WAVE ENERGY

ENABLING 100% RENEWABLES

DOES OCEAN ENERGY HAVE A ROLE IN THE ENERGY MIX?

- Have we understood the reason to exist?
- Levelized value per MWh of a certain technology in a current market vs LCOE
- The need to balance the energy system

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Wind farms paid record £.9.3m to switch off their turbines

The so-called 'constraint payments' have been declared a "national embarrassment" and a power management "disgrace" by campaigners

By Phoebe Southworth *and* Edward Malnick, SUNDAY POLITICAL EDITOR

23 May 2020 • 9:00pm

Related Topics

National Grid, Wind power

More than 80 plants across England and Scotland were compensated for the lack of demand | CREDIT: Danny Lawson/PA

Bloomberg Green

The Big Take

Global Energy Crisis Is the First of Many in the Clean-Power Era

The next several decades could see more periods of energy-driven inflation, fuel shortages and lost economic growth as electricity supplies are left vulnerable to shocks.

By David R Baker, Stephen Stapczynski, Dan Murtaugh, and Rachel Morison

October 4, 2021, 10:01 PM MDT *Updated on October 5, 2021, 3:40 AM MDT*

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THE OPPORTUNITY: 500 GW | 10% OF GLOBAL ELECTRICITY [REF]

- 500 GW | 2300 TWh
- CO_2 Reduction | 1 – 2.2 Gigaton (vs Gas - Coal)
- Production profile is more **consistent and complementary** to wind and solar, providing higher average revenue potential per MWh.
- Provides **grid balancing** enabling 100% renewable electricity systems.

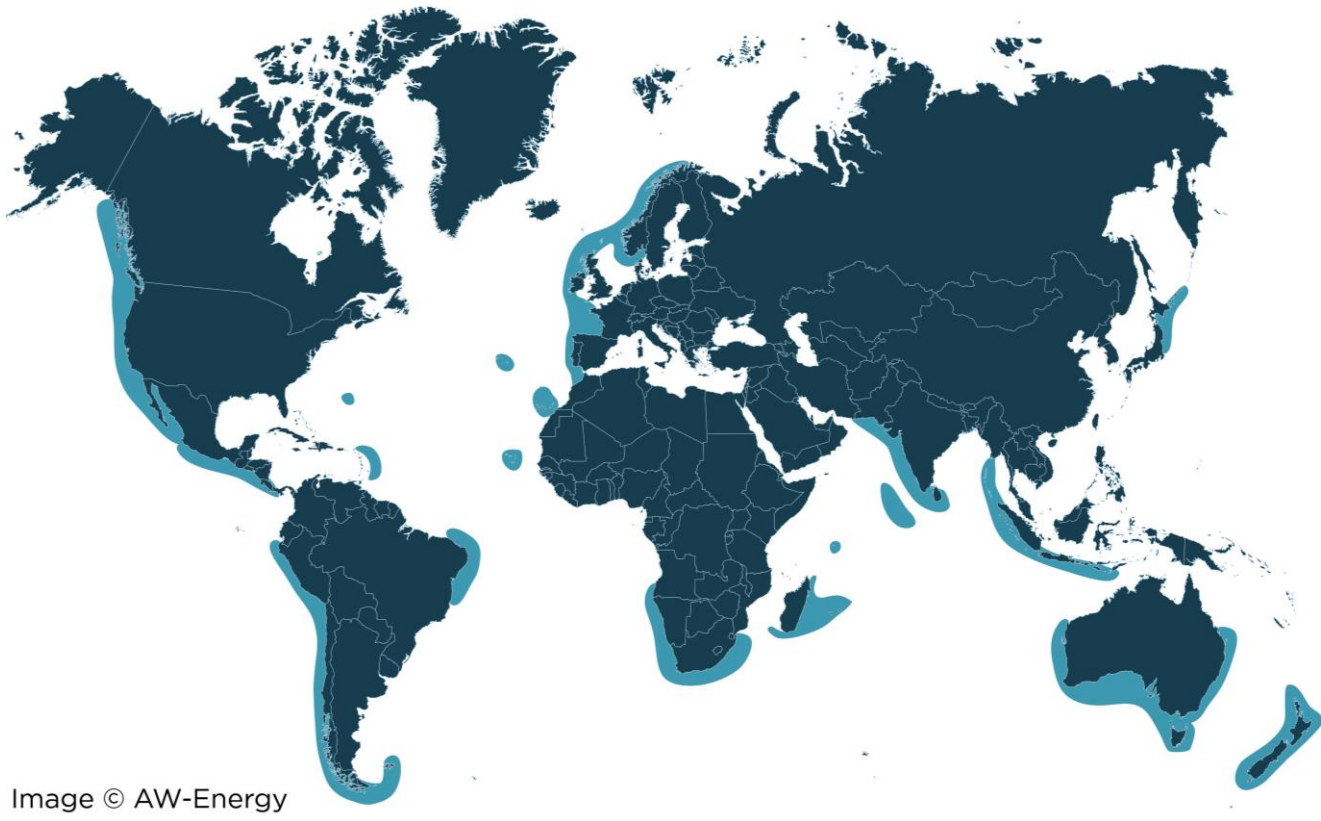
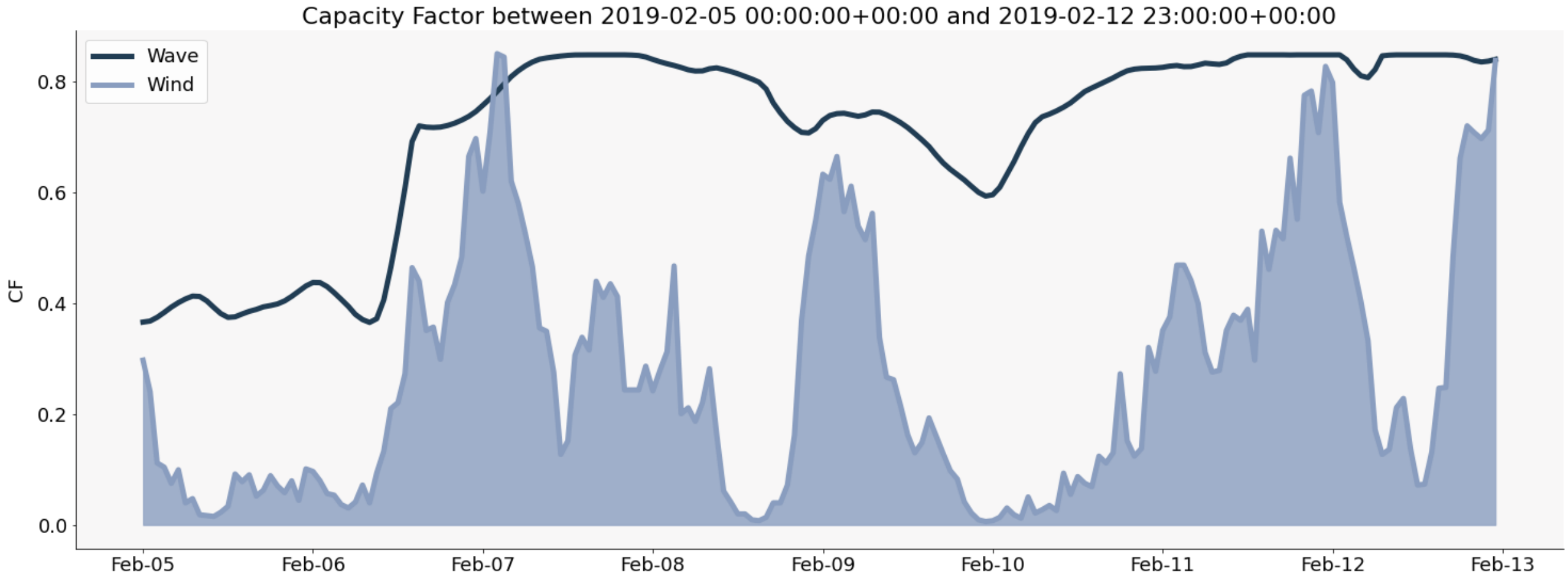


Image © AW-Energy

WIND & WAVE IN NORWAY

smoothing used:0 days 01:00:00



THE COMBINATION PROVIDES BALANCING

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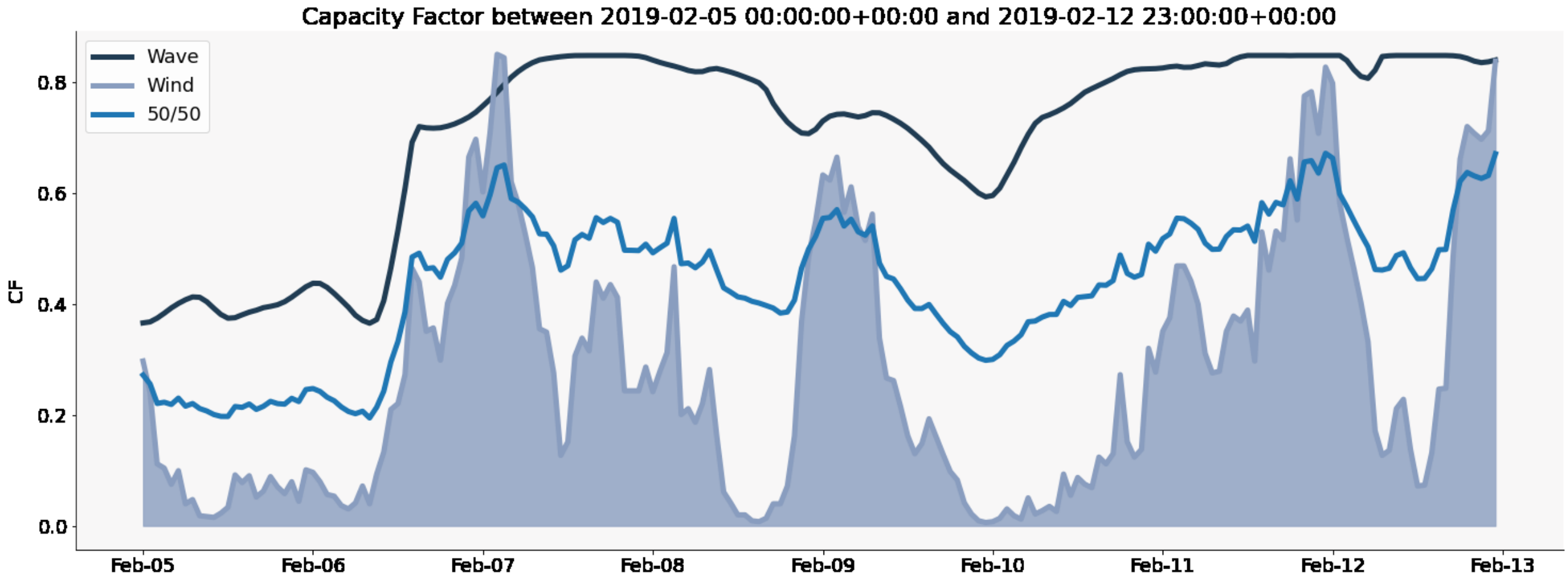
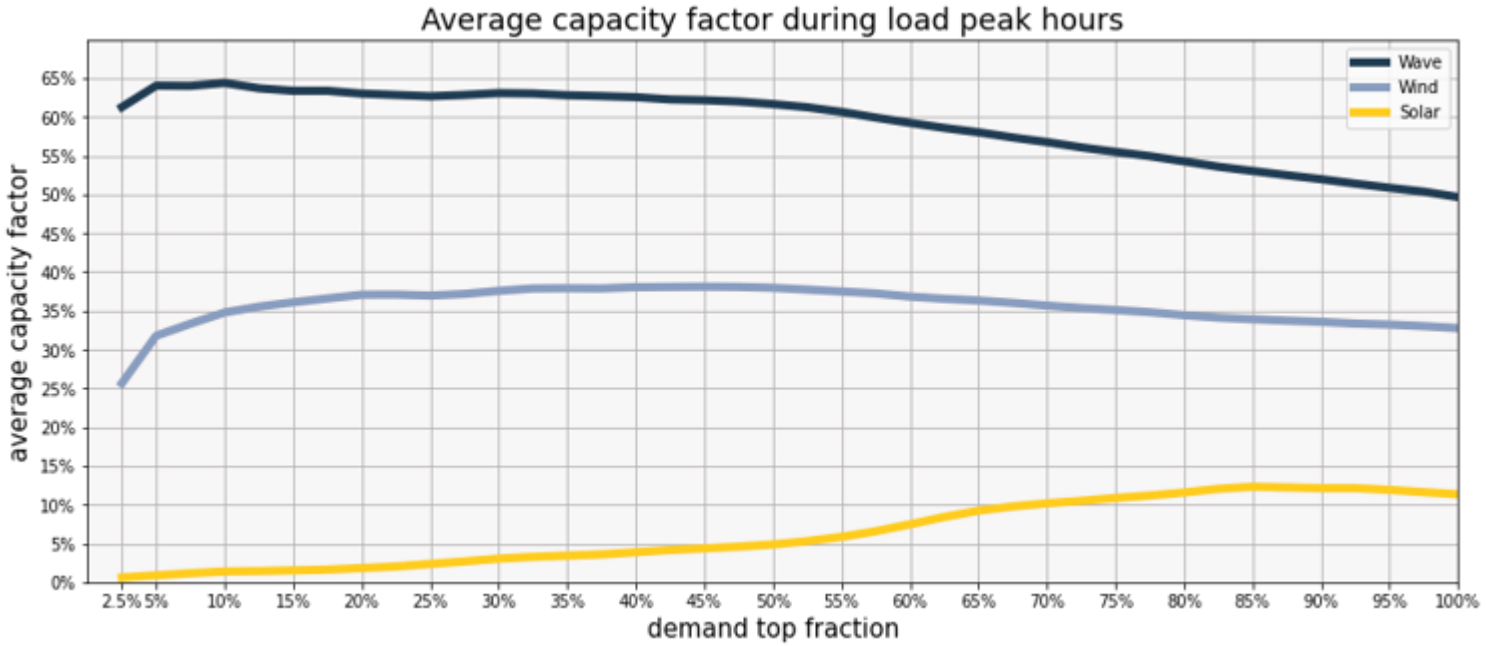


AVARAGE CF DURING PEAKS

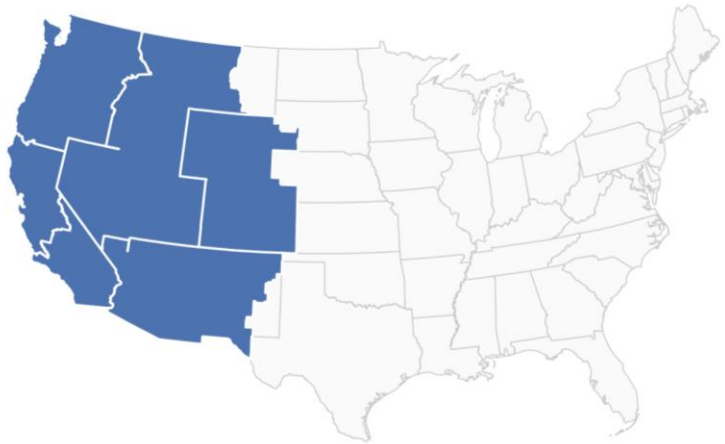


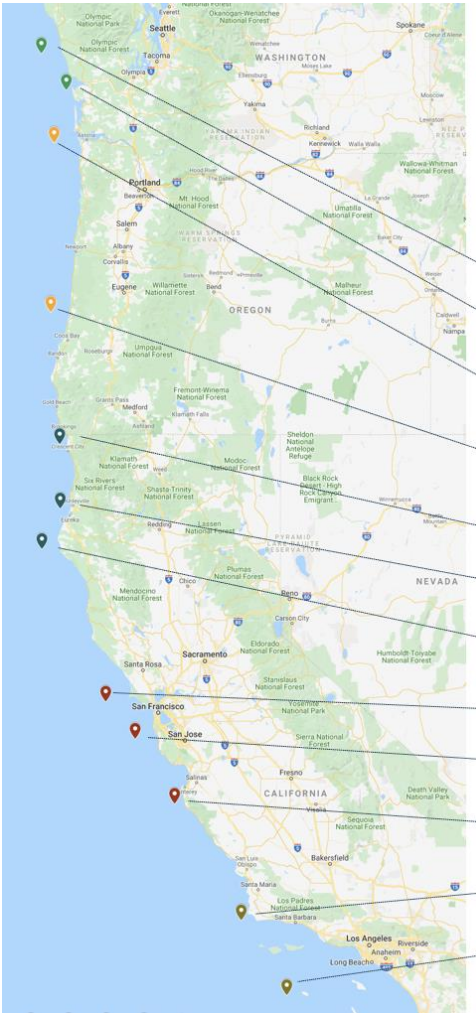
Wave energy over performs during peaks of demand, whereas wind and solar underperform

During the highest 5% hours of electricity consumption of Sweden and Norway, wave energy would have produced at 65% of its capacity whereas wind was only producing at 32% of its capacity and solar only a few percents.

US WEST COAST SYSTEMS STUDY

DeSolve
Data Analytics | Decision Support





Buoy ID	Latitude	Longitude	Site ID	Depth(m)	Seasonality (min/max)	Days below 40kW	Capacity factor (net)
NDBC46041	47.35	-124.74	WA2	128	25%	15.71	53.44%
CDIP36	46.86	-124.24	WA1	40	26%	7.63	50.43%
NDBC46029	46.14	-124.49	OR2	134	23%	21.54	55.04%
CDIP139	43.77	-124.55	OR1	186	22%	41.83	55.33%
NDBC46027	41.85	-124.38	CAN3	47	27%	17.83	54.09%
CDIP168	40.90	-124.36	CAN2	110	33%	6.75	56.17%
CDIP94	40.29	-124.73	CAN1	345	42%	0.50	61.43%
CDIP29	37.94	-123.46	CAC1	550	51%	0.21	63.45%
NDBC46012	37.36	-122.88	CAC3	209	44%	4.17	56.29%
CDIP157	36.33	-122.10	CAC2	369	42%	16.58	57.96%
CDIP71	34.45	-120.78	CAS1	558	51%	0.13	57.52%
CDIP67	33.22	-119.88	CAS2	274	58%	12.00	54.92%

Which energy mix gives the lowest cost zero carbon system?

GenX model by Jenkins and Sepulveda. [ref]

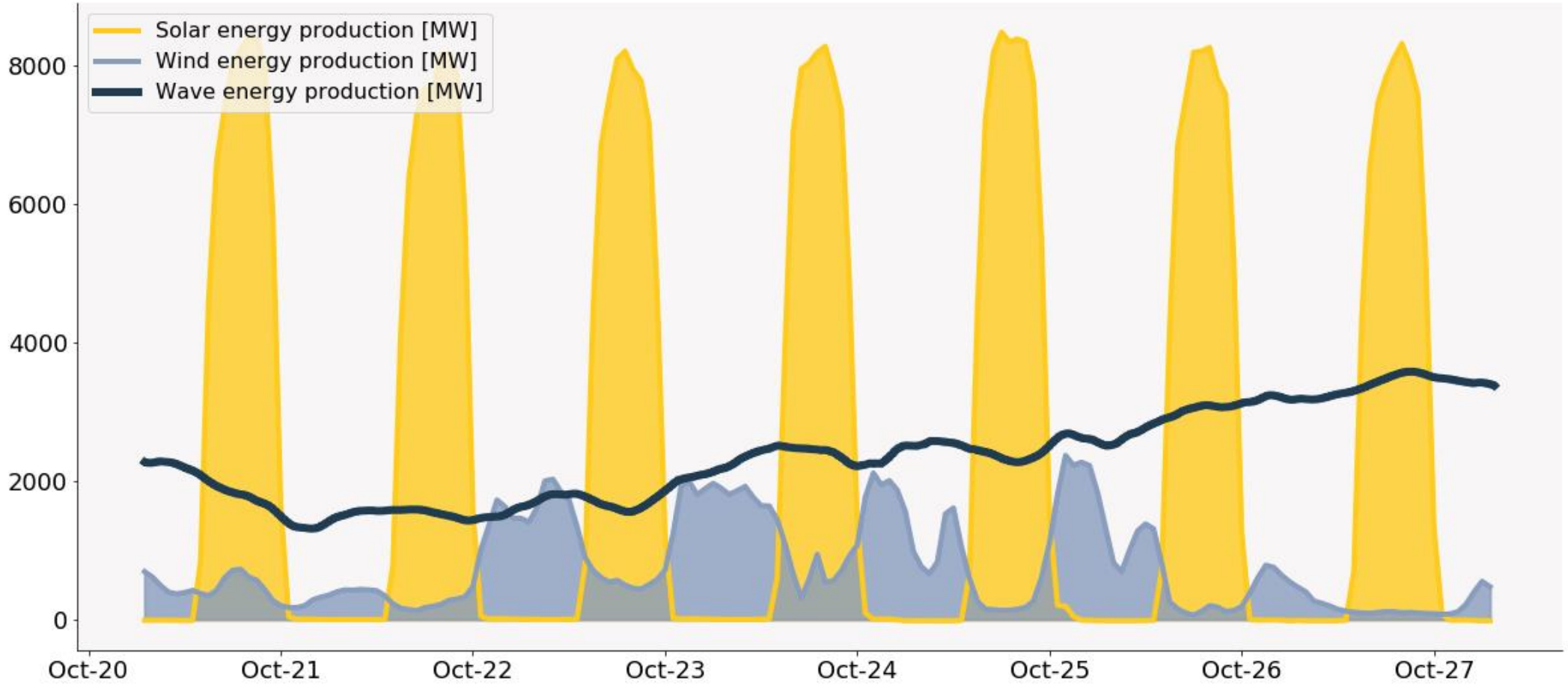
WECC simulated as three zones:

i) California
ii) Pacific Northwest (OR, WA)
iii) Interior West: ID, MT, UT, WY, CO, NV, AZ, NM

2011 weather data

Temporal resolution: 8760h full year model

CONSISTENT AND COMPLEMENTARY PRODUCTION PROFILE



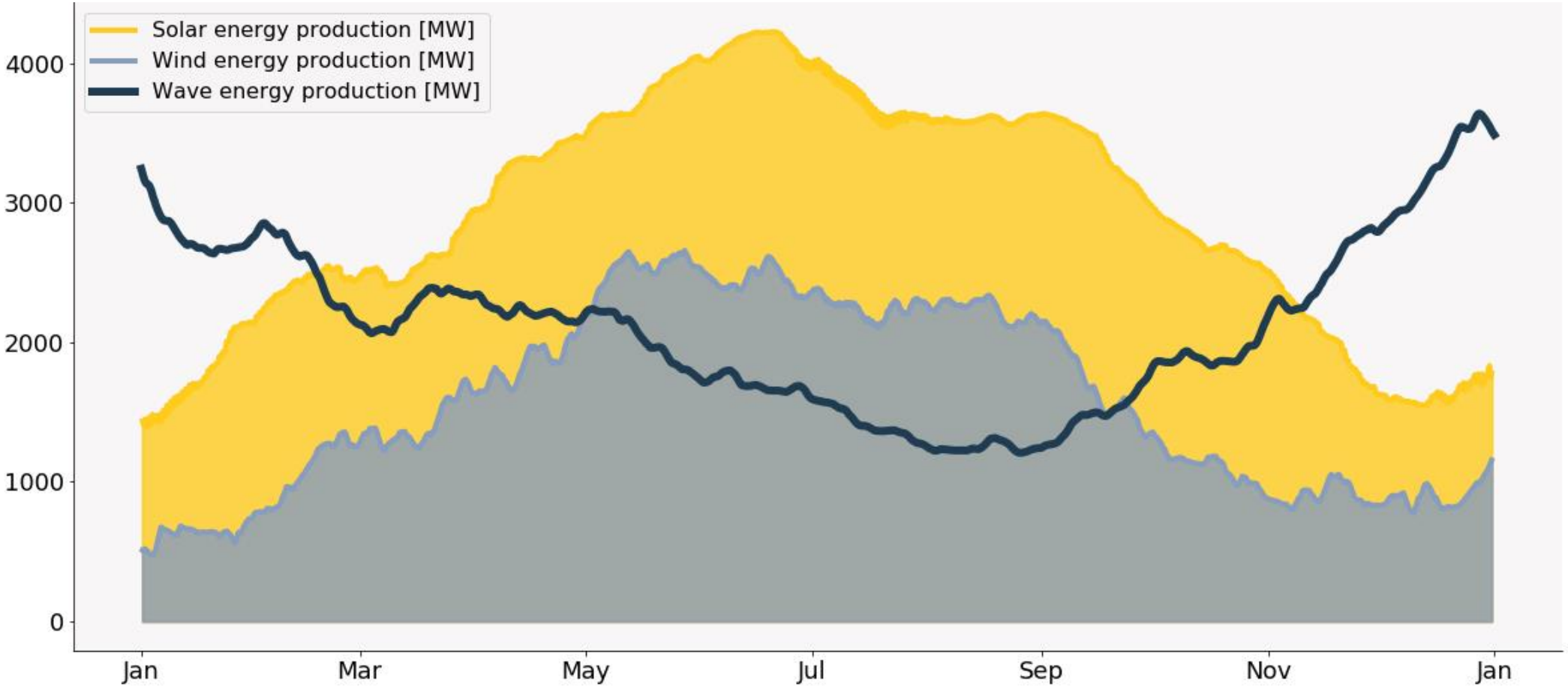
Wind (6.5 GW) and solar (13.5GW) production: Actual time series of the period
Wave production (6.0 GW): Estimate based on measured wave data and CorPower power matrix
6 GW wave energy devices evenly distributed over four sites along the coast of California

CORPOWER OCEAN

ANNUAL PROFILE

Annual profile is complementary to solar and wind on US west coast.

Attractive for seasonal balancing.



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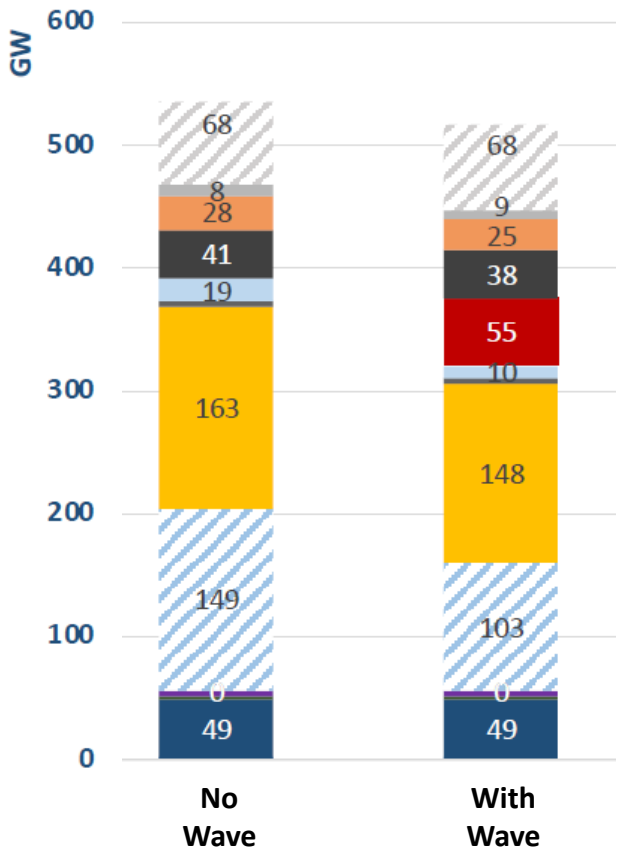
CORPOWER OCEAN

LOWEST COST ZERO CARBON SYSTEM [REF]

2040-2050 system: 0 g CO_2 / kWh



Lowest cost system by GenX:

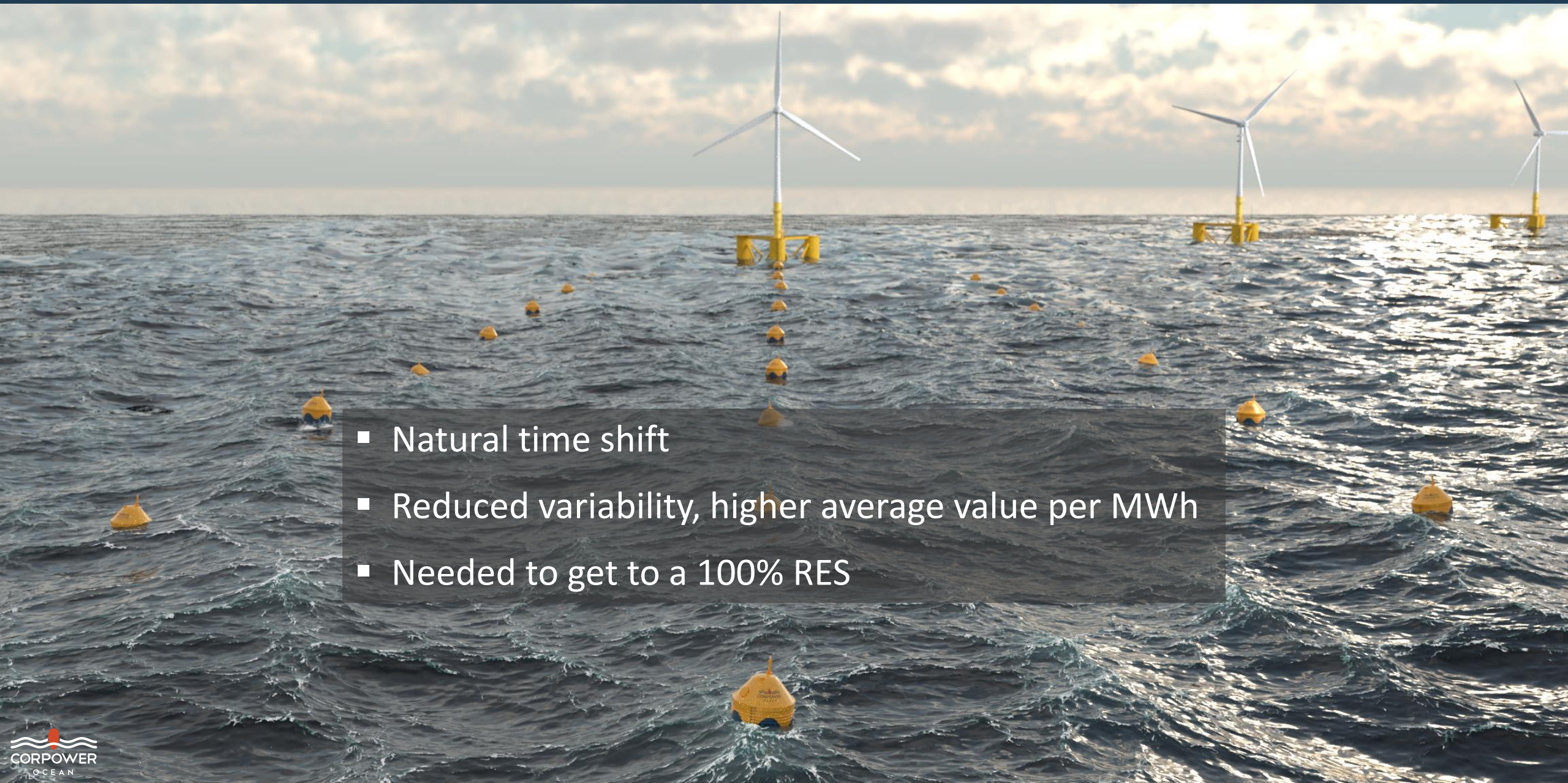
55 GW of Wave Energy

122 000 WECs

Net change: **- 24 GW** system

Biomass | Hydro | Geothermal | Nuclear | CCGT | OCGT
Onshore Wind | PV | PHS | Coal | CCS | Offshore wind
Wave | Battery | Biogas | Hydrogen | EV

REASON TO EXIST



- Natural time shift
- Reduced variability, higher average value per MWh
- Needed to get to a 100% RES

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THANK YOU

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