BLUE ECONOMY
COOPERATIVE RESEARCH CENTRE

Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

EXECUTIVE SUMMARY

Offshore Wind Energy in Australia

July 2021

The Blue Economy CRC is funded in part under the Australian Government's CRC Program, administered by the Department of Industry, Science, Energy and Resources. The CRC Program supports industry-led collaborations between industry, researchers and the community.

Report Contributions

The report bought together expertise from CSIRO, Saitec Offshore, Institute for Sustainable Futures, University of Technology Sydney, Maritime Union Australia along with contributions from the Electrical Trades Union, Australian Manufacturing Workers' Union and Australian Council of Trade Unions.

The full 96 page report is available at https://blueeconomycrc.com.au/projects/offshore-wind-potential-australia/

Report Citation: Briggs, C., M. Hemer, P. Howard, R. Langdon, P. Marsh, S. Teske and D. Carrascosa (2021). Executive Summary - Offshore Wind Energy in Australia: Blue Economy Cooperative Research Centre, Launceston, TAS. 92p.

Cover Image Credit: Øyvind Gravås © Equinor - Hywind Scotland

Executive Summary

Offshore wind energy is booming globally. The industry is rapidly scaling up across the UK, Europe and Asia-Pacific as costs have fallen and the size of turbines and projects has increased dramatically.

Globally, 2030 targets for offshore wind total around 200 Gigawatts (GWs), including 40 GW in the UK and US, 60 GW in the EU, 12 GW in Korea and 10 GW in Japan (which has a target of 45 GW by 2040). For the International Energy Agency (IEA), offshore wind energy is now one of the 'big three' in its energy scenarios – projected alongside on-shore wind and solar PV to be one of the bulk sources of electricity in the clean energy transition in coming decades. The UK Government project that by 2030, offshore wind will be cost-competitive with onshore wind. The scale of global development in offshore wind energy will translate into major employment growth by 2030. (see GWEC, 2020)

In Australia, there are currently more than 10 projects proposed with a combined capacity of over 25 GW. (Table ES1) In this study, we evaluate the potential for offshore wind energy in Australia by undertaking:

- High-level mapping to evaluate the quality of Australia's offshore wind energy resources, investigating 12 locations around the Australian coast that are adjacent to energy infrastructure and demand centres;
- A comparative analysis of the generation profile of offshore wind energy with onshore wind and solar energy and load profiles to investigate its potential value within Australia's electricity market states;
- The employment potential for offshore wind energy and the role it could play in a 'just transition' for coal, oil and gas workers.

Image Courtesy of Saitec Offshore

Table ES1: Offshore wind projects proposed in Australia.

Project	Location	Capacity
Star of the South	Gippsland, Victoria	2.2 GW
Oceanex	Newcastle, NSW	1.8 GW
	Wollongong, NSW	2 GW
	Bunbury, WA	2 GW
	Ulladulla, NSW	1.8 GW
	Eden, NSW	1.8 GW
Newcastle Offshore Wind	Newcastle, NSW	3 GW First Stage
Green Energy Partners	Wollongong/Port Kembla, NSW	3 GW grid
		5 GW hydrogen
	Bass Strait, Victoria	4 GW
	Western Victoria	500 MW – 1 GW
	South of Perth, WA	1 GW
	Southern Queensland	2 GW
Pilot Energy and Triangle Energy	Geraldton, Western Australia	1.1 GW
Brookvale Energy	Burnie, Tasmania	2 GW
Australis Energy/Warwick Energy	Bunbury, Western Australia (state waters)	300 MW
	Portland, Victoria (state waters)	495 MW
	South Australia	600 MW
Flotation Energy	Ninety Mile Beach, Victoria	1.5 GW

Image Courtesy of Saitec Offshore

Some of the key findings from the study include:

Australia has very high quality and abundant offshore wind resources in a range of locations.

Analysis of offshore wind energy resource was undertaken in terms of total resource, potential generation capacity and capacity factors. A bottom-up approach was taken, which used hourly wind speed data and a representative power curve from an International Energy Agency reference 15 megawatt (MW) wind turbine to evaluate offshore wind potential over the entire Australian Exclusive Economic Zone ('theoretical resource'), which was estimated to be 27,369 GW. We then evaluated the 'technically-accessible resource,' which included areas less than 100 km from shore, in water depths less than 1000m, within 100 km of sub-stations and transmission lines and excluding environmentally restricted areas. The technical resource was estimated to be 2,233 GW; far in excess of current and projected electricity demand across the Australian electricity markets (NEM, SWIS and others).

The Australian wind resource is strongest in southern latitudes (Figure ES1):

- There are maximum average wind speeds of over 12 metres/second (m/s) found south of Tasmania;
- In the Bass Strait between Tasmania and Victoria, along the south-western and south-eastern coast of the continent, off the coast of Western Australia and between Cooktown and Cape York in northern Queensland, there are average wind speeds in the range of 9-10 m/s;
- Off the coast of South Australia, much of New South Wales and the north of Queensland, there are also good quality offshore wind resources (8-9 m/s).

Australian offshore wind resources are comparable to areas such as the North Sea where offshore wind is an established industry (Figure ES2). Mean annual 100 m level wind speeds in the North Sea, are in the range of 9-10 m/s (Geyer et al., 2015).

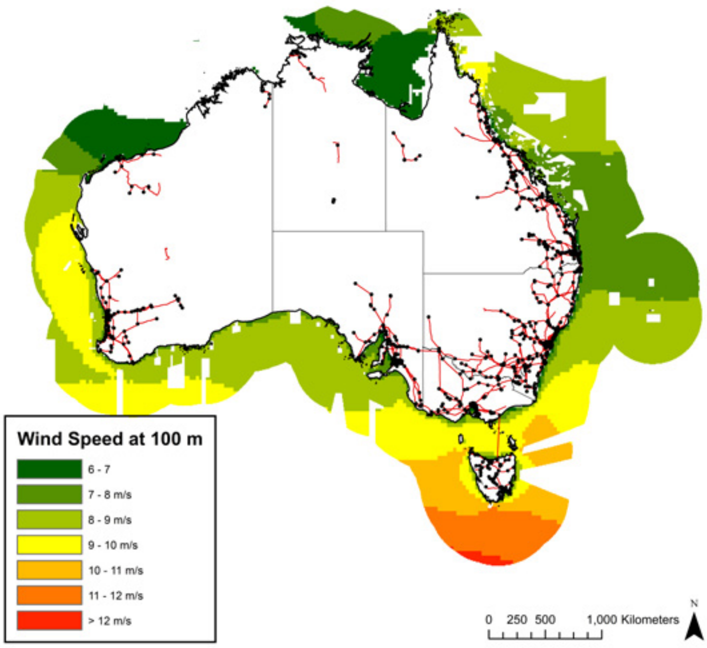


Figure ES1: National average wind speed (m/s) from 2010-2019 within the EEZ study area at 100 m height. White regions represent areas where average wind speeds below 6 m/s or environmental restrictions exist.

Australian offshore wind resources have strong capacity factors, which reflect the consistency of wind and indicate the proportion of the time that the generator can generate electricity. Offshore wind gross capacity factors greater than 80% (excluding losses) are found south of Tasmania (Figure ES3). In the more accessible regions in Bass Strait, along Australia's western coast and in north Queensland, theoretical capacity factors exceeding 55% are widespread. Off the coastlines of South Australia and New South Wales capacity factors greater then 45% are common.

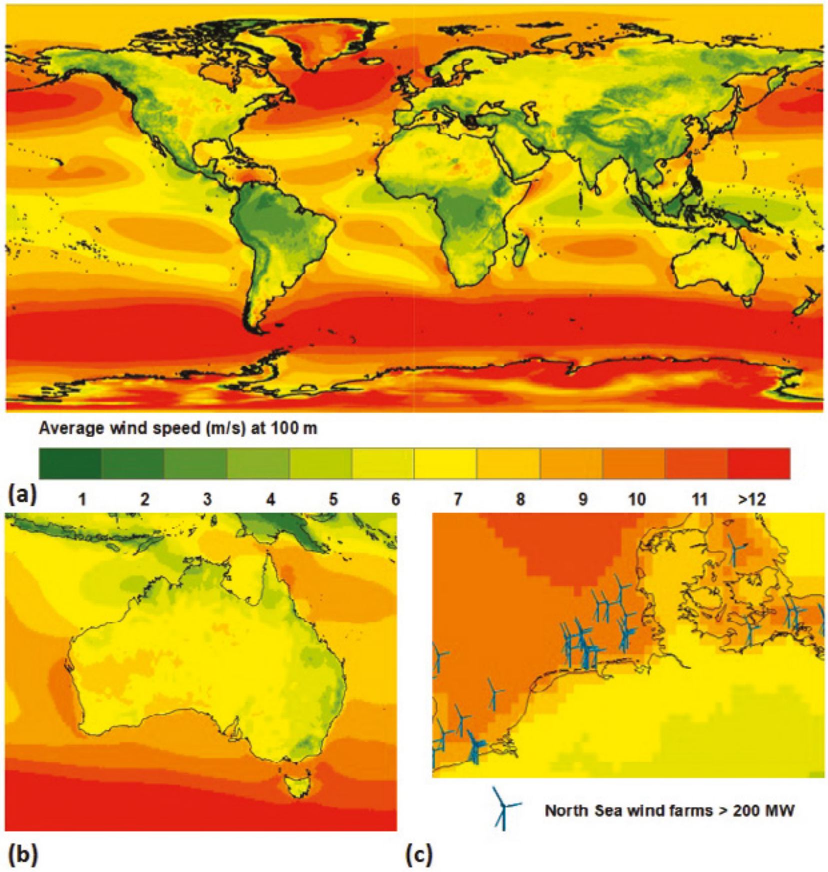


Figure ES2: Mean wind speed (m/s) at 100 m level, derived from ERA-5 reanalysis, showing (a) global and (b) Australian wind distribution. Location of existing offshore wind farms with nameplate capacity > 200 MW in North Sea shown in (c).

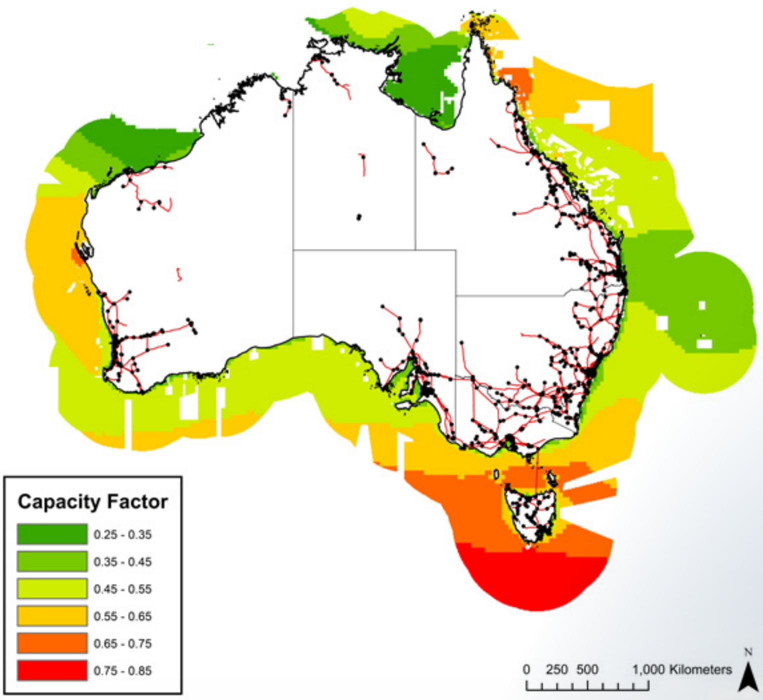


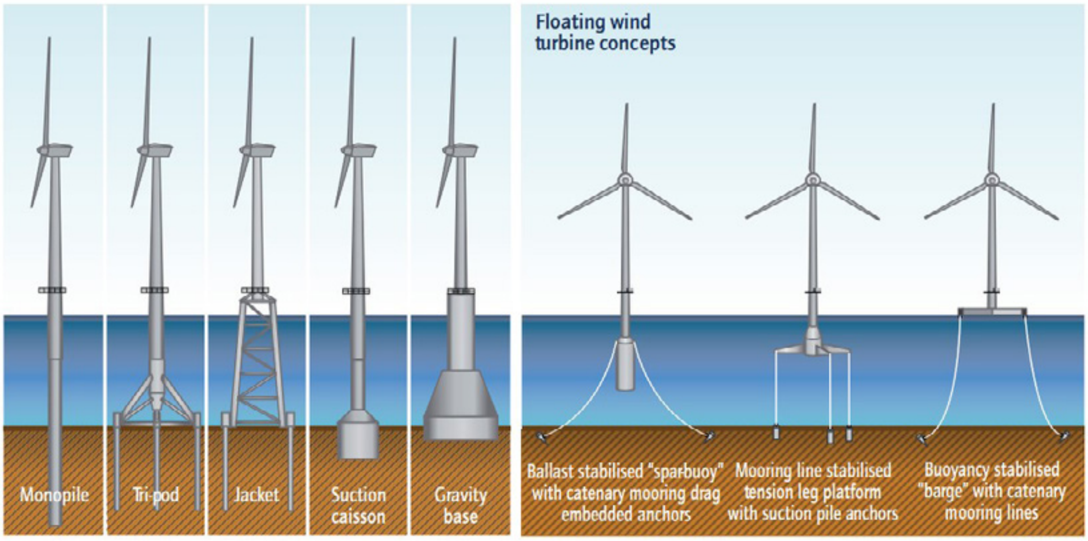
Figure ES3: Gross capacity factors for offshore wind around Australia.

It is not surprising that the first Australian offshore wind farm, the Star of the South, is planned for deployment off the south-east coast of Gippsland given the high average wind speeds, water depth ranges of 20-70 m suitable for both fixed and floating installations, and proximity to electricity and port infrastructure in the Bass Strait.

However, the picture that emerges from this resource assessment is that there are a range of promising locations for offshore wind including: Western and south-western Western Australia (with good quality wind resources located in shallow waters near to the coast); a small area in northern Queensland with high capacity factors; and off the New South Wales and Queensland coastlines. Many excellent locations are close to areas of large industrial loads, including Port Kembla, Newcastle, Gladstone, and south of Perth.

Floating offshore wind technologies will be necessary to access many of the best Australian offshore wind resources

There are two primary technologies for offshore wind energy: fixed foundation (secured directly to the seabed) or floating turbines (mounted on a floating foundation which is secured by anchored cables to the seabed). Internationally, commercial wind farms are almost exclusively fixed foundation turbines, but are limited to water depths of up to 50-60 metres. Floating wind turbines, which have now also reached commercialisation and are projected to be deployed in greater numbers over the next decade (Papalexandrou, 2021), and can be installed at greater depths.



Source: Wiser *et al.*, 2011.

Figure ES4: Fixed and floating offshore wind foundation types (GWEC, 2020).

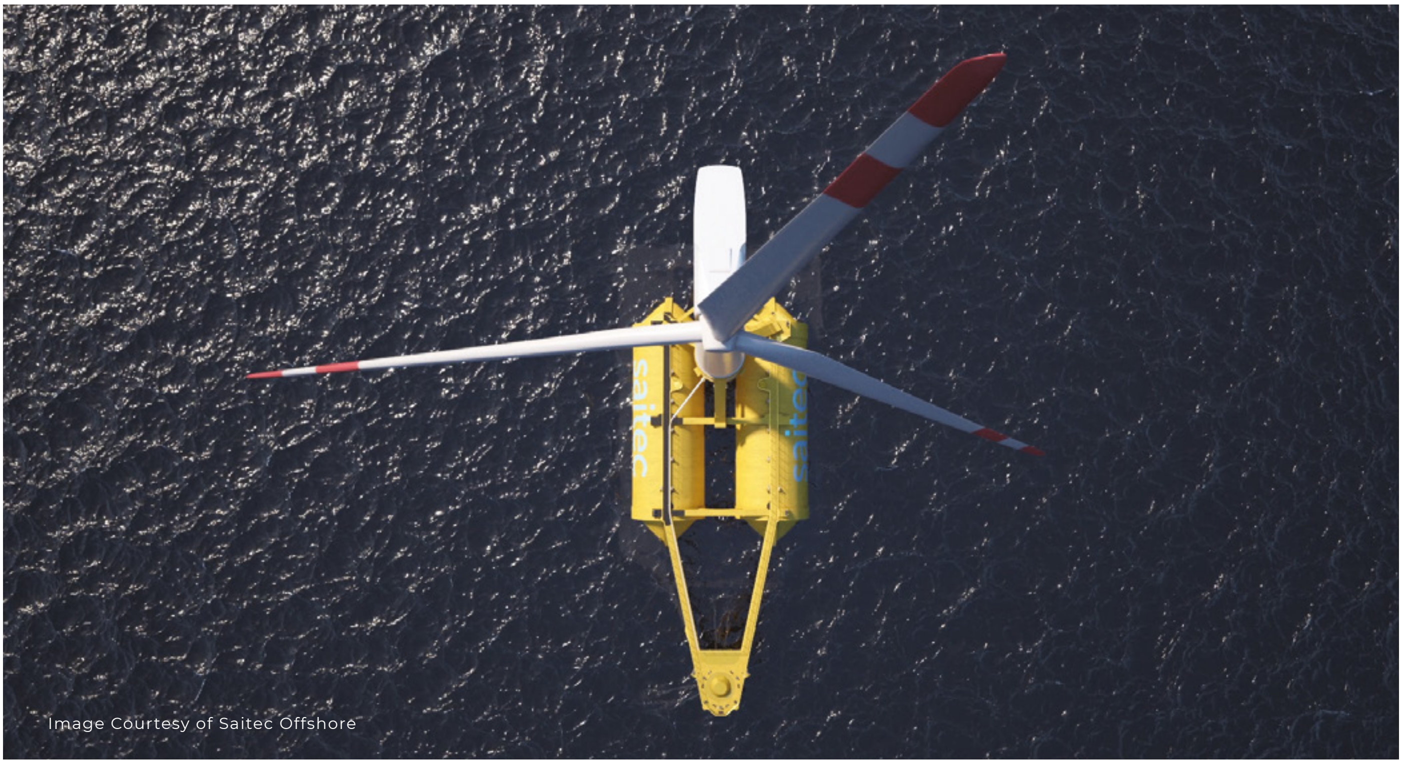


Image Courtesy of Saitec Offshore

Queensland, Victoria, Tasmania, South Australia and Western Australia all have offshore wind resources in shallow waters (<60m) that are near to the coast (<50km) suited to fixed foundation turbines. However, all states also have large resources in deeper waters (>60m depth), suited to floating technologies, and for New South Wales the offshore wind resource is almost entirely in deeper waters.

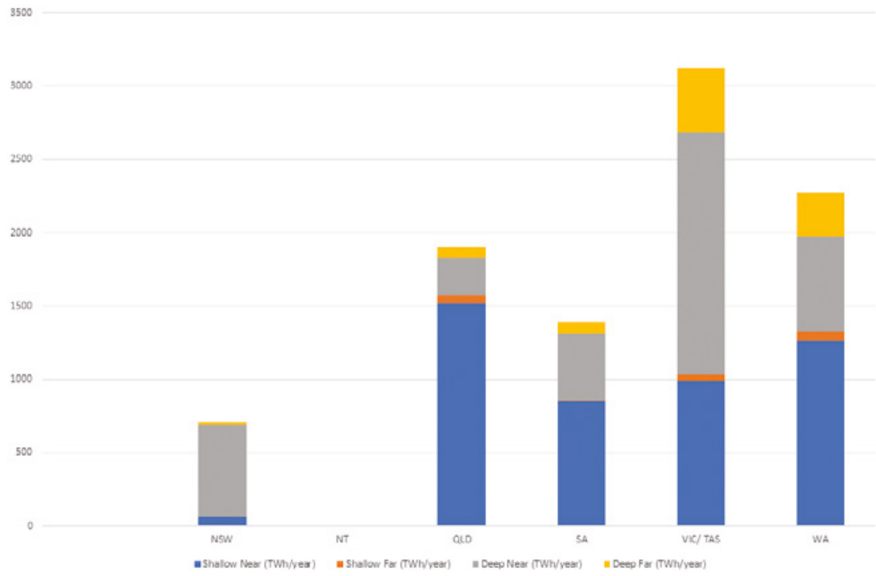


Figure ES5: Technical energy potential for offshore wind by state and water depth.

The theoretical offshore capacity factors for the potential offshore wind sites examined in this study are given in Table ES2. Generally, the capacity factors are higher further away from shore in deeper waters. For Tasmanian, Victorian and Queensland sites especially, capacity factors 100km offshore are around 10 percentage points higher than 25km offshore.

Table ES2: Gross Capacity Factors for offshore wind (100-m hub height) at selected sites examined in this study (close to electrical substations, at 25, 50, 100km offshore and in depths of less than 1000m). Capacity factors at 150-m hub height can be up to ~4-5% greater.

Location	25km	50km	100km
Georgetown (Tasmania)	51%	62%	66%
Hobart (Tasmania)	46%	55%	-
Latrobe (Victoria)	45%	54%	59%
Portland (Victoria)	55%	57%	59%
Newcastle (NSW)	39%	44%	-
Sydney (NSW)	36%	-	-
Port Kembla (NSW)	35%	-	-
Maroochydore (QLD)	24%	36%	-
Gladstone (QLD)	36%	45%	46%
Adelaide (SA)	47%	48%	49%
Perth (WA)	45%	50%	52%
Karratha (WA)	33%	33%	31%

The capacity factors for offshore wind are usually higher than onshore wind.

Capacity factors are generally higher for offshore wind sites relative to onshore wind. The Australian Energy Market Operator (AEMO) publishes low (yellow dots) and high (red dots) capacity factors for onshore wind across all the Renewable Energy Zones (REZs) within the National Electricity Market in the Integrated System Plan. The onshore wind capacity factors are compared to the potential offshore wind sites listed above across Tasmania, Victoria, NSW, Qld, SA and WA (Table ES2), and examined further in this report.

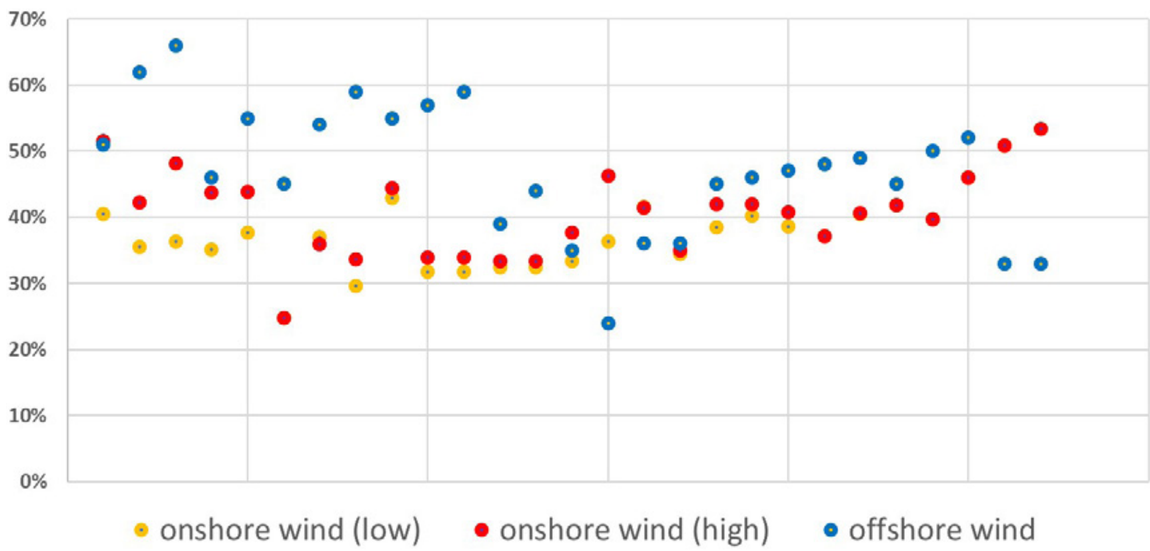
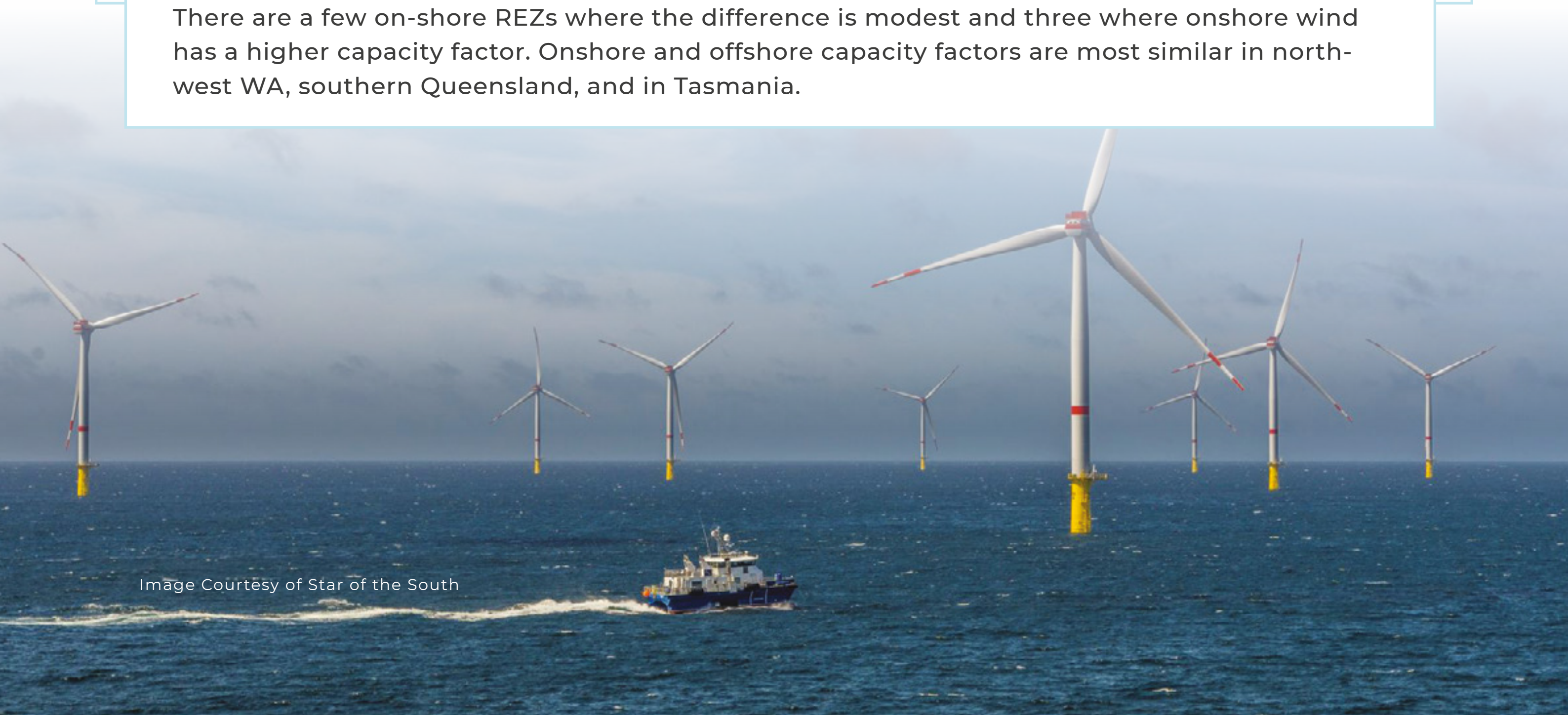


Figure ES6: Capacity factors for onshore and offshore wind (%). 100-m hub height. Offshore allows larger turbines, where higher hub heights will further increase capacity factor.

Source: On-shore Wind capacity factors are drawn from AEMO Inputs and Assumptions Workbook, Integrated System Plan 2020 (AEMO, 2020a). Offshore wind capacity factors are from this study.

Capacity factors for most of the offshore sites are higher than for on-shore wind; typically in the order of 10-15 percentage points, but in some regions by over 25 percentage points (Figure ES6). There are a few on-shore REZs where the difference is modest and three where onshore wind has a higher capacity factor. Onshore and offshore capacity factors are most similar in north-west WA, southern Queensland, and in Tasmania.

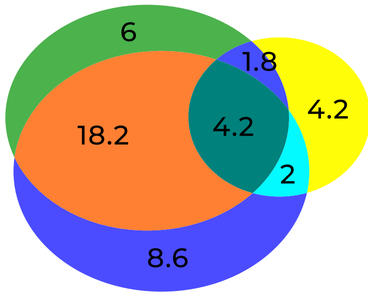


Offshore wind can provide diversity of energy supply due to its availability at times when solar power and onshore wind are not available.

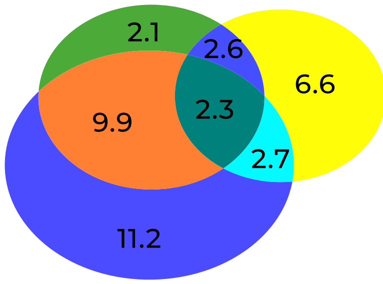
Offshore wind resources were analysed on an hourly basis against the grid electricity load curves of Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland and to onshore renewables (solar photovoltaic and wind power) in twelve locations. Most sites exhibit the strong diversification value of offshore wind Table ES3, (correlation with onshore wind < 55%, correlation with solar PV ~0), with offshore wind continuing to operate at high capacity during periods when onshore wind and solar is low (Table ES7). A case study provided by offshore wind developer Star of the South showed that in their location off Gippsland (Victoria), meteorological patterns mean that offshore wind is particularly strong on hot days. The contribution of offshore wind to the electricity system is thus a greater capacity and scale, and the provision of renewable electricity when it is otherwise unavailable.

This work should be considered indicative only - off- and on-shore wind resource data used here is derived from coarse resolution global scale meteorological reanalysis and not in-situ observations. Actual wind turbine generation curves are very likely to be different from the data used here. Furthermore, assessing the diversification value of offshore wind for potential projects should be considered against both existing and pipeline projects per state. We aim to motivate further analysis, resolving localised features of the resource, and the relationship of this resource to demand, and other renewable generation (existing and pipeline), to better resolve the magnitude and diversification value of offshore wind generation in Australia.

Latrobe, VIC



Newcastle, NSW



Gladstone, Qld

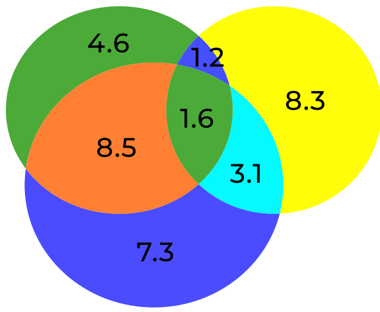


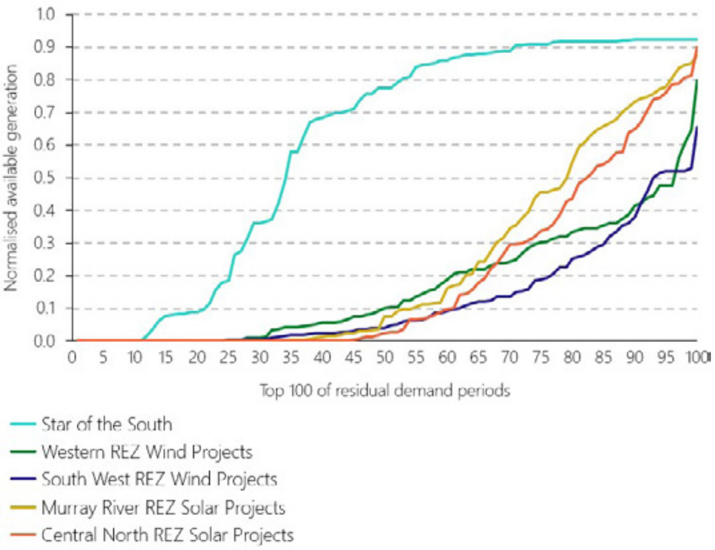
Figure ES7: Potential offshore wind sites in Victoria (top), NSW (middle) and Queensland (bottom), the percentage of year during which offshore wind (blue), onshore wind (green) and solar PV (yellow) generation is operating at high capacity (>50%), and others operate at low (<25%) capacity. Where circles do not overlap this indicates the percentage of the year when one energy source is at high capacity while the others are at low capacity. For example, in Newcastle, NSW, Offshore wind is operating at high capacity, with onshore wind and solar PV both operating at low capacity, for 11.2% of the year.

Wind and wave monitoring equipment off the south coast of Gippsland to confirm the wind conditions as part of planning and developing Australia's first offshore wind project. Image Courtesy of Star of the South

Case study:
Star of the South offshore wind, diversifying renewable generation

Star of the South is Australia's first offshore wind project, proposed to be located off the south coast of Gippsland in Victoria. The project is comprised of Australian founders and Copenhagen Infrastructure Partners (CIP), a global leader in offshore wind. If built to its full capacity, Star of the South has the potential to generate up to 2.2GW of electricity. Currently in the feasibility phase, the project is undertaking site investigations and monitoring the offshore conditions in the region.

Star of the South would harness Bass Strait's world-class wind conditions, allowing Victoria to harvest a diverse and new resource. Offshore wind would also complement other renewable technologies and firm up the electricity supply into the future.



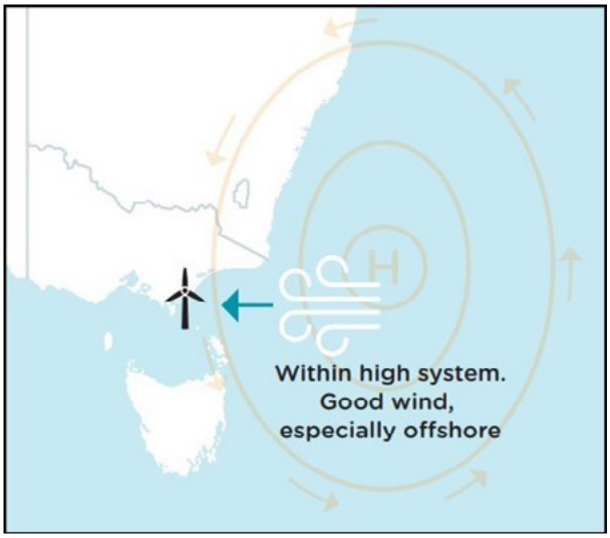


Figure CS1: (Left) Available generation resource[1] for Star of the South and representative future renewable projects during residual peak demand. The chart shows the available generation for each project across the same 100 peak demand periods, individually sorted from lowest to highest (duration curves). (Source: Independent analysis commissioned by Star of the South); (Right) Representative high-pressure system over the Tasman Sea, with location of Star of the South displayed.

Today, 2.1 GW of the 2.3 GW operating onshore Victorian wind farms are located in the western and south western regions of Victoria. Additionally, 1.9 GW of new onshore wind projects under construction are mostly located in the same areas resulting in nearly 4.0 GW of co-located onshore wind by the end of 2021.

Offshore wind in Gippsland would be located off the south east coast of the state, allowing access to a different wind profile that complements and firms up the growing wind portfolio in the state's west. Due to the diversified generation contributed by the project, times of lower onshore wind generation in western Victoria would be complemented by offshore wind generation in eastern Victoria, helping to fill the gap between higher demand and lower onshore renewable generation levels.

Case study provided courtesy of Star of the South

Peak Demand Periods

Analysis by EY[1] shows that Star of the South would provide a high level of generation resource during Victorian peak demand periods compared with onshore wind and solar PV. Figure CS1 (left) shows the difference between the project's generation profile and that of representative pipeline wind and solar projects in western and northern Victoria during a projection of the top 100 residual peak demand periods to be met by large-scale electricity generation in the data analysed for 2036-2037.

This is based on consumption and weather data over the past nine years. Residual peak demand is the demand not met by other existing or committed solar or wind generation in the state[1], and thus Figure CS1 represents the contribution of additional wind or solar generation from different sites to meeting peak Victorian demand.

For half of the potential peak demand periods analysed, Star of the South is projected to have more than 77 per cent of its capacity available. The project's average capacity availability factor across the top 100 peak demand periods is 60 per cent.

Star of the South also worked with the Bureau of Meteorology (BOM) and EY to identify the underlying weather systems causing the high wind conditions during likely peak electricity demand periods. Peak electricity demand is generally caused by high air conditioner use during heatwaves. BOM and EY both found that the Tasman Sea high pressure systems associated with Melbourne heatwaves consistently caused high offshore wind speeds at the Star of the South site.

[1] EY's analysis was completed in May 2020, based on historical data available from AEMO and the Australian Bureau of Meteorology, AEMO's demand projections and a set of existing and committed onshore wind and solar projects agreed with Star of the South. Generation availability was analysed from a meteorological perspective only; it does not consider unavailability due to technical reasons such as electricity transmission network constraints. Results could vary under a different set of assumptions.

Table ES3: Correlation of offshore wind with onshore wind at selected sites examined in this study. (Close to electrical substations, at 25, 50, 100km offshore and in depths of less than 1000m). A high correlation of 100% means that the same power is generated at the same times, but lower correlation figures indicate that offshore wind at that site will generate power at different times to the onshore reference sites.

Location	25km	50km	100km
Georgetown (Tasmania)	81%	76%	73%
Hobart (Tasmania)	49%	45%	-
Latrobe (Victoria)	39%	36%	36%
Portland (Victoria)	82%	79%	-
Newcastle (NSW)	32%	31%	-
Sydney (NSW)	33%	-	-
Port Kembla (NSW)	36%	-	-
Maroochydore (QLD)	48%	47%	-
Gladstone (QLD)	37%	34%	35%
Adelaide (SA)	46%	44%	41%
Perth (WA)	53%	51%	48%
Karratha (WA)	54%	50%	51%

Under 'energy superpower' scenarios including mass electrification and hydrogen production, offshore wind could become a key strategic resource.

In order to understand the employment potential, two potential scenarios or market segments were considered. Australia is blessed with an abundance of high-quality on-shore solar and wind energy sites which will dominate new renewable energy generation in coming years.

However, the development of an offshore wind industry in Australia for the domestic market would be strategic for two key reasons. Firstly, if the costs of offshore wind continue to fall amidst the global scaling up of the industry (in line with UK projections), offshore wind could become a cost-competitive source of electricity for the Australian domestic electricity market. Secondly, diversifying electricity generation sources to include offshore wind can reduce some of the potential risks, constraints and impacts with the build-out of onshore renewable energy and closure of coal generators. Under the Step Change scenario in AEMO's Integrated System Plan for the future electricity system, 50 GW of renewable energy generation would be built by 2035. Most of the coal plant closures are scheduled to occur in the late 2020s and early 2030s but there is high uncertainty over the pace and timing of closures. In this context, diversifying to offshore wind would be strategic as:

- the combination of high capacity factors and scale enables the construction of capacity equivalent to multiple on-shore projects with lower risk around timeframes. An offshore project could be 1.5-2GW under one set of agreements, whereas onshore wind farms are generally 200 – 600MW.
- offshore wind can connect near to existing electricity infrastructure built around coal power plants;
- as the scale of on-shore renewable energy development increases towards 50 GW, there may be increased conflicts over land use and community acceptance.

The ability to build and connect a large volume of renewable energy through a single project could be a valuable resource to mitigate against risks of a disorderly transition later in the decade.

The larger opportunity for offshore wind however is as a source of electricity for green hydrogen production for port-based export facilities, local heavy industry (e.g. 'green steel') and as a transport fuel. Within the National Hydrogen Strategy, the volume of electricity required for hydrogen production ranges from one-third to as high as four and a half times the size of the current National Electricity Market (COAG Energy Council, 2019, 87). AEMO is currently developing an 'energy superpower' scenario for the next ISP with large-scale electricity requirements required for hydrogen production but also electrification of industry and transport. There are larger scenarios under development such as the vision of the Australian Renewable Energy Agency for '1000% Renewable Energy' (Miller, 2021).

With electricity requirements of the scale under this type of scenario, hydrogen produced by offshore wind directly or through the supply of electrolysers located in port facilities could play a significant role. Offshore produced green hydrogen is currently subject to high costs, particularly relative to grey hydrogen as currently produced (Rystad, 2021). The blending of offshore wind with green hydrogen production is being strongly pursued internationally, recognising the potential economies of scale from offshore wind that could be deployed for commercial competitiveness. Where it is co-located with industrial ports or offshore gas infrastructure, hydrogen produced by offshore wind could have competitive advantages.

Offshore wind energy could play a significant role in a 'just transition' for oil, gas and coal workers

Offshore wind at the scale of an 'energy superpower' would also provide alternative employment for workers in the offshore oil and gas industry and to a lesser extent from coal fired power stations. Four scenarios have been produced to generate employment estimates to understand the employment potential based on a range in labour intensity (or employment factor) and a higher and lower share of local manufacturing. Australia's share of manufacturing for on-shore renewable energy is low but this could be increased if there is a large pipeline of offshore wind development to service hydrogen and a coordinated industrial strategy to encourage development of local manufacturing and skills.

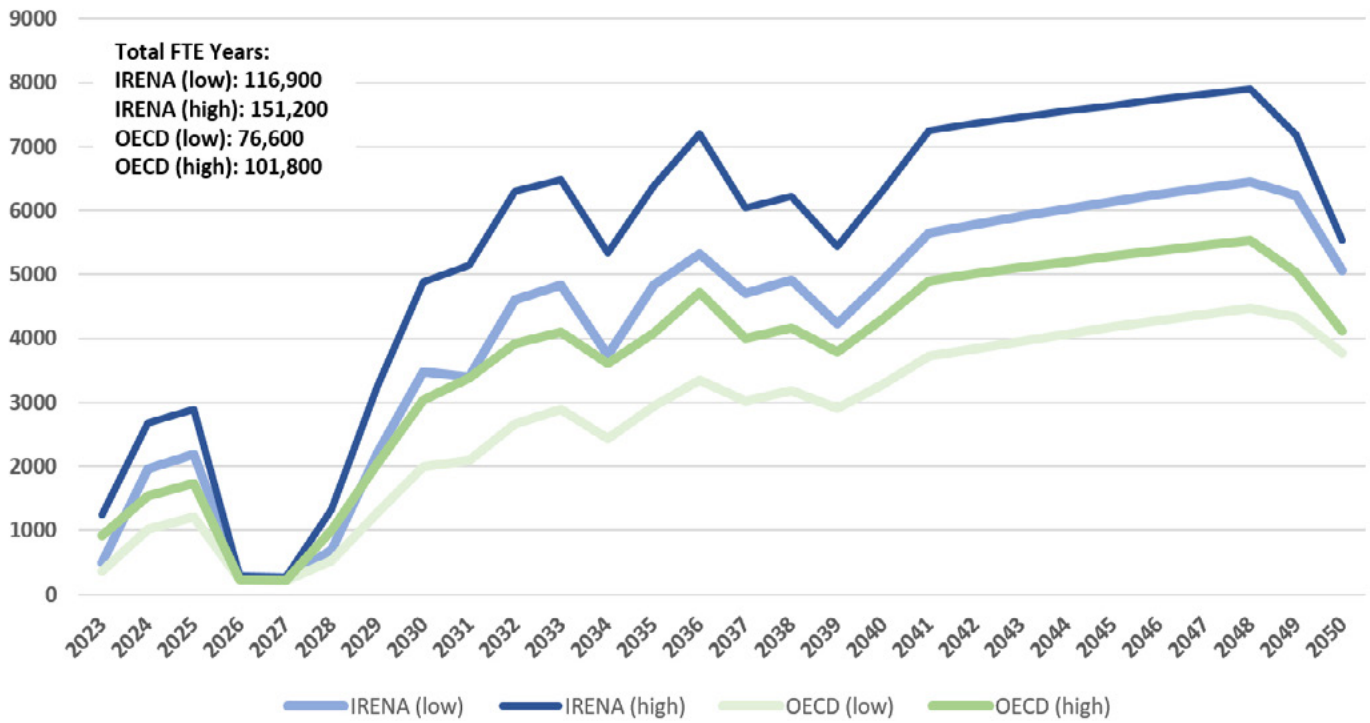
In the lower scenario, employment scales up to between 3,000 – 4,000 jobs annually from 2030 and in the higher scenario to 5,000 – 8,000 jobs each year. Increasing local manufacturing from 10% to 25% increases jobs per year by 1,000-1,500 (see Figure ES8). This is based on one large project being built mid-2020s and then further projects being developed from 2030. Oil and gas extraction currently employs around 20,000 – 25,000 people and while detailed data is not available for the offshore sector its employment is likely to be less than 10,000.

International experience (see Figure ES9) has found the main pathways into offshore wind are from other technically-related sectors (such as offshore industries and the energy sector), new entrant apprentices and graduates and the workforce with skills that cut across sectors (e.g. business / commercial, IT and data analytics, drone and underwater ROV operators, etc).

Consequently, the development of offshore wind energy could be an important source of alternative employment for the offshore oil and gas workforce and potentially onshore workers in fossil fuels industries.

In Australia there are approximately 5,000 jobs in coal-fired power and 40,000 - 50,000 jobs in coal mining (10,000 of these for domestic coal supply), in addition to the 20,000 - 25,000 jobs in oil and gas. Workforce and community transition programs are needed to successfully achieve a fair and smooth energy transition without causing significant social harm and a political backlash.

Figure ES8: Possible scenarios for offshore wind employment, 2025-2050



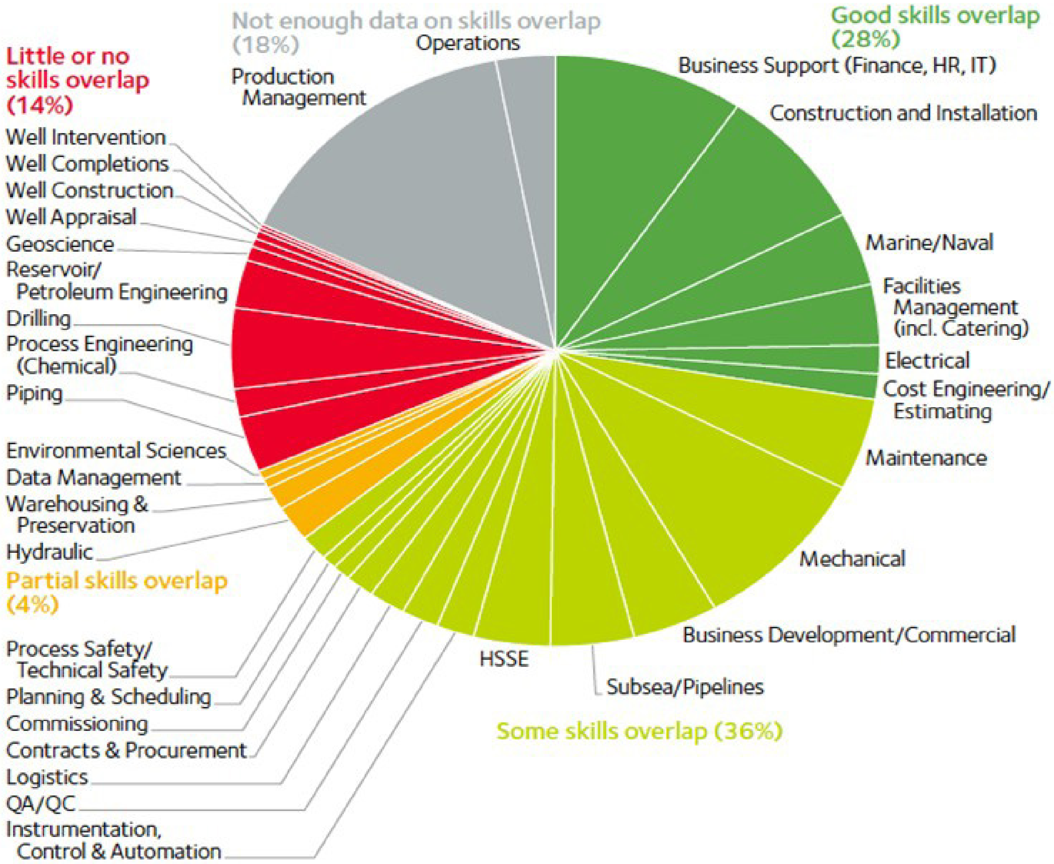


Figure ES9: Occupational match between offshore oil and gas and offshore wind energy (Friends of the Earth; Global Witness and Greener Jobs Alliance, 2019).

Recommendations

Our report has recommendations that span 5 key themes for the development of offshore wind in Australia:

AREA	RECOMMENDATION
Establishing a regulatory regime for offshore renewable energy	**1. A regulatory regime for the development of offshore renewable energy in Commonwealth waters needs to be established** A major barrier to investment and development of current offshore wind projects in Australia is that Australia currently does not have a regulatory framework to enable timely permitting and leasing decisions for offshore renewable energy. Consultation on a proposed regulatory framework for the Commonwealth Government has been occurring since early 2020. Given offshore wind projects will typically cross Commonwealth and State jurisdictions, consideration needs to be given in the framework on the ways to provide complementary processes for activities that occur in both Commonwealth and State waters. Government targets for reducing emissions from electricity, for the electrification of other sectors and for building an integrated renewable energy system are also needed to create a clear understanding of the necessary planning, infrastructure, skills and workforce. **2. Marine allocation of space for offshore renewable energy projects should be considered** With many OSW projects already in the development pipeline, Australia would benefit from proactive consideration, via Marine Spatial planning, to resolve potential conflicts in uses of the marine domain and ensuring it remains sustainably managed. This can help Australia meet its international commitments, such as Australia's pledge through the High Level Panel for a Sustainable Ocean Economy to sustainably manage 100% of the ocean area under national jurisdiction by 2025.
Offshore wind should be incorporated into national and state energy planning	**3. The Australian Energy Market Operator's Integrated System Plan (ISP) should identify and evaluate offshore wind renewable energy zones, and review electricity generation cost assumptions for offshore wind** Offshore wind was not included in the assessment of renewable energy resources used to design the current Renewable Energy Zones (REZs). Offshore wind should be included in the ISP's cost-benefit analysis for the construction of new transmission and designation of new REZs. Offshore REZs in key locations (e.g. Bass Strait, Port Kembla, Newcastle, Gladstone, Perth) should be modelled to enable transparent comparison of relative costs of offshore wind against other technologies over time, including transmission, storage and grid connection requirements. This project finds that across all states, offshore wind has potential to provide a significant amount of energy at times that other renewable energy is not producing, along with higher capacity factors. This could impact on the requirement for energy storage and other aspects of system planning. Current proposed electricity generation cost assumptions (GenCost) for the ISP assign current capital costs of offshore wind projects ~3 times greater than that of onshore wind, reducing to approximately 2.7 times for 2050 commissioning (Graham et al., 2021). This is in contrast to the global weighted mean capital cost projections reported by IRENA, where offshore wind capital costs are projected to be approximately 2.3 times onshore wind in 2050 (IRENA, 2019), and substantially greater that projected in the UK, where offshore wind is a mature sector, costs are better understood, and offshore wind construction costs are projected to be approximately 1.2 times that of onshore wind by the mid-2030's (BEIS, 2020). Owing to the higher quality of resource and development and deployment of mega-turbines unable to be deployed on land, the UK projects the levelized cost of electricity from offshore wind to be similar to onshore wind in the 2030s (BEIS, 2020).

AREA	RECOMMENDATION
Offshore wind should be incorporated into national and state energy planning	**4. State energy planning and programs to support the development of renewable energy should also consider the potential for offshore wind energy** State governments play a lead role in operating energy systems and incentivising the development of renewable energy. However, the lack of a regulatory framework for offshore renewables in Commonwealth waters and insufficient consideration of offshore wind in national energy planning has meant that states have also typically not included offshore wind in their energy planning and programs. State governments should review their future energy planning in light of the potential contribution of offshore wind to their energy systems. **5. Offshore wind energy should be incorporated into planning for the National Hydrogen Strategy and other renewable energy assessments** The opportunity for offshore wind to play an integral role under 'energy superpower' demand scenarios should be recognised. With the scale of electricity requirements, offshore wind could be an important source of power located adjacent to many ports and industrial facilities to meet increased demand associated with large industrial loads, electrification of other energy sectors, or for the production of hydrogen to meet the needs of industrial applications such as steel and aluminium production, or for export. Further research is required to understand the potential of offshore wind energy for hydrogen, and offshore wind should be incorporated into planning for the National Hydrogen Strategy. Future editions of the Australian Energy Resource Assessment should give greater consideration to offshore wind developments, such as the emergence of floating offshore wind, roles in the energy system, and the reduction in cost. Maps of Australian wind resources should include offshore wind.
Offshore wind should be recognised as a strategic resource for innovation and commercialisation funding	**6. The Australian Renewable Energy Agency (ARENA) and Clean Energy Finance Corporation (CEFC) should be allocated funding to develop a program to accelerate the commercialisation of offshore wind energy in Australia, with a particular focus on floating offshore wind** The commercialisation of offshore wind energy will be led by global developments and the large programs in the US, Europe and South-East Asia. These regions have invested in research and development of offshore wind technologies, baseline environmental research, offshore wind port hubs and local manufacturing capacity. Strategic investment in offshore wind via ARENA and/or CEFC should be considered to assist in de-risking and developing local offshore wind, particularly floating offshore wind which is a newer technology with larger opportunity for Australia. There are a range of local barriers that will likely need to be addressed such as port infrastructure, local supply chain and skills development and risk profiles of project financiers. A positive example of how innovation funding can de-risk and accelerate the development of renewable energy is provided by ARENA and the CEFC's large scale solar program which facilitated the rapid growth of the sector. The State of Victoria has invested in developing a business case for offshore wind and is supporting the offshore wind sector via the Energy Innovation Program. A national pipeline of projects is required to justify an Australian sector; a national commercialisation program for offshore wind can accelerate the sector.

AREA	RECOMMENDATION
The permitting process should support the development of local supply chain capacity to maximise investment and jobs and community benefit	**7. The Australian government should develop local supply chain capacity, including leveraging the permitting process for local content.** Offshore wind can develop into a significant source of employment in the maritime 'blue economy'. Australia's share of manufacturing and supply chain activity in most renewable energy sectors is low. Local supply chain development strategies and procurement strategies that include requirements for local supply chain plans are a feature of international programs. For example, in March 2021, the US Biden administration announced three coordinated steps to support rapid offshore wind deployment and job creation (Whitehouse.gov, 2021): (1) Advancing ambitious offshore wind energy projects to create good paying, jobs (2) Investing in infrastructure to strengthen the domestic supply chain and deploy offshore wind energy (3) Supporting critical research and development and data-sharing. The permitting process for offshore wind should include economic development and local supply chain involvement criteria to create requirements and incentives for industry development. Community benefit including benefits to Traditional Owners should also be incorporated. The use of local content criteria has been successfully used in on-shore renewable energy auctions in the ACT and Victoria and in offshore wind auctions and programs internationally. **8. Skills training and labour market programs should be developed to support oil, gas and coal workers to gain employment and skills in offshore wind energy** Active training and labour market adjustment programs should be developed to maximise the potential for the existing offshore oil and gas workforce and the workforce in coal regions located near offshore wind to transition to employment in offshore wind energy.
Detailed research is required to assess cost-benefits to energy, environmental and social systems	**9. Baseline data needs to be collected on environmental and social dimensions of offshore wind energy** The social acceptability of offshore renewable energy in Australia is largely untested, and indeed, environmental effects are largely unknown in the southern hemisphere. More research and collection of baseline data is required to understand the effects of offshore renewable energy on ocean and local communities, and on economies and local environments. Global knowledge gained in reducing the potential environmental effects of offshore wind turbines must be transferred to an Australian context. This work should not be left to individual companies, and the value of shared data agreements should be recognised. **10. Further research is required to understand the energy system value of offshore wind** This report presents a high-level assessment of the grid benefits of offshore wind for Australia. Further industry-focused research activity is required into the diversification benefits and system services that offshore wind could provide. Future assessment should set offshore wind in the context of the pipeline of renewable energy projects, making use of high quality in-situ observations or downscaled simulations to resolve the spatio-temporal resource variability. These considerations would enable high quality techno-economic assessment of what role and impacts offshore wind, given its high consistency and large scale, may have in relation to Frequency Control Ancillary Services (FCAS), and other technical requirements in Australian electricity networks.

Underpinning The Growth Of Australia's Blue Economy

The purpose of the Blue Economy CRC is to undertake world class, collaborative, industry focused research and training to underpin the growth of Australia's Blue Economy through increased offshore sustainable seafood and renewable energy production.

Through targeted and industry focussed research and training, the Blue Economy CRC paves the way for innovative, commercially viable and sustainable offshore developments and new capabilities that will see significant increases in renewable energy output, seafood production and jobs that will transform the future of Australia's traditional blue economy industries.

Bringing together expertise from leaders in aquaculture, offshore renewable energy and maritime engineering.

The Blue Economy CRC brings together 40 industry, government, and research partners from ten countries with expertise in aquaculture, offshore renewable energy, and maritime engineering.

OUR PURPOSE

To perform world class, collaborative, industry focused research and training that underpins the growth of the Blue Economy through increased offshore sustainable aquaculture and renewable energy production.

OUR VISION

Australia's Blue Economy industries in offshore sustainable seafood and collocated renewable energy are globally competitive, at the forefront of innovation and are underpinned by a robust environmental planning and management framework which consumers trust and value.

OUR APPROACH

Research

Our research is industry led, world-class, internationally connected and focussed on growing Australia's Blue Economy.

Engagement

Our Partners are engaged. We deliver on our commitments. We have a focus on growing our contribution base.

Adoption & Commercialisation

We deliver new and useful knowledge with commercial impact and create industry relevant intellectual property and facilitate its commercialisation by our partners.

Capability & Capacity Building

Our education and training program is developing a skilled workforce designed to support the Blue Economy.

Corporate Governance

We pursue the highest standards of governance and management, including development of capacity and capability, embracing diversity and equal opportunity.

The Blue Economy CRC-Co Ltd (ABN 64 634 684 549) is an independent not-for-profit company limited by guarantee and is a Cooperative Research Centre under the Australian Government's CRC Program.

Blue Economy CRC

PO BOX 897
LAUNCESTON, TAS 7250

www.blueeconomycrc.com.au

E enquiries@blueeconomycrc.com.au

Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

Image Courtesy of Star of the South

ABN: 64 634 684 549