Hunter & Lake Macquarie Power Station Workers:

An economic analysis of the requirements for a Just Transition

Report prepared for the Hunter Community Environment Centre

by Dr Ingrid Schraner

July 2022

Hunter Community Environment Centre.

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The Hunter Community Environment Centre is a not-for-profit community group funded by grants, donations and independent of government and corporate funding. The Centre was established in 2004 to encourage and facilitate environmental and social justice advocacy and education in the Hunter region, NSW, Australia.

The objectives of the Hunter Community Environment Centre are:

- To maintain a community environment information, resource and advocacy centre.
- To educate and inform the community about biodiversity and the need to protect it.
- To provide and promote the dissemination of information and views regarding environmental matters.
- To promote and assist cooperation, sharing of resources and coordination of activities amongst environment and community groups.
- To protect and conserve ecological processes, genetic diversity and the natural environment.

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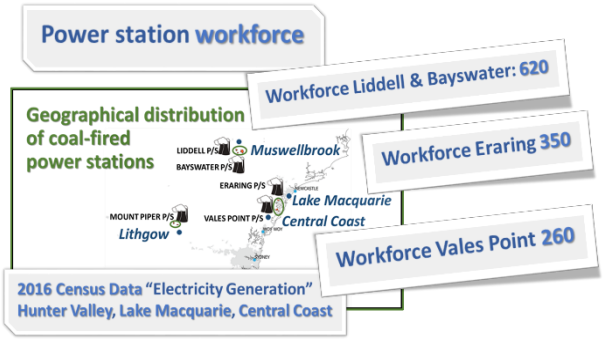
Cover photo: Eraring Power Station

Executive Summary



The four power stations in the Hunter Valley, Lake Macquarie and Central Coast between them employed **1,230** people in **2016**.

Of those who worked at **Vales Point**, 30% lived in Lake Macquarie and 60% in Central Coast council.

60% of **Eraring**'s workforce lived in Lake Macquarie, 20% in Central Coast, and 10% in Newcastle council.

Those who worked at **Liddell** and **Bayswater** were spread further, with 33% living in Muswellbrook, 24% in Singleton, 10% each in Maitland and Cessnock, and 4% each in Lake Macquarie and Newcastle.

The age structure of the 2016 workforce at Vales Point was such that by now more than half or about 130 people would be 55 and over. At Liddell and Bayswater this was a third or a little over 200 people, and at Eraring a little less than a third or a little over 100.

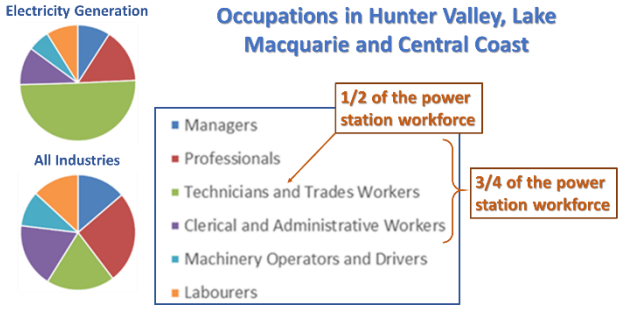
In other words, about **440** people would by now either **have retired** or **be ready** to take an **early retirement package**. According to the 2016 Census figures, some **700** people would need **redundancy payments** if all four power stations were to close today, assuming that since 2016 no job losses occurred from 'natural attrition' (not replacing workers who resigned). In reality, the four power stations can reasonably be expected to employ less than 700 people between them today.

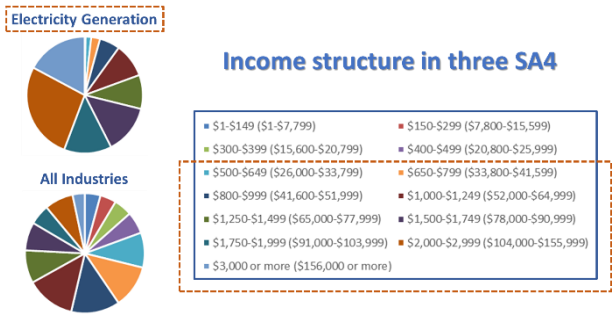
However, for the local economies around them not to decline compared to 2016, it is 1,230 jobs that need to be replaced – either by new businesses that have already absorbed some of the workforce that left the power stations by now, or by jobs that are being created between now and when the power stations close.

The occupational structure in the local Electricity Generation industry was markedly different from the local economies in general.

3/4 of the workforce were categorised as Professionals, Technicians and Trades Workers, and Clerical and Administrative Workers, with the middle group making up half of the workforce.

Power stations provided significantly less work for Machinery Operators and Drivers, and for Labourers, but also less for Professionals and Managers.





The occupational structure impacted on the income structure, but there are important issues that are typical for Electricity Generation:

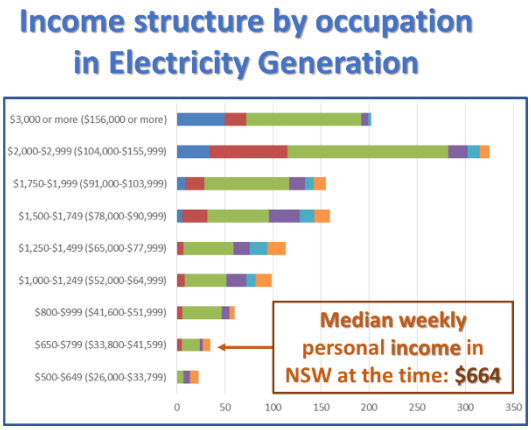
Nobody in the power station workforce fell into any of the **bottom four income brackets**.

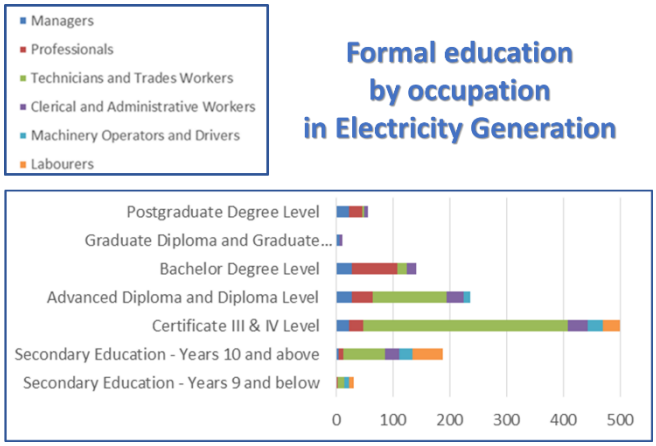
Basically the **whole power station workforce** was among the **top half income earners** in Australia.

- **More than half of the tradies** were in the top three income bracket earning **more than $91,000 a year**.

The 1,230 jobs that need to be created for a Just Transition in the economies of the four NSW coal-fired power stations discussed here need to be at the top end of the upper half of income earners in Australia.

The left hand bar chart below is showing the occupations in each income bracket, and the right hand bar chart shows the occupations in each formal education bracket.

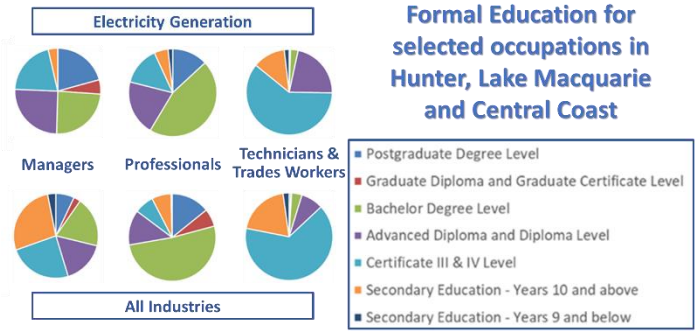




Formal education concluding with a Certificate III & IV Level and with an Advanced Diploma and Diploma Level were **by far the two most common** educational attainment levels in the power station workforce. They are the levels that correspond with **formal apprenticeships** – which indicates that **power stations played an important role in providing apprenticeships in the regional economies**.

The graph to the right illustrates how important **apprenticeships** were as the highest level of formal education (light purple and light turquoise, 4th & 5th from the top clockwise):

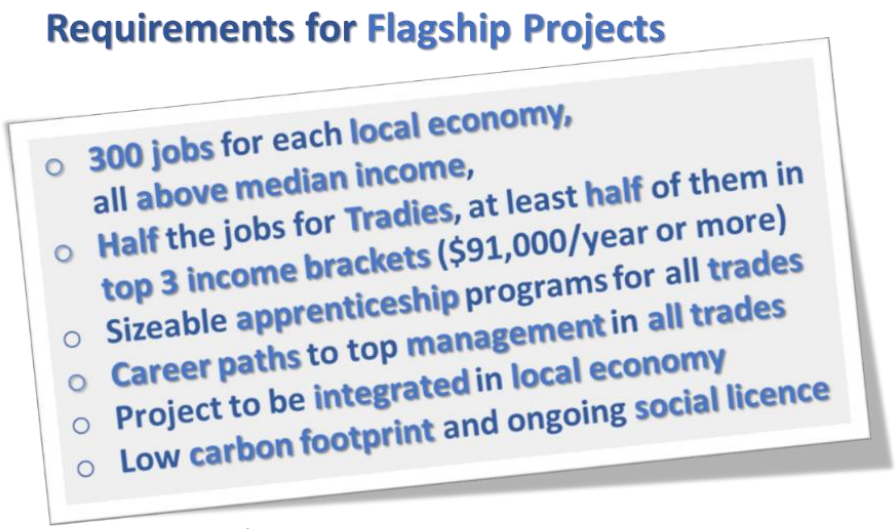
They accounted for more than **three quarters** for **Technicians & Trades Workers**, more than **one quarter** for **Professionals**, and, importantly, almost **half** for **Managers**.



Forward planning will need to ensure that enough apprenticeships are available in ways that provide pathways for school leavers into well remunerated jobs for Technicians and Trades Workers with interesting and rewarding career paths, all the way up to the highest management levels.

Recommendations

When public funding is used to fund Flagship Projects for an economic diversification that ensures a Just Transition, the findings of this report indicate the following minimum requirements:



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Geographical considerations

The coal-fired power stations operating in NSW are concentrated in three major areas, two in the Hunter Valley around Muswellbrook, two in the Lake Macquarie/Northern Central Coast area, and one near Lithgow. The people who will be most affected by the eventual closure of the coal-fired power stations in NSW live in those regions, and it will be their communities that most rely on a well-planned and just transition out of electricity produced from fossil fuel.

This analysis does not include the workforce at Mount Piper power station, because the statistical delineations around Lithgow are less clearly defined, both in terms of geography and of industry, and the region is clearly distinct from the two more integrated regions Hunter Valley and Lake Macquarie/Central Coast.

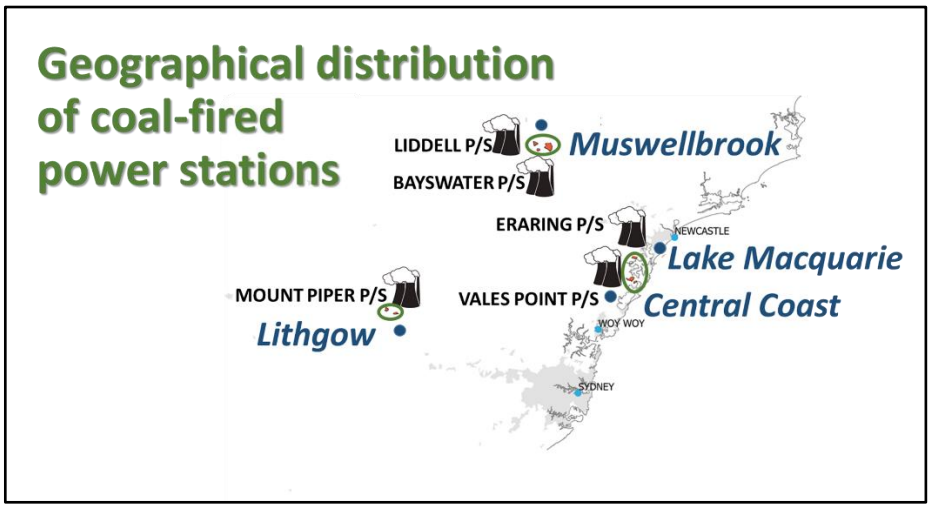

Figure 1: Where NSW's power stations are located
Four of the five NSW coal-fired power stations are located in the three Level 4 Statistical Areas (SA4) of 'Hunter Valley excluding Newcastle', 'Newcastle and Lake Macquarie', and 'Central Coast'

In terms of Place of Work (POW)[1] of those working in the industry Electricity Generation, the Level 4 Statistical Area (SA4) of Hunter Valley covers jobs located at both Liddell and Bayswater power stations, Newcastle and Lake Macquarie covers jobs at Eraring power station, and Central Coast covers jobs at Vales Point power station[2]. In terms of Place of Usual Residence (PUR) things are more complicated in so far as people working at Liddell and Bayswater power stations live as far away as around Lake Macquarie, from where people also commute to work at Vales Point power station, while people living on the Central Coast also work at Eraring power station.

Table 1 below illustrates this claim in more detail by tabulating the Place of Work in terms of the political boundaries of Local Government Areas (LGAs) of those working in Electricity Generation against the LGAs of their Place of Usual Residence. The table shows that 89% of the workforce of Vales Point lives on the Central Coast and in Lake Macquarie, and that 86% of those working in Eraring live in Lake Macquarie and on the Central Coast and in Newcastle.

Those working at Liddell and Bayswater power stations on the other hand come from further afar, but 96% of them come from LGAs in the Level 4 Statistical Areas (SA4) of Hunter Valley excluding Newcastle, Newcastle and Lake Macquarie, and Central Coast – the remaining four percent are spread over LGAs in numbers that are not

[1] For definitions of terms used in the Census (capitalised in this report for clarification) please see below the section *Key terms used in the Census.*
[2] The number of jobs in the industry Electricity Generation in these three areas that are not at these power stations is so small that it is not statistically relevant.

statistically relevant[3]. Similarly, 96% of the overall workforce employed in Electricity Generation in the three Level 4 Statistical Areas discussed here also live in these same three statistical areas.

Where the numbers allow, we will therefore use SA4 data for Bayswater and Liddell, for Eraring and for Vales Point. When we analyse the workforce in more detail, we may have to pool the three SA4 data to achieve statistically relevant numbers that will apply to all four power stations together[4].

LGA (POW)	Central Coast (C) (NSW)		Lake Macquarie (C)		Muswellbrook (A)		Total	
LGA (PUR)								
Lake Macquarie (C)	74	29%	181	57%	20	4%	278	24%
Central Coast (C) (NSW)	156	60%	60	19%	4	1%	225	20%
Muswellbrook (A)					189	33%	192	17%
Singleton (A)					137	24%	135	12%
Maitland (C)					64	11%	83	7%
Cessnock (C)					51	9%	69	6%
Newcastle (C)			35	11%	24	4%	62	5%
Upper Hunter Shire (A)					56	10%	56	5%
% of Workforce accounted for		89%		86%		96%		96%
Total Workforce	259		320		568		1148	

Table 1: Where power station workers live

The LGAs where the people live (UR) who work (POW) in Vales Point (Central Coast), Eraring (Lake Macquarie), and Bayswater & Liddell (Muswellbrook), all of which are covered by the three SA4 of 'Hunter Valley excluding Newcastle', 'Newcastle and Lake Macquarie', and 'Central Coast'.

Data Source: Census of Population and Housing, 2016, TableBuilder

Limitations and opportunities in the data available

Prior to investigating the relevant statistics, some words of caution are in order: firstly, the statistics available at the time of writing are based on the 2016 Census. The relevant 2021 Census data will only be available in October 2022, as part of the second Census data release. Given that none of the NSW coal-fired power station has taken on significant numbers of staff, rather to the contrary, any analysis based on 2016 Census data is erring on the side of caution, and the so calculated numbers of jobs to be created will be rather on the high side.

The ultimate interest of this study is to identify the number and kinds of jobs that need to be created in order to guarantee a just transition for the power station workforce, once the coal-fired power stations close their doors for good. If these power stations have reduced their workforce since the 2016 Census by not replacing retiring workers and no longer taking on apprentices, the local economy has already lost job opportunities that need to be replaced for communities that have borne more than their fair share of the costs for the State's electricity production over the last seven decades.

In other words, if this study errs on the side of caution and identifies some jobs that can be taken up by others, who have not worked in the coal-fired power stations before, then these jobs are still part of what a just transition has to provide for the local economies.

A second set of words of caution refers to the magnitude of the numbers in the available data. The numbers and characteristics of jobs in question are not large enough to allow for a detailed analysis for each coal-fired power station. However, leaving out the region around Lithgow and concentrating on the other four power stations provides a statistical area that covers the remaining four coal-fired power stations currently operating in NSW. As demonstrated above, this holds both in terms of Place of Work as well as the overwhelming majority of Place of Usual Residence for the workers in these jobs and thus covers the communities that have suffered the most in providing energy for the State of NSW.

[3] It is important to note that with the term 'not statistically relevant' we also cover numbers that are randomized by the Australian Bureau of Statistics in order to avoid situations where individuals could be identified.

[4] The three SA4 discussed here are geographically adjacent to each other and are often subsumed under 'The Hunter', even though this is strictly speaking not correct. However, for our analysis this proximity and economic interconnectedness is convenient – a benefit an analysis of the fifth NSW power station would not share.

Key terms used in the Census

Place of Work (POW) and Place of Usual Residence (PUR)

The **Place of Usual Residence** is the place where a person usually lives. It may, or may not be the place where the person was counted on Census night. Each person is required to state his/her address of usual residence in a question on the Census form (e.g. Question 8 on the paper Census Household Form). The Census also asks for the address of where a person goes to work, which is captured as **Place of Work** data. The ABS has a detailed system to impute this information if it is not provided. Based on the two places, the ABS develops Journey To Work Data, which are used by transport authorities, associated bodies, organisations and other interested people to plan public transport systems, and for the development and release of residential and commercial land.

Level 4 Statistical Area (SA4) and Local Government Area (LGA)

The **Level 4 Statistical Area** regions are the largest sub-State regions in the main structure of the Australian Statistical Geography Standard (ASGS). The ASGS brings together all the regions on which the ABS publishes statistics within the one framework. It is a hierarchically structured classification split into two broad groups, ABS structures and Non-ABS structures to satisfy different statistical purposes. One of the better known and often used Non-ABS structures is the political entity of local councils and their geographical equivalent, the **Local Government Area**.

Occupation (OCCP) – 1 digit levels

The 2016 Census collected occupation information for all employed people aged 15 years and over. The two questions used in the 2016 Census were

- 'In the main job held last week, what was the person's occupation – Give full title'
- 'What are the main tasks that the person usually performs in the occupation...'.

Following the experience of the 2011 Census, the ABS developed targeted supplementary questions for common occupations with responses that were difficult to code to an appropriate level of detail. These supplementary questions were added to the online census form. The 2016 Census uses the Australian and New Zealand Standard Classification of Occupations (ANZSCO), Version 1.2 to code occupation data.

The 1 digit level occupations of relevance in power stations[5] are

- Managers
- Professionals
- Technicians & Trades Workers
- Clerical & Administrative Workers
- Machinery Operators & Drivers
- Labourers.

[5] Those not relevant to power stations are the following two: Community and Personal Service Workers, and Sales Workers. Our analysis does not consider the three categories Inadequately Described, Not stated, and Not applicable, because their numbers are so small that they have been randomized by the Australian Bureau of Statistics.

Age (AGEP-5 and AGEP-10) – 5 and 10 year intervals

The 2016 Census form asks respondents to provide the date of birth for each person on the form, or their age in years if the date of birth is not known. Age is calculated from the date of birth when provided, otherwise the stated age is used. Age data is only output in whole years.

Total Personal Income (INCP)

Each person aged 15 years and over is asked to indicate the range of their total income from all sources (rather than their exact income). Total income, also referred to as gross income, is the sum of income received from all sources before any deductions such as income tax, the Medicare Levy or salary sacrificed amounts are taken out.

It includes wages, salaries, regular overtime, business or farm income (less operating expenses), rents received (less operating expenses), dividends, interest, income from superannuation, maintenance (child support), workers' compensation, and government pensions and allowances (including all payments for family assistance, labour market assistance, youth and student support, and support for the aged, carers and people with a disability).

The income brackets are more detailed at the lower end of the scale and less at the top end. The highest income bracket is $3,000 per week or more (or $156,000 per year or more), the second highest is $2,000 – $2,999 per week (or $104,000 – $155,999 per year), while the lowest is $1 – 149 per week (or $1 – $7,799 per year) and the second lowest is $150 – $299 per week (or $7,800 – $15,999 per year). There are nine more income brackets in between.

Level of highest educational attainment (HEAP)

This variable records a single measure of a person's overall highest level of educational attainment, whether it be a school or non-school qualification. It helps to build a picture of education attainment and qualifications across Australia and can be used

- to determine the general level of educational achievement of the Australian population and of specific groups in Australian society
- to investigate the relationship between levels of education and employment outcomes, income and other socioeconomic variables
- as a proxy measure of socioeconomic status

2. The age structure of the power station workforce

The figures

There are some interesting differences in the age structure of the workforce at the different power stations shown below in Table 2[6].

The 2016 census data for Vales Point shows that half of their workforce or about 130 people were in the two age brackets 50 – 54 and 55 – 59, which in the 2021 census would cover the workforce of those 55 – 65. On this basis, an early retirement plan would have to cover up to half of Vales Point's workforce. On the other hand, the roughly 40% of the workforce that would by now be below 55 years old, is spread fairly evenly between the five year groups shown in Table 2 above. This means that the figures for all age brackets can be affected by the randomisation of small numbers the Australian Bureau of Statistics uses to avoid the release of confidential data, and we can therefore draw no further conclusions.

While over half the workforce at Vales Point is now over 55 years old, the picture at AGL's power stations in Liddell and Bayswater is significantly different, as only a third of the workforce falls into this category.

[6] Due to the characteristics of the publicly accessible data, Liddell and Bayswater have to be analysed together, which may hide further differences.

Interestingly, the workforce numbers for all age brackets in the Hunter Valley SA4 are high enough that randomisation is not a significant problem. Their largest cohort, 126 people or 20% of the overall workforce, is the group of those who would now be 55-59, followed by those who would now be 60 – 65 and 50 – 54 years old, with 82 and 80 people respectively, or 13% each. On this basis, an early retirement plan at AGL's power stations would only have to cover a third of the workforce.

SA4 (POW)	Central Coast			Hunter Valley excl Newcastle			Newcastle and Lake Macquarie			Total		
AGE5P - Age in Five Year Groups												
15-19 years							8	2%		29	2%	
20-24 years	10	4%		58	9%		25	7%		98	8%	
25-29 years	18	7%		58	9%		49	14%		126	10%	
30-34 years	20	8%	39%	57	9%	61%	44	13%	67%	118	10%	58%
35-39 years	14	5%		46	7%		30	9%		95	8%	
40-44 years	18	7%		54	9%		36	10%		104	8%	
45-49 years	22	8%		80	13%		42	12%		142	12%	
50-54 years	53	20%	52%	126	20%	33%	42	12%	30%	217	18%	36%
55-59 years	81	31%		82	13%		63	18%		225	18%	
60-64 years	15	6%		24	4%		9	3%		52	4%	
65-69 years				8	1%		10	3%		17	1%	
70-74 years										3	0%	
Total	259	21%		621	51%		349	28%		1227	100%	

Table 2: How old power stations workers are

The age structure of people who work in Electricity Generation in the three SA4 of 'Hunter Valley excluding Newcastle' (Bayswater & Liddell), 'Newcastle and Lake Macquarie' (Eraring), and 'Central Coast' (Vales Point)
Data Source: Census of Population and Housing, 2016, TableBuilder

In terms of absolute numbers, at Vales Point around 110 people would now be under 55 years old[7], but at Liddell and Bayswater that figure is around 380 people, and at Eraring around 230 people, or roughly two thirds of the workforce at the three stations. Looking at the workforce in all three SA4 together, 58% of the 2016 workforce in Electricity Generation or a little over 700 people are now below 55 years old, and 36% or about 440 people are over 55 but under 65 years old[8].

The consequences

The estimates based on 2016 census data would therefore require the creation of some 700 jobs and funding for early retirement for 440 people as a baseline for a Just Transition for the power station workers and their communities if all four power stations were to close now. However, in order to maintain the local economies, the jobs of those who retire also need to be replaced, with jobs of at least the same quality in terms of job security, education and training, and remuneration.

This means that for the local economies not to go backwards, there need to be about 1,200 jobs of comparable quality and remuneration once the power stations close. But this figure includes those local jobs that have been created since 2016 and are of comparable quality and remuneration.

However, this figure does not include the mine worker from the coal mines that supplied the coal-fired power stations with coal – coal that appears to have been of a quality that is not necessarily good enough to be exported, at least not without significant investment in washeries, which means that these coal mines are likely to close their doors once the power stations close. If this were the case, significantly higher numbers of jobs will need to be created.

[7] This number is arrived at by deducting those who now would be over 55 from the total, to avoid randomization of the smaller numbers in the younger age brackets.

[8] As mentioned in the introduction, these figures are based on the 2016 census plus an additional five years – in reality it can reasonably be expected that the power stations have reduced their staffing levels over the last five years, so these figures are conservative estimates that put the number of jobs that need replacing at the high end.

3. The occupational structure of the power station workforce

Occupational structure

Table 3 below provides a first overview over the occupational structure of the power station workforce. There are a number of points that are noteworthy at first glance, including:

- Vales Point (Central Coast) has a significantly higher percentage of Managers than the other power stations, and a lower share of Labourers
- Liddell and Bayswater (Hunter Valley) have the lowest share of Managers and a significantly higher share of Technicians and Trades Workers than the others
- The distribution of occupations at Eraring (Newcastle & Lake Macquarie) is fairly close to that of the overall workforce in Electricity Generation in the three SA4.

SA4 (POW)	Central Coast		Hunter Valley exc Newcastle		Newcastle and Lake Macquarie		Total	
OCCP - 1 Digit Level								
Managers	34	13%	42	7%	32	9%	102	8%
Professionals	38	15%	89	15%	56	16%	182	15%
Technicians and Trades Workers	113	44%	332	54%	161	46%	606	50%
Clerical and Administrative Workers	34	13%	52	9%	39	11%	127	10%
Machinery Operators and Drivers	20	8%	34	6%	22	6%	73	6%
Labourers	14	5%	62	10%	29	8%	107	9%
Total	258		611		349		1217	

Table 3: The occupational structure in the power stations
The overall occupational structure of people who work in Electricity Generation in the three SA4 of Hunter Valley excluding Newcastle (Bayswater & Liddell), Newcastle and Lake Macquarie (Eraring), and Central Coast (Vales Point)
Data Source: Census of Population and Housing, 2016, TableBuilder

While Table 3 above shows the difference between the power stations, Figure 2 below puts the occupational structure in Electricity Generation in the context of All Industries at three different geographies. The most striking difference at the lowest geographical level, the level of the three Level 4 Statistical Areas, is the fact that half of those working in Electricity Generation are Technicians and Trades Workers, a share that is more than twice the size of its equivalent in All Industries[9].

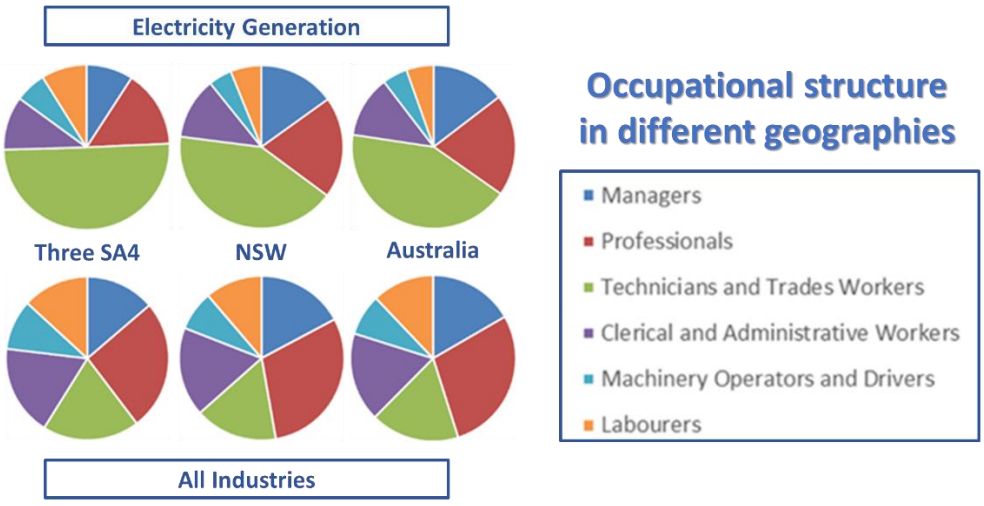

Figure 2: Comparison of occupational distribution between Electricity Generation and all industries
Data Source: Census of Population and Housing, 2016, TableBuilder

[9] It is worth remembering here that those working in Electricity Generation include not only those employed directly by power stations, but also contractors and sub-contractors in the industry.

There are two aspects to be noted here. Firstly, the regulations in Australia require a qualified tradesperson to deal with almost anything that has to do with electricity. This situation goes some way to explain the relatively large share of Technicians and Trades Workers. Secondly, this requirement has important implications when it comes to the planning of education and training in the sector, an issue that will be discussed later.

Electricity Generation (top row of pie charts) and All Industries (bottom row) at the three different geographical levels differ significant in two regards. Firstly, the shares of Labourers (orange), Machinery Operators & Drivers (turquois), and Clerical & Administrative Workers (light purple), the relatively lower paid occupations, are all smaller in Electricity Generation, compared to All Industries. Secondly, the share of Technicians & Trades Workers (light green) in Electricity Generation is significantly bigger at all three levels, while the share of Professionals (light brown) in Electricity Generation is smaller.

Within Electricity Generation, the shares of Managers (blue) and Professionals (light brown) increase the further away from the actual power station the geography in question is. In other words, when considering the State and national level, the industry Electricity Generation adds relatively more Managers and Professionals, which is not surprising.

Age and occupational structure combined

Figure 3 below illustrates the age structure at the four power stations, broken down for each of the relevant groups of occupations. While the numbers for each SA4 are not necessarily statistically significant, the combined 2016 Census data would indicate that the notably higher share of Managers at Vales Point identified above can be mostly found in the 50 – 59 age bracket, who by now would be 55 – 64 years old. While a significant proportion of these Managers at Vales Point may by now have taken an early retirement package already, as a group they hold a very valuable body of industry knowledge and contacts for any business that can harness it[10].

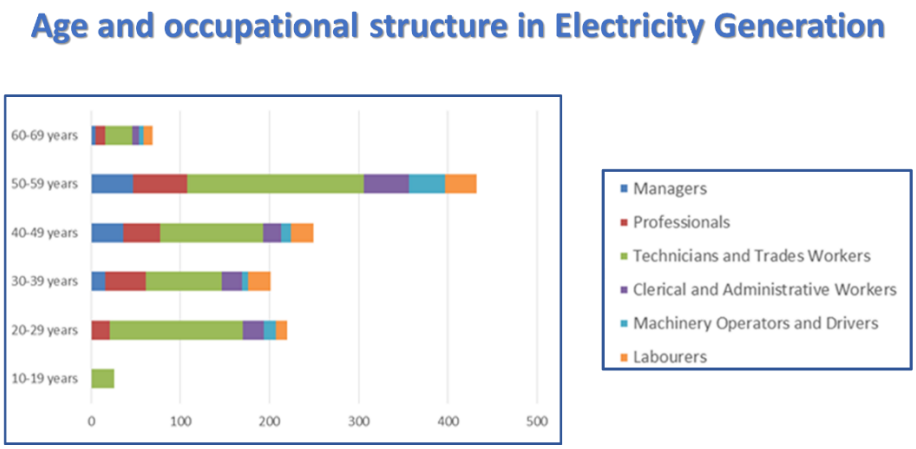

Figure 3: Occupations within the age structure of the power station workforce
Age structure by occupation of people who work in Electricity Generation in the three SA4 of 'Hunter Valley excluding Newcastle' (Bayswater & Liddell), 'Newcastle and Lake Macquarie' (Eraring), and 'Central Coast' (Vales Point)
Data Source: Census of Population and Housing, 2016, TableBuilder

While the percentage of Professionals is fairly similar at all four power stations, this occupation is also strongly represented in the 50 – 59 age bracket. It can be reasonably assumed that key aspects of professional knowledge are shared with younger colleagues, maybe more so than among Managers. Nevertheless, the same footnote as for Managers applies here.

However, in the context of a Just Transition it is important to plan for the creation of jobs that can replace those in which older Professionals have taken early retirement or redundancy packages. Figure 3 above illustrates that

[10] Tentative conclusions like these ones would need to be cross-checked against human resource information directly from the power stations, or at least triangulated in interviews with current or former staff and union officials.

this argument holds even stronger for Technicians and Trades Workers, who in every age group are the largest occupation.

The people, their communities and the local economies

Of the little over 1,200 people who would be employed today by the four power stations based on the 2016 census, just over 100 are classified as Managers and some 180 as Professionals. Almost 50 Managers and a little over 60 Professionals are by now in the 55 – 64 age bracket.

Half the total workforce or just over 600 people are counted as Technicians and Trades Workers, and some 200 of them are in the 55 – 64 age bracket. Roughly a tenth or almost 130 people are classified as Clerical and Administrative Workers and 50 of them are now 55 – 64 years old.

And there are a little over 70 Machinery Operators and Drivers, and some 40 of them fall into the age bracket that by now is 55 – 64 years old, while of the good 100 Labourers some 35 fall into this age bracket.

Unless specific economic development measures are taken, the people in the 55 – 64 age bracket have little chance of finding employment elsewhere and are likely to take an early retirement package, for which funding needs to be made available that is commensurate with existing payment levels in the industry. This will allow the local economy to continue without an instant major loss of purchasing power.

However, for the local economy not to contract, jobs at least equivalent to the whole workforce need to have been created when power stations close. While these closures may be a gradual process and be accommodated by retirements and regular attrition rather than big waves of retrenchments, once the number of jobs available in a local economy reduces, the economy shrinks. This is of particular relevance to the youngest age bracket that contains apprenticeships and traineeships.

On the other hand, once the 2021 Census data is available in October 2022, one also has to investigate whether comparable jobs in other industries have been created, that replaced some of the jobs in which power station workers have taken early redundancy packages.

The fact that currently only 2016 census data is available appears in a different light in this context: more recent data may well have obscured the focus on the power stations' contribution to the local labour market and the local economy overall, and with it the focus on not only the number of jobs that need to be created, but also their quality and occupational composition.

4. The income structure of the power station workforce

Workers in Electricity Generation[11]

Not surprisingly, half the managers in 2016 were in the highest income bracket of $156,000 or more per year. However, 20% of Technicians and Trades Workers were also in this income bracket. Given that this occupation made up half the workforce in the four power stations, 17% of the total workforce or a little more than 200 people earned more than $156,000 per year in 2016.

Almost half of the Technicians and Trades Workers or a little under 300 people earned more than $104,000 per year. Of the total workforce in Electricity Generation, 44% or some 530 people fell into the two top income brackets earning more than $104,000.

70% of the overall workforce in the four power stations analysed here, or more than 850 people earned $78,000 or more, at a time when half of NSW's population had a personal income of less than $34,500[12]. This last figure

[11] Just a reminder that the workforce in Electricity Generation also includes contractors and sub-contractors working in the industry, not only those employed directly by the power stations.

[12] The median weekly personal income for people aged 15 years and over in New South Wales was $664, according to the 2016 Census QuickStats (https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/1)

illustrates that on their own, the figures mentioned here do not say very much. Only once the figures are put into the context of NSW as a whole, or other industries are compared with Electricity Generation, the information becomes more meaningful.

1st context: other workers in the same geographies

Once the personal income structure of power station workers is compared to that of all workers in all three Level 4 Statistical Areas, the differences jump into sharp relief. Figure 3 below illustrates colourfully that there are four more brackets of personal annual income that are simply not represented in the pie charts for power station workers.

- $1 – $7,799
- $7,800 – $15,599
- $15,600 – $20,799
- $20,800 – $25,999

Graphically, this means that the first four colours in the legend, namely light blue, light marron, light green and pale purple are not represented in the top pie c.

This indicates first of all that the jobs in power stations are full-time jobs, which also means that in this industry there are no workers, who cannot get as many hours as they would like to or have to work in order to make ends meet. In other words, the phenomenon of under-employment appears to be absent from the electricity generation industry. This observation has important consequences for the kind of jobs that need to be generated in a Just Transition able to ensure that the local economies will not contract.

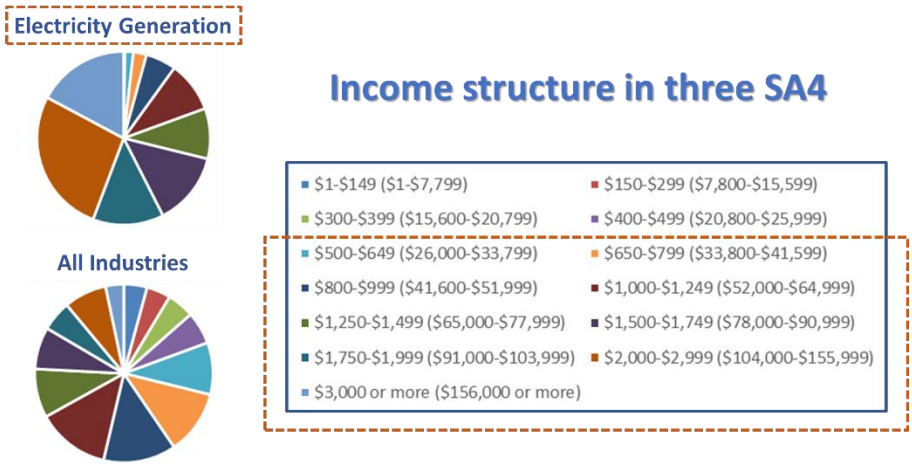

Figure 4: Personal income structure comparison between Electricity Generation and All Industries
Personal income structure in all three SA4 of 'Hunter Valley excluding Newcastle' (Bayswater & Liddell), 'Newcastle and Lake Macquarie' (Eraring), and 'Central Coast' (Vales Point)
Data Source: Census of Population and Housing, 2016, TableBuilder

Another important insight from comparing the two pie charts in Figure 3 results from the fact that the top four income brackets, here listed at the bottom, cover almost three quarters of the power station workforce (starting from the top counter-clockwise in the top pie chart), while the same four income brackets make up less than a quarter of the general workforce in the Hunter, Lake Macquarie and the Central Coast (pie chart at the bottom).

2nd context: NSW and all of Australia

As a backdrop, first a comparison of the total workforce in NSW with that of all Australia.

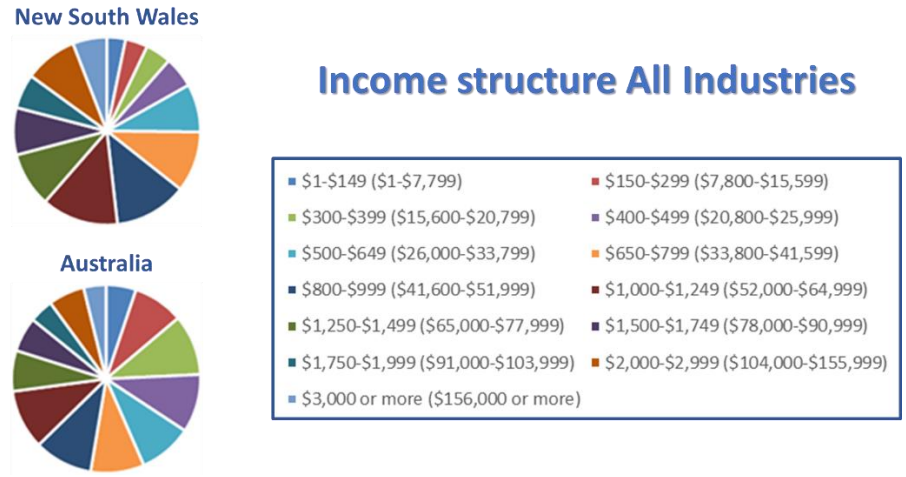

Figure 5: What people earn in NSW and in all of Australia
Personal income structure of people who work in NSW compared to that of all people working in Australia
Data Source: Census of Population and Housing, 2016, TableBuilder

Consider in the two pie charts above the first four segments clockwise from the top, the four bottom income brackets that are not represented at all in the Electricity Generation workforce at the four power stations investigated. These four segments make up significantly less than a quarter of the NSW workforce in all industries (top), but significantly more than a quarter in the Australian workforce in all industries (bottom). While some of this discrepancy could be due to more people working less than full-time hours, some of this effect could also be due to a generally higher wage level in NSW compared to the whole of Australia.

In this context it is interesting to compare for all of Australia the income composition of the workforce in Electricity Generation with the income composition of the workforce in all industries.

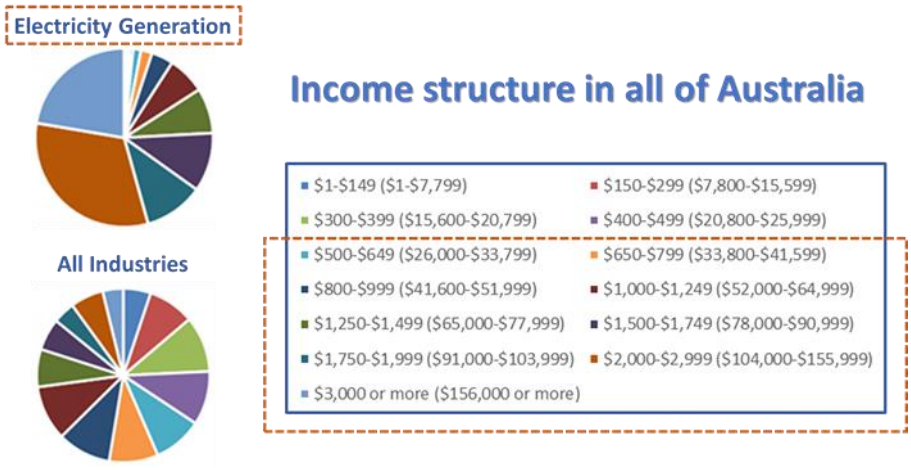

Figure 6: What power station workers earn, compared to all workers in Australia
Personal income structure of people who work in Electricity Generation compared to those working in all industries, all of Australia
Data Source: Census of Population and Housing, 2016, TableBuilder

In Electricity Generation nationwide the top income bracket covers almost a quarter of the power station workforce, and the top two income brackets, i.e. more than $104,000 annual personal income in 2016, covers more than half those employed. Looking at all industries nationwide, the distribution is more even, with the top four income brackets being among the smallest.

In other words, at a national level the highly paid share of the workforce in Electricity Generation is hugely bigger than what the highly paid share of the workforce is in all industries. This puts the difference shown in Figure 3 above into context: the difference in income distribution between power station workers and workers in all

industries is significant in the three level 4 statistical areas investigated here, but the difference is less big than it is for all of Australia.

However, without a more detailed analysis of the pay structure in different occupations, it is difficult to make meaningful comments on the kind of jobs that would need to be created to ensure a Just Transition for the power station workforce.

The income structure within occupations in NSW

The following set of pie charts compares the income structure of the relevant occupations in Electricity Generation with the income structure of the same occupations in All Industries in NSW.

For Managers, the income structure in NSW is significantly different between All Industries and Electricity Generation, where more than three quarters of managers earn $104,000 or more a year (top left pie chart in Figure 7 below). Importantly, for Managers in Electricity Generation, only the two top income brackets are statistically reliable with 178 and 92 managers respectively. When All Industries are considered, there are not only Managers in more income brackets, they are also spread more evenly between the income brackets, and the share of Managers in the top two income brackets is much smaller.

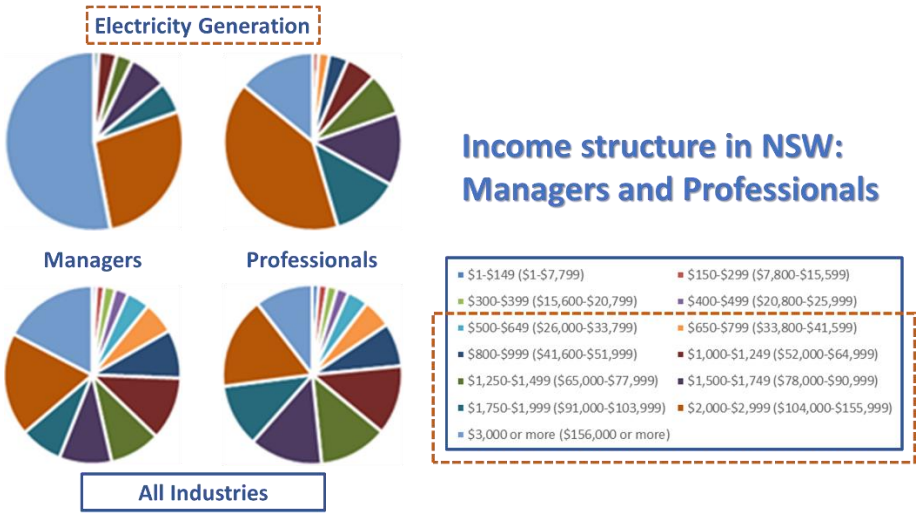

Figure 7: What NSW Managers and Professionals earn, Electricity Generation compared to All Industries
The personal income structure of NSW Managers and Professionals in Electricity Generation versus the personal income structure of NSW Managers and Professionals in All Industries
Data Source: Census of Population and Housing, 2016, TableBuilder

For Professionals, the income structure in NSW is also significantly different between All Industries and Electricity Generation, albeit in different ways. While in Electricity Generation there are also more Professionals in the top income bracket, the huge difference is in the second highest income bracket, between$104,000 and $155,000 annual income. In absolute numbers, the top four income brackets are statistically reliable in Electricity Generation, with 65, 186, 57, and 61 Professionals respectively being paid in the top four income brackets.

Figure 7 below compares the income structure between Electricity Generation and All Industries for NSW Technicians and Trade Workers and for Clerical and Administrative Workers. For the former, the top four income brackets are significantly bigger in Electricity Generation than in All Industries in NSW, with the lower income brackets covering smaller shares. However, only slightly more than half the tax brackets are statistically reliable, the seven higher ones. From the top income, they comprise 153, 247, 142, 126, 88, 79, and 66 workers respectively.

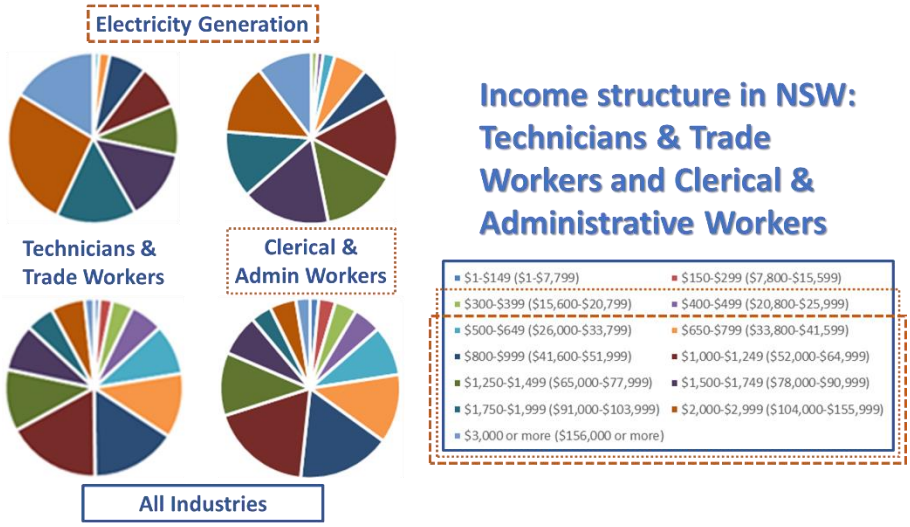

Figure 8: What NSW Technicians and Admin Workers earn, Electricity Generation versus All Industries
The personal income structure of NSW Technicians & Trade Workers and Clerical & Administrative Workers in Electricity Generation versus the personal income structure of NSW Technicians & Trade Workers and Clerical & Administrative Workers in All Industries
Data Source: Census of Population and Housing, 2016, TableBuilder

The figures for Clerical and Administrative Workers illustrated in the pie charts above also show significant and interesting differences. It is again the top four income brackets that have significantly bigger shares, with slices five and six (from the top counter clock-wise, in olive and brown respectively) being relatively similar in Electricity Generation and all industries. The top two of the bottom seven income brackets (midnight blue and orange) appear significantly smaller and the lower ones negligible in Electricity Generation. However, the absolute numbers in Electricity Generation are not very big, and all six top brackets are only just in the statistically reliable ranges with, from the top, 28, 36, 34, 45, 38, and 42 workers respectively.

The numbers for Machine Operators and for Labourers in Electricity Generation in NSW are too small to allow for statistically reliable analyses, while the two occupations of Community and Personal Service Workers and of Sales Workers are not relevant. This means that of the eight occupations the Census distinguishes, only four can be meaningfully analysed here. Interestingly, they are the four better paid ones.

Summary

Figure 9 below provides a visualisation of the income structure for the three Level 4 Statistical Areas (SA4s) of Hunter Valley excluding Newcastle (Bayswater & Liddell power stations), Newcastle and Lake Macquarie (Eraring power station), and Central Coast (Vales Point power station). The bar chart is based on the 2016 Census figures provided by the Australian Bureau of Statistics and includes their practice of randomising smaller numbers in order to guarantee anonymity. This means that the visualisation of the smaller sections cannot be relied upon, as they may be illustrating randomised figures.

Nevertheless, Figure 9 highlights not only the importance of Technicians and Trade Workers, but also how well-paid they are, and everyone else in Electricity Generation: only the last bar, and maybe a little bit of the second last one, represent incomes that are below the median income at the time of $664 per week.

In other words, almost the whole workforce in Electricity Generation makes part of the better paid half of the Australian workforce.

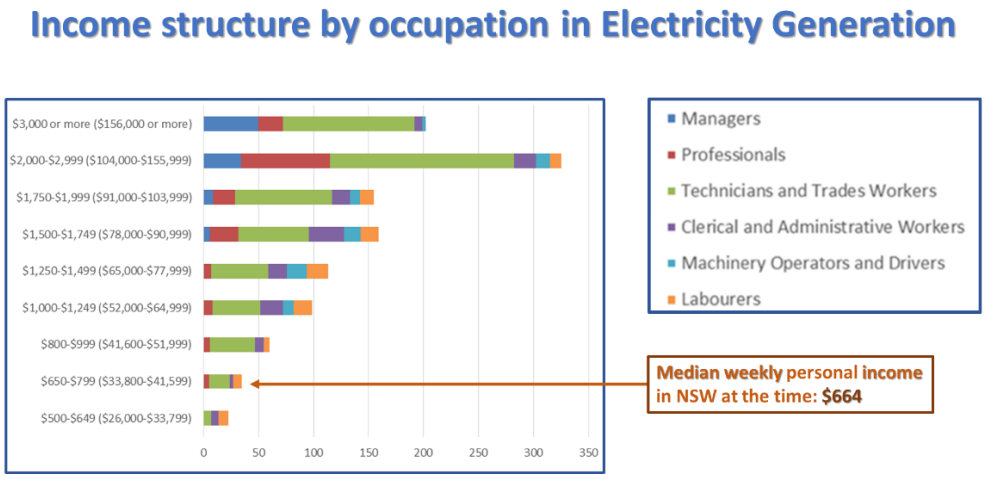

Figure 9: The different occupations within the income structure of the workforce
Income structure by occupation of people working in Electricity Generation in the three SA4 Hunter Valley excluding Newcastle (Bayswater & Liddell), Newcastle and Lake Macquarie (Eraring), and Central Coast (Vales Point)
Data Source: Census of Population and Housing, 2016, TableBuilder

Table 4 below provides the income structure of the main occupations in Electricity Generation in the Hunter Valley, Lake Macquarie and Central Coast together, and compares them to the numbers for NSW as a whole.

While the numbers for Clerical and Administrative Workers in NSW are at the lower end of statistically reliable, the figures for the three SA4s are not statistically reliable. Adding up the more reliable numbers for the four occupations investigated here leads to a figure of a little over 900, representing roughly ¾ of the overall workforce.

	Managers		Professionals		Technicians and Trades Workers		Clerical and Admin. Workers	
	NSW	3 SA4	NSW	3 SA4	NSW	3 SA4	NSW	3 SA4
$3,000 or more ($156,000 or more)	178	**50**	65	22	153	**120**	28	7
$2,000 - $2,999 ($104,000-$155,999)	92	**34**	186	**81**	247	**167**	36	20
$1,750 - $1,999 ($91,000-$103,999)			57	20	142	**88**	34	16
$1,500 - $1,749 ($78,000-$90,999)			61	26	126	**64**	45	32
$1,250 - $1,499 ($65,000-$77,999)					88	**52**	38	17
$1,000 - $1,249 ($52,000-$64,999)					79	**44**	42	20
$800 - $999 ($41,600-$51,999)					66	**41**		
Totals		84		149		**576**		112

Table 4: Overview personal income structure
Personal income structure of key occupations in Electricity Generation in NSW and the three relevant Level 4 Statistical Areas
Data Source: Census of Population and Housing, 2016, TableBuilder

Table 5 below summarises the earlier analysis based on the age structure of the power station workforce. Tables 4 and 5 together illustrate how important it is to investigate the quality of the employment opportunities in local economies and their communities, in terms of income and occupation, but also in terms of age structure of the people who currently hold those jobs.

Particularly in a declining industry it can be very informative to use slightly older census data, as such data reflect the jobs that were available back then, in this case in the communities where the power stations operated and created some wealth in the local economies – and left serious health and environmental legacies behind.

	Early retirement packages to be funded	Jobs to be created
Managers	50	100
Professionals	60	180
Technicians and Trades Workers	200	600
Clerical and Administrative Workers	50	130
Machinery Operators and Drivers	40	70
Labourers	35	100

Table 5: The occupational structure of the power station workforce
Data Source: Census of Population and Housing, 2016, TableBuilder

Coal-fired power stations left a legacy of environmental pollution and clusters of health issues, while the whole of NSW and Australia benefited from the electricity produced. The power station communities are rightly now demanding a Just Transition, a transition that is based on jobs that provide a comparable income structure and make use of the skills and training already available. These jobs have to provide career progression as well as opportunities for school leavers to find training opportunities and similarly qualified work.

5. The structure of education and training in the power station workforce

Apprenticeships

First of all it is useful to remember that in 2016 the power station workforce in the three Level 4 Statistical Areas of Hunter Valley excluding Newcastle (Bayswater and Liddell power stations), Newcastle and Lake Macquarie (Eraring power station), and Central Coast (Vales Point power station), was distributed unevenly, in the sense that the two power stations Bayswater and Liddell were in the same SA4. As a consequence, the distribution of Bayswater and Liddell's characteristics will have a stronger impact on the distribution in all three SA4.

The largest share or almost half of the workforce employed in Electricity Generation recorded a Certificate III or IV (turquois) as their Highest Educational Attainment, with a slightly smaller share in NSW and Australia overall than in the three SA4. Advanced Diploma and Diploma levels (light purple) are higher at the four power stations, and bachelor degrees (light green) are lower, compared to Electricity Generation in NSW and Australia overall. These findings not only reflect the earlier observations that most things to do with electricity require a trade qualification and that Certificate III & IV are the levels at which most apprenticeships are recorded. They also indicate that power stations provided a significant share of the apprenticeships available in their regions.

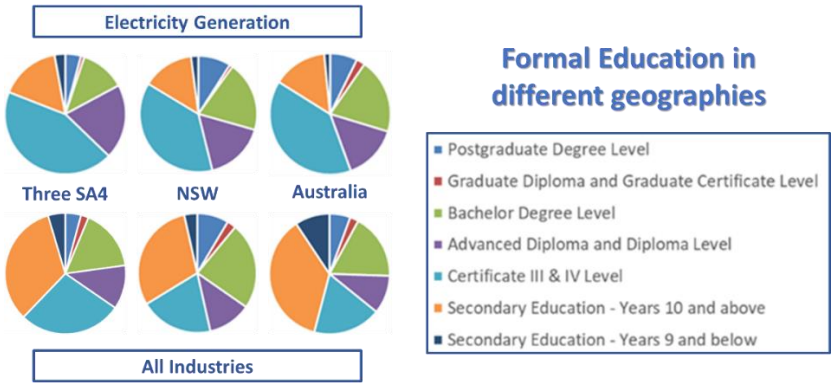

Figure 10: Education levels in Electricity Generation versus All Industries, different geographies
Data Source: Census of Population and Housing, 2016, TableBuilder

In comparison to all industries, the share of people with a Certificate III or IV in Electricity Generation is almost twice as big than in all industries together, both in NSW and in Australia overall. On the other hand, the share of those with no further training and education beyond high school is more than twice as big when all industries are considered in comparison to Electricity Generation.

Combining this information with the information on the occupational structure we depicted in Figure 2 earlier backs up our claim about the importance of power stations in the education and training landscape. Because apprenticeships are recorded as highest educational attainment (HEAP) of Certificate III & IV Level, and as Advanced Diploma and Diploma Level, depending on the occupation, their overwhelming dominance in Electricity Generation at the level of the three SA4s is a strong statistical indication for the power stations' role in the provision of apprenticeship places in a range of occupations[13]. Careful planning will need to ensure that this function will be fulfilled by other players or in other ways.

More details on selected occupations

Given that Managers, Professionals, and Technicians and Trades Workers make up three quarters of all occupations in Electricity Generation in the three Level 4 Statistical Areas investigated here, it is interesting to investigate the Highest Educational Attainment for each of these occupations in a little more detail, and then compare the findings with all industries for the same geography.

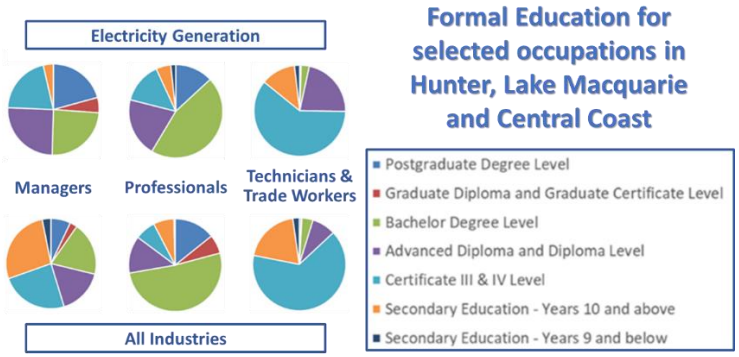

Figure 11: Education levels for three occupations, Electricity Generation versus All Industries
Data Source: Census of Population and Housing, 2016, TableBuilder

Figure 11 shows that among the Managers in Electricity Generation, those with a Postgraduate Degree (blue), those with a Bachelor Degree (light green), those with an Advanced Diploma or Diploma (light purple), and those with a Certificate III or IV (turquois) make up just a little under a quarter each. In other words, management in power stations has quite a varied educational background.

In comparison, Managers in All Industries in the same three Level 4 Statistical Areas have a much larger share of school leavers at Years 10 and above (orange), and a much smaller share of Managers with a Postgraduate Degree (blue). This may well be representative of the large share of owner-managers in small businesses, who built their business without formal training and further education[14].

Management in Electricity Generation on the other hand appears to include people with a range of trade and higher education backgrounds, which speaks to the variety of career paths in Electricity Generation open to those who completed apprenticeships and trade qualifications. This kind of career progression is another important function of power stations in their local communities that needs to be fulfilled by others for a transition to be a just one.

Among professionals the share of those with a Bachelor Degree is roughly half in both, Electricity Generation and All Industries, but the shares of those with an Advanced Diploma & Diploma and those with a Certificate III and IV are larger in Electricity Generation. This again would indicate that there is a significant proportion of those working in power stations, who progress their career from an apprenticeship through informal on-the-job training into a professional role.

[13] It is easy to verify this conclusion with a qualitative investigation of the completion data of the relevant certificates completed locally.
[14] Again, this claim would need to be triangulated with other than Census data.

Among Technicians and Trades Workers those with an Advanced Diploma & Diploma Level qualification make up a bigger share in Electricity Generation than in all industries, while those without a qualification beyond high school are a smaller share. Again, this is likely to reflect the fact that power stations provide formal training opportunities to many of their Technicians and Trades Workers.

Drilling a little deeper into the census information on the educational background by occupation therefore confirms the important role power stations traditionally played in their communities and their local economies, which highlights an important qualitative requirement for the jobs that need to be created to ensure a just transition: education and training have to be integral parts of those new jobs, together with career paths that provide on-the-job training beyond further formal education.

6. Conclusions: cornerstones for flagship projects

Based on this analysis of the characteristics of those who worked in power stations in 2016, the next section draws out some key aspects of the kind of employment that can replace power stations in a Just Transition, where the local communities and their economies can flourish, the kind of employment flagship projects have to provide.

Well-paid, stable jobs with interesting career progressions

If public money is to be used to support an economic diversification that can be called a Just Transition, then the Flagship Projects that are being supported need to meet the highest standards – in particular for the quality of jobs they provide.

The following graphs and charts put the power station workforce into context. In order to have large enough datasets, we first look at NSW. Figure 12 below shows a number of bar charts for the structure of total personal income brackets by occupation in a range of industries. The first chart shows all industries together, in order to provide a general reference frame for a rough comparison between different industries.[15]

Considering all industries in NSW, the middle income brackets are the largest ones and the occupations of Managers and Professionals are more strongly represented in the higher income brackets. Similarly, occupations, in which part-time work is more common are more strongly represented in the lower income brackets.

Manufacturing in NSW clearly employs less Professionals than all industries combined, but significantly more Technicians and Trades Worker. This trend is even more pronounced in the construction industry, but here we find Technicians and Trades Workers also in the higher income brackets.

In the mining industry the second highest income bracket representing an annual income between $104,000 and $155,999 is by far the largest bracket, more than twice the next largest one, which is the top income bracket. While the largest bracket encompasses the largest number of Technicians and Trades Workers, it contains an even larger share of Machinery Operators and Drivers. In fact, by far the largest share of Machinery Operators and Drivers fall into this category, the second highest income bracket.

The last industry illustrated here is Electricity, Gas, Water and Waste Services, which encompasses the power station workforce. Like mining, this industry is overrepresented in the top income brackets, but not just the top two, there are four more income brackets that are very strong in this industry, a pattern we have discussed in detail earlier for the power station workforce[16].

[15] There are many intricacies that would need to be considered in a detailed analysis of a person's Total Income from all Sources, but here we are only interested in some general characteristics of the overall workforce in an industry, hence the graphical illustration as a visual illustration of key points in the aggregate.

[16] See the discussion of Figure 9 above.

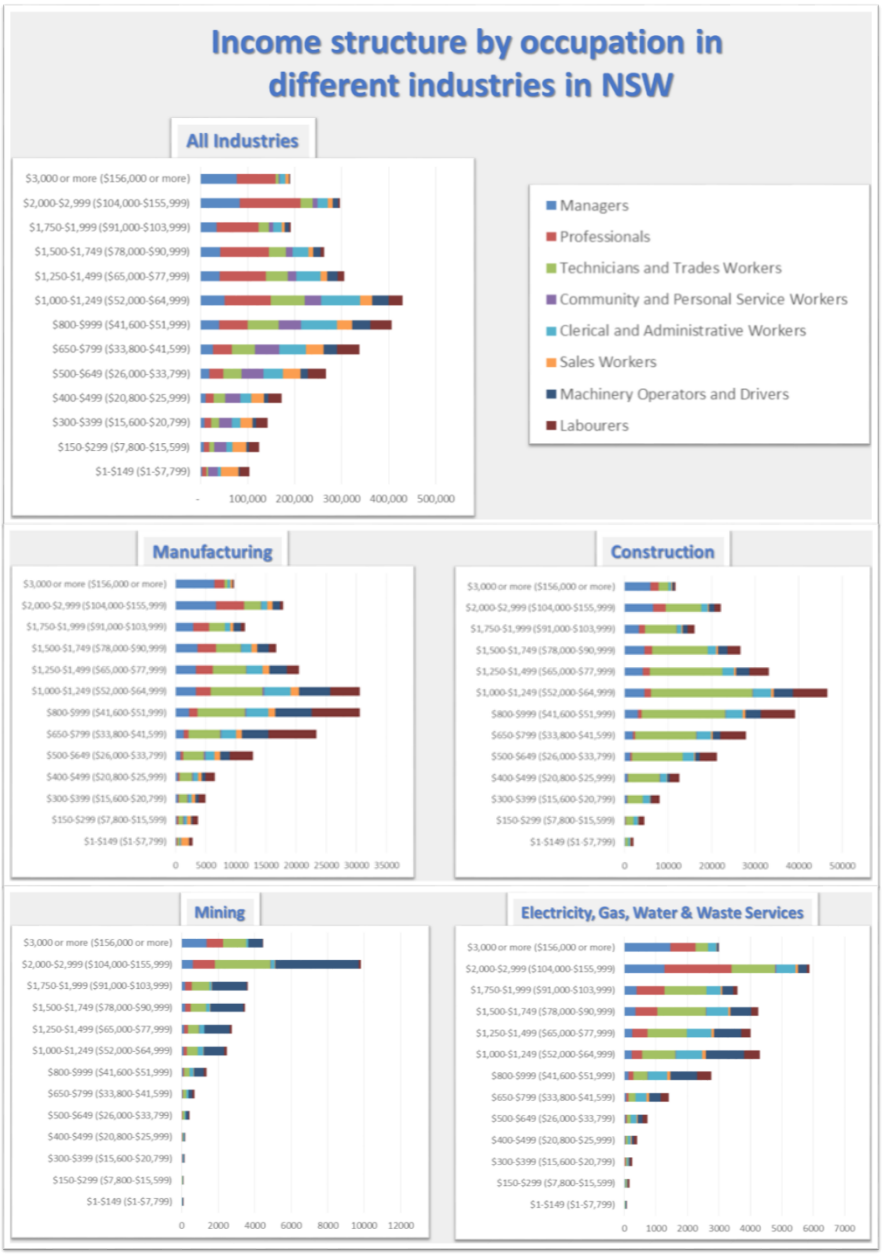

Figure 12: Income structure by occupation for selected industries in NSW
Data Source: Census of Population and Housing, 2016, TableBuilder

The overview provided in Figure 12 already highlights that careful planning and industry development leadership will be required to support the creation of jobs that can provide a vaguely comparable income structure to the one of the power station workforce. However, the data in Figure 12 is at the one digit level, which means it is highly aggregated.

Yet data based on an industry's income structure for the whole of NSW may not be appropriate to indicate industries that can provide well-paid jobs in the localities where the power station workforce and their families live. In addition, data for the whole of NSW may not be adequate for the three SA4 investigated here, because some industry subsectors may not be present in this area.

Figure 13 below thus provides information on the distribution of income brackets for three industry subsectors in the three statistical areas where the NSW coal-fired power stations are located. However, the numbers are now so small that only the relative shares of income brackets can be given, and they need to be interpreted with caution.

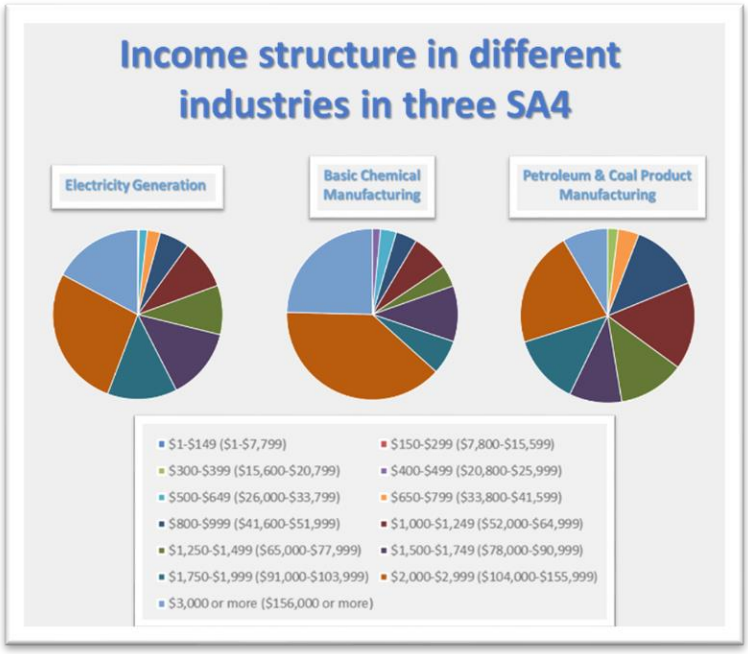

Figure 13: Local income structure for selected industries
Electricity Generation, Basic Chemical Manufacturing and Petroleum & Coal Product Manufacturing compared regarding their income structure for the combined geography of the Hunter, Lake Macquarie and Central Coast regions.
Data Source: Census of Population and Housing, 2016, TableBuilder

The information is not structured around occupations, but rather just gives the overall shares for each income bracket. Nevertheless, the pie charts give a first indication that Basic Chemical Manufacturing and Petroleum & Coal Product Manufacturing could be two industries with a comparable income structure to Electricity Generation in the three relevant statistical areas. The information for these industries is depicted below, but again only at the geographical level of NSW as a whole.

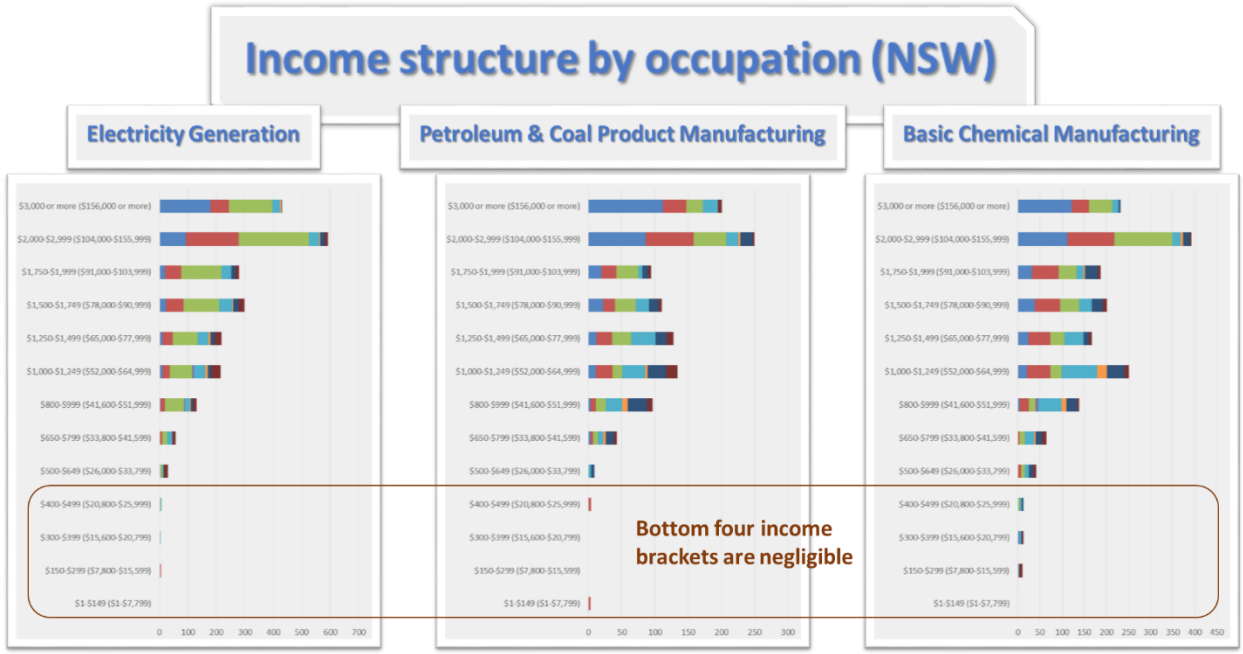

Figure 14: Income structure for selected industries for NSW
The income structure of Electricity Generation, Basic Chemical Manufacturing and Petroleum & Coal Product Manufacturing, NSW.
Data Source: Census of Population and Housing, 2016, TableBuilder

Figure 14 above checks the indication given by Figure 13 against the corresponding data for all of NSW. This lends a little more weight to the first impression gleaned from Figure 13. In addition, Figure 14 includes information about the occupational distribution within each income bracket, although some of the reservations mentioned above apply here too, as these figures refer to NSW as a whole.

Despite all the reservations due to data limitations, and keeping in mind that the analysis provided here is based on 2016 data, this high-level analysis of publicly available data illustrates that industry policies interested in supporting power station workers to transition into jobs of similar quality can identify clear priorities for flagship projects.

Skills match and skills regeneration

As this report has detailed, the power station workforce is not only well paid, it is also highly skilled. It is in the interest of those regional economies that hosted coal-fired power stations, that these skill sets be utilised locally. While one could argue that the skill sets used in a sunset industry are likely to be also obsolete, this argument has to be examined further.

Coal-fired power stations are connected to the national energy grid, which requires a common minimum level of sophistication. This means that the various skills needed to operate and maintain different power station equipment can be transferred to operate equipment in other factories, even though the power stations that are being shut down first may not employ the latest technology. And these skills provide a strong basis, from which workers can train further.

However, projects that receive support from the mechanisms that implement industry policies not only need to utilise these skills locally. These projects also need to contribute to the regeneration of the skill sets. This means on the one hand providing a wide range of apprenticeships, and on the other hand continuous investment in research and development initiatives.

In addition, flagship projects need to provide a variety of career paths that are supported by in-house training and by collaborations with local training institutions like universities and TAFE institutes in order to maximise the benefits for the local economy. High school students need to see themselves reflected at all levels of the workforce, from apprentices to general managers, in interesting jobs that have a bright future. These projects need to be employers of choice for people who have local alternatives.

Integration into local economies

In addition and closely linked to the last requirement, flagship projects also need to be well integrated into the local economies. They need to procure an important part of their inputs locally and sell them to other businesses, who then not only process them further, but do so locally. Ideally, flagship projects will work with similar subcontractors to power stations, but also add further linkages to the local economy.

Coal-fired power stations are large operations that operate in shifts continuously around the clock seven days a week, which means that they employ a relatively large number of people in shifts. Originally, coal-fired power stations were established by the public purse, because they require large capital investments upfront, and have a relatively long pay-back period. Both characteristics have implications for the kind of enterprise that can employ the power station workforce.

This is where well-targeted industry policy might have its biggest impact. There are many ways in which the public purse can provide support for a flagship project that addresses large upfront capital expenditure and long payback periods, which also make it easier for private investment to join in. However, capital intensive investments are not necessarily also labour intensive – flagship projects that operate around the clock and employ shift workers can be one type of project that is both capital and labour intensive.

If the projects are carefully chosen with the issues discussed above in mind, they can also be well-integrated into the local economies and provide backwards and forward linkages. Well-chosen, they can kick-start a range of new industries that are locally based and multiply the effect of public money spent.

Environmental contributions and social licence

The pressure for coal-fired power stations to close earlier than planned comes from two sides: market conditions and environmental pressures. Addressing the latter first, it is of crucial importance that any flagship project that receives public funding makes a positive environmental contribution. After all, it is on this front that the social licence of coal-fired power stations is most under threat.

The carbon footprint of every business becomes more and more important, illustrated in Australia by the mainstreaming of environmental, social and governance standards in ESG reporting, even though carbon accounting is still in its infancy here. Forward-looking industry policy has to take into account the environmental contribution of any flagship project considered. Without a good scorecard on ESG requirements, any flagship project will struggle to gain the social licence necessary to spend the amounts of public money required for an industry policy with teeth.

The other reason for early closures of coal-fired power stations mentioned above, market pressure, highlights the need for flagship projects to have a sizeable growth potential. In order to qualify as a flagship project, the project needs to make part of an industry that is in ascendency, as opposed to a sunset industry like coal-fired power.

If the industry policy wants to encourage what has been termed sunrise industries, there needs to be special support for innovation and start-ups. This adds significantly to the public funds required, but the returns can also be manifold, provided the selected projects have at least the potential to meet all the other requirements outlined here.

References

ACIL Allen, 2021, *Economic Impact Analysis of Renewable Energy Industrial Precincts – Hunter Valley REIP*, Prepared for Beyond Zero Emissions. May 2021. https://bze.org.au/wp-content/uploads/2021/07/Hunter-Valley-REIP-FINAL-18-May-2021-1.pdf (accessed 25 May 2022)

Australian Bureau of Statistics (ABS), 2016, *Census of Population and Housing: Census Dictionary*, Catalogue Number 2901.0, https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/2901.0Main%20Features12016 (accessed 14 April 2022)

Australian Energy Market Operator (AEMO), 2021, *Draft 2022 Integrated System Plan. For the National Electricity Market*, 10 December 2021, https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp (accessed 14 February 2022)

Bowyer J, 2021, *Australian Government Emissions Projections Imply Early Coal Exit of 5GW by 2030. Analysis of Australian Government DISER Emissions Projections* (Institute for Energy Economics and Financial Analysis IEEFA), December 2021, https://ieefa.org/ieefa-australian-government-emissions-projections-show-44-of-coal-capacity-will-close-by-2030/ (accessed 14 February 2022)

Hunter Joint Organisation, 2020, The Hunter Central Coast Circular Economy Ecosystem Report https://www.hunterjo.com.au/projects/hunter-circular/ (accessed on 25 May 2022)

Infrastructure NSW, 2020, Annual Report 2019-2020 https://www.infrastructure.nsw.gov.au/about-us/annual-reports/ (accessed on 25 May 2022)

NSW Government, 2019, NSW Circular Economy Policy Statement 'Too Good To Waste' https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/response-to-china-national-sword/circular-economy-policy (accessed on 25 May 2022)

Saevarsdottir G, Kvande H, Welch B, 2019, Aluminum Production in the Times of Climate Change: The Global Challenge to Reduce the Carbon Footprint and Prevent Carbon Leakage, *JOM – The Journal of the Minerals, Metals & Materials Society* 72(1), p296-308 (DOI: 10.1007/s11837-019-03918-6)

Rose T, 2021, *Climate Risk and the Cost of Capital in NSW. Australia's Climate Policies Will Materially Impact NSW's Long Term Economic Outlook* (Institute for Energy Economics and Financial Analysis IEEFA), October 2021, https://ieefa.org/ieefa-australias-climate-policies-could-push-new-south-wales-into-a-debt-spiral/ (accessed 24 January 2022)

Sheldon P, Junankar R, De Rosa Pontello A, 2018, *The Ruhr or Appalachia? Deciding the future of Australia's coal power workers and communities* (IRRC Report for CFMMEU Mining and Energy) https://me.cfmeu.org.au/news/download-report-deciding-future-australias-coal-power-workers-and-communities (accessed 24 January 2022)