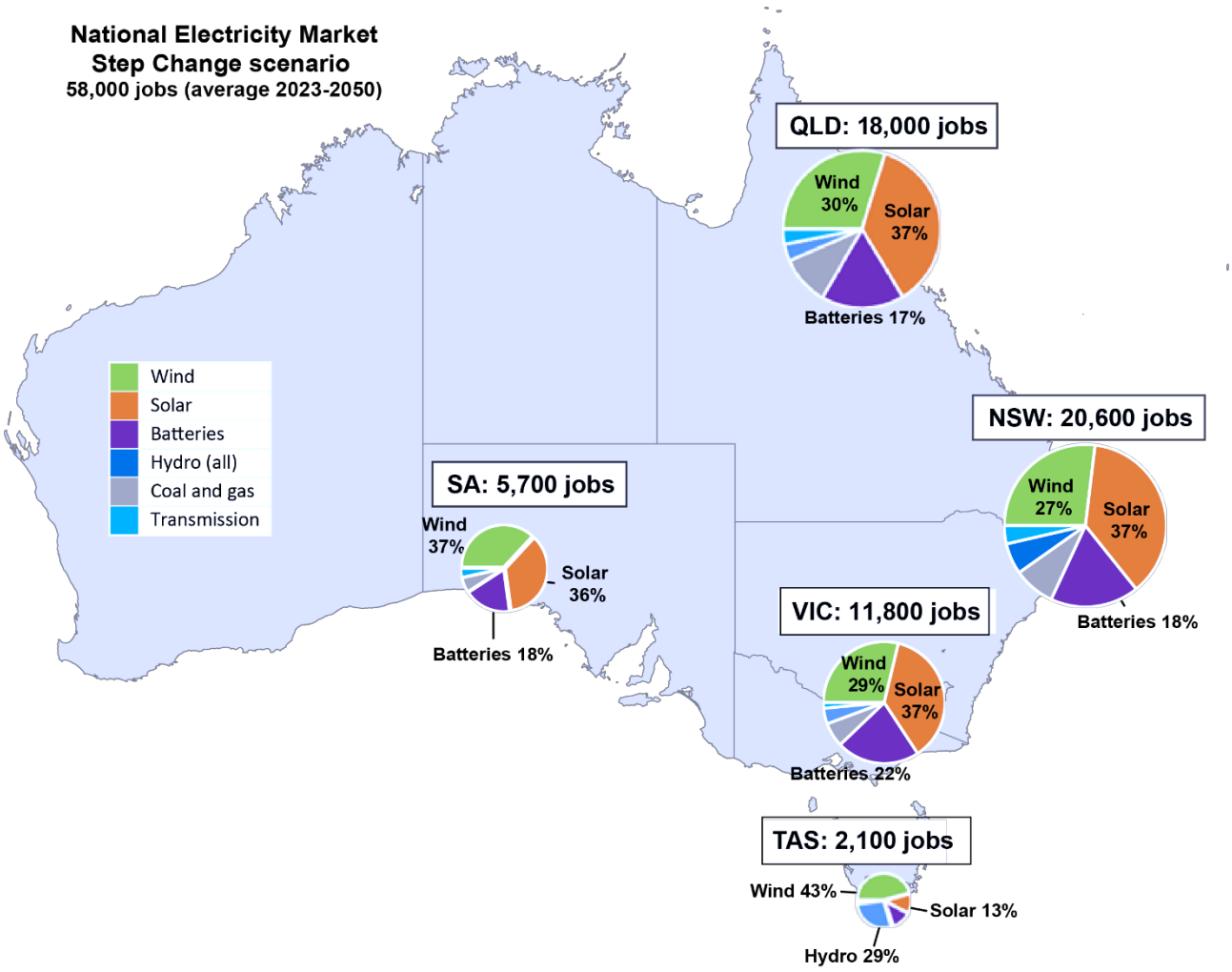
- The Step Change scenario: includes rapid consumer-led transformation of the energy sector and coordinated economy-wide action moving fast to fulfil Australia's net zero policy commitments. Energy stakeholders consider this the most likely scenario, as the NSW Electricity Infrastructure Roadmap is broadly aligned with this scenario, and during this project Victoria and Queensland released energy plans similarly aligned.
- The Hydrogen Superpower scenario: includes strong global action, significant technological breakthroughs, and a near quadrupling of NEM energy consumption to support a hydrogen export industry. There is large-scale development of the renewable energy sector, especially in the 2030s and 2040s.
- The Slow Change scenario: features a slow pace of policy and technology change, assuming a challenging environment following the COVID-19 pandemic, with the risk of industrial load closures. This scenario is considered unlikely and would not reach Australia's decarbonisation targets.
- The Offshore Wind sensitivity: the ISP includes a sensitivity to the Step Change scenario that takes account of the Victorian target to build 9GW of offshore wind by 2040 and assumes a lower cost. In all other scenarios, no offshore capacity is projected until the late 2040s. Offshore wind displaces onshore wind and utility-scale solar and reduces the overall capacity needed, with 9% (13 GW) less generation capacity over the entire NEM by 2050. There is no offshore wind projected for South Australia, and offshore wind capacity elsewhere displaces 1.3 GW of onshore wind and 1 GW of utility-scale PV by 2050.

The Progressive Change scenario was not included as the workforce profile is very similar to the Step Change.

To put the workforce demand in South Australia in context, South Australia accounts for an average of just under 10% of the forecast electricity sector workforce (

Figure 1). NSW is the leading state for renewable energy employment, averaging over 20,600 full-time jobs per year. This is followed by Queensland (18,000) and Victoria (11,800). The share by technology is very similar for the three largest states, with solar contributing 37%, wind 27%-30% and batteries 17%-22%. South Australia has a higher proportion of wind (37%), while Tasmania has a very different distribution, with 29% of jobs in hydro.

Figure 1 Average electricity sector jobs by State, 2023-2050 (Step Change)



See the main report *The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050* (Rutovitz et al, 2022). for details on the methodology including a full list of employment factors, results for the National Electricity Market as a whole, and a comparison of results by State, and recommendations for further work to support planning for workforce development.

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2 Workforce projections for South Australia by scenario

Employment projections for each of the four workforce scenarios are presented in Figure 2:

- Under the Step Change scenario, electricity sector employment averages 6,000 per year, and peaks around 9,000 jobs in 2049.
- Under the Hydrogen Superpower scenario, employment averages 19,000 jobs per year with strong growth starting in the 2030s and rising signficantly in the 2040s, to a peak around 46,000 jobs.
- Under the Slow Change scenario, employment falls to a low of 2,000 jobs, and averages only 3,000 jobs per year as the pace of energy transition slows.
- The Offshore Wind scenario has somewhat lower employment compared to the Step Change scenario. The average is 5,000 jobs and the maximum is 8,000 jobs, reflecting the displacement of onshore wind and utility-scale solar by offshore wind elsewhere.

Figure 2 South Australia, electricity sector jobs by scenario

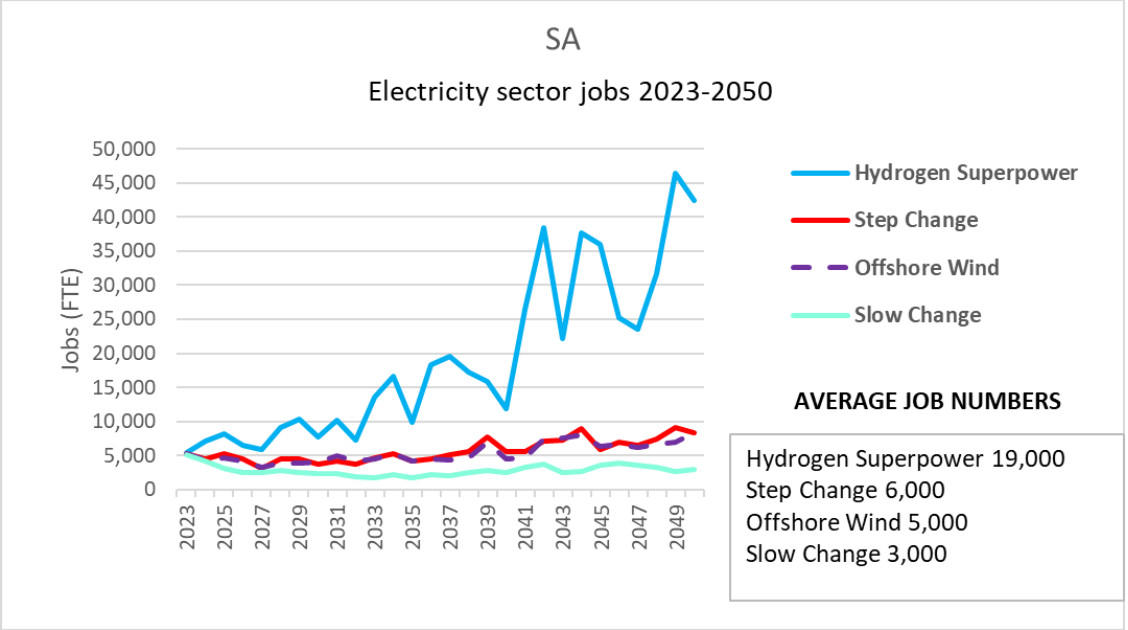


Figure 3 shows the total employment by whether it is construction, manufacturing, operations and maintenance, or fuel supply. Under all scenarios, construction dominates the employment profile through the 2020s but ongoing operations and maintenance (O&M) employment gradually increases as the fleet of renewable energy generation and storage increases.

In all scenarios, O&M employment is greater than 50% by 2050, varying from 54% in the Hydrogen Superpower to 65% in the Slow Change scenario.

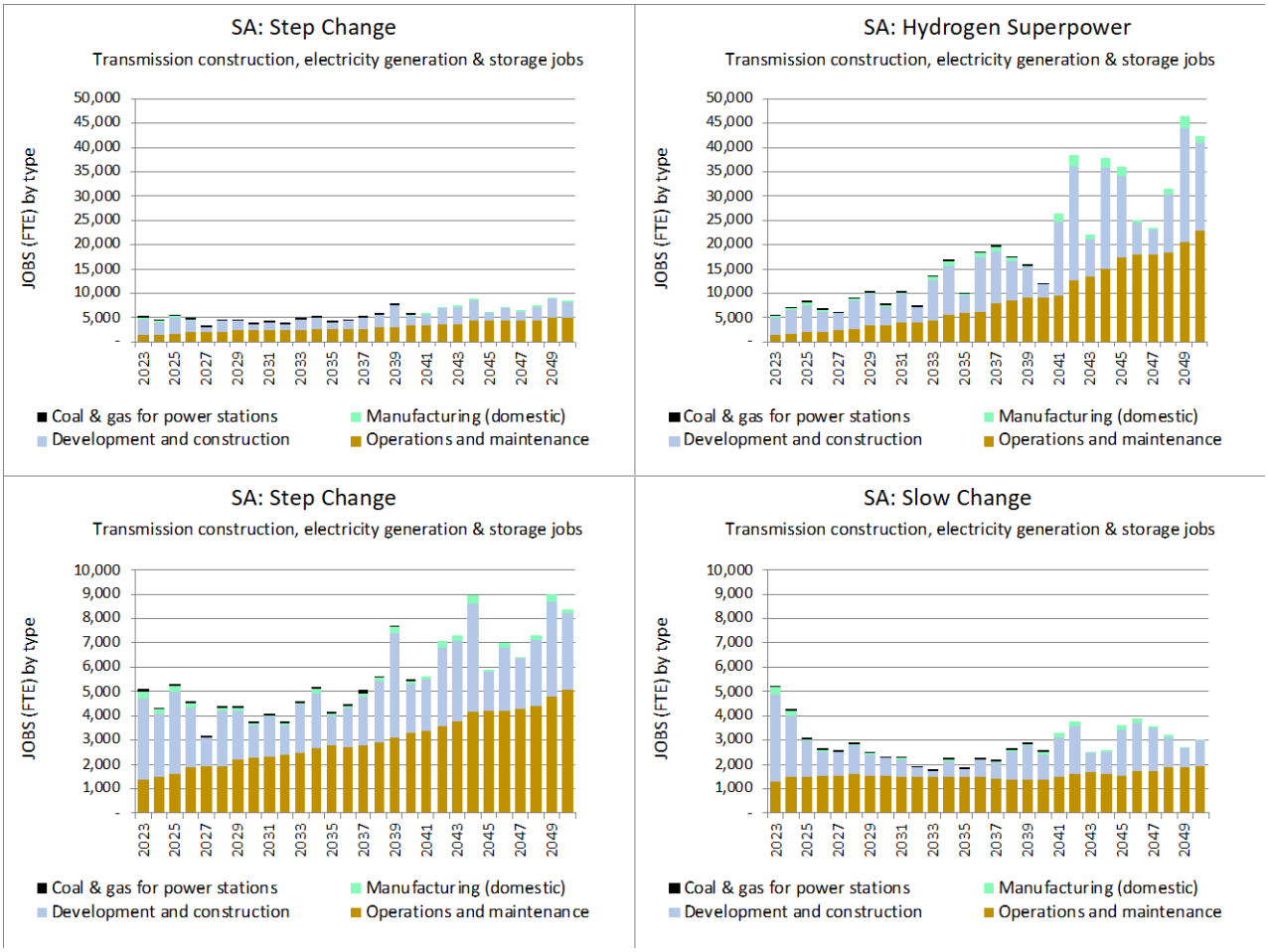
Figure 4 shows the breakdown between renewable generation, fossil fuel generation, storage, and transmission construction. Most of the employment growth in all scenarios is produced by renewable energy. The proportion of coal and gas employment falls to between 1% and 2% in the late 2040s in all scenarios.

Jobs are presented as full time equivalent (FTE) for each year and are the sum of people working on construction projects, operations and maintenance, manufacturing, and fuel supply for coal and gas generation in that year. One FTE could be one person working full time, two people working full time for six months, or an ongoing full-time job in operations and maintenance. Construction jobs are by their nature temporary, although workers may move from one project to another and be in continuous employment.

The numbers of jobs added varies significantly by scenario, particularly towards the end of the projection period. Taking the 2023 total in the Step Change scenario (5,400) as the reference point in all cases, in the Step Change scenario there are 2,500 additional jobs in 2039 (3,100 extra by 2050), in the Hydrogen Superpower scenario there are

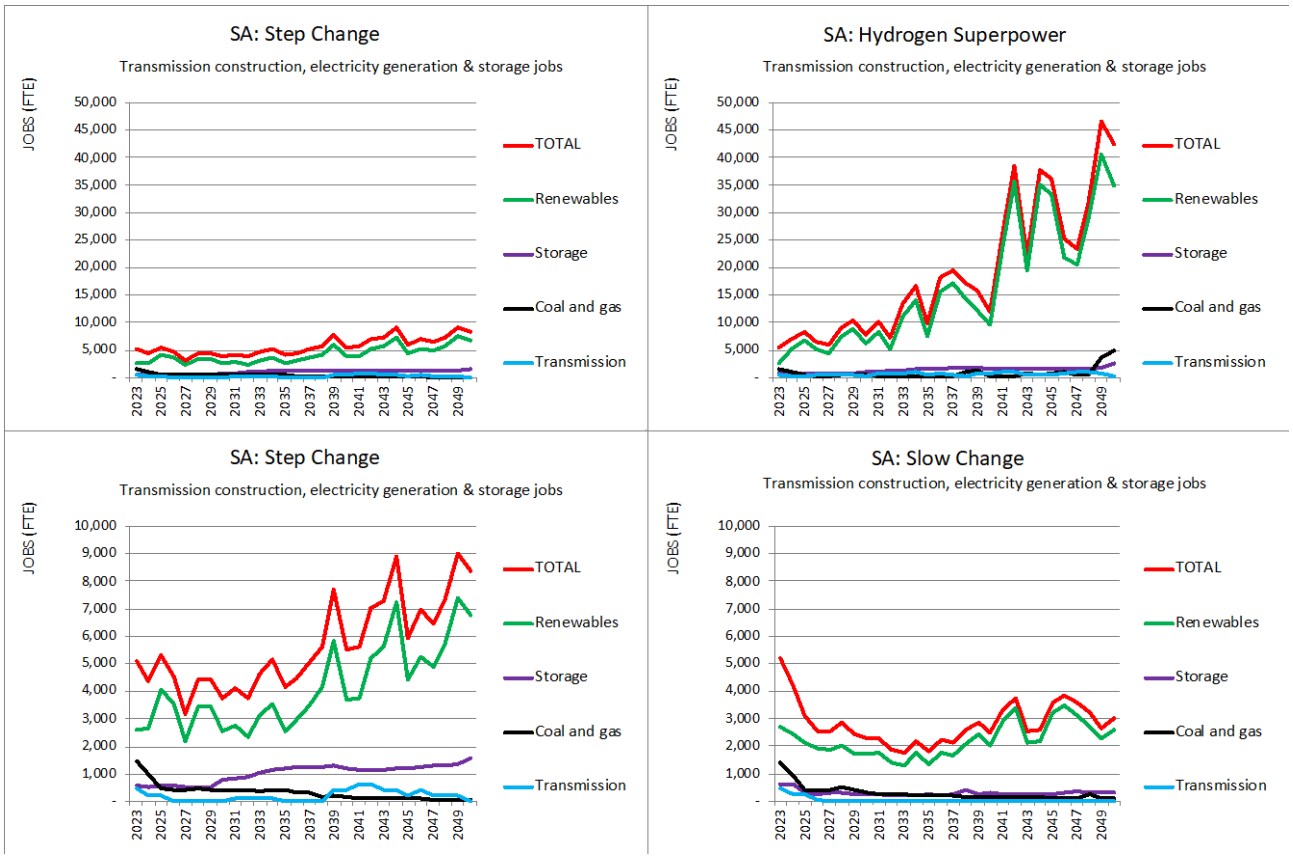
10,700 additional jobs in 2039 (37,000 extra by 2050), in the Slow Change scenario there are 2,400 **fewer** jobs in 2039 (2,200 fewer by 2050), and in the Offshore Wind scenario there are 1,800 additional jobs in 2039 (3,100 extra by 2050).

Figure 3 South Australia, jobs by phase (Step Change, Hydrogen Superpower, Slow Change)



Note different scales for lower graphs

Figure 4 South Australia, jobs by technology group (Step Change, Hydrogen Superpower, Slow Change)



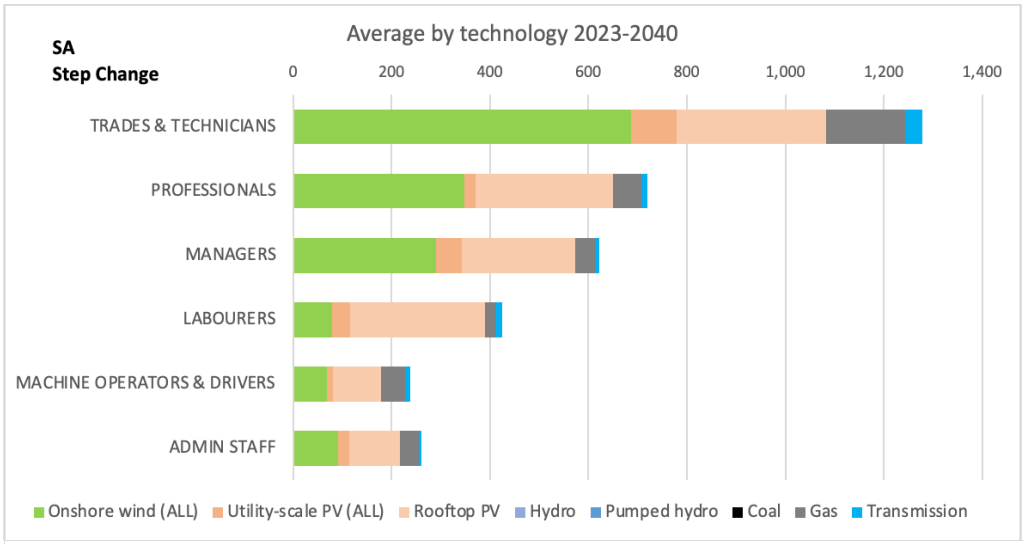
Note different scales for lower graphs

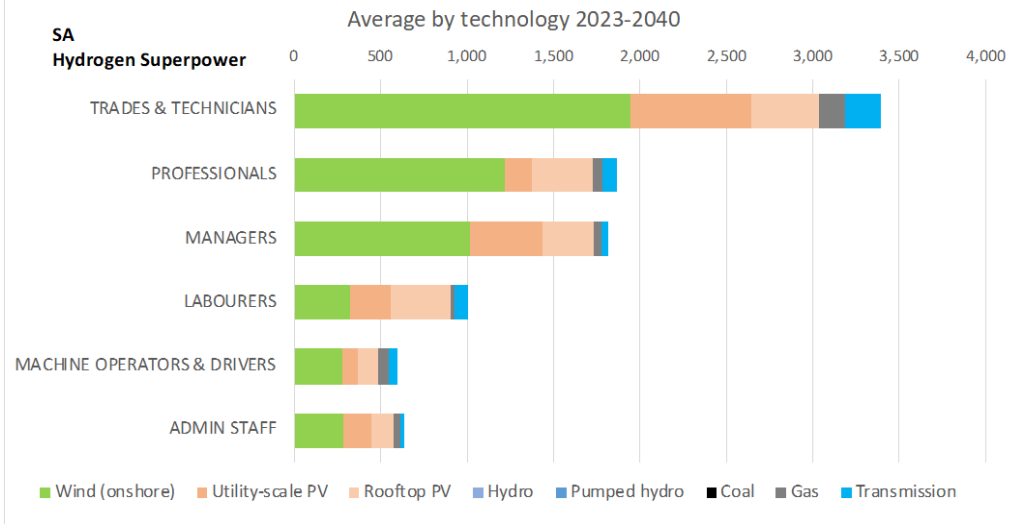
3 South Australia – employment by occupation

Occupational employment trends are important for government, industry, the training sector, and the community to understand what type of jobs will be required as a result of the energy transition.

- Average annual employment projections illustrate the bulk distribution of jobs between technologies, and the occupations that are most in demand overall.
- Figure 5 shows the average annual employment demand from 2023 until 2040 by employment grouping:
- The largest group of occupations is trades and technicians, which average just under 1,300 jobs per year between 2023 and 2040 under the Step Change scenario and around 3,400 jobs under the Hydrogen Superpower scenario.
- The next largest groups are professionals at around 700 jobs per year (this includes a wide range of 'white collar' occupations such as finance, health and safety, and engineers) and just over 1,800 jobs for Hydrogen Superpower. Managers account for just over 600 jobs per year in the Step Change scenario, led by construction managers, and over 1,800 jobs for the Hydrogen Superpower scenario.
- Over 400 labourers are projected per year (especially construction labourers), around 200 machine operators and drivers (e.g., truck drivers, crane operators), and around 300 administrative staff for the Step Change scenario. Under the Hydrogen Superpower scenario, there would be demand for around 1,000 labourers, 600 machine operators and drivers, and 600 administrative staff.

Figure 5 South Australia, average occupational structure





From the perspective of skills, training, and labour supply, the peaks in employment are the most important, with training provision in the medium term likely to be designed to cater to the next ten to fifteen years. The peak labour requirement year in this period is chosen to illustrate peak demand for the most in-demand occupations.

Labour requirements in 2034 (the peak year before 2035 in the Step Change scenario) are shown in Figure 6. There are nearly 800 electricians and nearly 300 mechanical trades and technicians needed in the Step Change scenario. In the Hydrogen Superpower these requirements are much higher, with more than 2,500 electricians and 1,200 mechanical trades needed. Annual requirements for in-demand occupations in the Hydrogen Superpower scenario are shown in Appendix A.

Annual requirements for the six most in-demand occupations over the entire period are shown in

Figure 7. Those occupations needed in large numbers primarily during construction (such as construction labourers and managers, and electrical engineers) are very volatile, while occupations such as electricians and mechanical trades increase steadily over the entire period.

Figure 6 South Australia, in-demand occupations during Step Change peak year (2034)

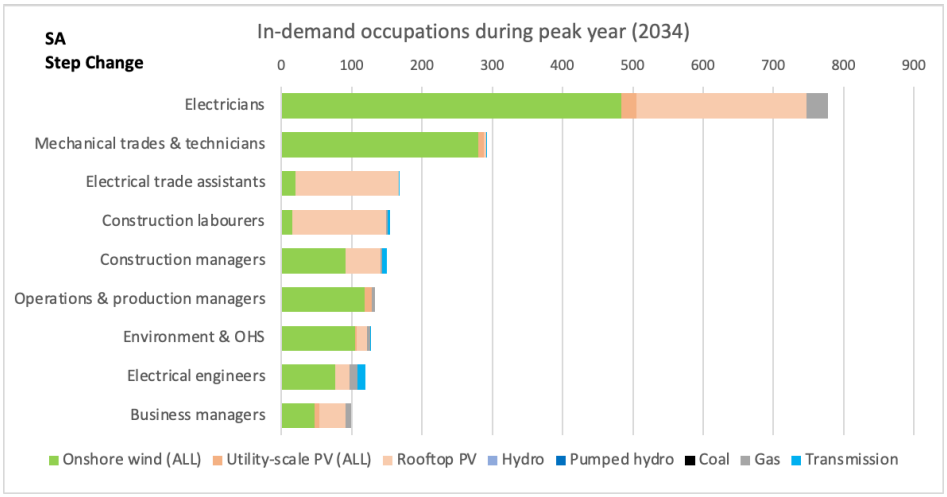
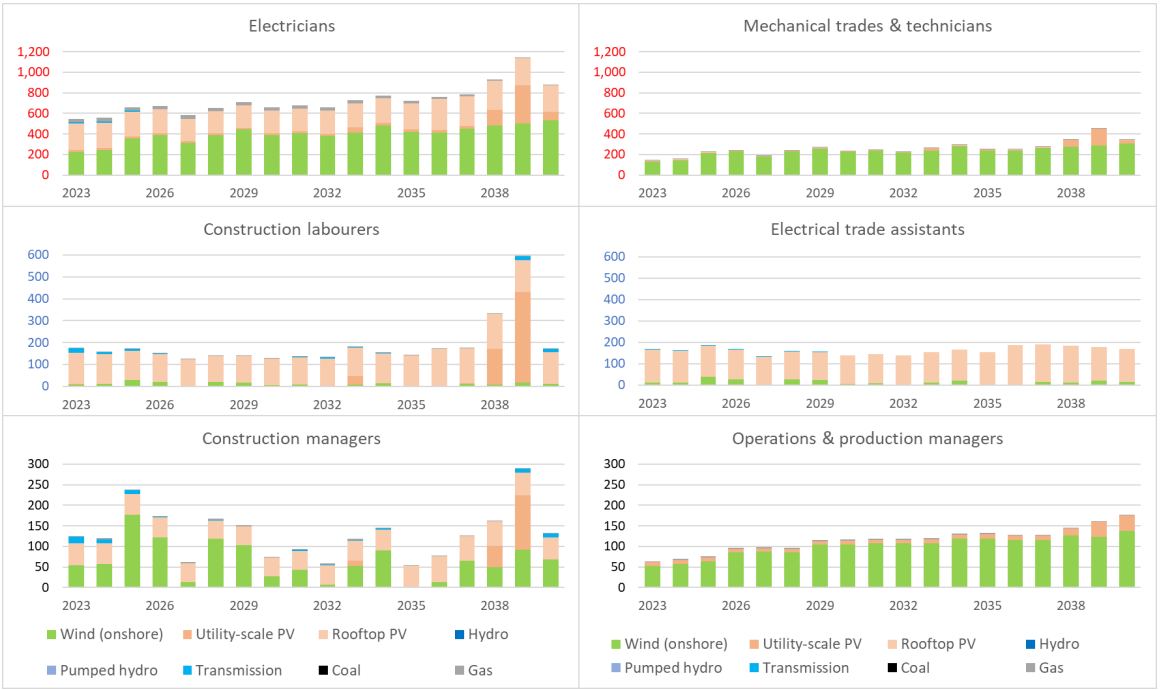


Figure 7 South Australia, in-demand occupations annual requirement by technology, Step Change



Note different scales: electricians and mechanical trades & technicians 0-1,200, construction labourers and electrical trade assistants 0-600, construction managers and operations/ production managers 0-300

4 Workforce projections by technology for South Australia

Under all scenarios, most employment growth occurs in solar and wind farms. Figure 8 shows the average employment by technology over the period, while

Figure 9 shows the annual variation.

- Rooftop PV and distributed batteries account for the highest share of employment all but the Hydrogen Superpower, with 45% in the Step Change, 51% in the Slow Change, and 47% in the Offshore Wind scenarios. In the Hydrogen Superpower scenario, although the number of jobs in these technologies are slightly higher, the proportion of electricity sector employment is lower as other technologies grow so quickly. Batteries employment is more than 99% in distributed batteries.
- Wind accounts for an average of between 33% in the Slow Change scenario, and up to 54% of all employment in the Hydrogen Superpower scenario. Wind accounts for a lower proportion of the total employment in the Offshore Wind scenario (34% compared to 37% in Step Change), reflecting the fact that offshore wind in other states displaces onshore solar or wind farms. No offshore capacity is projected for South Australia.
- Utility-scale PV contributes 4% of average employment in the Slow Change, 9% in the Step Change, and grows the fastest in the Hydrogen Superpower scenario, to account for 22% of electricity sector employment.

Repowering is replacing wind turbines or solar panels, either at the end of their life, or because technology improvements mean that the replacements are sufficiently higher performance to make replacement economic. Repowering is included for wind, utility solar, and rooftop solar, with employment factors and construction times assumed to remain the same. Employment associated with recycling of panels or turbines is not included.

Figure 8 South Australia, average electricity sector jobs by technology and scenario

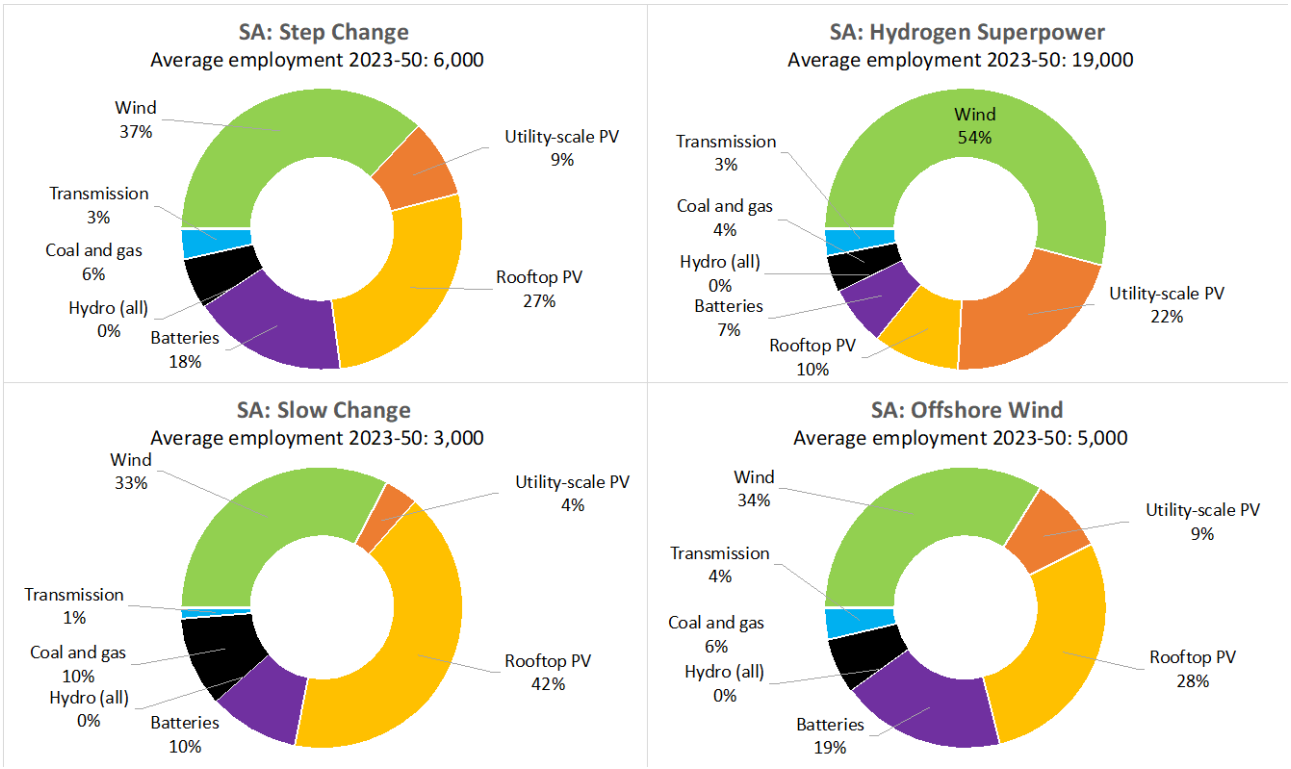
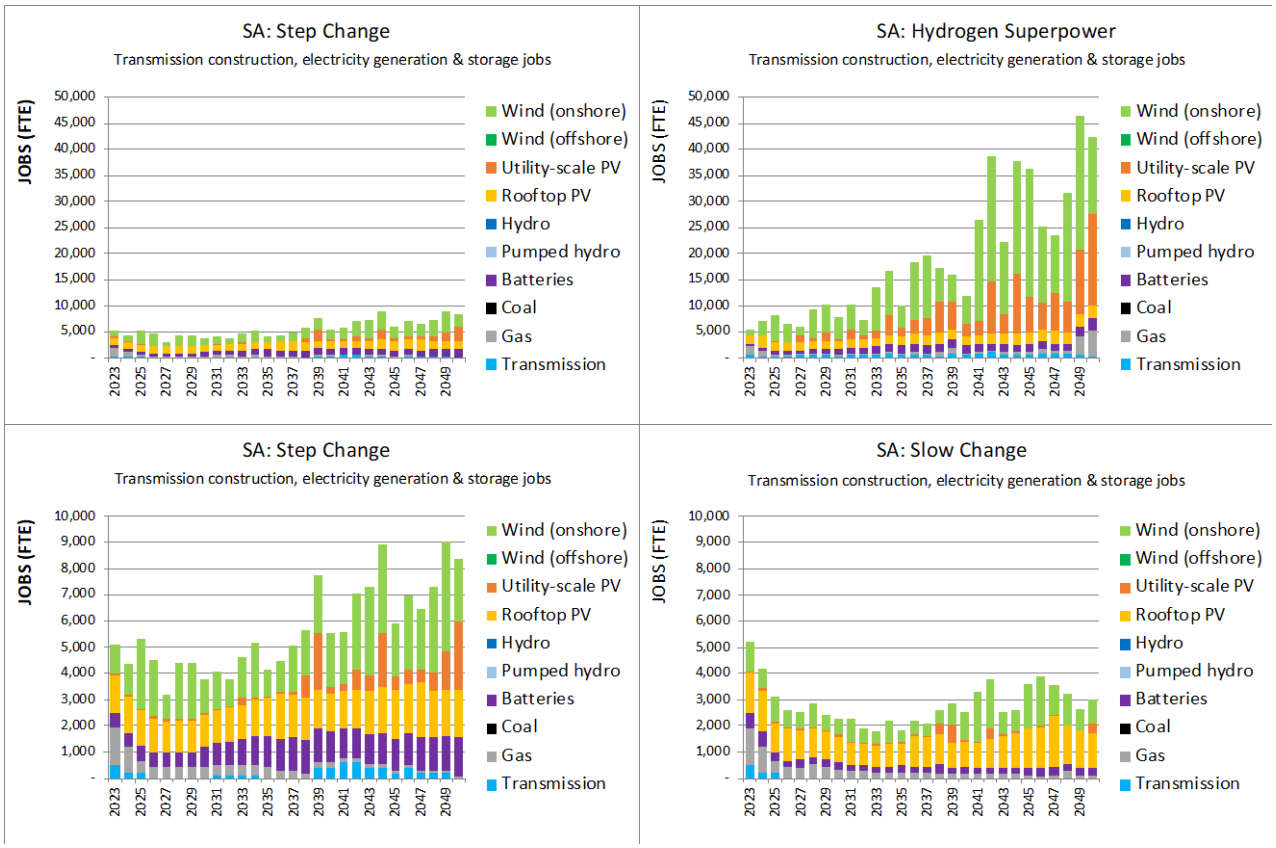


Figure 9 South Australia, jobs by technology (Step Change, Hydrogen Superpower, Slow Change)



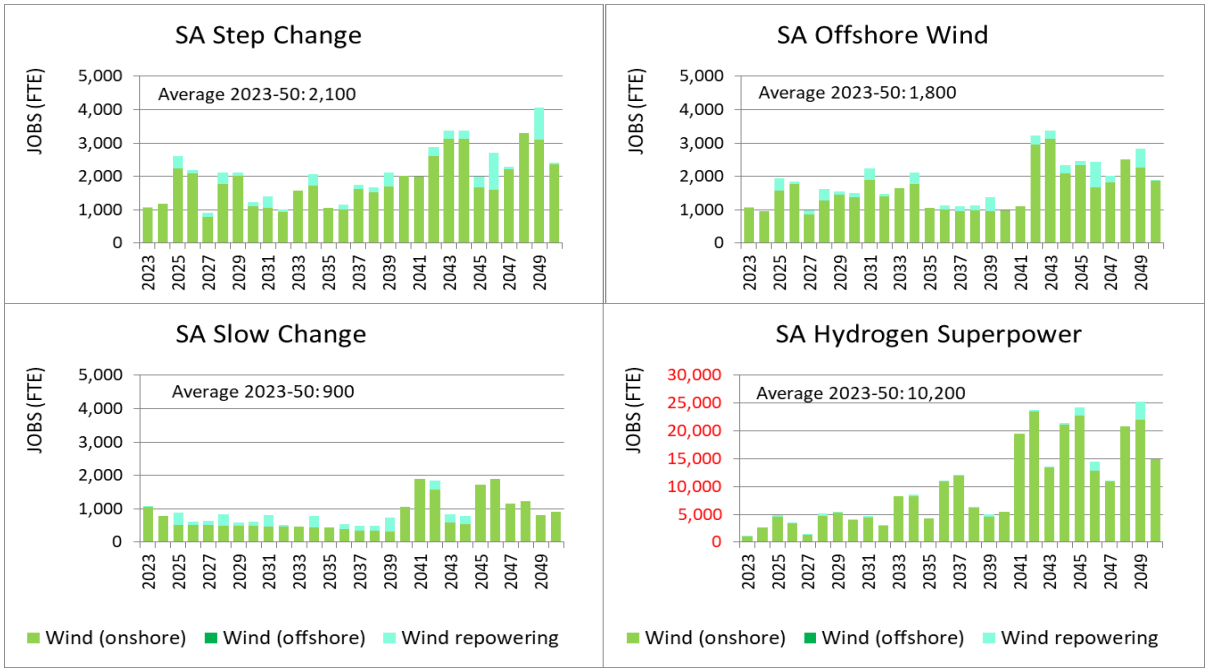
Note different scales for lower graphs

4.1 Wind

Total jobs in wind power for all four scenarios are shown in Figure 10 with an average employment of between 900 jobs per year in the Slow Change and up to 10,200 in the Hydrogen Superpower scenario. In the Step Change employment fluctuates corresponding to build periods during the 2020s, and then grows steadily for a decade from the mid-2030s. Repowering starts playing a noticeable role in the late 2030s, reaching a maximum of 4000 in 2049.

In the Offshore Wind scenario average employment is just below the Step Change, as growth in the second half of the 2030s is displaced by offshore wind elsewhere. Average employment in the Slow Change is less than 1,000 jobs, with marginal growth until the late 2040s.

Figure 10 South Australia, jobs in wind (all scenarios)



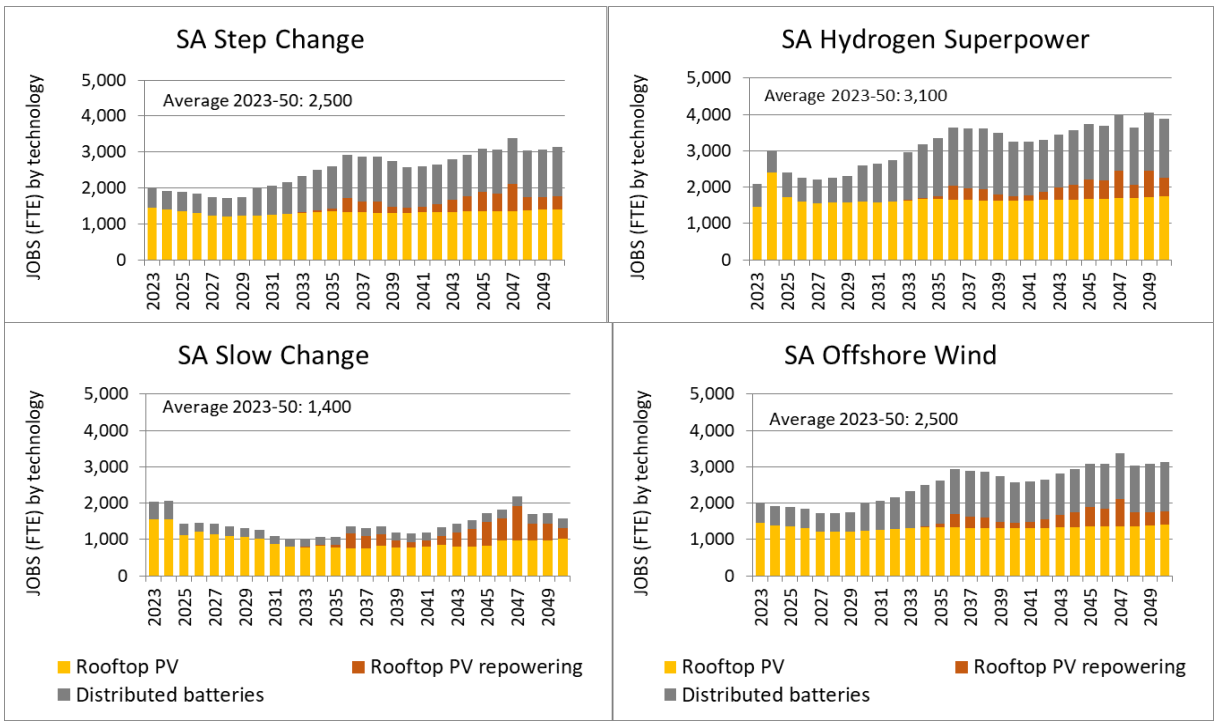
Note different scale for Hydrogen Superpower

4.2 Rooftop solar and distributed batteries

Employment in rooftop solar and distributed batteries for all scenarios is shown in Figure 11. Rooftop solar provides steady employment, with most growth and variability coming from installation of batteries. The employment profile is very similar between the Step Change and the Hydrogen Superpower, albeit with slightly higher employment in the Hydrogen Superpower (average of 2,500 – 3,1000 per year). The Offshore Wind scenario is the same as the Step Change.

Employment in the Slow Change is noticeably lower at 1,400 and falls during the 2020s, with very little growth in battery employment.

Figure 11 South Australia, jobs in rooftop solar and distributed batteries by scenario



4.3 Utility-scale PV

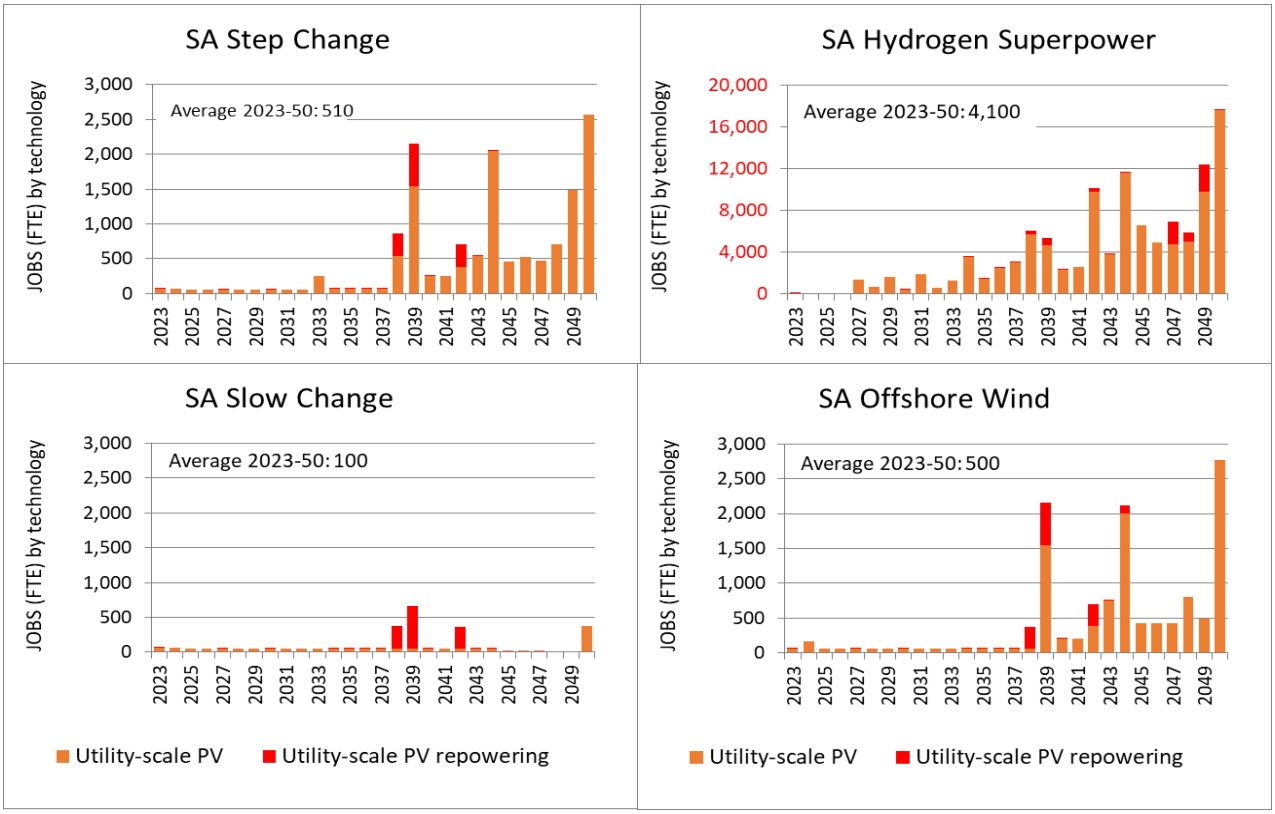
Total jobs in utility-scale PV for all scenarios are shown in Figure 12 with an average of between 100 in the Slow Change and up to 4,100 in the Hydrogen Superpower scenario.

In the Step Change scenario, utility-scale solar employment averages 500, but only takes off in the late 2030s to reach a maximum of 2,500 at the end of the period. Repowering starts to play a noticeable role in the late 2030s. Employment in the Offshore Wind scenario is very similar to the Step Change up until the late 2040s, when there is a noticeable reduction in employment as solar farms are displaced by offshore wind elsewhere.

Utility-scale PV only takes off significantly in the Hydrogen Superpower scenario, where it grows fairly steadily from the mid-2020s. Employment averages of just over 4,000 jobs and reaches a maximum approaching 17,000.

Average employment in the Slow Change is only 100 with marginal growth until the 2040s

Figure 12 South Australia, jobs in utility-scale solar by scenario

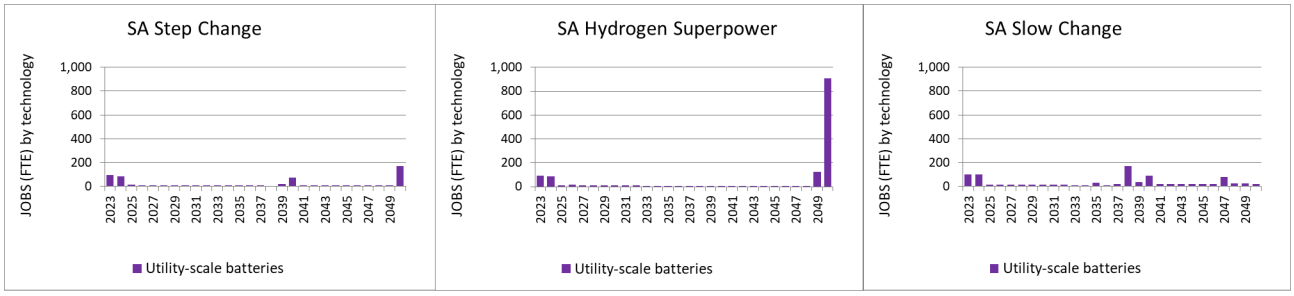


Note different scale for Hydrogen Superpower

4.4 Large scale storage: utility batteries

Employment in utility batteries is shown in Figure 13 for the Step Change, Hydrogen Superpower, and Slow Change. Offshore Wind is not shown, as the profile is the same as the Step Change. Employment is sporadic, corresponding to years when there is an increase in capacity. There is no pumped hydro development projected in South Australia.

Figure 13 SA, jobs in utility scale batteries (Step Change, Hydrogen Superpower, Slow Change)

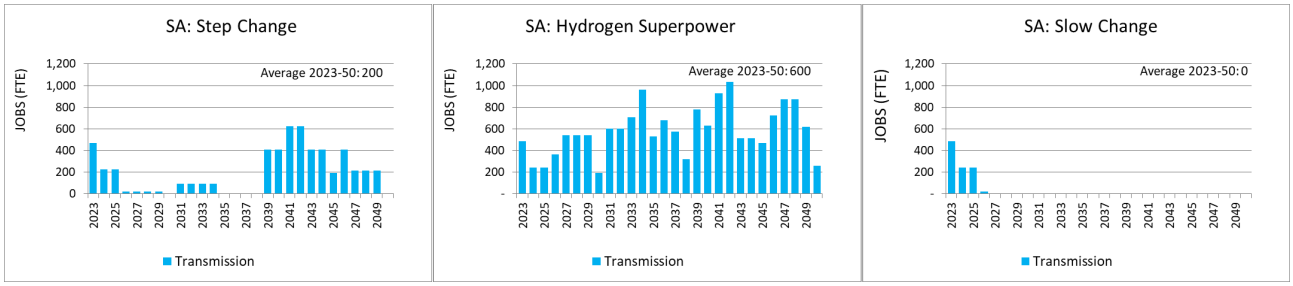


4.5 Transmission construction

Employment in transmission construction[1] is compared for the Step Change, Hydrogen Superpower, and Slow Change scenarios in Figure 14 (Offshore Wind is identical to the Step Change scenario). The employment profile corresponds to build periods for transmission lines, and averages around 200 jobs in the Step Change scenario, and 600 jobs in Hydrogen Superpower.

The Step Change scenario features a peak in employment between 2023 and 2025 of nearly 500 jobs, employment drops in the 2030s and then rises again to 600 jobs in the 2040s. The Hydrogen Superpower scenario has a much stronger employment profile, although employment is volatile with peaks in 2034 and 2042 of around 1,000 jobs, dropping to as little as 200 jobs in 2030. Slow change features very little transmission employment, with a peak of around 500 jobs in 2023 and then dropping to nothing by 2027.

Figure 14 SA, jobs in transmission (Step Change, Hydrogen Superpower, Slow Change)



[1] This projection only includes transmission construction as it would be extremely difficult to separate operation and maintenance for the new lines from the operations and maintenance for the rest of the network

5 Electricity sector workforce projections, by REZ

In South Australia, over 15.5 GW of new utility-scale wind and solar renewable generation is projected under the Step Change Scenario for the candidate REZs by 2050. It is not yet determined which REZs will go ahead, so four were selected based on the most significant renewable capacity shown in the ISP. Figure 15 shows the candidate REZs identified in the ISP, with the four modelled here indicated in red. They are South East SA, Mid-North SA, Leigh Creek, and the Eastern Eyre Peninsula, noting that the employment associated with any offshore development in Offshore Zone 6 has been allocated to South East SA. Employment associated with electricity infrastructure in the rest of the state, including the other REZs, has been modelled as 'Rest of South Australia'.

Figure 15 Candidate REZs for South Australia, and the REZs with modelled employment

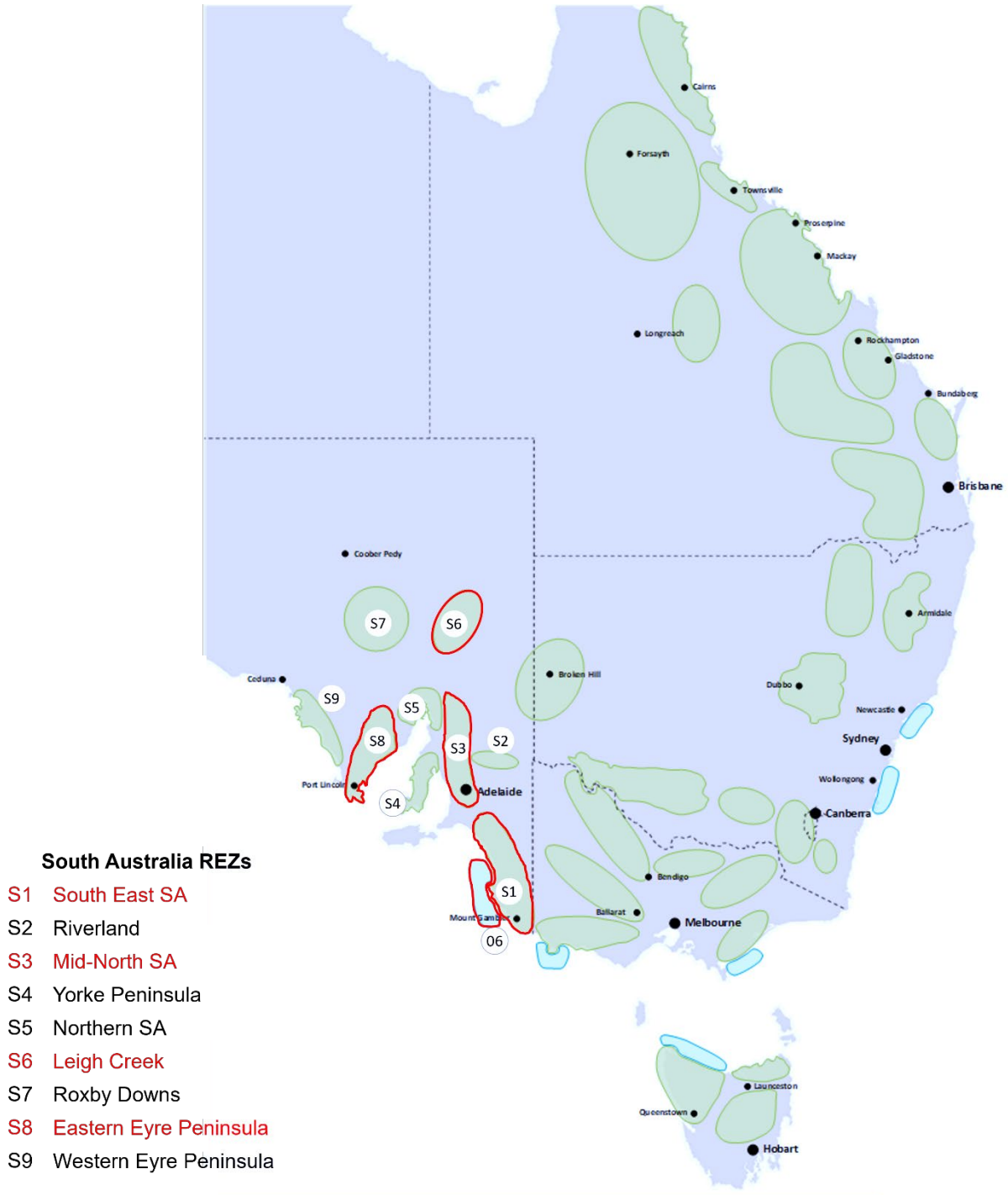
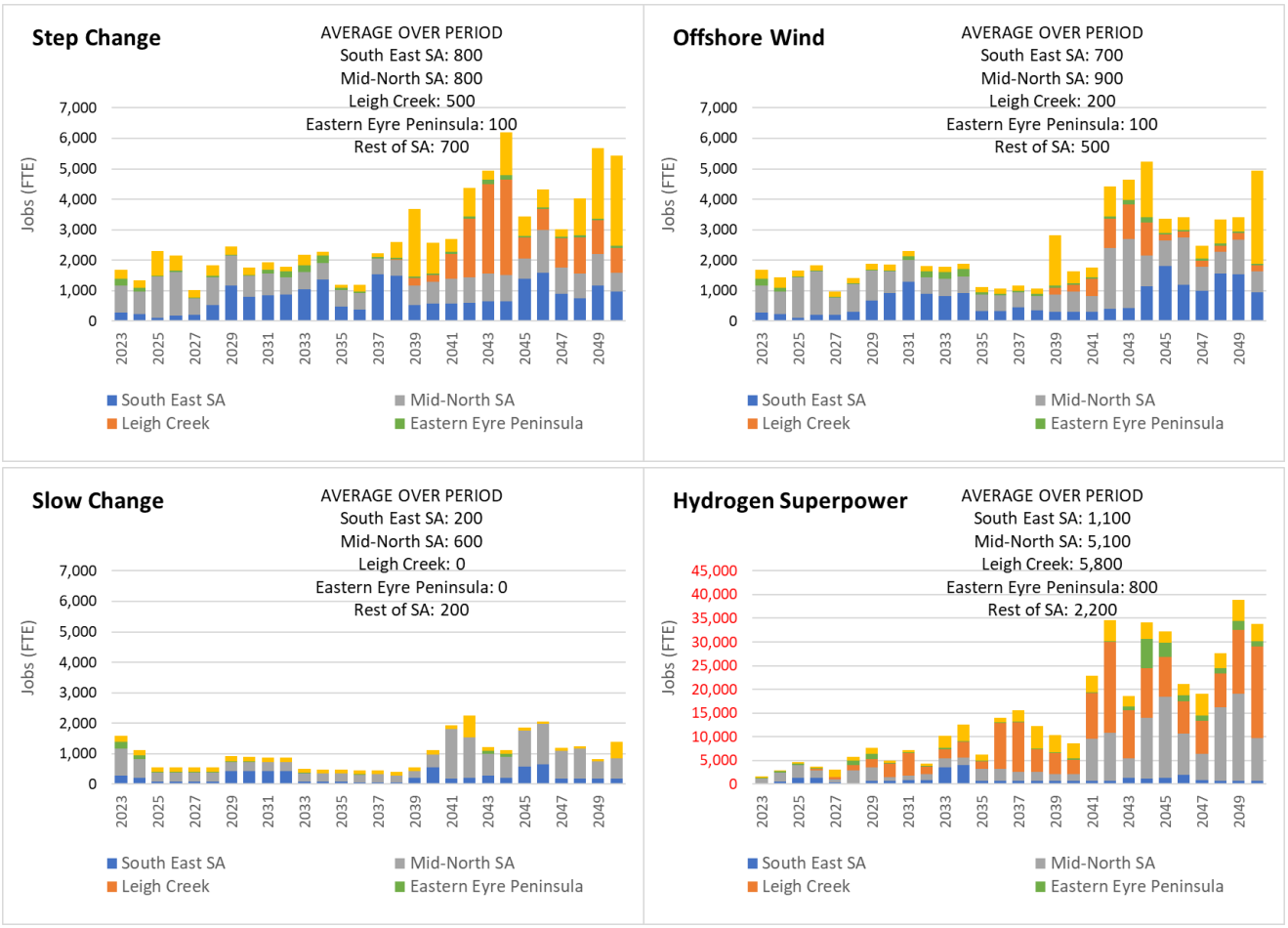


Figure 16 Employment by SA REZ (all scenarios)



Note different scale for Hydrogen Superpower

Figure 16 compares employment in all Scenarios for the four REZs and the rest of South Australia. In the Step Change, Slow Change, and Offshore wind scenarios South East SA or Mid-North SA have the highest employment, with Eastern Eyre Peninsula much lower. In the Hydrogen Superpower, utility-scale solar becomes important, with the result that the more northern REZs, particularly Leigh Creek and Mid-North SA, have the greatest employment creation; the Eastern Eyre Peninsula also grows strongly.

Figure 17 compares wind employment for REZs in the Step Change and Offshore Wind scenarios; overall employment drops slightly in the Offshore Wind scenario (Figure 10). For individual REZs the variation is mostly a small drop, as offshore technology in other states displaces onshore wind in South Australia, although employment in the Mid North REZ increases slightly. The main reduction is in other REZs which have not been modelled (shown as 'Rest of SA').

Figure 18 shows wind employment the Hydrogen Superpower scenarios, noting that the scales are an order of magnitude higher in the Hydrogen Superpower scenario. The Mid-North REZ sees very strong growth after the 2040s, with maximum employment above 15,000. The Slow Change sees significant reductions of wind employment for most REZs and for most of the period.

Figure 19 shows employment in utility-scale PV in the Step Change and the Hydrogen Superpower scenarios, noting that the scale for Leigh Creek is significantly different. In the Step Change, some utility-scale PV is developed in the late 2030s and 2040s in the northern REZs. In the Hydrogen Superpower employment grows from the late 2020s, with very strong growth in the Leigh Creek REZ.

There is almost no development of this technology in the Slow Change, and the Offshore Wind scenario is very similar to the Step Change).

Figure 17 Employment in wind by SA REZ, Step Change and Offshore Wind

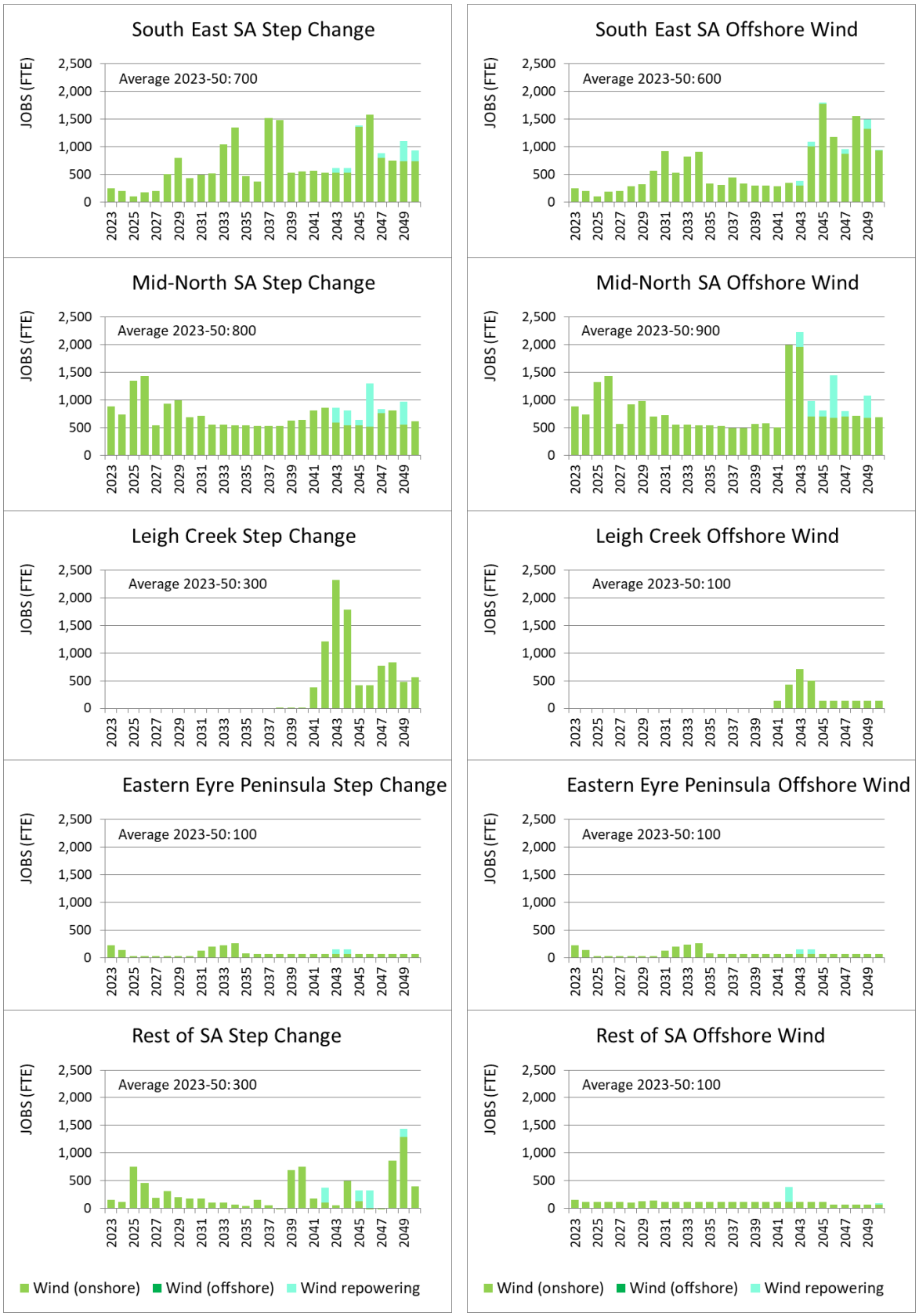


Figure 18 Employment in wind by SA REZ, Hydrogen Superpower

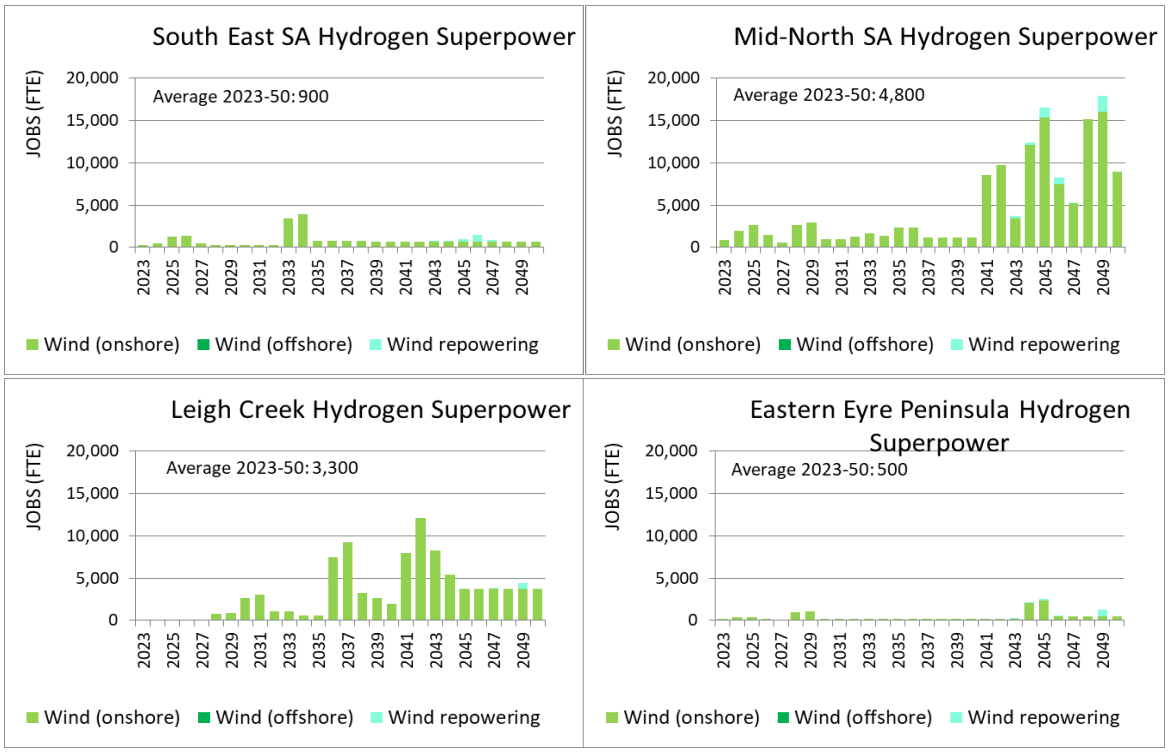
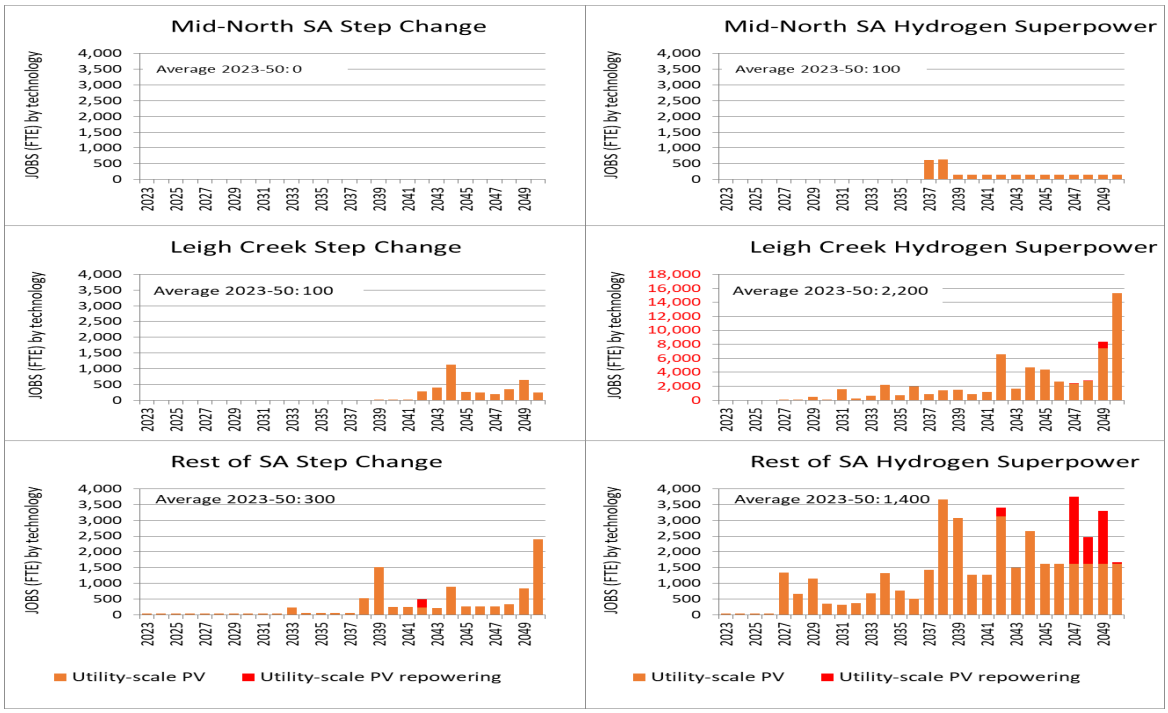


Figure 19 Employment in utility-scale PV by SA REZ, Step Change and Hydrogen Superpower



Note different scale for Leigh Creek

Appendix A Additional information on South Australian occupational breakdown

Figure 20 SA, in-demand occupations during peak year (2034) for the Hydrogen Superpower

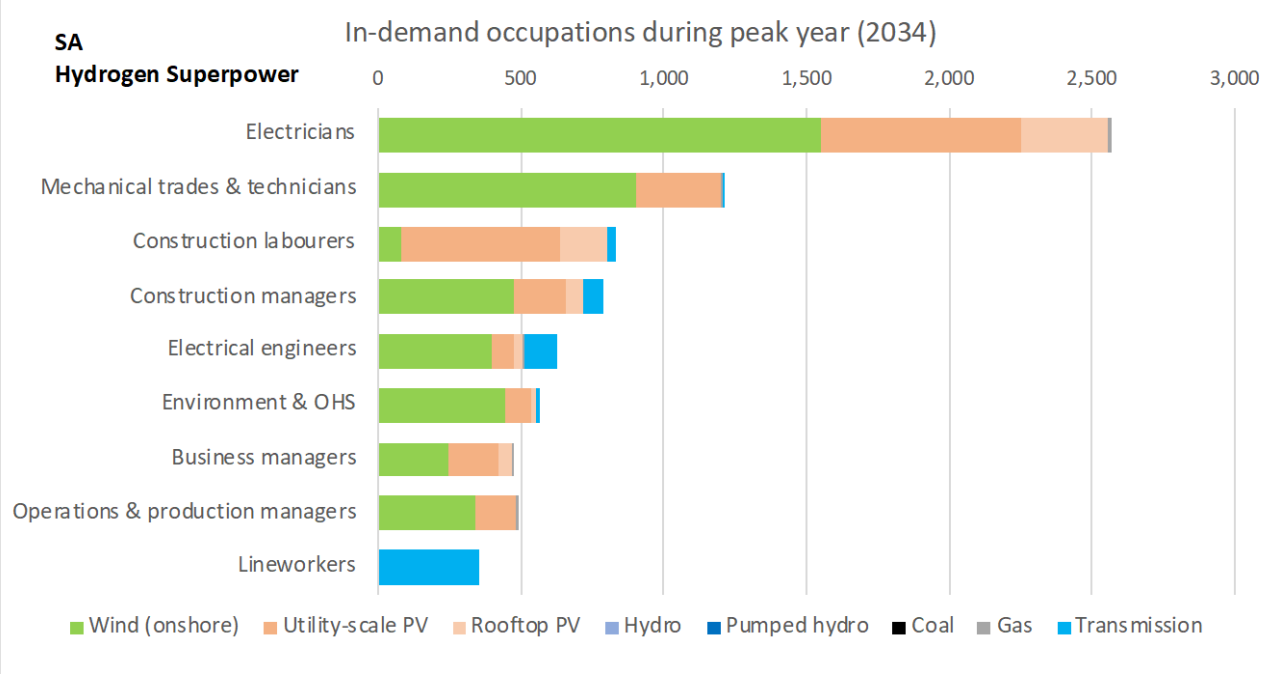
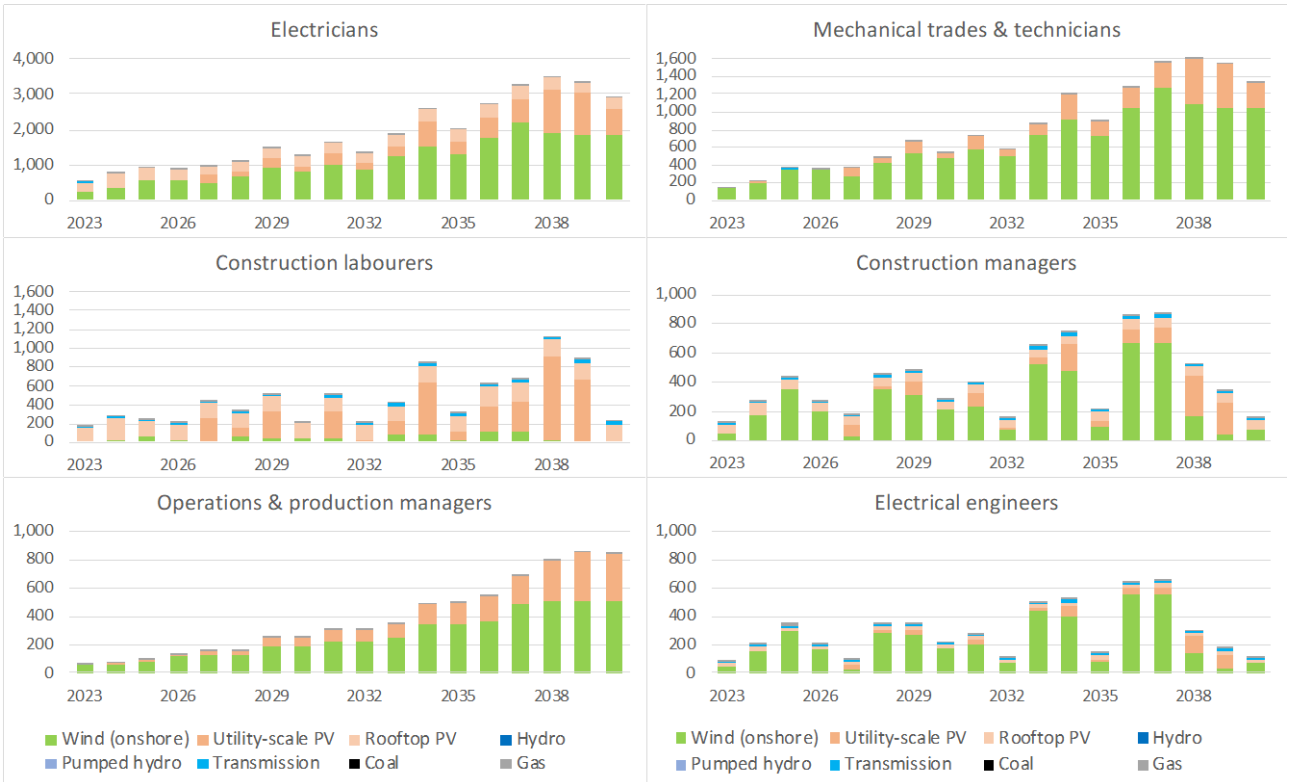


Figure 21 SA, in-demand occupations annual requirement by technology, Hydrogen Superpower



Note different scales: electricians 0-4,000, mechanical trades & technicians, construction labourers 0-1,600, construction managers and operations & production managers, and electrical engineers 0-1,000

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