OFFSHORE WIND ENERGY

OCTOBER 2021

As Australia's offshore energy regulator, NOPSEMA is responsible for the regulation of health and safety, infrastructure integrity and environmental management of offshore energy activities in Commonwealth waters.

WINDS OF CHANGE

The global offshore wind sector has undergone rapid expansion in recent years with major advances in technology and cost reductions, making offshore wind an increasingly competitive option for large scale energy generation.

Europe has traditionally been the global leader in offshore wind from a technology and generation capacity perspective, however the Asia-Pacific region has surged forward recently, with China leading the world in new installed capacity in 2019[1].

In addition to China, Australia's regional neighbours Vietnam, Taiwan, Japan and South Korea are rapidly adopting offshore wind technologies as the global move to a lower carbon energy future gathers pace (Figure 1).

Global interest in Australia's offshore wind potential is increasing with a number of highly prospective sites for offshore wind energy generation around the continent.

A site is considered to be suitable for an offshore wind project if it has high and relatively consistent wind speeds, water depths are appropriate, and the site is either able to be connected to an electricity grid or is in a suitable location for the generation of energy export products such as hydrogen and ammonia.

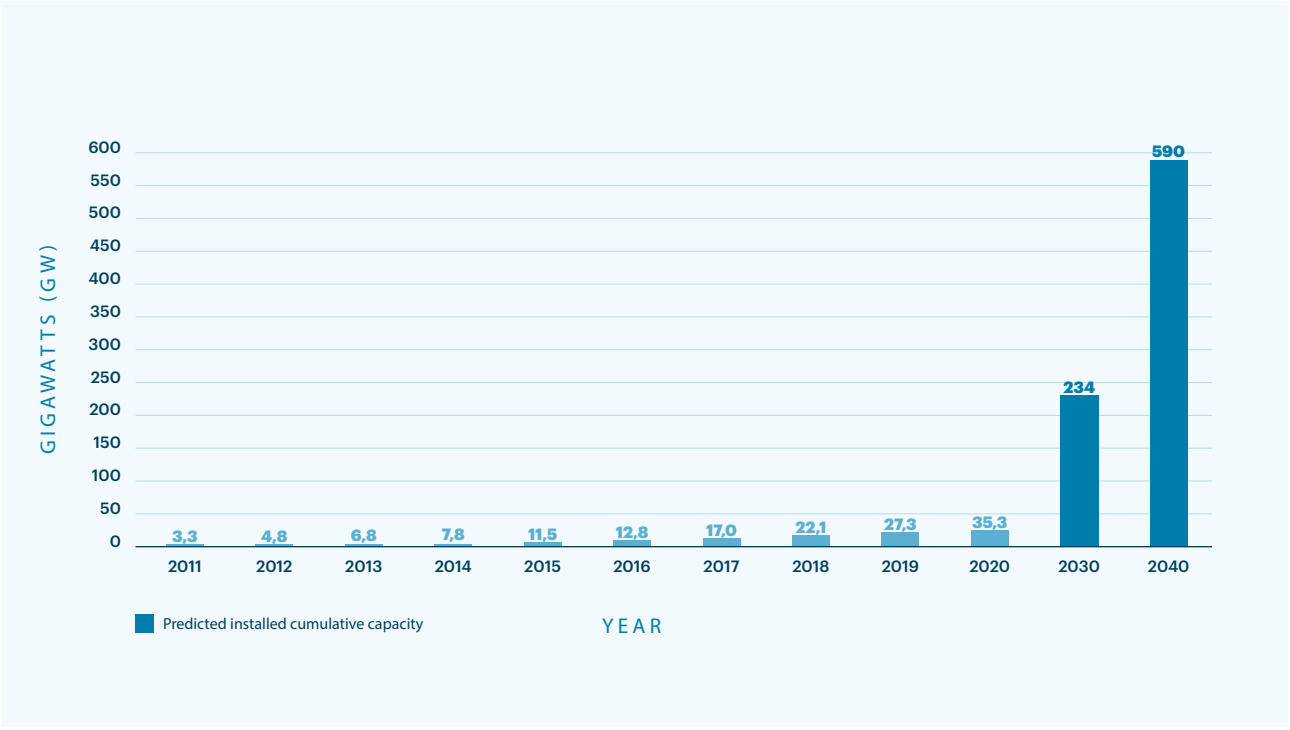


Figure 1. Global cumulative installed offshore wind generation capacity in operation and future predictions[2]

*Predicted installed capacity for 2030 and beyond is based on current offshore wind targets and research conducted by the Global Wind Energy Council as of October 2021. Data may be subject to change as further information becomes available.

[1] Global Wind Energy Council (GWEC), Global Offshore Wind Report 2021

[2] Sources: World Forum Offshore Wind (2021) and International Renewable Energy Agency, Future of Wind Paper (2019).

OFFSHORE WIND TECHNOLOGIES

The wind industry has experienced significant technological advancements over the past few decades in terms of the size and generation capacity of wind turbines.

In the 1980's wind turbines were approximately 17 metres tall with a capacity of around 75 kilowatts (or .75 megawatts (MW)).

In 2021 the latest generation of offshore wind turbines are up to 250 metres tall and have a generation capacity of up to 15,000 kilowatts (or 15 MW). To put that in perspective one of these turbines can produce enough electricity in a year to power approximately 20,000 households and save around 38,000 tonnes of carbon dioxide emissions. That's the equivalent of removing about 25,000 passenger cars from the road every year[3].

Technology continues to advance at pace with floating offshore turbine technologies allowing access to a far greater range of suitable offshore locations for energy generation.

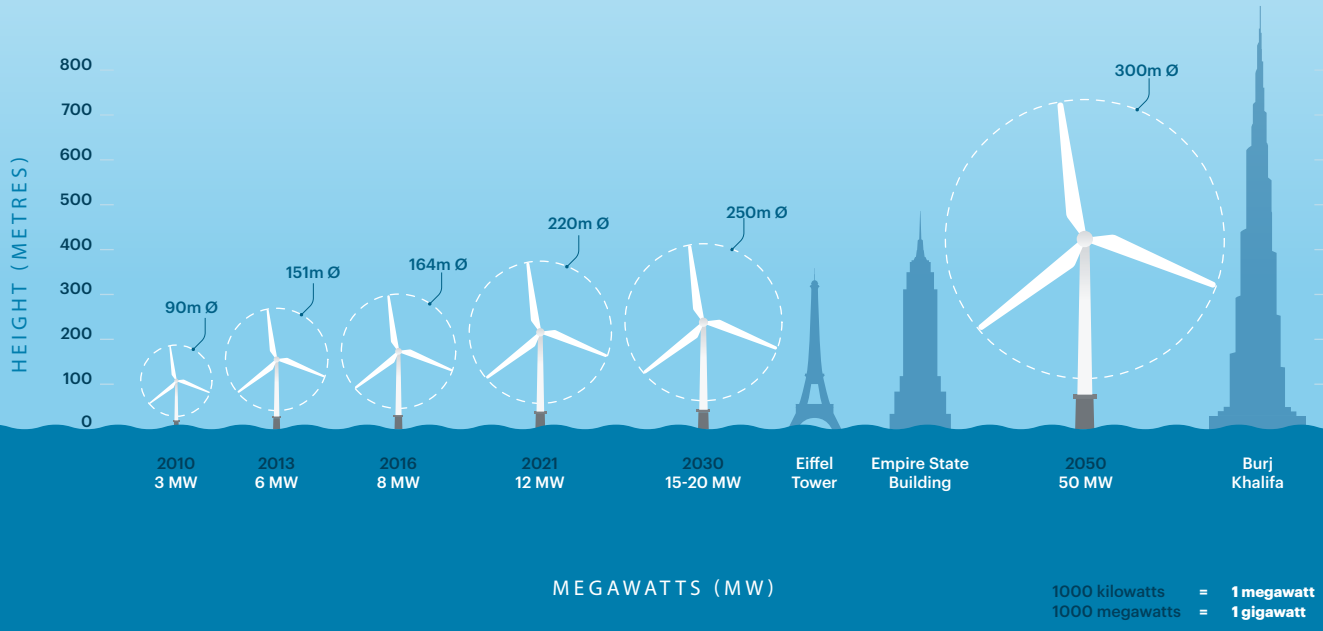


Figure 2. Evolution of wind turbine size and power output

[3] vestas.com.

WHAT DOES AN OFFSHORE WIND FARM LOOK LIKE?

An offshore windfarm consists of generation and transmission infrastructure.

The number of wind turbines to be installed will depend on the intended generating capacity of the wind farm. Using current technologies and dependent on site specific factors such as wind speeds, a 1 gigawatt (GW) (1,000 MW) offshore wind farm may need between 60 and 100 turbines. Turbines are connected via subsea cables to offshore electrical substations which regulate current and boost voltage for export to onshore grid connection infrastructure via a high voltage export cable.

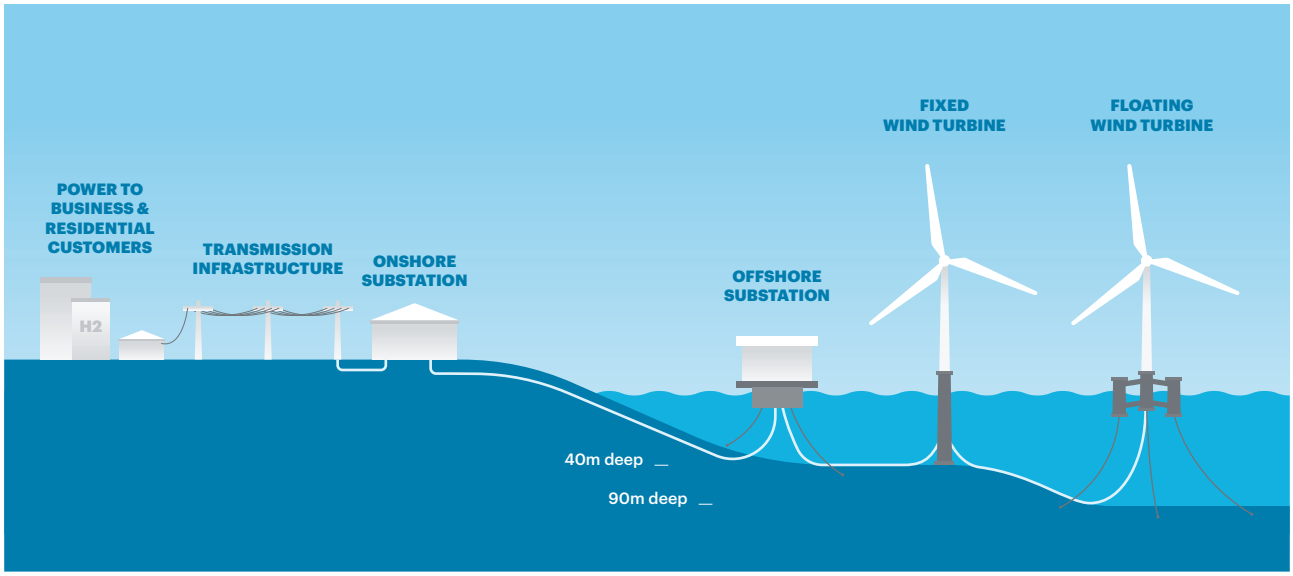


Figure 3. Typical example of an offshore windfarm

WHY GO OFFSHORE?

Australia is fortunate to have a large landmass, a relatively small population and abundant solar and wind resources.

So the question arises, why would you build windfarms offshore? The short answer - bigger is better. Whilst building windfarms onshore can reduce challenges and costs associated with operating in the marine environment, there are transport and logistical constraints which limit how large an individual turbine can be[4]. Other factors such as competing land uses, socioeconomic and environmental impacts, proximity to markets and generally lower and less consistent wind speeds limit the potential size, generation capacity and efficiency of onshore wind installations[5].

Taking wind offshore reduces or removes many of these constraints allowing wind farms to be scaled up to generate more energy, more efficiently, with fewer installations. These benefits, combined with access to more reliable and consistent wind speeds and reducing costs means that offshore windfarms are becoming increasingly competitive in the global energy market.

In some locations, offshore wind has already become the most cost competitive option for new generation with further efficiencies expected from economies of scale and future innovation.

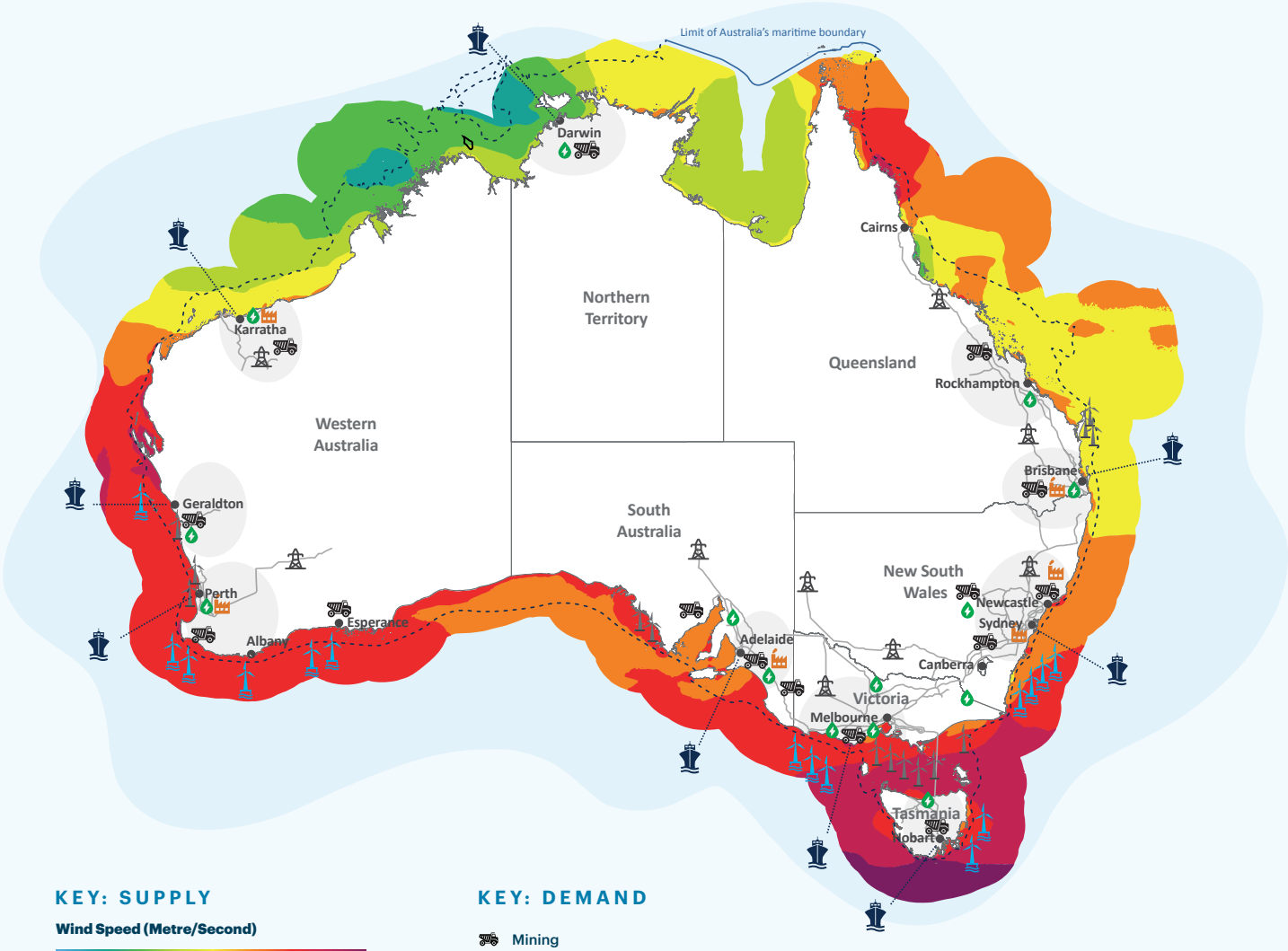
[4] The largest onshore wind turbines have a capacity of around 6,000 kilowatts (ge.com; vestas.com).

[5] The report "Wind Energy in Europe 2019" showed onshore windfarms generated on average 24% of their total capacity compared to 38% for offshore windfarms windeurope.org.

OFFSHORE WIND POTENTIAL IN AUSTRALIA

Australia possesses world class offshore wind resources. The Global Wind Energy Council estimates Australia has the potential to generate up to 5,000 gigawatts (GW) of electricity from offshore wind using a combination of fixed and floating infrastructure. This represents 100 times the installed capacity of Australia's two largest electricity networks.

Australia's highest quality offshore wind resources are generally in the southern half of the continent adjacent to large population centres, industrial hubs and mining projects. International offshore wind developers are increasingly recognising the potential of Australia as an emerging market. Offshore wind represents a proven and competitive generation technology that can contribute to the diversification of Australia's energy mix.



KEY: SUPPLY

Wind Speed (Metre/Second)

<4 5-6 7-8 9-10 >11

Wind speed data is sourced from the Global Wind Atlas and depicts wind speed at 100 metre hub height at 250 metre resolution.

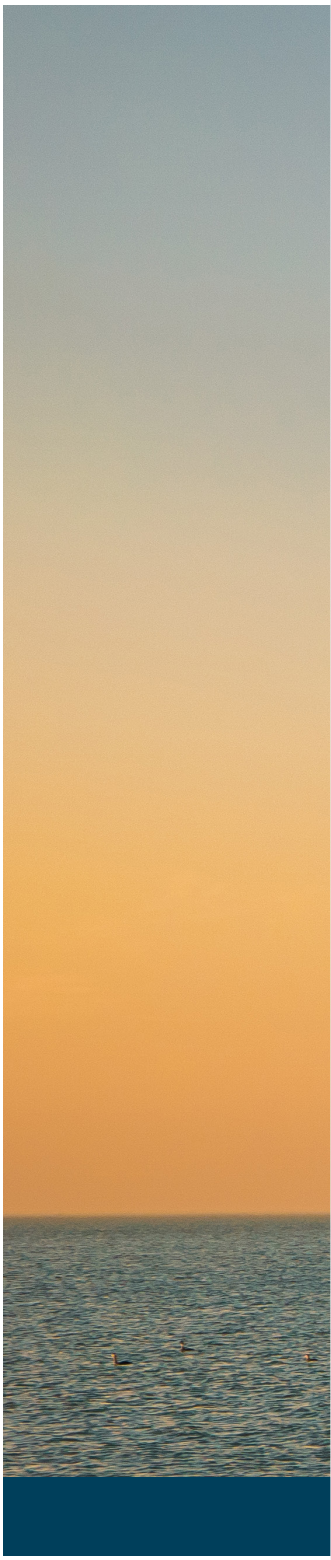
90 metre mark

Fixed wind turbines
Suitable for water depths of up to 90 metres.

Floating wind turbines
Suitable for water depths greather than 90 metres.

KEY: DEMAND

- Mining
- Green hydrogen potential
- Heavy industry
- Transmission infrastructure
- Ports
- High electricity demand



Contact details
+61 (08) 6188 8700
offshorerenewables@nopsema.gov.au

Head office
Level 8, Alluvion Building
58 Mounts Bay Road, Perth WA 6000

nopsema.gov.au