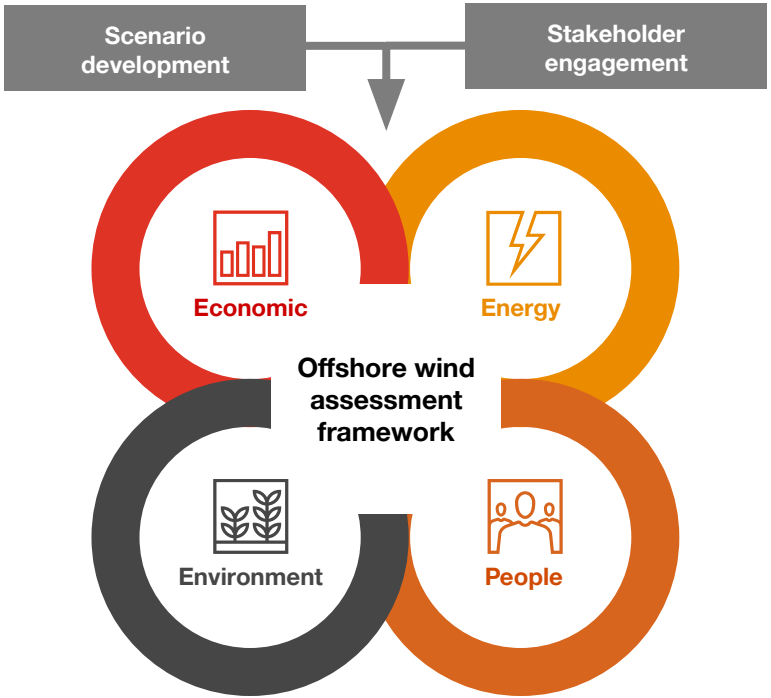
NATIONAL IMPACT STUDY:

New Zealand Offshore Wind Industry

BEC PRESENTATION | 11 APRIL 2024

Presented by Aaron Webb - Director - PwC Consulting

The National Impact Study considers the potential future role and impact of an offshore wind industry in New Zealand



1	**The future of New Zealand offshore wind:** Three scenarios for the development of the offshore wind sector
2	**Economic:** Estimate GDP and employment opportunities and impacts on other sectors
3	**Energy:** Explore the contribution offshore wind can make to decarbonisation, energy security and affordability
4	**People:** Consider potential implications for local communities and iwi-Māori
5	**Environmental:** Summarise environmental considerations and potential mitigations

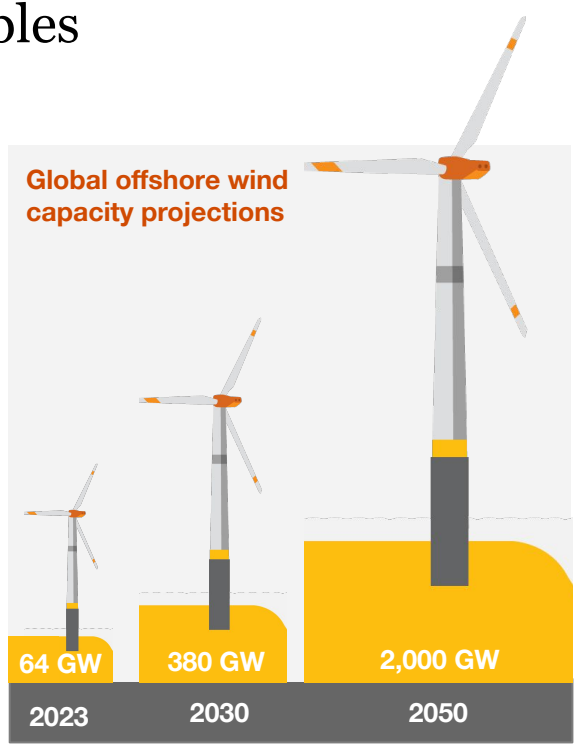
Project steering group members:

- BlueFloat Energy / Elemental Group
- Business NZ Energy Council (BEC)
- Clarus
- Parkwind
- Port Taranaki
- Powerco
- NZ Trade and Enterprise
- NZ Wind Energy Association
- Sumitomo Corporation
- Taranaki Offshore Partnership
- Te Puna Umanga Venture Taranaki
- Transpower

Concern is growing that the global energy transition is not moving fast enough and we need to scale and accelerate renewables

"To keep on track with net zero emissions by 2050 goals... [global] annual investment in clean energy will have to rise substantially from.... $US1.8 trillion to US$4.6 trillion in 2030" - PwC

- Developing our offshore resource will be strategically important in scaling and accelerating renewable energy:
  - **COP28 global commitment (2050)** **3x renewables**
  - **NZ Government target (2050)** **2x renewables**
  - **NZ energy forecasts (2050)** **1.8x - 3.7x renewables**
- Need to target both **renewable electrons** (eg electrification) and **renewable molecules** (eg hydrogen).
- **Hard to** abate **heavy transport fuels** are a critical challenge requiring hydrogen based PtL solutions

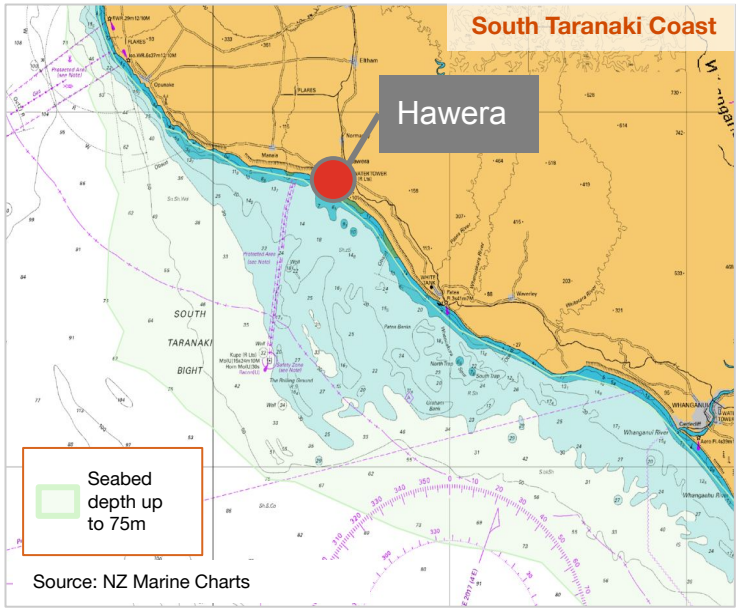


Source: GWEC 2023

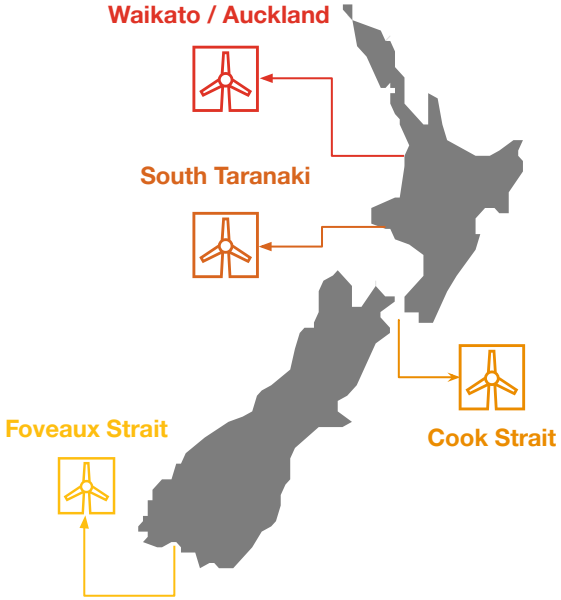
New Zealand has an excellent offshore wind resource that makes us an attractive investment destination

New Zealand offshore wind:

- 9th largest EEZ and coastline
- ‘Roaring forties’ latitudes with superb wind speeds
- Estimated generation capacity factors of 45%-55%
- Fixed pile can currently be built in coastal water depths of less than 75m
- Much greater potential for developing floating offshore, once commercialised



Source: NZ Marine Charts



To explore the future of the industry, three scenarios of offshore wind uptake were developed based on a synthesis of industry forecasts

Future demand

- New industrial load
- \+
- Green hydrogen
- \+
- Grid

How we built up these scenarios?

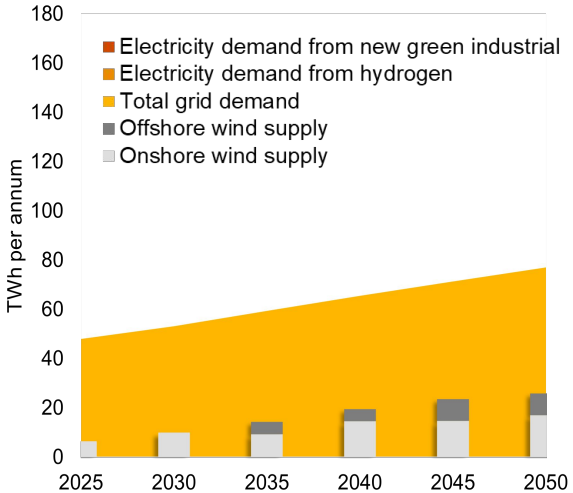
	Grid Electrification	Green Hydrogen	New Green Industry
Electrification	Average of recent industry scenarios	-	-
Electrification Plus		H2 Scenarios - Low	1x Tiwai eq.
Green Vision		H2 Scenarios - High	2x Tiwai eq.

We use existing energy industry scenarios and PwC analysis to build up a view of New Zealand electricity demand growth from:

- grid based electrification
- P2X / hydrogen production
- new green industry opportunities.

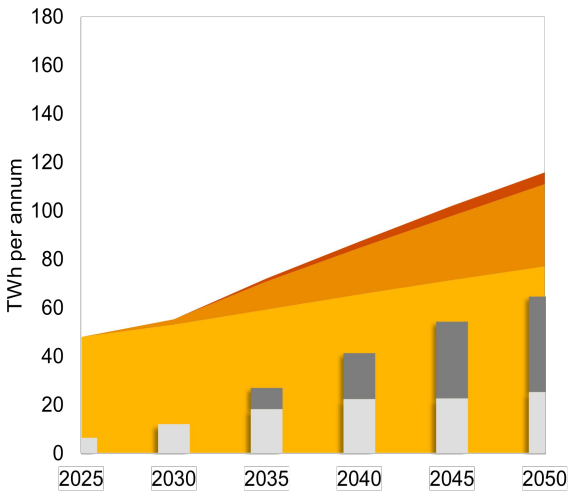
Between 8.8 TWhs and 74.4 TWhs of offshore wind generation is projected across these scenarios

1. Electrification - Forecast electricity demand (net) and wind supply



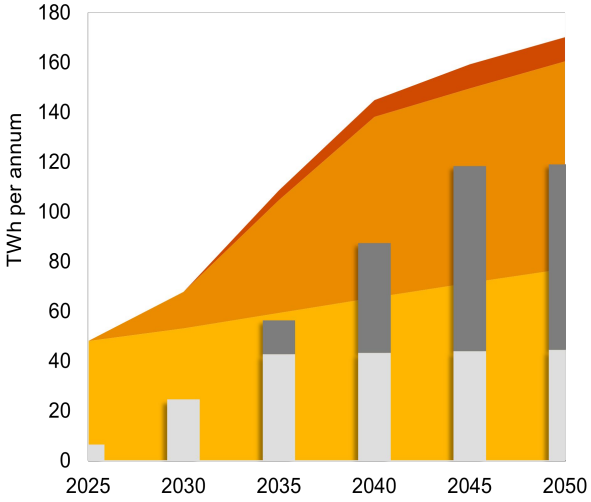
Annual Generation: 8.8 TWhs
Capacity: 2 GW

2. Electrification Plus - Forecast electricity demand (net) and wind supply



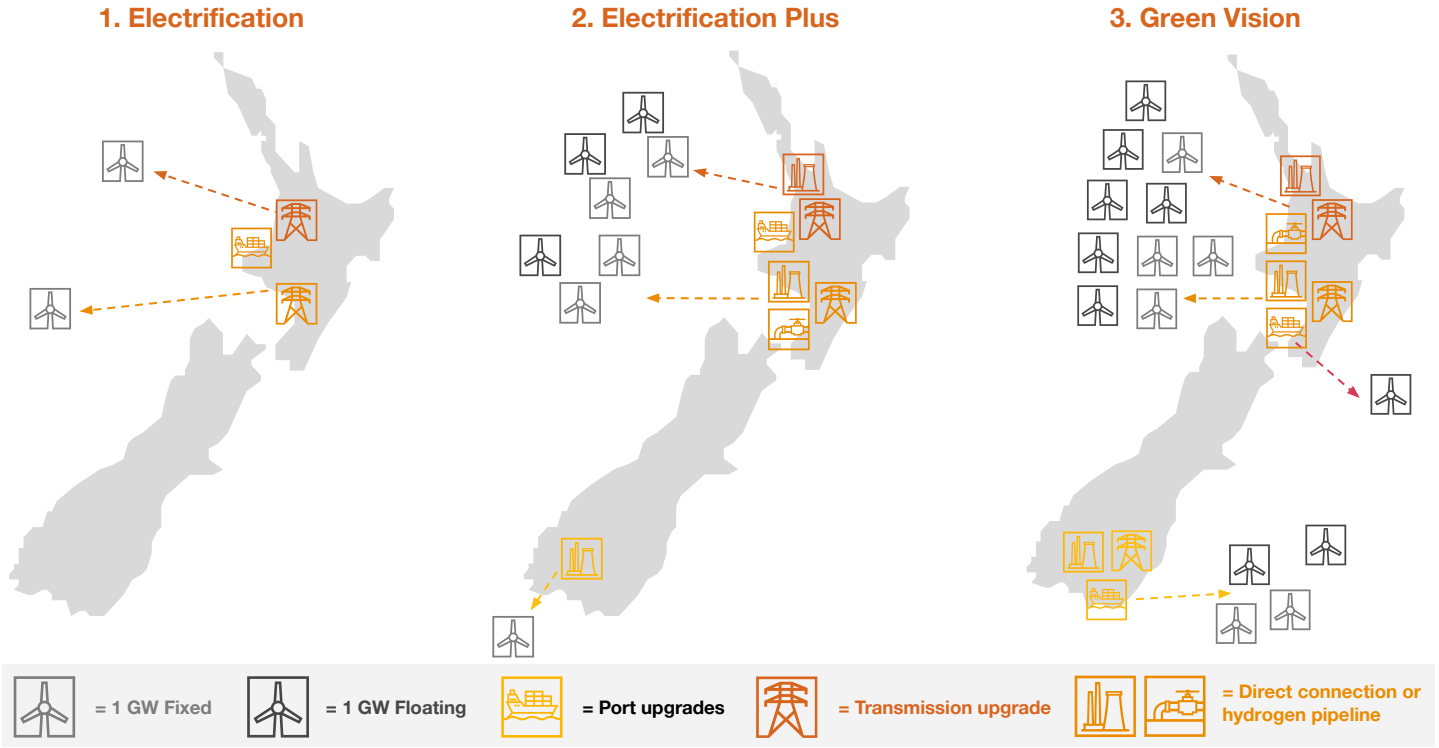
Annual Generation: 39.3 TWhs
Capacity: 8 GW

3. Green Vision - Forecast electricity demand (net) and wind supply



Annual Generation: 74.4 TWhs
Capacity: 15 GW

The study highlights the essential role of ports and energy infrastructure, which will need to lead OWF developments



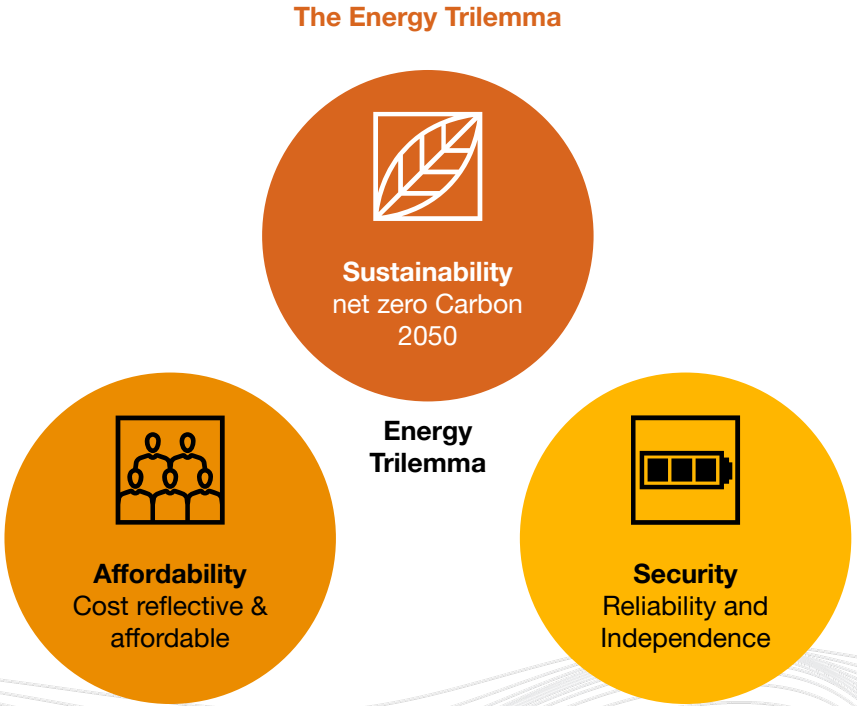
Multi-port strategy requiring upgrades to facilitate construction and operations of offshore wind. ~$320 to $720m of expenditure.

Transmission upgrades crucial to unlocking offshore wind. $120m - $160m for first two OWFs.

H2 pipeline infrastructure important to unlock higher levels of offshore wind out of Taranaki.

Offshore wind could make a significant contribution to New Zealand balancing its Energy Trilemma goals over the energy transition

- **Sustainability:** offshore wind could play a critical role in accelerating and scaling electrification and a domestic P2X and hydrogen economy
- **Affordability:** As with other renewable technologies, the cost of offshore wind is projected to fall rapidly with improvements in technology, global manufacturing scale and our understanding of the offshore resource.
- **Energy security and independence:** While an intermittent source of energy, offshore wind can support higher levels of energy security and sovereignty through diversity of supply and support for domestically produced renewable fuels.



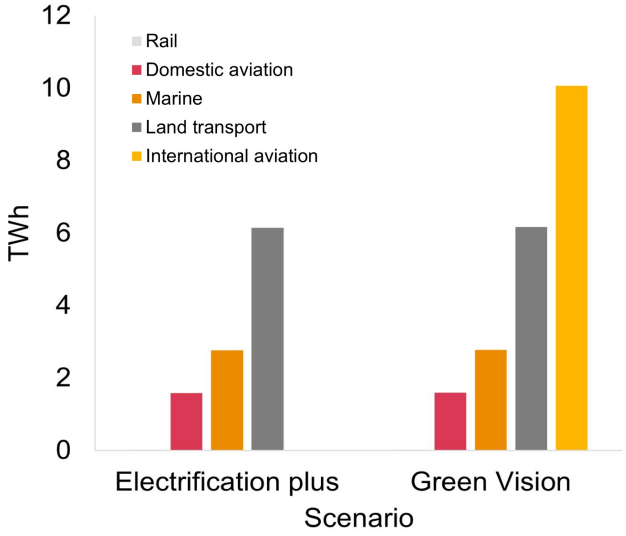
Beyond electrification, offshore wind could have a vital role in decarbonising hard to abate heavy transport fuels through PtL technology

SAF: hydrogen based e-SAF is being investigated for short and long haul flights. The EU recently mandated that 35% of jet fuels need to be e-SAF by 2050.

Marine: In 2023, the International Maritime Organisation (IMO) committed to net zero emissions in shipping by 2050 & 10% near zero emission fuels by 2030.

Freight: hydrogen fuel cells and hydrogen - diesel blends are already being piloted by New Zealand freight trucking companies.

Generation supply required for transport related hydrogen production

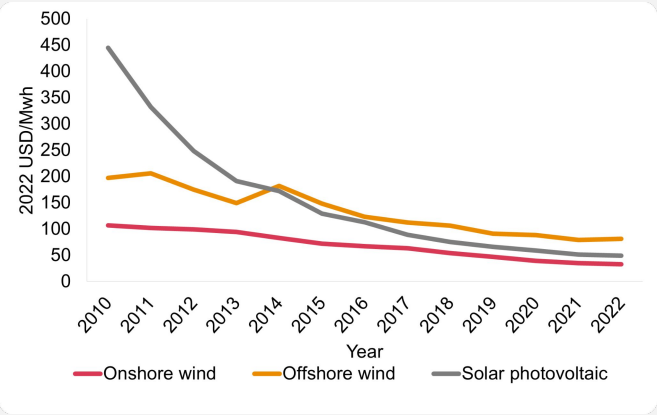


Source: PwC, EY/MBIE

The cost of offshore wind is projected to fall with improvements in technology, manufacturing scale, funding, and experience of the resource

Global cost of offshore wind dropped 60% between 2010 and 2022

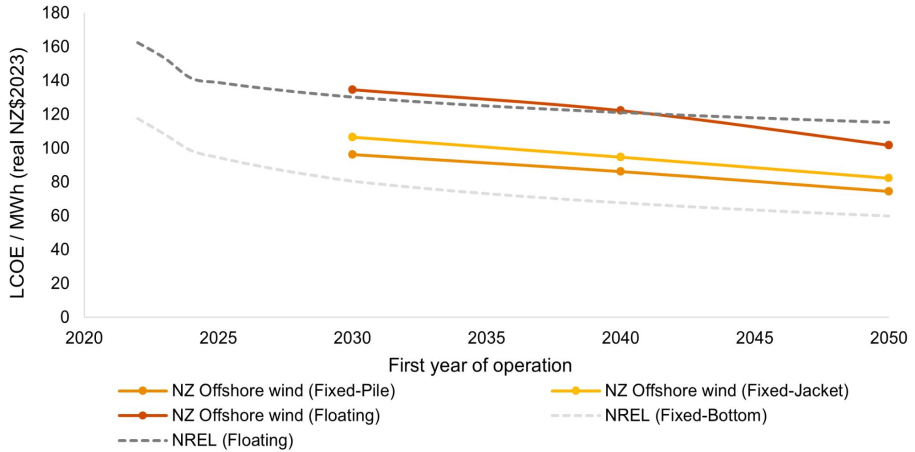
Generation - Levelised cost of energy (LCOE)



Source: Lazards

NZ offshore wind costs are projected to fall to about the current cost of onshore wind by 2050

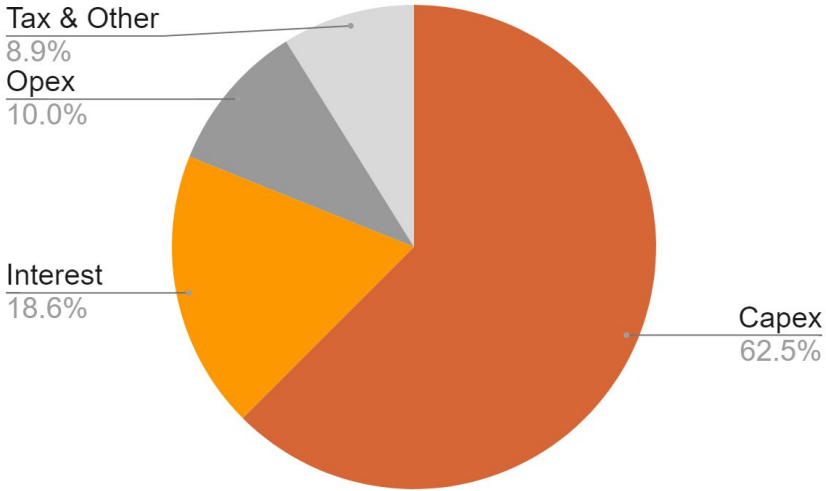
New Zealand offshore wind - Levelised cost of energy (LCOE)



Source: NREL, PwC

Capex and debt funding is critical to the future economics of offshore wind

Costs breakdown of typical offshore wind farm



Source: PwC

Revenue stabilisation mechanisms will reduce funding costs and the cost of offshore wind projects

Debt Service Coverage Ratio (DSCR)
le net operating income : debt servicing costs

1.3x	>1.7x
With hedges	Without hedges

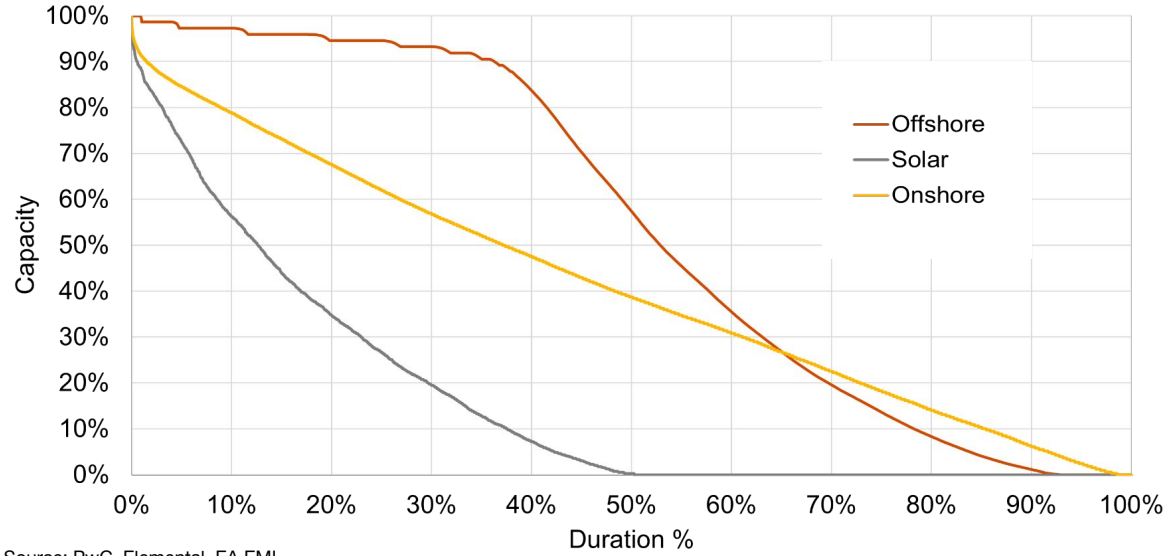
$7 - $11 per MWh

Reduction in offshore wind LCOE with hedges

While an intermittent source of energy, offshore wind can support higher levels of energy security

Offshore wind harnesses a more powerful ocean wind resource - generating more power, more often, more efficiently

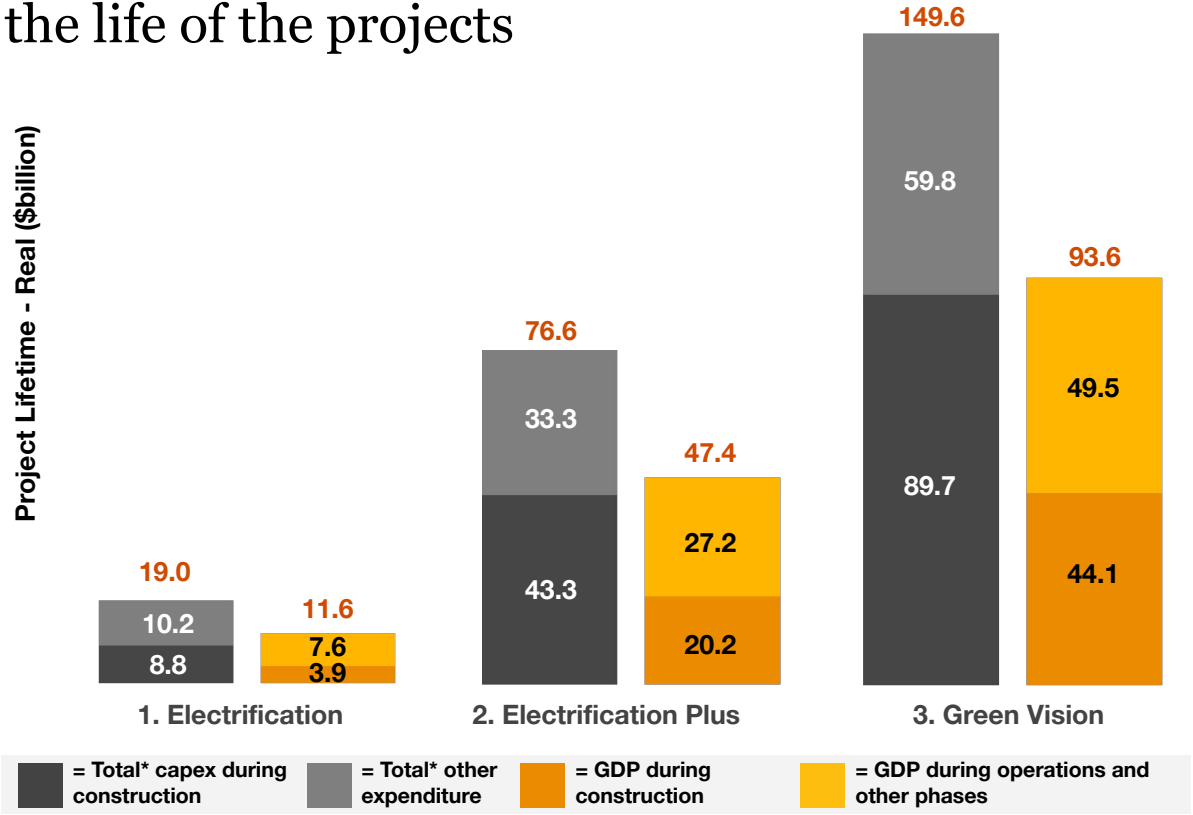
Capacity duration curve - wind and solar



Source: PwC, Elemental, EA EMI

- Higher capacity factors of 45%-55%
- Operates at >85% of capacity 40% of the time
- A diversified portfolio of offshore and onshore wind will support more consistent levels of renewables
- Offshore wind may support improved winter and dry year energy security as production peaks during winter when solar generation and hydro lake inflows are lowest.
- Can also support:
  - Batteries
  - Flexible hydrogen electrolyser production
  - new blended hydrogen and natural gas turbine peaker units.

An offshore wind sector is estimated to generate $12b to $94b GDP over the life of the projects



Offshore wind
2040 GDP real

NZ $0.5 billion to $4.3 billion

NZ Oil and gas sector
2023 GDP

NZ $3.6 billion

Future NZ hydrogen sector
2040 GDP real

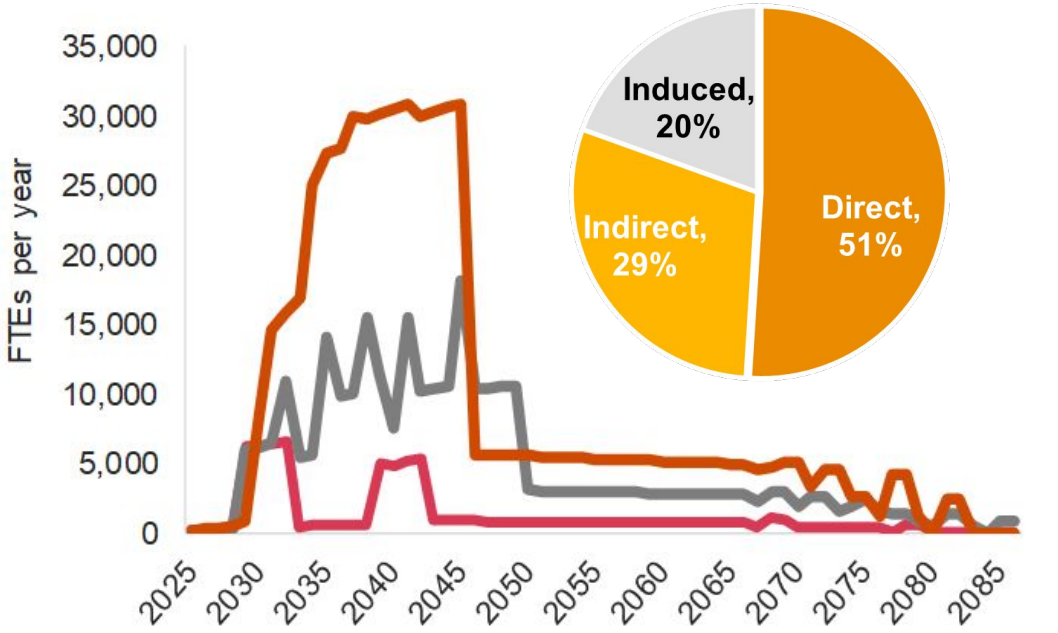
NZ $1.7 billion to $4.8 billion

An offshore wind sector is estimated to create between 5,300 and 30,000 domestic jobs over the peak of the construction phase

Key observations:

- A mix of general and highly skilled jobs are required in each phase
- Significant flow on job creation with half of jobs being indirect and induced roles
- Workforce synergies can be leveraged from the Taranaki based offshore oil and gas sector
- The offshore wind industry will create a ripple effect impacting many other sectors, from maritime activities to retail and education.

Total employment contribution of the sector
Under the three scenarios



Community impacts

1. **Labour and economic:** OWFs will support 5,000 to 30,000 jobs and significant commercial activity creating new opportunities and strengthening sectors affected by the energy transition.

2. **Community:** OWFs can be divisive. Views range from pride in sustainability, jobs and economic opportunities through to concern over natural and observational effects. Small communities are often most affected.

3. **Construction:** While construction may create localised and temporary impacts, these are lower for OWFs as marshalling and construction occurs at the port or out at sea.

4. **Observational:** A key potential benefit of OWFs is they are typically located at large distances from communities, reducing visual and noise impacts. Placement and community engagement is important.

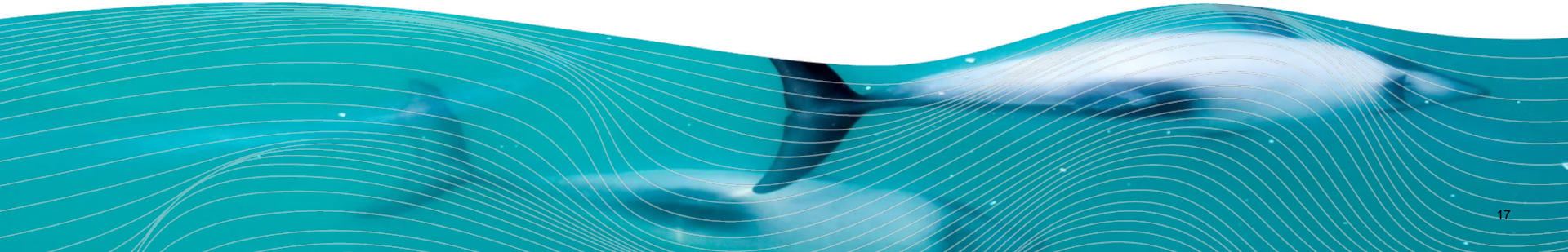
5. **Recreational** impacts are expected to be minor (eg perceived changes in surf) with potential benefits for tourism and recreational fishing

Developers are working together with Iwi-Māori to explore roles and mutual opportunities in offshore wind together

- **Iwi-Māori interests in offshore wind concern:**
  - use of the sea and land in customary iwi-hapū homelands (Mana Moana)
  - impacts on existing rights (eg fisheries and aquaculture)
  - Economic, educational and social development opportunities for Māori in offshore wind and supporting activities
  - traditional roles as ‘kaitiaki o te moana’ (guardians of the sea).
- Dialogue between iwi-Māori and the Crown on the regulatory roles and economic opportunities in offshore wind will allow for both Treaty partners to make decisions on what is in the best interests of all New Zealanders.

Rapid decarbonisation will require trade offs to be made, but work to mitigate and reduce negative environmental effects remains important

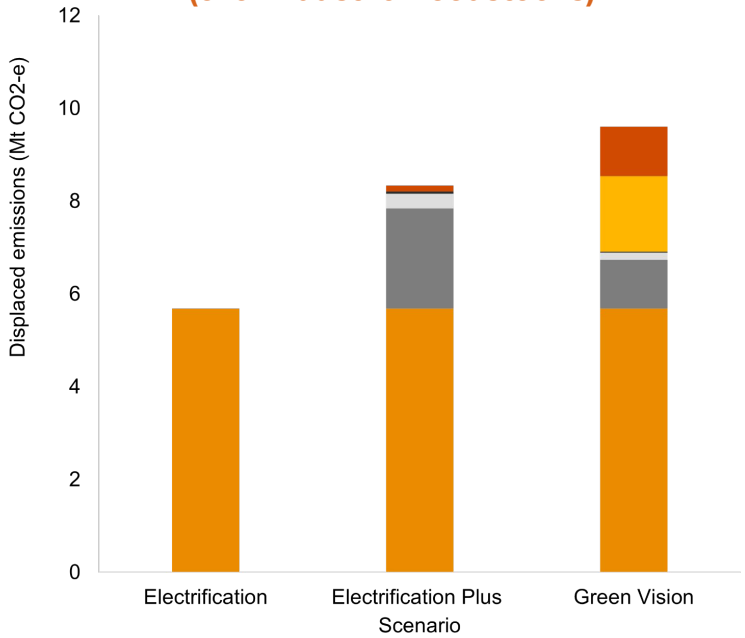
- **New Zealand need to significantly scale renewable energy** in order to meet decarbonisation commitments
- Any **human activity will impact on the natural environment,** but the **impact from climate change may be bigger**
- It will be critical in our energy transition to **find solutions that have the lowest environmental impact and highest decarbonisation potential**
- **OWFs are potentially a good solution,** they offer abundant renewable energy and have the lowest emissions intensity with relatively lower impacts on flora and fauna
- Key to maximising the OWF opportunity is **prudent location choice** and **research into how the natural environment will be affected**, which the regulatory regime can facilitate.



Of all the renewable energy solutions, offshore wind power has the lowest overall life cycle carbon footprint

- Advantages for offshore wind are its:
  - **Ability to scale renewables**
  - **Lowest emissions intensity**
  - **Minimal footprint**
  - **Lower opportunity cost** of the space it uses.
- Offshore wind has a **short carbon payback period** of only 5-12 months, which is negligible given the general operation lifetime of 30 years
- We estimate that offshore wind could enable an **18% to 30% reduction in national energy related emissions (excluding industrial feedstocks)**.

2050 annual emissions reduction from offshore wind (excl industrial feedstocks)



Question & Answers

Image: Descending from Wind Turbine, Northwester 2, Belgian North Sea, Courtesy of Parkwind

Disclaimer

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We have not independently verified the accuracy of information provided to us, and have not conducted any form of audit in respect of this information on which we have relied. Accordingly, we express no opinion on the reliability, accuracy or completeness of the information provided to us, and upon which we have relied.

Our engagement did not constitute a statutory audit (the objective of which is the expression of an opinion on financial statements) or an examination (the objective of which is the expression of an opinion on management's assertions).

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Thank you