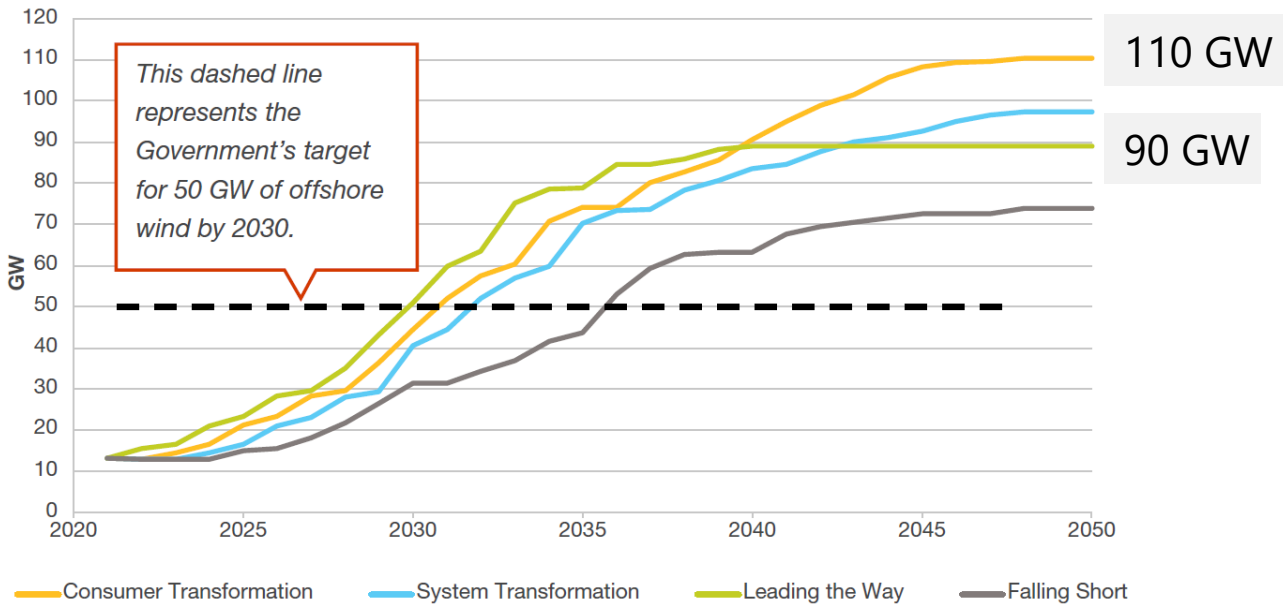
Go West!

Jack Adkins – Senior Energy Analyst

An analysis of the energy system benefits and implications of a more diversified offshore wind portfolio

Photo credit: WindFloat

Figure ES.E.13: Installed offshore wind generation capacity (GW)

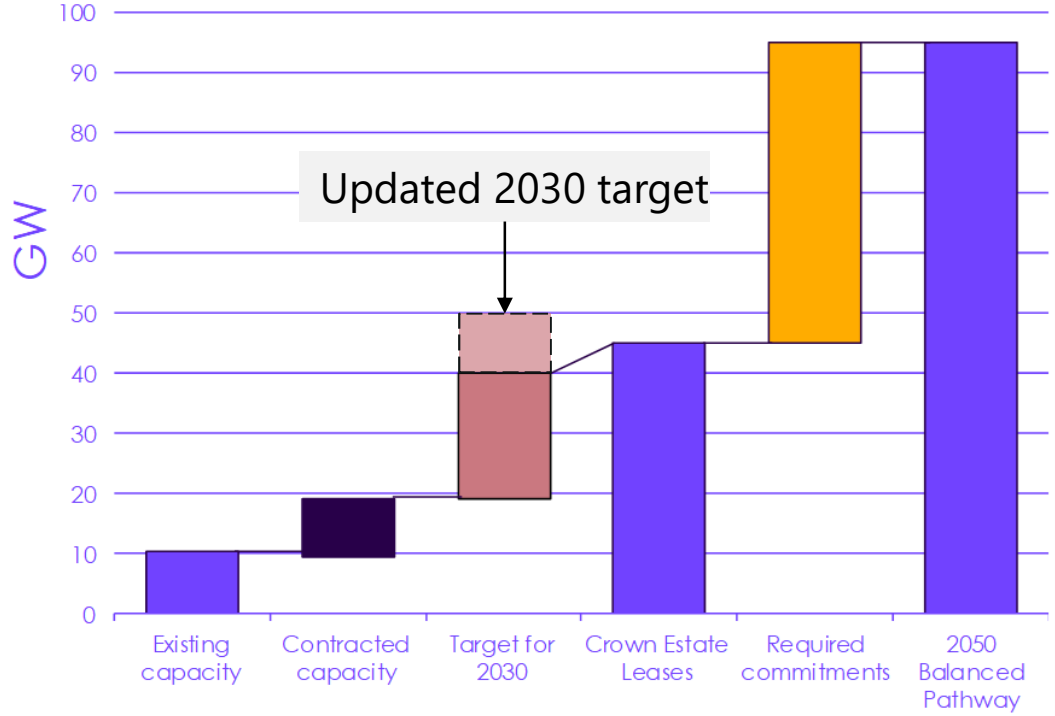


National Grid ESO Future Energy Scenarios 2022

Wind is main source of UK electricity for first time

11 May · Comments

Figure B5.1 Delivering offshore wind to 2050 in the Balanced Pathway



Climate Change Committee's 6th Carbon Budget (2020)

Source: CCC analysis based on BEIS (2019) *Energy Trends: Table 5.1* , The Crown Estate (2019) *Offshore wind operational report* , Low Carbon Contracts Company (2020) *CfD Register*

Overview

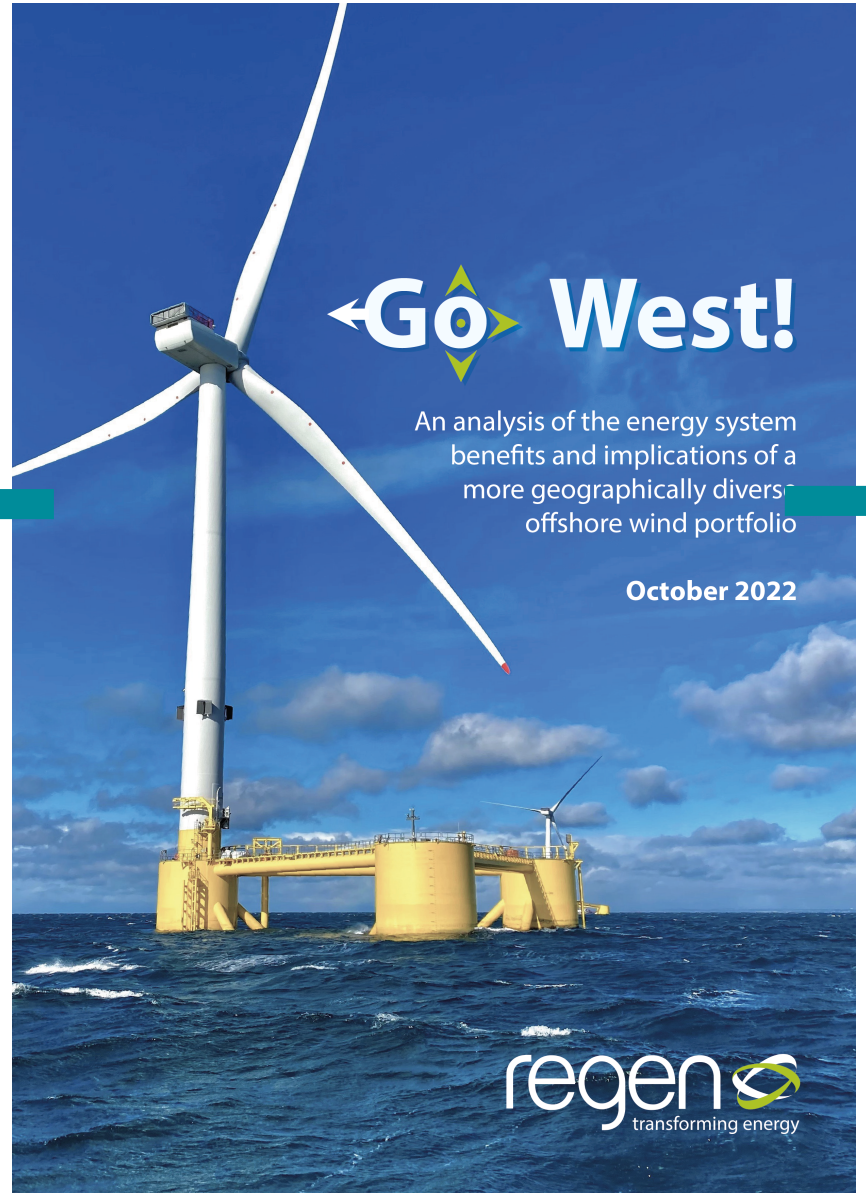
Who, in the UK institutional framework, is responsible for systems-thinking and asking questions like:

"Are those Offshore Wind Farm sites optimal from a wider energy system reliability and resilience perspective?"

Independent report of the Offshore Wind Champion

Seizing our Opportunities

March 2023



A recent study by Regen found that balancing offshore wind capacity between east and west coasts offers multiple benefits, including ***more consistency*** *and* ***reduced variability of total available GB generation, with no reduction in total energy generation (yield) per year.***

Delivering a reliable decarbonised power system

March 2023

Climate Change Committee

Contents

What I learned from the tidal stream sector

What I learned from the tidal stream sector

‘Huge mistake’: Britain throwing away lead in tidal energy, say developers

Nation is a leader in capturing tidal and wave energy, but companies are starting to leave due to lack of government support

Damian Carrington
Environment editor
@dpcarrington
Tue 19 Jun 2018 07.00 BST

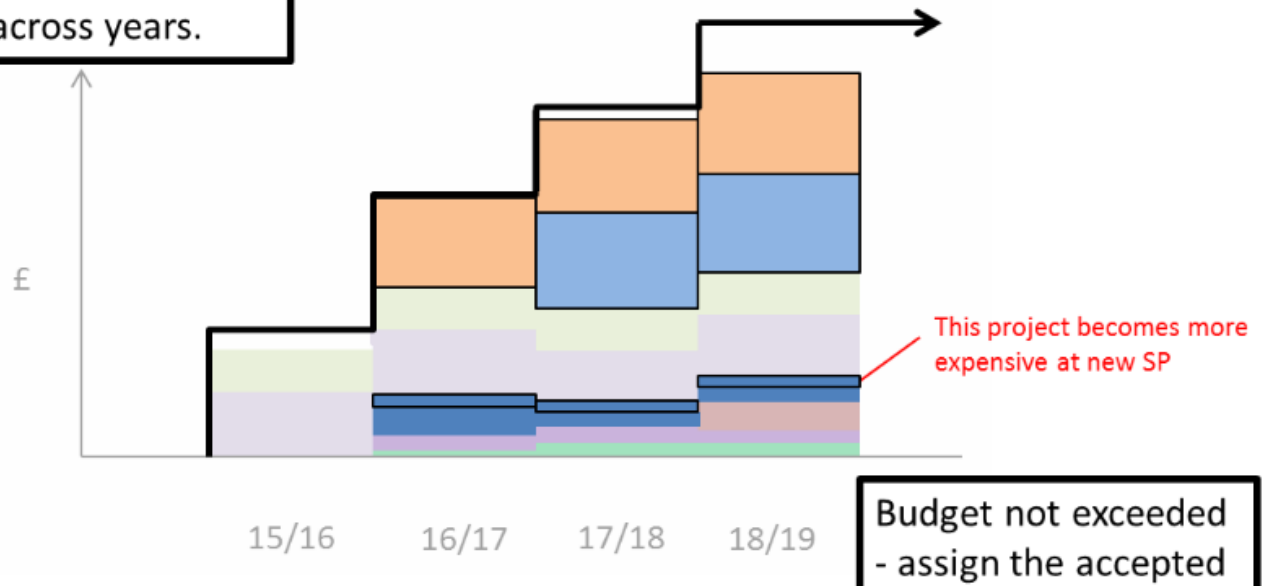
A tidal energy turbine is loaded onto a barge, heading for an Atlantis Resources test site off Orkney. Photograph: Jeff J Mitchell/Getty Images

Contracts for Difference

Department of Energy & Climate Change

Look at impact on budget across years of this and all projects accepted so far. Check if fits under budget profile across years.

If budget were exceeded in this case, Tiebreaker rules would apply.



Budget not exceeded - assign the accepted projects the highest SP bid for that year of deployment, capped at its ASP.

Lack of wind sparks new fears over green energy revolution

Lulls trigger questions over the long-term predictability of wind patterns amid escalating climate change

UK energy titan SSE says low wind, driest conditions in 70 years hit renewable generation

PUBLISHED WED, SEP 29 2021•2:37 PM EDT | UPDATED WED, SEP 29 2021•3:50 PM EDT

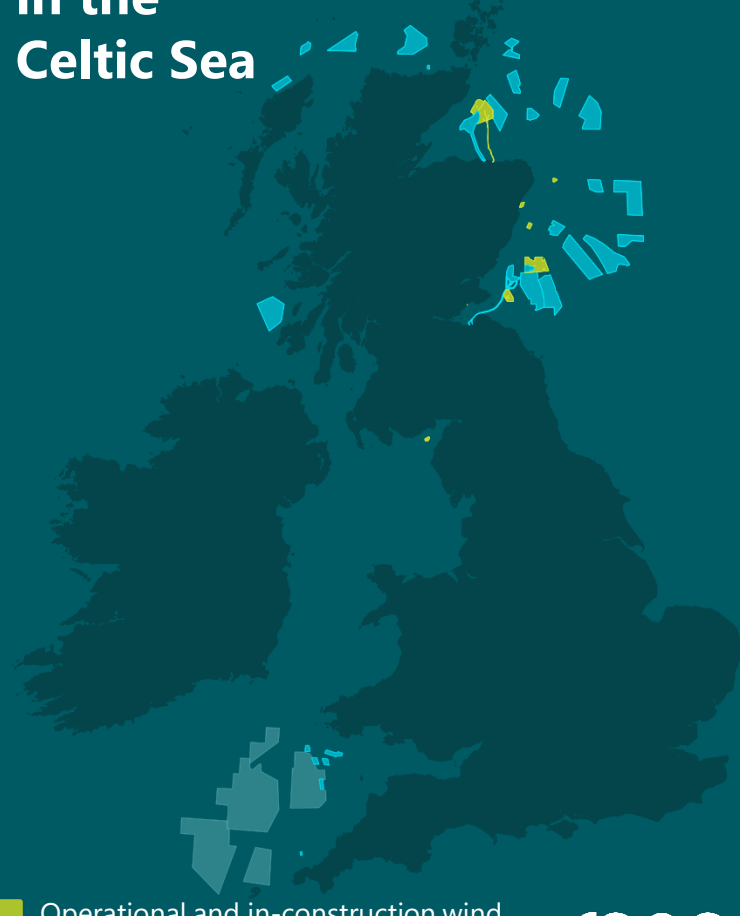
January 11, 2021

Balancing Mechanism price jumps to highest level since 2001, hitting £4,000/MWh

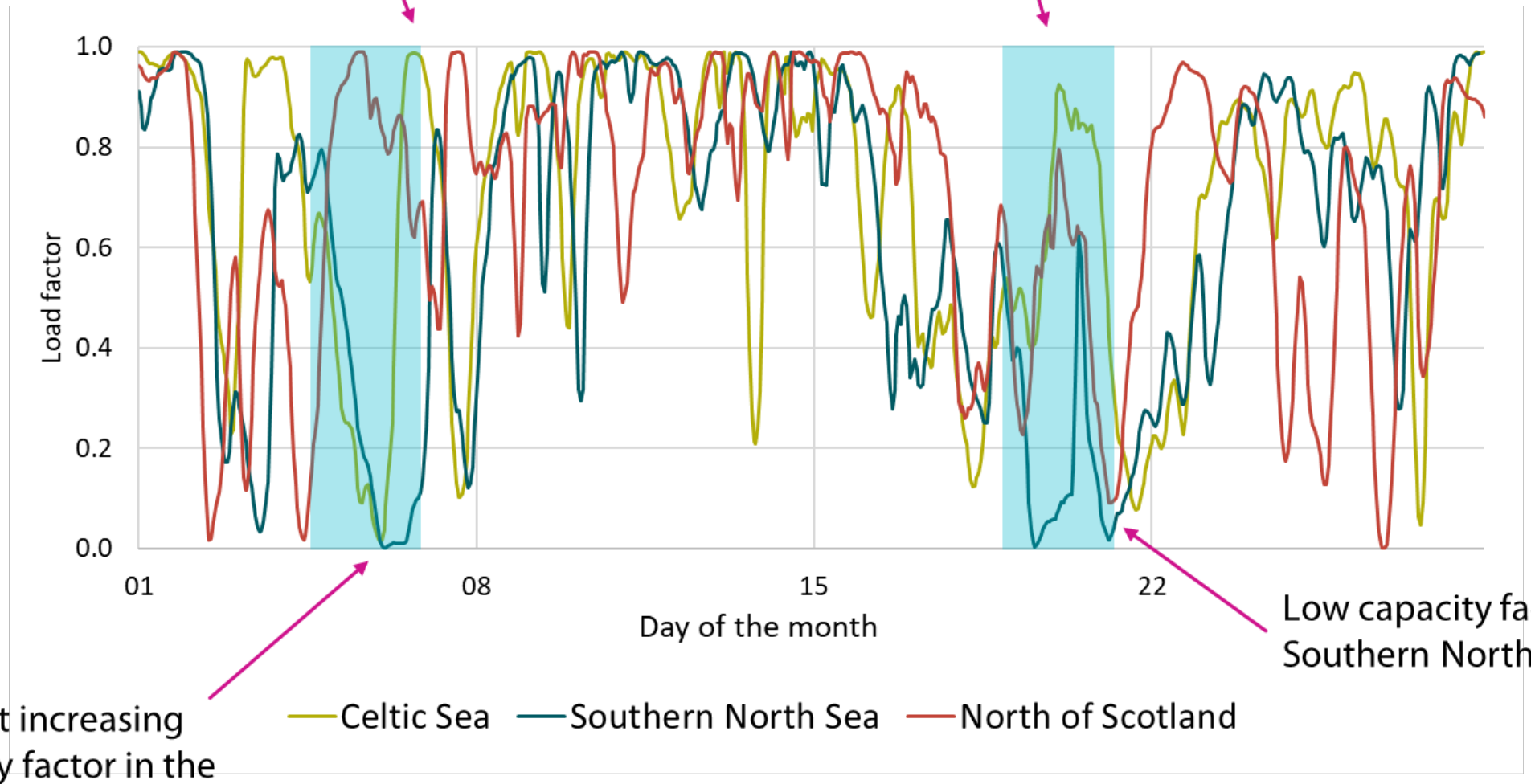
The current offshore wind fleet

The majority of operational and under construction wind farm sites lie on the east coast of Great Britain

Anticipated build-out of offshore wind around Scotland and in the Celtic Sea



Example of complementary resource



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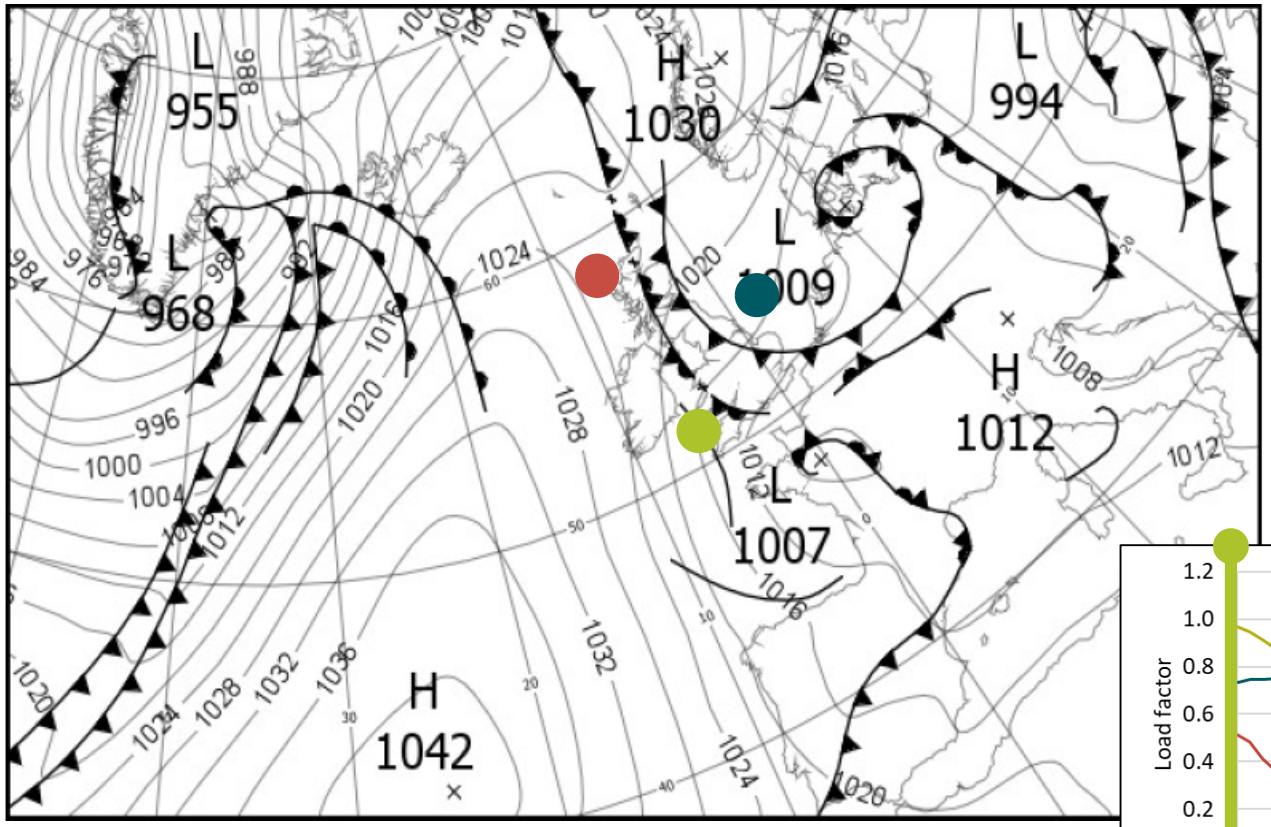

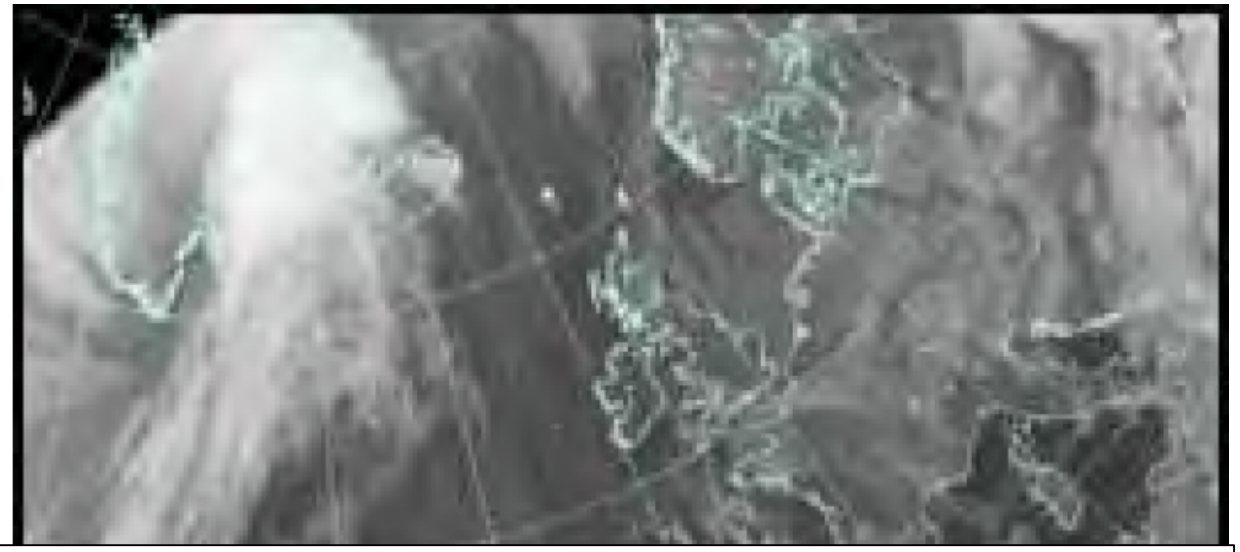

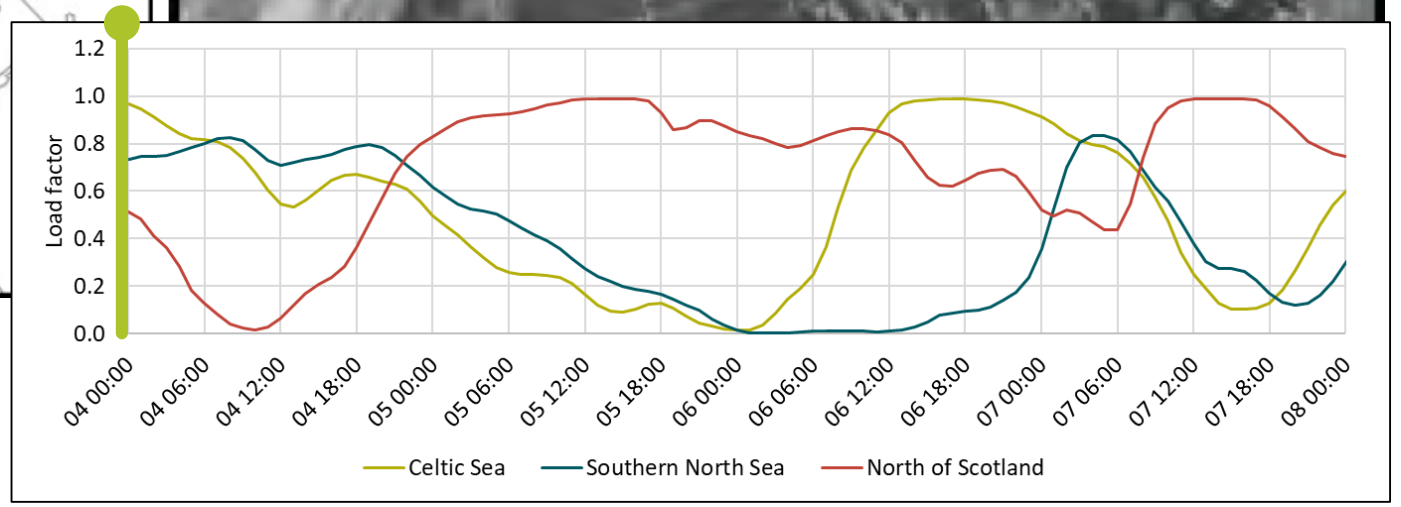

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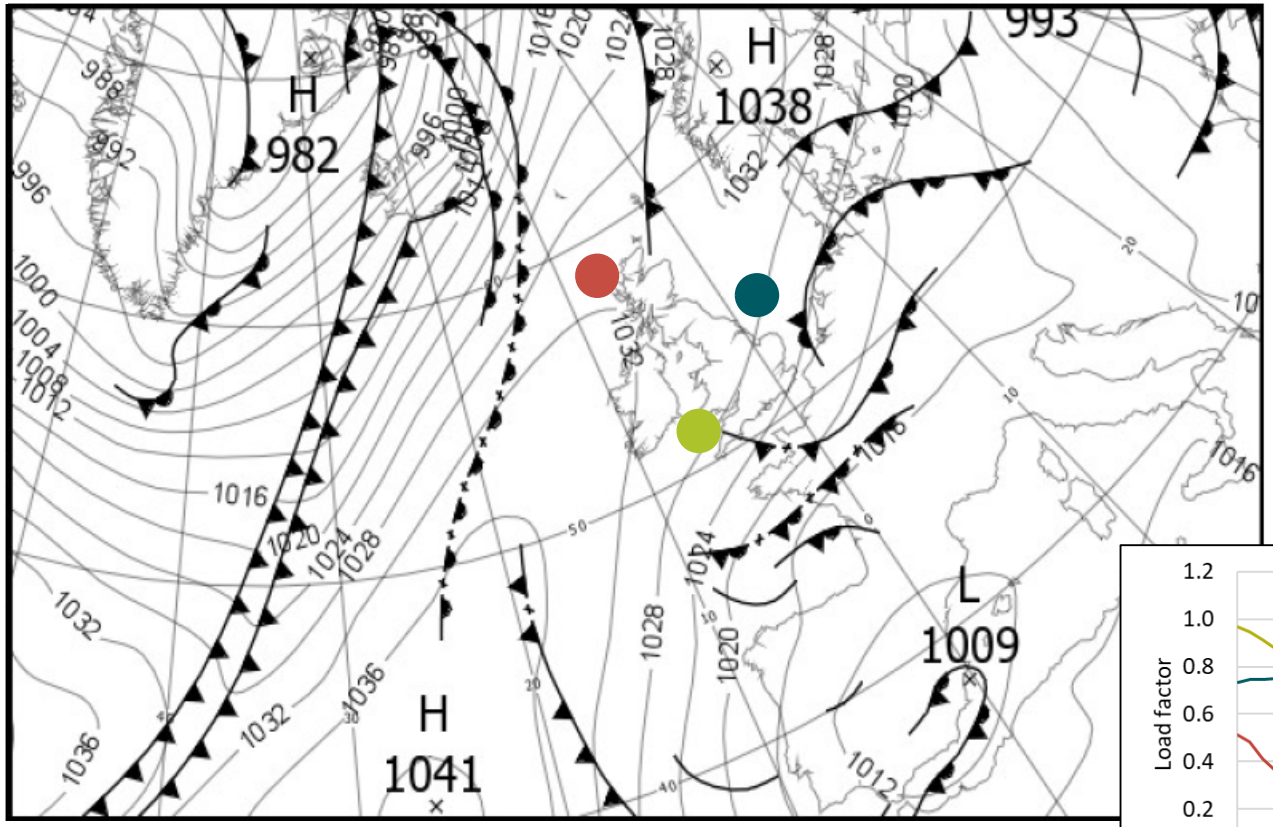

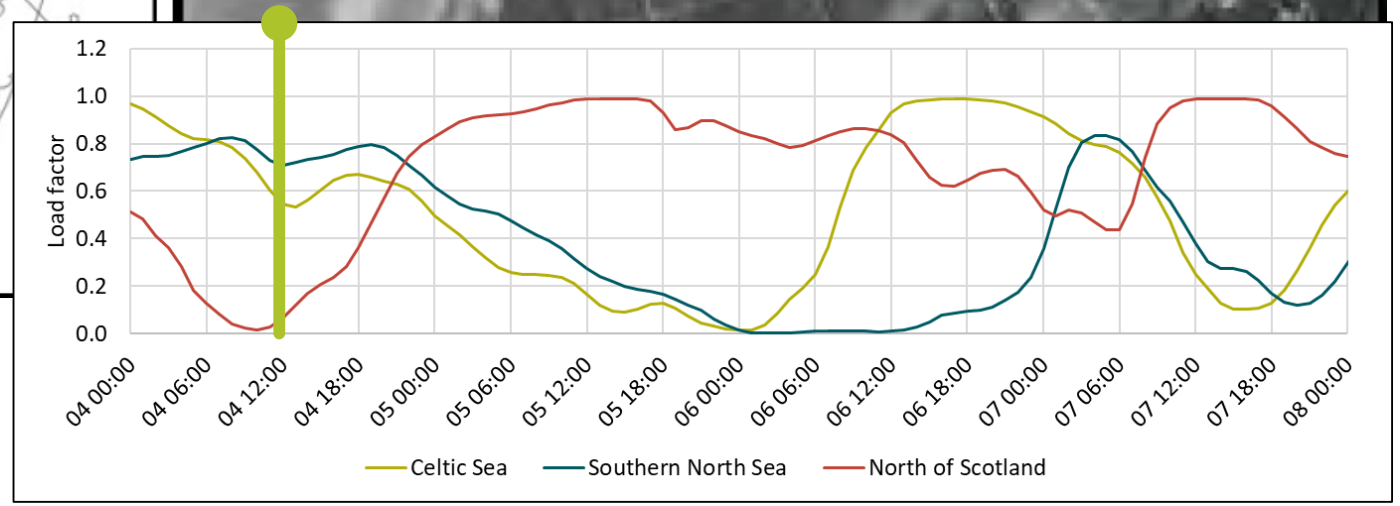

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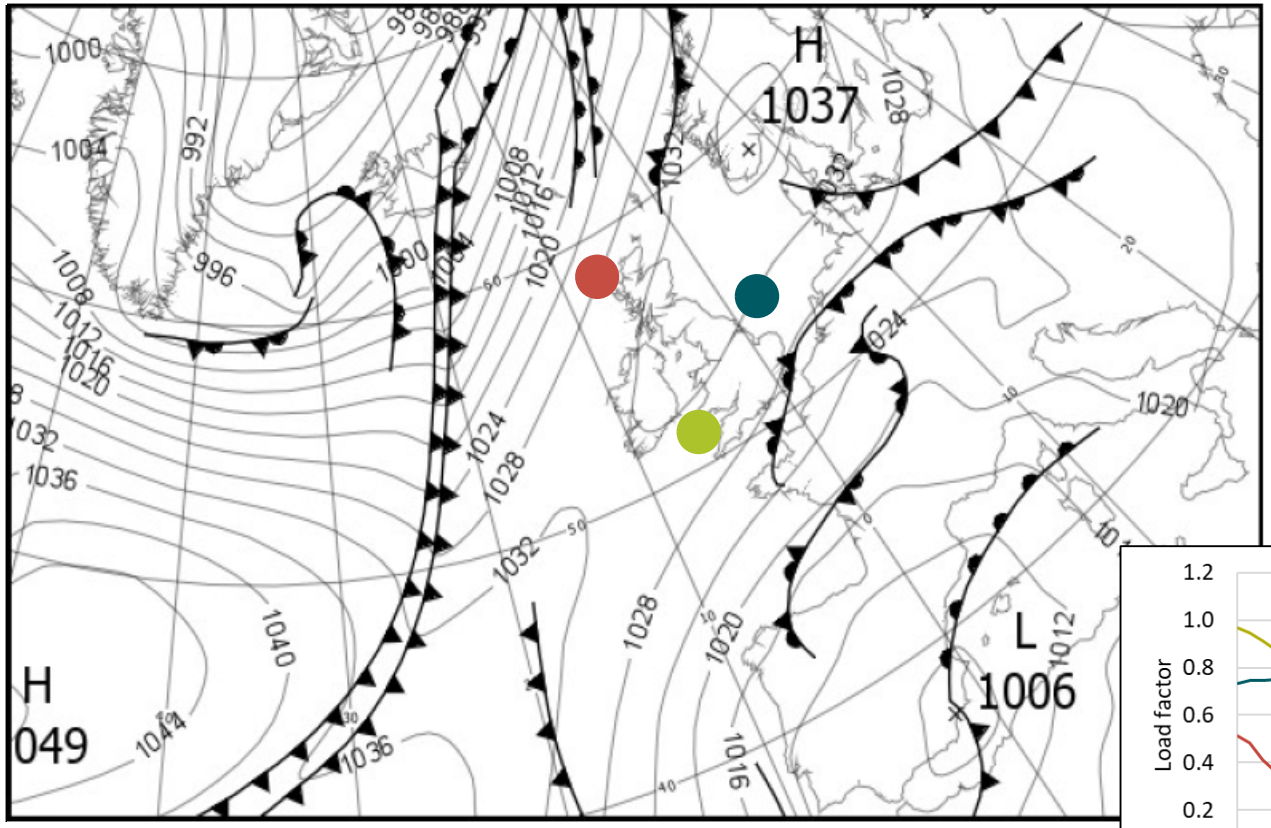

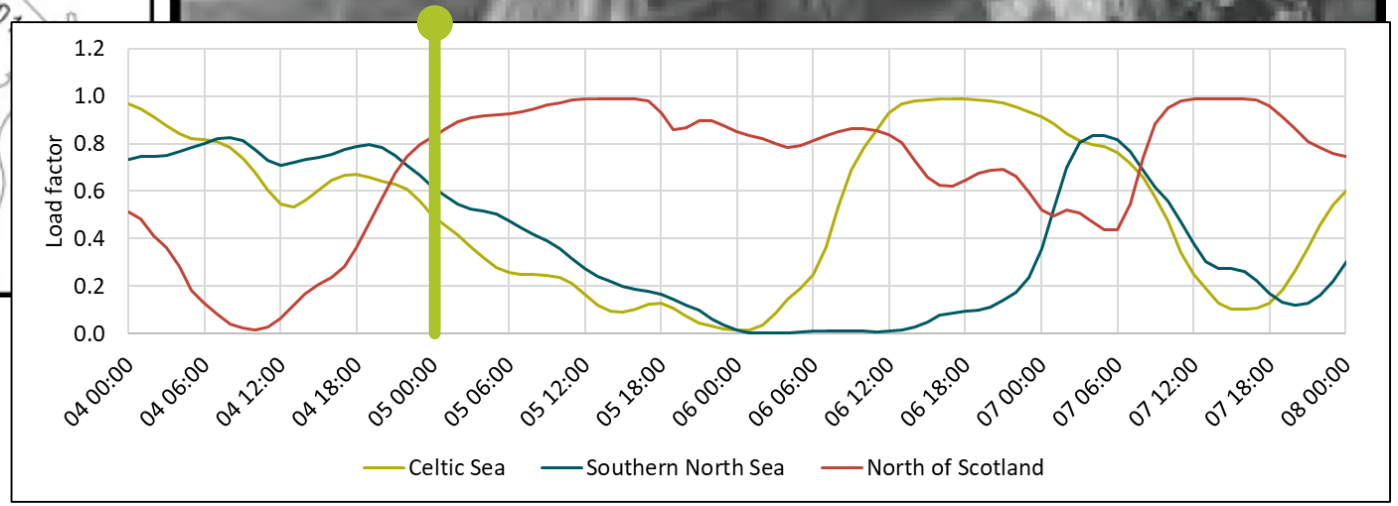

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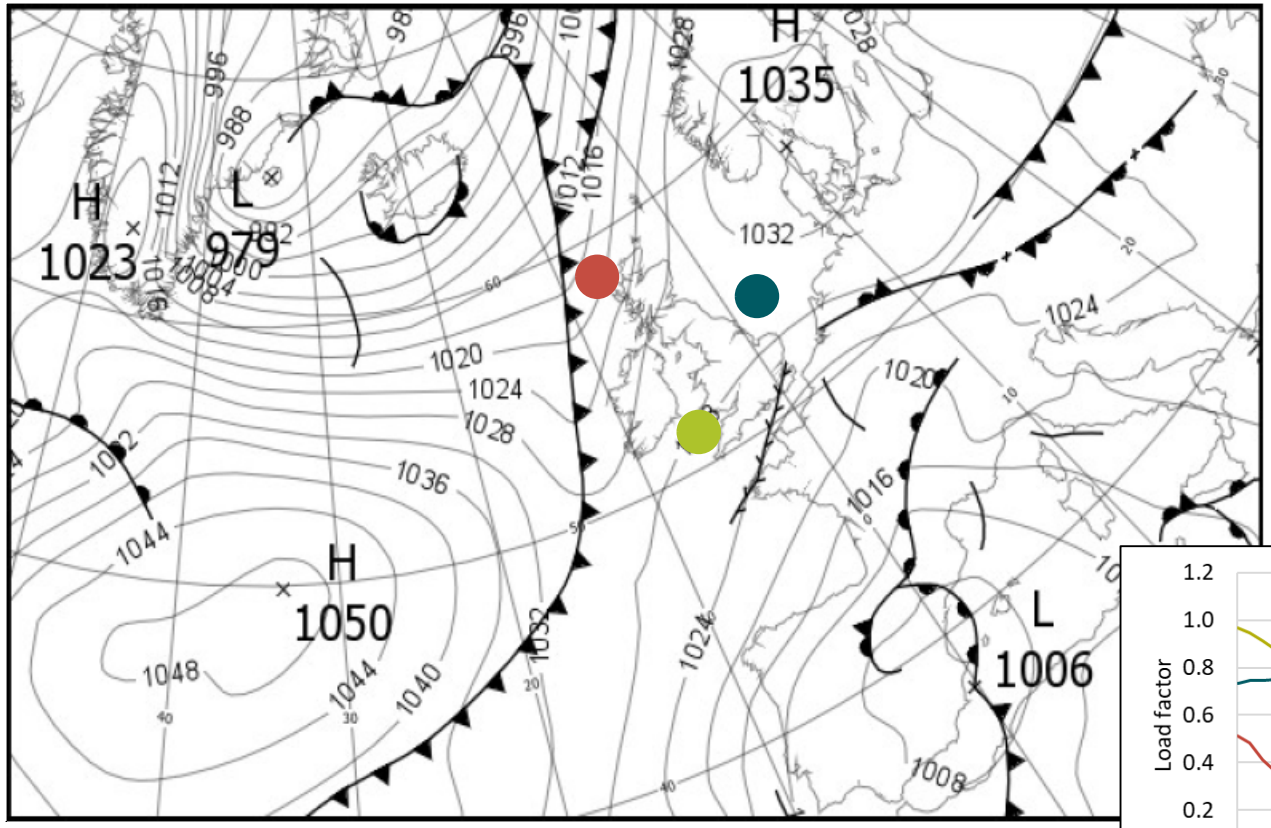

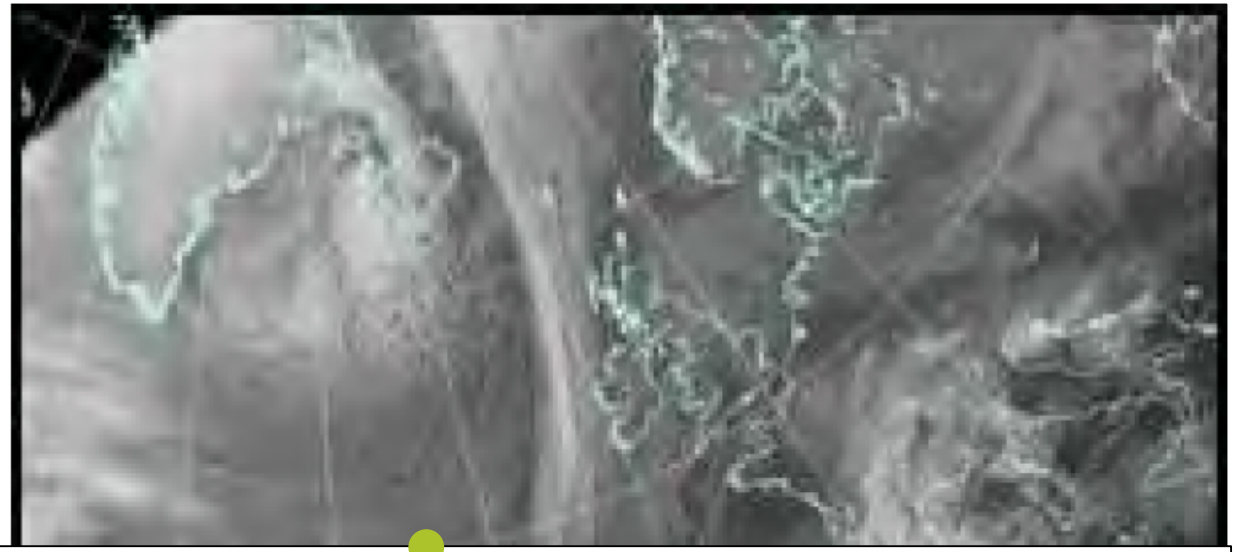

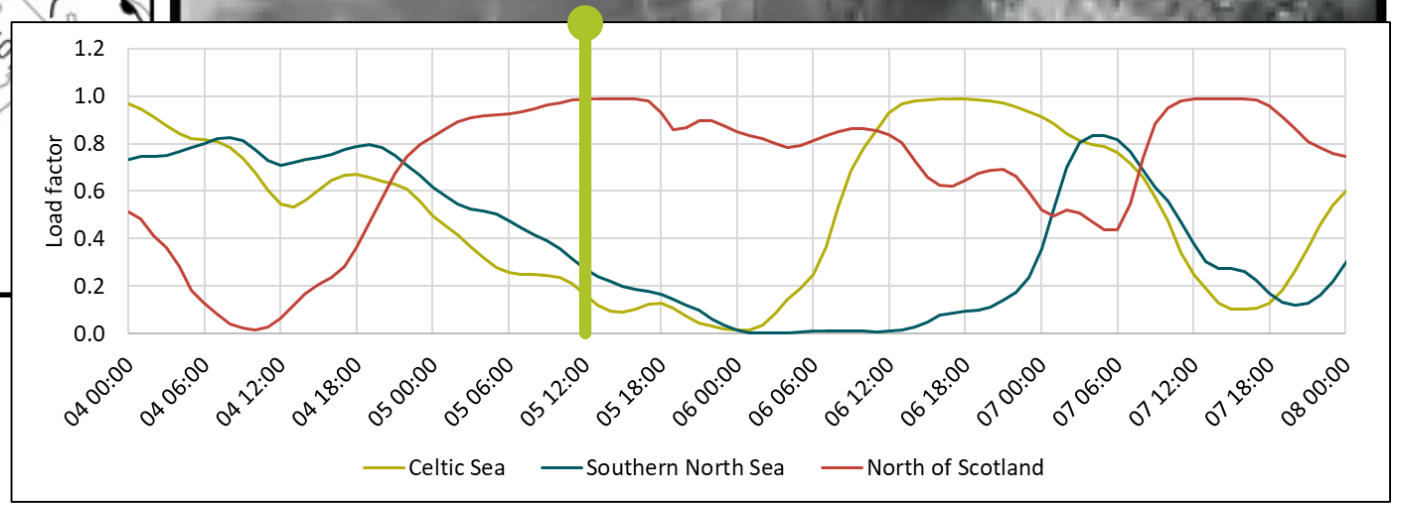

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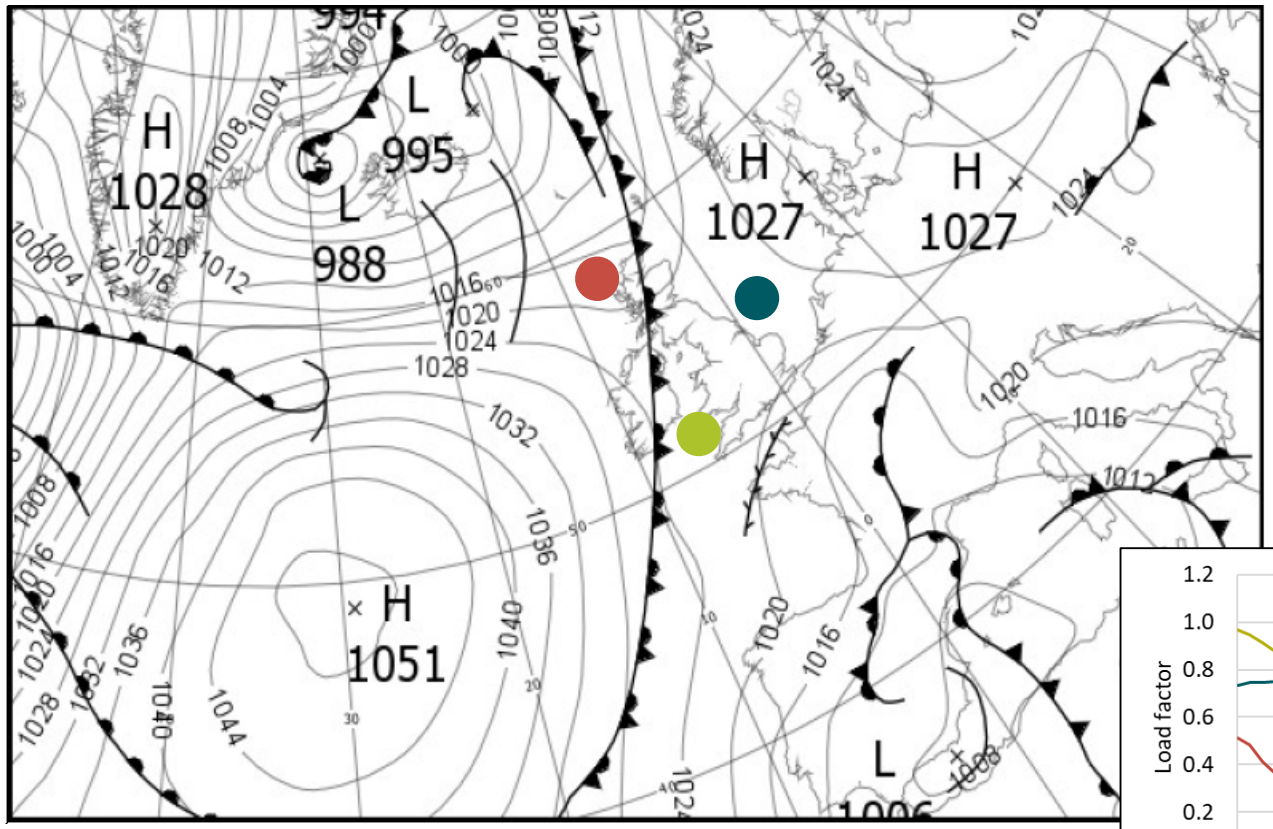

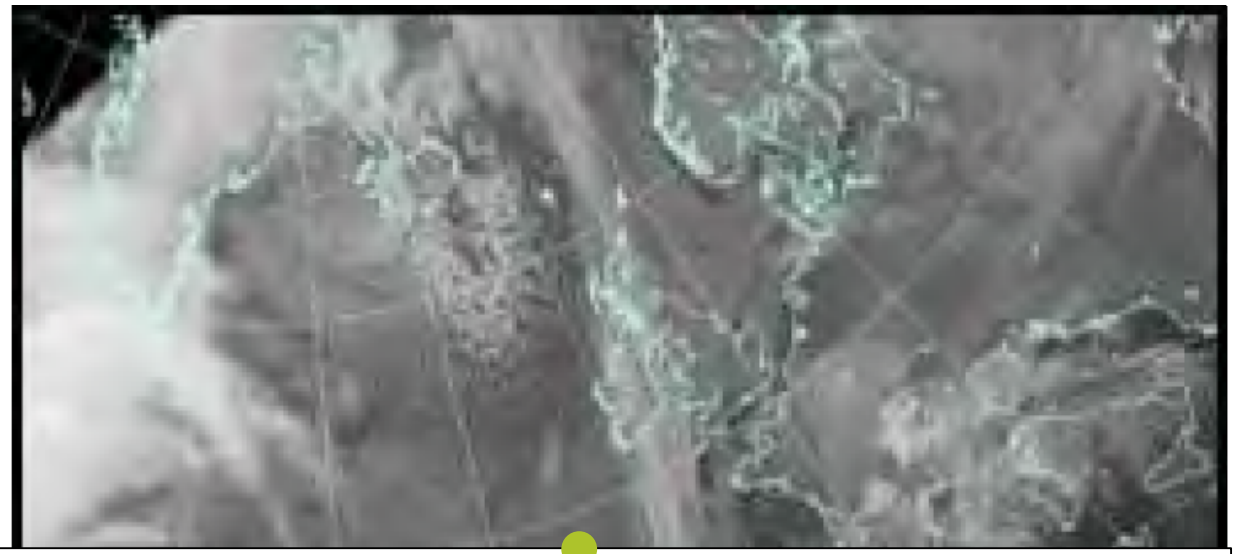

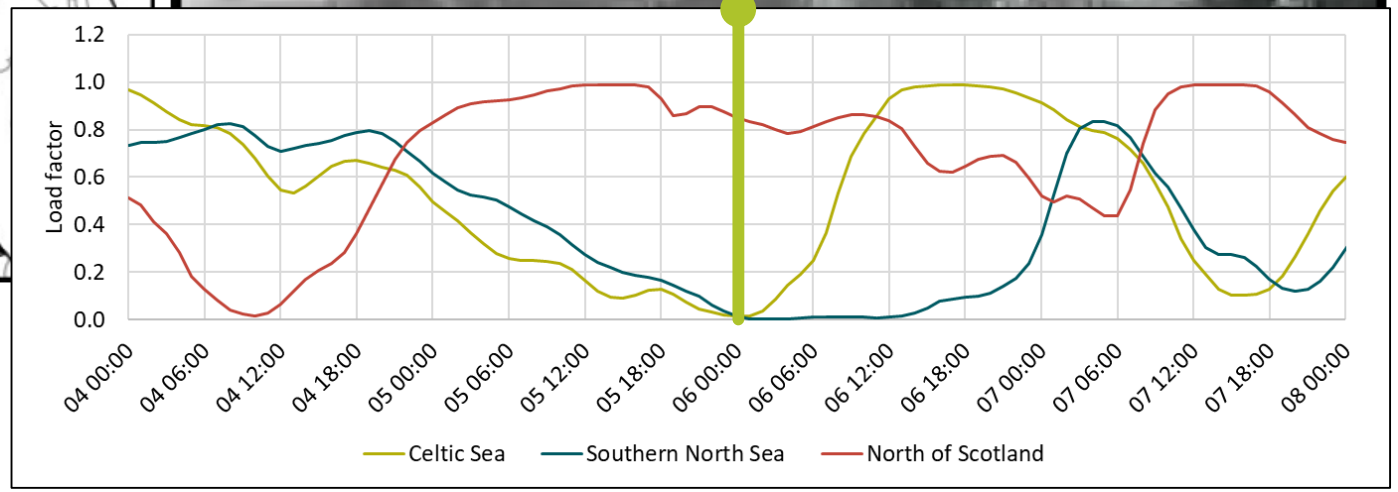

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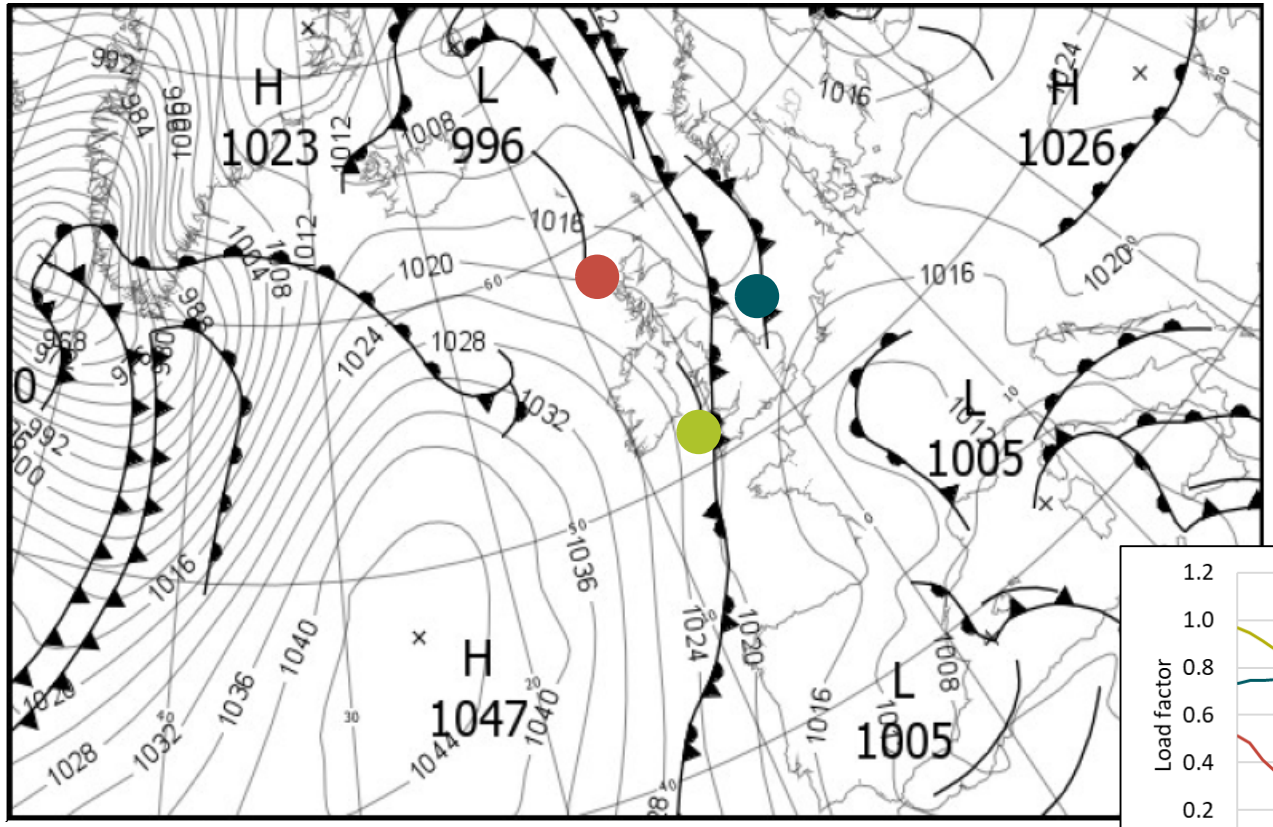

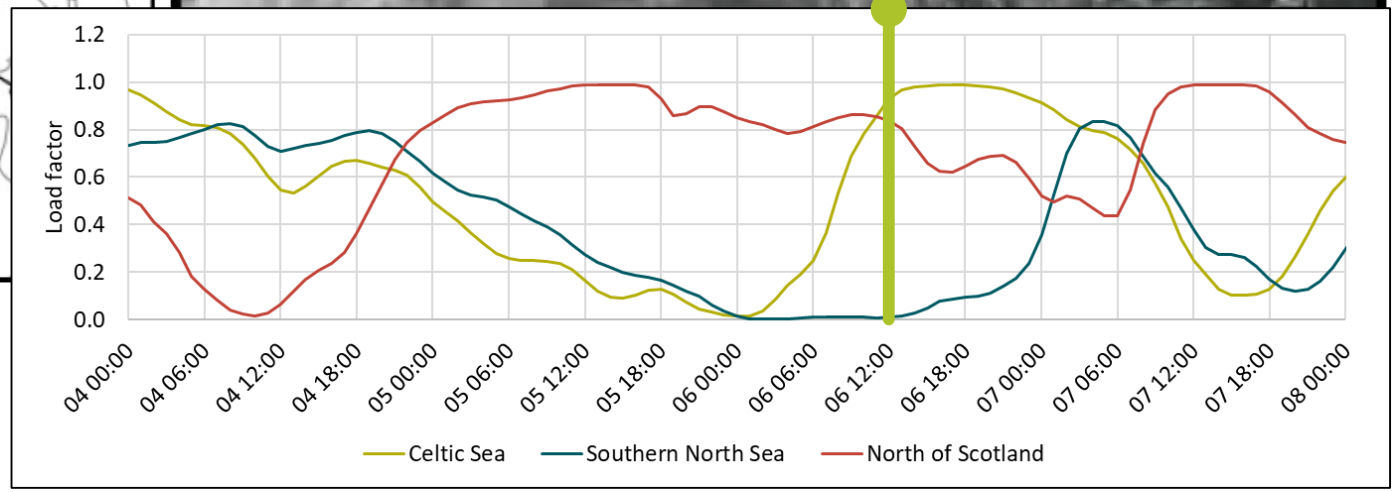

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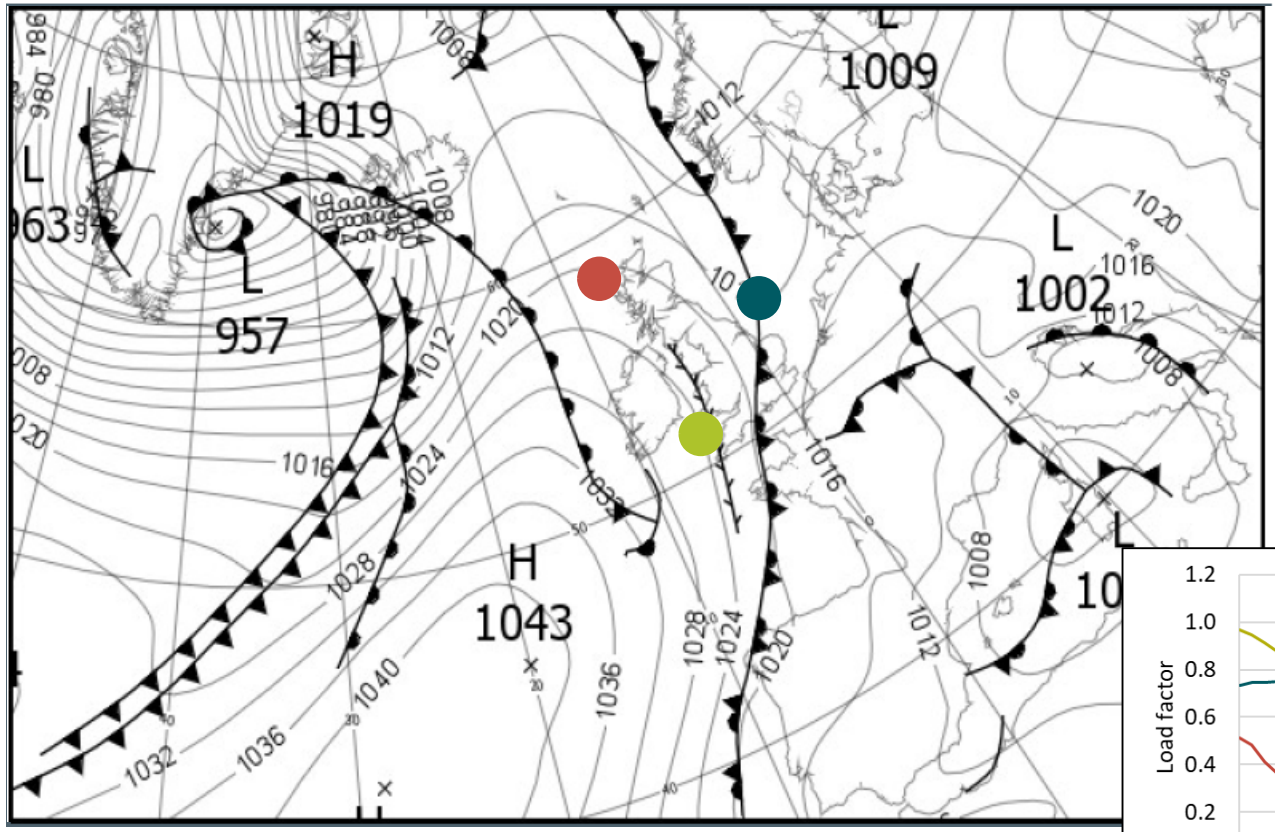

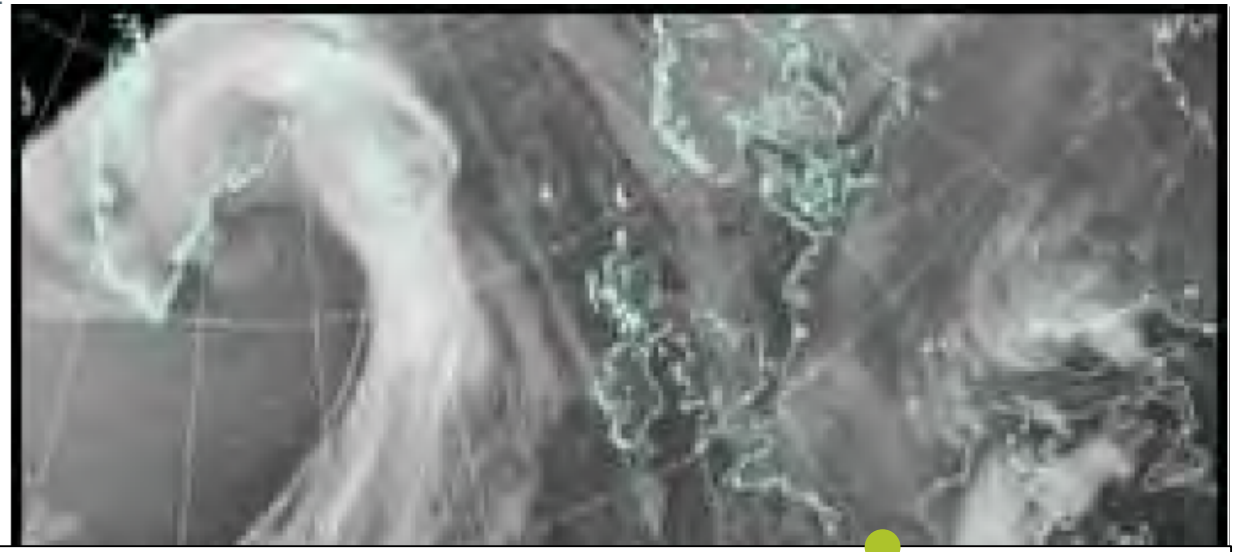

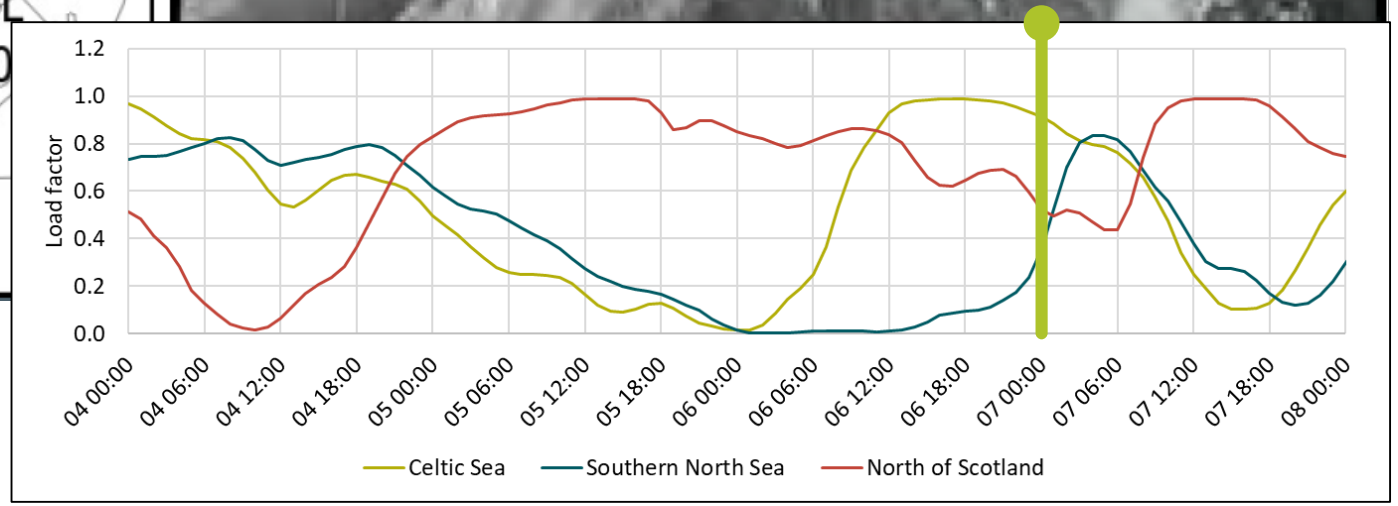

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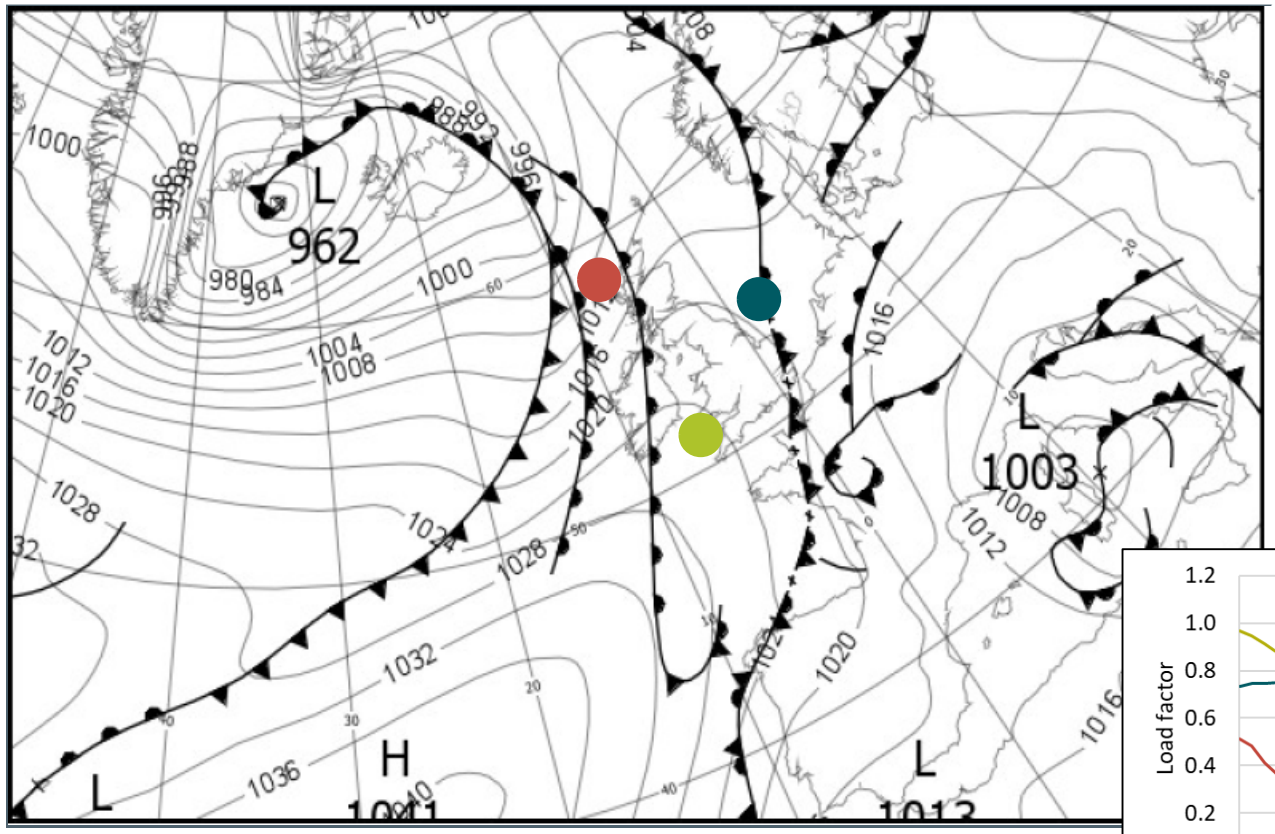

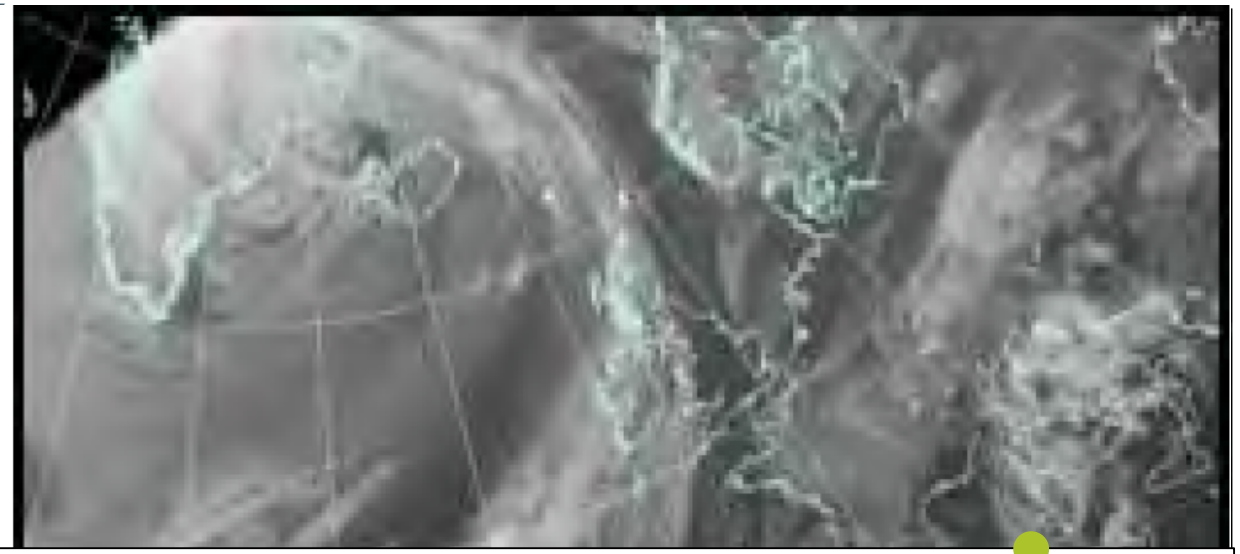

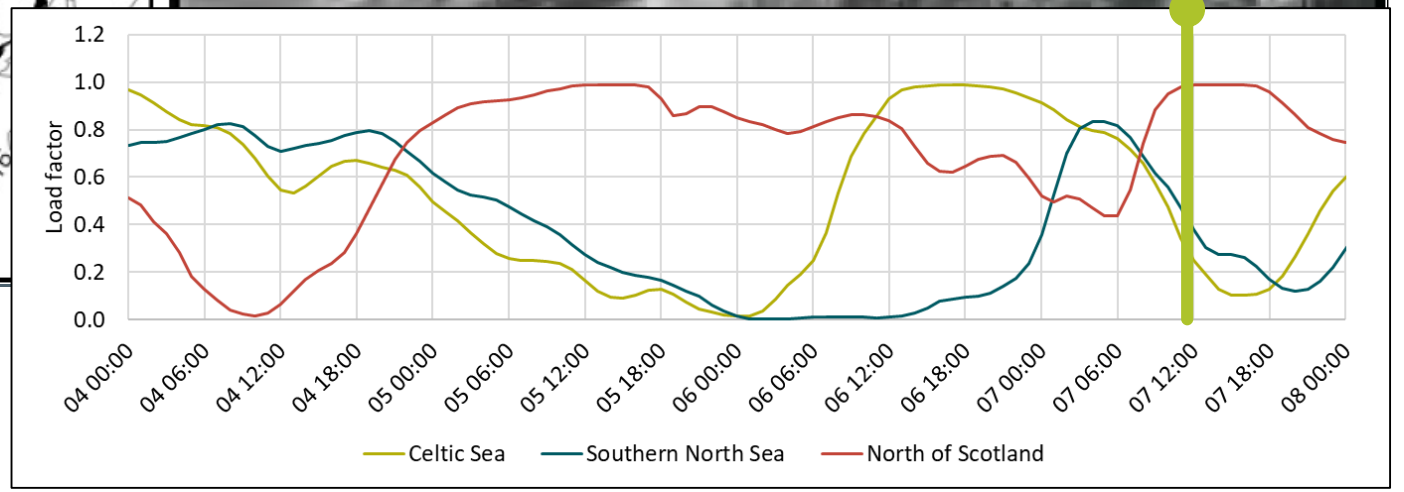

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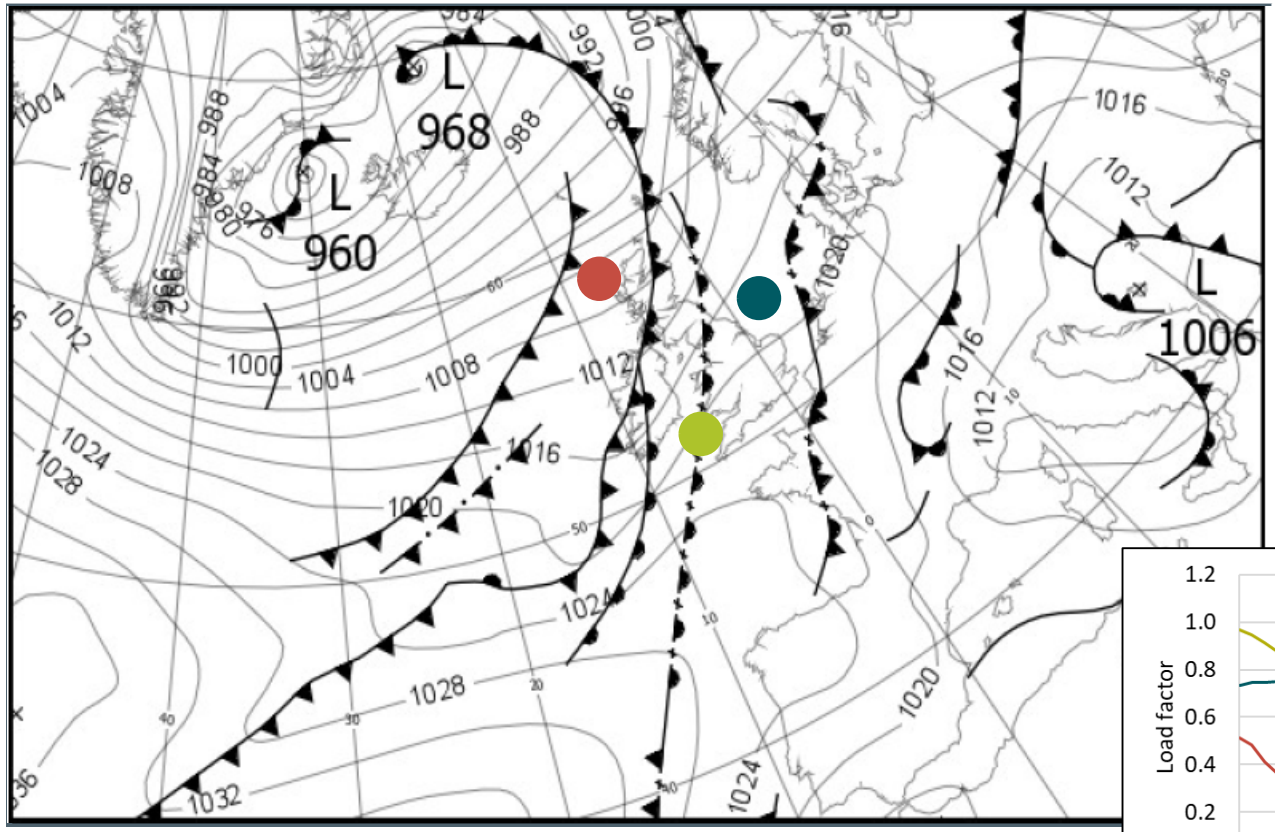

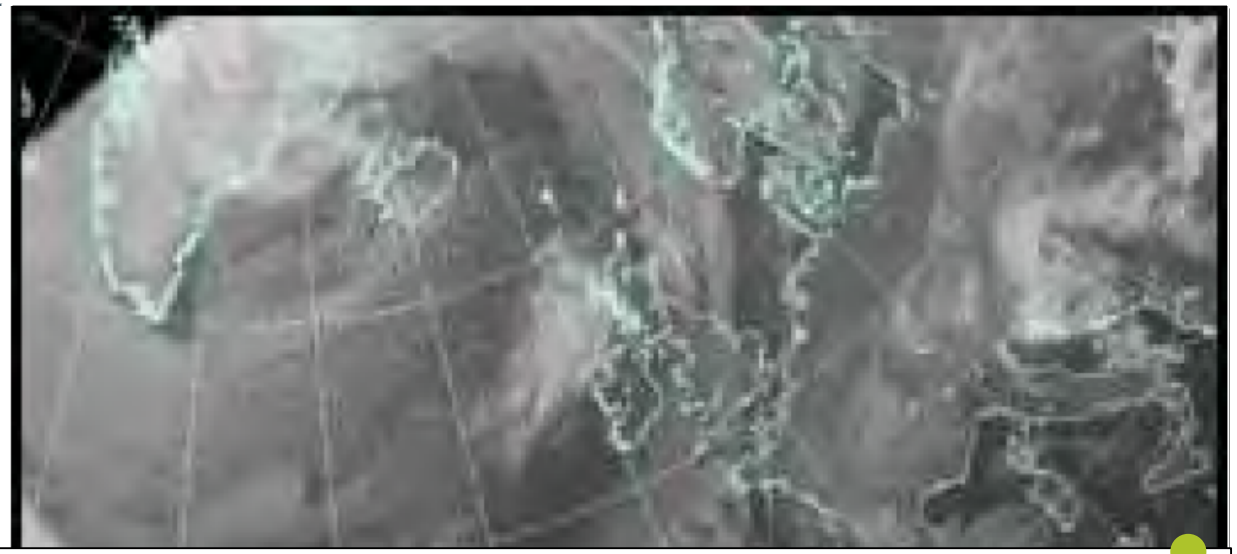

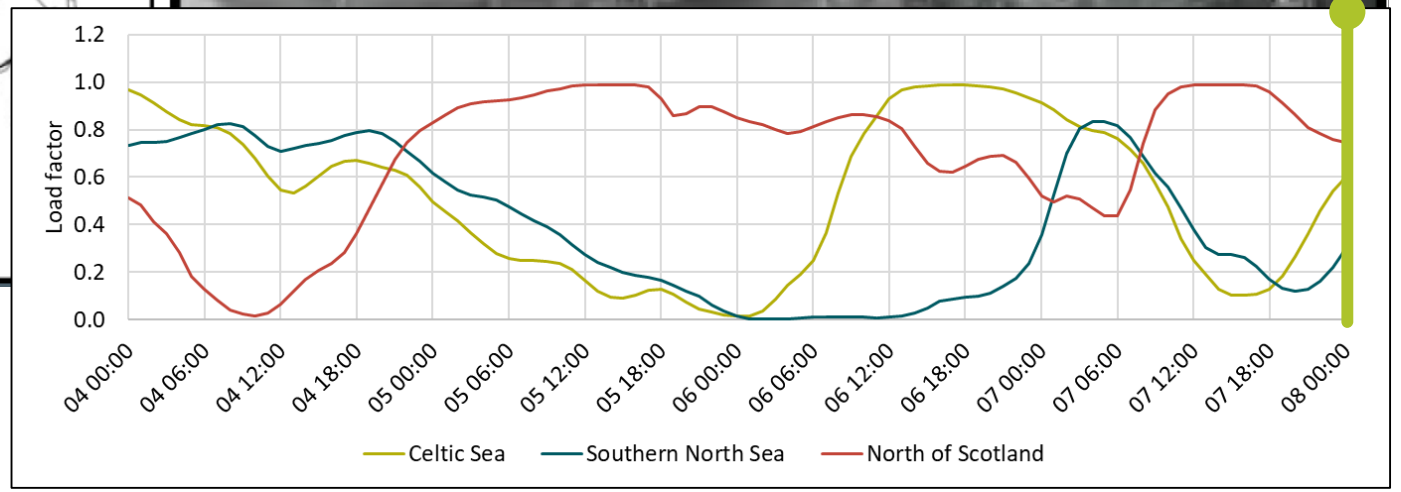

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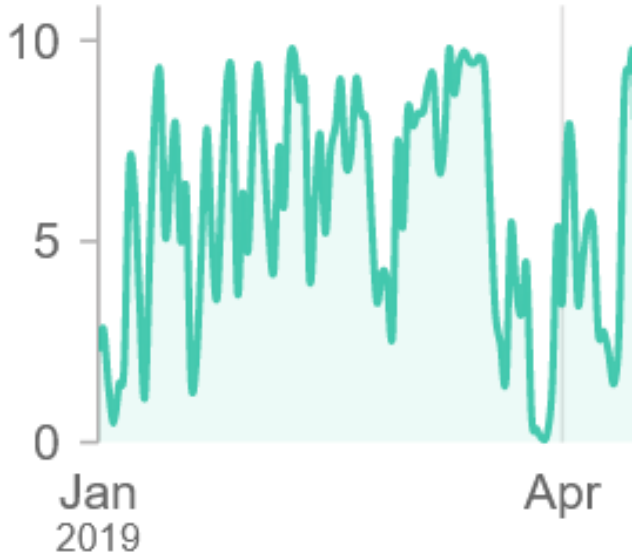
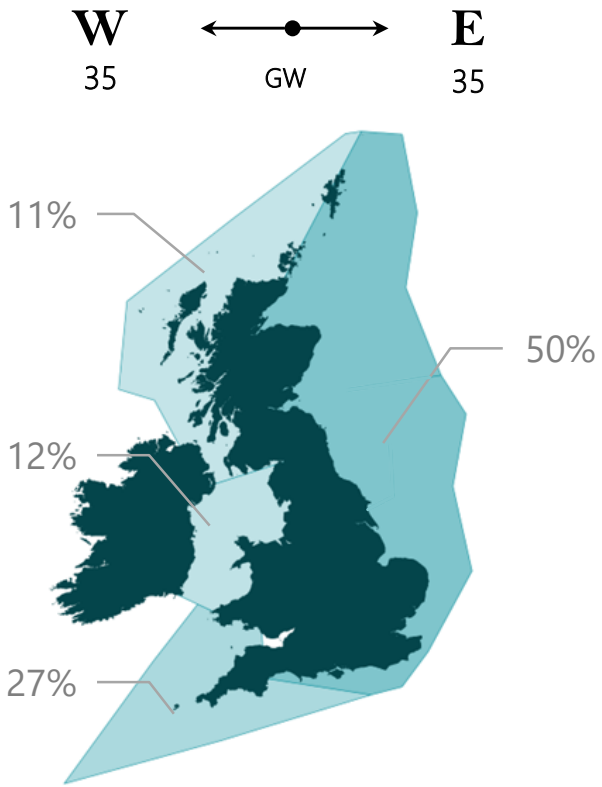
Zoning

Wind power data

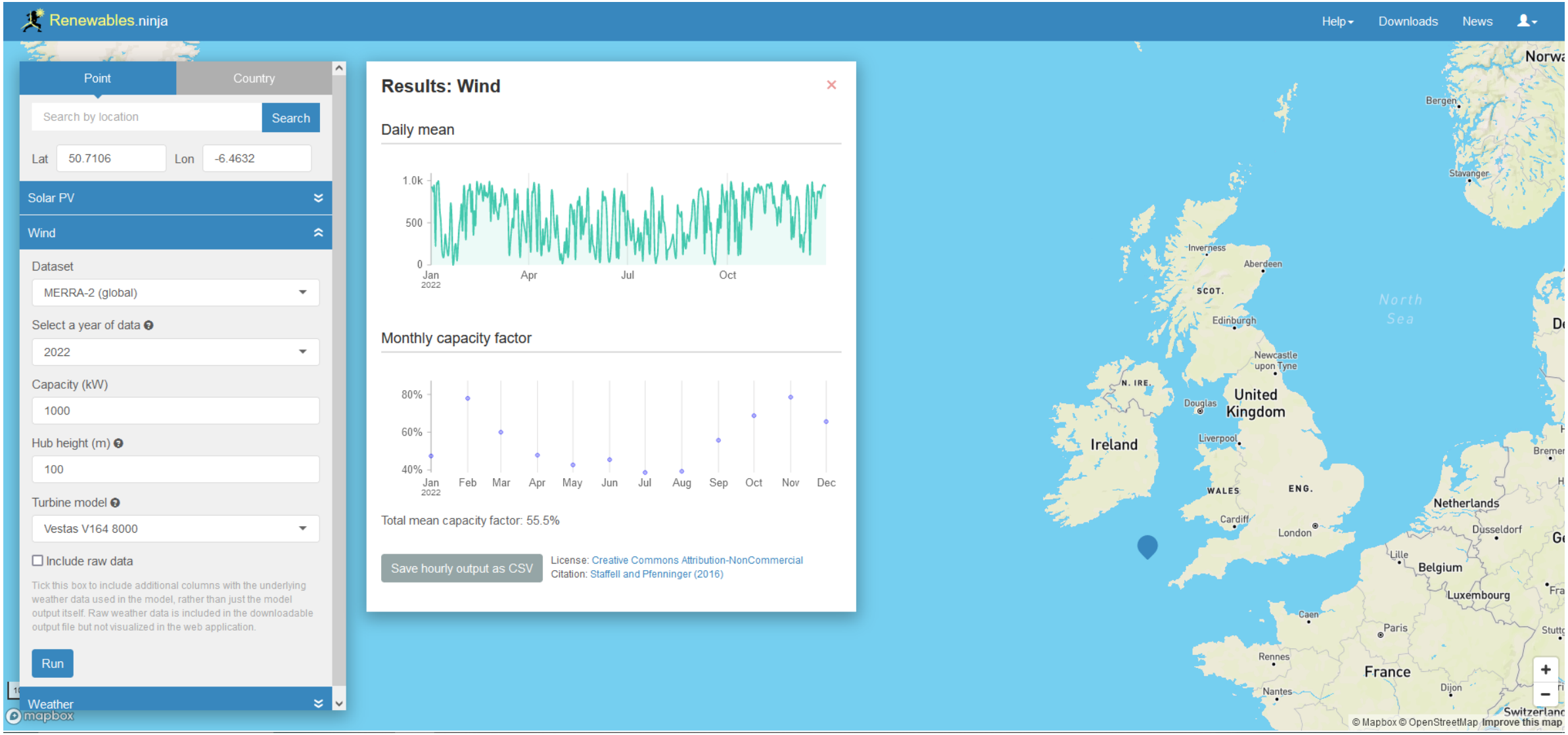


Scenarios



Results

Wind data - Renewables.ninja



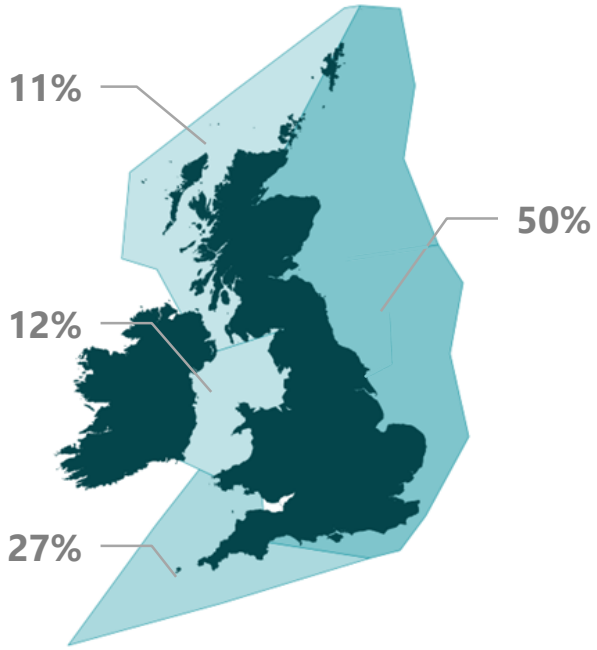
Staffell, Iain and Pfenninger, Stefan (2016). Using Bias-Corrected Reanalysis to Simulate Current and Future Wind Power Output. Energy 114, pp. 1224-1239. doi: 10.1016/j.energy.2016.08.068

All scenarios are based on **70 GW** installed capacity with analysis of **20 years** of data at **1 hour** resolution.

Go West!

Shows the benefits of spreading capacity equally between east and west

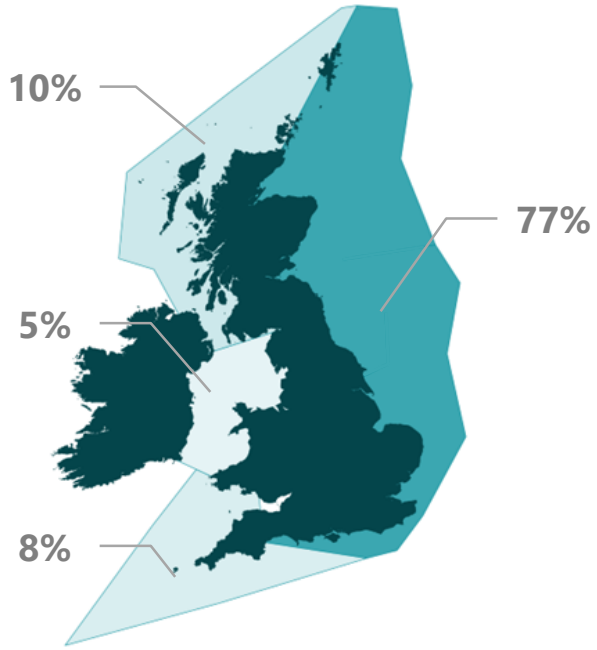
W 35 — GW — E 35



Lean West

Demonstrates impact of prioritising and building out west coast projects already identified

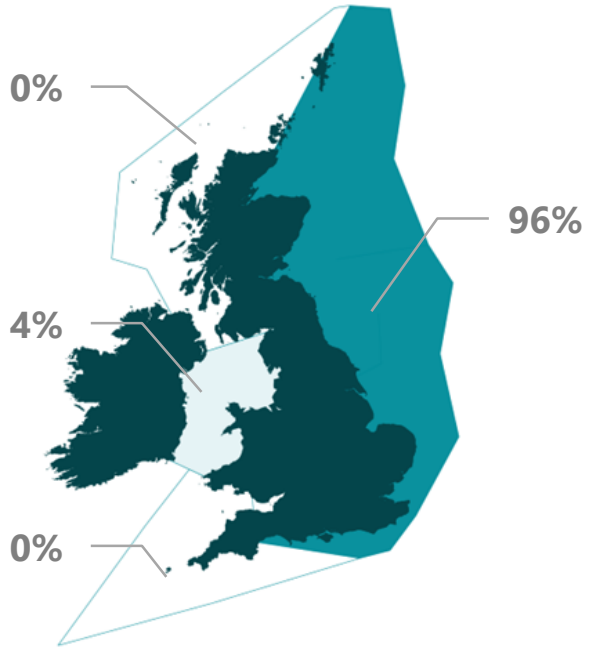
W 16 — GW — E 54



Stay East

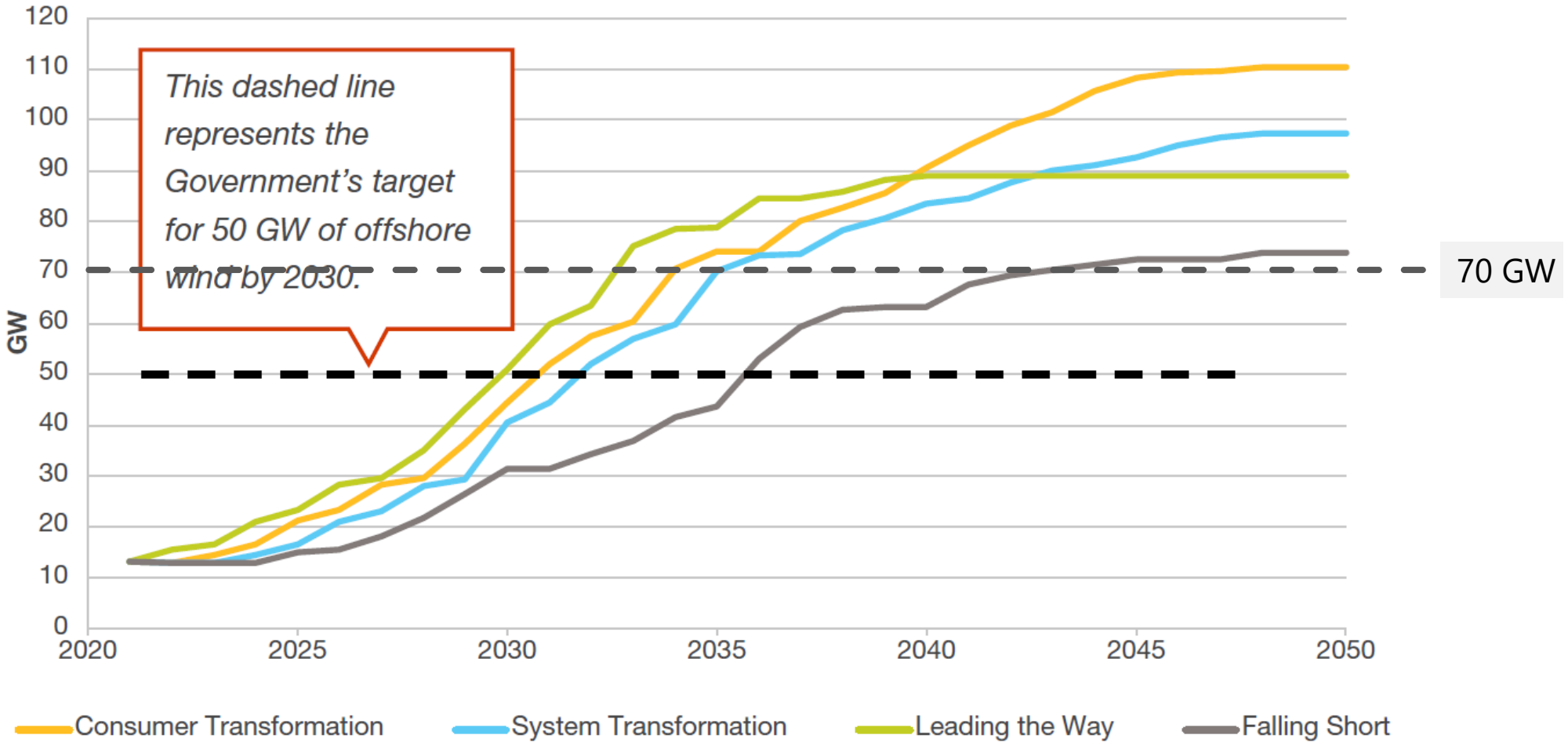
Counterfactual to compare against more diverse scenarios

W 3 — GW — E 67



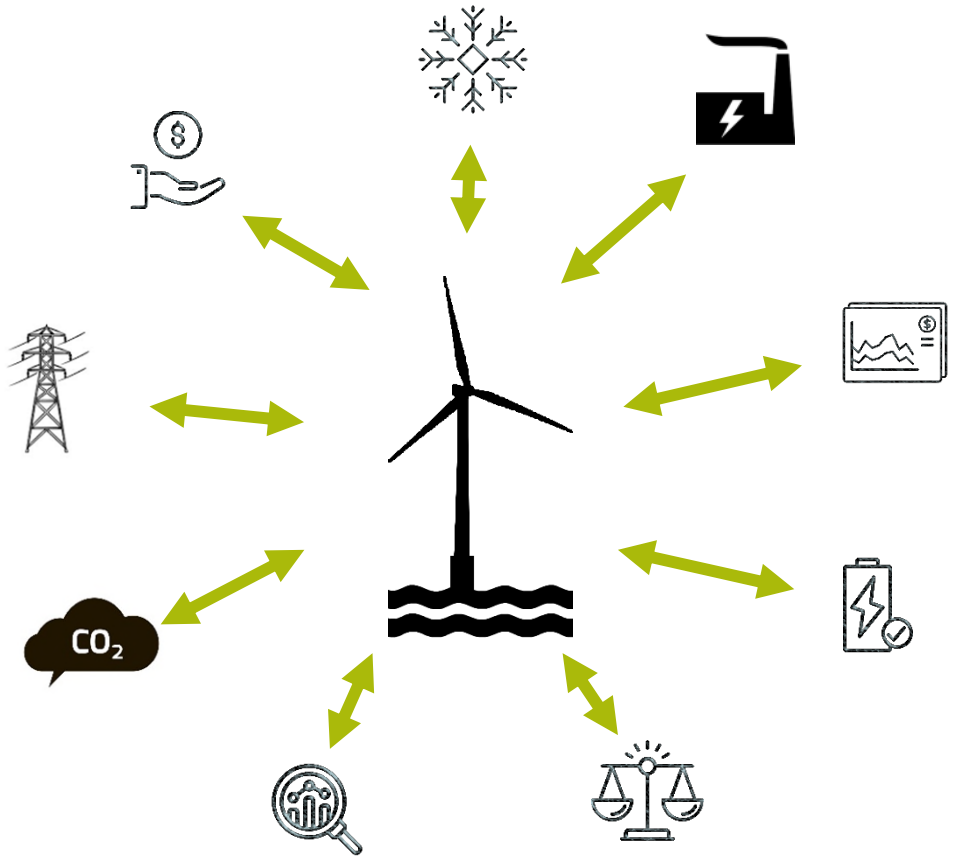
Why 70 GW?

Figure ES.E.13: Installed offshore wind generation capacity (GW)



National Grid ESO Future Energy Scenarios 2022

System impacts



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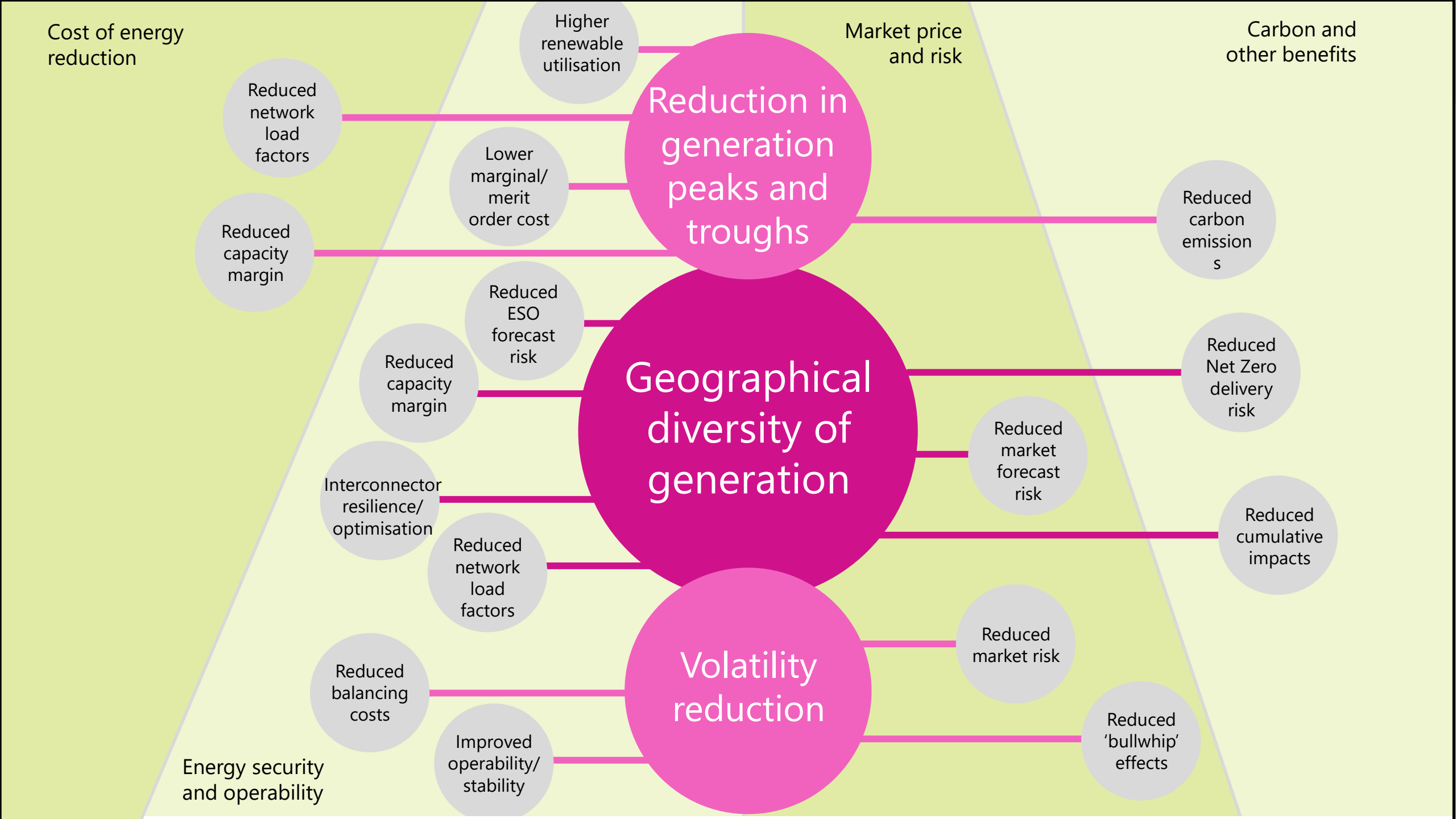
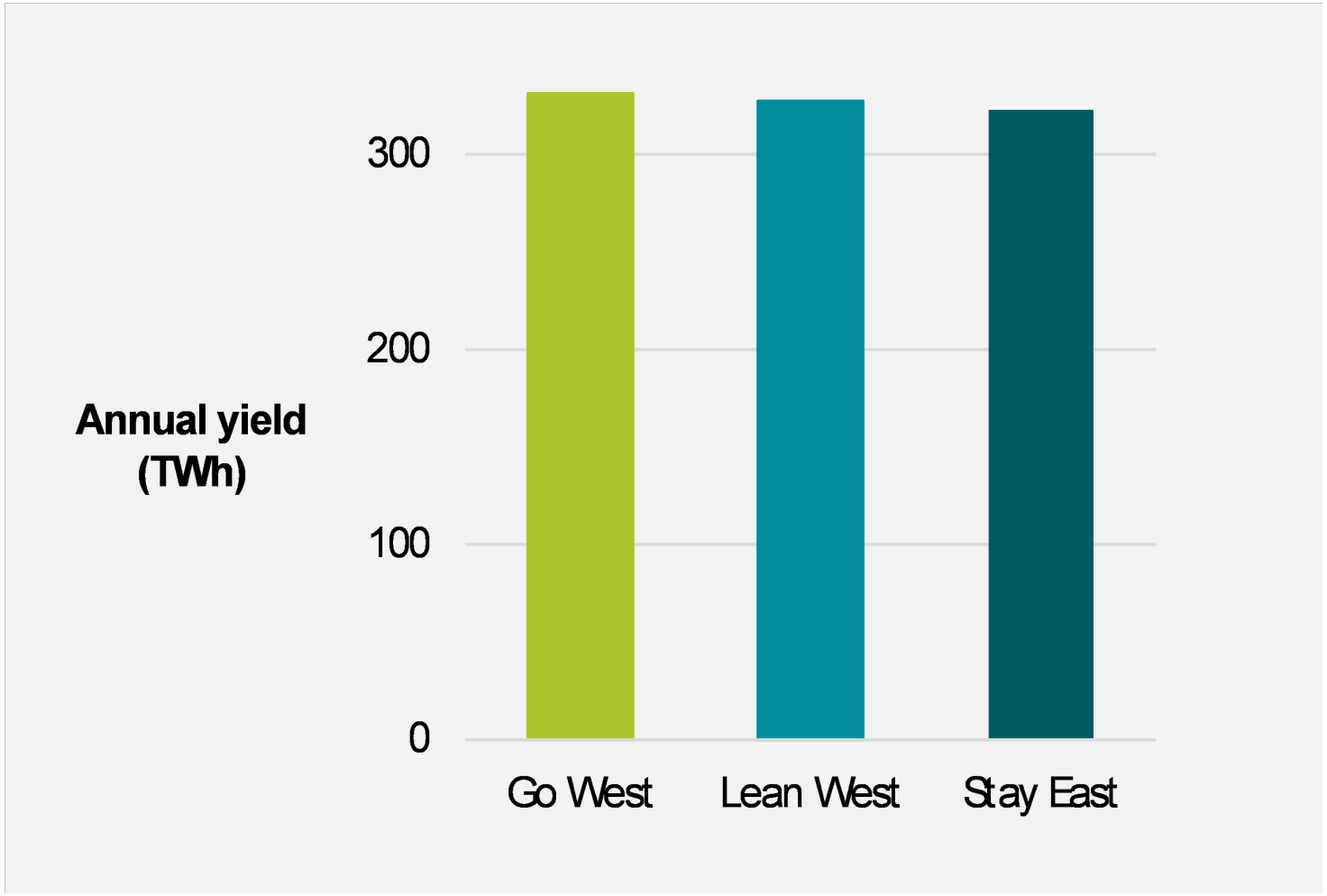
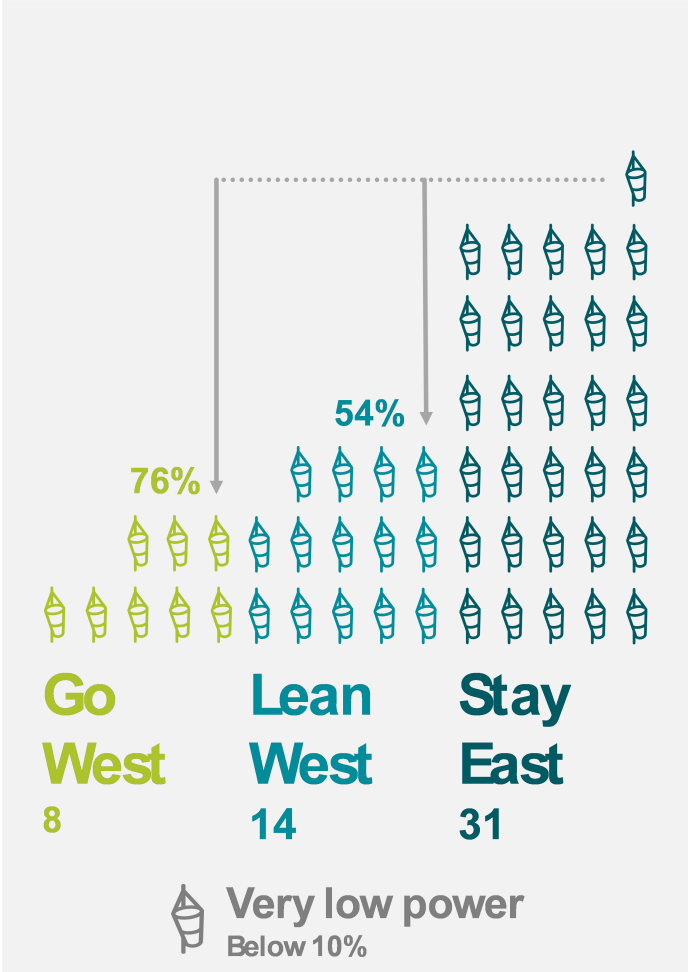
Policy implications

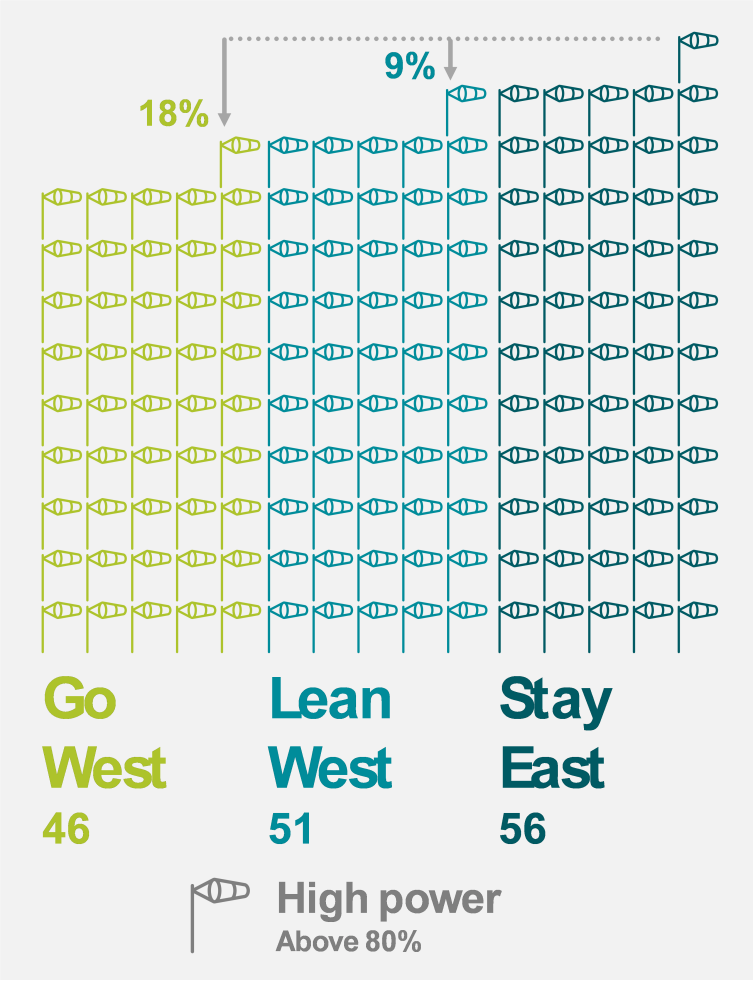

Cost of energy reduction
Market price and risk
Carbon and other benefits
Higher renewable utilisation
Reduced network load factors
Lower marginal/ merit order cost
Reduction in generation peaks and troughs
Reduced capacity margin
Reduced carbon emissions
Reduced ESO forecast risk
Reduced capacity margin
Geographical diversity of generation
Reduced Net Zero delivery risk
Reduced market forecast risk
Interconnector resilience/ optimisation
Reduced cumulative impacts
Reduced network load factors
Reduced market risk
Reduced balancing costs
Volatility reduction
Reduced 'bullwhip' effects
Improved operability/ stability
Energy security and operability

Average annual energy generation is broadly the same



Significant reduction in the average annual number of ‘troughs’ in generation

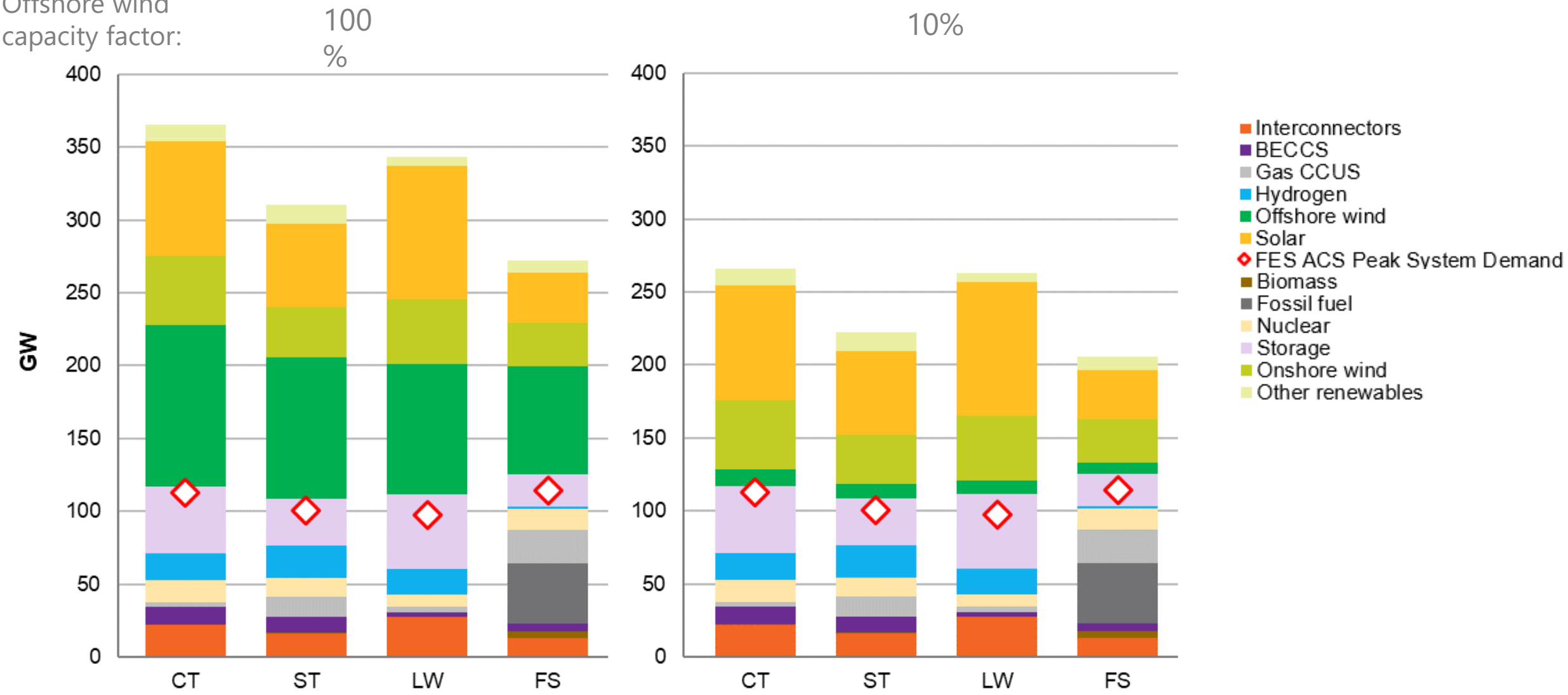




Note: An ‘event’ is defined as a single continuous time period, lasting one or more hours, where wind power output is lower/higher than a defined threshold.

Contextualising troughs and peaks in generation

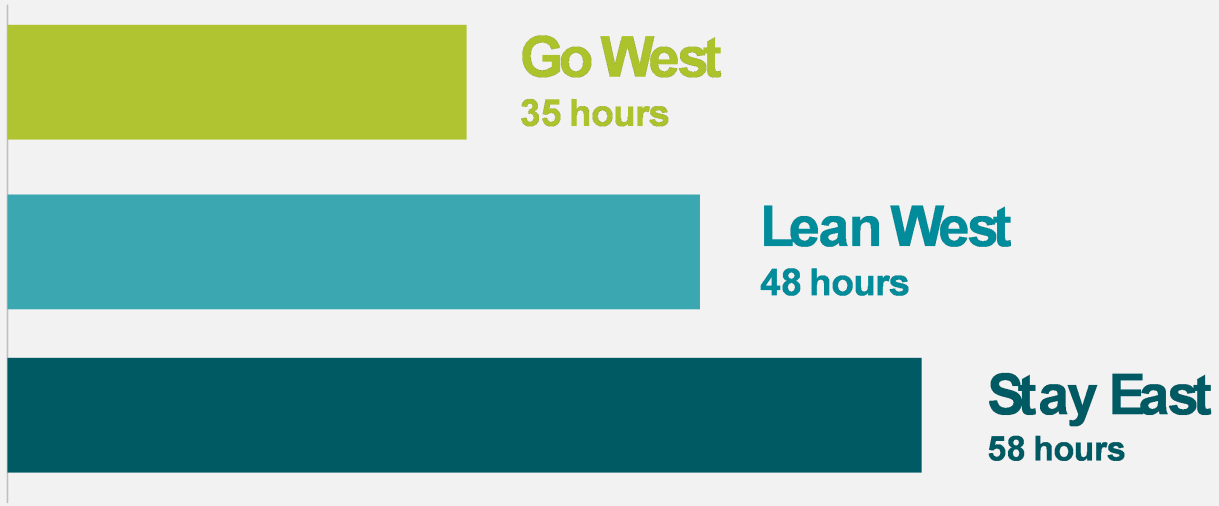
Offshore wind capacity factor:



Demand ~30% of capacity

Demand ~42% of capacity

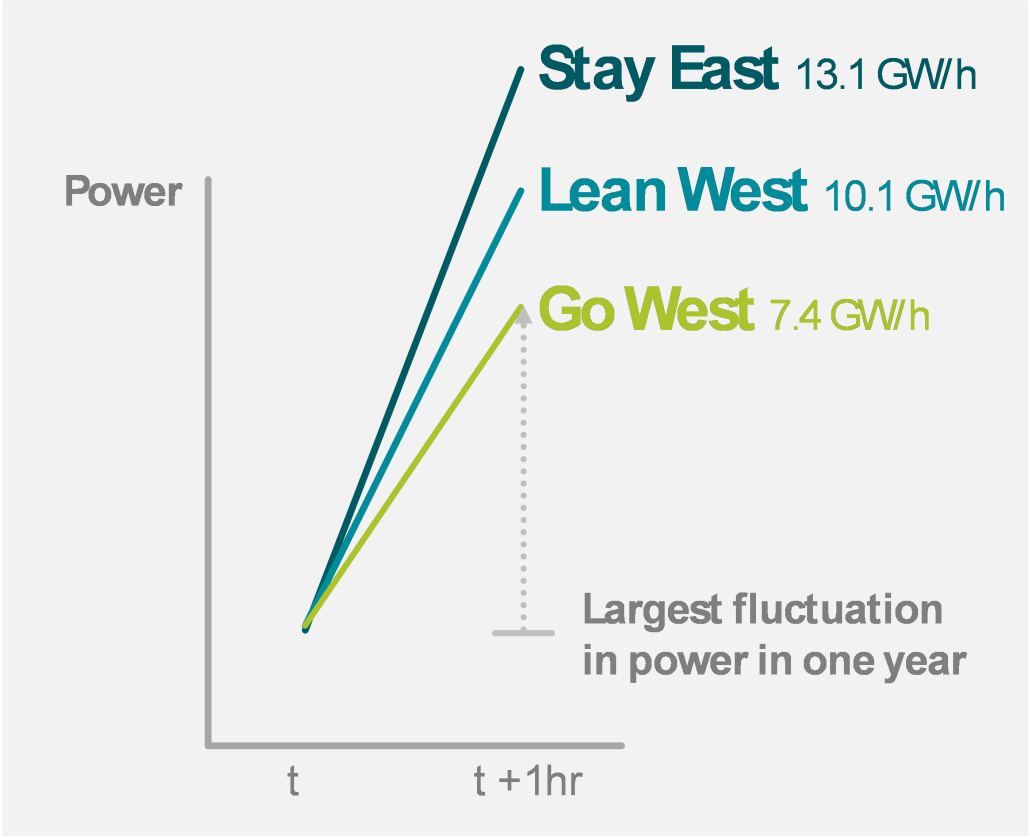
Large reduction in the maximum duration of a very low power event

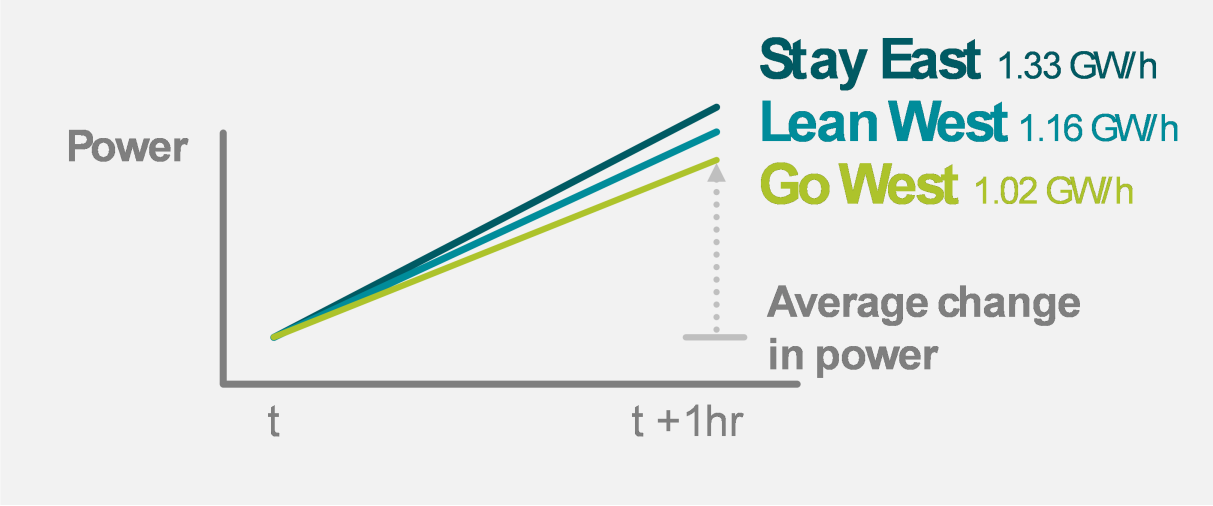


Maximum duration of a very low power event in 20 years of data

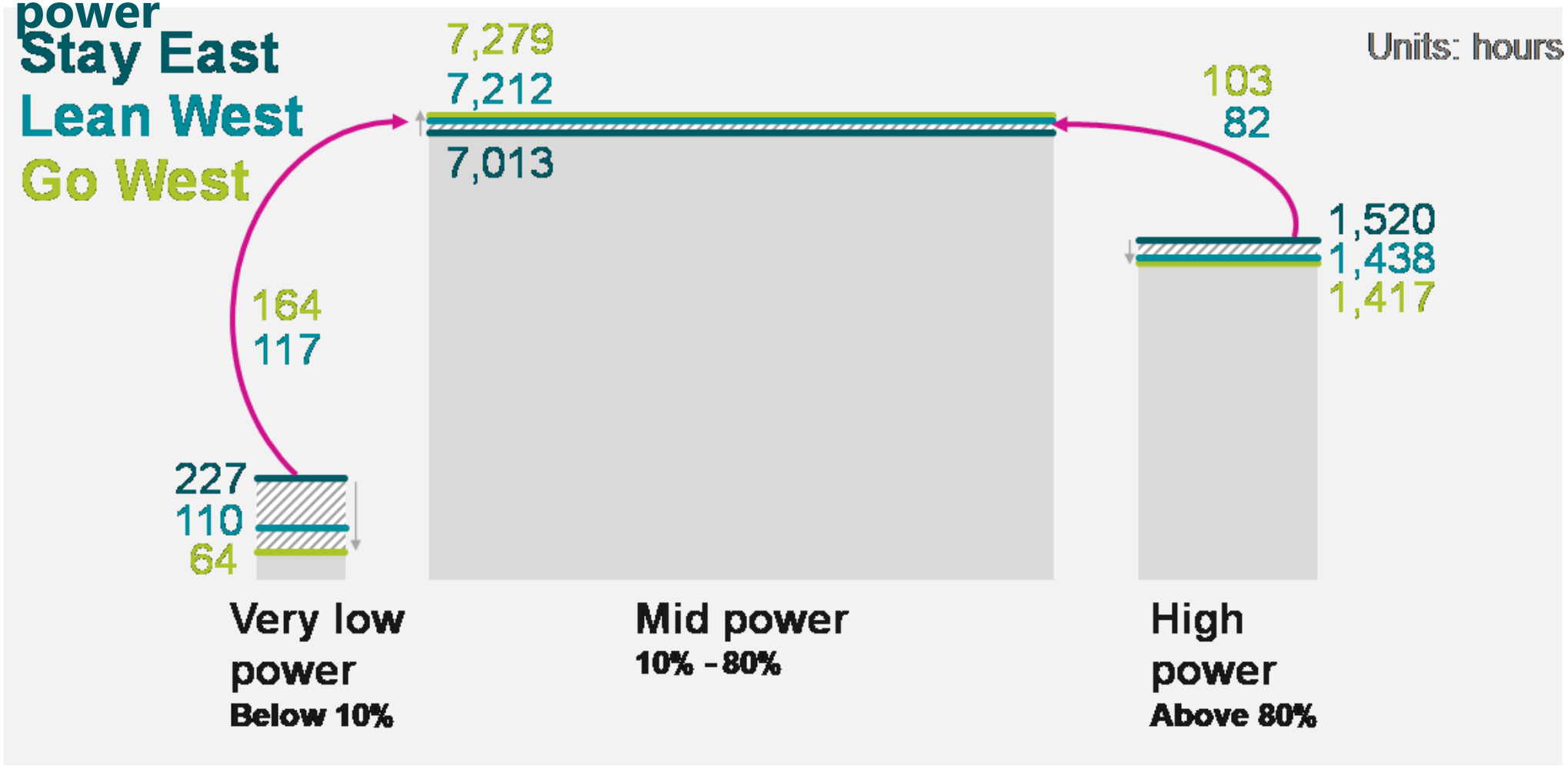
Note: An 'event' is defined as a single continuous time period, lasting one or more hours, where wind power output is lower/higher than a defined threshold.

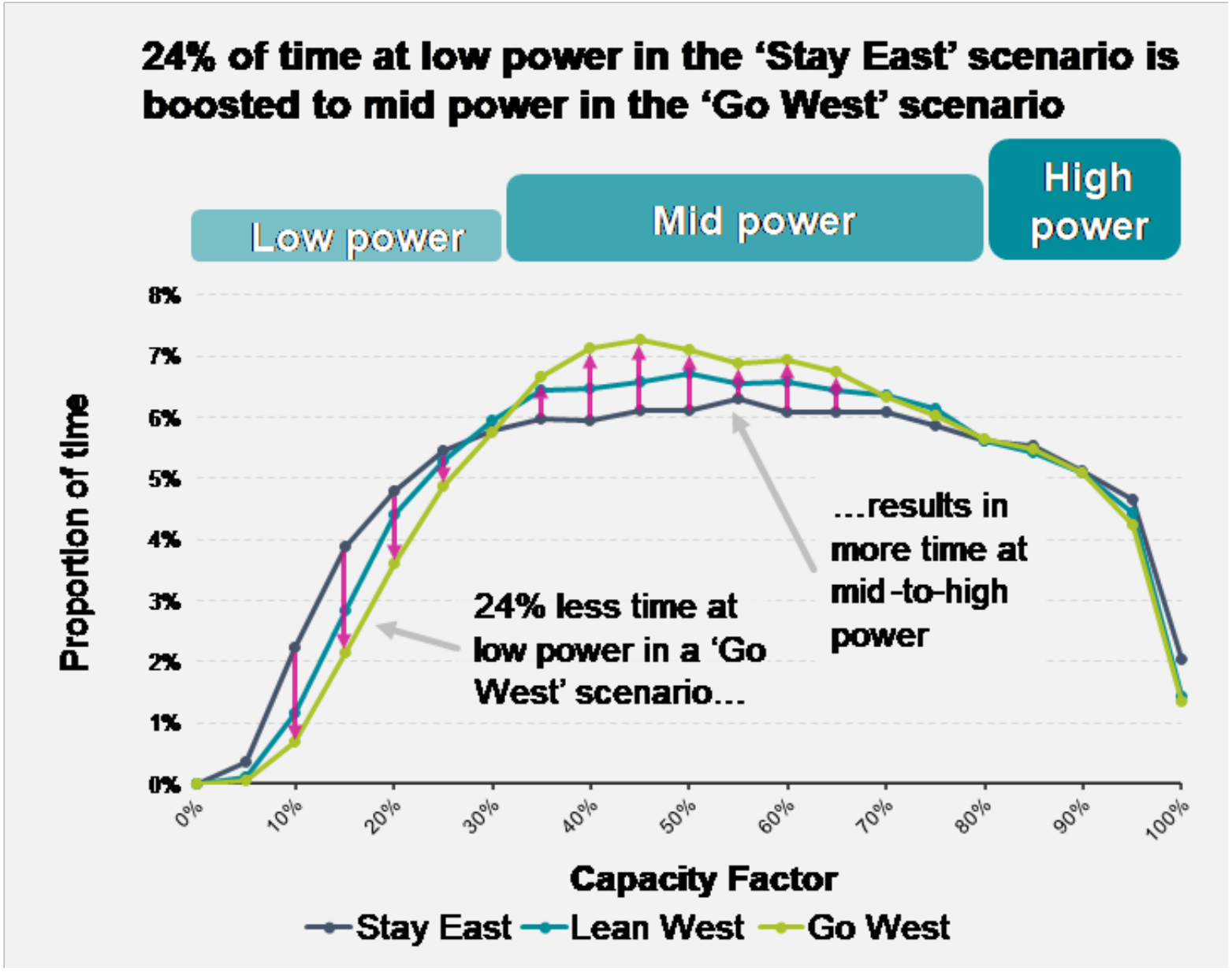
Significant reduction in peak and average generation volatility

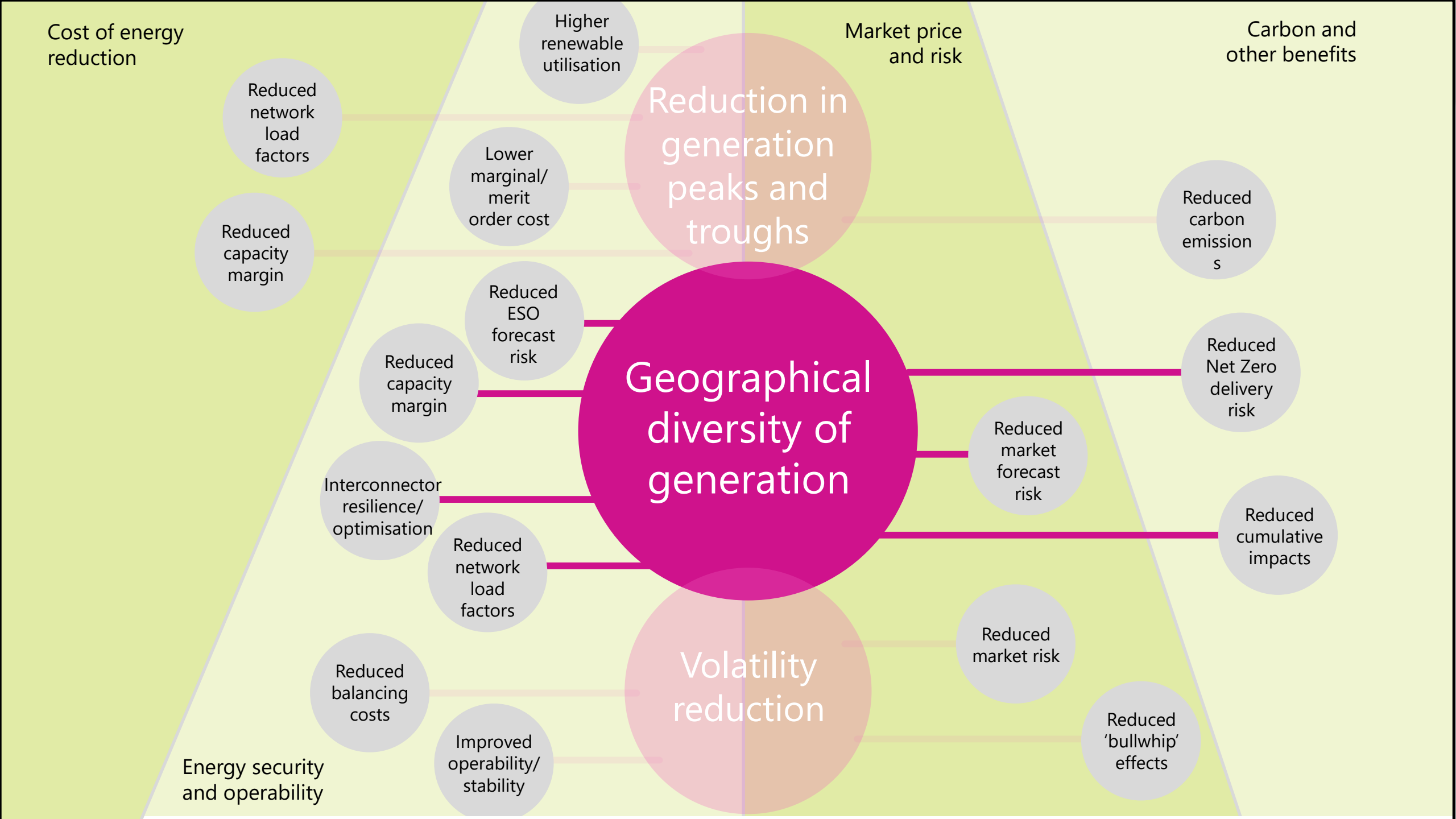




Reduction in the average number of hours per year at very low and high power



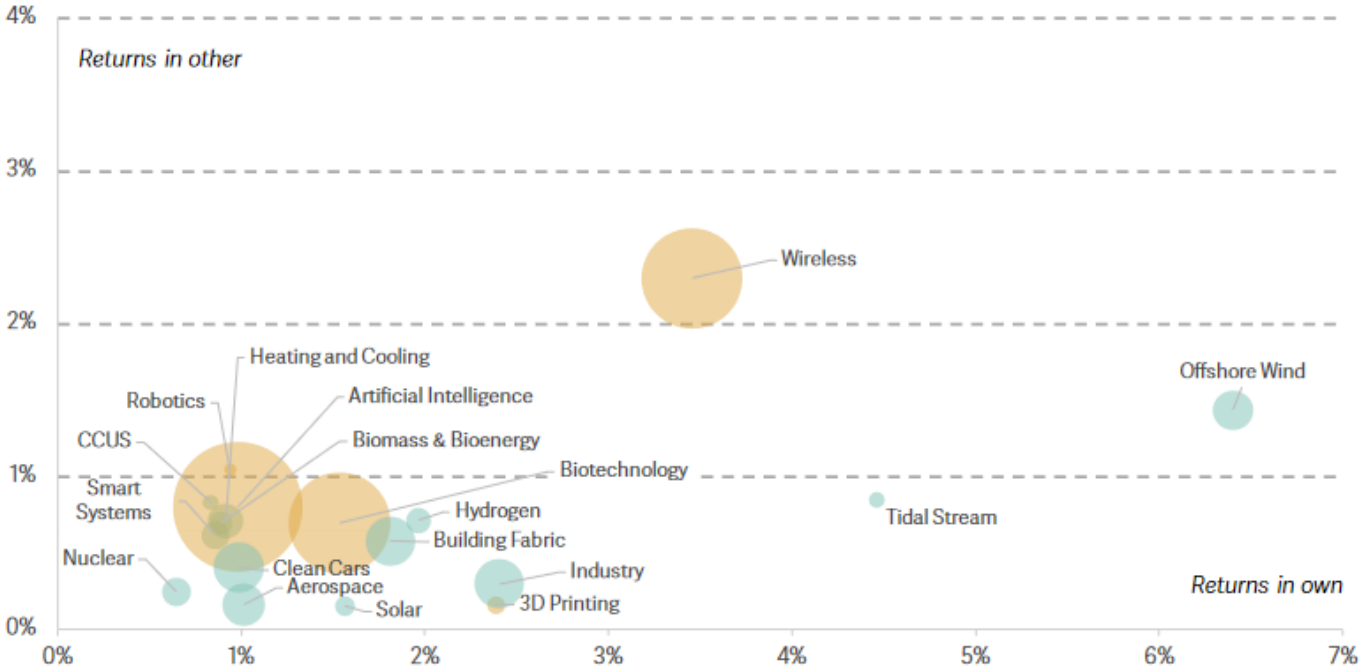

24% of time at low power in the 'Stay East' scenario is boosted to mid power in the 'Go West' scenario
Low power
Mid power
High power
Proportion of time
8%
7%
6%
5%
4%
3%
2%
1%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Capacity Factor
24% less time at low power in a 'Go West' scenario...
...results in more time at mid-to-high power
Stay East
Lean West
Go West


Cost of energy reduction
Market price and risk
Carbon and other benefits
Higher renewable utilisation
Reduced network load factors
Reduction in generation peaks and troughs
Lower marginal/ merit order cost
Reduced capacity margin
Reduced carbon emissions
Reduced ESO forecast risk
Reduced capacity margin
Geographical diversity of generation
Reduced Net Zero delivery risk
Reduced market forecast risk
Interconnector resilience/ optimisation
Reduced cumulative impacts
Reduced network load factors
Reduced balancing costs
Volatility reduction
Reduced market risk
Improved operability/ stability
Reduced 'bullwhip' effects
Energy security and operability

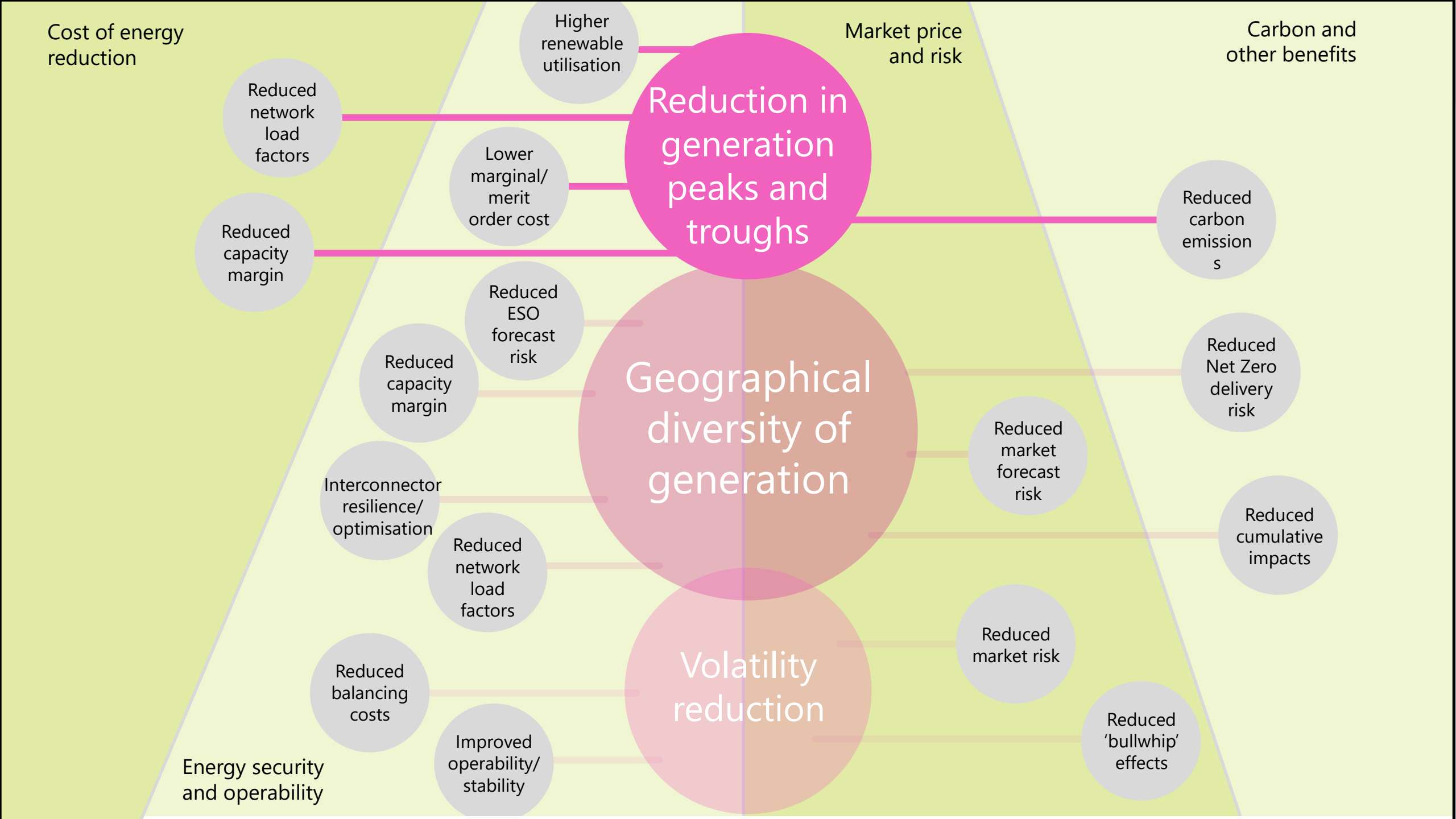
Spreading economic benefits

FIGURE 14: **Outside the golden triangle, investments in offshore wind and tidal stream innovation generate particularly high returns in those same regions, and little spillover outside**

Returns to public investments in innovation taking place in non "golden triangle" regions, retained in those regions, versus those felt in the rest of the country



NOTES: The vertical axis shows the estimated returns to a £1 additional R&D subsidy in the field outside the region where investments are made, and the x-axis shows the equivalent for returns that are retained in the same region. The size of the bubbles indicates the relative size of a particular technology grouping within the regions in this chart. Patents from 2005-2014 are included. Green bubbles are clean technology categories, and yellow bubbles are technologies within the 'trending' category.
SOURCE: Analysis builds on R Martin & D Verhoeven, Knowledge spillovers from clean and emerging technologies in the UK, CEP Discussion paper 1834, March 2022.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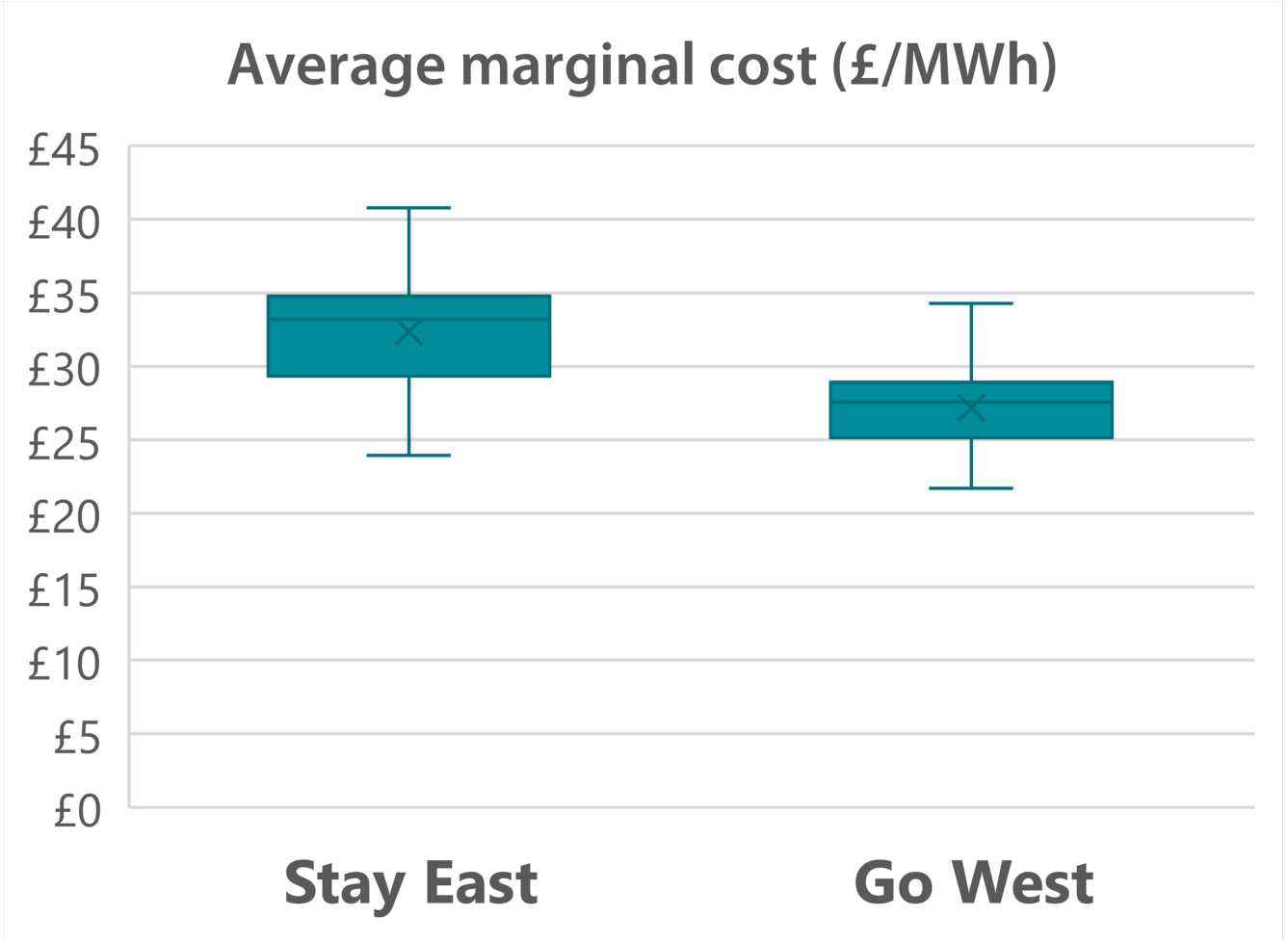
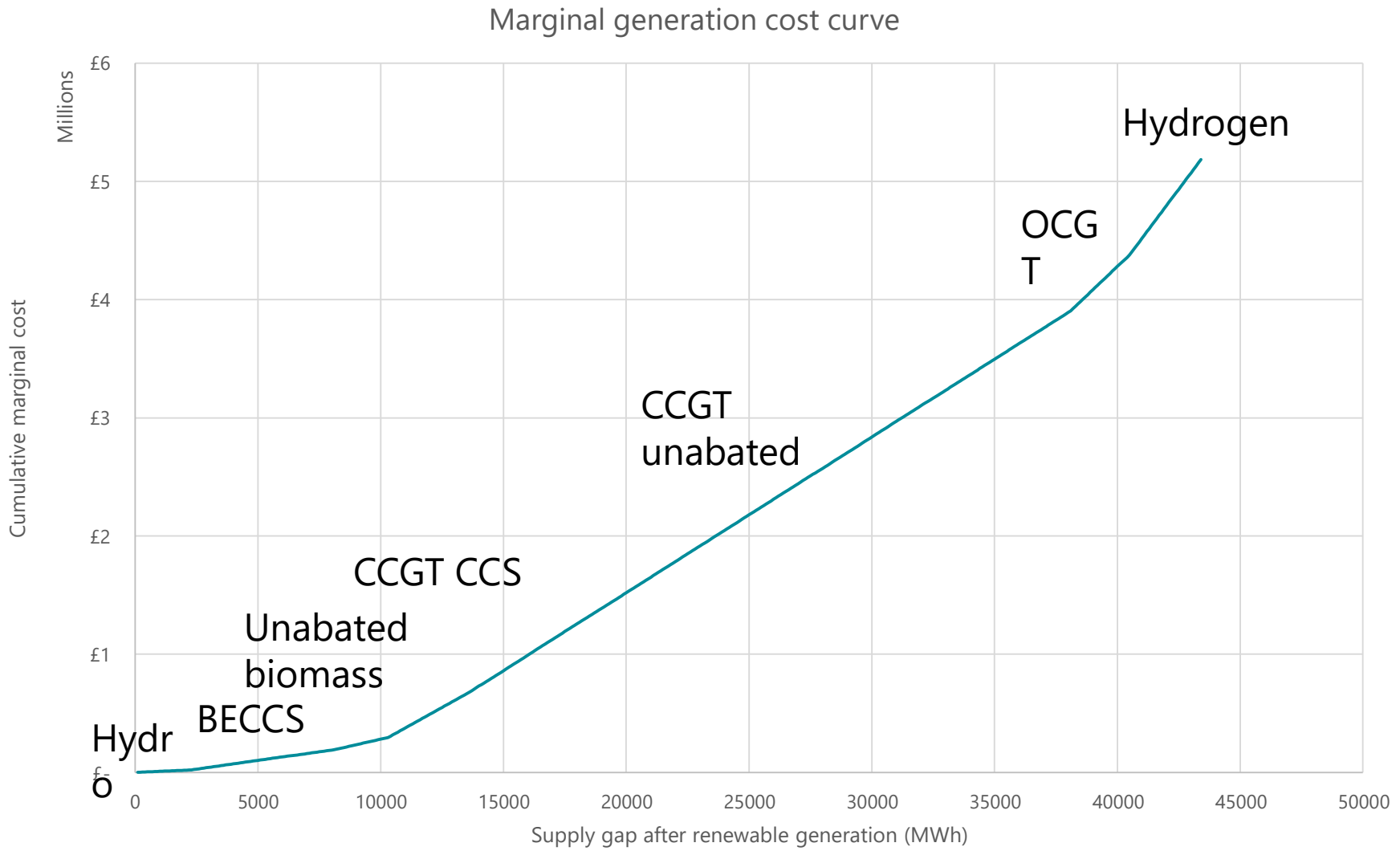
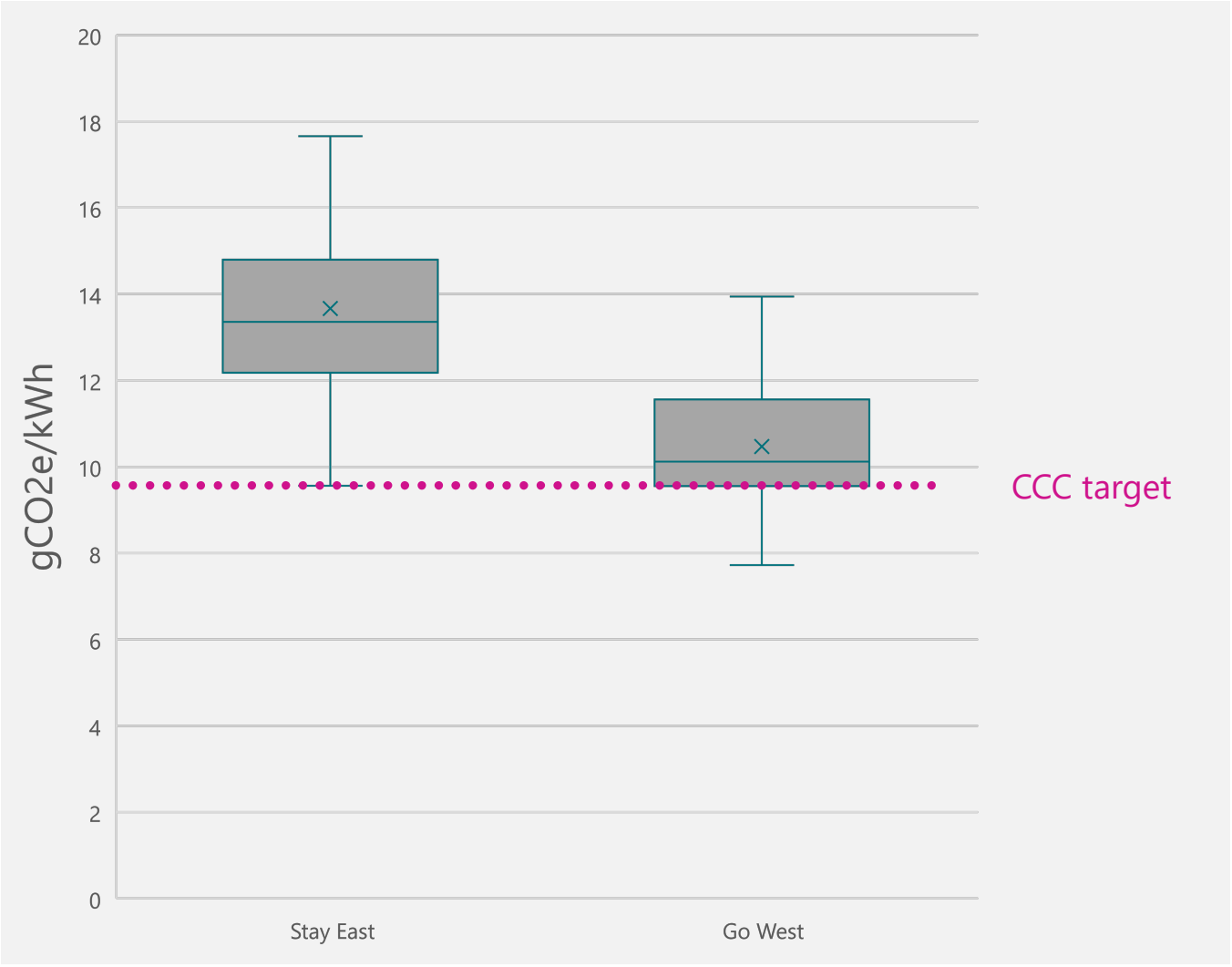
Cost reduction



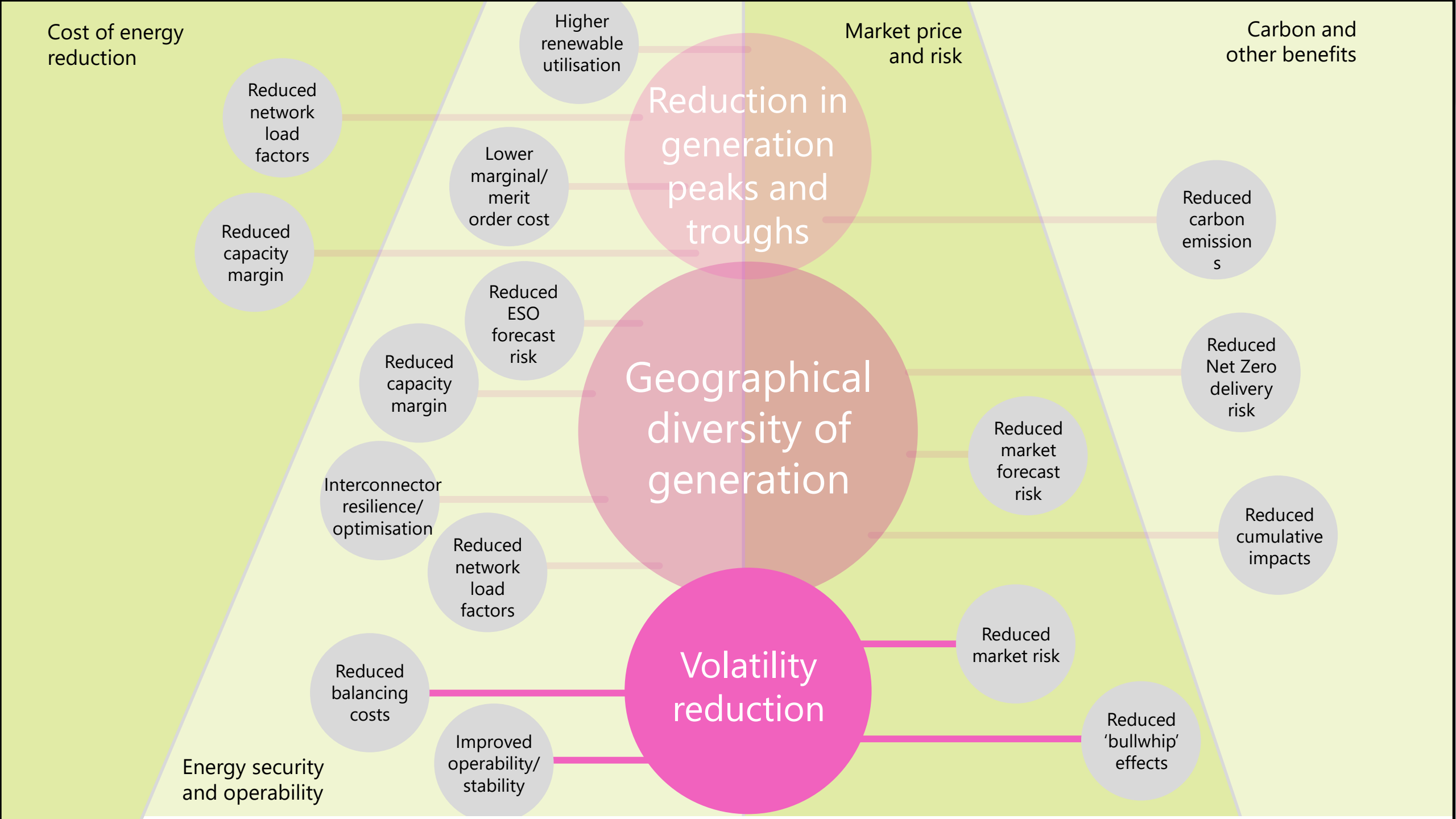
Marginal generation cost curve



Results



Reduction in grid carbon intensity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- An integrated, strategic approach to offshore development, leasing and planning
- Financial mechanisms that support increased diversity of supply
- Infrastructure investment, innovation and supply chain development

Q&A

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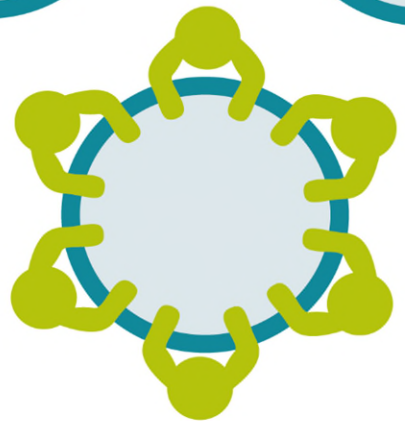
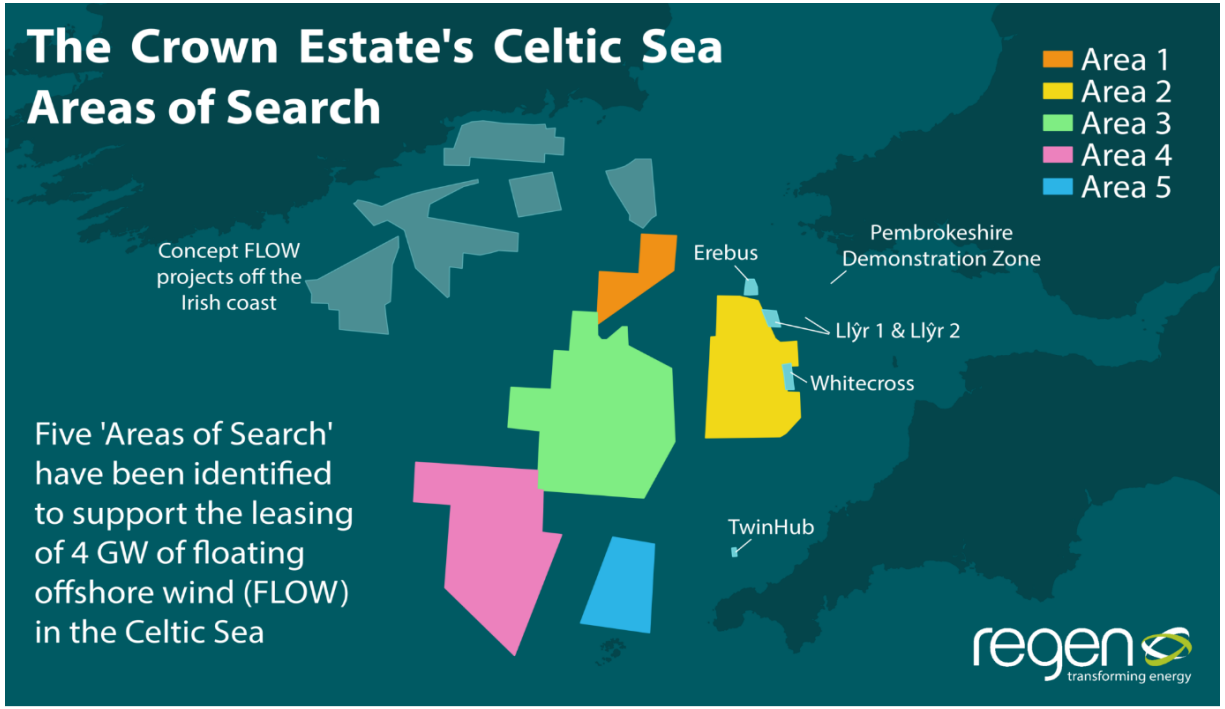
We choose to work in areas that are innovative or new. We take on challenges; we get cutting edge projects off the ground and share the learning to inspire and enable others to follow.

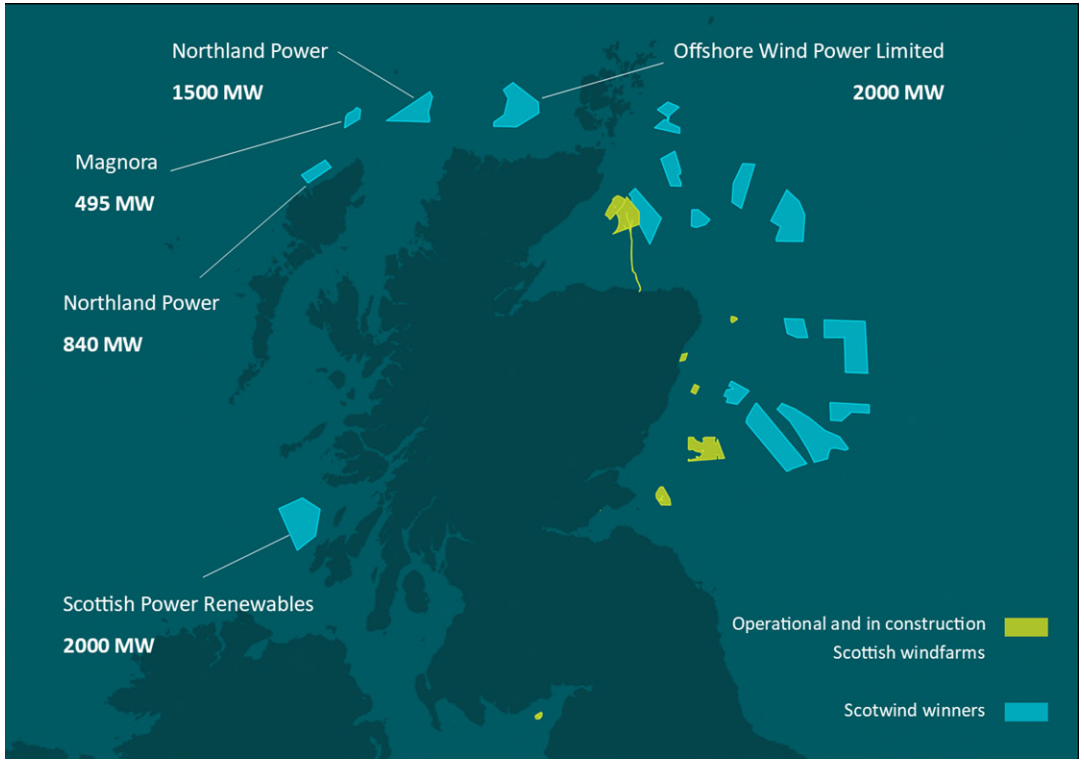


Convenors

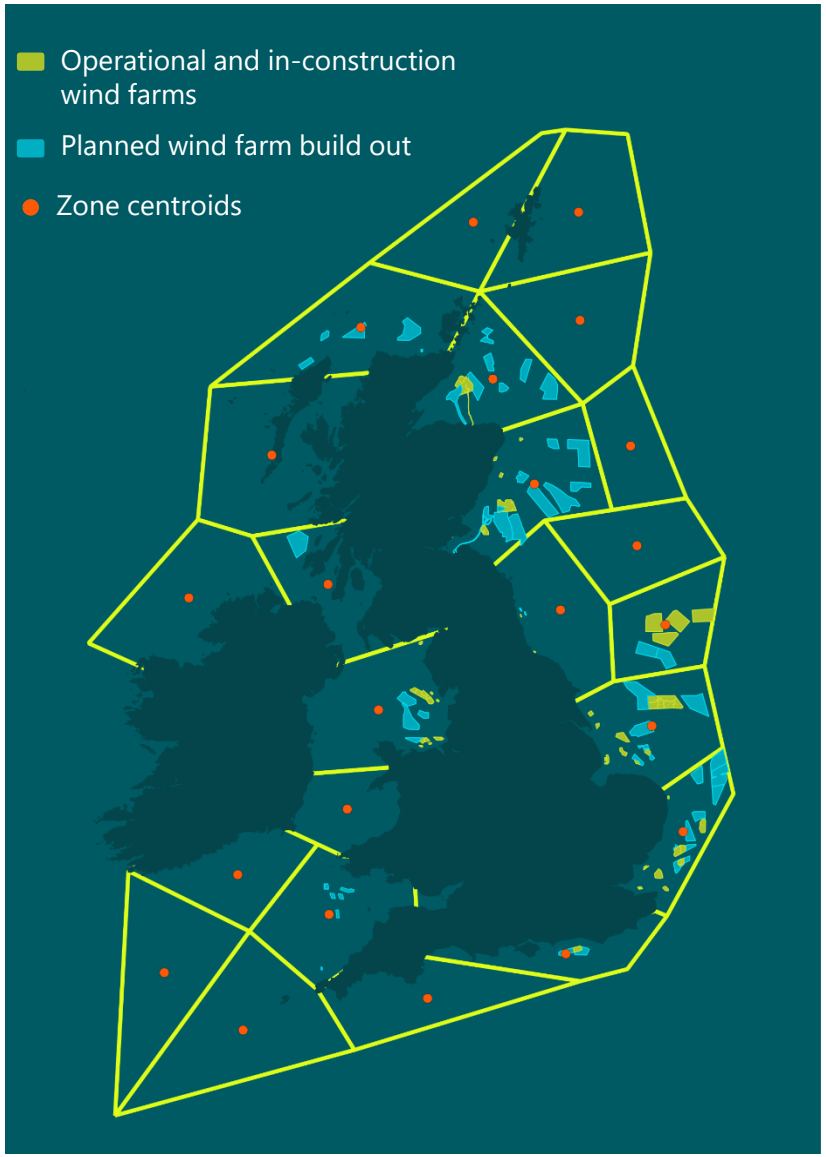
We bring the right people and organisations together to create ideas and solutions to achieve change. We work across the energy industry and its wide range of stakeholders.

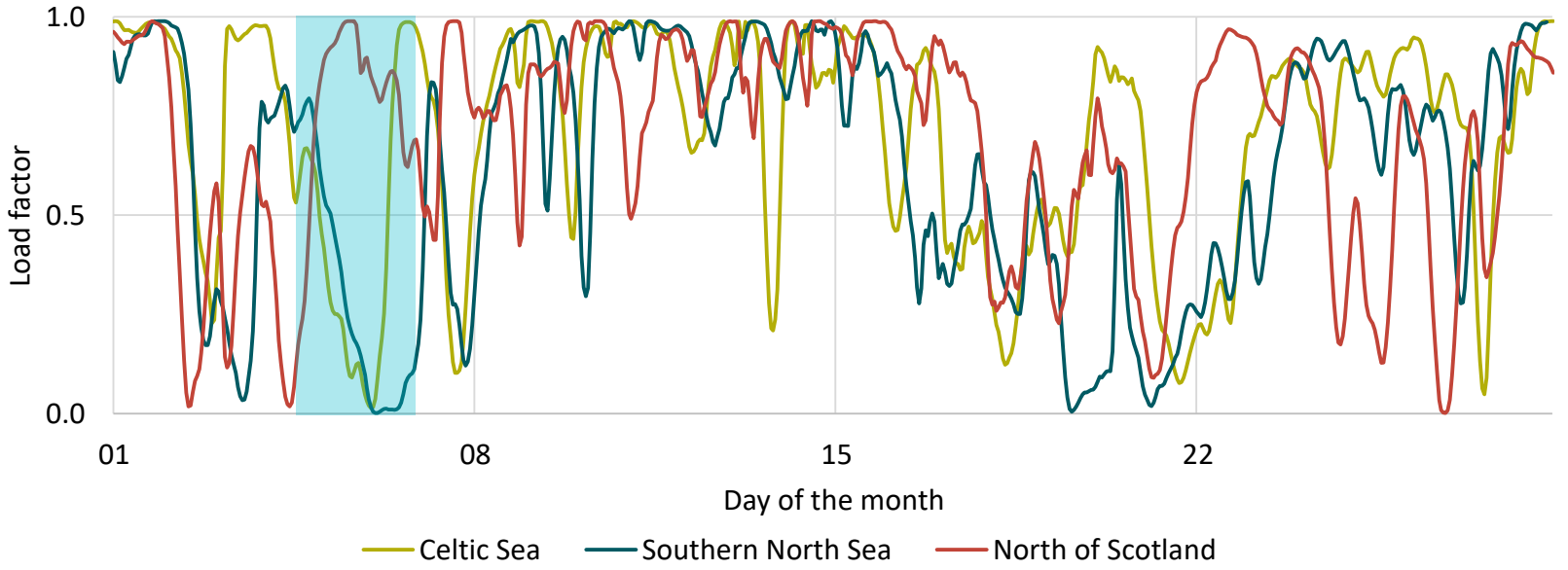
Celtic Sea and Scotland offshore wind development





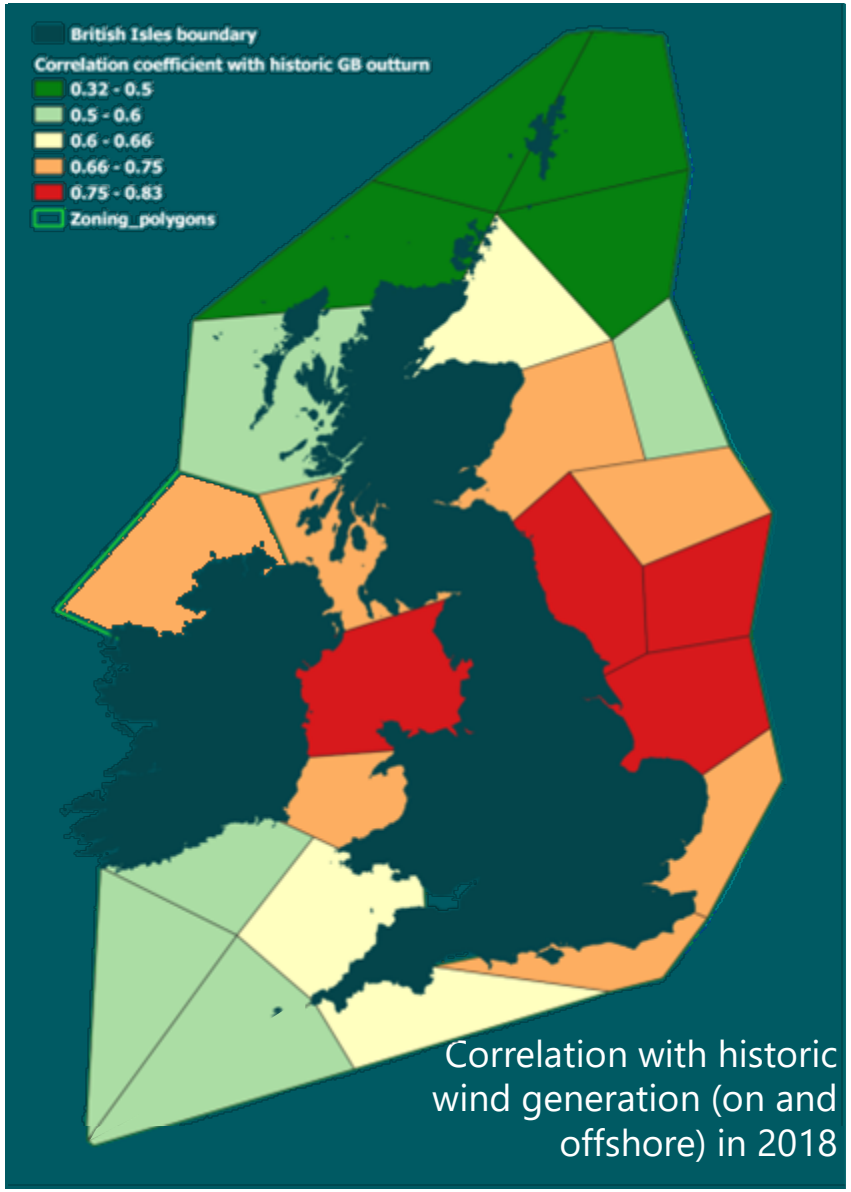
An example of the benefit of Go West





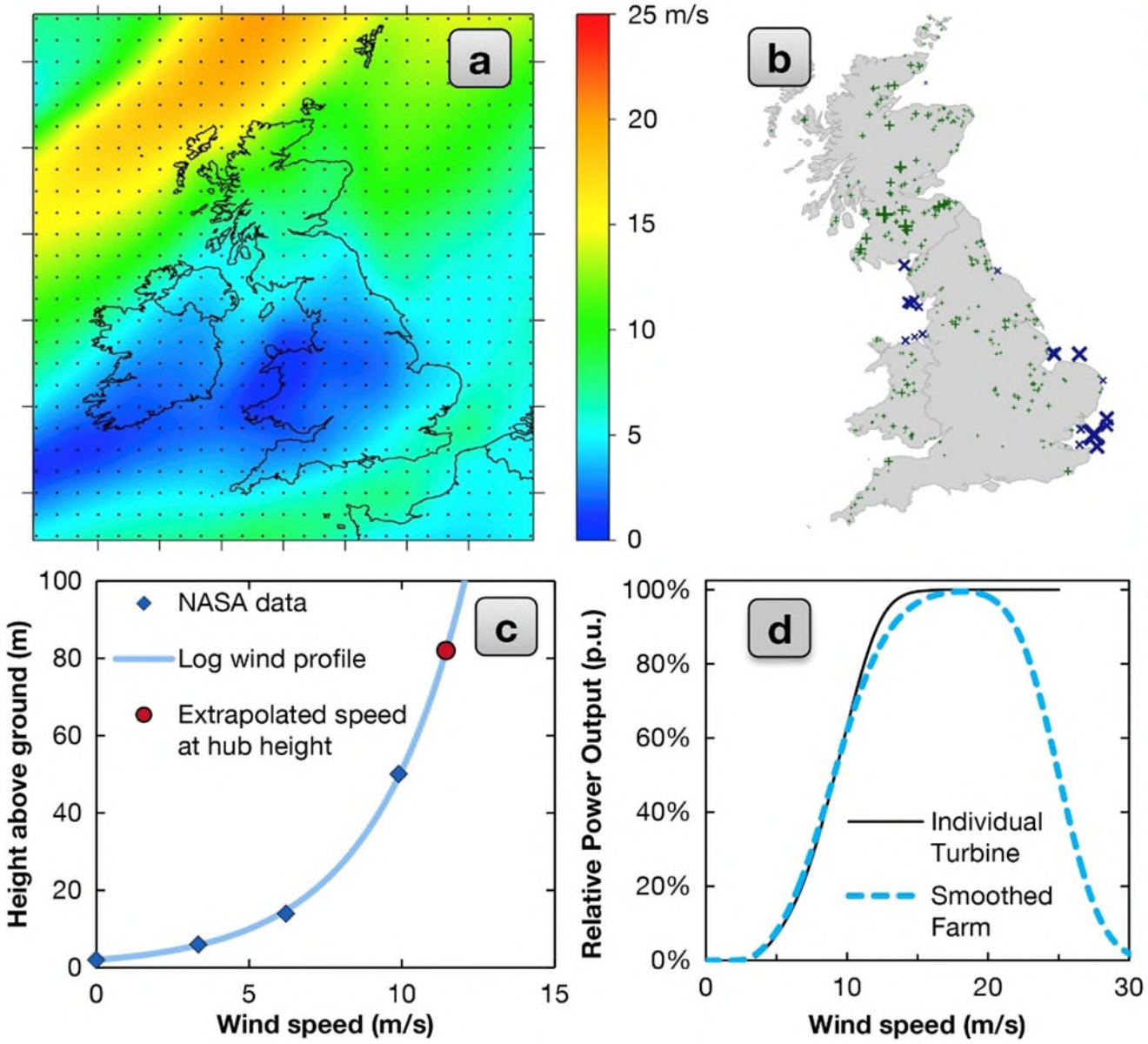
Zoning

- 23 zones
- 20 covering GB economic area + 3 in Irish economic area
- GB zones used for main scenarios and most sensitivities
- Irish zones added for ‘Further West’ sensitivity
- Built around existing and planned developments where possible
- Capacity factors for individual zones are in the range 40 – 63%
- But key for the Go West project is **the correlation between zones**



Correlation with historic wind generation (on and offshore) in 2018

Renewables.ninja method



a) Wind speeds for each hour are acquired from MERRA's regularly-spaced grid (shown as black dots).

b) Speeds are interpolated to the location of each wind farm (the UK's fleet as of January 2015 shown).

c) A logarithmic curve is fitted to the speed data with time- and spatially-varying roughness length and friction velocity to extrapolate speeds to the turbine's hub height.

d) Wind speed is converted to the expected power output from an aggregated wind farm.