FLOTATION ENERGY

Offshore Wind and the Opportunity for Western Australia

SEN
Sustainable Energy Now

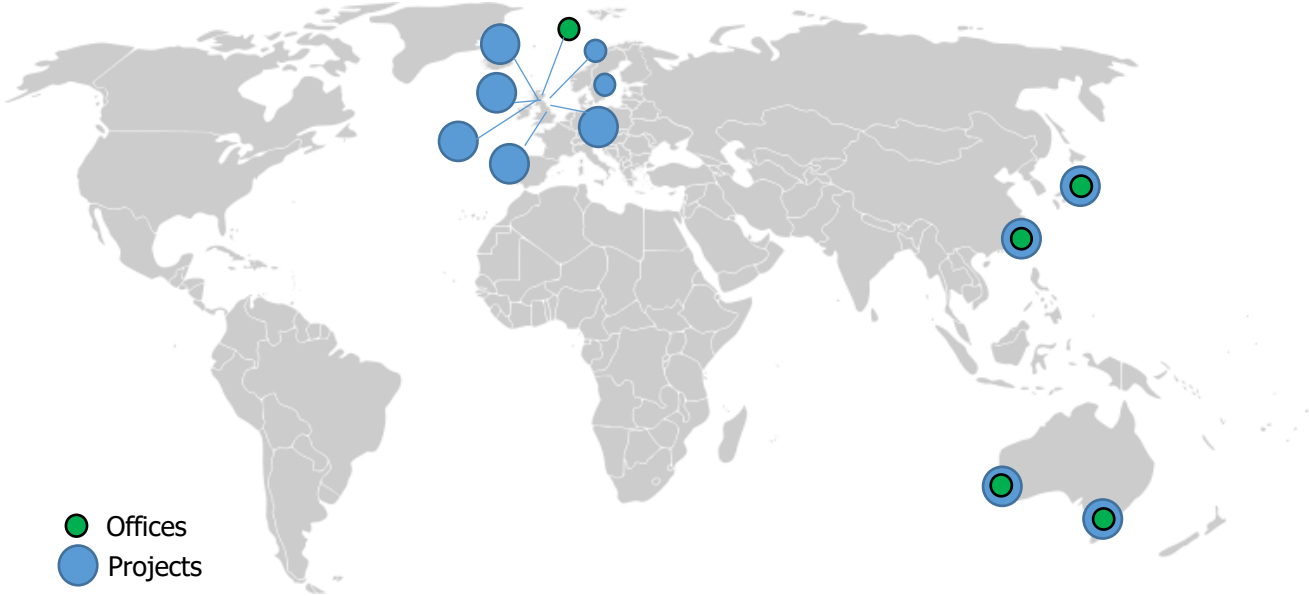
Sustainable Energy Now Presentation

28 November 2022

Marcus Dowling
Engineering Projects Manager

Flotation Energy

- Global leader in offshore wind development
- Acquired by TEPCO RP November 2022
- HQ in Scotland with subsidiaries in Taiwan, Japan & Australia
- Global team of 52
- Australian Head Office in Fremantle WA established in 2019 with a team of 10
- Pioneering the Energy Transition
- Proven track record of developing and delivering 3GW of floating and fixed offshore wind
- Our team developed Kincardine – the world's largest floating windfarm
- 16GW portfolio of projects
- Objective to develop global projects and partnerships



Anatomy of an Offshore Windfarm

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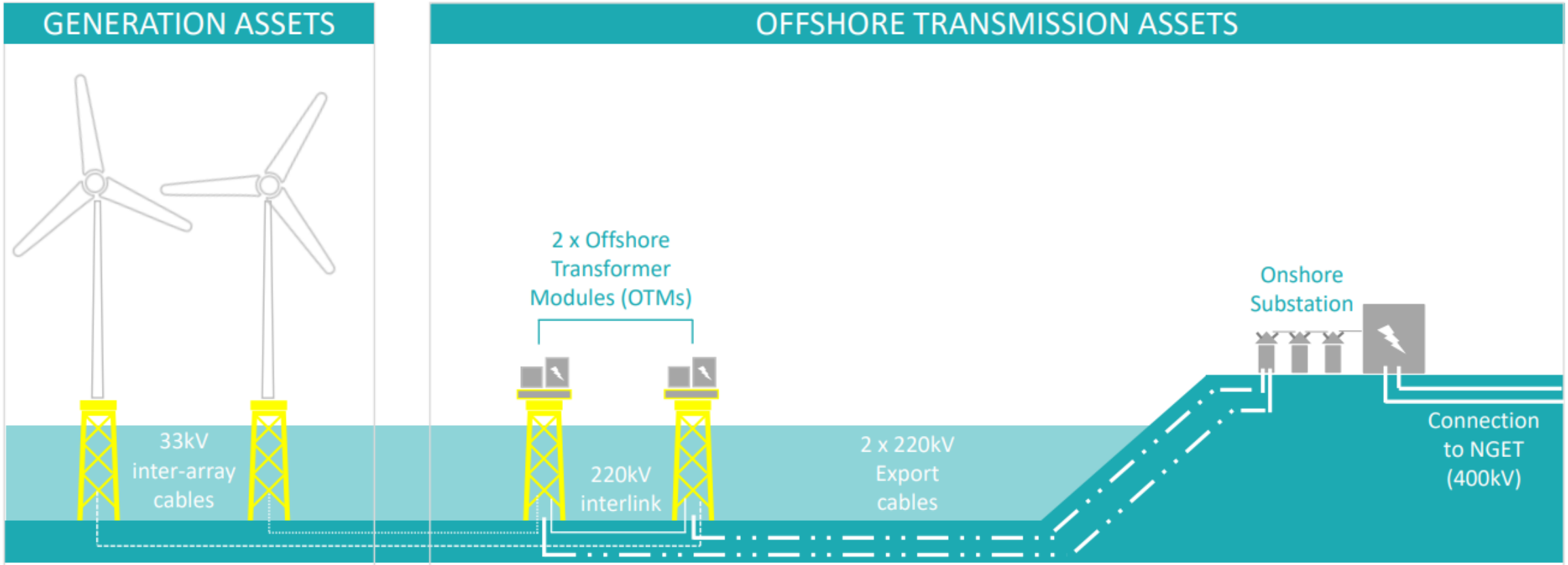
GENERATION ASSETS

OFFSHORE TRANSMISSION ASSETS



- 84 Siemens SWT-7MW-154 on jacket foundations
- 91 x 33kV inter array cables
- 14 strings in total, with 7 strings connecting into each OTM

- Two OTMs transform the power from 33kV to 220kV
- Two export cables (one per OTM) connect the OTMs to the Onshore Substation
- Onshore Substation at Blackhillock connects to the SSE Networks substation

Typical Fixed Offshore Wind Installation

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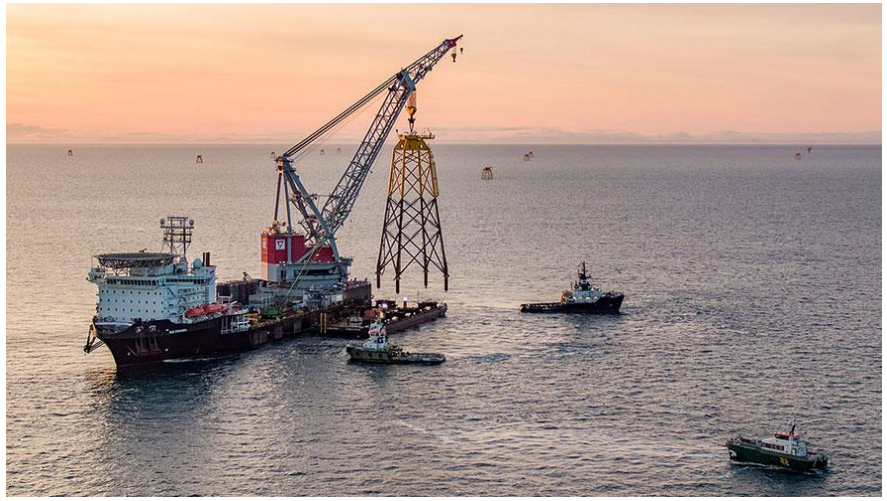
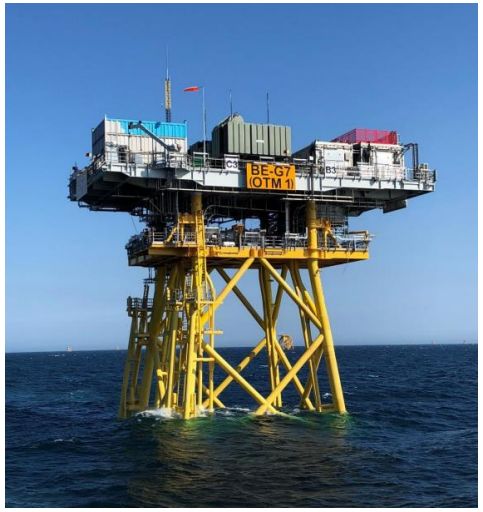
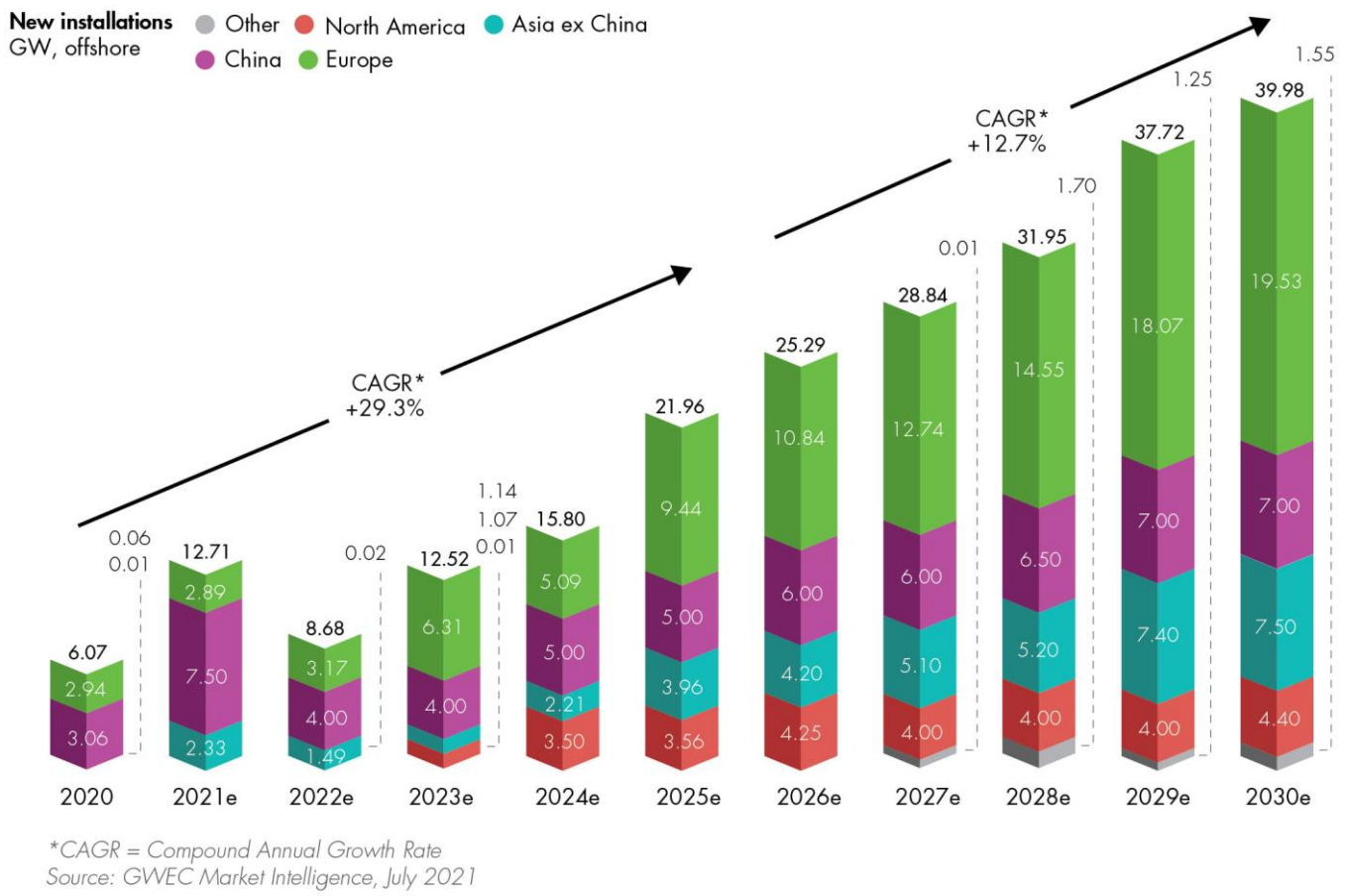




Offshore Wind – Maturing Industry

- Started with Vindeby in 1991, 4.95MW,11 x 450kW turbines
- Global installed (fixed) capacity ~50GW, ~200GW in development
- Floating wind emerging quickly
- 13-15MW turbines by 2025
- Influx of capital at >Au$23bn/year, including big oil
- Highly scalable, more reliable and consistent winds, close to markets, removes or reduces many constraints
- Driven by decarbonisation & economic gains
- Costs falling (July 2022 UK CFD £36.35 Au$70/MWh), approaching grid parity with costs falling



*CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, July 2021

Fixed Offshore Wind – Cost Reduction

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Competitive tenders have brought price into focus

- Previously the focus was on mitigating risks; priority is now on lowering LCOE/bid prices
- Investors and contractors have the experience to better understand risks and assess them more precisely

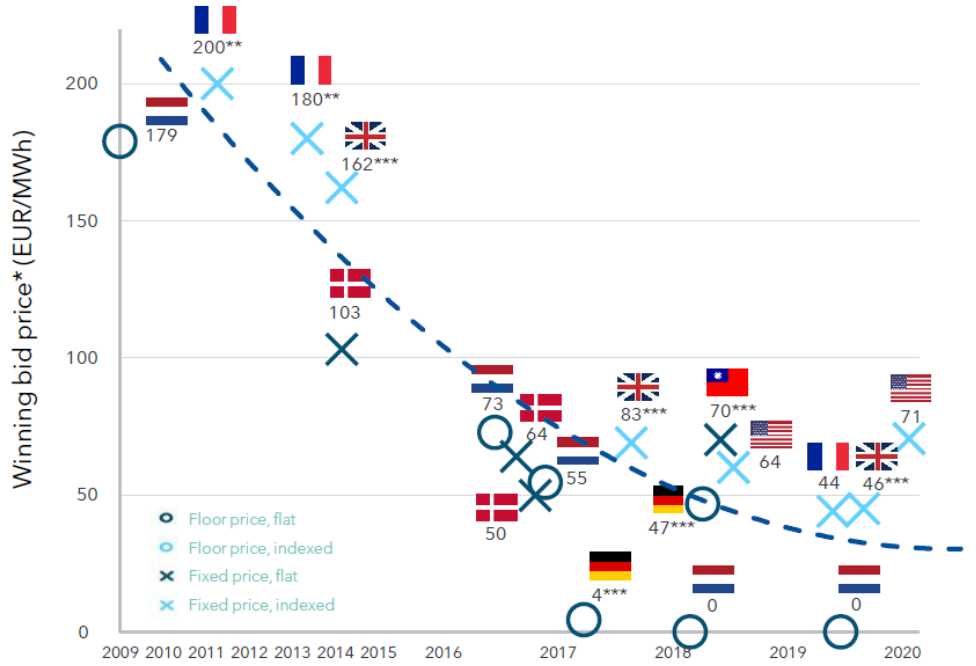
Competition across supply chain has helped decrease prices

- Competitive supplier market with several contractors for turbines, marine works and other key equipment & services
- Utilities are natural participants in tenders, though consortia with the right skills have proven to be competitive

Decreasing return levels have accompanied this trend

- Maturing industry, attracting lower cost of equity and debt
- Competitive funding for all phases of projects

Historical tender results



Vertical line corresponds to the range of prices allocated in a given tender

* bid prices exclude interconnection costs

** based on public statements (bid results confidential)

*** based on weighted MW-average for all projects awarded

Tenders with zero bids for fixed-bottom offshore wind have steadily become the new reality

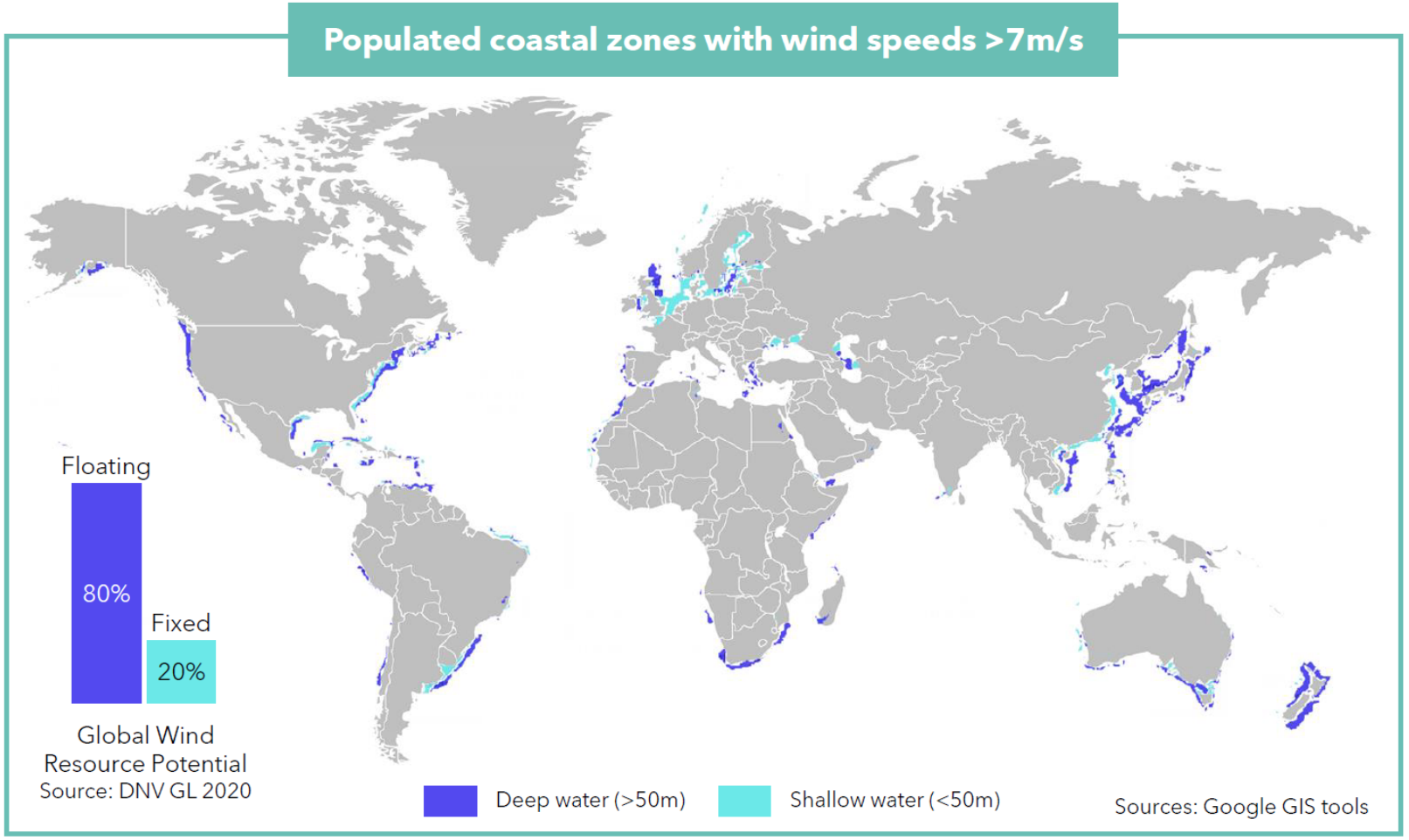
Floating wind is rapidly emerging

Approx. 2/3 of windy, populated coastal zones are located in deep water, where fixed-bottom OW is not suitable

- 2/3 of the North Sea offshore wind resource is in deep water
- 80% of Japan's EEZ offshore wind resource is in deep water
- >50% of the US offshore wind resource is in deep water

Opportunities in fixed-bottom still exist but competition will be fierce as it becomes mainstream

- Globally, potential OW generation in deep water is four times larger than shallow and transitional waters
- Territories suited for fixed-bottom OW are becoming scarce in existing markets; some markets only have deeper waters



Floating Offshore Wind (FOW) projected to grow quickly

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Key advantages of floating offshore wind

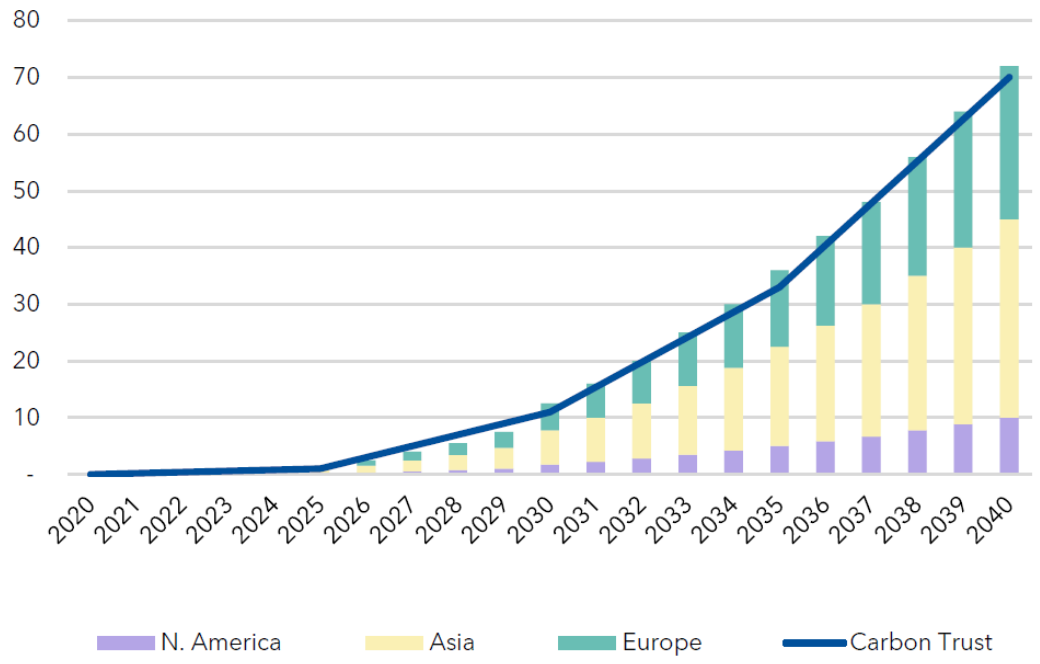
Location
- Access to deeper sites
- Versatile anchoring and mooring systems

Resource
- Flexibility to choose sites with most favourable wind
- Layout can be optimised for max. capacity factors

Operations
- FOW allows for assembly in harbour & towing to site
- Systems can be towed to harbour for repair

Environment
- No damage to seabed from piling and jack-up vessel
- Can be built further offshore; reduced visual impact

Cumulative FOW installed capacity forecast (GW)



Source: Carbon Trust (2020) "Floating Wind Joint Industry Report – Phase 2"

Forecasted growth of 70 GW of FOW by 2040, mostly in Europe and Asia – with growth picking up from 2025

Floating wind costs falling but challenges remain

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124 MW operating FOW farms worldwide in 2021
11 GW target installed by 2030 and
70 GW target installed by 2040

Source: Carbon Trust (2020) "Floating Wind Joint Industry Report – Phase 2"

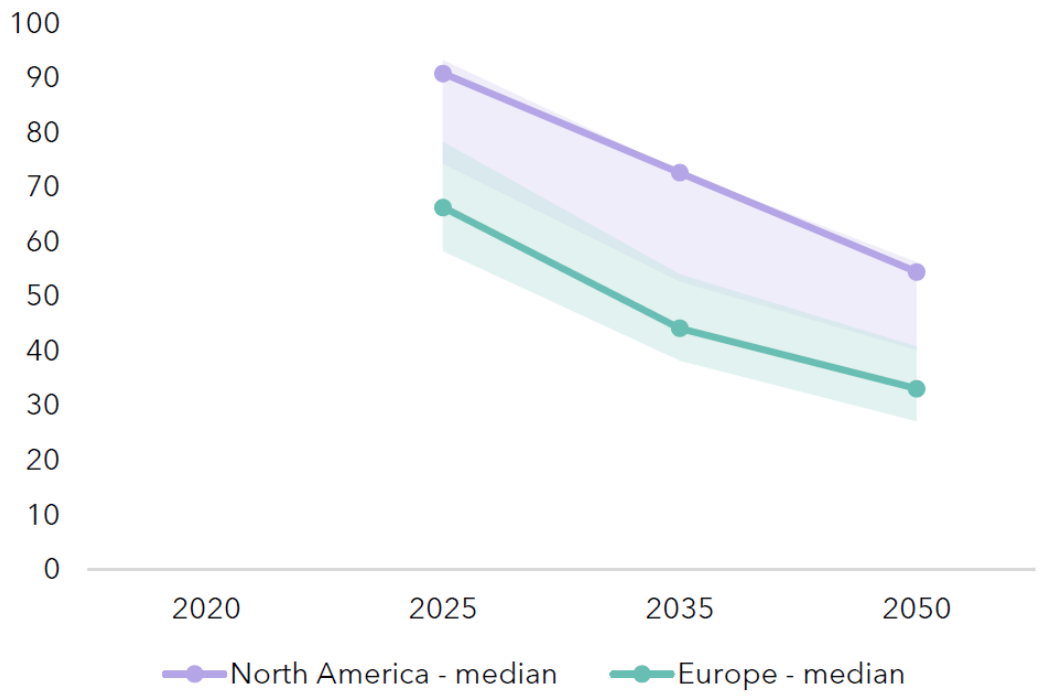
Cost of FOW should decrease sharply in the coming years

- Experts forecast that FOW's LCOE could decrease below 40 GBP/MWh by 2050, starting at 66 GBP/MWh in Europe in 2025, as a result of higher capacity factors and cost reductions on CAPEX
- Fixed OW was able to outpace its forecasts, and FOW can build on this experience

But challenges remain

- Key challenge is in supply chain and infrastructure, as FOW heads to mass production
- Solutions must be found to improve dynamic cables cost (and improve performance)
- Commercialisation of mooring systems, and foundation structures are also key challenges

Estimates of LCOE for FOW (GBP/MWh)



Source: Nat Energy 6, 555–565 (2021). https://doi.org/10.1038/s41560-021-00810-z
GBP/USD exchange rate of 1.35 assumed

FOW is expected to be competitive with fixed OW in the 2030s, accelerating its deployment

Australian Legislation Enabling Offshore Wind Industry

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- Federal Government Climate Change Bill passed 2022 committing Australia to 43% reduction in emissions on 2025 levels, and net zero 2050.
- Offshore Electricity Infrastructure Bill 2021 enacted
  - Dedicated regulatory regime for offshore infrastructure and technologies
  - Licencing scheme covering feasibility, commercial, research and transmission activities occurring in the Commonwealth Offshore Area.
- Initial regulations out for review
  - Offshore Electricity Infrastructure Regulations 2022 (Regulations)
  - Offshore Electricity Infrastructure (Regulatory Levies) Regulations 2022
  - Cost Recovery Implementation Statement (CRIS)
- **Gippsland declared a priority offshore wind area by Victorian State Government …**


13:41 4G

THE AUSTRALIAN

$20bn push for offshore wind farms in Bass Strait

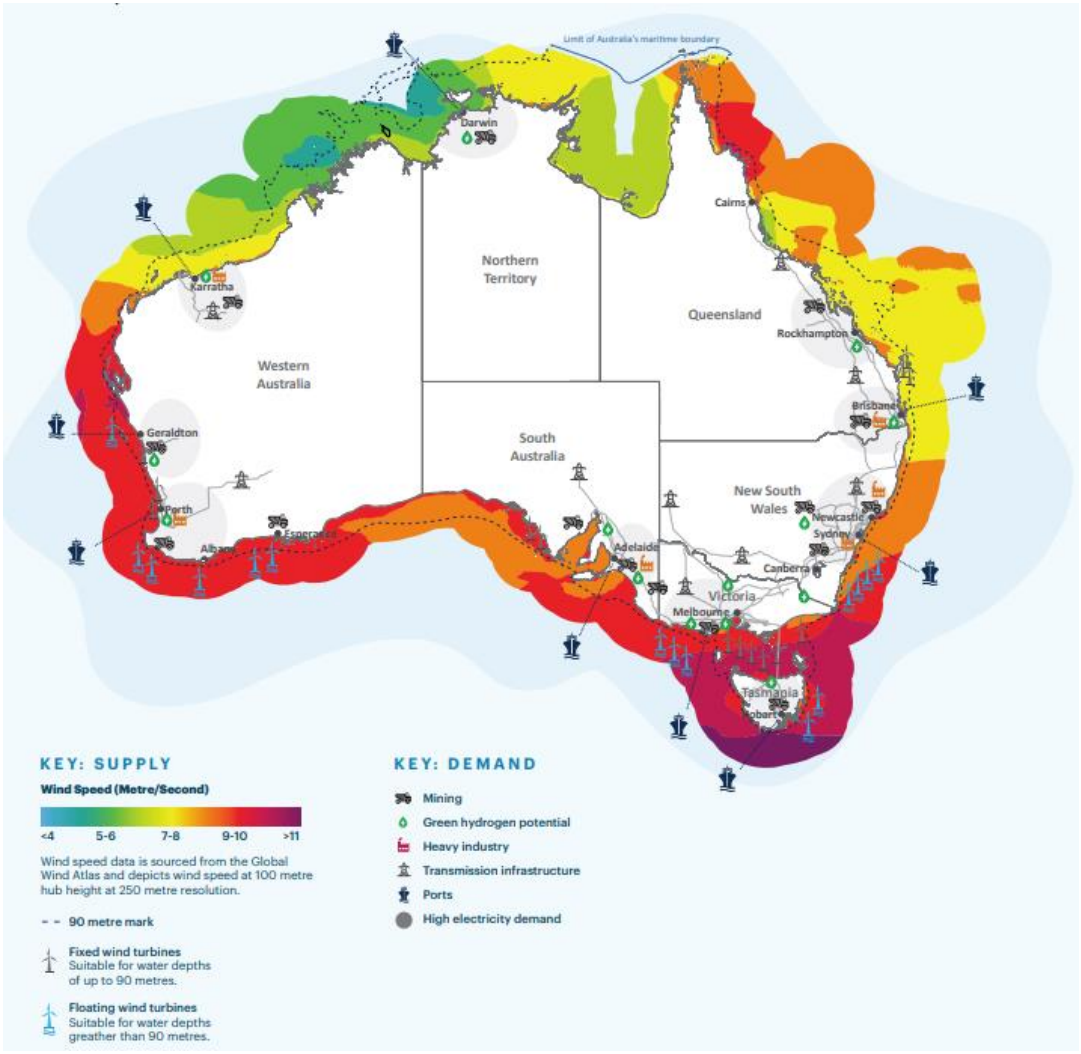
While there are currently no offshore wind farm projects operating in Australia, they are common in Europe. Picture: AFP

By CAMERON ENGLAND Aa

Bass Strait has been earmarked as the nation's first priority area for offshore wind power developments, with the federal government move a crucial step in unlocking more than $20bn in potential new investment.

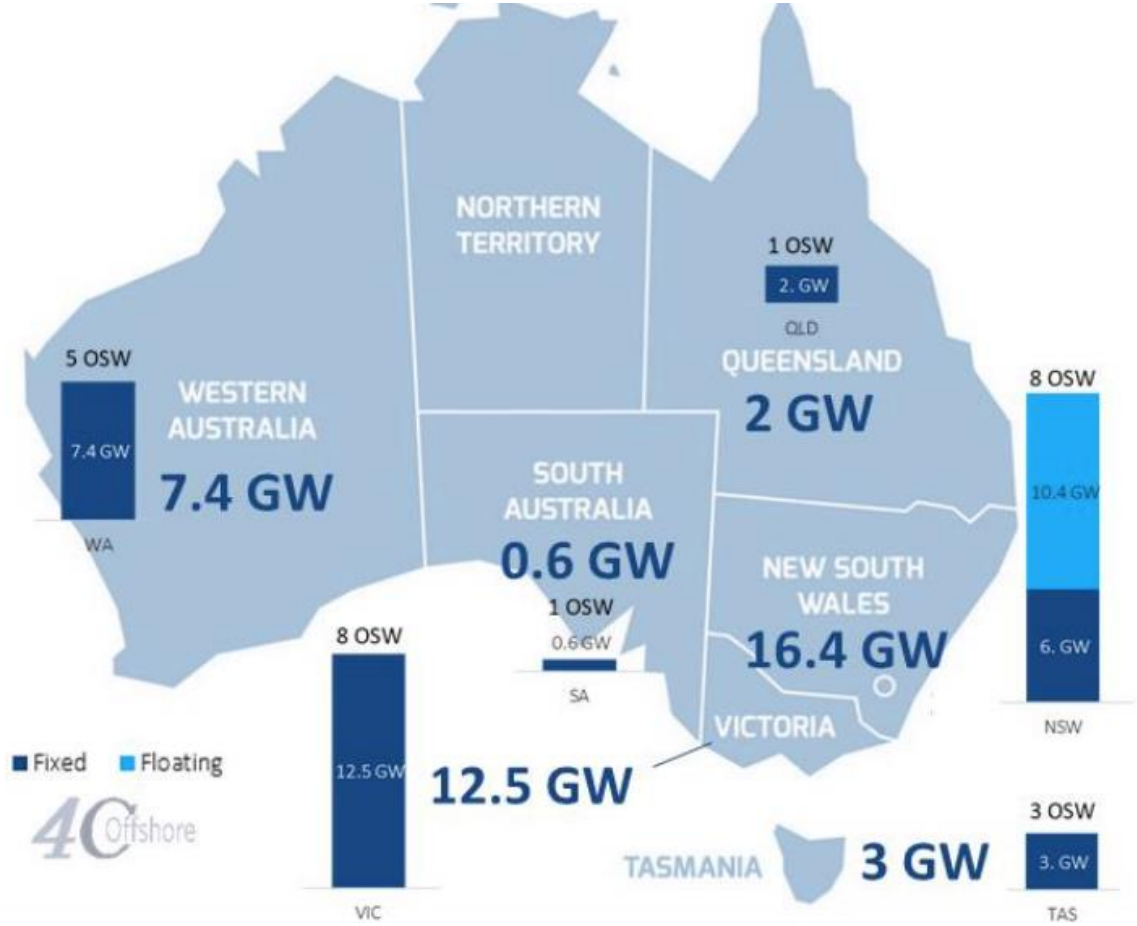
Australia Offshore Wind

- Massive untapped resource
- Complementary to solar PV and onshore wind
- Competitive at the GW scale
- Supports energy transition and leverages existing grid infrastructure
- Transfers skills, maintains and generates jobs, domestic and export opportunity
- No operating offshore wind projects in Australia, but development is increasing with Federal and State Government commitments….



Source: NOPSEMA, 2021

Welcome to the Wild West…

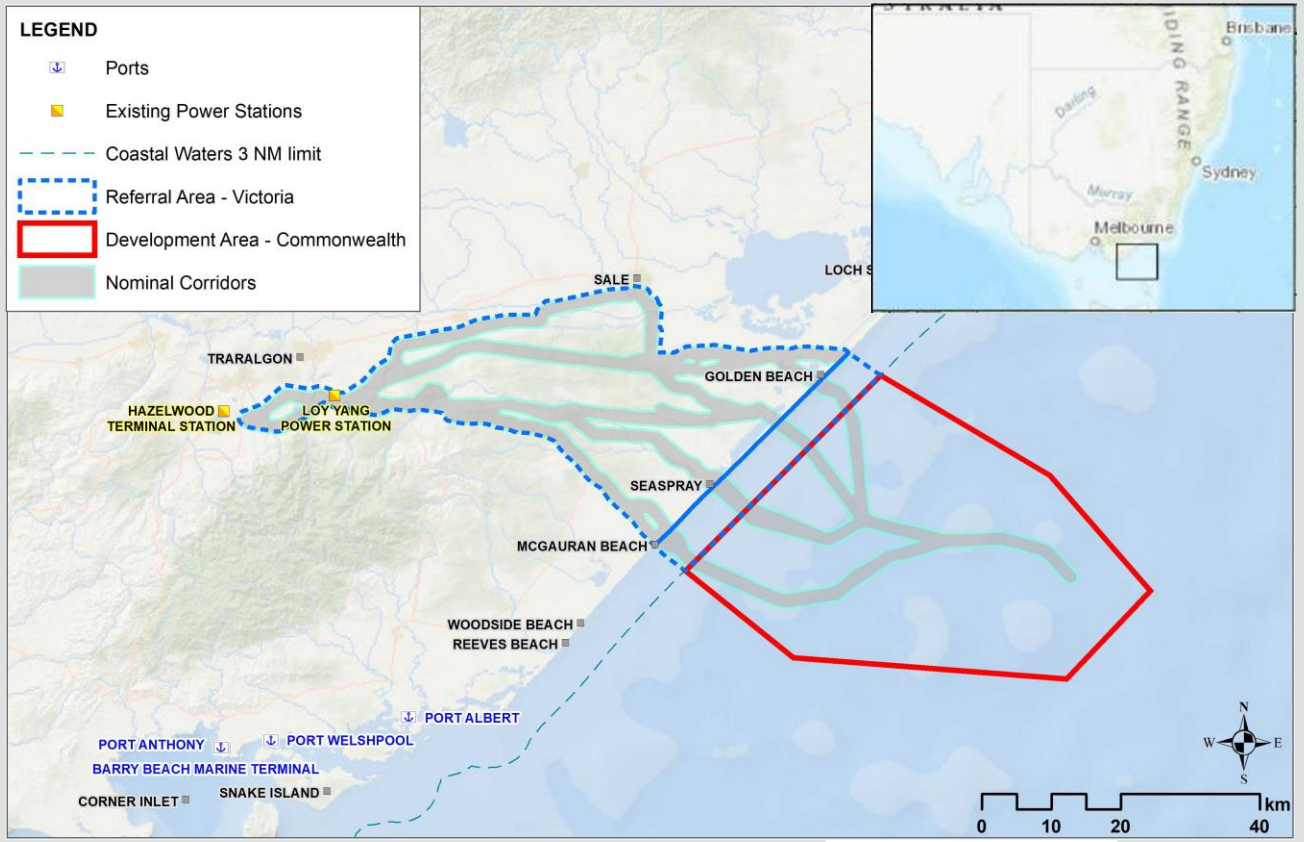


NAME	LOCATION	MW	OWNER
Star of the South	VIC	2200	Star of the South, CIP
Mid West	WA	1100	Pilot Energy
Australis WA	WA	300	Ae
Australis VIC	VIC	495	
Australis SA	SA	600	
Novocastrian	NSW	1800	Oceanex
Illawarra	NSW	2000	
Eden	NSW	1800	
Ulladulla	NSW	1800	
Bunbury	WA	2000	
Bass - 1A	TAS	500	Nexsphere
Bass - 1B	TAS	500	
Bass - 2	TAS	2000	
Seadragon	VIC	1500	FLOTATION ENERGY
Newcastle	NSW	3000	
Port Kembla	NSW	3000	GREEN ENERGY. PARTNERS
Bass Strait	VIC	4000	
Western Victoria	VIC	1000	
Western Australia	WA	1000	
Southern Queensland	QLD	2000	
Hunter Coast	NSW	1400	BlueFloat energy estate
Wollongong	NSW	1600	
Greater Gippsland	VIC	1300	
Great Southern	VIC	1000	
Leeuwin	WA	3000	CE COPENHAGEN ENERGY ▶ + Midwest 2GW & Samphire 2GW
Spinfex	VIC	1000	alintaenergy

Source: 4COffshore Markey Overview Report, June 2022

Seadragon – Gippsland Victoria

- 1.5 GW bottom-fixed offshore wind farm
- 100 to 150 turbines
- FID 2026/7, Operational 2030, 30-year life
- $6 billion CAPEX, 2,000 direct jobs over lifetime, power ~1 million homes
- $4.6m partnership with Victorian Government
- Energy and supply chain transformation
- Economic Asset and job re-purposing & environmental benefits
- Options for floating…



Policy and Requirement for Decarbonizing of WA Economy

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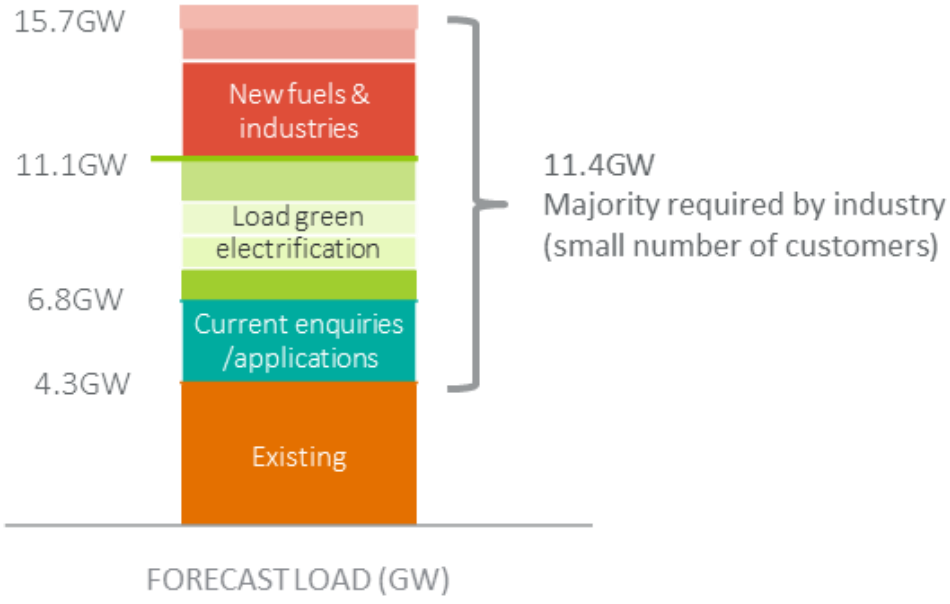
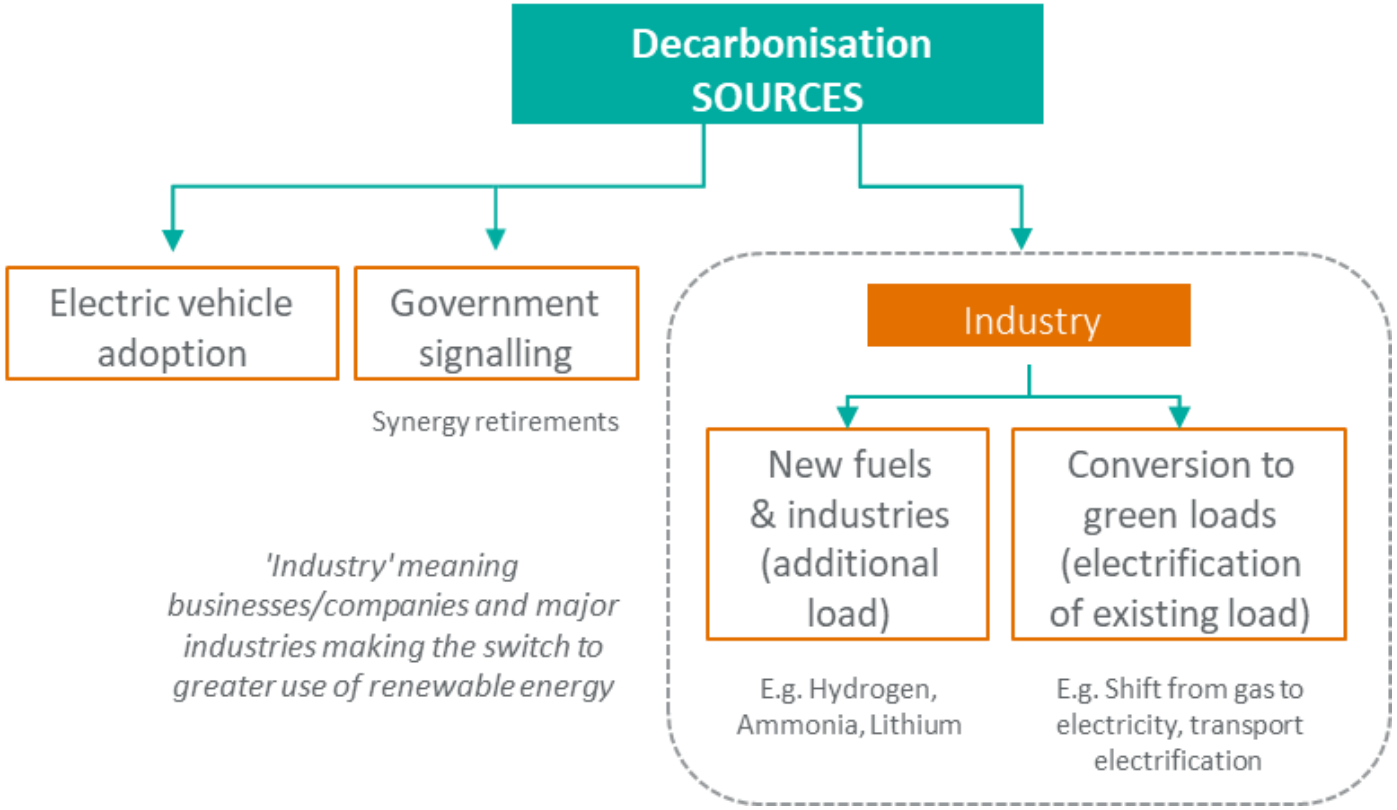
- WA Government committed to an 80 per cent, or 5.8 MTPA reduction in carbon emissions caused by state assets by 2030 as part of its overall plan to achieve net zero emissions by 2050.
- 70% of this target will be achieved by closing all state owned coal fired generation by 2030.
- WA Government only attributes 8% of overall state carbon emissions, hence, other businesses are required to contribute. Many have already pledged, including South 32, Alcoa, and BHP.
- Concerns for meeting future electricity demand, WA Government have commissioned an early SWIS Demand Assessment (SDA) study to be performed ahead of WOSP 2 to determine demand - due to be published end of 2022.

Policy and Requirement for Decarbonizing of WA Economy - continued

- The task for the decarbonisation of the Southwest of WA is going to be enormous.
- Decarbonisation could result in electricity demand increasing from 4.3 GW to 11.1 GW.
- In addition, new fuels and industries could increase this further to 15.7 GW.



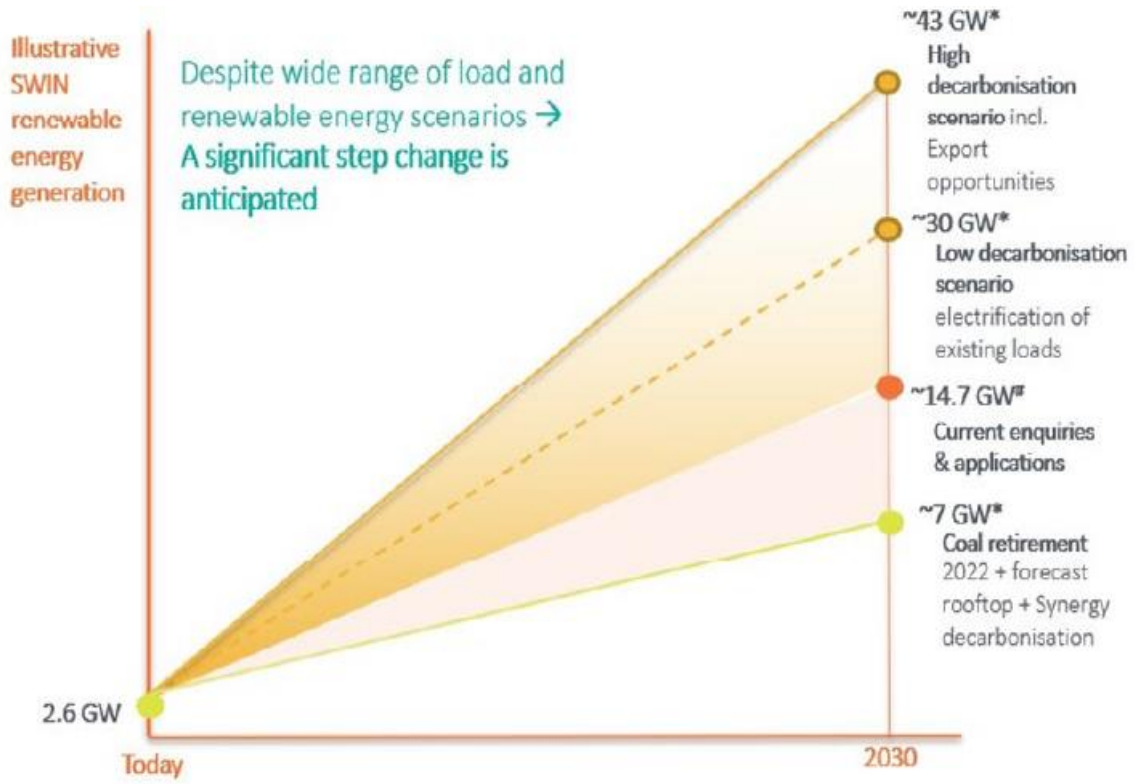
*EPWA forecast 11.5GW load connections between 2026 to 2038



Source: Sam Barbaro (CEO), Western Power, Network Transformational Panel, Energy in WA Conference, 26 August 2022

Western Power SWIS Forecasting (2022)

- Requirements for renewable electricity in the SWIS (also referred to as the SWIN) could be an additional 27.4 GW of capacity to achieve electrification of industry and other sectors
- Also, more than 40 GW if a high decarbonisation scenario with hydrogen exports is factored in.
- Illustrative South West Interconnected Network Energy Generation Requirements shown in figure opposite



* Renewable generation based on (i) AEMO forecast rooftop increase by 2,5GW and (ii) current renewable enquiries / application 9.6GW generation.
** Renewable generation forecasts based on conservative 3 x capacity factor on market intelligence loads

Western Power SWIS Forecasting (2022)

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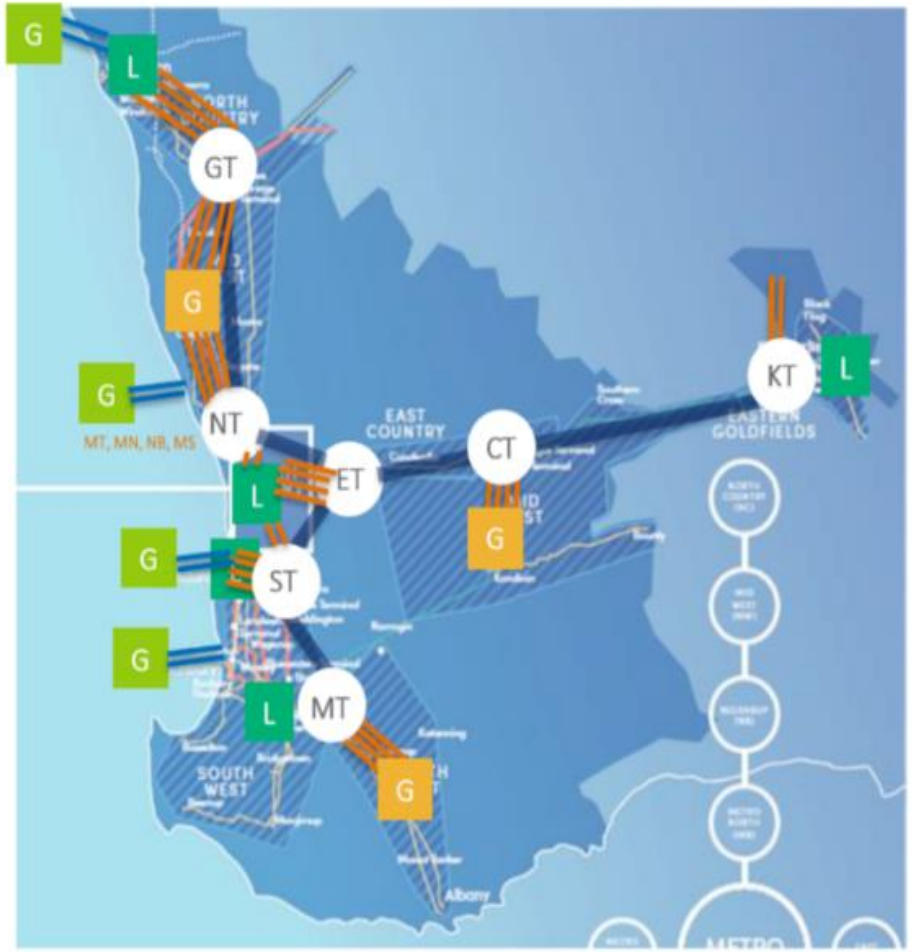
- The increase in renewable energy capacity in the SWIS cannot be achieved without significant augmentation of the SWIN as outlined by Western Power.
- Part of Western Power's interim plan for SWIN augmentation is the connection of offshore wind farms.

Potential future

- Future renewable generation (incl. offshore and onshore) and load interest in the North, South, East and Kwinana
- Significant growth in the transmission network foreseen to meet range of potential decarbonisation pathways

Legend

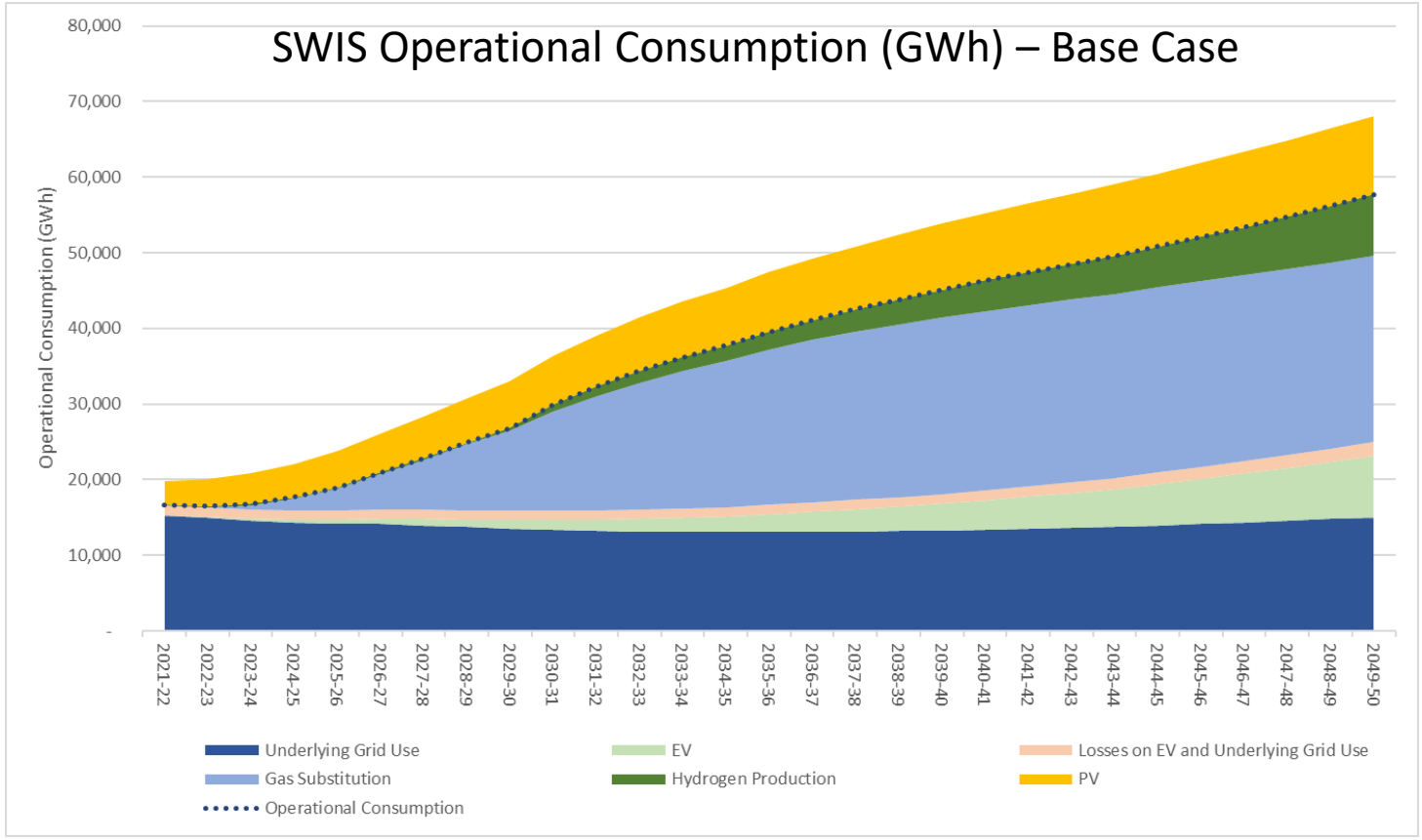
- G — Offshore wind application
- G — Expected generation hub
- L — Expected load centre
- Prospective EHV terminal
- EHV – new backbone
- 330kV overhead
- Undersea cable



Source: Sam Barbaro (CEO), Western Power, Network Transformational Panel, Energy in WA Conference, 26 August 2022

SWIS Operational Consumption Forecasting

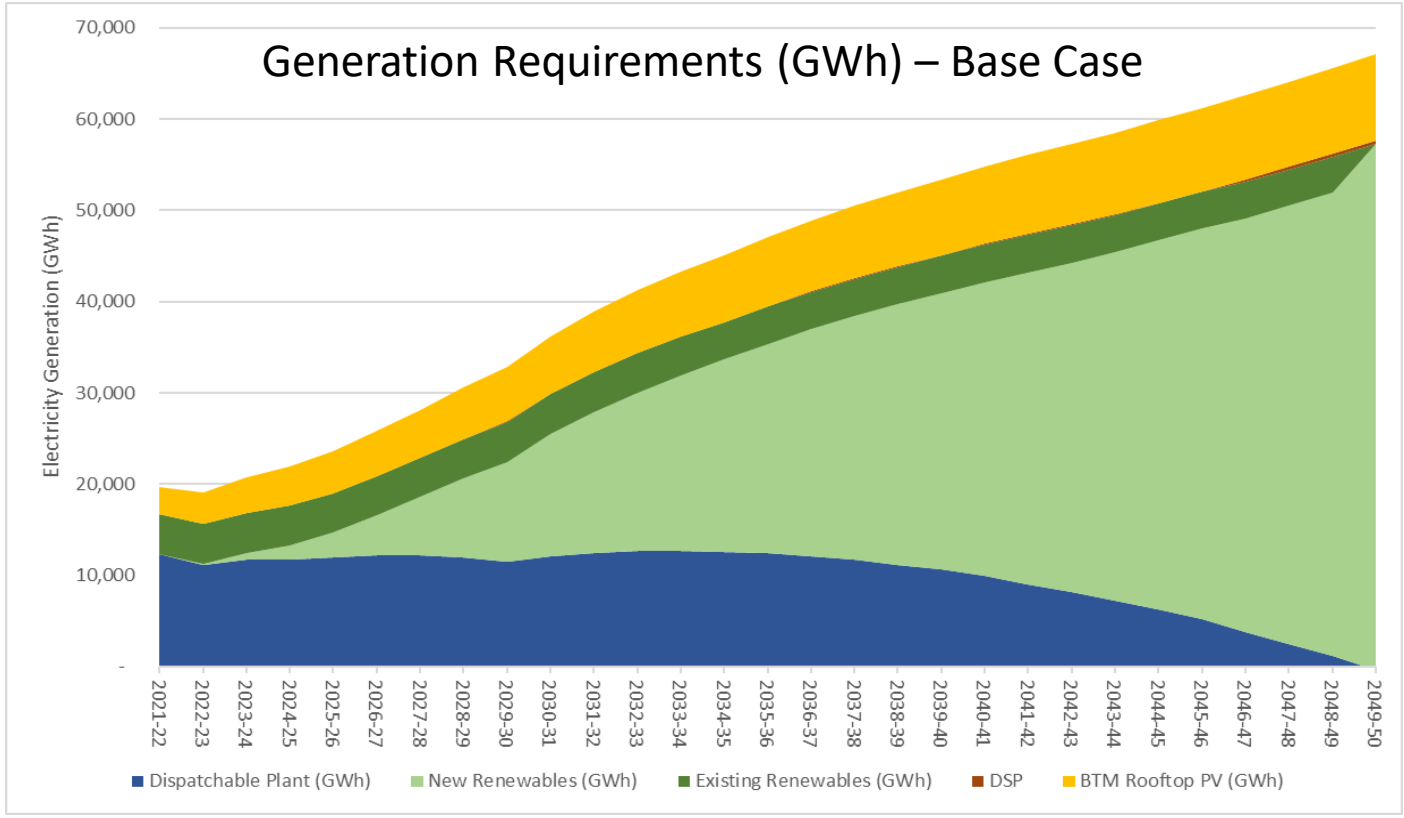
- SWIS Operational Consumption forecasts from 2022-23 to 2049-50 taking into account the impact of the potential decarbonization strategies from the government and major industry (gas substitution).
- Base case assumes decarbonisation strategies of the WA Government and major industry (gas substitution).
- Also includes the continued uptake of rooftop solar (PV), increased penetration of EVs, production of hydrogen for Fuel Cell Electric Vehicles and for some industrial processes
- Consumption increases from 16,660 GWh in 2021-22 to 26,867 by 2029-30 and further to 45,077 GWh by 2039-40.



Source: Marsden Jacob 2022

SWIS Operational Generation Forecasting

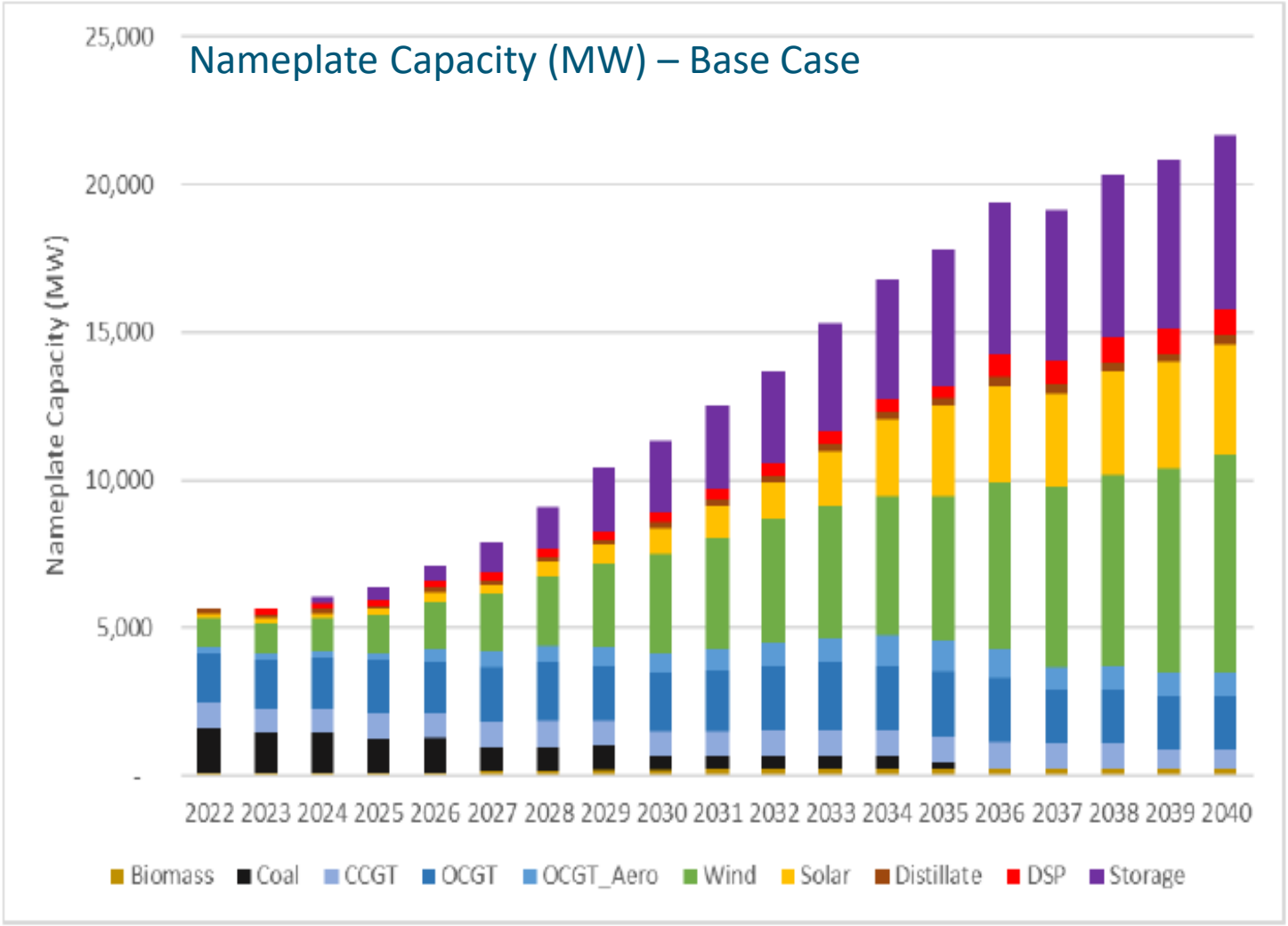
- Base case:
- Renewable generation (includes roof top PV) needs to be 65% of underlying generation by 2029, providing 44% reduction on generation emissions
- & 80% by 2039/40, providing 58% reduction generation emissions



Source: Marsden Jacob 2022

SWIS Name Plate Capacity Generation Forecast

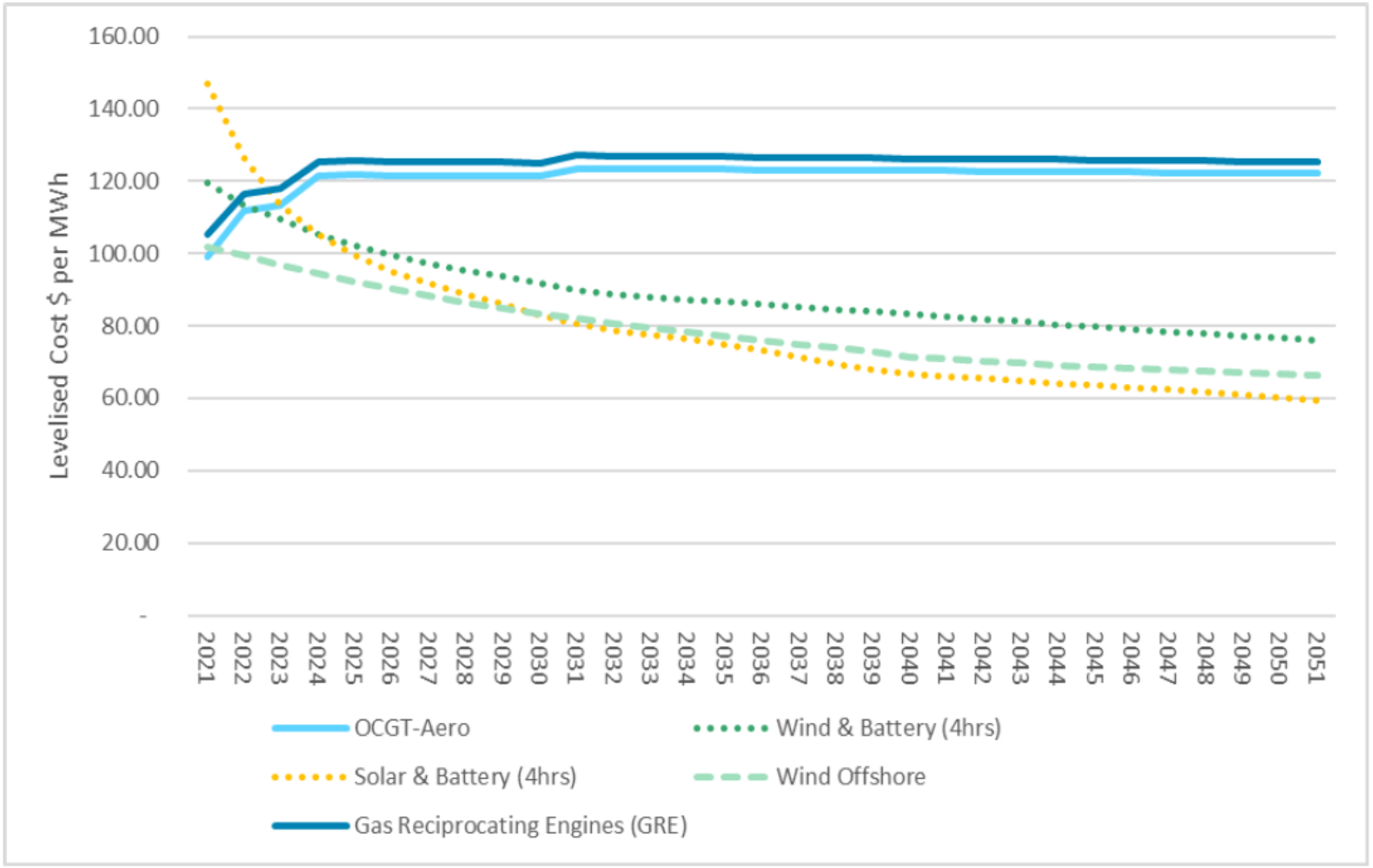
- Base case:
- By 2030, required 3,356 MW wind capacity (currently installed 997MW)
- By 2040, required 7,376 MW wind
- Currently 8GW of large-scale generation committed or in development in the SWIS, 50% offshore wind projects.
- Without offshore wind projects, it's unlikely that sufficient wind capacity could be developed to achieve 65% renewable energy penetration in 2030, or 80% renewable energy penetration in 2040.



Source: Marsden Jacob 2022

LCOE for mid-merit generation in the SWIS

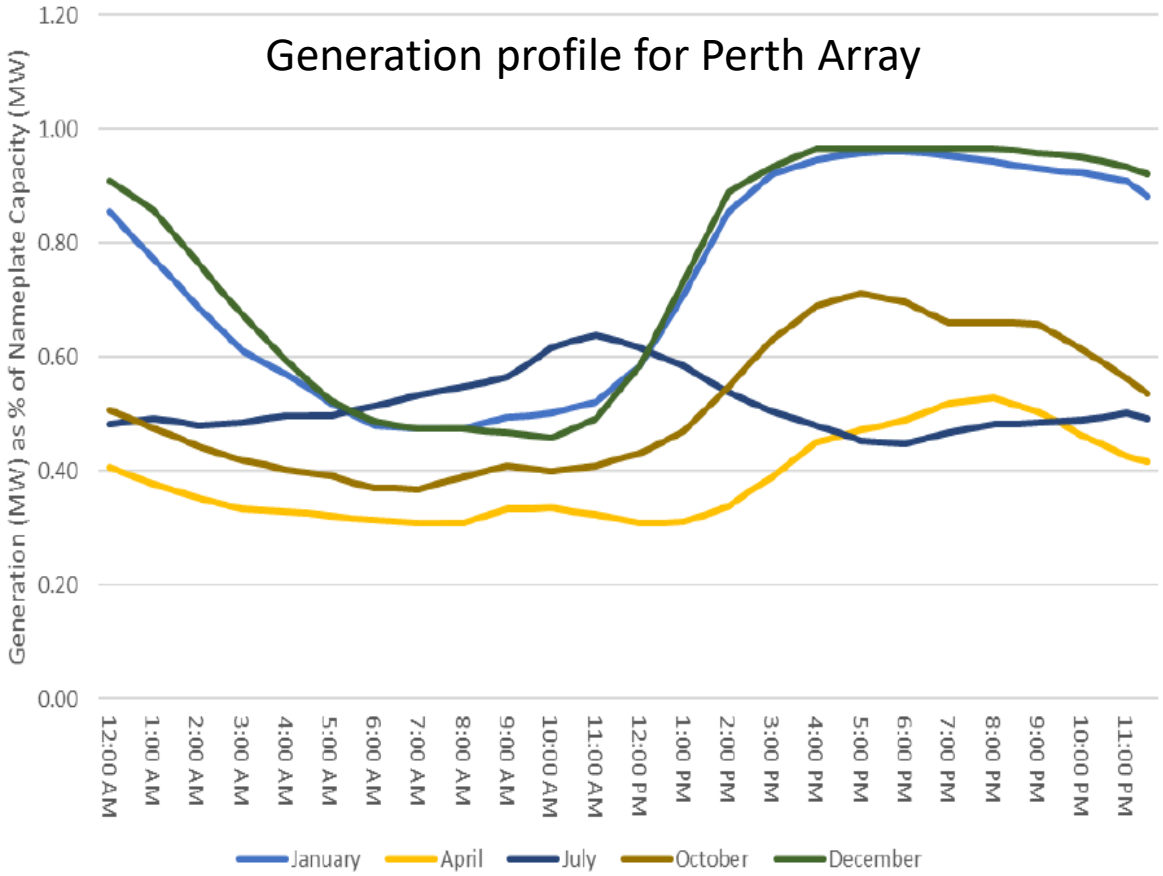
- Mid-merit with CF between 25 to 56%
- Offshore wind has lower LCOE compared to OCGT-Aero & Gas Reciprocating Engines
- Competitive with onshore wind and solar where both have a 4 hour battery storage
- Investment into new transmission infrastructure is significantly less for offshore wind ($0.4bn) than Merredin onshore hub ($2.2bn)
- Cost including the augmentation of the Transmission for onshore wind is approx. 70-75 $/MW vs 80-85 $/MW



Wholesale Electricity Market

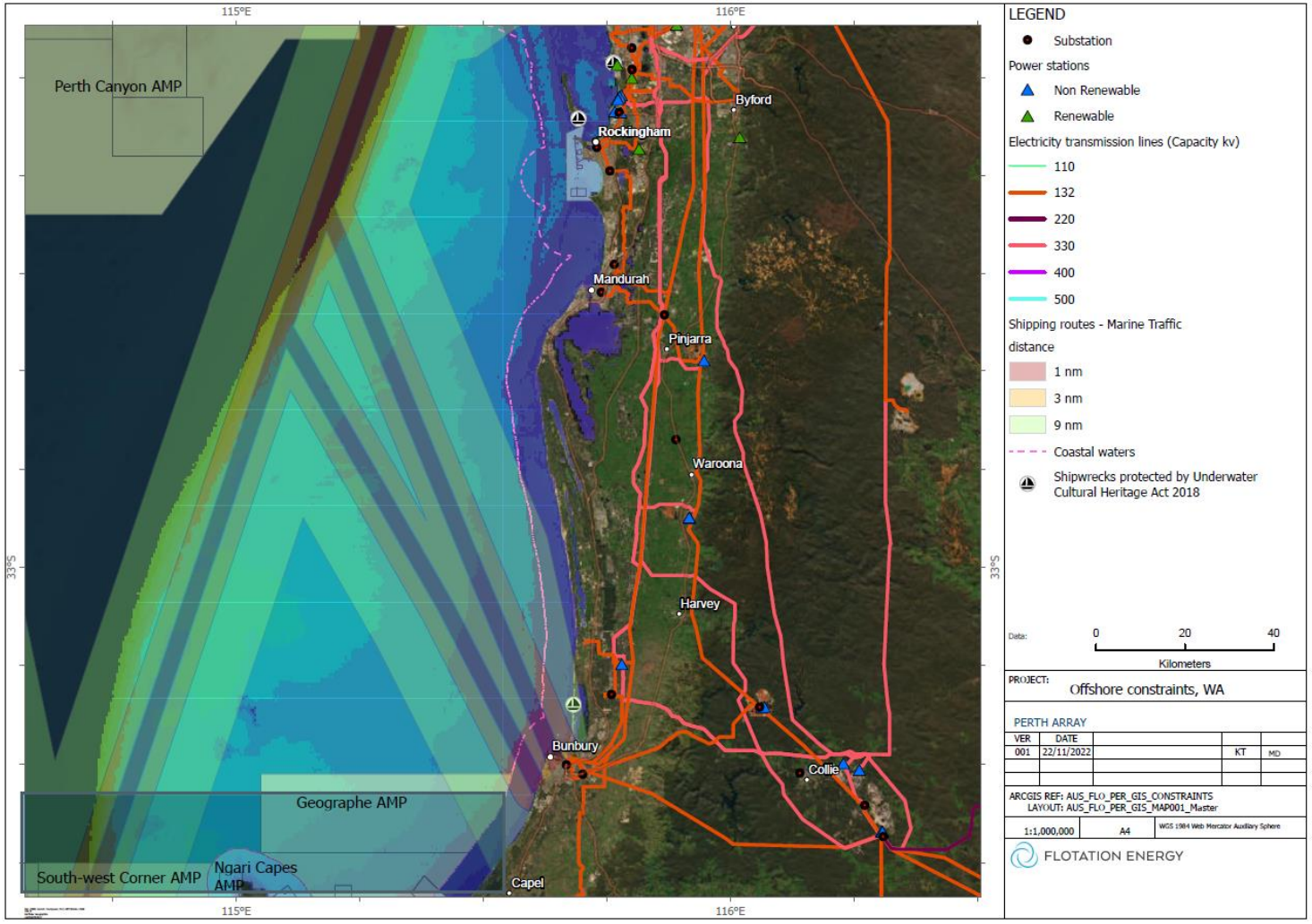
Number of market mechanisms in the WEM

- Balancing Market (BM). Dispatch Weighted Price (DWP) calculated from generation profile for the offshore wind farm.
- Reserve Capacity Mechanism (RCM) – Annual payments for providing capacity (MW) that can be used to meet peak load (plus a reserve margin and provision of ancillary services).
- Green certificates
- Essential System Services – this includes frequency regulation raise and lower, as well as contingency reserve raise and lower.
- Wrapped up revenue for Perth Array is higher than for Merredin onshore hub, establishing a strong business case



Perth Array Potential Offshore Wind Sites - Drivers and Constraints

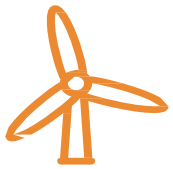
- 1.5GW bottom fixed offshore wind farm
- 8.5 m/s winds, water depth 35m –45m
- Development since early 2020, construction from 2029
- $7 billion CAPEX, power ~1 million homes
- Connection to 132kV/330kV network (Kwinana to Bunbury)
- Primary port infrastructure at AMC / Kwinana and Bunbury.



Offshore Wind Supply Chain Opportunities

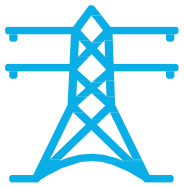
Development, Design & Surveys

- Development services
- Environmental surveys
- Coastal process surveys
- Metocean equipment
- Seabed / geo surveys
- Front-end engineering and design (FEED)
- Socio-economic studies



Turbine Supply

- Blades
- Major castings
- Gearboxes
- Generators
- Electrical control systems
- Nacelles
- Towers



Balance of Plant / Manufacturing

- Foundations (monopile, jacket, gravity, floating)
- Offshore electrical
- Onshore electrical
- Subsea cables

Installation & Commissioning

- Turbines
- Foundations
- Offshore electrical
- Onshore electrical
- Subsea cable
- Vessels and equipment supply
- Construction port(s)

Operations & Maintenance

- Remote monitoring
- Operations management
- Port services
- Maintenance and service

Economic Benefits for of Offshore Wind Projects in WA

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- Development of an Offshore Wind Industry in WA would bring vast potential benefits for economic activity and employment.
- ~~WA economy is highly dependent on jobs in the fossil fuel industry.~~ Skill sets in the fossil fuel industry transferable to Offshore Wind Industry.
- IRENA estimates approx. 20,000 job- years created over the life of Perth Array (1.5GW).
- Development of an offshore wind farm manufacturing, construction and operations sectors will utilise common infrastructure and services.
- Large scale offshore wind is an enabler for green hydrogen production and export industry.

Supply Chain	Manufacturing Multiplier	Development and Construction	Operations and Maintenance	Total
Employment Factor (job-years per MW)	10.5	2.16	0.21	
Offshore Wind Farm Capacity (MW)	Total Jobs-Years Created			
1500	15750	3240	315	19305

Thank You - Questions & Contacts

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