Winds of opportunity:

Powering Australia's clean energy future with offshore wind

Short report

CLEAN ENERGY COUNCIL

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Contents

Introduction

There are a lot of questions asked about offshore wind energy in Australia, however, the most common question is '**why** do we need offshore wind energy?'

In mid-2024, the Clean Energy Council, as part of its leadership through the Australian Offshore Wind Taskforce, commissioned Deloitte to deliver a case for offshore wind energy in Australia and to provide an answer to that question.

This case is drawn from the research and analysis undertaken by Deloitte, intended to highlight the immense opportunity available for Australia to harness the world-class offshore wind resources off our coastlines. As a technology of choice across the world, offshore wind energy would complement Australia's existing and future onshore renewable generation capacity, deliver high gigawatt projects with the least amount of transmission buildout, and provide coastal and regional communities with long term employment opportunities and economic windfalls.

Offshore wind has immense potential to deliver stable and complementary clean energy into our grids when we need it, making it a strong addition to the power mix for Australian homes and businesses.

Key findings

Australia finds itself in an advantaged position. Our world-class wind and solar resources offer us the opportunity for abundant green electrons, and offshore wind is an essential component to achieving this potential.

A scaled offshore wind industry of 20 gigawatts could boost Australia's economy by up to AU$15.2 billion, attracting AU$100 billion of capital investment to Australia. It would also create thousands of high-value jobs in construction, operations, and maintenance, delivering economic benefit for coastal towns and regions, supporting an equitable transition – adding some 5,000 additional jobs to the Australian economy, with industry potential to employ close to 17,000 Australians and deliver $2 billion in average annual operating expenditure.

With strong and consistent offshore winds delivering high-capacity factors of 40 to 50 percent, offshore wind can be generating at times when onshore renewables aren't. This can reduce dependence on more expensive and carbon-intensive energy, decreasing the need for peaking gas plants in periods of peak summer demand. The analysis found that each gigawatt of peaking gas not required could save up to 0.8 Mt of CO2e each year[1] and allow between AU$1 billion to AU$1.5 billion of investment[2] to be reallocated across the economy.

The complementary nature of offshore wind energy will be key to establishing a diversified energy portfolio and ensuring Australia's energy security. Ultimately, helping to reduce our electricity prices.

Australia can also benefit from drawing on the more than three decades of industry experience, across the globe. There are approximately 77 gigawatts of offshore wind currently operational in more than 20 countries and an additional 450 gigawatts of projects in development across 40 countries.

Global experience has shown that the cost of offshore wind comes down as the industry matures and as competition increases. Government tenders in well-established global offshore wind markets for offshore wind generation offtake agreements have seen an average reduction in strike prices of 18 percent between the first tender rounds to the second tender rounds. With reductions from the first rounds to the most recent tender rounds also reducing between 10 to 50 per cent across markets. Additionally, the average size of projects has also tripled over the decade, bringing more energy into grids by delivering economies of scale.

The Australian market is well-placed to leverage these decades of learnings. The Australian Government has declared six offshore wind areas across the country in Gippsland and Southern Ocean (Victoria), Hunter and Illawarra (New South Wales), Bunbury/Indian Ocean (Western Australia), and Bass Strait (Tasmania). These wind areas have potential capacity for more than 67 gigawatts of generation. Further, offshore wind farms in Australia will be built in areas with high industrial loads and close to existing transmission infrastructure[3]. This means projects will require the least amount of new transmission built per megawatt of capacity added.

Given the gigawatt scale of each new project, offshore wind will be a critical technology to support the energy transition as 90 percent of thermal coal plants retire in Australia over the next decade. And implementation will be rapid; unlike some other technology types, offshore wind has an established legislative and regulatory framework. Importantly, leading global offshore wind developers have already demonstrated significant interest in the Australian market, with an appetite for project development in all six declared areas and a pipeline of projects representing AU$100 billion of investment potential. Further, the Australian Government has awarded more than 26 gigawatts of feasibility licences, with projects on track to deliver clean offshore electrons into our grid by the early 2030s.

[1] AEMO (2024), Integrated Systems Plan

[2] Based on 1GW OCGT being displaced in 2032 and CSIRO (2024), GenCost 2024-25 Consultation Draft.
Based on OCGT (large) at ~$1,000 / kW in capital cost, ~10 / kW in O&M fixed over 25 years, and $ 7 / MWh over 25 years.

[3] DCCEEW (2024), *Australia's offshore wind areas*

Offshore wind harnesses strong and consistent winds that complement onshore renewables

Offshore wind energy can help diversify Australia's generation mix by creating electricity when onshore renewables aren't as strong.

As offshore ocean winds are strong and consistent, turbines located at sea generate more power and boost electricity levels when the grid needs it most.

In the federally declared offshore wind areas, offshore windfarms will have capacity factors of 40 to 50 per cent – meaning offshore windfarms will be producing energy at maximum power for about 12 of every 24 hours. This is, on average, five to ten percentage points higher than the corresponding onshore wind capacity factors, however, in some periods this may grow even higher as shown in Figure 1[4].

For comparison, capacity factors of Australia's ageing and emissions intensive thermal coal plants have been declining and now operate at approximately 59 per cent[5].

Offshore wind will play an important role in periods of peak summer demand, as its complementary profile reduces reliance on other technologies such as drawing on peaking gas plants or requiring large industrial sites to turn off (load shedding) on hot summer days and winter evenings when energy demand rises, and offshore wind resources remain strong.

With our oceans home to some of the world's strongest and most consistent winds, offshore wind will provide more consistent, clean power that strengthens and futureproofs Australian electricity grids.

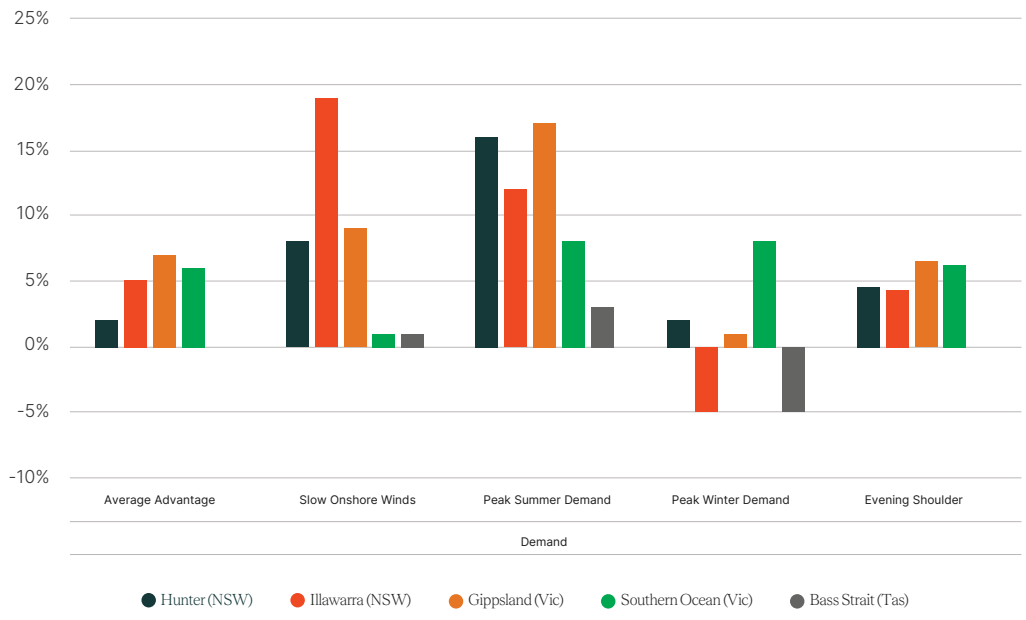

Figure 1: AEMO integrated system plan 2024 ratio of offshore wind and onshore wind capacity factor for New South Wales, Victoria and Tasmania[6]

[4] AEMO (2024), *Integrated System Plan, IASR Assumptions Workbook.* Victoria's OSW zones' (Gippsland and Southern Ocean) capacity factors are compared to Victoria onshore wind capacity factor (average of Victoria's REZs).

[5] CSIRO (2024), *GenCost 2024-25*

[6] AEMO ISP 2024 30 minute wind traces, 2024 to 2052, from New South Wales, Victoria and Tasmania.

Offshore wind creates thousands of jobs and delivers economic benefit for coastal and regional communities

Long term employment in regional Australia

Offshore wind projects present opportunities for a just transition for workers located near offshore wind zones including those transitioning from fossil fuel industries. It also provides benefits for coastal communities and local maritime industries and will spark broader regional economic development.

In a scenario where the industry sees stable progress to deliver 20 gigawatts by 2050, the offshore wind industry could deliver close to 4,000 jobs during project construction.

Importantly the scale and complexity of offshore wind projects makes them a large ongoing employer with more than 7,500 ongoing operations and maintenance roles expected over the 30-year lifespan of a windfarm – representing AU$2 billion in average annual expenditure. At the peak of this opportunity, the industry could be employing close to 17,000 Australians in operational roles.

Australia's declared offshore wind areas are positioned near existing coal-fired generators; 11 of the existing coal-fired power stations are located within a two-hour drive of Australia's six offshore wind zones. This presents an important opportunity to deliver a just transition for up to 15 percent of transition-exposed workers near offshore wind areas during both construction and operational phases.

Additionally, by engaging local businesses and maritime services, an additional 3,500 indirect jobs annually would also be delivered around the country, further stimulating regional economies. These jobs would be concentrated in downstream sectors, like manufacturing, trade, construction and services, with a large portion of these jobs likely to be co-located near offshore wind areas in regional and coastal communities.

Overall, an annual net increase of close to 5,000 full time equivalent roles is expected out to 2050.

Economic boost for Australia

In addition to value delivered through employment opportunities, a scaled offshore wind industry of 20 gigawatts by 2050 could boost Australia's economy by up to AU$15.2 billion, attracting AU$100 billion of capital investment to Australia.

Given the location of the offshore wind areas, most of these economic benefits will be realised in regional Australia.

Already, developers are investing in communities near offshore wind zones, even before construction has begun. In the Gippsland region, Southerly Ten, through its Star of the South project, are already having a positive impact.

- At the end of 2024, the Star of the South project had spent $4.8 million in Gippsland during its development, including through hiring local staff, purchasing from approximately 100 Gippsland businesses, and using local vessels for marine surveys.
- The project is expected to inject around $8 billion into the Australian economy across its lifetime, including $3 billion in the Gippsland region alone.

The development of large-scale offshore wind creates ripple effects throughout local economies and can be a meaningful part of a just energy transition and is well-positioned to provide opportunities to re-skill personnel with transferable skills.

Offshore wind will help to electrify the grid by adding gigawatt scale capacity with the least amount of new transmission

Least new transmission required

Offshore wind will minimise the need for extensive transmission infrastructure development.

The four transmission projects that would be required to connect the offshore wind areas into New South Wales, Victoria and Tasmania would deliver the most energy capacity from the shortest transmission distances of any new transmission project (Figure 2) – connecting more electricity into the grid per kilometre of transmission line built.

This also means offshore wind would impact fewer landholders, reducing complexity and facilitating quicker decision-making and implementation.

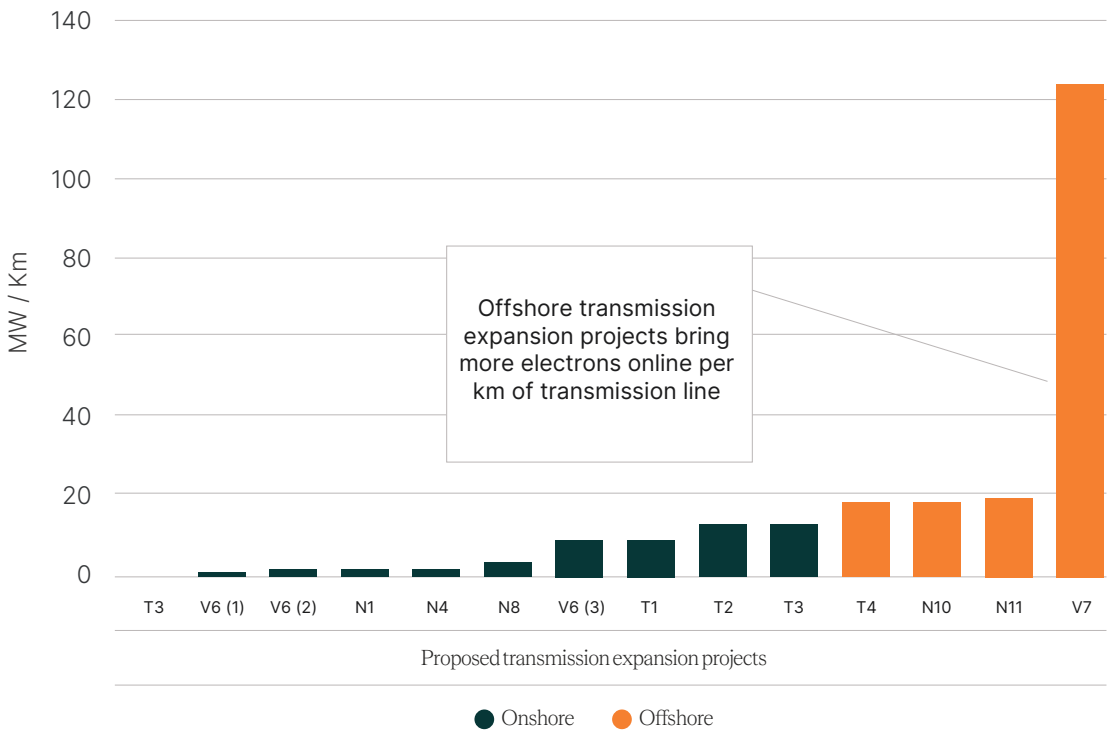

Figure 2: Megawatt capacity unlocked per kilometre of transmission line easement length

Offshore wind offers clean electricity at scale where Australia needs it most.

Offshore wind is a key enabler of a clean energy grid in Australia, as the diversification benefits of offshore wind can be realised at a gigawatt scale and connected to the grid swiftly and efficiently.

Australia's coastline hosts some of the world's most consistent and powerful wind resources. Aided by the fact that 87 per cent of Australians live within 50km of the shore, offshore wind areas are generally located near major industrial demand and population centres.[6]

Additionally, the declared offshore wind areas are co-located in proximity to retiring coal-fired power stations with existing transmission infrastructure (Figure 3).[7] This means areas with high-demand for electricity can have access to high quality, low variability clean electricity that can connect to the grid with limited transmission upgrades.

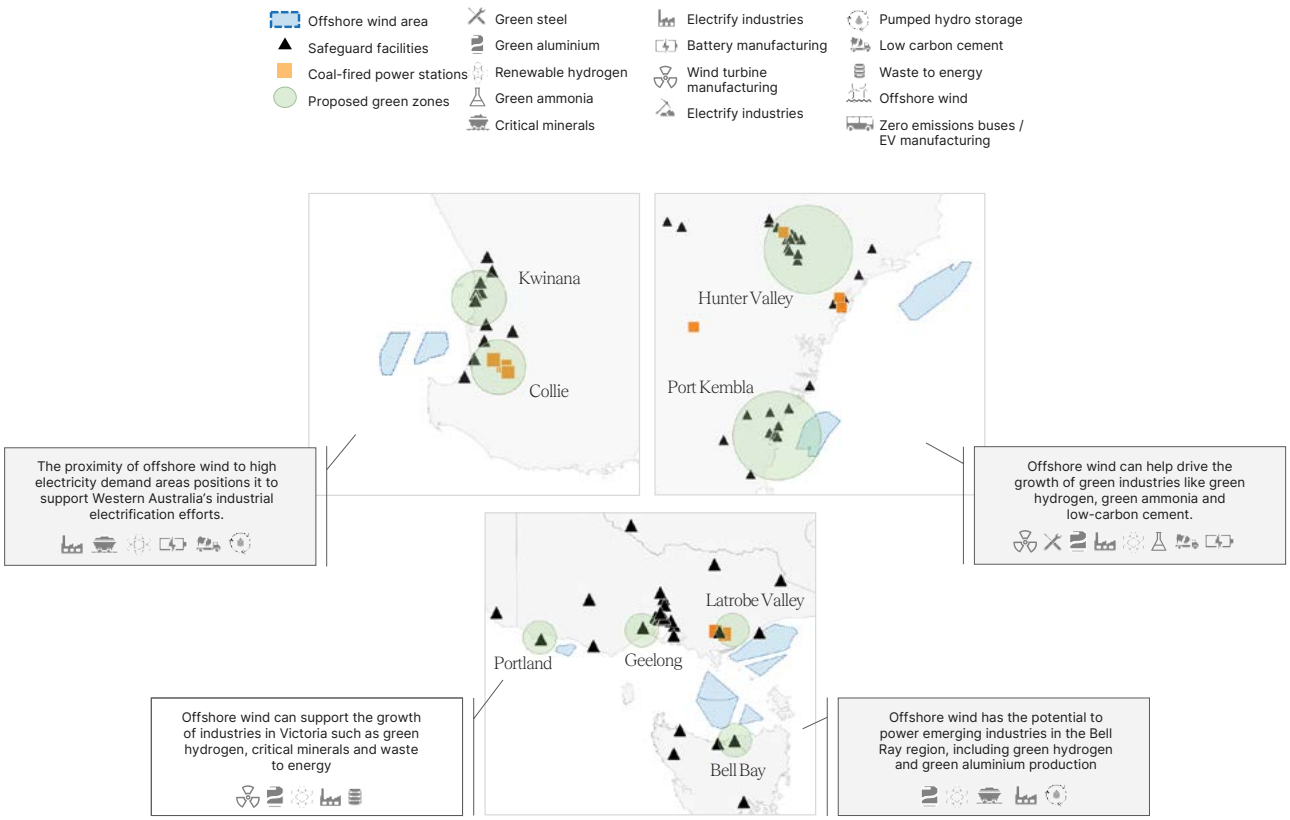

Figure 3: Proximity of offshore wind zones to key industrial demand centres

[6] Blue Economy CRC (2021), Offshore Wind Energy in Australia
[7] Blue Economy CRC (2021), Offshore Wind Energy in Australia

Gigawatt scale baseload capacity

The International Energy Agency (IEA) recognises offshore wind is in a category of its own – separate from onshore wind and solar – as the only variable baseload power generation technology.[8] In other words, wind turbines at sea generate energy more consistently than turbines on land:

- Wind speeds at sea tend to be faster and steadier than on land, given there is no obstruction by natural landscapes and built infrastructure. This means that offshore wind generates electricity consistently and often at different times during the day, night and across all four seasons.

- Offshore wind turbines are much larger in size than their onshore counterparts, enabled by shipping wind turbine components directly to ports for construction, which removes limitations imposed by road or rail transportation.

- The newest offshore wind turbines in operation have reached 20 MW[9] (compared to the largest onshore wind turbines currently installed in Australia which are just over 6 MW[10]), with further opportunities for technology improvements being explored by industry leaders.

Offshore wind projects, due to their scale, are often characterised by the vast amounts of green electricity they can unlock for the grid. The typical Australian offshore wind project proposed is approximately 2 gigawatts in size[11], which can power well over 1 million Australian homes.

Just 80 offshore wind-turbines could produce enough electricity to power the Tomago Aluminium smelter – the single largest consumer of energy in New South Wales.[12]

By unlocking more capacity with minimal stakeholder impact, offshore wind is a powerful addition to the Australian energy mix.

[8] International Energy Agency (2019), Offshore Wind Outlook 2019 (https://www.iea.org/reports/offshore-wind-outlook-2019)
[9] Balkan Green Energy News (2024), China breaks records with offshore, onshore wind turbines
[10] Renew Economy (2024), Australia's biggest wind project installs first turbine
[11] Average GW capacity based on the proposed capacity of 13 offshore wind projects awarded feasibility licences across the Gippsland and Hunter region. Data derived from project websites.
[12] Tomago requires 950 MW of firm electricity 24/7, which translates into 8.3 TWh pa. Tomago Aluminium (2024), Tomago Keeps the Lights on Across the State. A 2.1 GW offshore wind farm, which requires 80 offshore wind turbines at 26 MW capacity per turbine, generating at 45% capacity factor will generate 8.3 TWh pa.

Offshore wind is mature and a technology of choice for more than 40 countries

Successes achieved by leading offshore wind jurisdictions overseas show Australia stands to gain from large-scale investment in regional communities and coastal areas if it deploys offshore wind in a timely manner and at scale.

Mature global industry

Offshore wind is a mature global industry, having been operating for more than 30 years. While the technology currently operates in more than 20 countries, an additional 20 countries have offshore projects in development.

At the end of 2023[13], 77 GW of offshore wind capacity was in operational globally – equating to almost 13,315 turbines – with another 450GW of capacity in the global pipeline across 40 countries including in the UK, US, France, Germany, South Korea, Japan and China.[14, 15,16,17].

Figure 4: Global offshore wind industry

Costs reduce as industry matures

Drawing on extensive experience of developed offshore wind markets, the cost of offshore wind comes down over time as the industry matures and competition increases. This can be seen by the reduction of stike prices in government tenders for offshore wind capacity across established jusidictions (Figure 5).

Government-led tenders for offshore wind generation offtake agreements have seen an average reduction in strike price of 18 percent between the first round and the second round of tenders. Further reductions from the first rounds to the most recent tender rounds have also been experienced, with strike prices reducing by 10 to 50 per cent across markets.

Additionally, the average size of projects that have won these tenders has tripled over the decade, bringing more energy into grids by delivering economies of scale. For example, Japan, France, and the UK have respectively seen a 35 per cent, 27 per cent and 50 per cent reduction between their first and last tender rounds. Markets such as the Netherlands, Germany and Taiwan have even seen zero-subsidy bids after their first tenders – meaning projects in those markets do not require a subsidy on top of the wholesale electricity price they will receive for selling their capacity into the relevant market.

[13] Engineering and Technology (2024), UK poised to build 'record' number of new offshore wind farms
[14] Engineering and Technology, (2024), UK poised to build 'record' number of new offshore wind farms
[15] International Energy Agency (2024) Renewables 2024; NREL (2024), Offshore Wind Market Report: 2024 Edition
[16] NREL (2024), Offshore Wind Market Report: 2024 Edition
[17] 4C Offshore (2024)

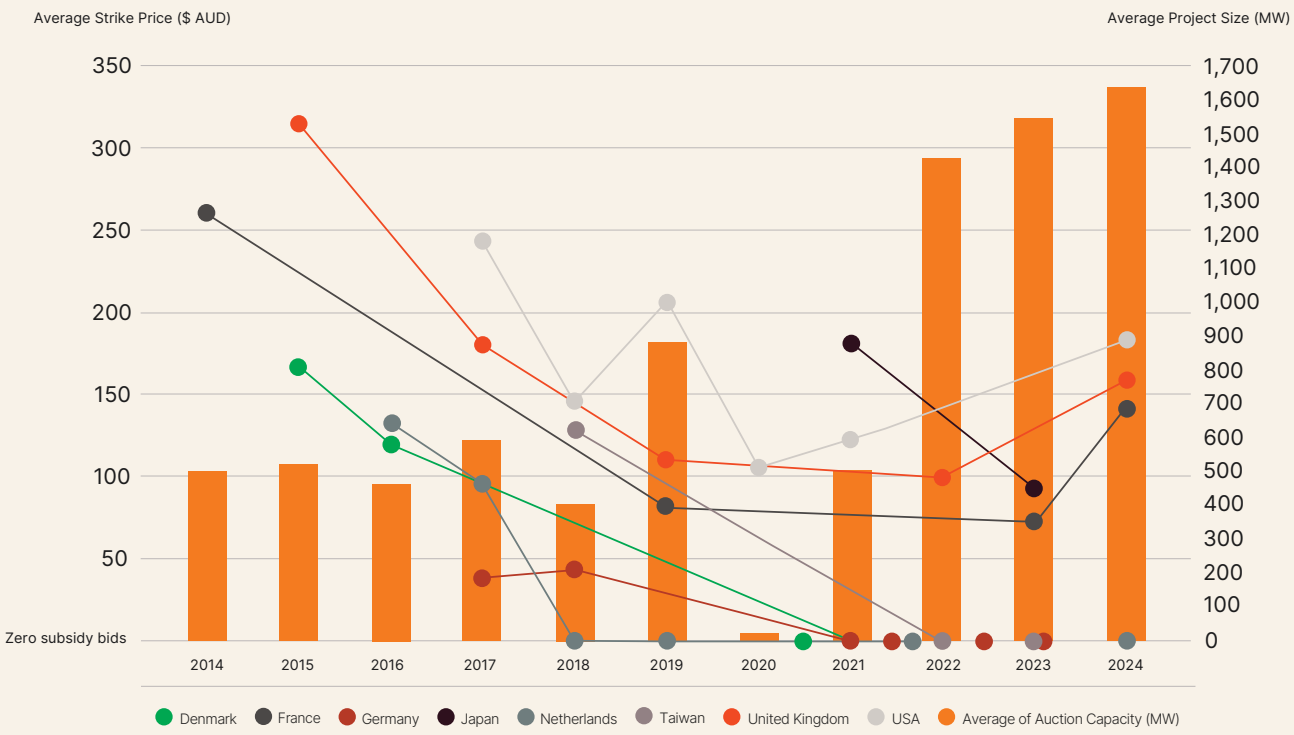

Figure 5: Global offshore wind tender prices over the past decade (by jurisdiction, in 2024 adjusted AUD) [18]

Offshore wind reduces reliance on expensive peaking technologies, reducing overall system costs

Evidence from mature offshore wind markets shows that deployment of offshore wind can reduce dependence on more expensive and carbon-intensive energy, leading to lower overall system costs. This has been shown in both the US and UK, and Australia has the potential to capture a similar benefit.

- For example, international energy advisory Aurora Energy Research modelled that offshore wind helps reduce the need for expensive peaking gas in the UK at a ratio of 1 TWh offshore wind to ~0.6 TWh to 1 TWh peaking gas.[19]
- In the US, the National Renewable Energy Laboratory modelled that offshore wind helps reduce peaking gas in the north-east at the ratio of 1 TWh offshore wind to ~0.75 TWh peaking gas. While the Pacific Northwest National Laboratory modelled that offshore wind is complementary – especially on a seasonal basis – to pumped hydro due to significant yearly changes in water inflows, especially low inflows at the end of summer and in winter. Offshore wind can support pumped hydro by reliably producing energy in late summer and winter when pumped hydro output is low.

In the Australian context, each gigawatt of peaking gas not required could save up to 0.8 metric tonnes of carbon dioxide equivalent (CO2e) each year[20] and allow AU$1 billion to AU$1.5 billion in investment[21] to be reallocated across the economy. Given the strong and consistent nature of offshore wind, it will help reduce the need for peaking gas plants in periods of peak summer demand, helping to reduce overall system costs and costs to consumers.

[18] Based on Deloitte analysis. Auction tender prices sourced from (House of Commons Library, Bundesnetzagentur, Norton Rose Fulbright, S&P Global, BWO, Ørsted, Japan Energy Hub, TGS, Westwood Global Energy Group, Energy Trend, Wind Europe, Offshore Wind Biz), with currencies converted to AUD using RBA historical exchange rate averages and adjusted for inflation using the RBA Inflation Calculator.

[19] Aurora Energy Research (2024), Is offshore wind still good for billpayers? The range is based on "Offshore wind dominated" and "Gas CCUS dominated" scenarios, as the only two scenarios that are not dependent on interconnectors.

[20] AEMO (2024), Integrated Systems Plan

[21] Based on 1GW OCGT being displaced in 2032 and CSIRO (2024), GenCost 2024-25 Consultation Draft. Based on OCGT (large) at ~$1,000 / kW in capital cost, ~10 / kW in O&M fixed over 25 years, and $ 7 / MWh over 25 years.

Offshore wind projects in Australia are on track to generate electricity by the early 2030s

Industry, Federal and state governments already recognise the opportunity offshore wind presents to Australia and have made strong progress in establishing regulatory frameworks, regional implementation plans and commencement of early development works for projects (Figure 6).

While there is still much work to be done, the most progressed projects are on track to generate electricity by the early 2030s.

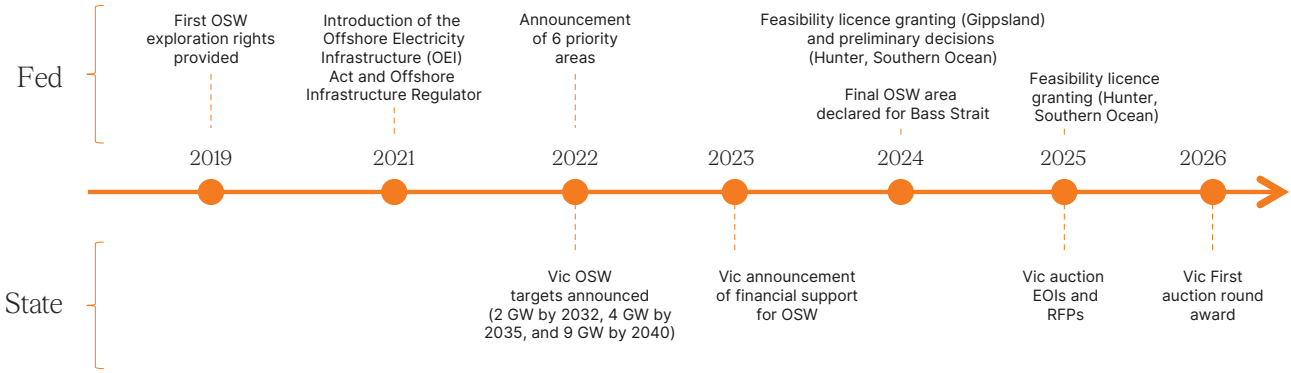

Figure 6: Timeline of key decisions and announcements from governments related to offshore wind[22]

Industry progress

Australia has attracted all major global offshore wind proponents, and early announcements from industry saw consideration for 47 projects, totalling over 90 gigawatts[23] - highlighting the world-class resource and eagerness to participate in the Australian market.

While this number has reduced following the awarding of feasibility licences, there is still extensive interest from industry-leading developers in all six declared offshore wind areas across Australia, resulting in a pipeline of projects representing AU$100 billion of investment potential.

The roll-out of feasibility licences by the Federal Government in 2024 allowed developers to commence survey works and baseline environmental assessments, the critical next step in the environmental impact assessment process.

[22] DISR (2024), Morrison government approves licence to explore possibility of Australia's first offshore wind farm; DCCEEW (2024), Offshore wind in Australia; DEECA (2024), Offshore wind energy and OIF (2024), Governance and accountability

[23] Energise Renewables (2024), Australia Offshore Wind Energy Summary

Federal leadership

The Australian Government has declared six offshore wind areas across four states, including: Gippsland and Southern Ocean (Victoria), Hunter and Illawarra (New South Wales), Bunbury/Indian Ocean (Western Australia), and Bass Strait (Tasmania), with a total potential capacity of 67.4 GW.[24]

All areas have progressed to the feasibility licence stage, with more than 28 GW of feasibility licences either awarded or offered across three of the areas (Gippsland, Hunter and Southern Ocean).

There has been strong bi-partisan support in shaping the development of the legal framework for the establishment of an offshore wind industry, as well as in the establishment of the Offshore Electricity Infrastructure (OEI) Act, and the Offshore Infrastructure Regulator (OIR), which oversees the offshore renewables industry.[25]

In partnership with the states, the Federal Government has established working groups focused on progressing industry development, such as the Gippsland Licence Holders Advisory Committee and the Southern Ocean Wind Industry Committee.

State action

The Victorian Government has legislated offshore wind capacity targets of at least 2 gigawatts by 2032, 4 gigawatts by 2035 and 9 gigawatts by 2040.[26] The State has also announced the development of a financial support package for the first 2 gigawatts[27], making it the only state that has explicitly developed targets and outlined financial support for offshore wind so far, resulting in significant private sector investment interest.

Planning of shared transmission infrastructure to connect Victoria's offshore wind to the grid has also begun, with VicGrid launching a call in late-2024 to the private sector for expressions of interest to build the infrastructure.[28]

[24] DCCEEW (2024), Australia's offshore wind areas
[25] Offshore Infrastructure Regulatory (2024), Governance and accountability
[26] Energy and Public Land Legislation Amendment (Enabling Offshore Wind Energy) Act 2024.
[27] DEECA (2024), Offshore wind energy
[28] Premier of Victoria (2024), Delivering the Infrastructure for Offshore Wind Energy

What's next

The winds of change are blowing strong. Australia can harness the full power of offshore wind and deliver a prosperous clean energy future.

As we head toward 2030, across Australia we can expect to see industry and governments:

- undertake technical studies, including metocean geotechnical and geophysical surveys, to gain a detailed understanding of the marine environment in which projects would operate
- complete baseline environmental surveys to enable the assessment of potential project impacts and inform appropriate project design
- continue consultation with Traditional Custodian partners to understand how projects can work on Sea Country in a considered and supported way
- to continue to undertake ongoing engagement in coastal communities to provide updates and information on project progress, and answer questions as they arise
- develop and deliver enabling infrastructure such as ports and transmission shore connection points
- roll-out training programs for upskilling and reskilling of workers, ready for construction and operation of projects
- will enable feasibility licence holders to apply for commercial licences.

In ensuring offshore wind is a core part of the national energy mix, Australia will create new economic and investment opportunities, maximise our abundant clean energy resource to fortify our grids, and bring forward the economic potential of electrification.

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