
UNSW Engineering Response to Clean Energy Capacity Study – April 2023

Executive Summary

UNSW Engineering is the largest engineering Faculty in Australia and offers the widest range of engineering degrees in the country with 8 Schools and more than 70 years' experience. The Faculty, along with UNSW Future Students welcomes the Clean Energy Capacity Study and the objective, among others, to provide much needed clarity on viable career pathways and job prospects associated with Australia's growth in clean energy. The capacity to equip and meet the current and future needs of industry associated with clean energy is significantly dependent upon education providers being able to attract students into the associated disciplines by providing clear data, along with robust information on prospective career paths and job opportunities within clean energy. As reinforced by Engineers Australia, demand forecasting and its role in informing career choices is one of the 5 most influential factors that influence the engineering workforce.ⁱ

This response paper provides input from the UNSW Future Students division, along with feedback and additional resources from the four principal schools within UNSW Engineering concerned with research education, and equipping industry with employees within clean energy: The School of Photovoltaics and Renewable Energy, The School of Electrical Engineering and Telecommunications, The School of Chemical Engineering, and the School of Minerals and Energy Resource Engineering. The Faculty and Schools support the current draft definition of "clean energy." The study its objectives of providing greater data and clarity on the future opportunities within clean energy is imperative and we note in particular the value of collaboration with Engineers Australia, sharing final data and information with high school career advisors and utilising additional data sources and reports for this study reference below such as , " Energy Efficiency Employment in Australia report," "Developing the future energy workforce."

UNSW Future Students

Despite UNSW Engineering ranking as the #1 Engineering and Technology university in Australia,ⁱⁱ and leading the Group of 8 in engineering enrolments, it is a challenge to attract and enrol students into both undergraduate and postgraduate into the disciplines that are specifically aligned to the clean energy sector. A prime example are the renewable engineering programs within the School of Photovoltaics and Renewable Energy Engineering. The School is an international world leader and pioneer within clean energy, particularly photovoltaics. However, given how difficult it is for universities and high school career advisors to source and provide clear information on potential career paths and roles linked to clean energy, it is a challenge to persuade prospective students and parents to such disciplines compared to other more prevalent Engineering disciplines. The latter are, linked or associated with clear industry classifications, sectors and ANZSCO job codes readily available through labourmarketinsights.gov.au and Jobs and Skills Australia. For universities and high schools to use when guiding students. The inability of education providers to promote such information in comparison to what is currently available has a negative impact on the future supply of engineers with knowledge in this area.

We acknowledge the already identified challenge of classifying certain positions within "clean energy" and agree with a narrower definition being used for the purpose of providing clear data and the implications this has on easily sharing this information with prospective students. In using the above, we also encourage the creation of a "clean energy" industry classification which would be immensely beneficial to increasing the visibility of this growth area and ability of education providers to reference the opportunities to attract students. This could be akin to the industry category of "Professional and scientific services" which naturally spans a multitude of areas but is at least a designated broad industry

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that can be referenced in marketing messaging, not only to domestic students, but international students as well.

We also encourage the prioritisation through this study of how job opportunities within clean energy can be better informed and promoted to women, noting that “lack of familiarity with engineering” is the most cited reason for women not choosing engineering as their field of study.ⁱⁱⁱ The clarity of information should also take into consideration the international student audience and how it will inform their choice of Australia as study destination. This will contribute not only to Australia’s 3rd largest export industry, international education, but also help address the engineering skills shortage that Engineers Australia, states as being essential to the nation's engineering capacity.^{iv}

UNSW School of Photovoltaics and Renewable Energy Engineering Response

The discussion paper would be improved by considering more explicitly studies on the workforce requirements for the Energy Efficiency industries in Australia. For example see:

- Energy Efficiency Employment in Australia
<https://www.eec.org.au/uploads/Projects/Energy%20Efficiency%20Employment%20in%20Australia%20-%20full%20report.pdf>

On Page 22 there are a number of past studies reviewed, however all focus on supply side clean energy workforce studies with no studies reported for the Energy Efficiency workforce. End use Energy Efficiency in Australia has been neglected for some time. Australia currently ranks 18th in a group of 25 countries globally in the International Energy Efficiency Scorecard (ahead of Brazil and behind Indonesia) <https://www.aceee.org/international-scorecard>

Improving Energy Efficiency policy and aiming for greater ambition in this area in Australia (e.g. light vehicle fuel efficiency standards) would also stimulate the industry and the workforce required so any investigations should be aware of this low starting point of the industry at present in Australia. Despite this the Energy Efficiency area is already a significant employer in Australia with the above report stating a range of 60,000 to 240,000 jobs in 2016/17.

Response to Page 4: Barriers to developing and delivery clean energy education and training?

The clean energy industry is growing rapidly and is keen to engage with Universities and TAFEs to attract graduate engineers and tradespeople. A major challenge is attracting students into these areas. A barrier could well be that public perception has been coloured by the past decades of politicizing renewable energy that could have discouraged potential students from this area. A further challenge is that Australia has had a long term challenge in attracting sufficient students into Engineering such that Australia currently only produce about 50% of the engineers our economy requires with the rest coming from overseas.

Response to Page 6-9 Definition of Clean Energy

The definition of Clean energy is very good, as it covers renewable energy and energy efficiency.

Response to Page 26 Discussion Questions:

The School of Photovoltaic and Renewable Energy Engineering was established over 20 years ago with the specific aim of providing engineering education in the clean energy and energy efficiency areas with programs at undergraduate and postgraduate level. Our programs are accredited by Engineers Australia:

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both the Bachelor of Engineering (Hons) programs as well as the Masters of Engineering (coursework). We recognize that renewable energy crosses many of the traditional silos within engineering and so these programs include courses across many different schools in the Faculty of Engineering. Our School has an excellent track record in Photovoltaic research – with UNSW Passivated Emitter and Rear Contact (PERC) technology developed by Professor Martin Green and others at UNSW, is now utilized in over 90% of all solar modules produced globally today.^v In addition to developing the PERC technology, our education efforts and supervision of research students for the past 40 years, has produced many engineers and researchers who are now at the forefront of the Photovoltaic industry globally.

The barriers that students and prospective workers face in accessing education and training specific to clean energy is one of awareness. Many students are aware of traditional engineering programs – one of the challenges faced is therefore visibility and knowledge of the degrees offered by the School of Photovoltaic and Renewable Energy Engineering.

Response to Page 27 Discussion Questions

The renewable energy and energy efficiency industries are growing rapidly and are keenly aware of the shortage of applicants for the positions they advertise. Surveying the industries on a regular basis to ascertain emerging areas of growth and need and working with those industries to reach out to the Australian community to communicate the job opportunities in these industries would be productive. It would also be beneficial to partner with Engineers Australia and Universities, especially the Engineering faculties, to communicate the educational opportunities in this space.

UNSW School of Electrical Engineering and Telecommunications Response

Any investor who has embarked on a renewable energy generation project (e.g. solar farm or wind farm) has quickly come to appreciate one of the grand challenges facing clean energy transition: the electricity grid integration of renewables. Not only is this a challenge for renewable generation projects, it is a challenge for everyone in the electricity grid ecosystem, dealing with intermittency, storage, inertia, coordination of millions of generators and much more. Further, investment in electricity grids ('poles and wires', transmission etc) needs to increase by a factor of 2-3 as transport moves to electric power. This is such a major challenge that in the brand-new NSW Decarbonisation Innovation Hub, one of the three major focus areas is Electrification and Energy Systems.

The scale of need is difficult to assess accurately, although “Developing the future energy workforce” (RACE for 2030 CRC, <https://www.racefor2030.com.au/wp-content/uploads/2021/10/RACE-E3-Opportunity-Assessment-FINAL-REPORT-October-2021.pdf>) does give some projections about this. However, the School of Electrical Engineering and Telecommunications – the largest electrical engineering school in Australia – is keenly aware from multiple interactions with utilities, generators, transmission authorities and market operators that there is *already* a significant shortfall in the number of power engineers graduating to fill the available positions in in this area. Concerningly, the transition to clean energy is arguably only just getting started, while the pipeline of future power engineering graduates is flat or even declining (depending on what fraction of international students might be retained in Australia following their studies in Australian universities). Further, there is intense competition for electrical engineering graduates from other sectors (e.g. infrastructure, defence, electronics, telecommunications, automation, finance, cyber security, IT, to name just a few), which are all experiencing significant shortfalls also, meaning that there is no guarantee that the pipeline of future graduates will all be employed in clean energy.

One industry partner has privately shared its own projection that Australia will need to double its number of energy sector engineers within 5 years to meet the demand, and that is only on the base

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scenario of decarbonisation. In their view, availability of skilled engineers will be a major challenge. The retraining of engineers from other sectors may mitigate this, for example using ‘short’ engineering courses to retrain engineers in power engineering. However, it is easy to overestimate the benefits of such courses, since in general these will require engineers to have significant experience in relevant areas before commencing them, because engineering disciplines are largely completely different during Years 2-4 of study.

A further challenge, based on the School’s direct experiences (from audiences in the hundreds at UNSW Open Days(recruitment of UG students, is that prospective students (e.g. high school students) and their parents have little idea what decarbonisation is, what degrees are needed to contribute to it, or what careers in decarbonisation could look like. Surprisingly, many current electrical engineering students even have little idea that their degree may be pivotal to combating climate change. The School has begun addressing this (e.g. <https://www.unsw.edu.au/news/2022/11/decarbonisation-how-your-future-career-can-help-us-get-to-net-zero-emissions>), however if decarbonisation is to become a significant industry sector for Australia, a huge campaign will be needed to explain what it is and how everyone can participate.

UNSW School of Chemical Engineering

As the world races towards achieving net-zero emissions, chemical engineering has become a critical player in the transition to clean energy. Chemical engineers play a crucial role in designing, developing, and operating processes that utilise alternative carbon sources, such as CO₂ from emissions or air, to create feedstocks for the chemical industry and sustainable fuel. With their expertise, chemical engineers can also develop technologies that generate clean energy from renewable sources like solar, wind, hydro, biomass, and geothermal energy.

The need for chemical engineers in the clean energy sector is more significant than ever before. They can help reduce the environmental impact of traditional energy sources by developing cleaner and more efficient technologies for their production and utilisation. At UNSW, chemical engineering researchers are actively involved in the development of clean energy technologies, including hydrogen and its derivative production, energy storage technologies, and more.

Capacity building is crucial for the development of clean energy technologies, and the School of Chemical Engineering at UNSW is committed to designing and delivering education programs for students so they are ready for the clean energy workforce. Additionally, the School collaborates with the industry to develop research projects, promote knowledge sharing among experts, and work with policymakers to assess feasibility and promote the adoption of clean energy technologies.

As the demand for clean energy continues to grow, chemical engineers are in high demand. Young graduates can pursue a wide range of careers in the clean energy industry, including research and development, project management, process design, and consulting. There are opportunities to work in academia, government, and private industry. With their expertise, chemical engineers can help pave the way for a more sustainable and cleaner energy future.

UNSW School of Mining and Energy Resources Engineering

The IPCC in its 2022 report identifies the need to consider diverse strategies and all disciplines for an optimal outcome regarding the transition to net zero emissions. Resources engineers are in a unique position in this context as they are strongly affected in the sense of the transition from fossil fuels to renewable resources. Namely, while fossil fuels are phasing out, there is increased demand for long-term storage of CO₂, intermediate large-scale storage of hydrogen, and the delivery of critical minerals.

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As a global leader in resources engineering (mining and petroleum engineering - two transitioning disciplines), UNSW can have a large global impact on emission reduction in its target markets by providing a capable and critical workforce equipped with the skills to safely and efficiently implement geostorage solutions of fluids, gases and pressure, the extraction of geothermal energy, and to extract critical minerals while steadily reducing the carbon footprint.

Developing these new skills sets has been an ongoing effort supported by industry and government grants as well as the establishment of extensive laboratory capabilities. Based on this knowledge, MERE is in the process of setting up multiple new educational offerings both at undergraduate and postgraduate levels, and in collaboration with other engineering disciplines.

The energy transition stands and falls with the provision of sufficient materials and temporary energy storage as well as the de-carbonisation of heavy industry. Resources engineers with a view for the future and an appreciation for advocacy, resources stewardship, and in-demand technical skills is what industry and academia desire - and MERE can deliver.

CONTRIBUTORS

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ⁱ Bell M., Briggs P., Roamnis J., MacMaster., "Strengthening the engineering workforce in Australia" Engineers Australia, August 2022. <https://www.engineersaustralia.org.au/publications/strengthening-engineering-workforce-australia>

ⁱⁱ QS 2023 World University Subject Rankings

ⁱⁱⁱ Romanis, J. 'Women in Engineering: Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression' *Engineers Australia*, June 2022 <<https://engineersaustralia.org.au/sites/default/files/women-in-engineering-report-june-2022.pdf>>

^{iv} Bell. M., Briggs P., "Engineering skills- supply and demand" Engineers Australia, March 2022 <https://www.engineersaustralia.org.au/sites/default/files/2022-03/Engineers-Australia-Skills-Discussion-Paper-20220310.pdf>

^v <https://www.vdma.org/international-technology-roadmap-photovoltaic>