Submission No 222

SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

Organisation: Institute for Sustainable Futures (University of Technology Sydney)

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Institute for Sustainable Futures
Submission to NSW Inquiry into Sustainability of Energy Supply and Resources in NSW

Introduction

Energy transition is underway and accelerating in NSW and Australia. Last year, record levels of large-scale and distributed solar were installed. The Australian Energy Market Operator records that NSW has 1428MW of 'committed' solar and wind farms and 11,556 MW of proposed solar and wind farms. Under the Australian Energy Market Operator's Integrated System Plan, the 'neutral scenario' project projects a total of 60,000 MW of solar, wind and storage capacity across the National Electricity Market by 2040. AEMO also has a 'fast' scenario and is now working on a scenario which is consistent with the Paris Climate Agreement.

The focus of energy transition planning and debate so far in Australia has been on power generation. This is understandable. Coal power stations have started closing, the plants are aging and there is a broad timetable for further closures out in the public domain from AEMO. However, NSW needs to start planning for a wider energy transition which includes coal mining as many of the factors underpinning transition here also apply in Australia's coal export markets. Coal producing regions around the world are already under pressure due to a combination of factors including the falling cost of renewable energy, climate and renewable energy policies, local environmental issues and rising supply-chain costs.

The timing is uncertain – it could be gradual, it could be abrupt – but one of the key lessons from coal and industrial transitions in other nations is that early planning and diversification is essential to manage the impacts in regional communities. Transition from coal power generation and mining requires the development of alternative industries and the retraining and redeployment of workers – which takes time. If transition planning is delayed until mass redundancies are on the horizon, regional labour markets will not cope with the volume of displaced workers.

The Institute for Sustainable Futures (ISF) has specialist expertise in a range of areas relating to energy sustainability and transition, including technical dimensions (such as modelling energy system changes, renewable energy technologies and costs, impacts on and the role of electricity networks) and socio-economic dimensions (employment, social licence, impacts on low-income households and equity).[1]

However, the focus of this submission is on the impact on regional communities and the economic opportunities, risks and challenges. NSW should be actively

[1] List studies here.

developing and implementing diversification strategies for the Hunter Valley in particular. Other studies have highlighted the Hunter Valley contains a range of economic strengths which could form the basis for industry development. Our submission will focus on economic opportunities for regional communities, especially the Hunter Valley, from renewable energy, hydrogen, and bio-energy.

Capacity and Economic Opportunities of Renewable Energy

There is a proven opportunity for a range of renewable energy technologies, especially large-scale solar PV and wind energy and rooftop solar PV which are mature technologies. Our submission focuses on areas in which ISF has recently undertaken original work to add to understanding of the capacity and economic opportunities.

The Opportunity from Renewable Hydrogen [2]

There is currently a high degree of interest in renewable (green) hydrogen produced by electrolysis of water, and low carbon hydrogen produced by steam reforming (SMR) of natural gas with carbon capture and sequestration (CCS). Multiple roles are proposed for renewable and low carbon H_2 in the path to decarbonisation, as an energy carrier, storage medium, and transport fuel, as well as a means to decarbonise industry feedstocks[3]. There are estimates that global production could increase 10-fold by 2050, at which point hydrogen could supply close to 20% of final energy demand[4].

This represents an enormous opportunity for Australia and for NSW. Australian wind and solar resources are among the best in the world, with the entire continent potentially able to produce renewable H_2 at 2 – 2.6 US$/kg (below Japan's target for hydrogen imports at 2030, and very close to their long term aspirational target).[5,6] Combined with Australia's stable political landscape, small population, and existing relationships with energy importers, Australia is in the position to develop this opportunity and become a clean energy leader at the same time.

It is highly likely that international efforts to reduce greenhouse gases are going to accelerate, given the science currently emerging and the increasing public concern. The sustainable development scenario published in the World Energy Outlook, which is a plausible scenario to reach internationally adopted targets, shows a decline of 57% in coal demand by 2040, with coal trade falling by 53%. Fortunately, the same decarbonisation pathway offers an opportunity to maintain NSW's position as an

[2] This section is taken from an unpublished paper, Increasing NSW Resilience – The Renewable Hydrogen Opportunity Rutovitz, J, James, G, and Schaaf, A. (2019) which is attached in confidence in advance of publication.
[3] Decarbonising the H_2 feedstock for ammonia is itself important – it is estimated that emissions from ammonia production are responsible for 1% of global greenhouse emissions, almost all from the production of the H_2 feedstock.
[4] Hydrogen Council. *Hydrogen Scaling Up*. Vol 50.; 2017, p.20.
[5] International Energy Agency (IEA). *The Future of Hydrogen. Seizing Today's Opportunities.*; 2018, p.49
[6] Commonwealth of Australia (2018) *Hydrogen for Australia's future*., p.5

energy exporter, and potentially create a new industry to diversify the economy and build on existing strengths.

Potential CCS sites in NSW appear to be located in the Darling Basin, approximately 800 km inland, so it is unlikely that the production of H_2 using SMR plus CCS is viable in NSW[7]. However, NSW has other advantages. It has Newcastle Port, with existing ammonia production and other chemical industries close by. It has heavy engineering expertise. Crucially, it has a pipeline of 13 GW of wind and solar[8], which is unlikely to be developed without increased demand.

Rapid scaling of truly renewable hydrogen would accelerate the cost reductions for both renewable electricity and electrolyser, and NSW could lead the development of truly renewable H_2 in Australia. Potential benefits for NSW are the development of a new industry, based primarily in regional areas with the associated revenue and job creation, and the development of a more resilient and cost effective electricity system. At least one international projection for ammonia puts Australia's potential exports at 350 MT by 2050, equivalent in mass to about 62 MT H_2[9]. The absence of suitable cost-effective sites for CCS could prove an advantage by putting NSW at the forefront of developing renewable H_2, noting that potential recipient countries have already set targets for carbon intensity of imports, with zero carbon H_2 favoured[10]. There may also be significant supply chain advantages, as electrolysers may include a significant assembly element which is likely to be undertaken onshore.

The development of a renewable hydrogen industry has the potential to create perhaps 4,000 direct jobs in NSW. Assuming that 20% of hydrogen production occurred in NSW, this would create demand for more than 70 Terawatt-hours additional electricity, requiring about 30 GW of wind and solar combined, compared to approximately 2 GW currently. This increase in capacity could create at least 3,500 ongoing jobs over the next 20 years, with perhaps another 500 on the hydrogen supply side[11]. This does not include the indirect jobs which accompany any industry expansion.

There is potential for re-skilling of the workforce in areas vulnerable to coal industry decline to take advantage of the hydrogen opportunity. For example, the Hunter has

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[7] The CO_2 storage assessment program has so far completed a preliminary investigation of the Darling Basin, with storage potential is estimated to be between 48 and 1,730Mt.

[8] AEMO. Generation information. Downloaded 29/07/2019 https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information, current as at 12/07/2019.

[9] Brown, T. *What drives new investments in low-carbon ammonia production? One million tons per day demand*. Ammonia Industry, April 20th 2018

[10] Kosturjak, A. *et al.* (2019) *Advancing Hydrogen: learning from 19 plans to advance hydrogen from across the globe.* P.37

[11] Note that these are preliminary estimates, based on the employment factors used by the ABS in 2019 estimates of the current industry. These employment factors are currently being updated by ISF (Clean Energy Solar and Wind Employment survey, in process). The direct hydrogen production jobs are taken from ACIL Allen Consulting (2018) *Opportunities for Australia from Hydrogen Exports*., p. 53. These estimates assume that NSW produces 20% of Australian H2 exports of 7 MT.

existing ammonia production at Orica, which could provide a pilot for the transition to renewable hydrogen, and there are excellent port facilities for export.

The NSW is currently behind other states in strategic consideration of hydrogen[12], despite the vulnerability of current commodity exports and the opportunities that development of a renewable hydrogen export industry could provide. Only one of the 14 Australian hydrogen projects listed in the IEA database is located in NSW.[13]

We recommend the NSW government actively engages with the opportunities associated with making NSW the renewable hydrogen state, by:

- Undertaking research on system integration in collaboration with Transgrid
- Establishing a cross-industry working group
- Identify the potential for hydrogen industries to locate in areas currently involved in fossil fuel extraction, as one element of economic diversification.
- Encourage NSW renewable H_2 pilot projects in the short term
- Depending on the outcomes of system integration research, ensure that any state support is conditional on eventual flexibility provision.

Many of the benefits of the renewable energy industry and the new renewable hydrogen industry will accrue to regional NSW. They include large numbers of new jobs as the industry continues to grow rapidly, and diversification of income for landholders who are facing the impacts of climate change much more directly than city dwellers.

The combination of renewable energy and renewable hydrogen could stimulate a transformative shift of economic activity towards regional Australia, and future proof state revenues from energy.

Rooftop Solar

ISF and the Australian Photovoltaic Institute were commissioned by the Clean Energy Finance Corporation to undertake the first estimate of the total potential for rooftop solar PV using two path-breaking datasets:[14]

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[12] For example, Government of South Australia (2017) *A Hydrogen Roadmap for South Australia*., Queensland Government (2019) *Queensland Hydrogen Industy strategy*, WA Dept. of Primary Industries and Regional Development (2019) 'Western Australian Renewable Hydrogen Strategy'., Victorian Hydrogen Investment Program, https://www.energy.vic.gov.au/renewable-energy/victorian-hydrogen-investment-program

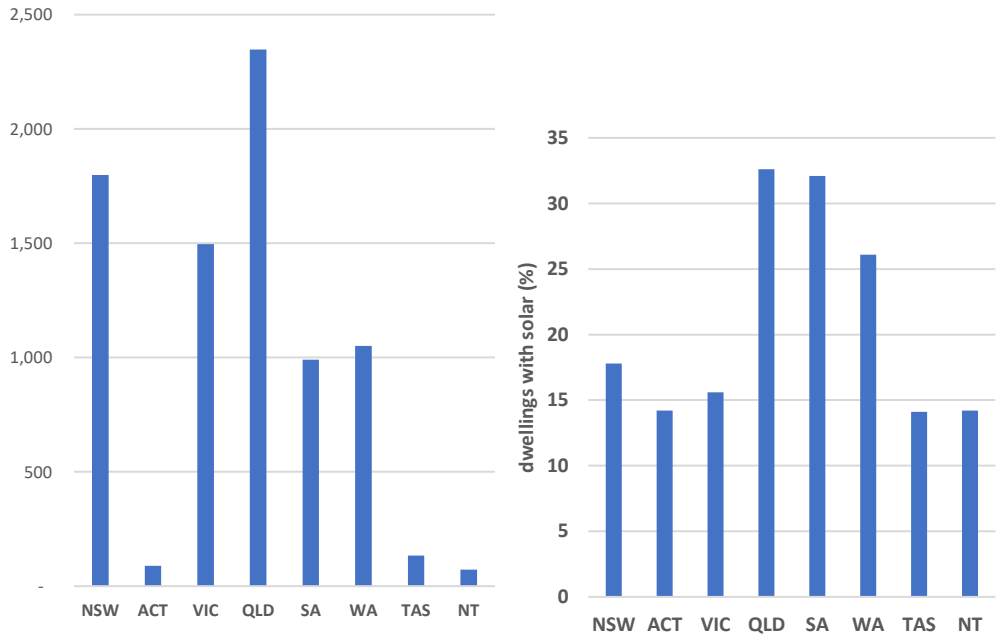
[13] IEA project database, downloaded 11/07/2019. Available https://www.iea.org/media/publications/hydrogen/IEA-Hydrogen-Project-Database.xlsx

[14] Roberts, M., Nagrath, K. Briggs, C., Copper, J., Bruce, A., and Mckibben, J (2019) *How much Rooftop Solar can be Installed in Australia?* Report for the Clean Energy Finance Corporation and the Property Council of Australia. Sydney. https://www.cefc.com.au/media/402125/isf-rooftop-solar-potential-report-final_.pdf .

- a top-down estimate of available roof space generated by OMNILINK using the PSMA Geoscape database – a government-owned initiative which has mapped all the buildings in Australia for the first time; and
- a bottom-up estimate of solar potential which includes a range of constraints on the available rooftop space for solar (e.g. shading, orientation) using the data from detailed studies in inner-city areas undertaken by UNSW for the APVI across five capital cities.

At the time of publication, NSW had 450,000 installations (1.8 GW) with a solar PV system on less than 20 per cent of dwellings. In terms of coverage, NSW trails Queensland, South Australia and Western Australia and is ahead of other states where coverage is generally around 15 per cent.

Figure 1 Solar PV, by State (MW)



Source: (CER, 2018)APVI, 2018b)

This study estimates the total potential for rooftop solar on Australian buildings to be 179 gigawatts with an annual output of 245 terawatt-hours. To put this in perspective, it is greater than the current electricity consumption on the main grids in Australia. Just under 200 terawatt-hours was consumed in the National Electricity Market (NEM) and just under 20 terawatt-hours was consumed in Western Australia's grid (the South-West Inter-Connected System) in 2018. Even with the high recent growth, Australia is using less than 5 per cent of the potential capacity for rooftop solar. The study does not suggest Australia can or should be powered 100 per cent by rooftop solar but it does highlight Australia is only using a small fraction of the potential for rooftop solar.

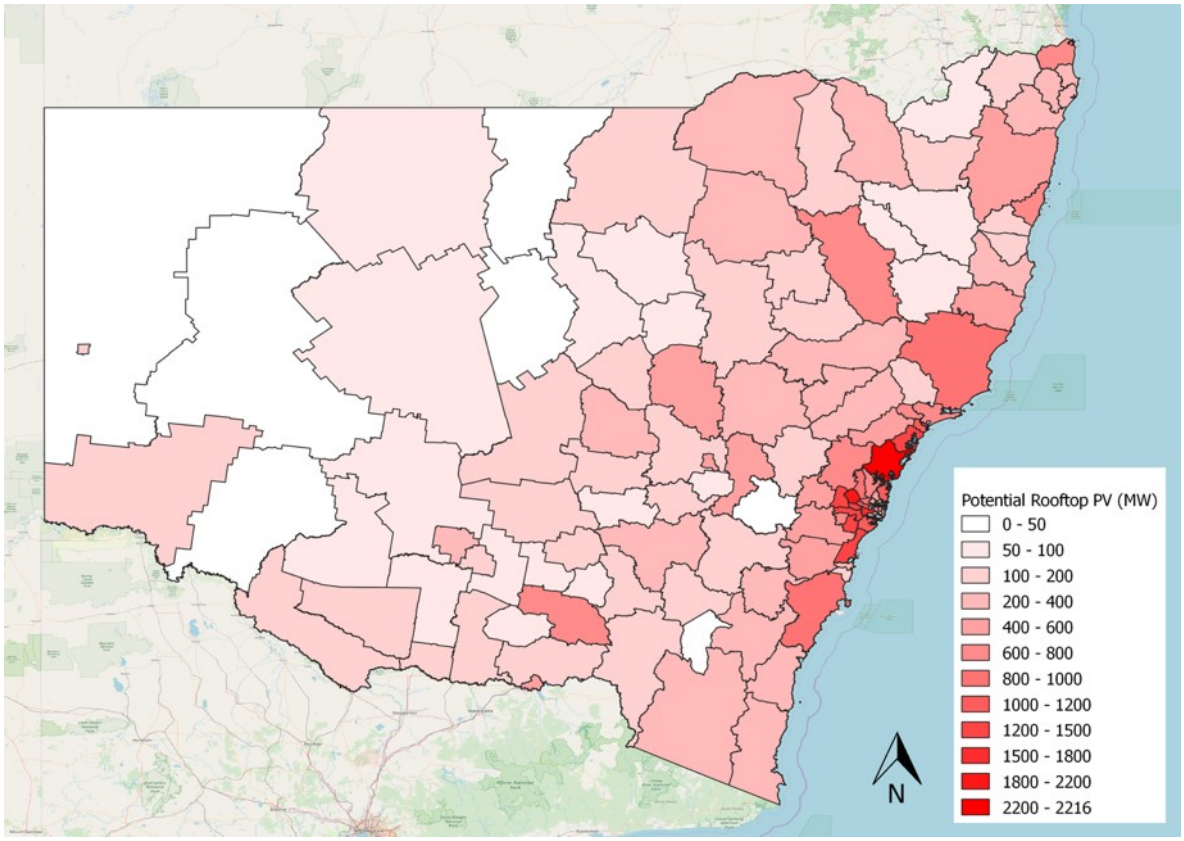
NSW has the largest potential for rooftop solar amongst all states with 49 GW of potential rooftop PV capacity and an expected output of 65 TWh.

Table 1: Installed and potential capacity, by State

State	PV potential (GW)	Annual energy output (GWh)	Installed Capacity (GW)
NT	1	2,375	0.1
NSW	49	65,520	2
ACT	2	3,315	0.1
VIC	45	56,411	1
QLD	37	54,287	2
SA	17	23,516	1
WA	23	34,438	1
TAS	4	5,404	0.1

The highest potential is in the Central Coast. The overall potential is much higher along the coast than in the interior; in particular there is a concentration in the urban areas around Sydney. This band stretches from Shoalhaven and Wollongong on the south coast to the north coast of NSW. The regional LGAs in the interior with the highest potential are Tamworth and Wagga Wagga.

Figure 1 Rooftop Solar PV Potential in NSW



Renewable Energy Jobs

ISF has been undertaking modelling on renewable energy employment for over a decade.[15] One of the key findings from ISF modelling – and other studies – is that renewable energy will create many more jobs overall than fossil fuel industries. In the most recent study undertaken last year on the employment implications of the Paris Climate Agreement, it was estimated the volume of employment in the global energy sector would increase from 33 million to 50 million.[16]

However, there is limited information on the location and type of jobs in renewable energy in Australia. The Australian Bureau of Statistics classifies and collects data on occupations within fossil fuel sectors and their location but not for renewable energy generation.[17] An annual estimate of renewable energy employment is published by the ABS, but the ABS does not undertake surveys to collect data. The estimate is primarily based on a literature review and other sources on employment factors (full-time employment/MW). The ABS estimated there was 4,470 persons employed in renewable energy in 2017-18.

To improve the quality of data, the Clean Energy Council has commissioned the Institute for Sustainable Futures to undertake a national survey of its membership on employment in renewable energy. The scope of the survey in Stage One is large-scale solar and wind energy, distributed solar PV, manufacturing and supply-chain employment, hydro power (large-scale, small-scale and pumped hydro) and battery storage. The second stage (to be funded) is intended to cover bio-energy, renewable hydrogen, professional service employment and energy efficiency and demand management.

The key objectives of the project are to:

- Estimate employment in renewable energy now and until 2030 based on the projections of the Integrated System Plan of the Australian Energy Market Operator and the Whole of System Plan in Western Australia – by occupation, state and high-level regional analysis;
- Identify current skill and labour shortages and priority occupations to facilitate skills planning for the growth of renewable energy.
- Identify opportunities for renewable energy to support energy transition for workers in the fossil fuel sectors.

The survey is currently underway but results will not be available until November 2019. We can provide a copy to the Committee at that time if requested.

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[15] See Rutovitz, J., Dominish, E & Downes, J. (2015) 'Calculating Globel Energy jobs; 2015 Methodology Update'. https://opus.lib.uts.edu.au/bitstream/10453/43718/1/Rutovitzetal2015Calculatingglobalenergysectorjobsmethodology.pdf .

[16] Dominish, E, Briggs, C, Teske, S & May, F. (2019) 'Just Transition: Employment Projections for 2.0 Degree and 1.5 Degree Scenarios', in S.Teske (ed) *Achieving the Paris Climate Goals*, https://www.springer.com/gp/book/9783030058425.

[17] See Australian Bureau of Statistics (2017), *Employment in Renewable Energy Activities – Explanatory Notes*, for a summary. http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4631.0Explanatory+Notes12015-16. Accessed September 16 2018.

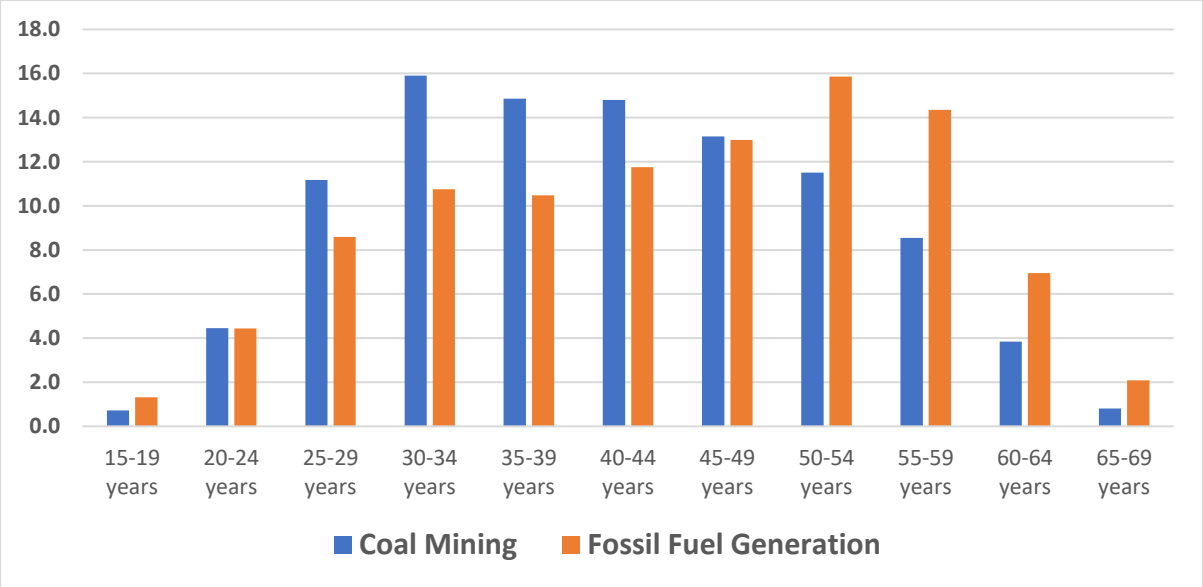
Effects on Regional Communities

The major impact of energy transition will be concentrated in coal producing regions. The coal sector is not a mass employer but its employment (and associated linkages) are important to regional economies in the Hunter Valley. The ABS census in 2016 found there was 18,872 persons employed in coal mining and 1609 persons employed in fossil fuel generation (which includes gas power stations as well as coal mining).

There are some important workforce characteristics to consider when understanding impacts and planning for energy transition.

Firstly, whereas the workforce in coal and gas power generation is aging, there are a lot of younger and prime-aged workers in coal mining.

Figure One: Age Profile, Coal Mining and Fossil Fuel Power Generation (%)

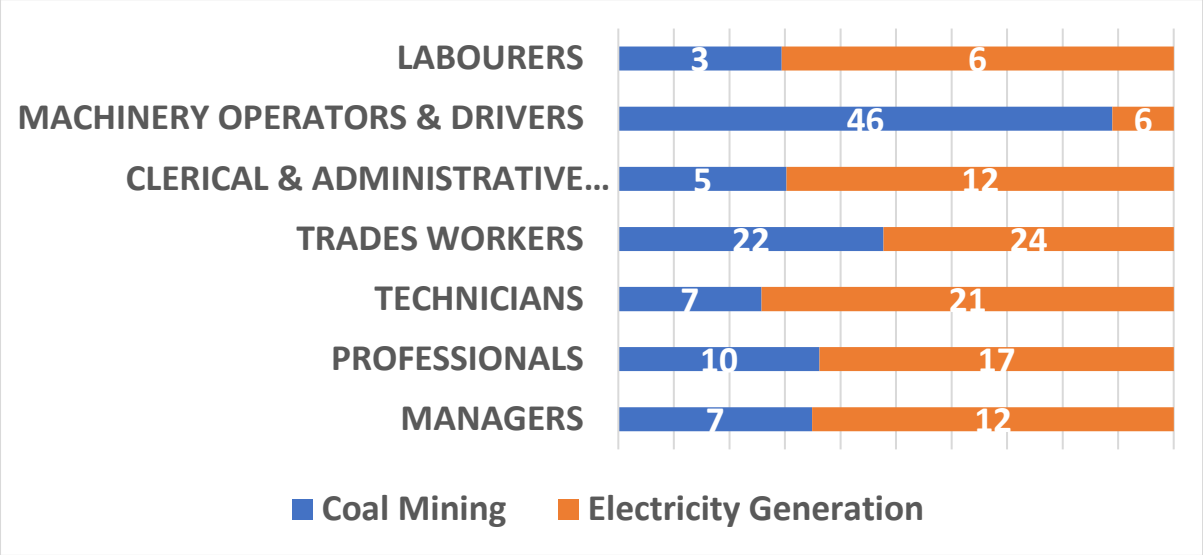


Source: ABS Census 2016

Almost half the coal mining workforce is aged under 40 and almost 60 per cent are aged 30 – 50 years. In overseas jurisdictions, the use of early retirement has been a key measure to match labour supply with falling labour demand as industry declines. Whilst this can play a significant role in power generation it will be much less effective in coal mining.

Secondly, there is very high proportion of semi-skilled labour in coal mining. Whereas almost two-thirds of the power station workforce is a tradesperson, technician or professional, almost half the workforce in mining are machinery operators or drivers.

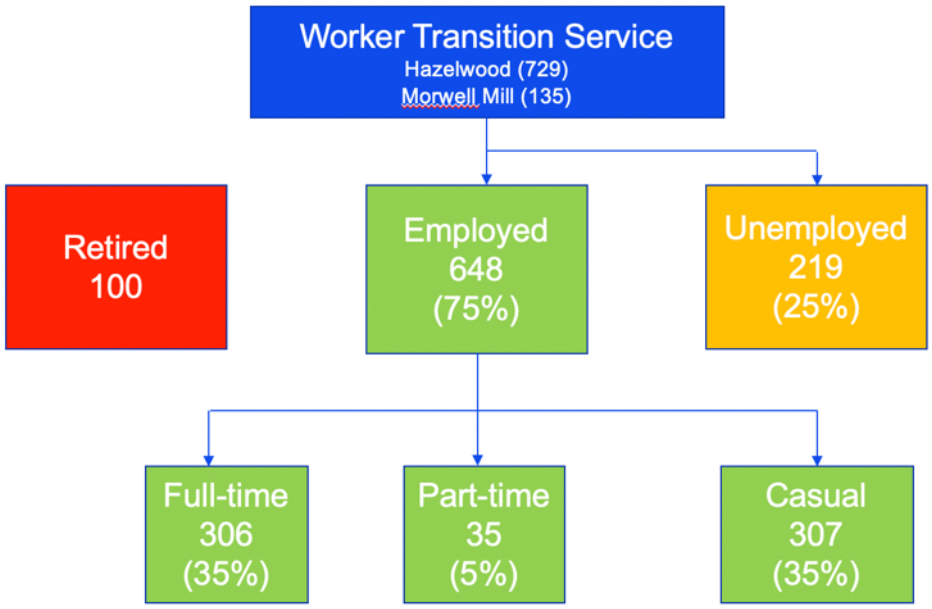
Figure Two: Composition of Workforce by Skill Level, Coal Mining and Fossil Fuel Power Generation (%)



The coal mining workforce is consequently much more vulnerable as the coal sector declines.

In Victoria, a worker transfer scheme was established after the closure of Hazelwood power station alongside a range of industry development programs. Figure three summarises the results to date using data provided to the Victorian Parliament in response to a question on notice.

Figure Three: Worker Transition Service, Labour Flows



One-quarter of workers are unemployed and only around one-third have found full-time employment. Hazelwood power station was closed with only a few months'

notice: these figures underline the challenges for transitioning workers to new jobs without time to prepare.

Sustainable Economic Opportunities for Regional Communities

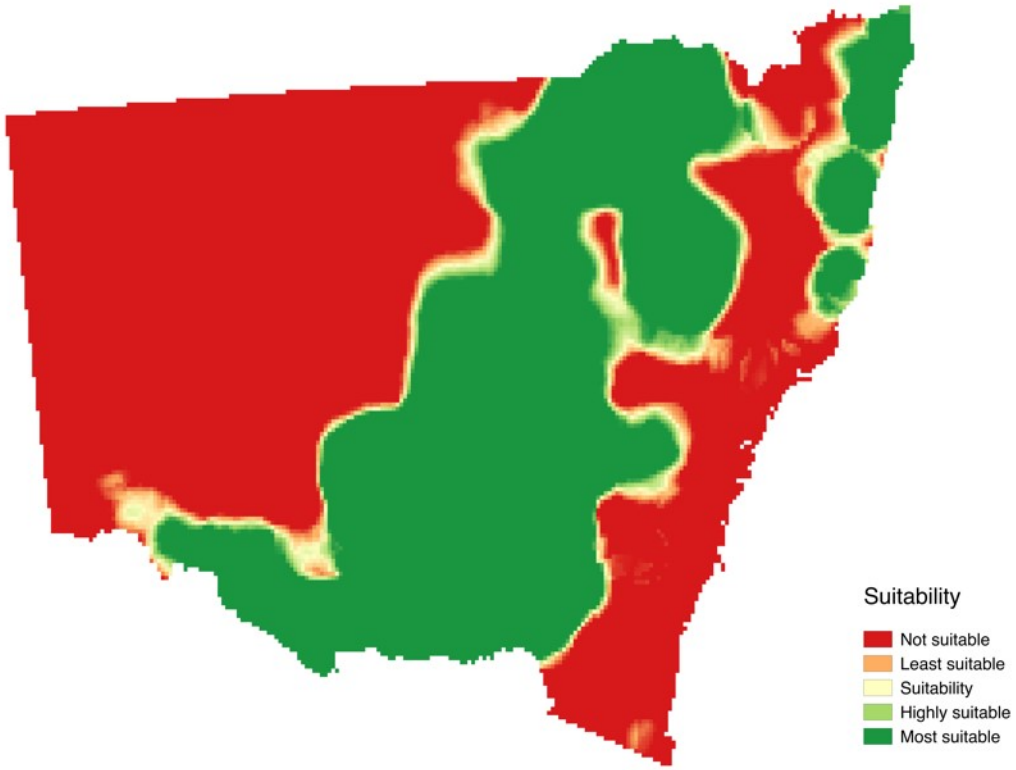
There are a range of opportunities from energy transition for regional communities:

Hybrid Solar-Biomass Power Stations

ISF is currently investigating opportunities for the establishment of hybrid concentrated solar power(CSP)/biomass power stations in a range of different areas in NSW. The primary focus is on electricity generation, however opportunities for other energy outputs are also considered. This project builds on previous work undertaken by UTS by providing an up-to-date assessment of the biomass resource and a higher resolution appraisal to support targeted regional assessments for NSW. A spatial constraint model has been developed for identifying technically feasible locations ('hot-spots') for hybrid CSP:biomass facilities in NSW based on factors such as bio-resources and transmission network capacity and modelling has been undertaken for potential hot-spots.

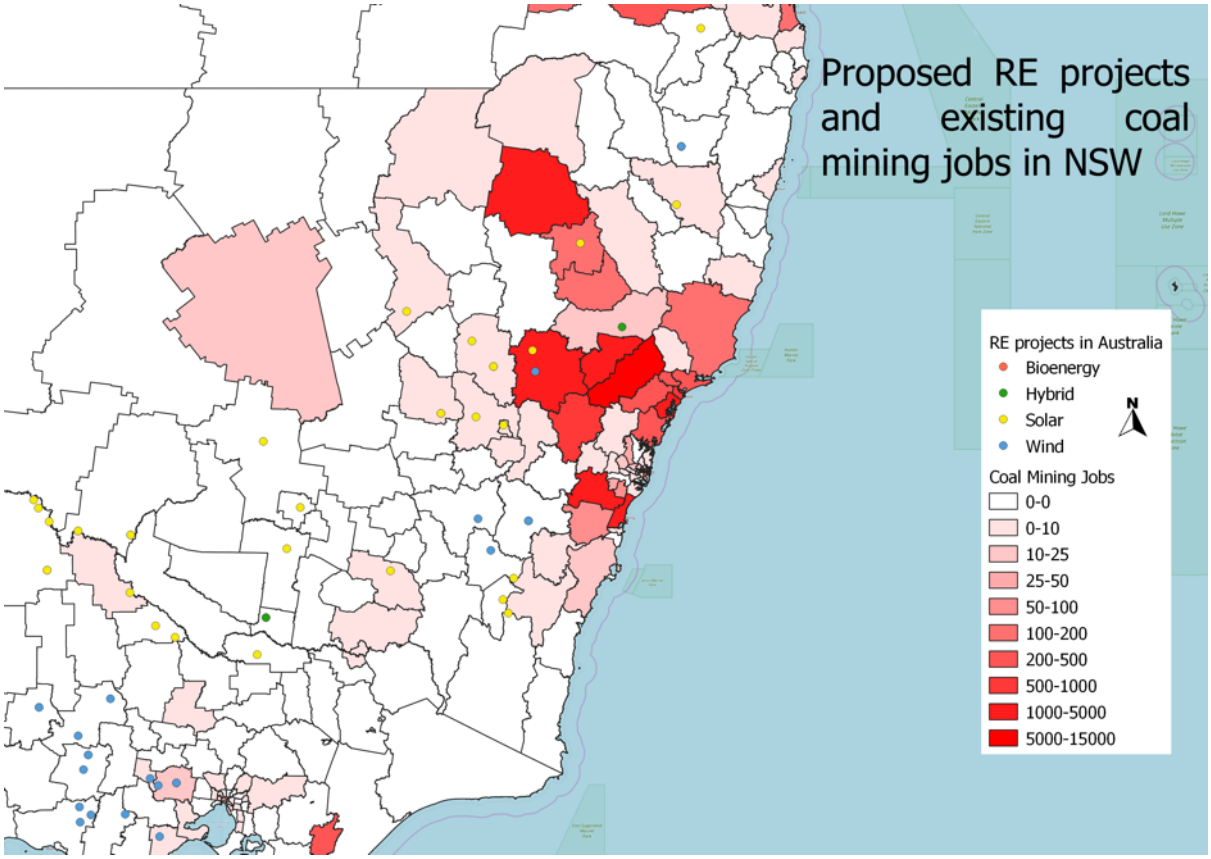
Significantly, this preliminary work demonstrates clear potential for hybrid CSP:biomass as an alternative electricity source for NSW. There is sufficient biomass availability within suitable hybrid CSP:biomass areas for approximately 1,016MWe of installed generation capacity.Identified LGAs with the greatest biomass resource supply in regions with suitable solar resource are clustered around the Griffith area, the Hunter Valley, the Parkes region and Northern NSW. Further more detailed feasibility work is being undertaken which is being funded by the NSW Department of Primary Industries.

Figure Four: Hybrid CSP/Biomass Power Stations, Feasibility Assessment, NSW



Large-Scale Renewable Energy

Figure 5 shows there is a high number of current and proposed large-scale renewable energy projects throughout regional NSW and their location relative to current coal mining jobs:

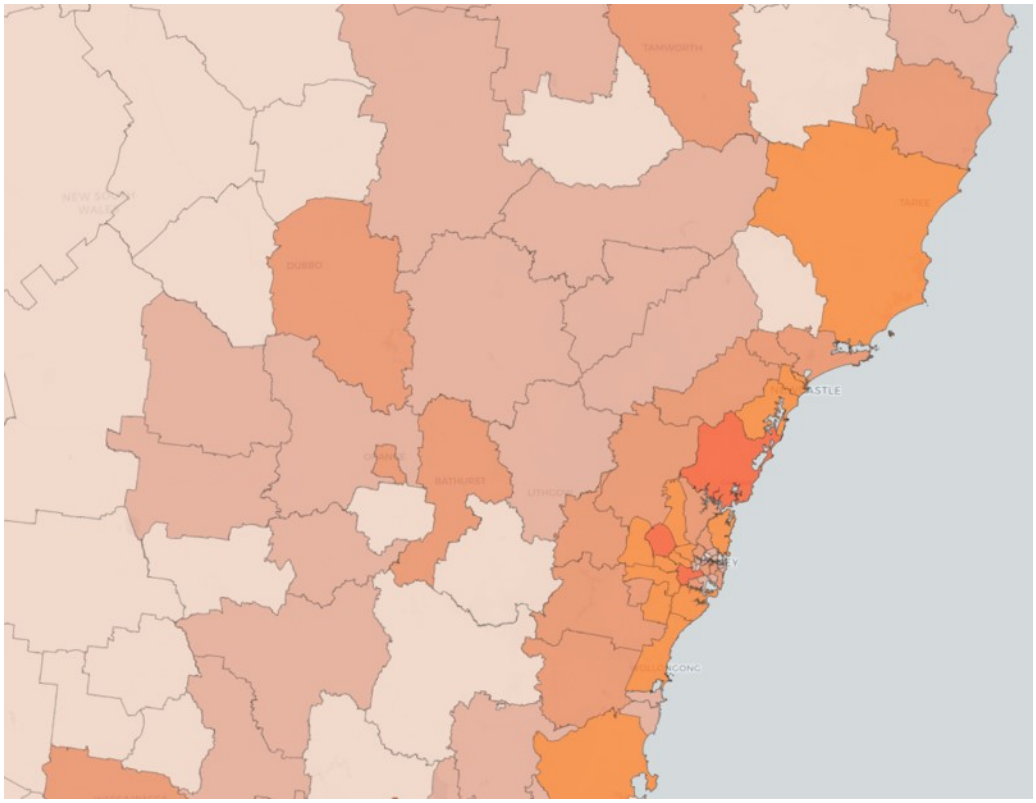


There is a cluster of renewable energy projects on the edge of the Hunter Valley and surrounding areas, although most large-scale solar projects are further west and most wind energy projects are south-west.

Rooftop Solar

The Institute for Sustainable Futures, in partnership with the Australian Photovoltaic Institute, undertook the first estimate of total potential for rooftop solar for a study commissioned by the Clean Energy Finance Corporation.

Figure 6 shows the total potential for rooftop solar in LGA's in the Hunter Valley region. In LGAs in the Hunter Valley region, there is potential within Muswellbrook LGA (216 MW), Singleton LGA (268 MW), Upper Hunter Shire (216 MW).



Note: darker orange areas have higher potential for rooftop solar potential.

If the Committee would like to see results for other regional areas, please go to the Australian Renewable Energy Map Initiative: https://www.nationalmap.gov.au/renewables/

Attachments included with submission

Increasing NSW Resilience – The Renewable Hydrogen Opportunity, Rutovitz, J, James, G, and Schaaf, A., 2019 - unpublished