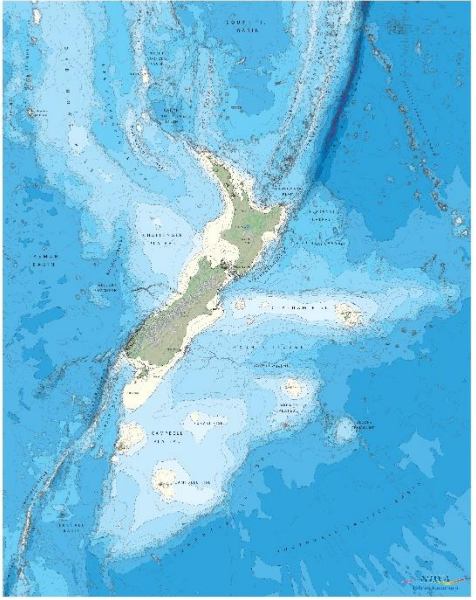

Developing Offshore Wind In New Zealand

Technical, socio-economic and environmental issues in relation to a post-pandemic future

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Overview

- Post-Covid-19 opportunities
- Society’s Cost of Energy
- Energy needs, wind resources, environmental issues
- Offshore Wind advantages, engineering issues
- Local content & employment
- Financing options
- Post-Covid-19 Development Strategy

Post-Covid-19 Opportunities

- “Build Back Better from Covid-19” (Jacinda Ardern);
- “Just Transition”; local resilience, energy security & community well-being
- The NZ Covid-19 response => model for climate change mitigation
- Reduced vulnerability to a globalised economy
- NZ has advantage of strong response to Covid-19; likely to come across as a safe business space, e.g. as for the movie industry

Societal costs of energy

SCOE - Society's Costs of Energy

- Macro-economic focus
- Benefits and damages internalised
- Long-term, inter-generational view
- Jacobson et al., 2015: conventional LCOE 10.6 c/kWh; SCOE 27.6 c/kWh

LCOE - Levelised Cost of Energy

- Micro-economic focus
- Benefits and damages externalised
- Short-term, individualised view

"An economy should be designed to thrive, not grow" - Kate Raworth


SCOE Analysis Germany
Projection for 2025

SCOE: Society's costs of electricity [EUR/MWh]
Projection for Germany in 2025 - custom Scenario

Legend LCOE Split: CAPEX OPEX Fuel CO2

	Nuclear	Coal	Gas	Photovoltaics	Wind On	Wind Off
LCOE w/o CO2	79,2	80,3	67,3	100,2	55,4	95,0
- thereof CO2	0,0	23,4	10,4	0,0	0,0	0,0
Cost subsidies	47,4	0,0	0,4	0,0	0,0	0,0
Transmission	0,0	0,0	0,0	10,8	3,2	2,8
Variability	1,0	0,5	0,0	15,4	14,5	13,6
LCOE + system costs	**127,6**	**80,8**	**67,8**	**126,4**	**73,1**	**111,4**
Social impact	0,1	0,1	0,1	0,0	4,0	0,0
Employment effects	-34,1	-6,2	0,0	-49,3	-19,4	-49,0
Geopolitical impact	0,3	2,5	5,9	0,0	0,0	0,0
SCOE	**93,8**	**77,2**	**73,8**	**77,1**	**57,8**	**62,3**

Future LCOEs expected to decline

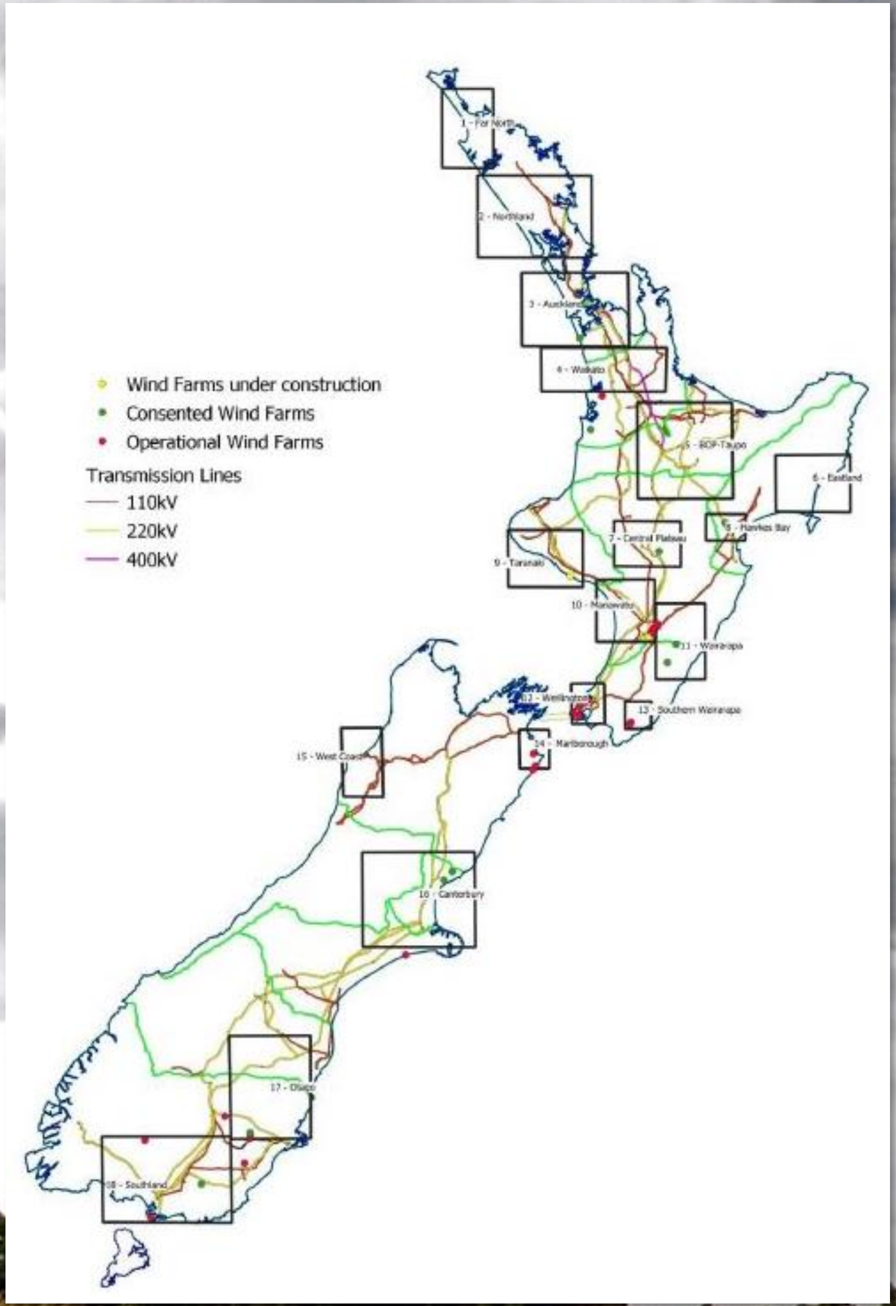
Future energy requirement (Mason, Gates, Chua & Miller, 2017; Transpower, 2018)

Electrification of
Stationary energy &
transport (incl. T&D)
41,580 GWh/y
+ Hydrogen?

2050 projection:

- 90,000 GWh/y
- +50,000 GWh/y

More than 2x present electricity production



Wind Resources

(Roaring 40s/MBIE, 2020)

- **Onshore projection** (78 sites):
  10,800 MW, 36,900-41,900 GWh/y; 120 m

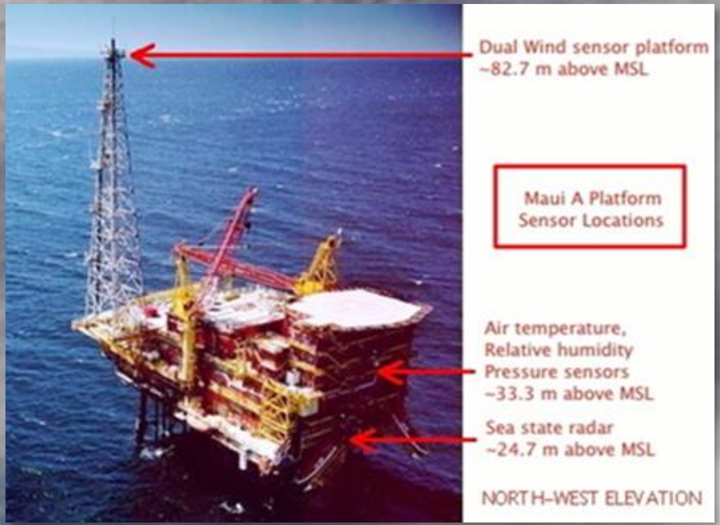
- **Offshore projection** (3 sites):
  8000 MW, 28,300-32,100 GWh/y; 120 m

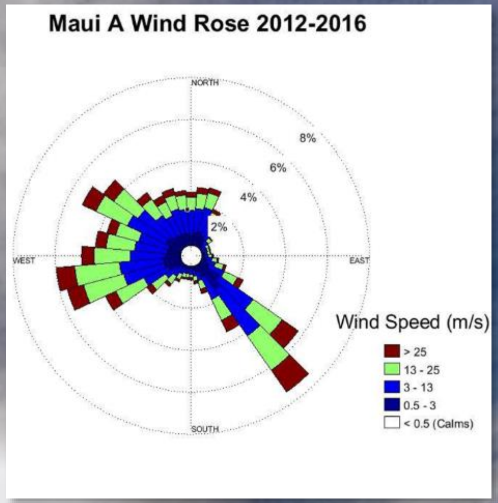
- **Offshore Taranaki projection**:
  2000 MW, 7703-8730 GWh/y; 120 m

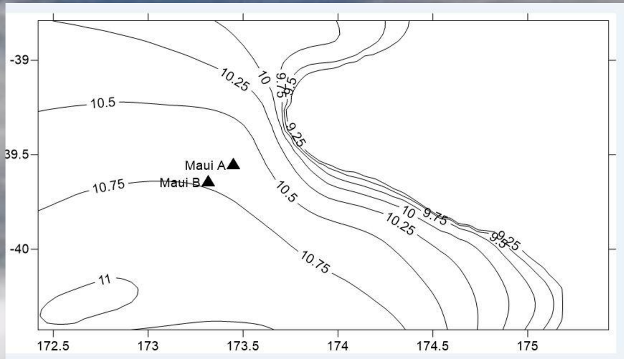
South Taranaki potential

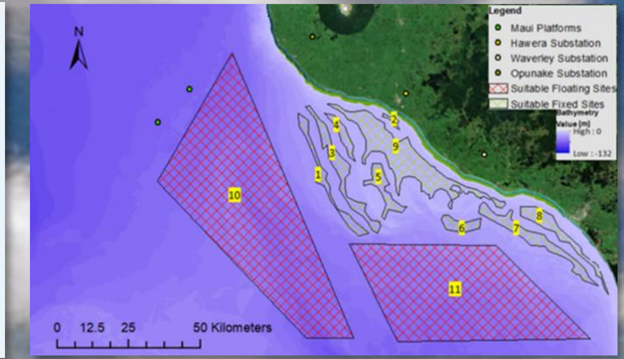
(Ishwar & Mason, 2019; Wind Map - Thorp, 2020)

- Mean wind speed: 10.1 to 10.7 m/s at 105 m => 10.3 to 10.9 m/s at 120 m
- Fixed: 7016 MW, 28,460 GWh/y, 877 turbines; 1065 km^2; Floating: 4680 km^2
- Electrical, financial, social, & environmental issues…









Visual Impact

Offshore Wind Farm

Climate change

Environmental impacts

- Marine life; vibration/noise
- Sediments/water quality
- Birds & bats
- Coasts; tidal currents, wave heights, surfing
- Decommissioning
- Enhanced marine life => recreational diving; enhanced fishing

Advantages

- Generation easier to predict
- **Greater wind speeds/reliability**
- Less wind shear/turbulence
- High capacity factors: 40%-60%
- “No” limits on turbine capacity
- **“Easier” to transport components**
- Can be ‘Out of sight, out of mind’ – both turbines & transmission
- **Large infrastructure projects, creating growth and innovation**
- High local content potential
- Low SCOE

Disadvantages

- Weather impacts on construction & maintenance
- **Specialised vessels needed**
- International supply chain required (NZ too small to go it alone)
- Visual impact < 54 km
- **Higher LCOE**

Design background

Foundations - Monopiles

- Length: 40-90m
- Diameter: 4-8m
- Thickness: 30-120mm
- Weight: 200-1300t

- **Simple structure**
- Easy to install
- **Low natural frequency**
- Sensitive to soil conditions
- Cheap
- 3-10 MW turbines
- 10-45m water depth

Foundations - Jackets

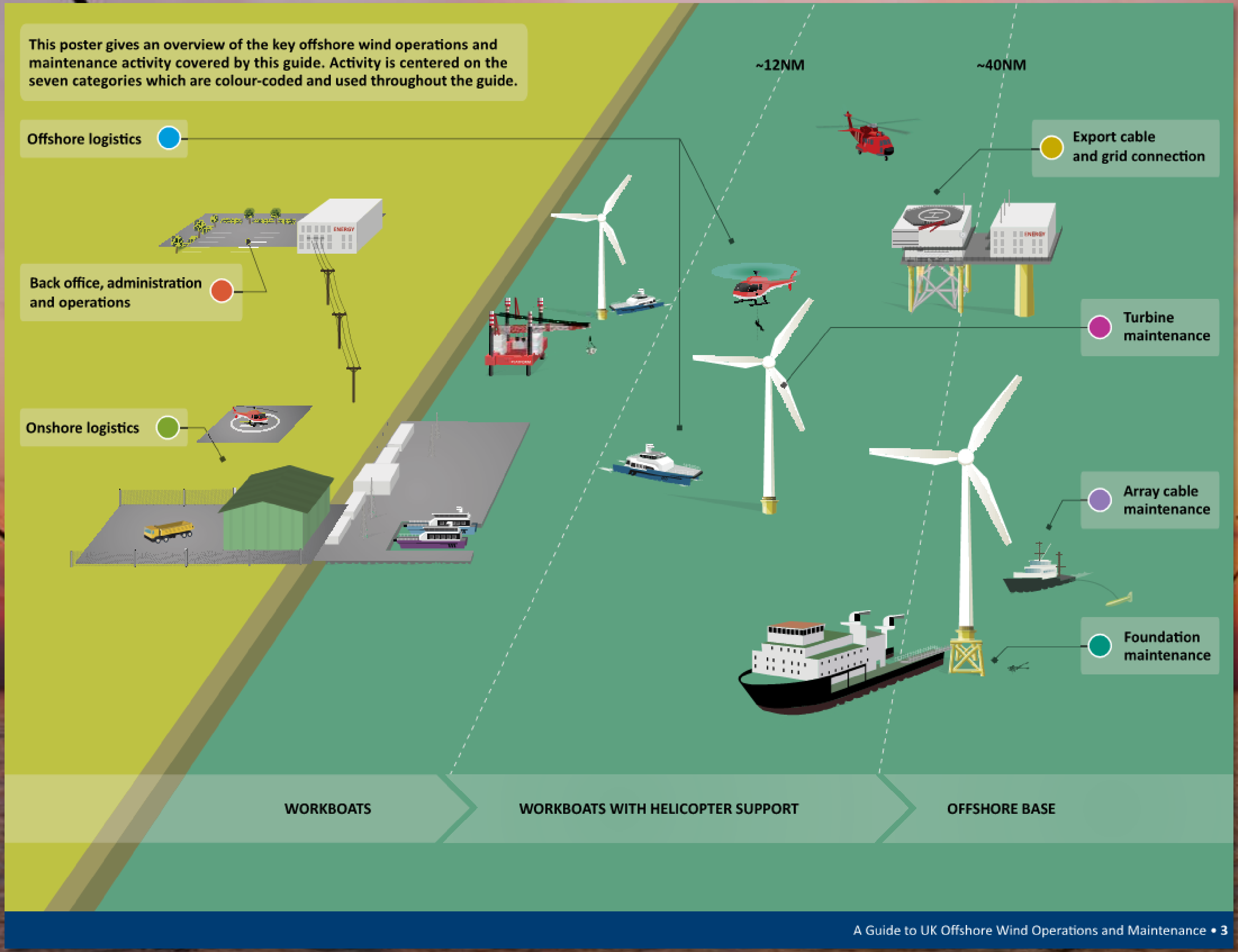
- **Stiffer than monopile**
- Efficient load transfer
- Can accommodate various turbine sizes
- Complex dynamic interactions
- Expensive to fabricate


Floating offshore wind

Offshore substation

- Transmit electricity to shore
- Generally unmanned, remote controlled from land
- Stabilize and maximise voltage of power generated offshore
- Reduce electrical losses
- Maximise return on investment
- Provide emergency offshore refuge

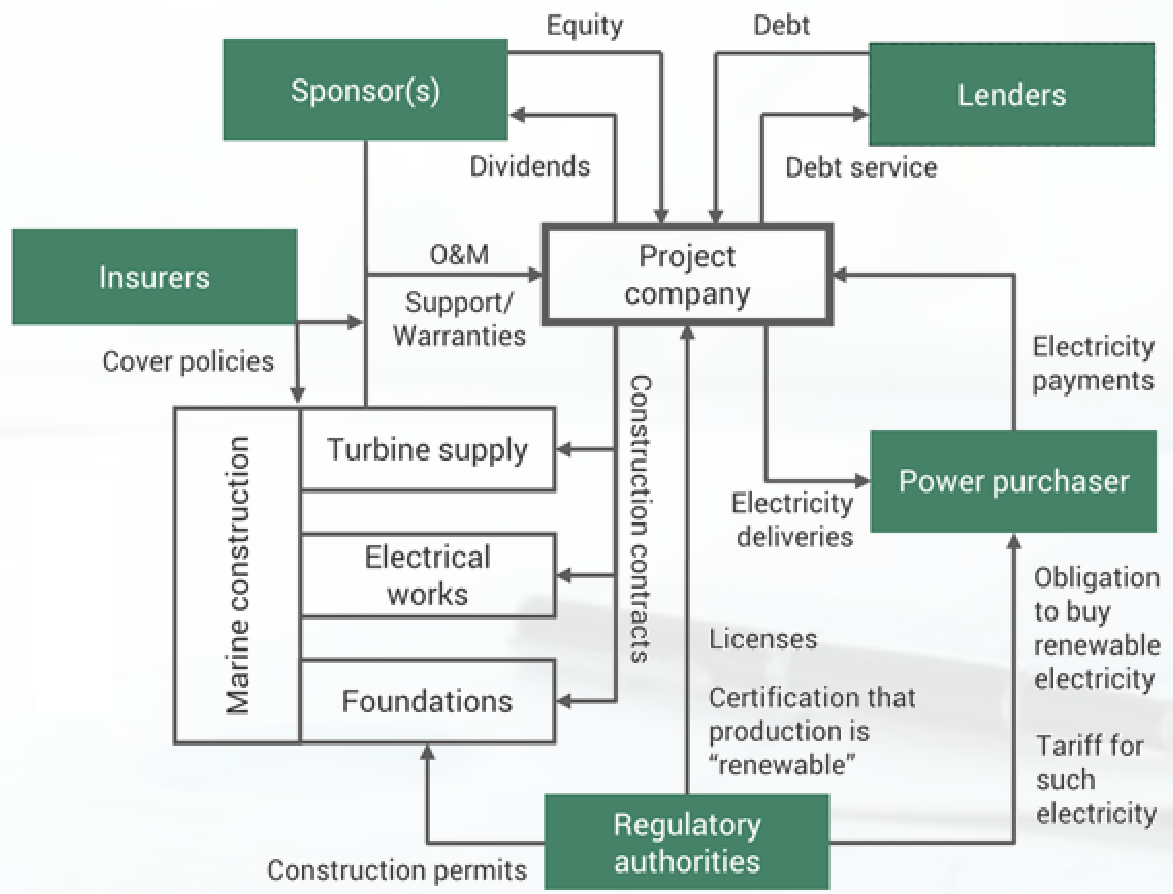
Local content opportunity – O&M



Operations & Maintenance Supply Chain

- **<u>Onshore logistics</u>**
- **<u>Workboats</u>**
- **<u>Aviation</u>**
- **<u>Crane barge services</u>**
- Offshore accommodation
- Turbine maintenance
- Turbine spare parts
- **<u>Offshore substation maintenance</u>**
- **<u>Export cable surveys and repairs</u>**
- **<u>Onshore electrical</u>**
- **<u>Array cable surveys and repairs</u>**
- Scour and structural surveys
- Foundation repairs
- **<u>Lifting, climbing and safety equipment</u>**
- **<u>SCADA and condition monitoring</u>**
- **<u>SAP and marine coordination</u>**
- **<u>Weather forecasting</u>**
- **<u>Administration</u>**

Project Finance



- Network of Contracts
- Risk Management
- Financial resilience

NZ OWWG

New Zealand Offshore Wind Working Group

Working Group

<u>NZ Offshore Wind Working Group</u>

- Professional engineers, energy industry personnel, planners, academics…
- Networking, conversation, sharing ideas, information, data, experiences
- Slack site: Offshore Wind & H_2; 35 international & national participants
- Links with Oceanex

Star of the South

- First Australian OWF

Roadmap for development

- Long-term plan; considerable onshore wind likely in short term
- Consultations – developers, banks, central government, supply chain participants, local manufacturers, local communities
- Legal & consenting procedures & timelines
- Local content requirements e.g. 30-70%
- Identify & target specific industries e.g. hydrogen, ammonia (shipping)
- SCOE analysis for Taranaki (not everything can be assigned $$ value)
- Establish a wellbeing framework – an inter-generational view in the context of climate change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