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Offshore wind goes floating

How this evolution might be a revolution

Quentin BCHINI, Maylis CASTELEYN, Stephane HIS

Webinar – March 14th, 2023

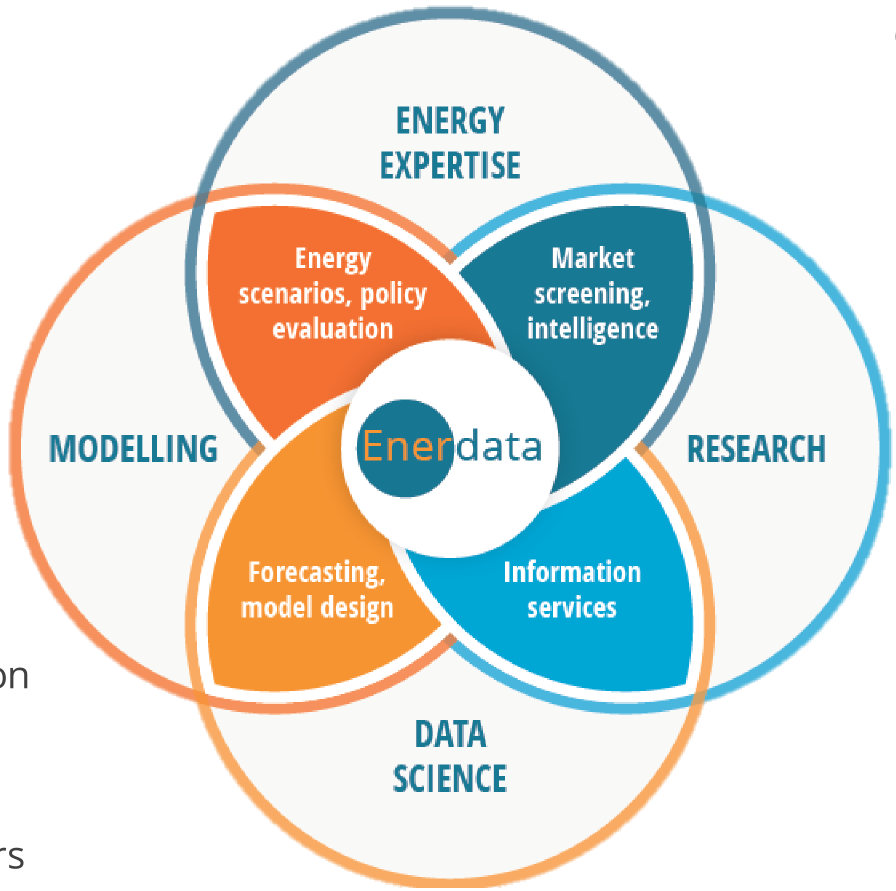
Our services – Combining fields of expertise from research, data science to modelling

Modelling

- Creation of E-C scenarios, climate alignment trajectories
- Identification of alignment pathways by sector and by country

Expert in energy / climate

- Knowledge of market drivers
- Expertise covering all energy transition pillars: mix decarbonisation, energy efficiency, sufficiency, and flexibility (assets and markets)
- Deep coverage: all energies, all sectors and 150+ countries



Market intelligence

- Market Research
- Business intelligence
- Energy market watch
- Tracking of E-C policies worldwide

Data science

- Gathering, consolidating and analysing energy data
- Market forecasts: supply, demand and prices

A wide portfolio of services & products

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- Market reports
- Long-term forecasts
- Market watch

CUSTOM SERVICES

- Tailor-made research platform
- Tailor-made forecasting models

CONSULTING

- Market studies & diagnostics
- Strategic analysis
- Due Diligences
- Tailor-made forecasts
- Regulatory studies
- Feasibility studies

TRAINING

- Energy prices
- Energy statistics
- Modelling
- Energy Efficiency
- Climate change

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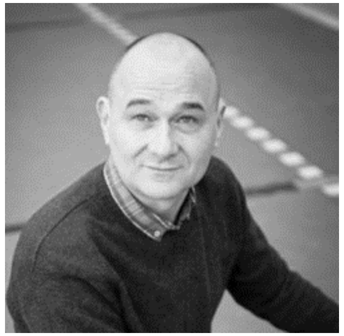
Speakers

Quentin BCHINI
Project Manager
Innovation Department
Enerdata

Maylis CASTELEYN
Energy Market Analyst
Innovation Department
Enerdata



Stéphane HIS
Senior Energy & Climate expert

Consultant

Agenda

- The role of renewables in long-term energy scenarios
- The (r)evolution of floating offshore wind
- Global technical potential of floating wind
- Q&A

The role of renewables in long-term energy scenarios

Scenarios point to a significant switch towards renewables globally

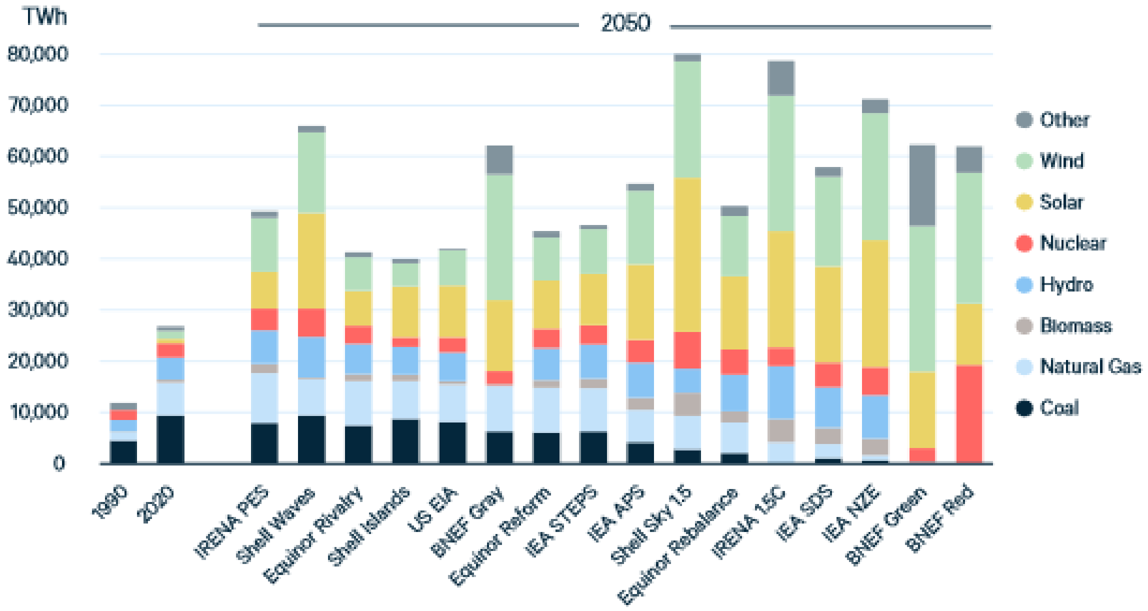
A consensus on renewable electricity in long-term energy scenarios

- Long-term energy scenarios (up to 2050 or 2100) are projections relying on a set of highly uncertain assumptions

- While scenarios may widely differ in their assumptions and results, there is a large consensus on renewables taking over as the main source of electricity globally by 2050

- Renewable electricity generation is expected to increase by up to eight-fold by 2050 in the more ambitious deep-decarbonization pathways (e.g. WEO-NZE)

Global electricity mix in a selection of long-term energy scenarios



Source: Resources for the Future, Global Energy Outlook 2022: Turning Points and Tension in the Energy Transition. April 2022.

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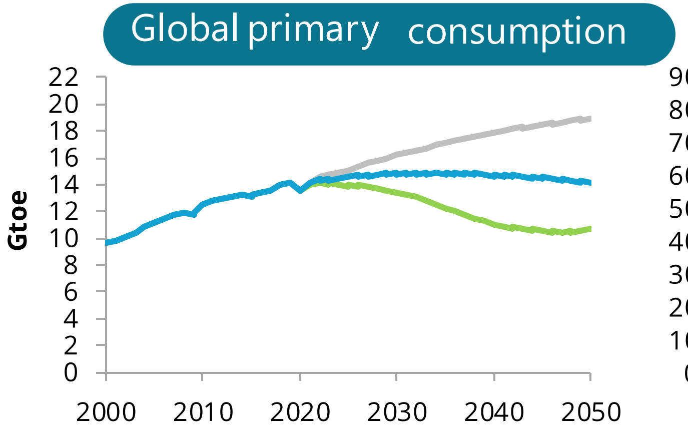
EnerFuture scenarios

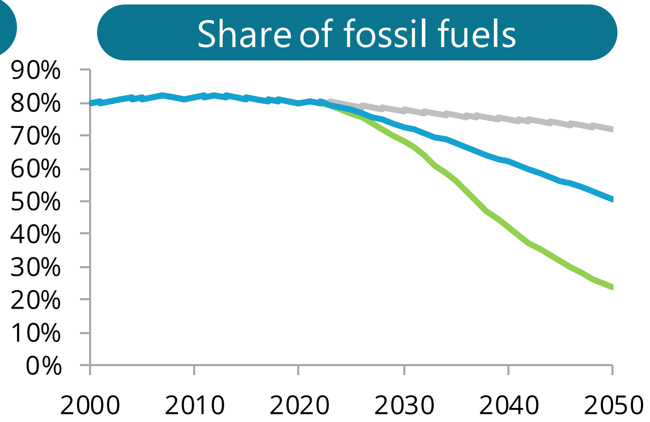
EnerBase: existing measures, extrapolation of historic trends

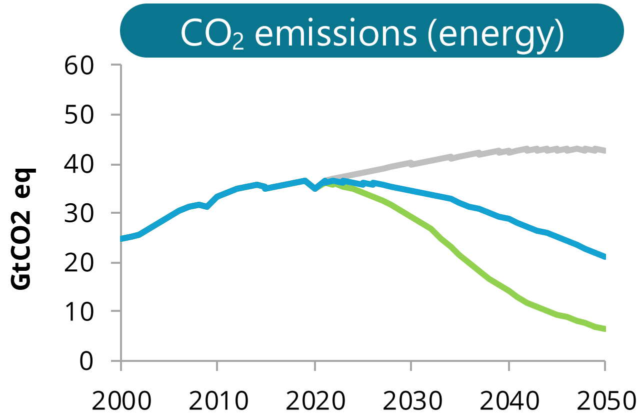
EnerBlue: additional realistic measures, aligning with NDC (Nationally Determined Contributions) emission targets

EnerGreen: scenario compatible with a temperature increase below 2°C

Average evolution (%/a)	1990 - 2020	*2010 - 2020*	2020-2050			
			+5-6°C	+3-4°C	+2°C	
Carbon intensity	-1.5%	*-2.1%*	-1.9%	-3.0%	-7.3%	*CO_2 emissions released to produce one unit GDP*
Energy intensity of GDP (final)	-1.4%	*-1.7%*	-1.6%	-2.1%	-3.7%	*Energy consumption necessary to produce one unit of GDP*
Carbon factor	-0.1%	*-0.4%*	-0.3%	-0.9%	-3.7%	*CO_2 emissions released for an average unit of energy consumption*



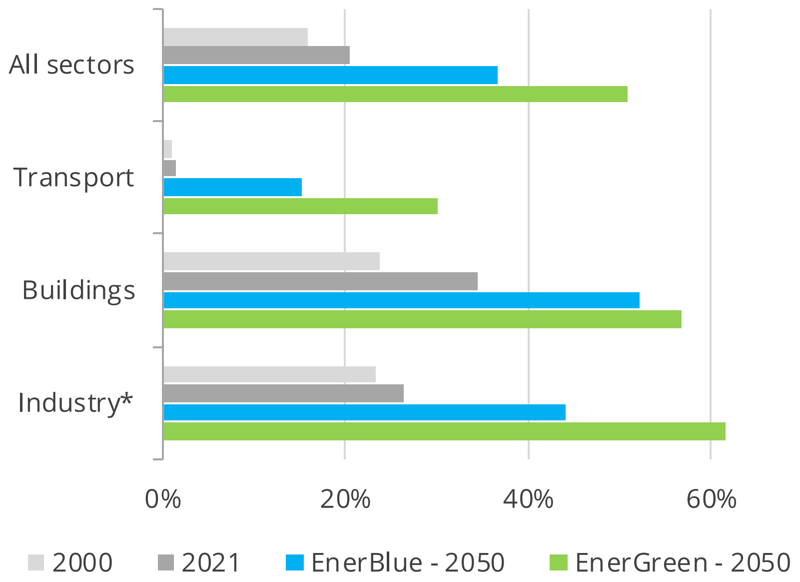




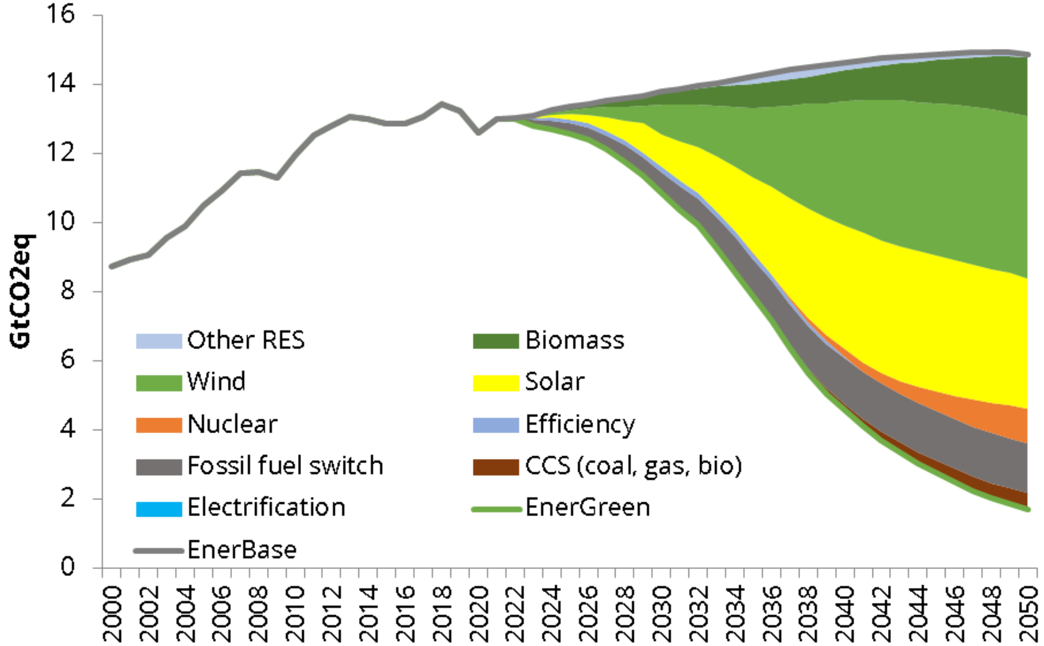
Electrifying energy uses while decarbonizing electricity

- Electrification is essential to reach ambitious climate targets
- **High potential for decarbonization and often leading to significant energy efficiency improvements**

Share of electricity by sector (World Average)



Total abatement between EnerBase and EnerGreen, split by technology or driver



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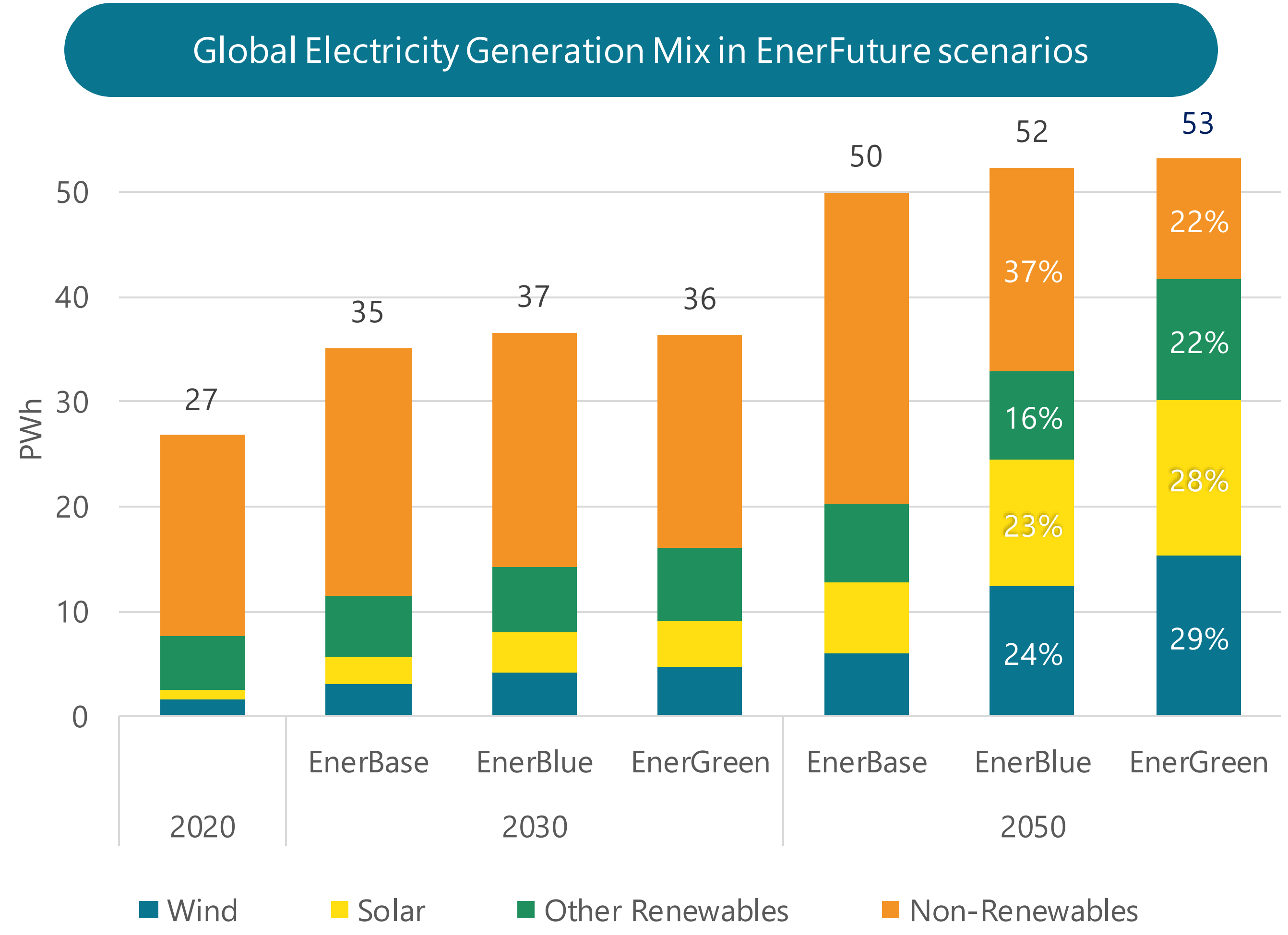
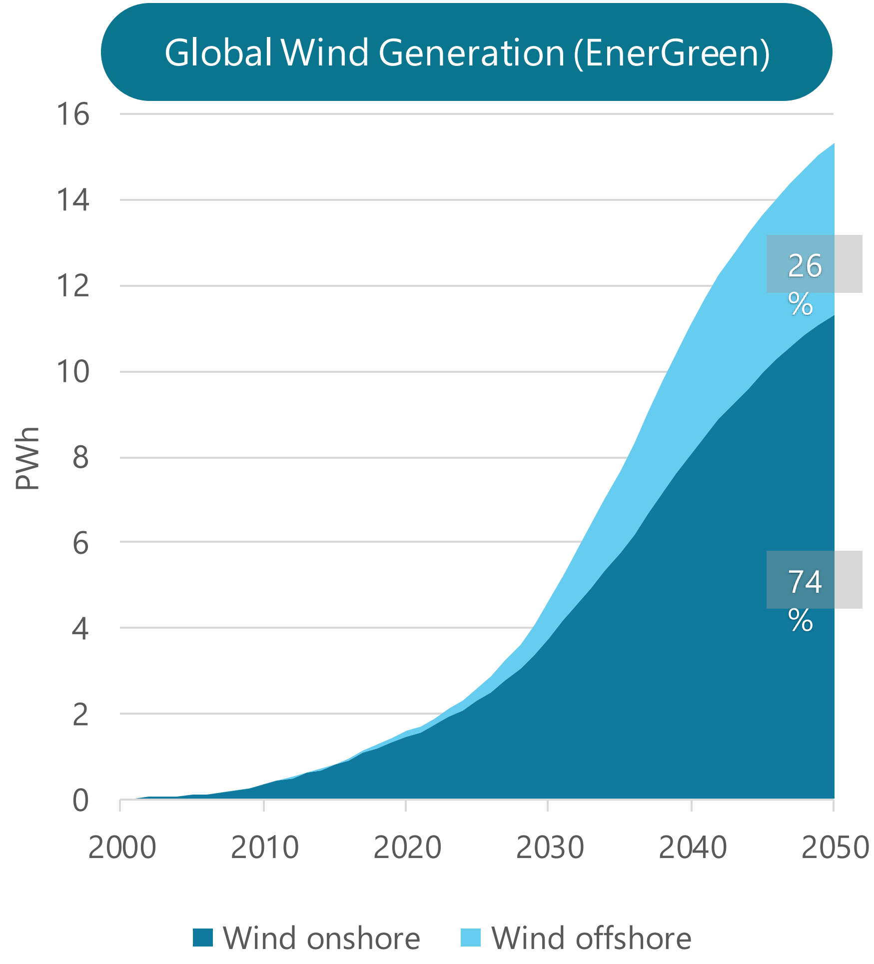
Renewables become the main source of electricity in ambitious climate mitigation scenarios



Source : Enerdata, Enerfuture



Source : Enerdata, Enerfuture

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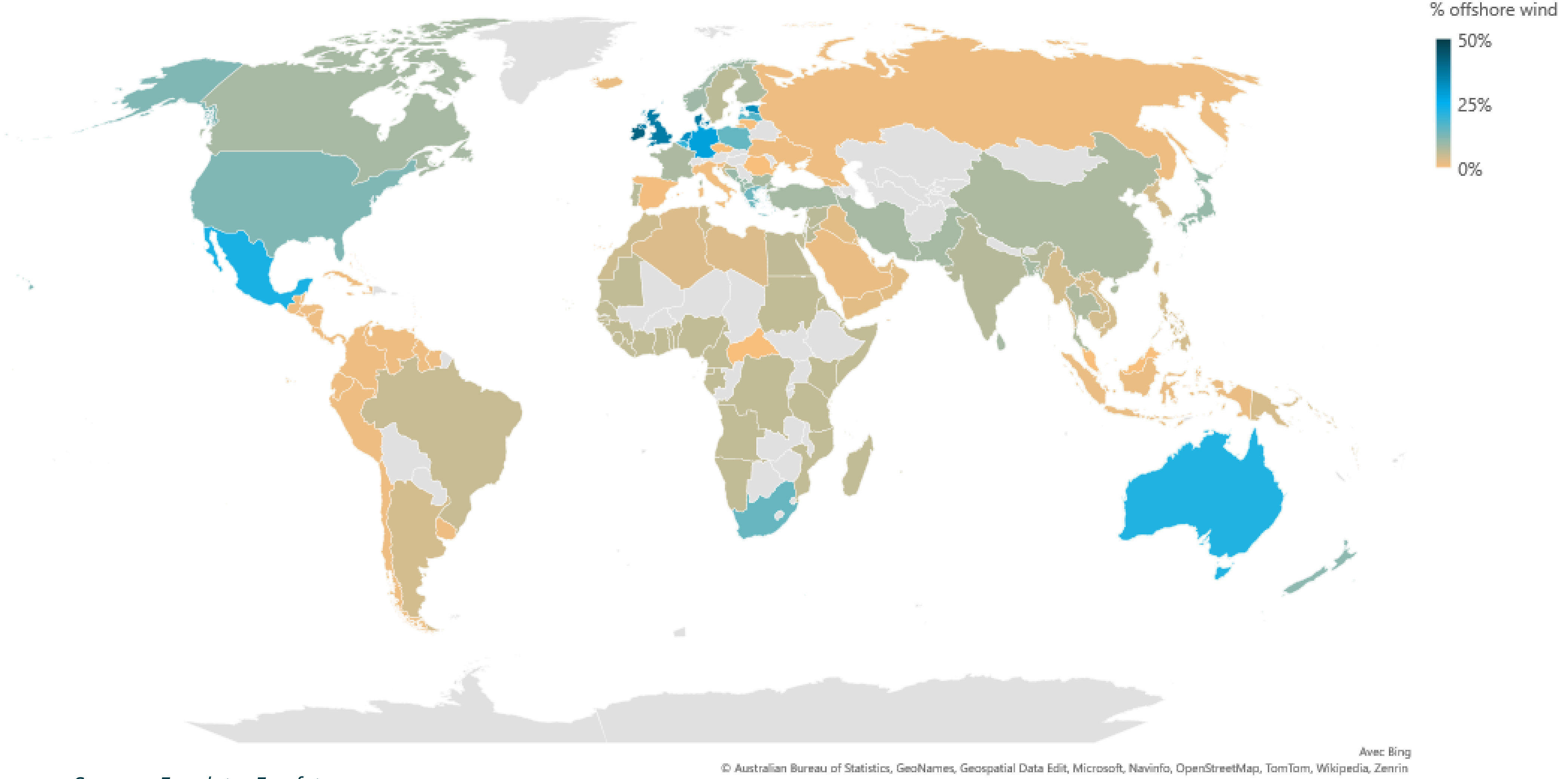
Global offshore wind deployment in 2050 (EnerGreen)



Source : Enerdata, Enerfuture

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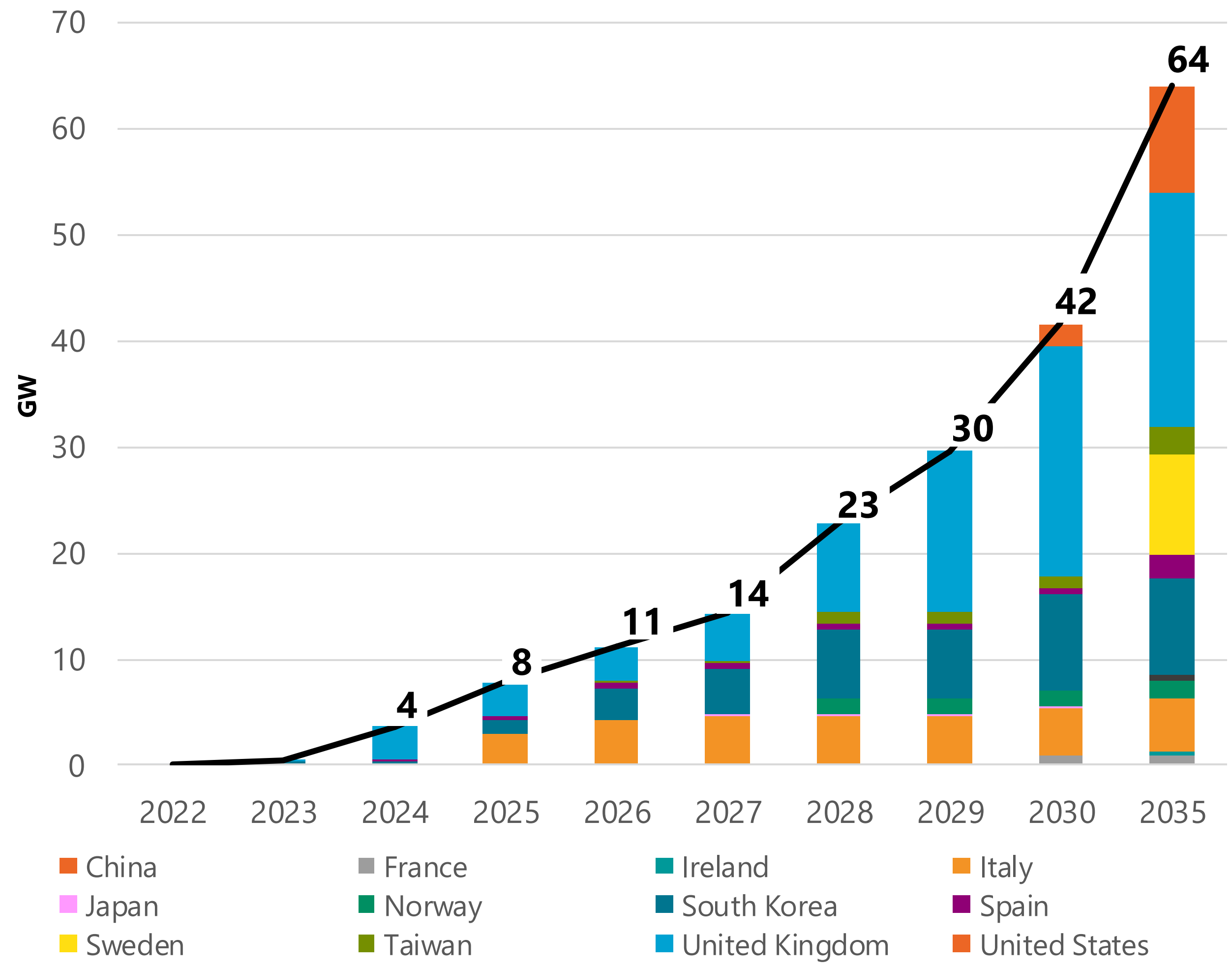
The (r)evolution of floating wind

A technical deep-dive into this emerging technology

Main offshore wind zone of development

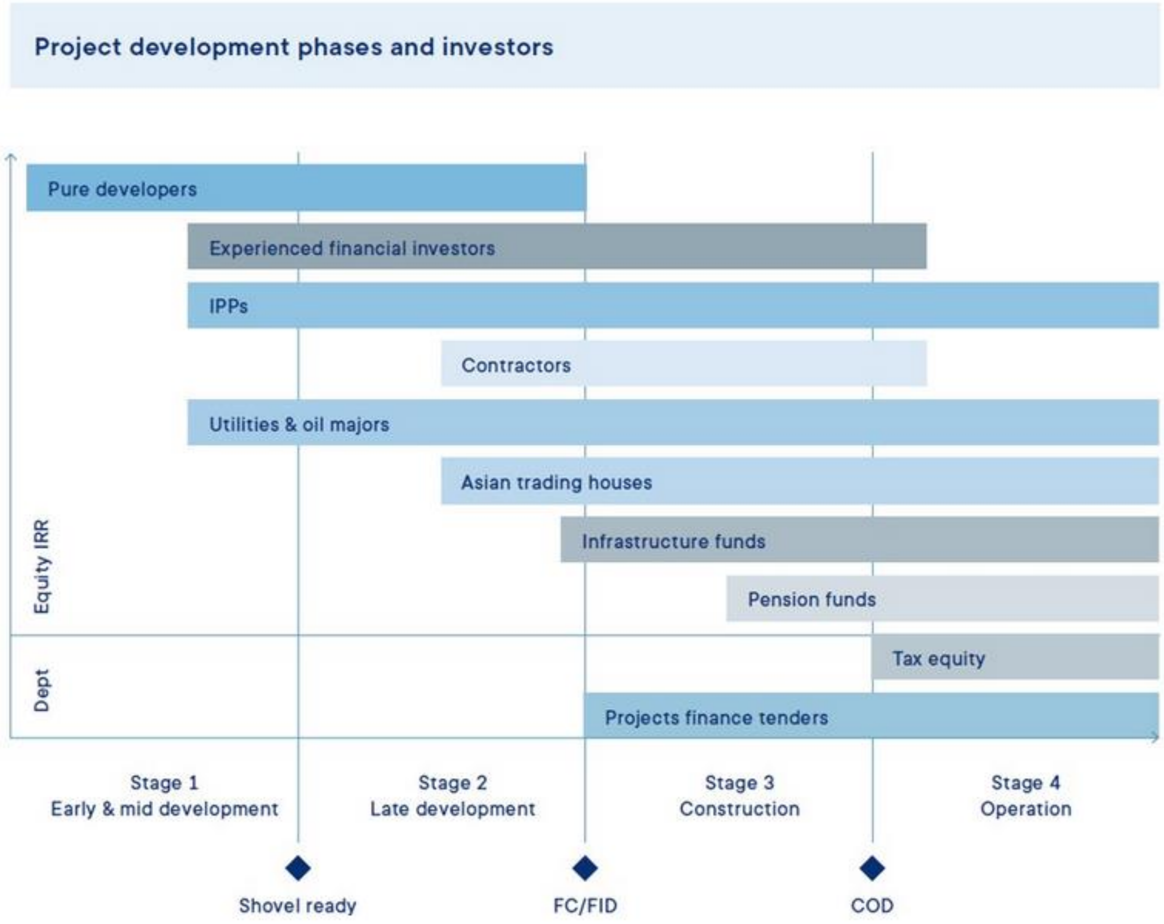
Source: Global Wind Energy Council – Global Offshore Wind Report 2020

Evolution of cumulative floating offshore wind projects around the world



Source: Enerdata – Power Plant Tracker

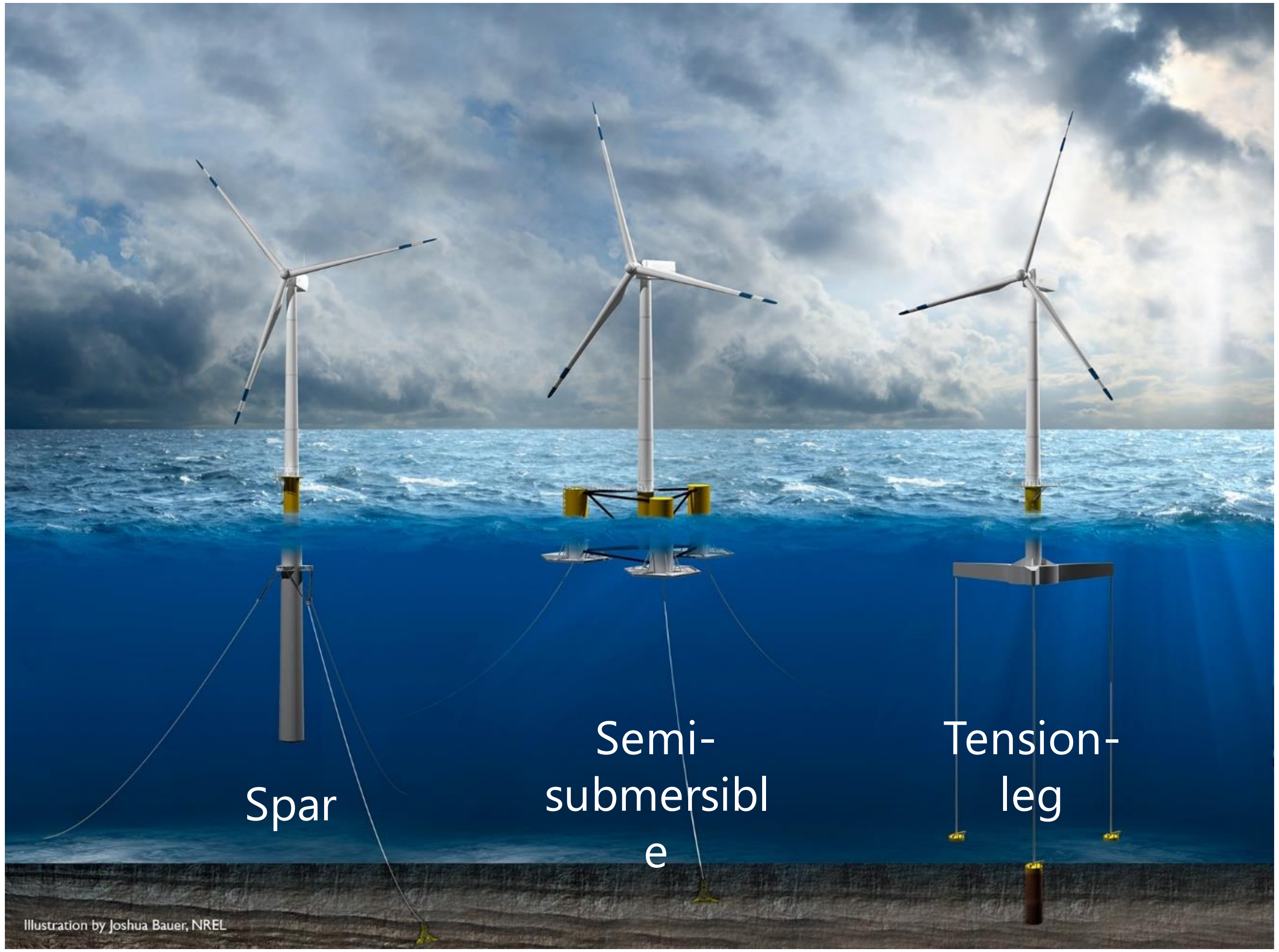
Typology of actors involved in offshore wind projects according to the maturity phases of the projects



Source: Guillet, Financing Offshore Wind 2022

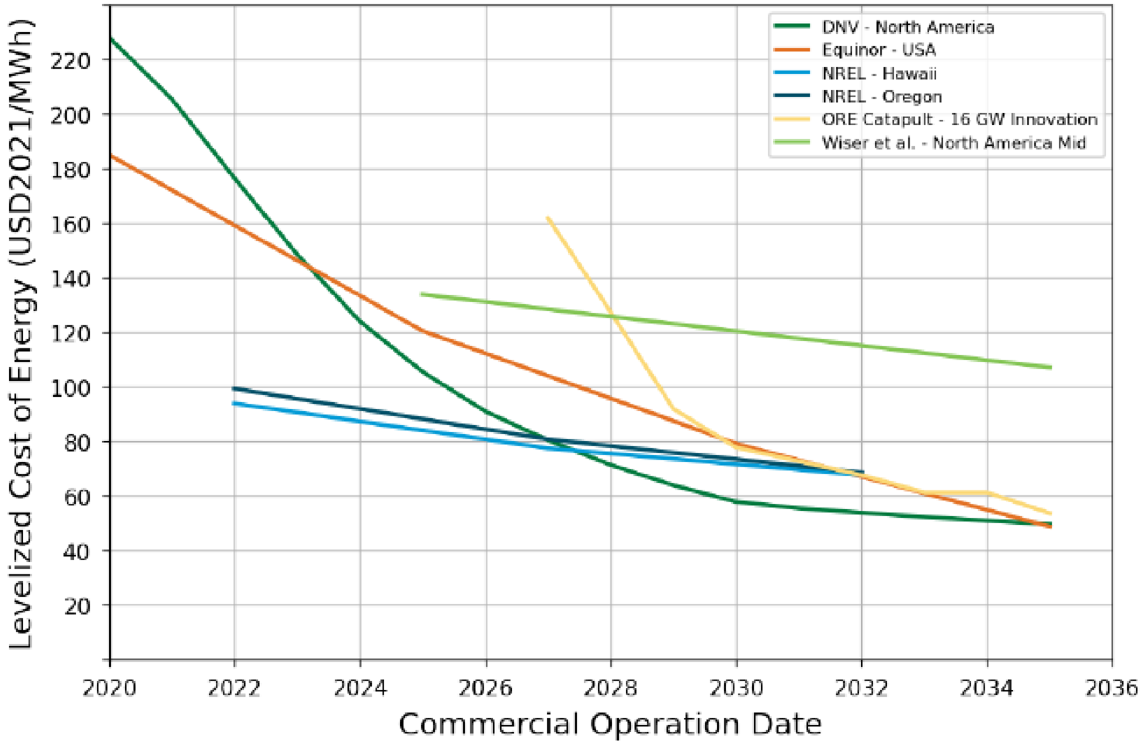
Types of floating offshore wind technologies

- Different types of foundations for floating turbines:
  - Barge foundation;
  - Semi-submersible foundation, a structure that floats between two "canisters" connected to each other by a metal mesh;
  - SPAR foundation, a “pencil” buoy with a large draft (up to 100 m);
  - "Tension Leg Platform" (TLP), a technology whose float stability is ensured by tendons anchored to the seabed.



Source: NREL

Anticipated floating offshore wind cost reduction



Source: Musial, et al., Offshore Wind Market Report: 2022 Edition

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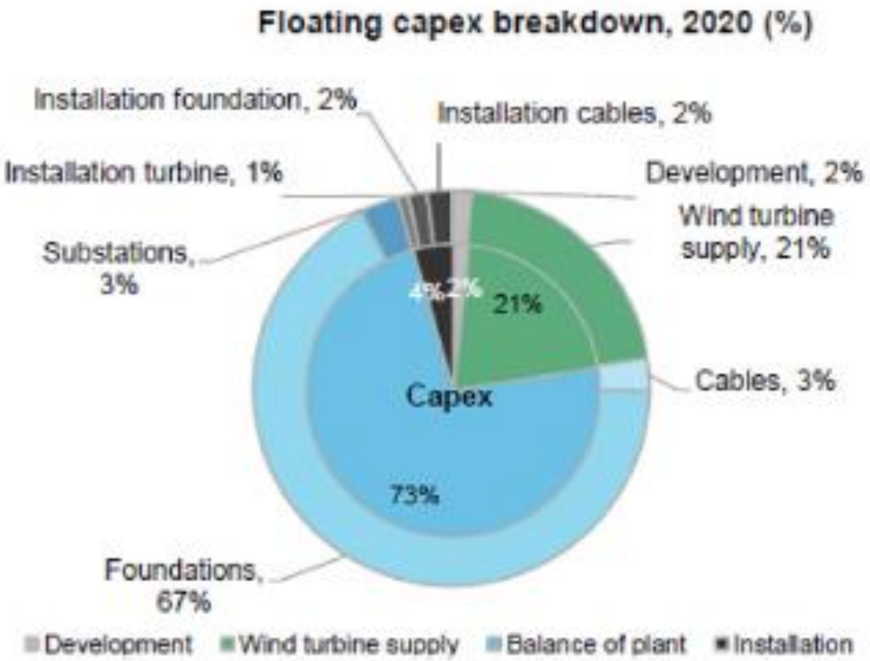
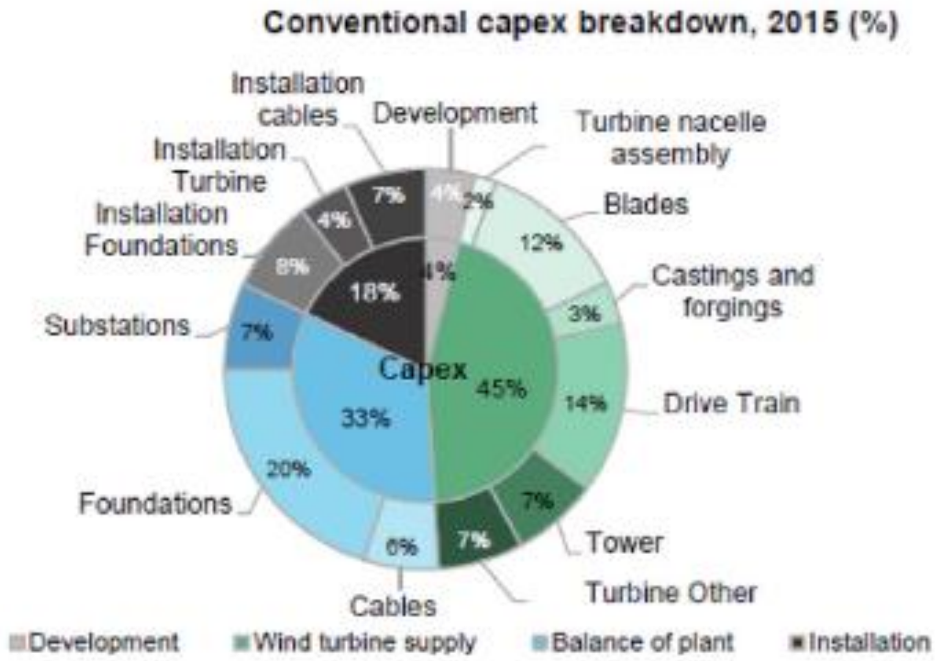
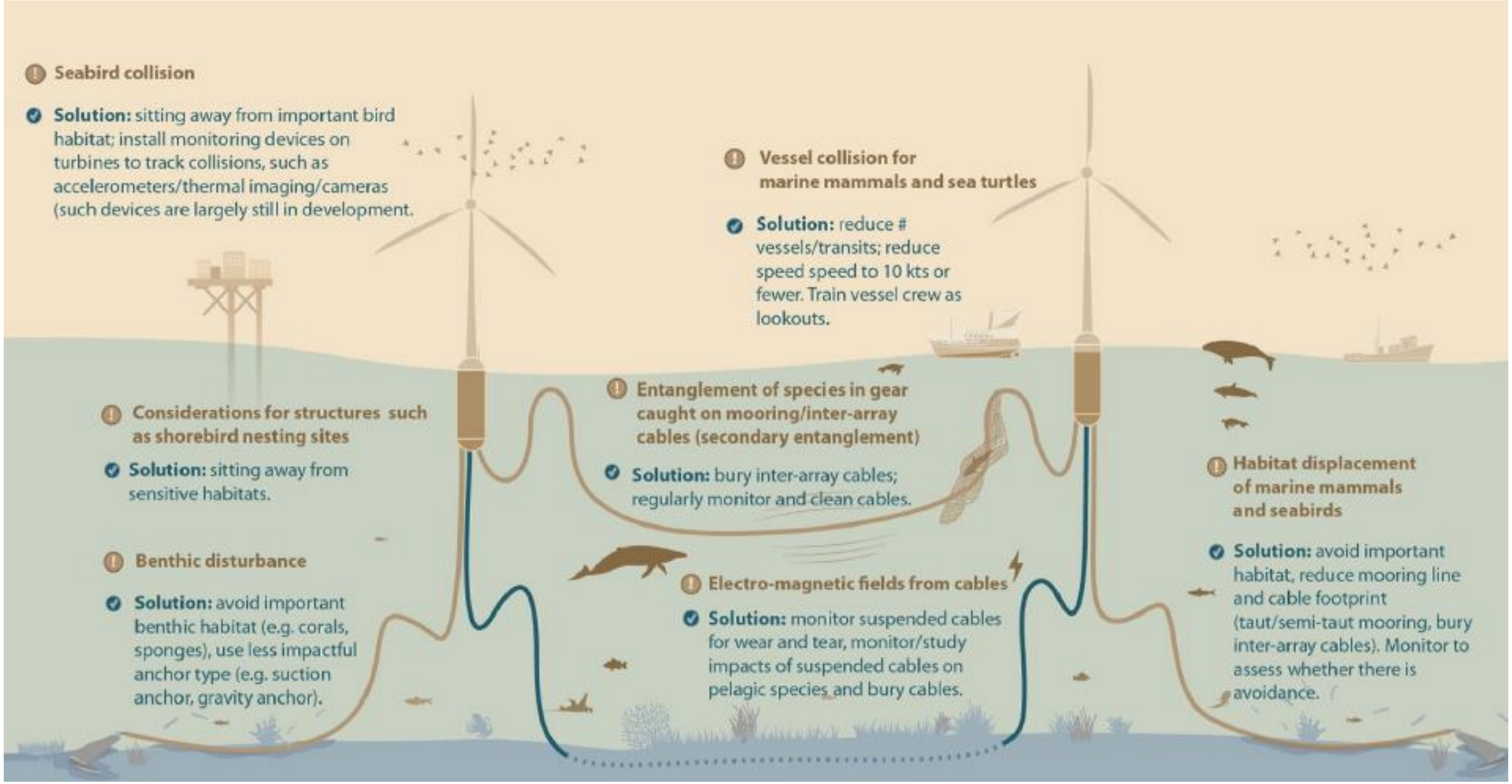
Bottom fixed and floating offshore wind have a different CAPEX breakdown





Source: Kausche, Adam, Dahlhaus, & Großmann, Floating offshore wind - Economic and ecological challenges of a TLP, 2018

Environmental impact of floating offshore wind projects



Source: Maxwell, Kershaw, Locke, & Conners, Potential impacts of floating wind turbine technology for marine species, 2022

Key takeaways

- Floating offshore wind is the next growth driver of the offshore wind sector with 42 GW currently in project and expected by 2030, i.e. more than 20% of all offshore wind projects

- This new technology breaks free from water depth restrictions and allows massive production of renewable energy in new areas outside Europe, the historical region of bottom fixed offshore wind developments

- Many different types of players are active in the development of this intensely competitive and dynamic emerging sector

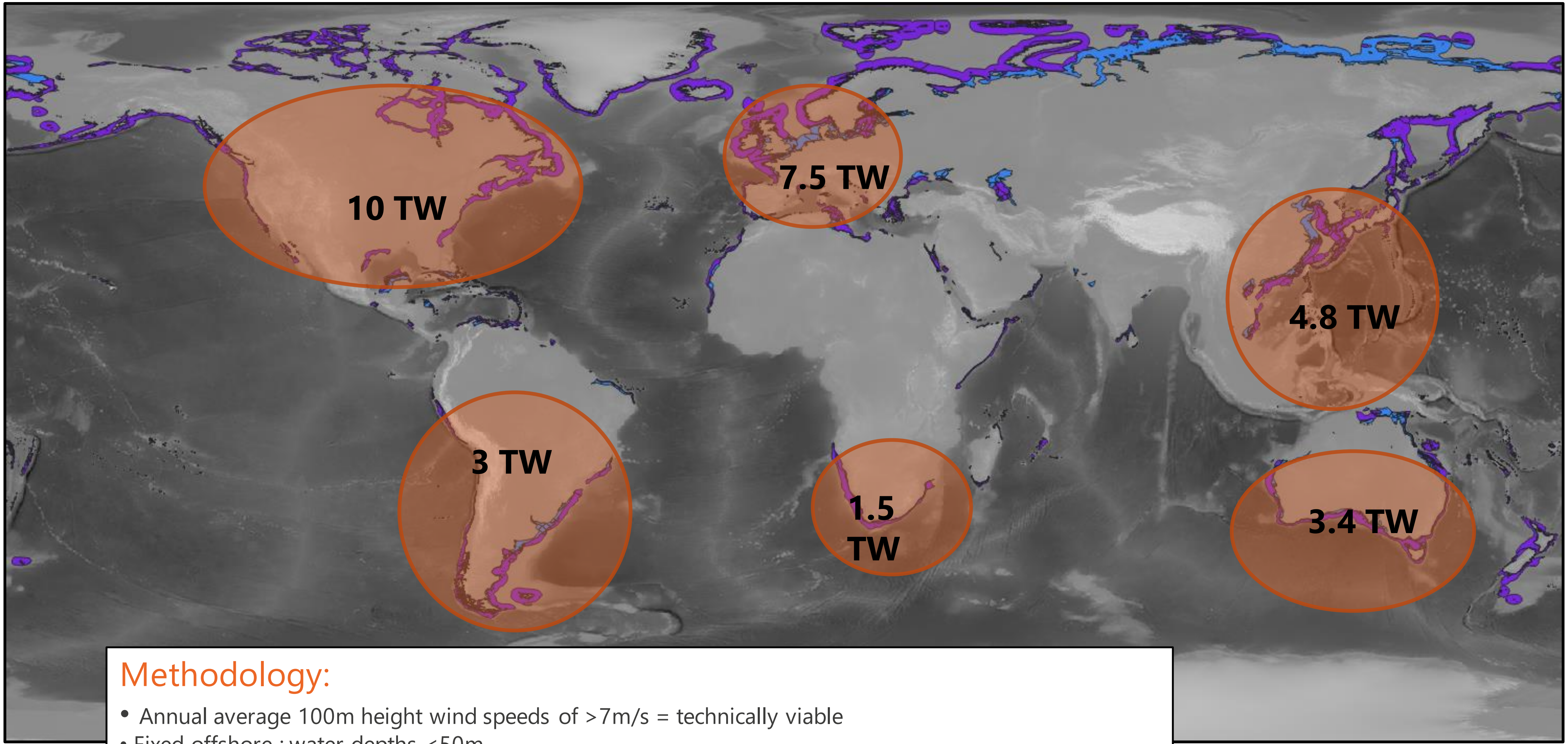
- The expected costs of electricity produced by floating wind projects should be close to those of bottom fixed offshore wind projects, around €50 to €100/MWh

- Given the scale of the projects envisaged, a duty of vigilance is required on the impact on the environment linked to the implementation of large-scale floating offshore wind projects

Global technical potential of floating wind

A glimpse regarding its potential

Global Floating Wind Technical Potential



Methodology:

- Annual average 100m height wind speeds of >7m/s = technically viable
- Fixed offshore : water depths <50m
- Floating wind : water depths from 50-1,000m
- Only regions less than 200 km from shore considered
- Isolated regions <10 km2 were exclude
- Turbine planting densities of 3 MW/km2 for wind speeds between 7–8 m/s and 4 MW/km2 for wind speeds >8 m/s

Data from ESMAP analysis

North America

- Offshore wind potential *(including Alaska)*

Floating wind: 13 TW

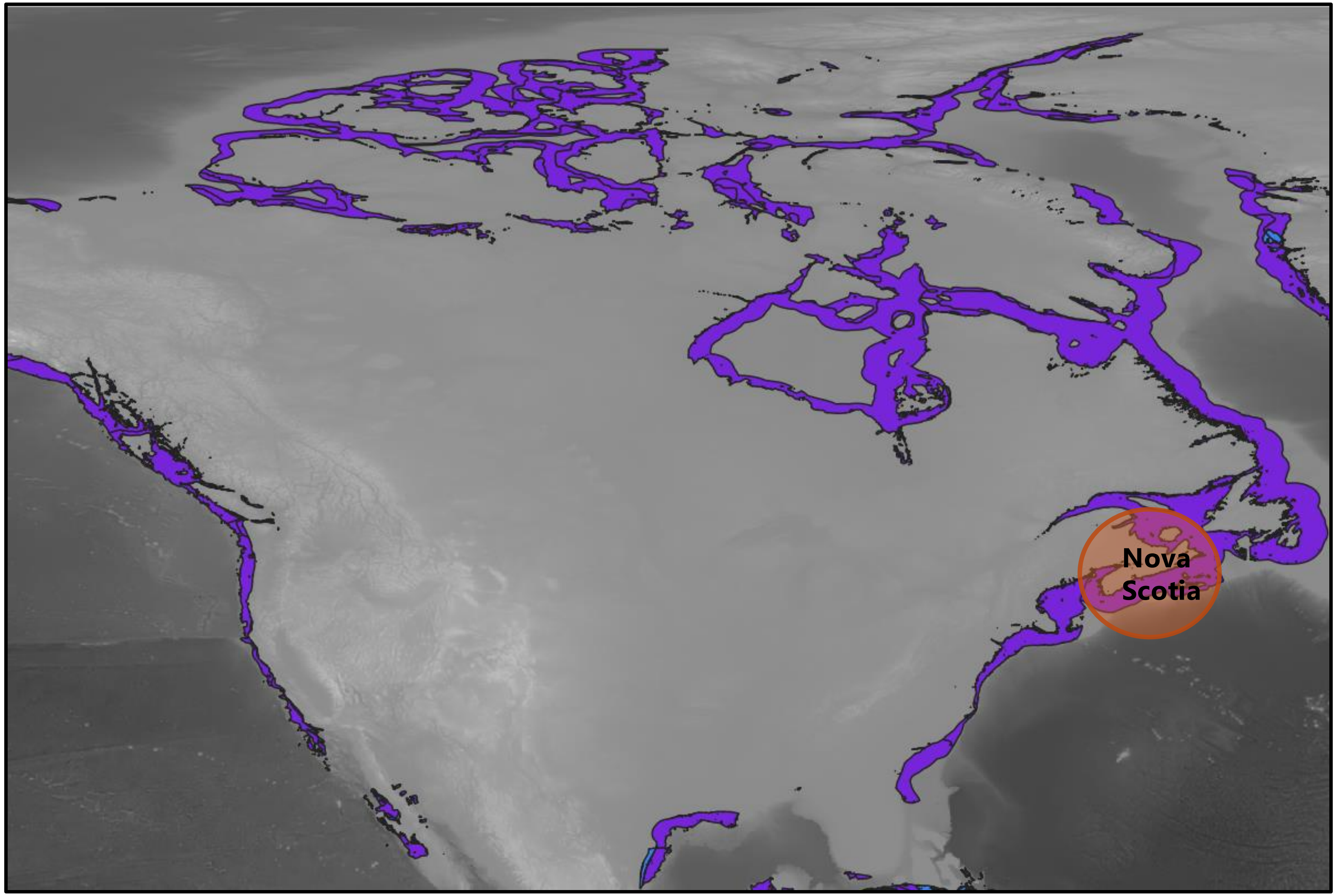
Fixed wind: 4.5 TW

- Main opportunities for floating wind

Canada (7.2 TW)

US (2.8 TW, exc. Alaska 3 TW)

- Political Support
  - In Canada, Nova Scotia province plans to offer 5 GW offshore wind leases by 2030
  - In the US, “Floating offshore wind shot” to reduce cost by >70% by 2035 (to US$45/MWh) & deploy 15 GW by 2035



South America

- Offshore wind potential

Floating wind: 3.7 TW

Fixed wind: 1.7 TW

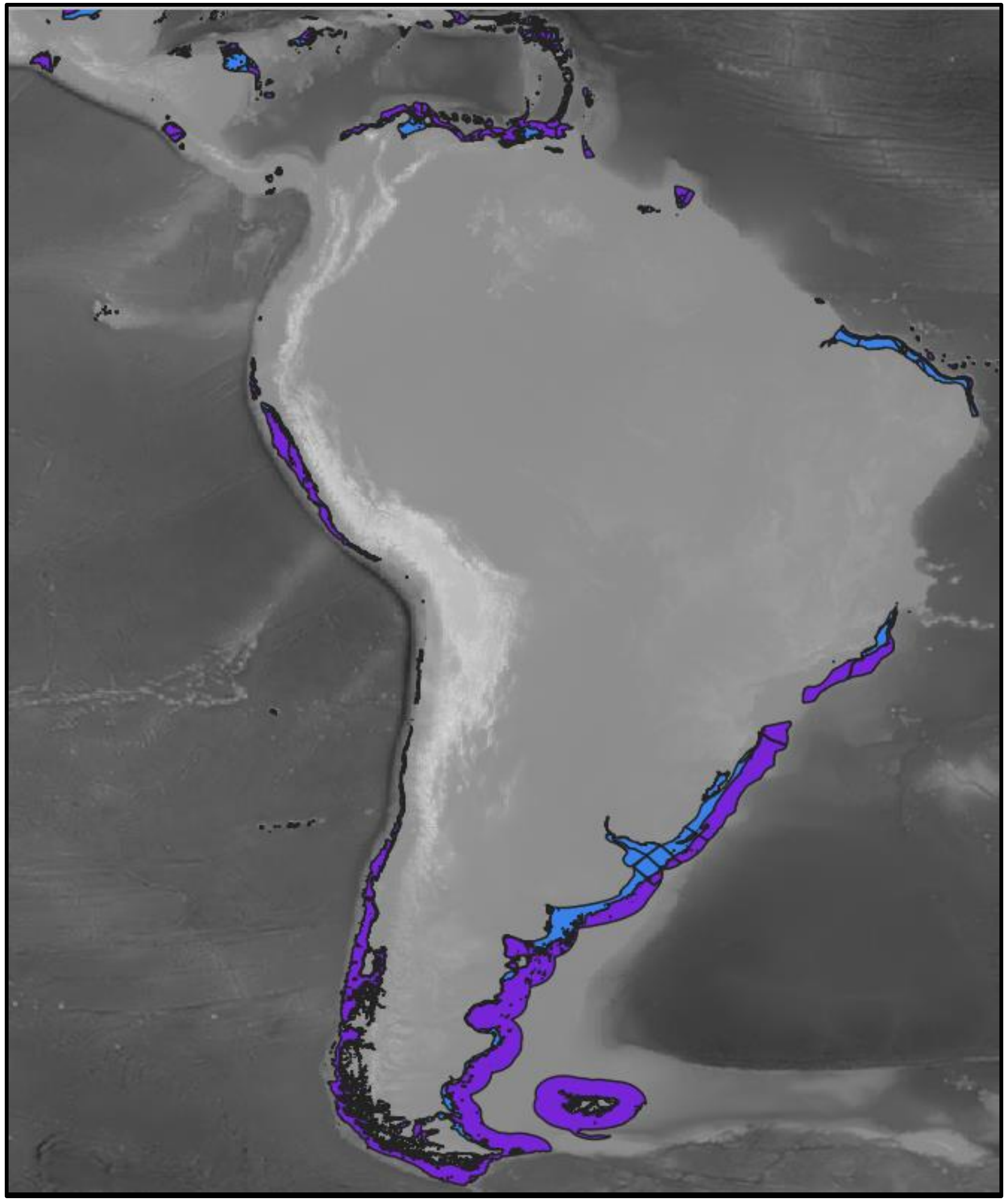
- Main opportunities for floating wind

Argentina (1.3 TW)

Chile (830 GW)

Brazil (750 GW)

- Political Support
  - Argentina, aims to increase wind & solar to 20% mix by 2025. RenovAR (2016) to boost wind & solar via public tenders
  - Brazil, published a Presidential decree (2022) regulating offshore EEZ & continental shelf offshore projects. Many offshore wind projects planned: OW (>15 GW), Petrobras (2 GW), etc.



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Europe

- Offshore wind potential

Floating wind: 7.5 TW

Fixed wind: 1.6 TW

- Main opportunities for floating wind

Norway (2.4 TW)

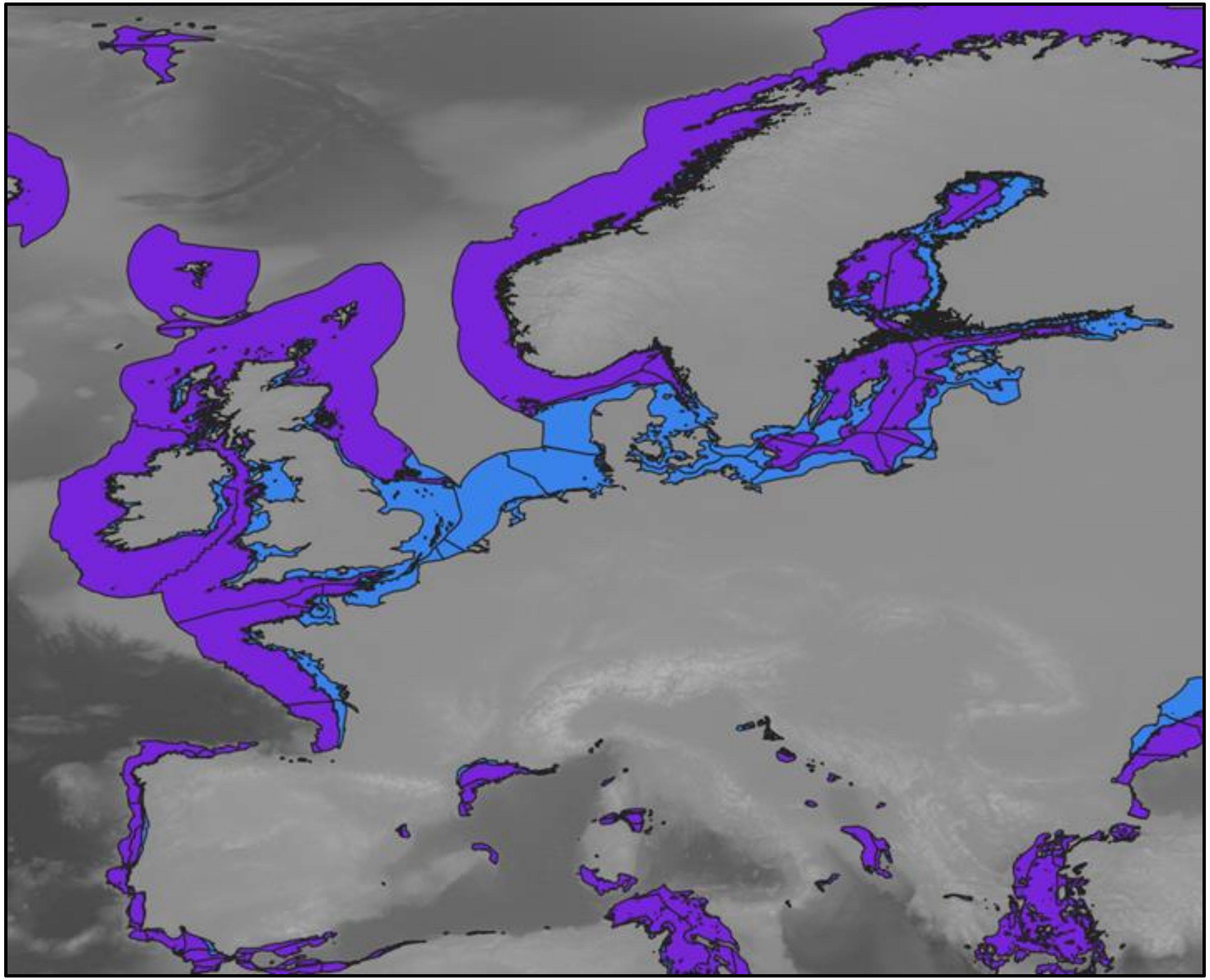
Denmark (1.9 TW)

UK (1.4 TW)

France (450 GW) & Spain (250 GW)

- Political Support
  - Norway, targets 30 GW offshore wind by 2040
  - Denmark, targets12.9 GW of offshore wind by 2030 (+4 GW)
  - UK, aims 40 GW offshore wind by 2030.

  Latest in date: Welsh Gov approved 100 MW Erebus floating wind farm



Southeast Asia

- Offshore wind potential

Floating wind: 4.8 TW

Fixed wind: 2 TW

- Main opportunities for floating wind

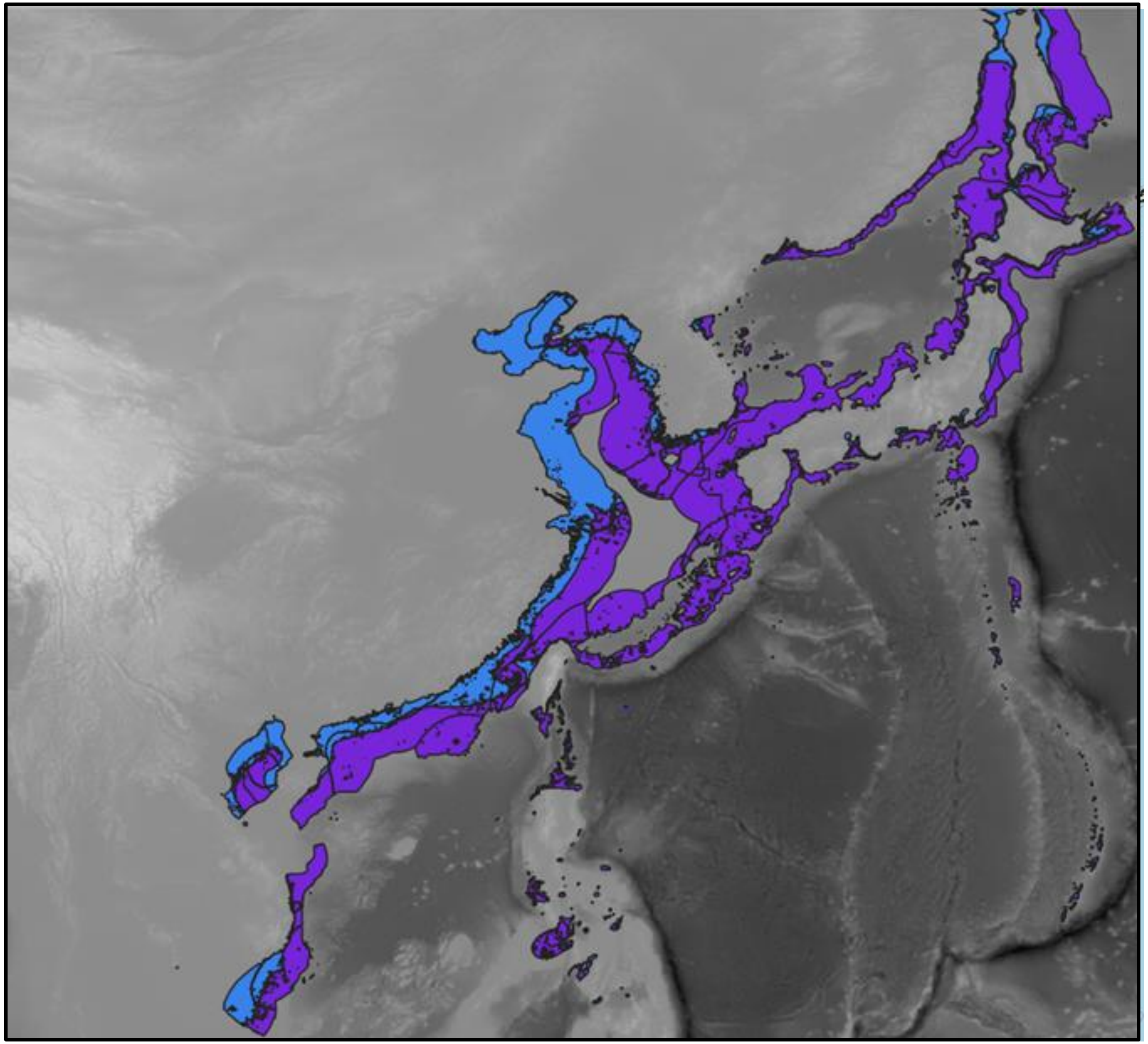
Japan (1.8 TW)

China (1.1 TW)

South Korea (720 GW)

Taiwan (600 GW)

- Political Support
  - Japan, targets 30-45 GW offshore wind by 2040 (10 GW by 2030)
  - China is moving out from FIT schemes for offshore wind but +73 GW added in 2020 & +47 GW in 2021



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Conclusions

Conclusions

- All long-term energy scenarios highlight the need for significant investment towards renewable energy sources, among which wind energy is expected to play a key role
- An emerging technology, floating wind could become an important asset in achieving climate mitigation goals
- Due to lower water depth restrictions, its technical potential is much higher and more evenly distributed globally than that of fixed offshore projects (e.g. 10 TW in North America, 7.5 TW in Europe…)
- Governments from countries with large offshore wind & floating potentials will have a leading role in creating the right circumstances for floating wind market to develop (via new policies & regulatory frameworks, eg. US's "Floating offshore wind shot"), notably countries with limited land areas
- It is expected to become more and more cost-competitive over the next decades

Q & A

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CONTACT quentin.bchini@enerdata.net

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About Enerdata:

Enerdata is an independent research company that specialises in the analysis and forecasting of energy and climate issues, at a variety of different geographic and business / sector levels. The company is headquartered in Grenoble, France, where it was founded in 1991, and has a subsidiary in Singapore.

Leveraging its globally recognised databases, business intelligence processes, and prospective models, Enerdata assists clients – which include companies, investors, and public authorities around the world – in designing their policies, strategies, and business plans.

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