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E3 Fast track

Electricity Sector Workforce Projections for the 2022 ISP: Focus on Queensland. 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
The Australian Electricity Workforce for the 2022 Integrated System Plan: Focus on Queensland

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.

Citation

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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 Queensland 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 Queensland broken down by technology, occupation, and location for three ISP scenarios and one sensitivity:

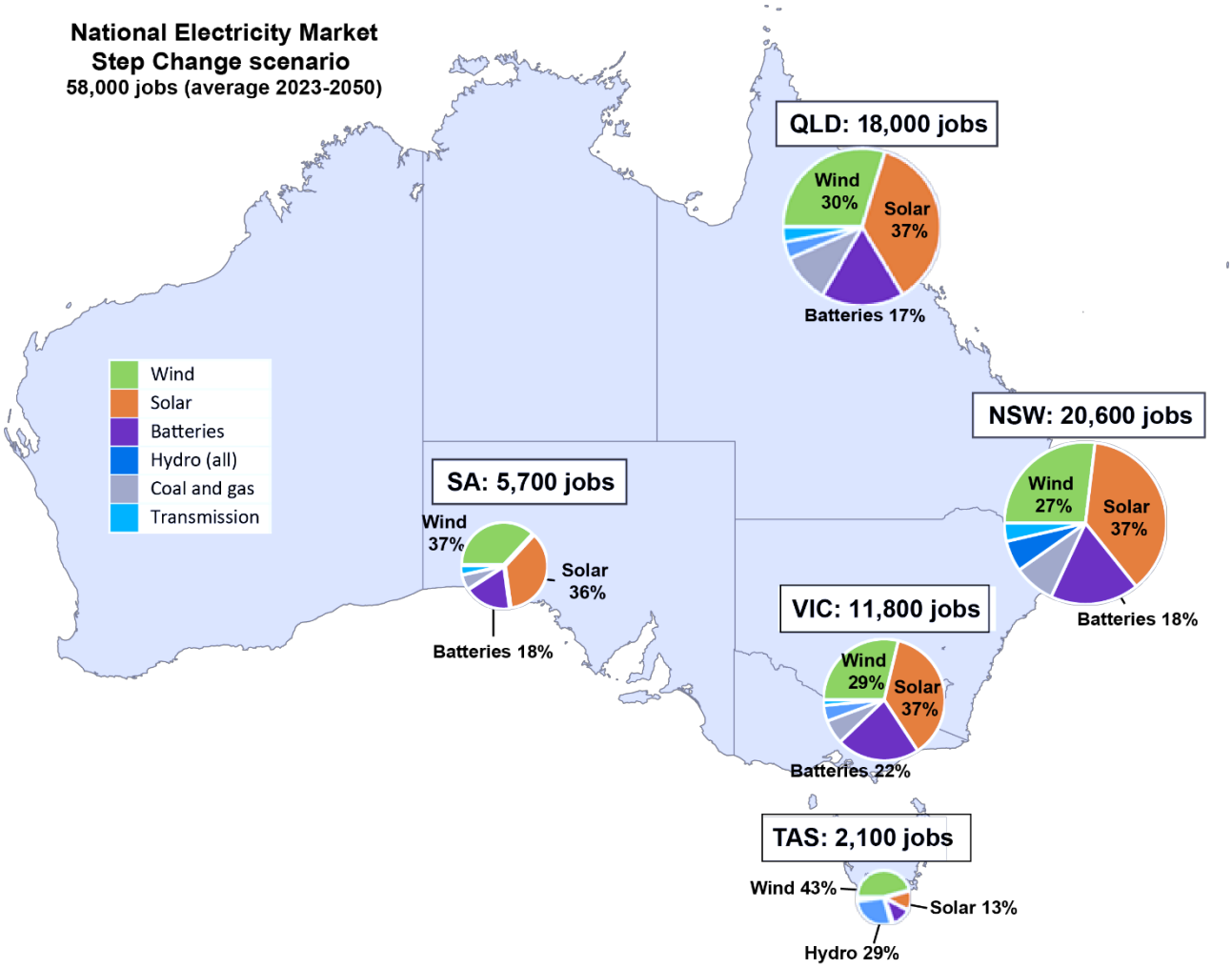
- **The Step Change scenario:** includes rapid consumer-led transformation of the energy sector and co-ordinated economy-wide action moving fast to fulfil Australia's net zero policy commitments. Energy stakeholders consider this the most likely scenario, as the NSW Electricity Infrastructure Roadmap 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. There is no offshore wind in Queensland, and offshore wind capacity elsewhere displaces 0.9 GW of onshore wind and 2 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 Queensland in context, Queensland accounts for nearly one third of the average 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 Queensland by scenario

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

- Under the Step Change scenario, employment averages 16,000 per year until 2040, increasing from 10,000 in 2023 to peak at 22,000 in 2039. From 2040 to 2050 the average employment is 21,000 per year, with a maximum of 27,000.
- Under the Hydrogen Superpower scenario, employment averages 25,000 per year up to 2040, with a peak of 43,000 in 2035. There is especially strong growth in the 2040s, with average employment of 67,000 per year from 2040 to 2050 and a peak of 110,000 at the end of the period.
- Under the Slow Change scenario, employment falls to a low of 6,000, and averages only 8,000 per year up to 2040 (9,000 per year 2040–2050) as the pace of energy transition slows.
- Employment in the Offshore Wind is very similar to the Step Change scenario. There is no offshore wind capacity projected in Queensland, and there is marginally lower employment compared to the Step Change. This reflects the displacement of some onshore wind, utility-scale solar and utility storage in Queensland by offshore wind elsewhere[1]. The impact is small, with average employment and minimum employment the same in both scenarios.

The Step Change is widely considered the most likely scenario, and the rest of this report will present graphical results comparing the Step Change to the Hydrogen Superpower and the Slow Change scenarios, It will not present further results for the Offshore Wind scenario, as the impact in Queensland is minimal.

Figure 2 Queensland, electricity sector jobs by scenario

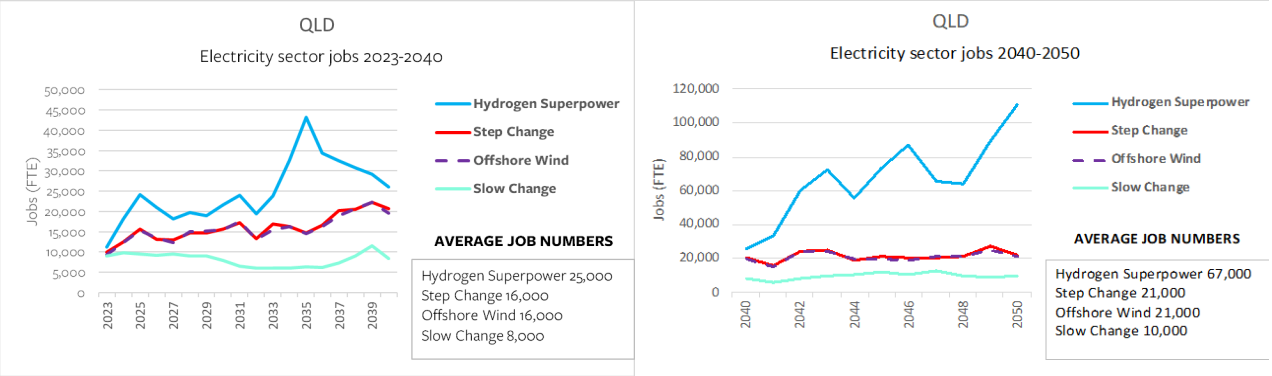


Figure 3 shows the total employment by whether it is construction, manufacturing, operations and maintenance, or fuel supply. Under all scenarios, construction dominates the employment profile through the 2020s but ongoing operations and maintenance (O&M) employment gradually increases as the fleet of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

O&M employment grows to 69% in the Step Change scenario by the end of the period and 58% in the Slow Change scenario. In the Hydrogen Superpower scenario, the continuing construction means the proportion of O&M is lower, at 45%, although the actual amount of employment is much higher.

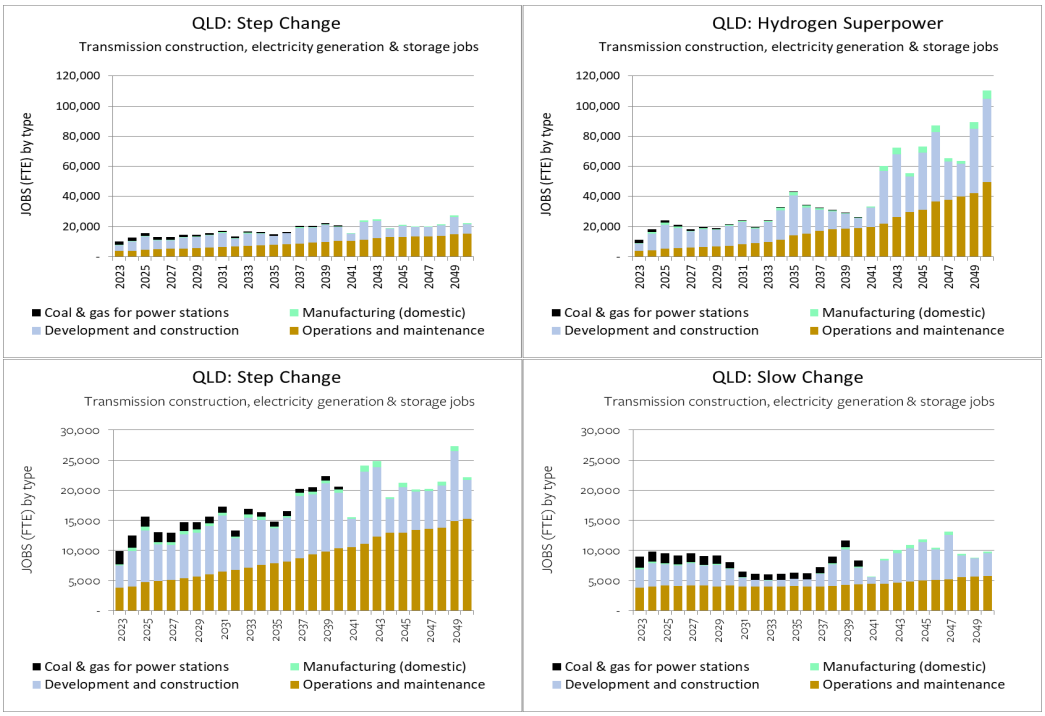
Jobs are presented as full time equivalent (FTE) for each year and are the sum of people working on construction projects, operations and maintenance, manufacturing, and fuel supply for coal and gas generation in that year. One FTE could be one person working full time, two people working full time for six months, or an on-going 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.

[1] In 2050 projected onshore wind in Queensland is reduced by 2 GW compared to the Step Change scenario, utility solar is reduced by 1 GW, and utility storage is reduced by 1 GW.

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 in the electricity sector falls to close to 1% in the Step Change and Hydrogen Superpower scenarios and to 7% in the Slow Change scenario (this does not include jobs associated with coal and gas for export).

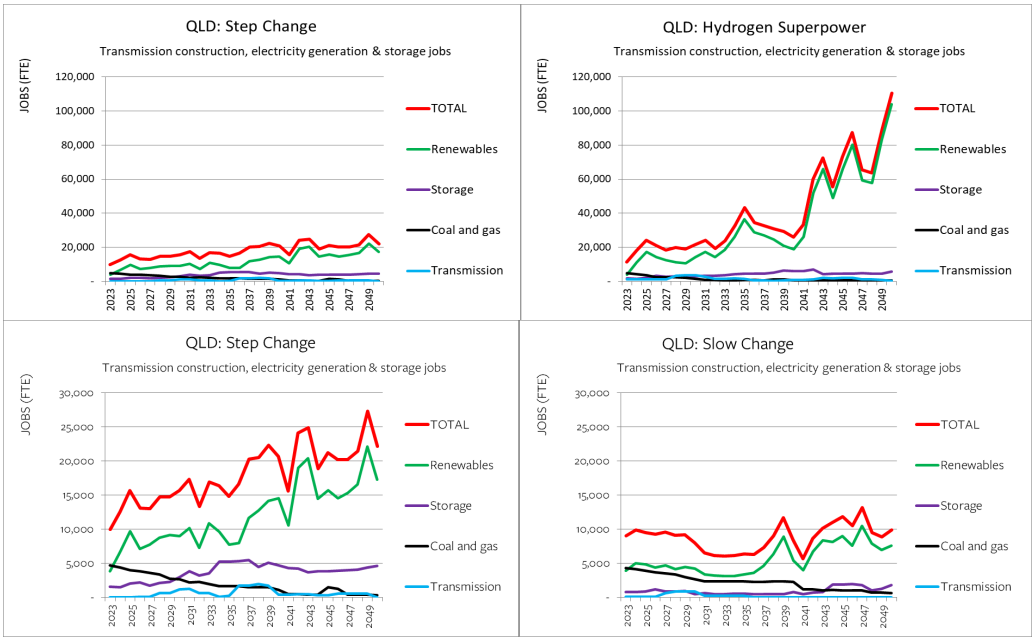
The numbers of jobs added varies significantly by scenario, particularly by the end of the projection period. Taking the 2023 total in the Step Change scenario (10,000) as the reference point in all cases, in the Step Change scenario there are 11,000 additional jobs in 2040 (12,000 extra by 2050), in the Hydrogen Superpower scenario there are 16,000 additional jobs in 2040 (100,000 extra by 2050), in the Slow Change scenario there are 2,000 **fewer** jobs in 2040 (1,000 fewer by 2050), and in the Offshore Wind scenario there are 10,000 additional jobs in 2040 (11,000 extra by 2050).

Figure 3 Queensland, jobs by phase and scenario



Note different scale for lower graphs

Figure 4 Queensland, jobs by technology group by scenario



Note different scale for lower graphs

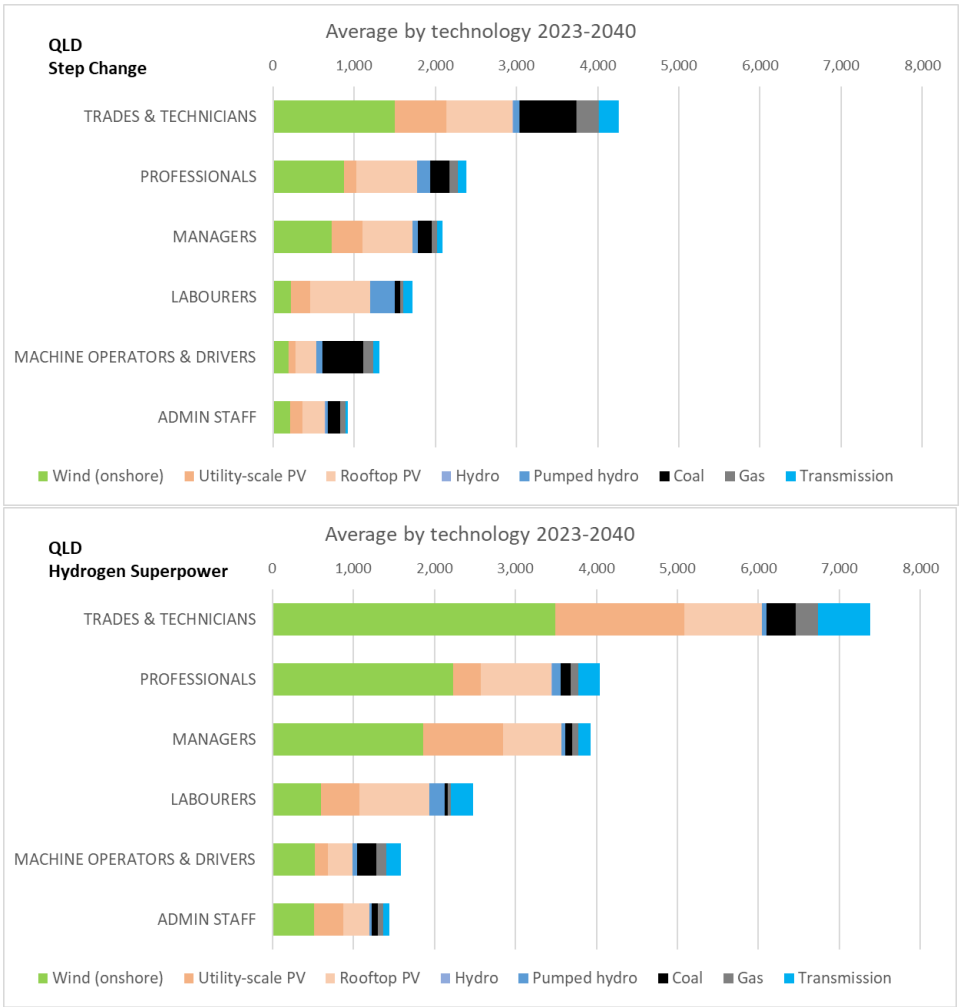
3 Queensland – Employment by Occupation

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 over 4,000 per year until 2040 under the Step Change scenario and around 7,500 under the Hydrogen Superpower scenario.
- The next largest groups are professionals (around 2,500 per year across a wide range of occupations including finance, health and safety, engineers – or over 4,000 for Hydrogen Superpower) and managers (over 2,000 per year led by construction managers – or just under 4,000 for the Hydrogen Superpower scenario)
- 1,700 labourers are projected per year (especially construction labourers), 1,300 machine operators and drivers (e.g., truck drivers, crane operators) and 900 administrative staff. Under the Hydrogen Superpower scenario, there would be demand for around 2,500 labourers, 1,600 machine operators and drivers, and 1,500 administrative staff.

Figure 5 Queensland, 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 year in this period is chosen to illustrate the requirement for the most in-demand occupations.

Labour requirements in 2031 (the peak year before 2035 in the Step Change scenario) are shown in Figure 6. There are nearly 2,500 electricians and 1,000 construction labourers in the Step Change scenario. In the Hydrogen Superpower these requirements are much higher, with nearly 3,400 electricians and 1,400 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 5. 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 Queensland, in-demand occupations during Step Change peak year (2031)

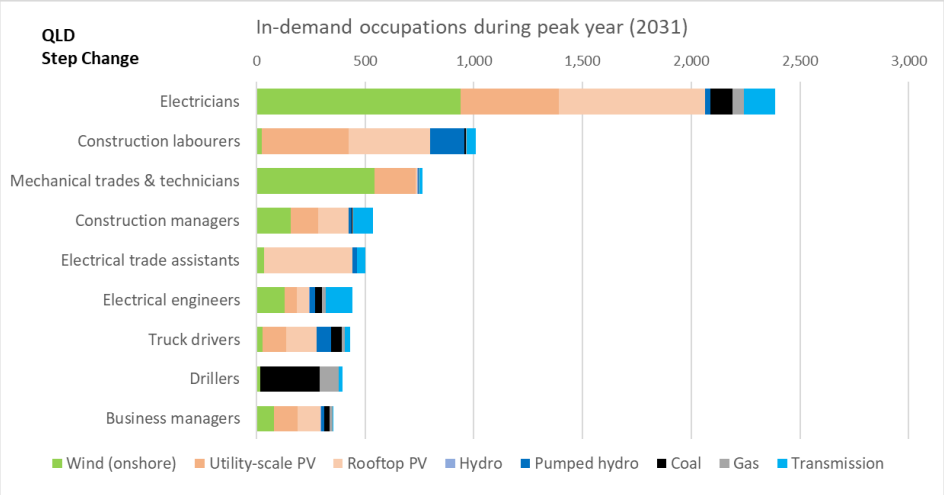
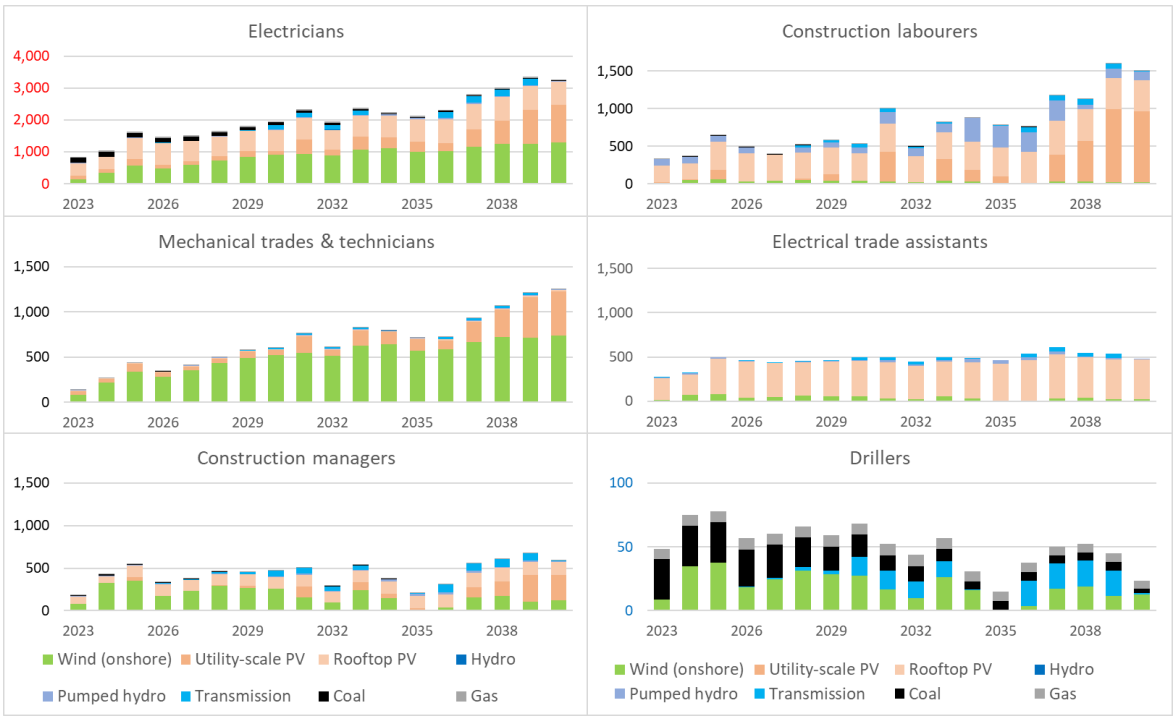


Figure 7 Queensland, in-demand occupations annual requirement by technology, Step Change



Note different scales: electricians 0-4,000; construction labourers, mechanical trades, construction managers & electrical trade assistants 0-1,500, and drillers 0-100.

4 Workforce projections by technology for Queensland

Under all scenarios, most employment growth occurs in wind farms. Figure 8 shows the average employment by technology over the period, while Figure 9 shows the annual variation.

- Rooftop solar and distributed batteries employment combined account for the highest share in the Step Change, Slow Change, and Offshore Wind scenarios, with over 40% of average electricity sector jobs. In the Hydrogen Superpower scenario, the number of these jobs are slightly higher than the other scenarios, although the proportion of total employment is much lower (19%) as other technologies grow so fast.
- Wind accounts for next greatest share of employment in the Step Change, Slow Change, and Offshore wind scenarios, varying from 22% to 30%, and 50% of all employment in the Hydrogen Superpower scenario. Wind accounts for a slightly lower proportion of the total employment in the Offshore Wind compared to the Step Change scenario (29% rather than 31%), as offshore wind in other states displaces a certain amount of onshore wind in Queensland. There is no offshore wind forecast for Queensland.
- Utility-scale PV grows the fastest in the Hydrogen Superpower scenario, and accounts for 22% of electricity sector employment (9%-14% in the other scenarios).

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-scale 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 Queensland, average electricity sector jobs by technology and scenario

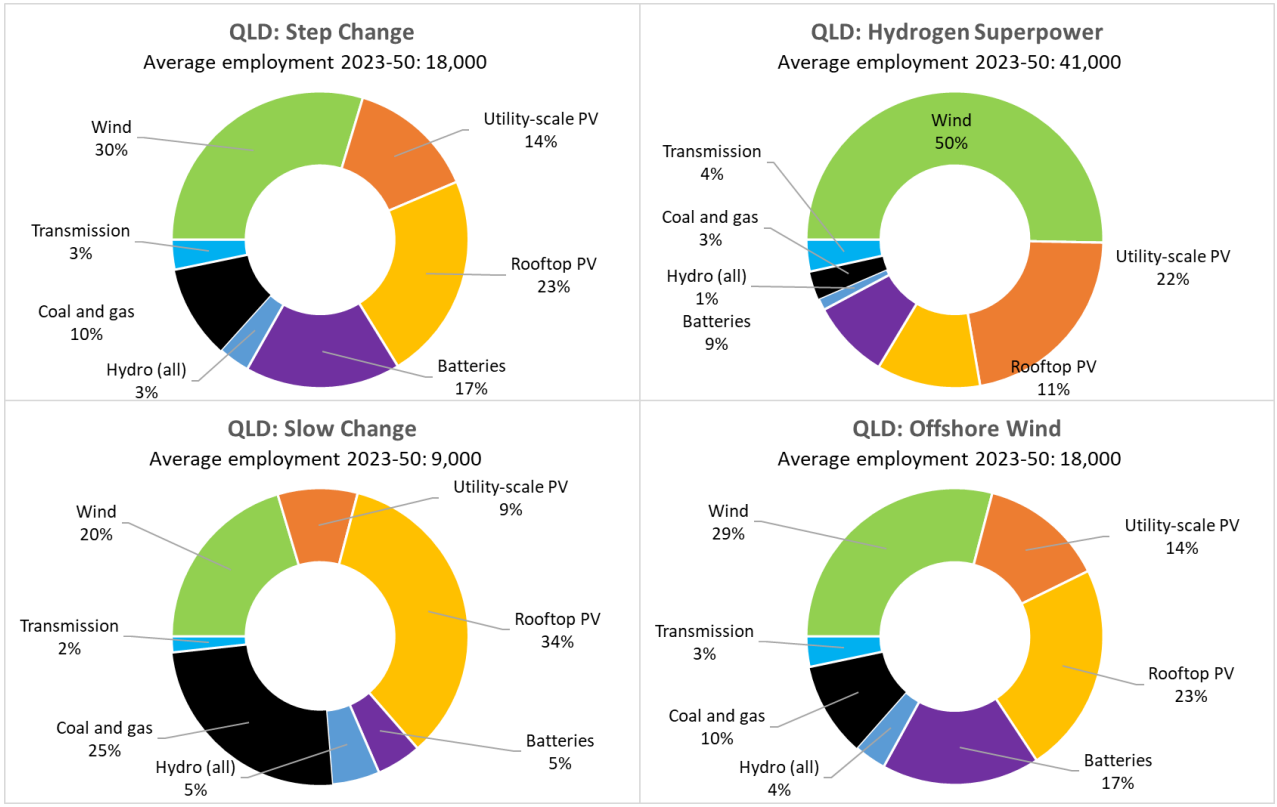
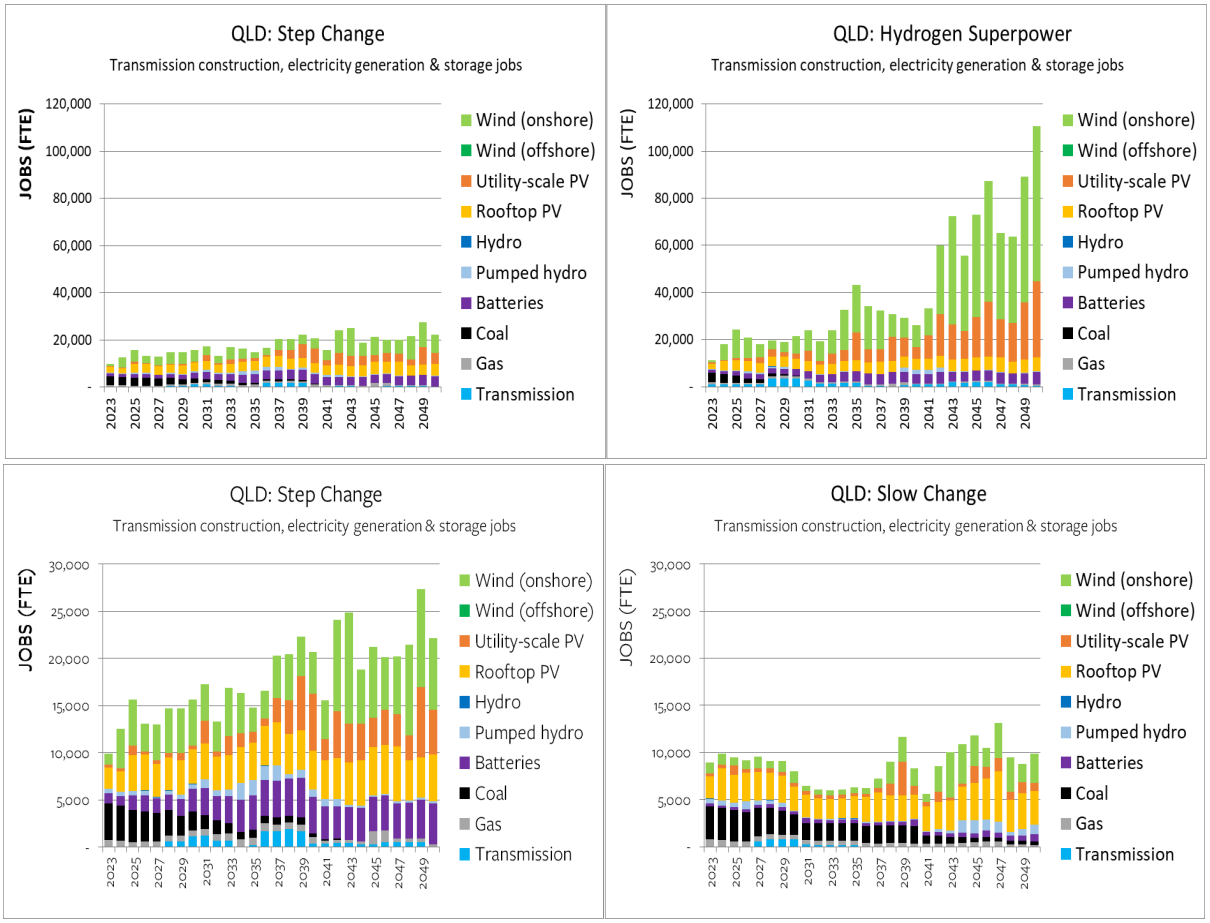


Figure 9 Queensland, jobs by technology (Step Change, Hydrogen Superpower, Slow Change)



Note different scale for lower graphs

4.1 Wind

Total jobs in wind power for all four scenarios are shown in Figure 10 with an average of between 1,800 in the Slow Change and up to nearly 21,000 in the Hydrogen Superpower scenario.

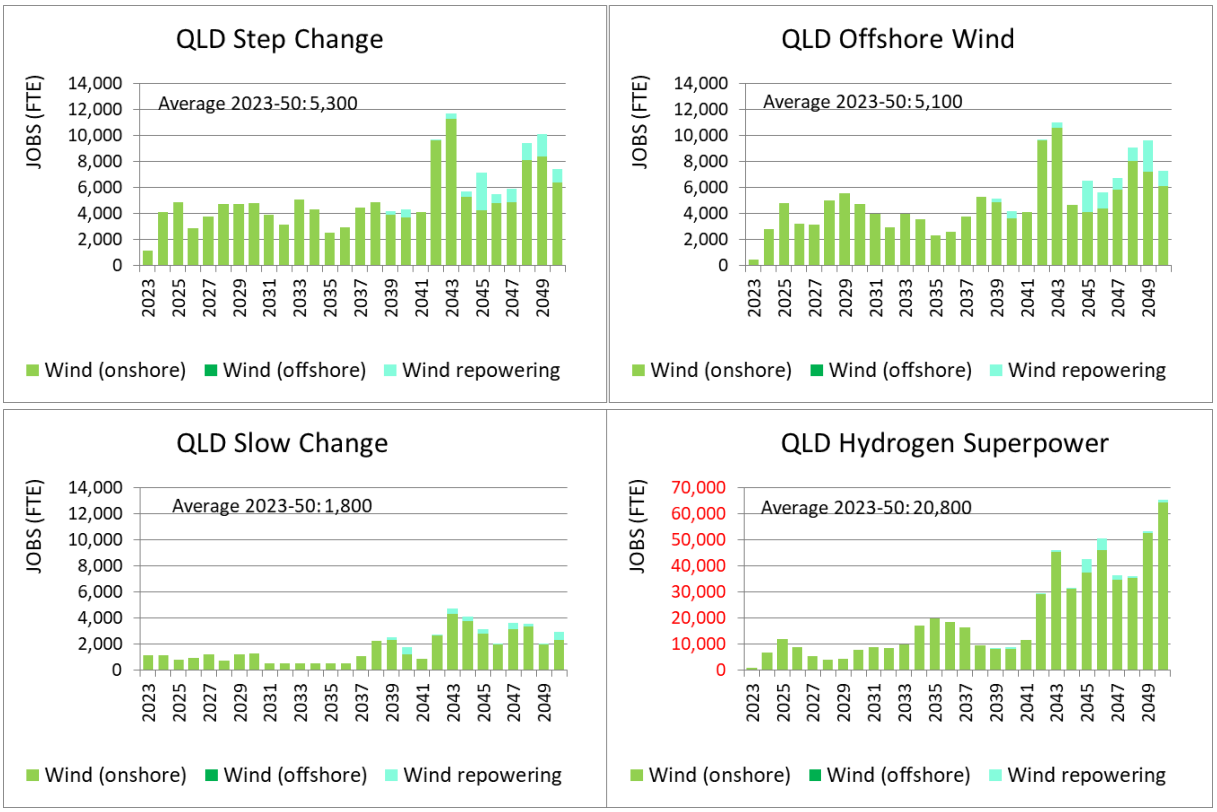
Wind employment generally grows steadily during the period in the Step Change scenario, apart from some employment peaks corresponding with large build periods, and averages 5,300 per year. Repowering starts playing a

noticeable role in the late mid-2040s.Employment in the Offshore Wind scenario is somewhat lower, reflecting the displacement of onshore capacity by offshore wind elsewhere.

Employment is greatest in the Hydrogen Superpower scenario with an average of nearly 21,000 jobs. After a dip in the 2030s, employment grows steadily until 2039 and starts playing a more important role with a peak in repowering jobs in 2040 and 2046.

Average employment in the Slow Change is only 1,800 with marginal growth until the late 2030s.

Figure 10 Queensland, jobs in wind by scenario

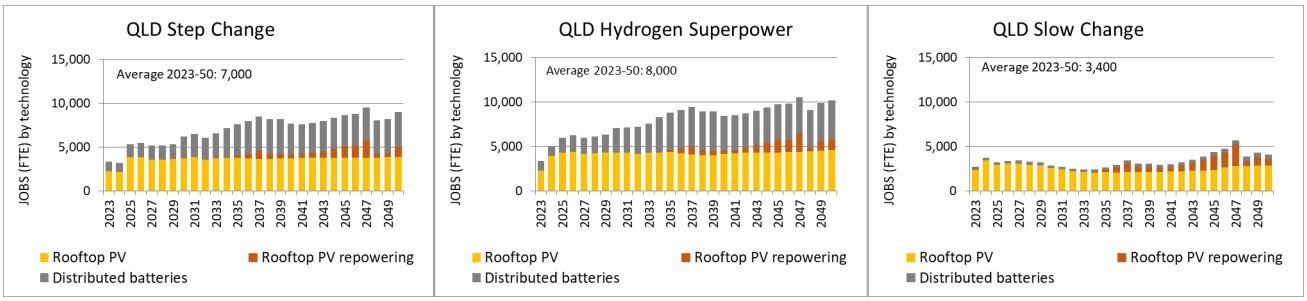


Note Hydrogen Superpower scale is 0-70,000, remainder 0-14,000

4.2 Rooftop solar and distributed batteries

Employment in rooftop solar and distributed batteries are shown for the scenarios in Figure 11 (noting that offshore wind is not included as it is the same as the Step Change). Rooftop solar provides steady employment, with most of the growth and variability coming from installation of batteries. The employment profile is very similar between the Step Change and the Hydrogen Superpower average (average of 7,000-8,000 per year), with the Slow Change significantly lower at 3,400. Rooftop solar repowering starts playing a noticeable role in the mid-2030s.

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



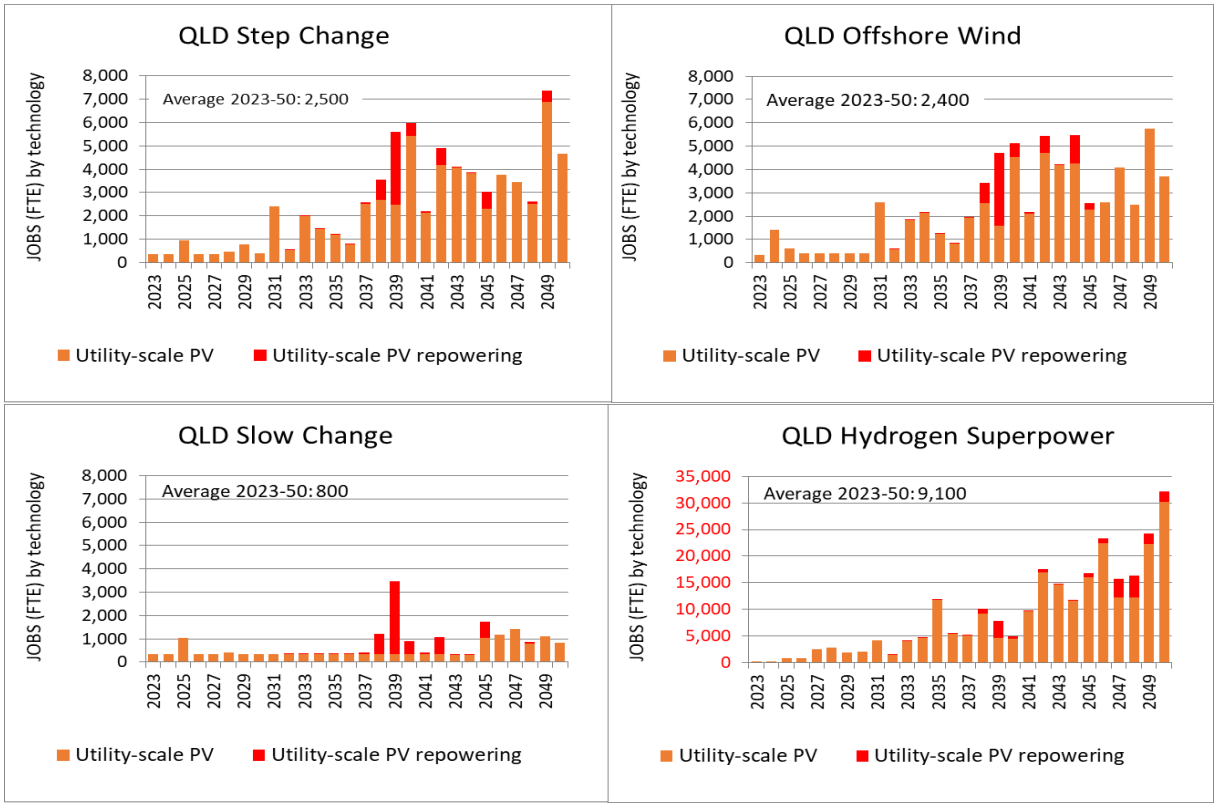
4.3 Utility-scale PV

Total jobs in utility-scale PV for all scenarios are shown in Figure 12, with an average of between 800 in the Slow Change and up to 9,100 in the Hydrogen Superpower scenario.

Utility-scale PV employment generally grows steadily during the period in the Step Change scenario, and averages 2,500 per year. Jobs are reduced in the Offshore Wind scenario, reflecting the displacement of solar farms by offshore wind in other states. Repowering starts playing a noticeable role in the late 2030s.

Employment is greatest in the Hydrogen Superpower scenario with an average of just over 9,000 jobs, while Average employment in the Slow Change is only 800 with marginal growth until the late 2040s.

Figure 12 Queensland, jobs in utility-scale solar by scenario



Note Hydrogen Superpower scale is 0-35,000, remainder 0-8,000

4.4 Large scale storage

Pumped hydro jobs are shown in Figure 13 and utility batteries in Figure 14 for the Step Change, Hydrogen Superpower, and Slow Change scenarios, noting that the scale for pumped hydro (Figure 13) goes from 0-2,500 and the scale for batteries employment goes from 0-1,200. Offshore Wind is not shown as the profile is the same as the Step Change scenario.

Figure 13 Queensland, jobs in pumped hydro (Step Change, Hydrogen Superpower Slow Change)

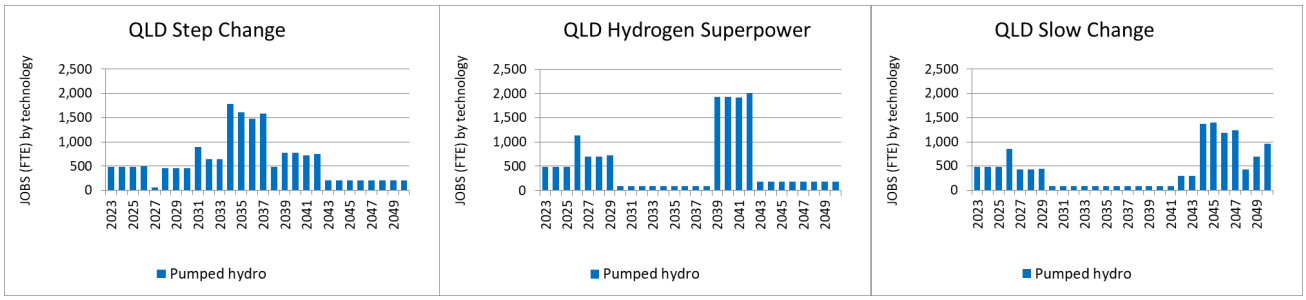
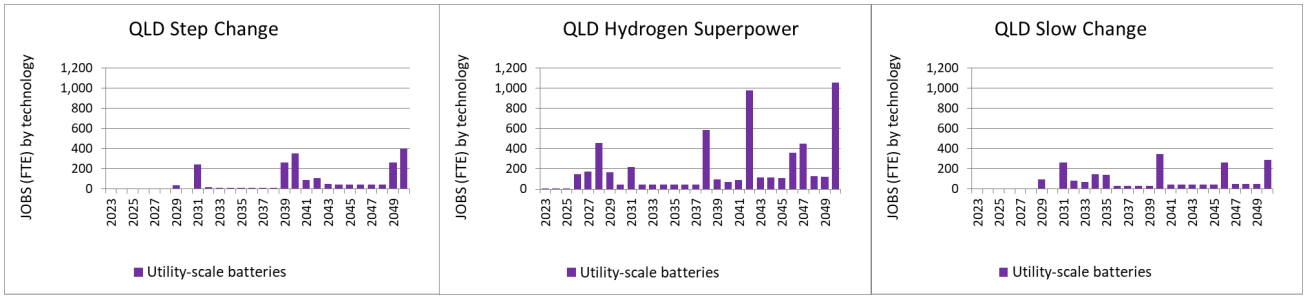


Figure 14 Queensland, jobs in utility-scale batteries (Step Change, Hydrogen Superpower, Slow Change)



Jobs in pumped hydro are volatile, reflecting the periods when new facilities are constructed. There is an extended build period in the Step Change, which continues from now until the early 2040s. In the Hydrogen Superpower and Slow Change scenarios there is a period of activity during the 2020s, followed by a low period, and then activity starts again in the late 2030s or early 2040s.

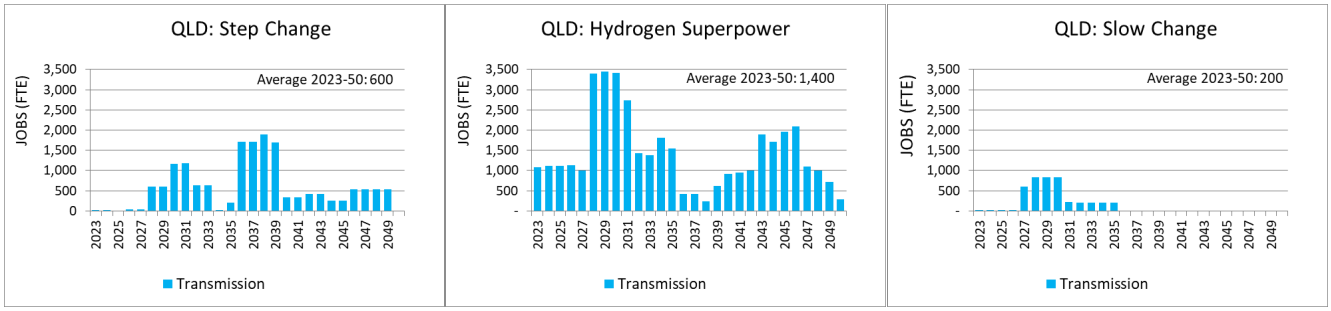
Employment in utility batteries shown in Figure 14. Employment is very peaky, reflecting the periods when batteries are installed, and averages between 400 in the Slow Change, to 3,600 in the Hydrogen Superpower scenario.

4.5 Transmission construction

Employment in transmission construction is compared for three scenarios in Figure 15 (Offshore Wind is identical to the Step Change scenario), with the employment peaks representing period when lines are under construction. Transmission employment averages 600 jobs for the Step Change scenario, 1,400 jobs for the Hydrogen Superpower scenario, and 200 jobs for the Slow Change scenario. The Hydrogen Superpower scenario maintained labour demand throughout the period as the transmission system is expanded to service the expansion in wind and solar, with a peak of nearly 3,500 at the end of the 2020s. Step Change transmission employment is considerably lower, with peaks at just over 1,000 jobs in 2030 and at nearly 2.000 jobs in 2039.

It should be noted that actual employment is likely to be more variable than shown here, as these calculations assume that employment is spread evenly across the construction period for each project.

Figure 15 Queensland, jobs in transmission (Step Change, Hydrogen Superpower, Slow Change)



5 Electricity Sector Workforce Projections, by REZ

In Queensland, 50 GW of new utility-scale wind and solar renewable generation is projected under the Step Change Scenario for the candidate REZs shown 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 16 shows the candidate REZs identified in the ISP, with the four modelled here indicated in red. They are Fitzroy, Wide Bay, Darling Downs, and Banana. Employment associated with electricity infrastructure in the rest of the Queensland, including the other REZs, has been modelled as 'Rest of Queensland'.

Figure 16 Candidate REZs for Queensland, and the REZs with modelled employment

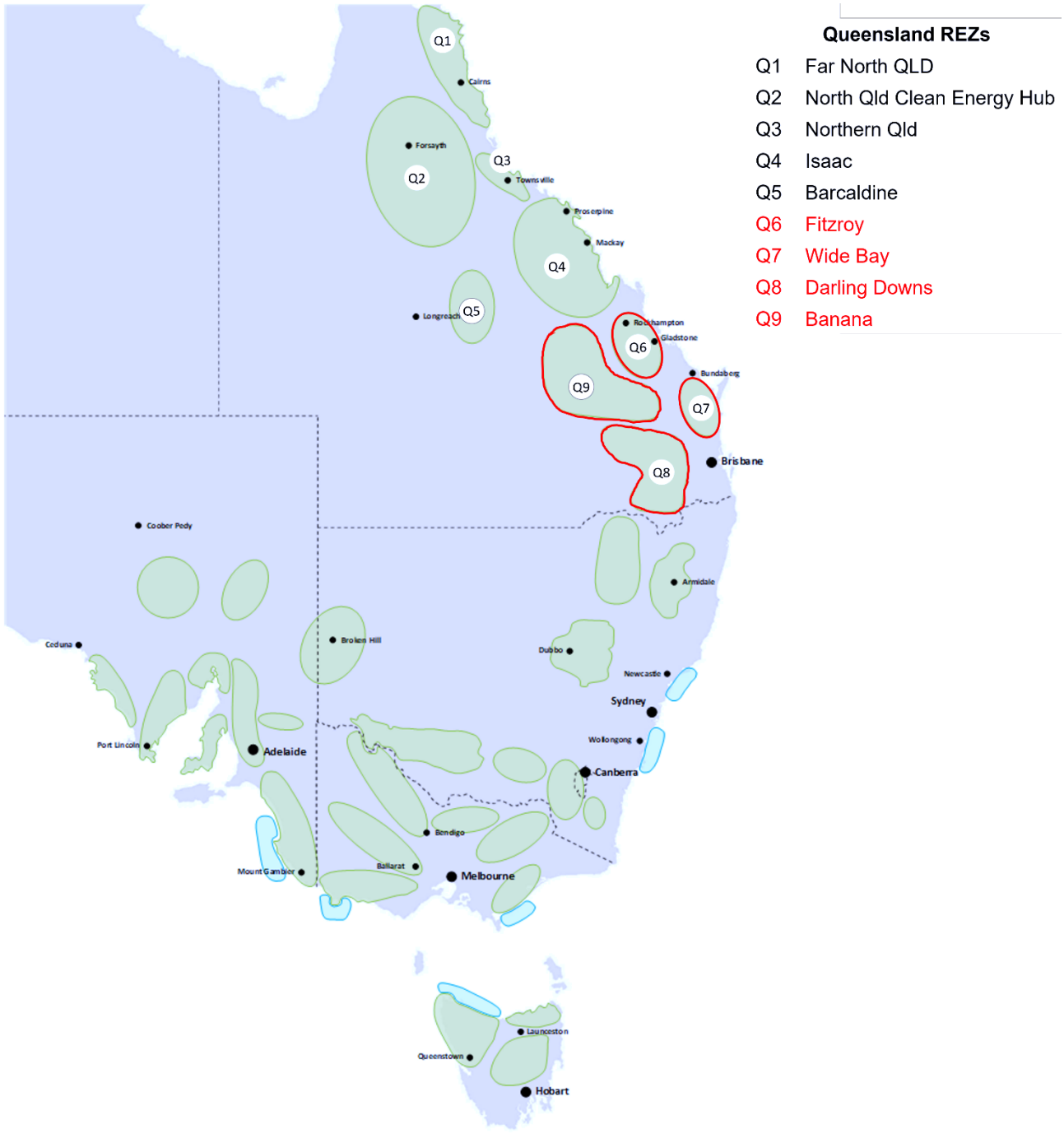
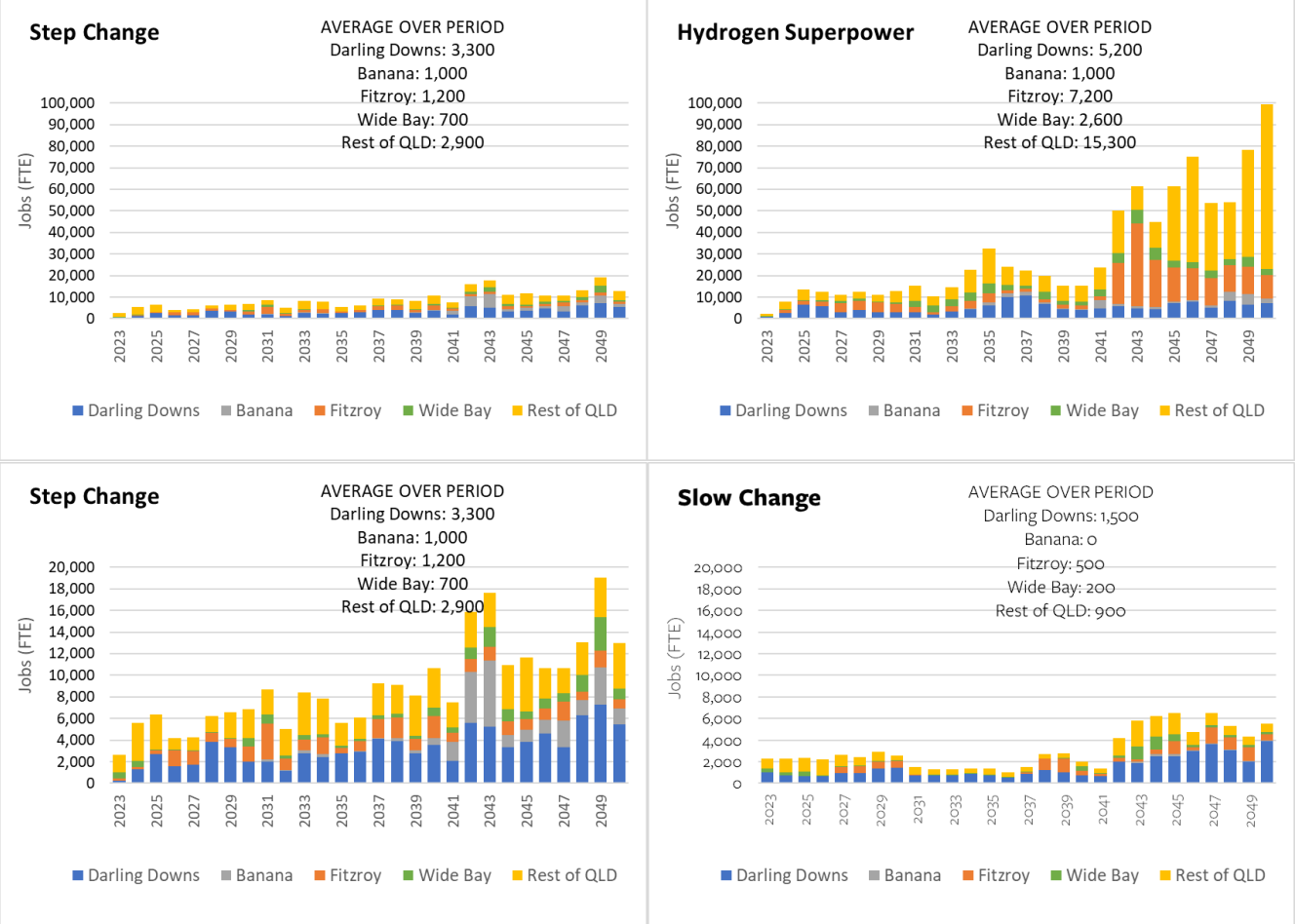


Figure 17 Employment by Queensland REZ (Step Change, Hydrogen Superpower, Slow Change)



Note different scale for lower graphs

The distribution of employment growth across the REZs is shown in Figure 17 and varies somewhat by scenario. In the Step Change scenario and Slow Change scenarios, Darling Downs sees the greatest share of employment by a considerable margin.

In the Hydrogen Superpower scenario, Fitzroy and Wide Bay grows to five times the amount in the other scenarios, with an average of over 7,200 and 2,600 jobs respectively.

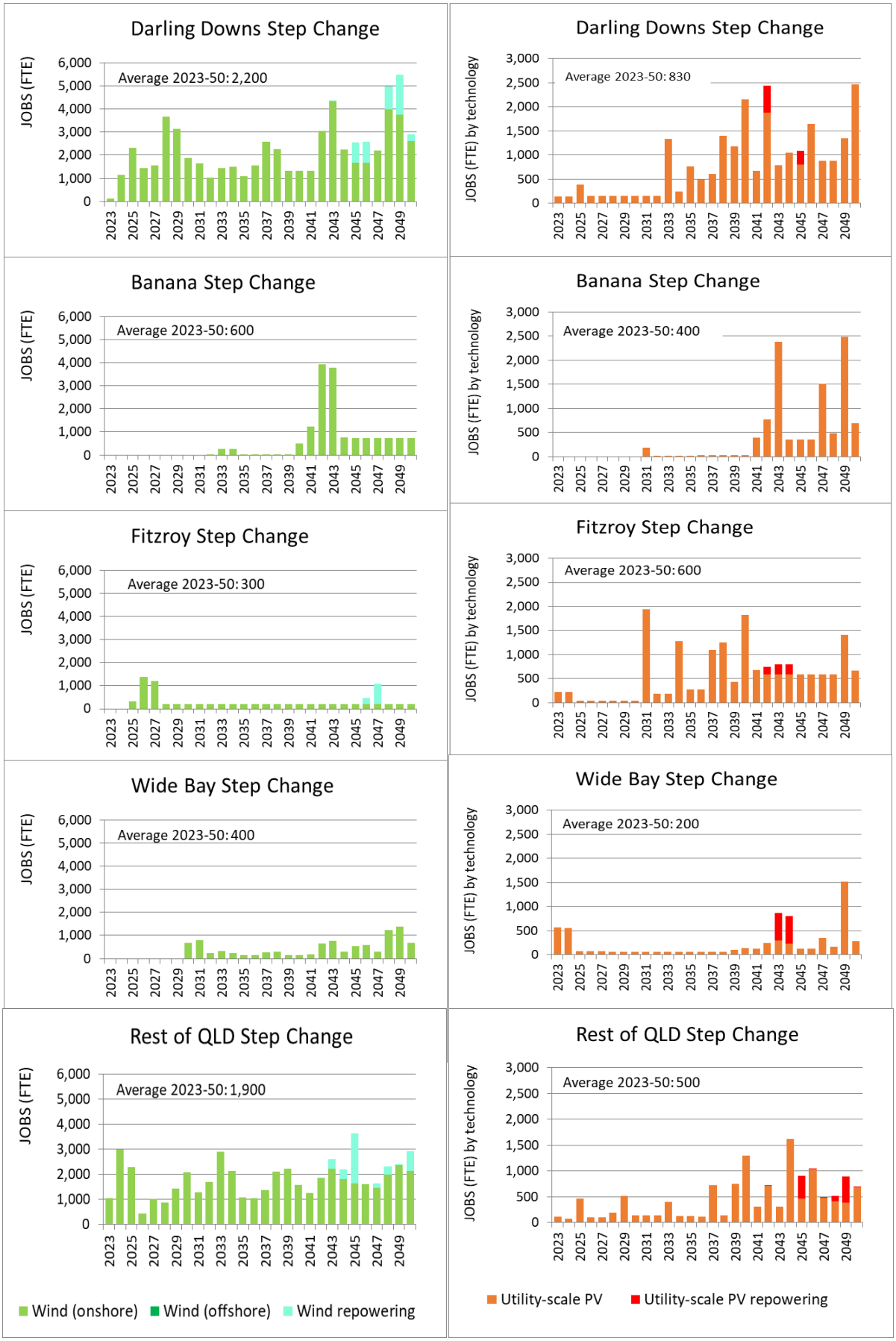
Figure 18 shows employment for four REZs and the rest of Queensland in wind and utility-scale solar in the Step Change scenario, while Figure 19 shows this employment under the Hydrogen Superpower scenario.

In the Step Change scenario, Darling Downs leads on wind employment, with an average of 2,200 per year overall. Employment is variable, although on a generally upward trend (Figure 18). Banana sees development later in the period. Employment in utility-scale solar is more dispersed, with Darling Downs, Fitzroy, and Banana all showing between 400 and 800 average employment per year.

Under the Hydrogen Superpower, employment is very volatile. For example, wind employment in Fitzroy averages 4,000, a big increase from the Step Change, but peaks at 30,000. Utility-scale solar also grows very sharply in Fitzroy, with an average of 2,700. In both wind and utility-scale Solar, the Rest of QLD grows very strongly in the Hydrogen Superpower.

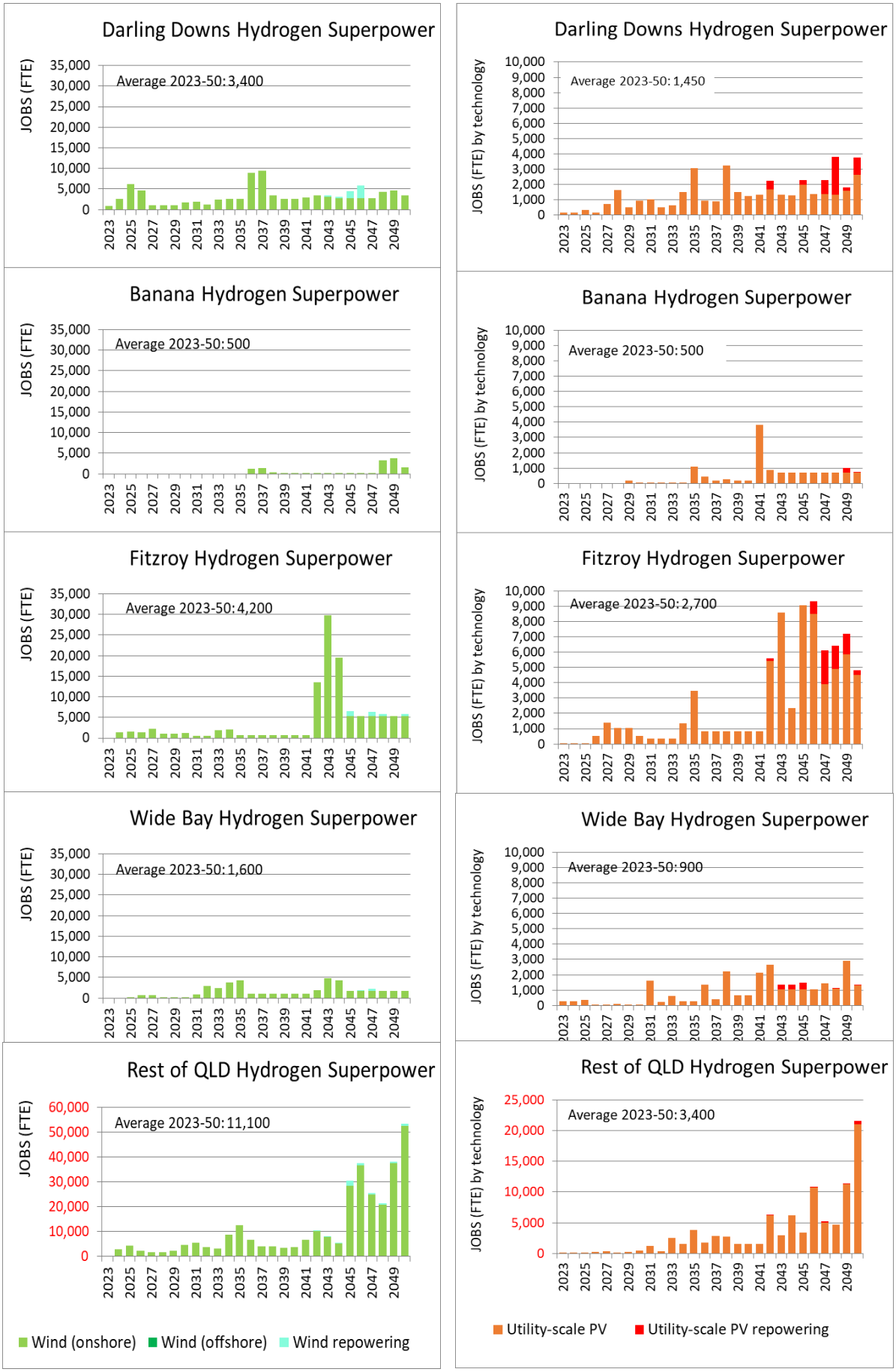
Figure 20 shows the utility battery employment for all scenarios for Darling Downs, Wide Bay, and the rest of Queensland. There is little employment other than during a couple of construction periods. Employment is below 500 in all cases, other than the modelled employment outside of these two REZs in the Hydrogen Superpower, where average employment reaches some peaks close to 1000 in the late 2040s.

Figure 18 Employment in utility-scale wind and solar by Queensland REZ, Step Change



Note different scale for graphs – wind 0-6,000, solar 0-3,000

Figure 19 Employment in utility-scale wind and solar by Queensland REZ, Hydrogen Superpower



Note different scales REZ wind 0-35,000, REZ solar 0-10,000, Rest of Qld 0-60,000 (wind), 0-25,000 (solar)

Figure 20 Employment in utility batteries by Queensland REZ, all scenarios

Note different scale for Rest of QLD in the Hydrogen Superpower

Appendix A – Additional information on Queensland occupational breakdowns

Figure 21: Queensland, in-demand occupations during peak year 2031

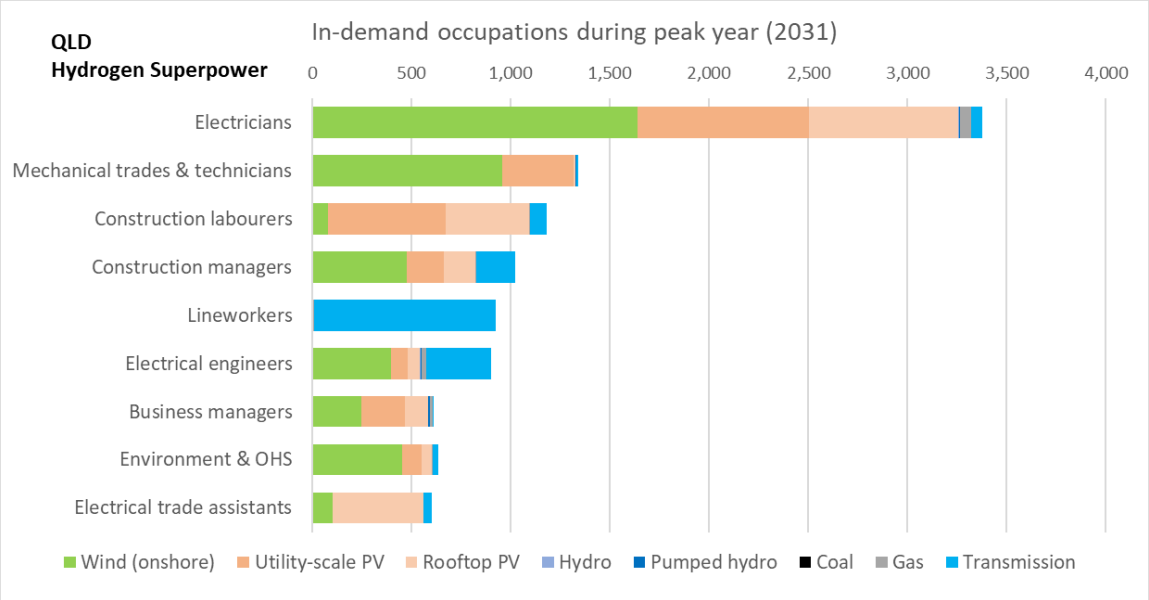
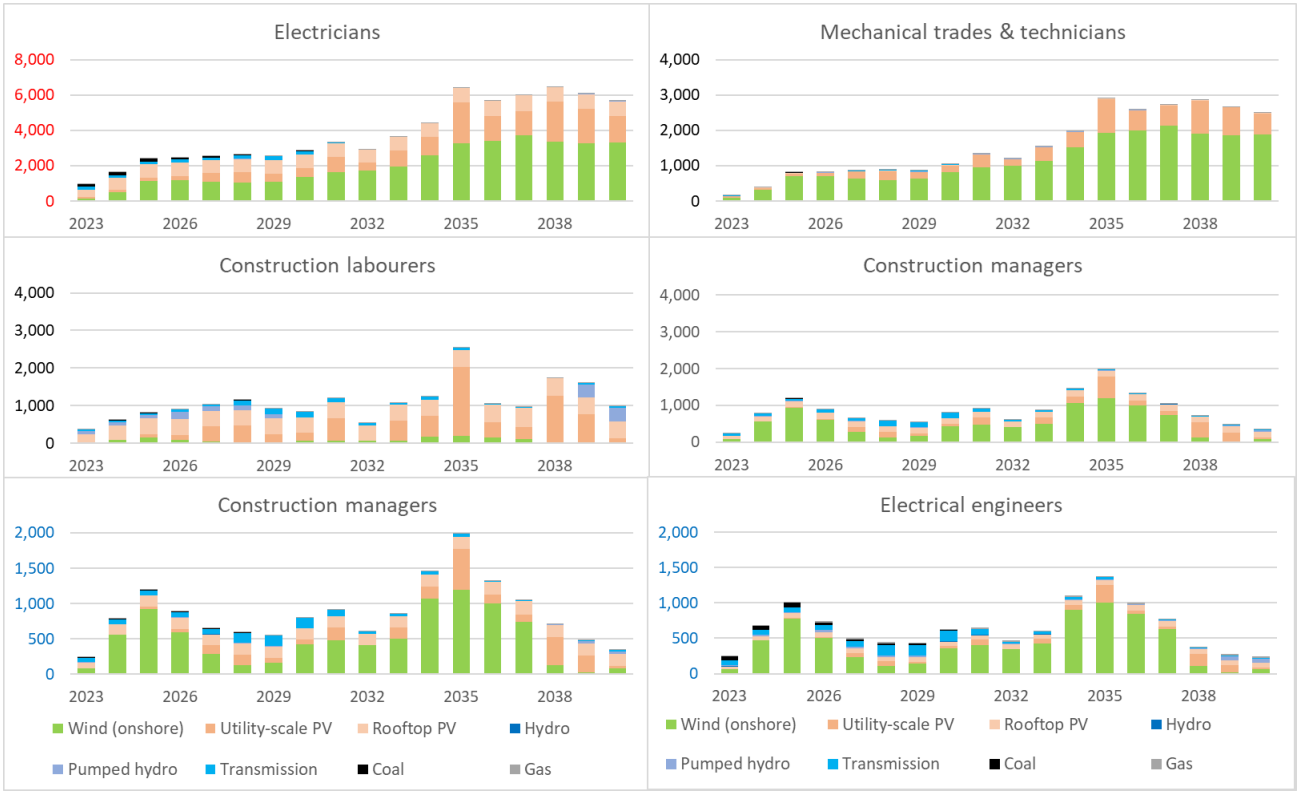


Figure 22: Queensland, in-demand occupations annual requirement by technology, Hydrogen Superpower



Note the scale for electricians goes from 0-8,000, construction labourers, managers and mechanical trades 0-4,000, all other graphs from 0-2,000

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