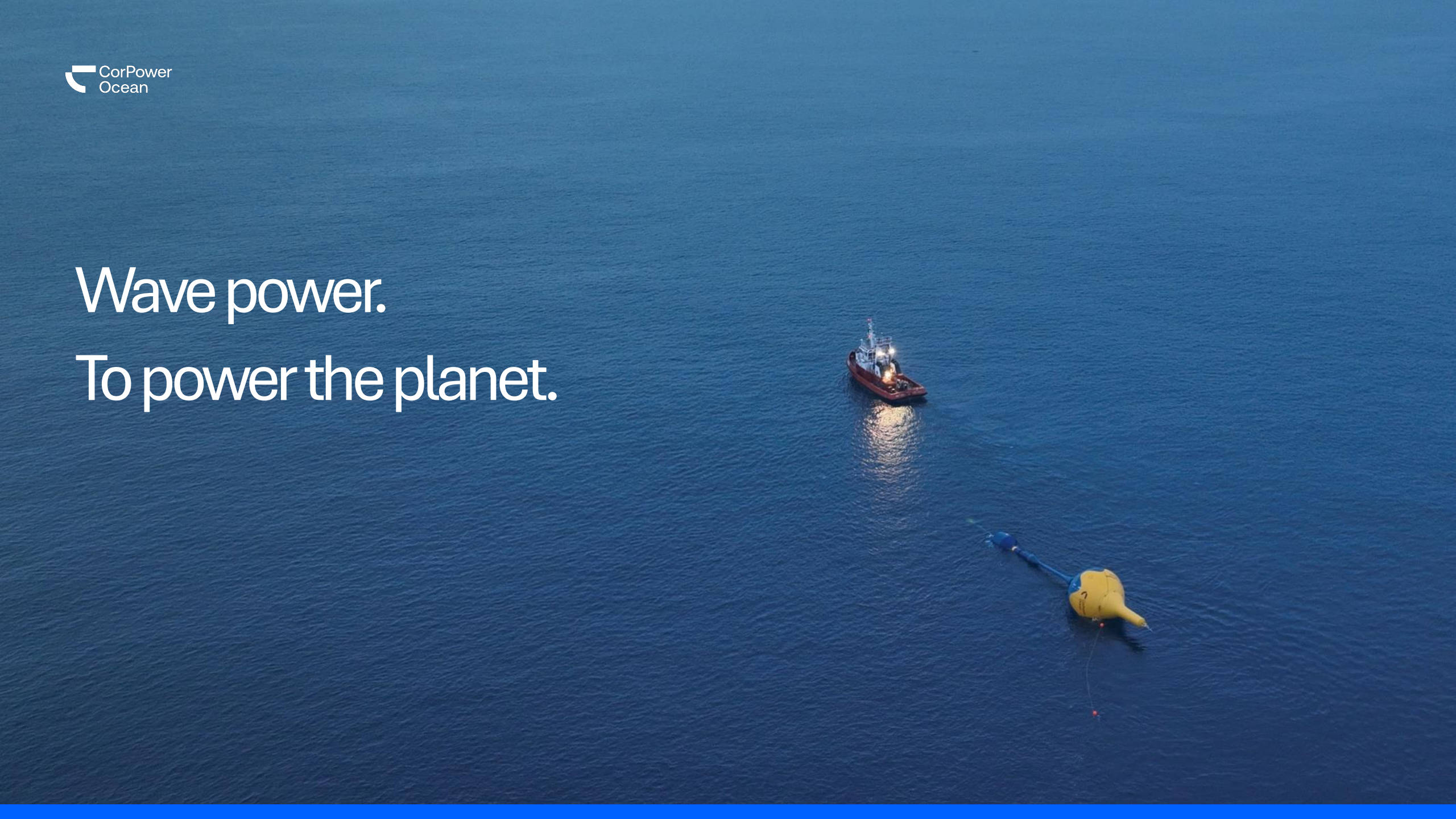
CorPower Ocean

Wave power.
To power the planet.



CorPower Ocean

CorPower Ocean
in short

- Leading developer (OEM) of turnkey wave energy systems
- Started in 2012. Offices in Sweden, Norway, Scotland & Portugal
- Physics providing competitive LCOE, verified through step-by-step approach
- Traction with energy majors, including Simply Blue, ESB, EDP, ENEL Green Power
- Broad backing across Europe. 75 MEUR funding secured to date

CorPower Ocean

Structured product verification

5-stage program according to IEA-OES / ETIP Ocean best practice

2012—2013

Stage 1
Concept

Validation

2014—2015

Stage 2
Critical System tests

Dry and tank testing

2015—2018

Stage 3
1:2 scale device

Dry and ocean testing

2018—2023

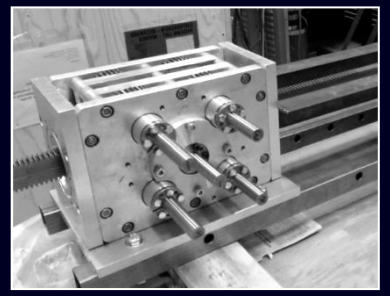
Stage 4
Full scale device

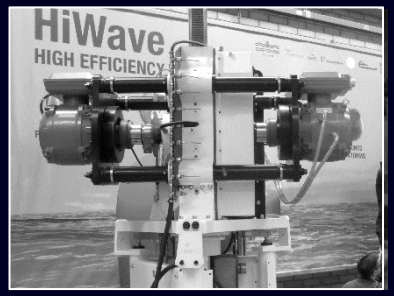
Dry and ocean demo

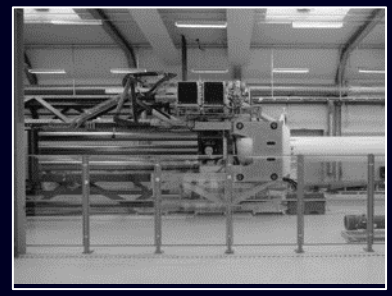
2024—2026

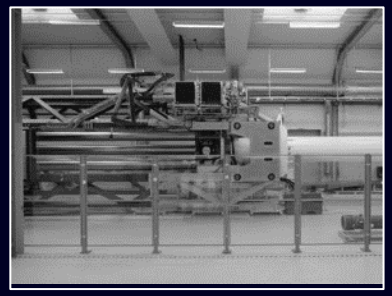
Stage 5
4 device array

Pilot array (4 WECs)





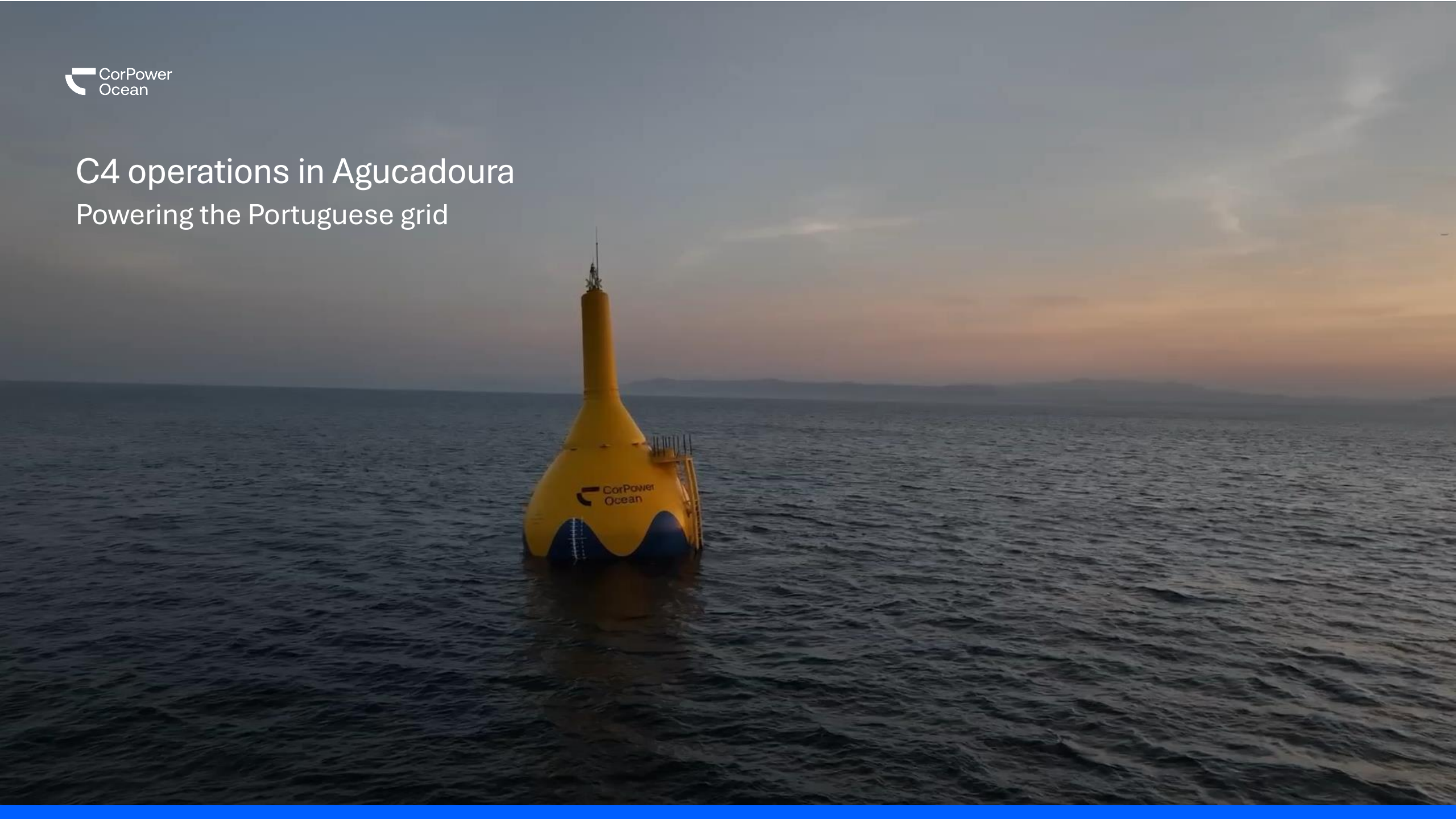




CorPower Ocean

C4 operations in Agucadoura

Powering the Portuguese grid



CorPower Ocean

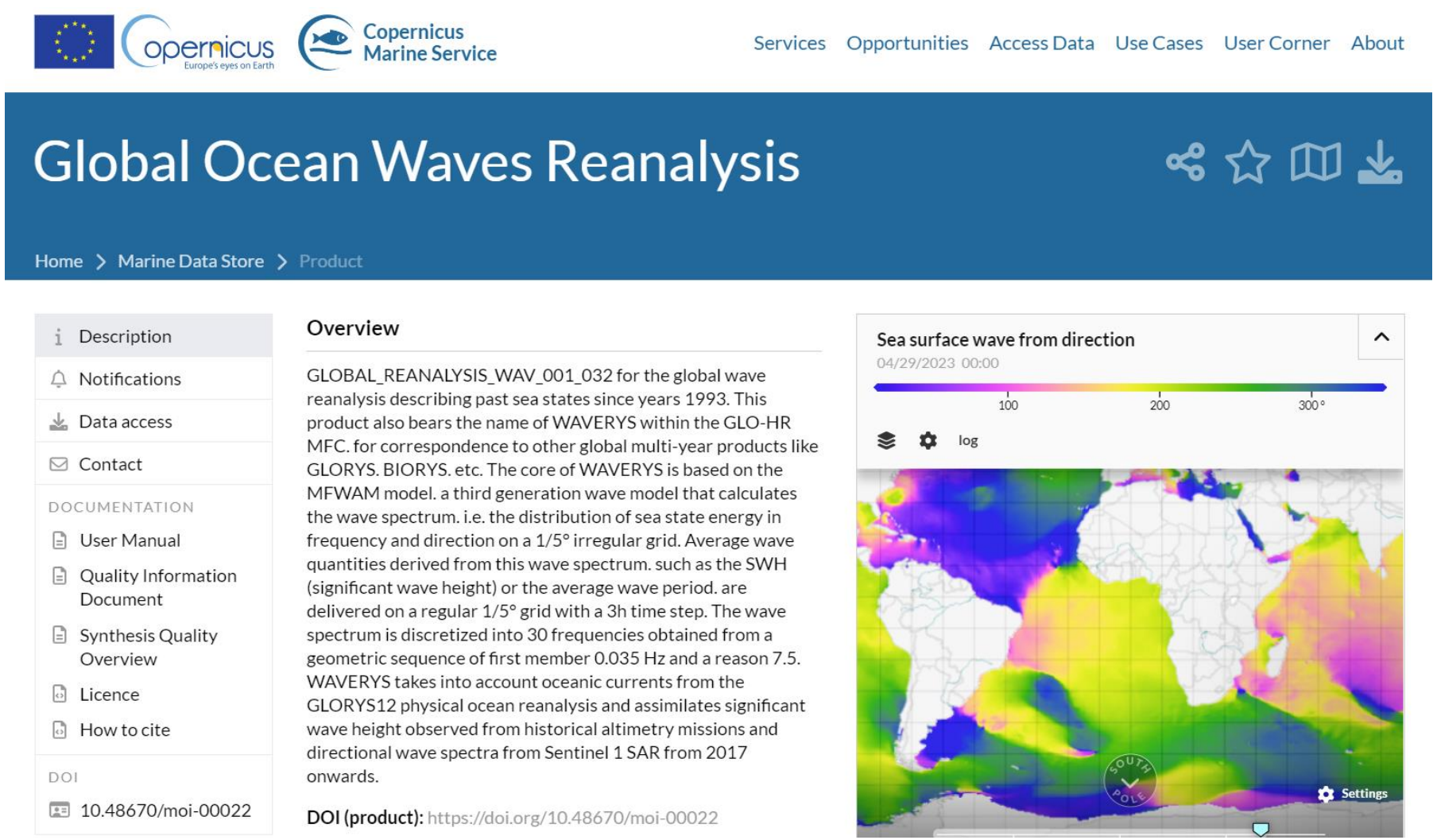
Copernicus data

Why do we use Copernicus Marine Services?

- Accessible data with good spatial and temporal resolution

Which Copernicus Marine Service products are we using?

- Wave reanalysis products
- Wave forecasting products



CorPower Ocean

Copernicus data

How do we use Copernicus products at CorPower?

Modelled historical sea states

- Wave height and period data

Spatial analysis – site studies around the world

- Example: EVOLVE project spatial modelling

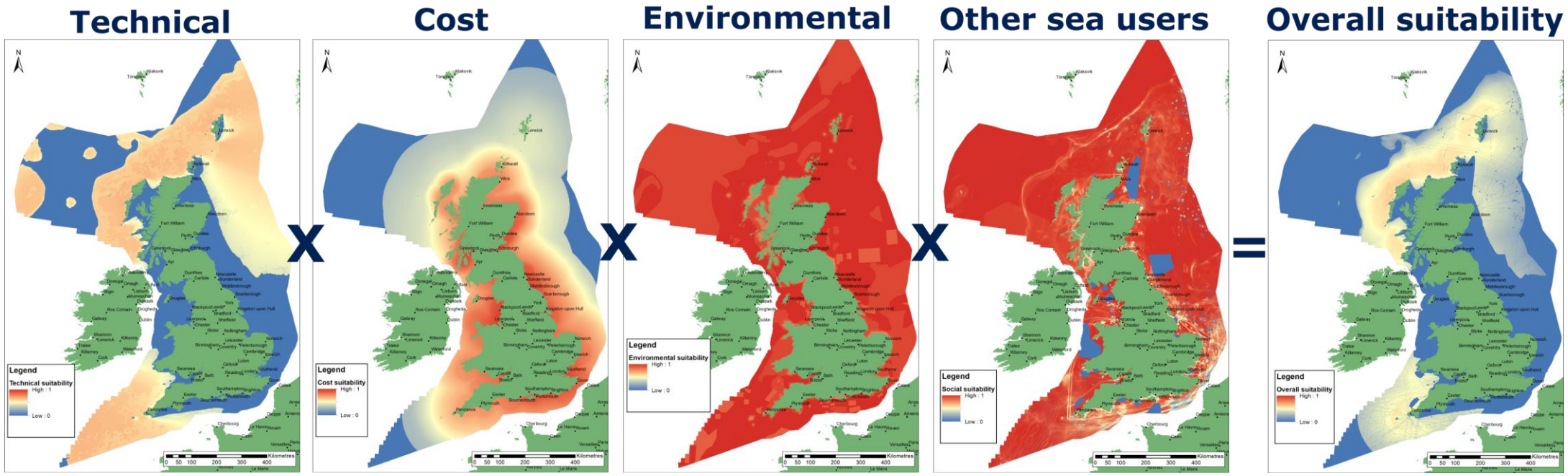
Power system optimisation – wave in combination with other renewables

- Example: EVOLVE project power system modelling

			Te																						
			0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	0.25	0	0.5	0	0	0	0	5E-05	2E-04	6E-04	9E-04	9E-04	3E-04	6E-05	0	0	0	0	0	0	0	0	0	0	0
	0.75	0.5	1	0	0	0	2E-05	1E-03	0.007	0.018	0.026	0.021	0.017	0.009	0.003	0.001	5E-04	2E-04	5E-05	9E-06	3E-05	1E-05	5E-06	0	0	0
	1.25	1	1.5	0	0	0	0	8E-04	0.018	0.038	0.047	0.046	0.037	0.026	0.016	0.008	0.003	1E-03	3E-04	2E-04	8E-05	1E-05	9E-06	0	2E-05	0
	1.75	1.5	2	0	0	0	0	0	0.007	0.027	0.04	0.042	0.039	0.03	0.022	0.013	0.005	0.002	6E-04	2E-04	2E-04	4E-05	9E-05	3E-05	0	0
	2.25	2	2.5	0	0	0	0	0	1E-04	0.006	0.018	0.029	0.031	0.027	0.02	0.012	0.006	0.003	8E-04	3E-04	2E-04	1E-04	5E-06	0	0	0
	2.75	2.5	3	0	0	0	0	0	0	3E-04	0.005	0.014	0.019	0.021	0.016	0.01	0.006	0.003	8E-04	4E-04	1E-04	2E-05	9E-06	0	0	0
	3.25	3	3.5	0	0	0	0	0	0	9E-06	0.001	0.007	0.013	0.015	0.012	0.009	0.005	0.002	0.001	3E-04	1E-04	3E-05	9E-06	5E-06	0	0
	3.75	3.5	4	0	0	0	0	0	0	0	1E-04	0.003	0.006	0.01	0.009	0.006	0.004	0.003	6E-04	3E-04	1E-04	5E-06	2E-05	9E-06	0	0
	4.25	4	4.5	0	0	0	0	0	0	0	0	7E-04	0.003	0.006	0.007	0.005	0.003	0.002	7E-04	2E-04	5E-05	9E-06	9E-06	5E-06	0	0
	4.75	4.5	5	0	0	0	0	0	0	0	0	1E-04	0.001	0.003	0.005	0.004	0.002	0.001	7E-04	4E-04	8E-05	3E-05	1E-05	5E-06	0	0
	5.25	5	5.5	0	0	0	0	0	0	0	0	0	4E-04	0.002	0.003	0.003	0.002	0.001	6E-04	3E-04	2E-04	2E-05	1E-05	0	0	0
	5.75	5.5	6	0	0	0	0	0	0	0	0	0	3E-05	6E-04	0.001	0.001	0.001	6E-04	3E-04	5E-05	5E-05	1E-04	0	0	0	0
	6.25	6	6.5	0	0	0	0	0	0	0	0	0	0	2E-04	4E-04	8E-04	8E-04	7E-04	4E-04	5E-05	3E-05	9E-06	9E-06	0	0	0
	6.75	6.5	7	0	0	0	0	0	0	0	0	0	0	3E-05	3E-04	4E-04	5E-04	4E-04	2E-04	1E-04	0	0	0	0	0	0
	7.25	7	7.5	0	0	0	0	0	0	0	0	0	0	5E-06	1E-04	3E-04	3E-04	3E-04	1E-04	1E-04	9E-06	0	0	0	0	0
Hs	**7.75**	7.5	8	0	0	0	0	0	0	0	0	0	0	0	3E-05	1E-04	2E-04	3E-04	5E-05	2E-05	0	0	0	0	0	0
	8.25	8	8.5	0	0	0	0	0	0	0	0	0	0	0	0	3E-05	1E-04	2E-04	4E-05	5E-06	0	0	0	0	0	0
	8.75	8.5	9	0	0	0	0	0	0	0	0	0	0	0	0	5E-06	2E-05	3E-05	3E-05	0	0	0	0	0	0	0
	9.25	9	9.5	0	0	0	0	0	0	0	0	0	0	0	0	0	9E-06	0	0	0	0	0	0	0	0	0
	9.75	9.5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.25	10	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.75	10.5	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11.25	11	11.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11.75	11.5	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12.25	12	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12.75	12.5	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13.25	13	13.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13.75	13.5	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

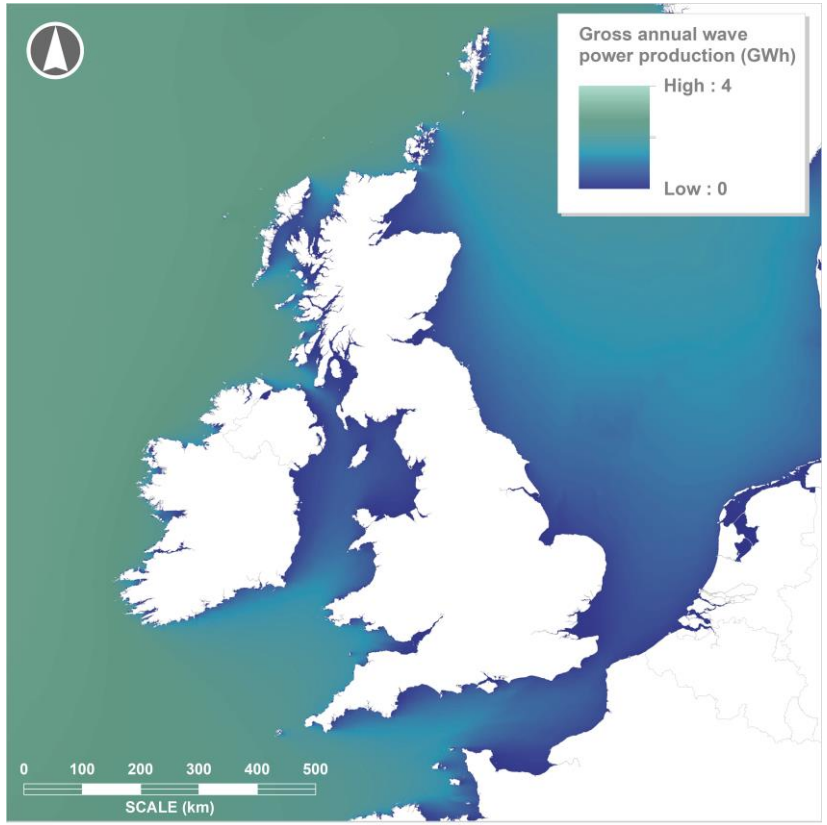
EVOLVE spatial modelling

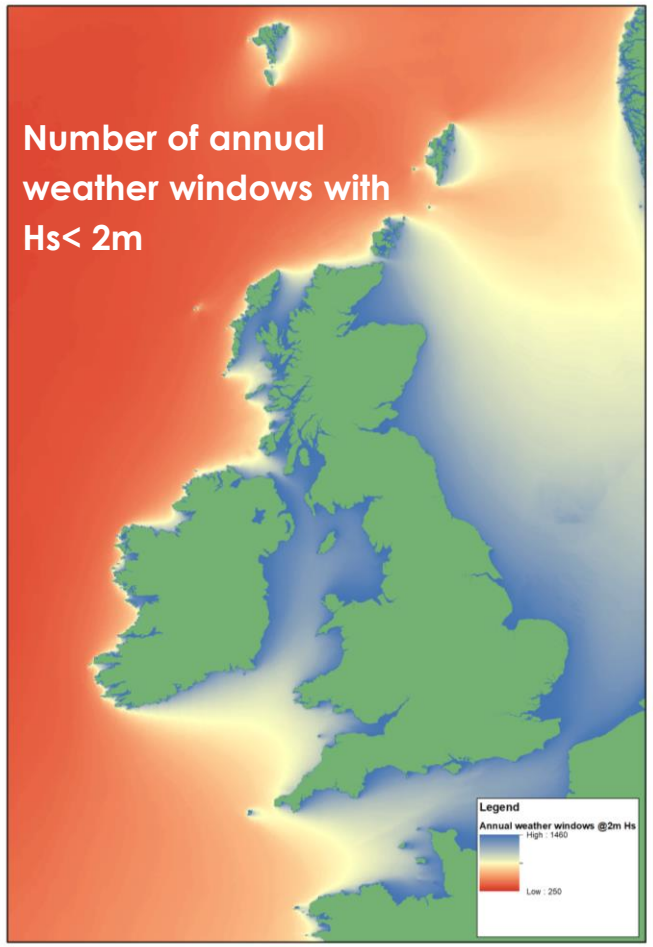
Method - RADMAPP

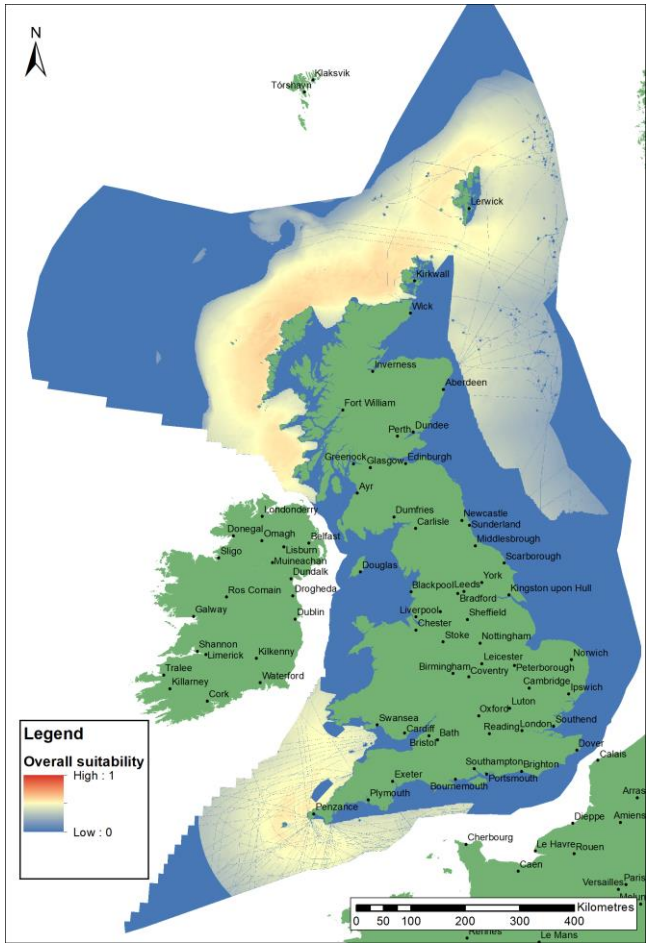


EVOLVE Spatial Modelling

Analysis







EVOLVE Spatial Modelling

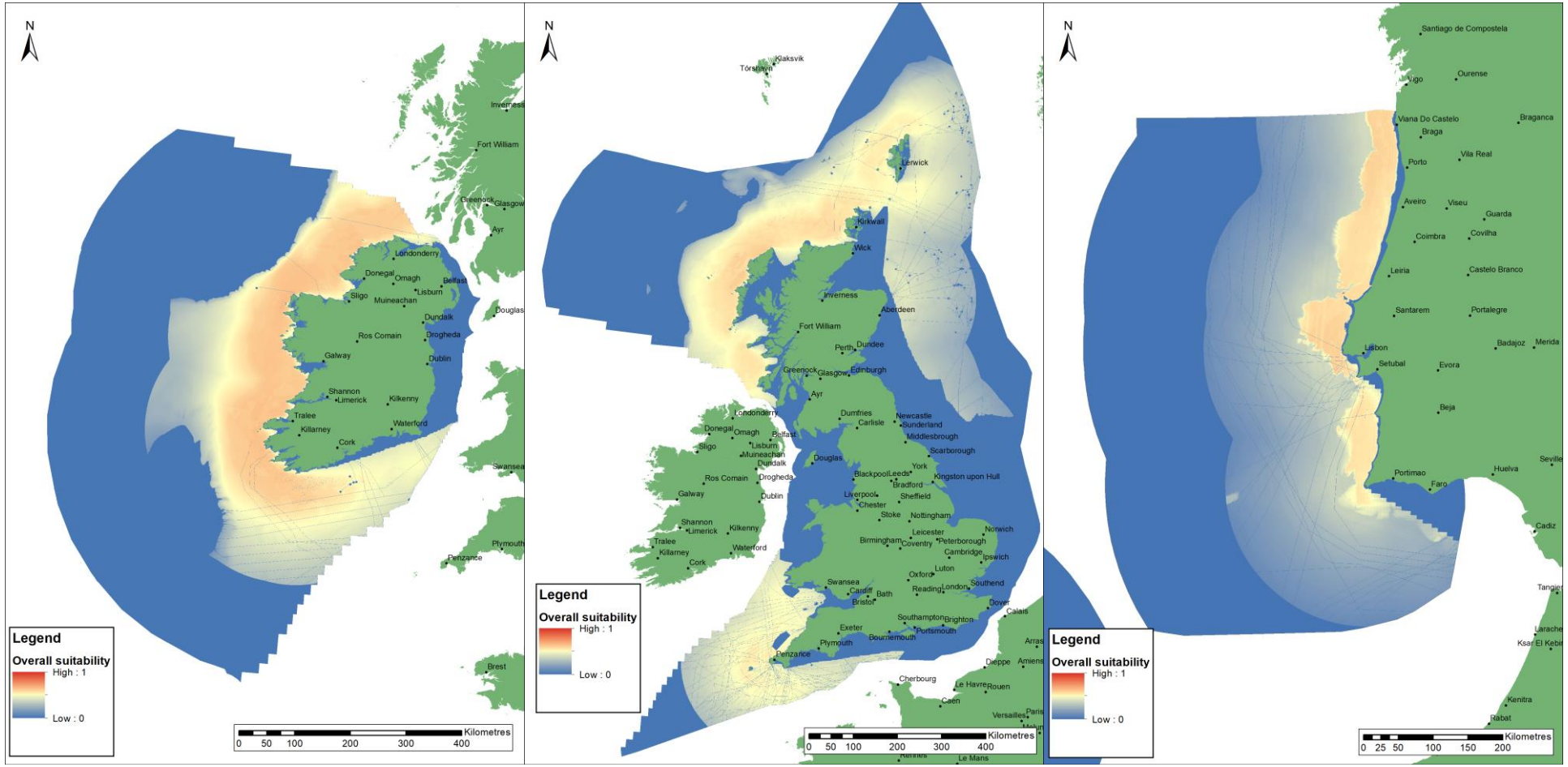
Results

Ireland
18.9 GW, 89.7 TWh

Great Britain
24.8 GW, 106.7 TWh

Portugal
15.4 GW, 57.3 TWh

Combined:
59.1 GW, 253.7 TWh



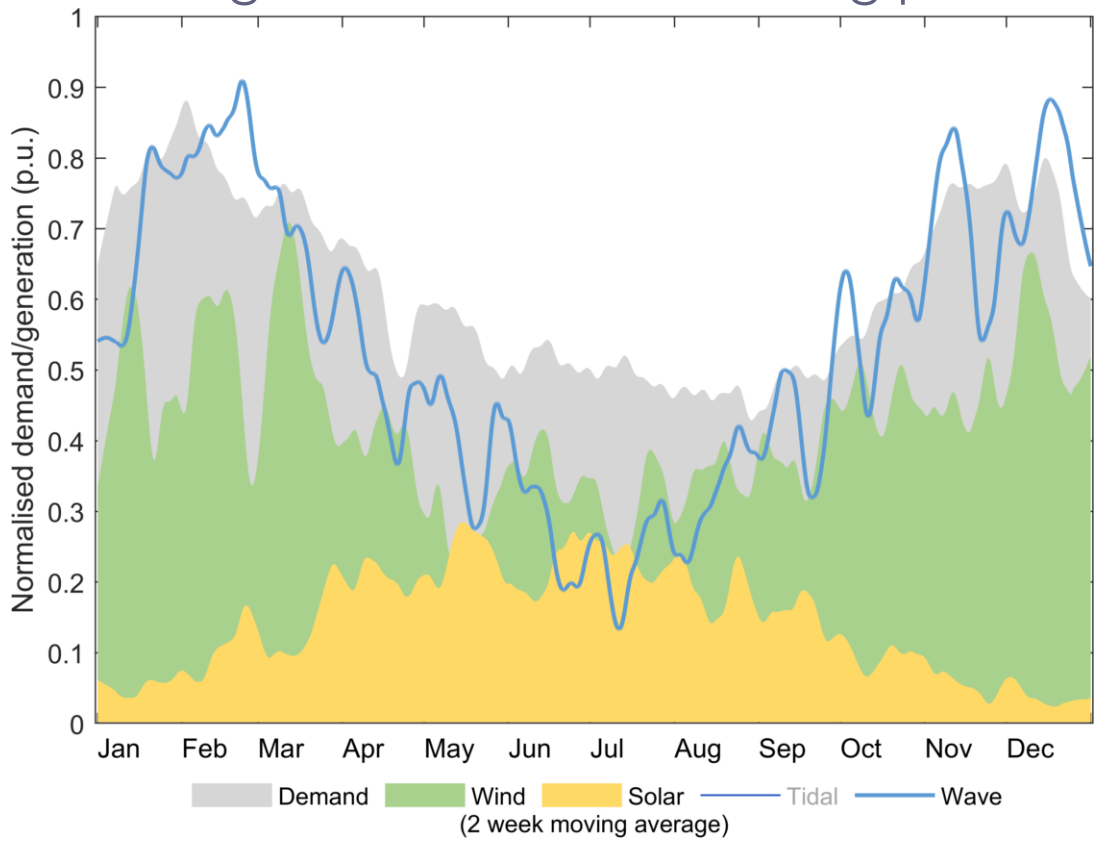
EVOLVE power system modelling

Data inputs

Electricity demand is highly seasonal in GB

Wind Generation is higher in winter, Solar Generation is higher in summer

Wave is higher in winter – matching peak demand



EVOLVE power system modelling

Method - PyPSA

Great Britain model split into nine zones based on selected National Grid boundaries

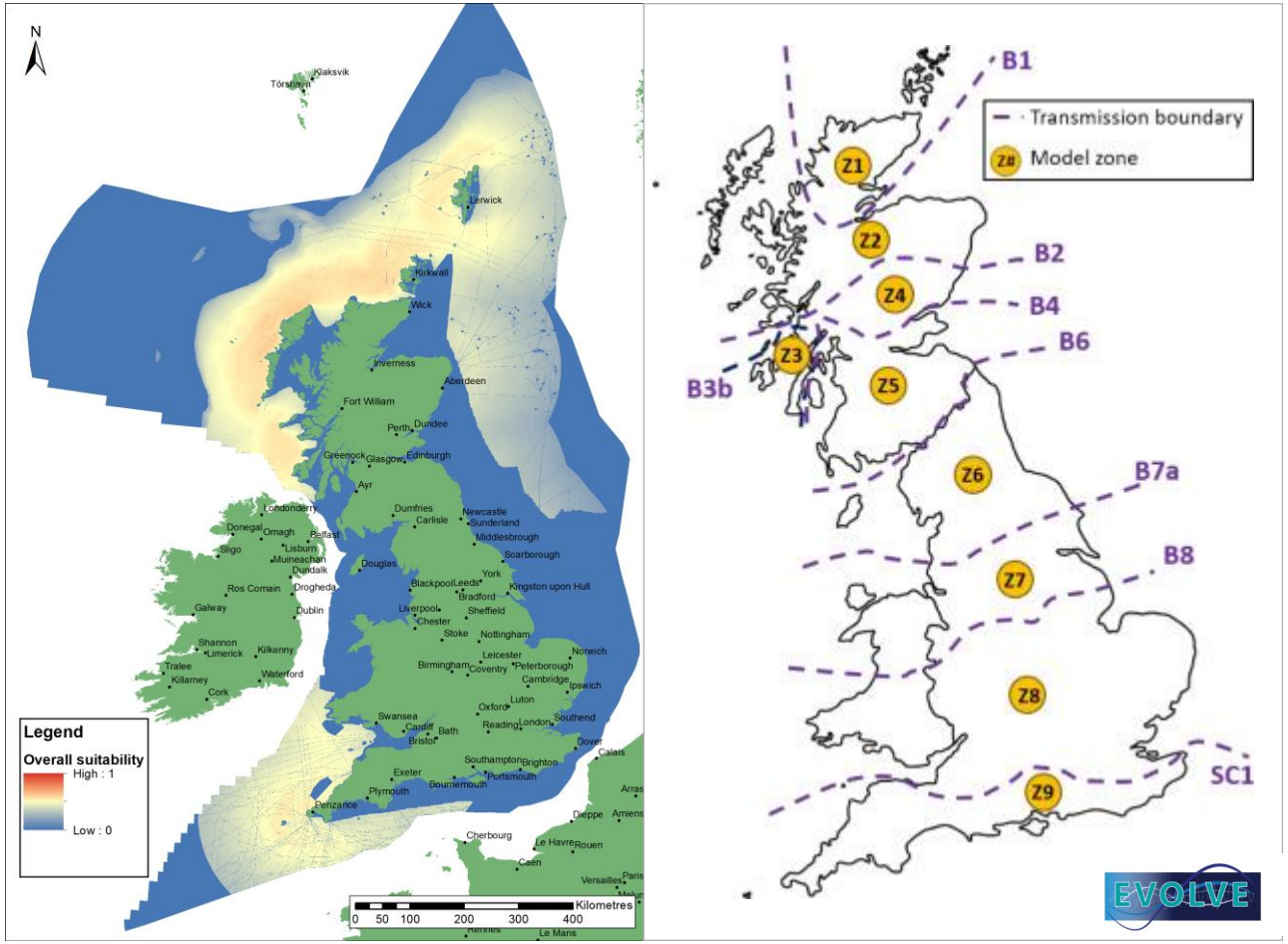
Computes hourly optimal dispatch: supply-demand matching

Key model inputs:

- Hourly demand profile data
- Hourly availability of intermittent renewables
- Fuel prices, carbon costs

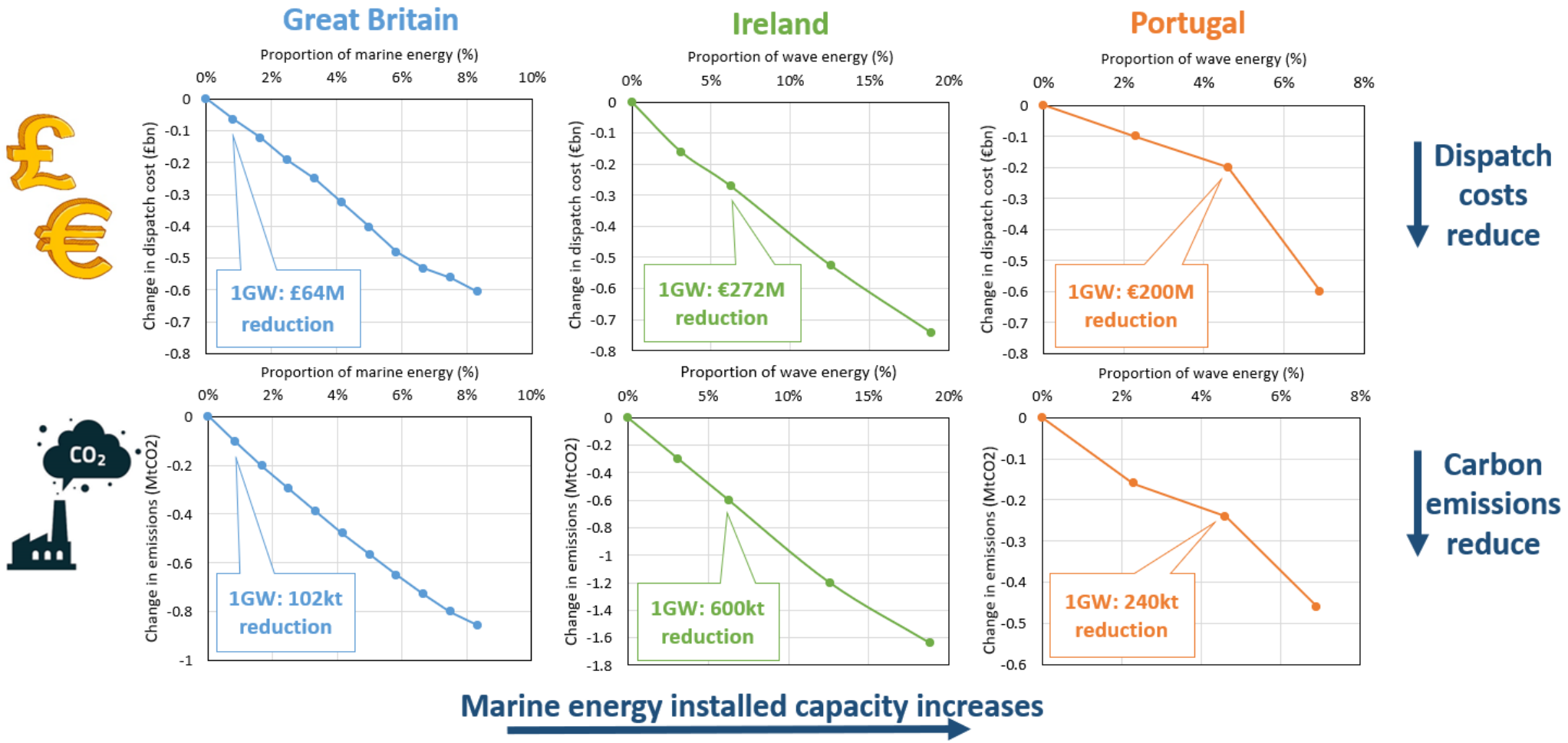
Key model outputs:

- Hourly generation, prices, carbon emissions



EVOLVE power system modelling

Results



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Conclusions

Copernicus Marine Services data products are an incredibly useful and powerful tool for ocean energy research and development

Wave data from Copernicus is being used for:

- Site studies and resource assessments
- Power system modelling
- Lifecycle assessments
- Technoeconomic assessments

CorPower Ocean

Research outputs

Studies using Copernicus data

- EVOLVE Project Consortium, “Technical Note: The system benefits of ocean energy to European power systems”, 2023. https://evolveenergy.eu/project-outputs/
- EVOLVE Project Consortium, “Technical Note: A review of practical deployment locations for European ocean energy projects”, 2023. https://evolveenergy.eu/project-outputs/
- S. Pennock and H. Jeffrey, “What are the UK power system benefits from deployments of wave and tidal stream generation?”, 2023. http://www.policyandinnovationedinburgh.org/uploads/3/1/4/1/31417803/supergen_ore_power_system_benefits_study_2023.pdf
- S. Pennock, D. Coles, A. Angeloudis, S. Bhattacharya and H. Jeffrey, “Temporal complementarity of marine renewables with wind and solar generation: Implications for GB system benefits,” Applied Energy, vol. 319, 2022. https://doi.org/10.1016/j.apenergy.2022.119276
- EVOLVE Project Consortium, Technical Note: The system benefits of ocean energy to islanded power systems, 2023. https://evolveenergy.eu/project-outputs/
- D. Keiner et al, “Powering an island energy system by offshore floating technologies towards 100% renewables: A case for the Maldives,” Applied Energy, vol. 308, 2022. https://doi.org/10.1016/j.apenergy.2021.118360

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