AURORA Spring Forum
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AURORA GLOBAL KEYNOTE

RENEWABLES INVESTMENTS: HOW MUCH CARBON ARE YOU ACTUALLY SAVING?

Investors are increasingly looking to quantify their carbon footprint, including emissions avoided through their financed activities

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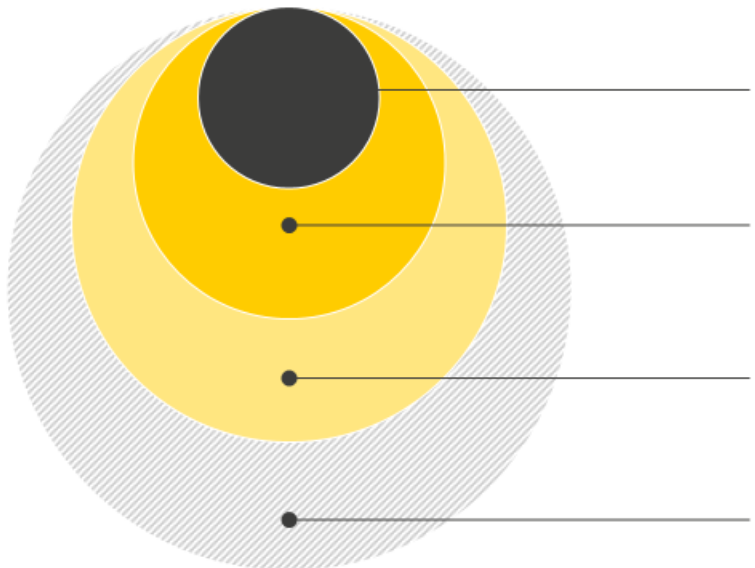
The scope of carbon emissions accounting



Scope 1 – Direct emissions
From company-owned and controlled resources.

Scope 2 – Indirect emissions
Emissions created by the production of the energy a consumer uses.

Scope 3 – Indirect emissions (upstream)
All indirect emissions in a company's value chain not included in scope 1 or 2. Includes 'financed' and 'facilitated' emissions through investor activity.

Scope 3 – Indirect emissions (downstream)
Can include emissions avoided in the wider system or through changes in behaviour as a result of the financed activity.

Selected carbon accounting frameworks

GREENHOUSE GAS PROTOCOL

International Capital Market Association

GRI

PCAF Partnership for Carbon Accounting Financials

LMA Loan Market Association

Source: Aurora Energy Research

Estimating carbon avoided through a renewables investment can be done in four steps to determine the Marginal Avoided Carbon (MAC)

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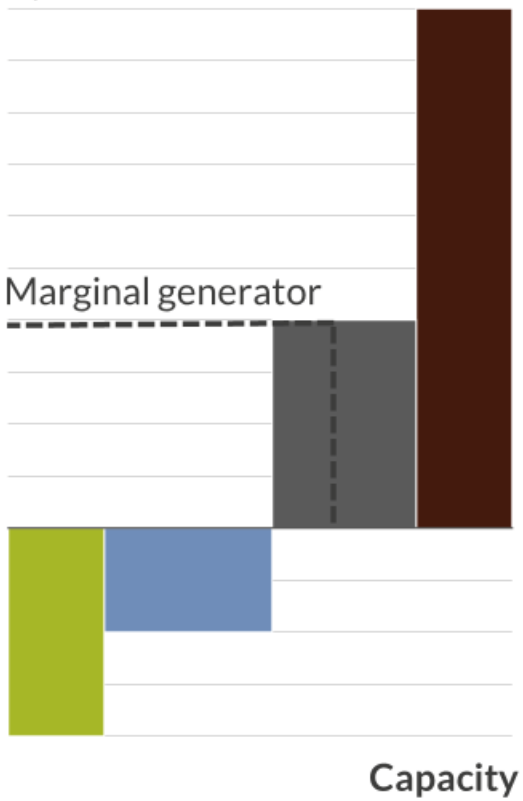
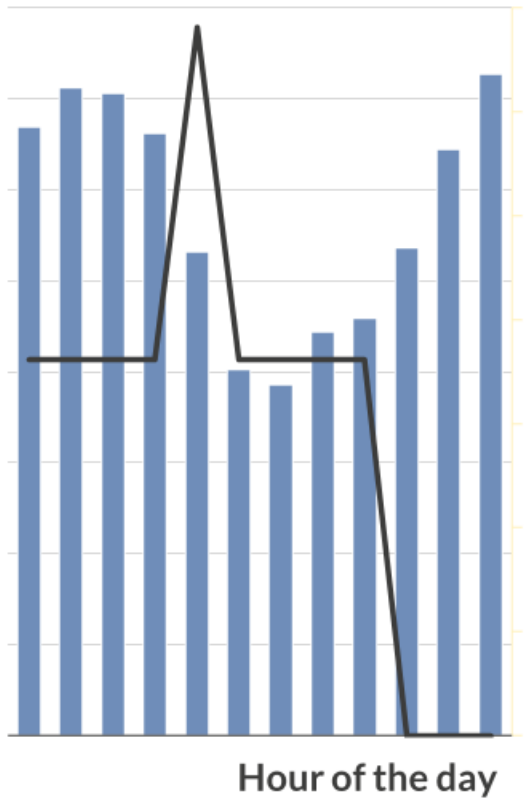
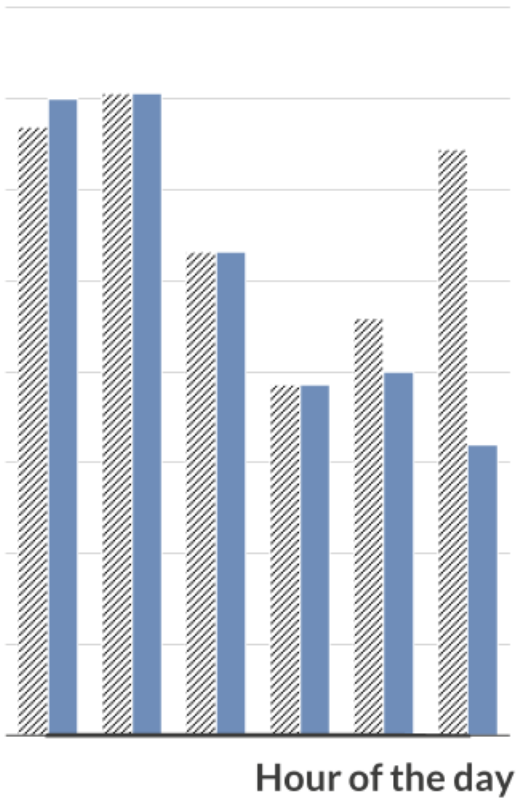
1 Identify Marginal Carbon Intensity



2 Calculate technology-specific savings



3 Calculate site-specific savings



4 Account for grid constraints

Solar PV | Offshore Wind | Gas | Coal | Specific asset | Marginal Carbon Intensity | Curtailed line | Uncurtailed line | X Deep-dive

Source: Aurora Energy Research

Start by identifying the carbon intensity of the marginal generator displaced as an additional 1 MW is added to the system

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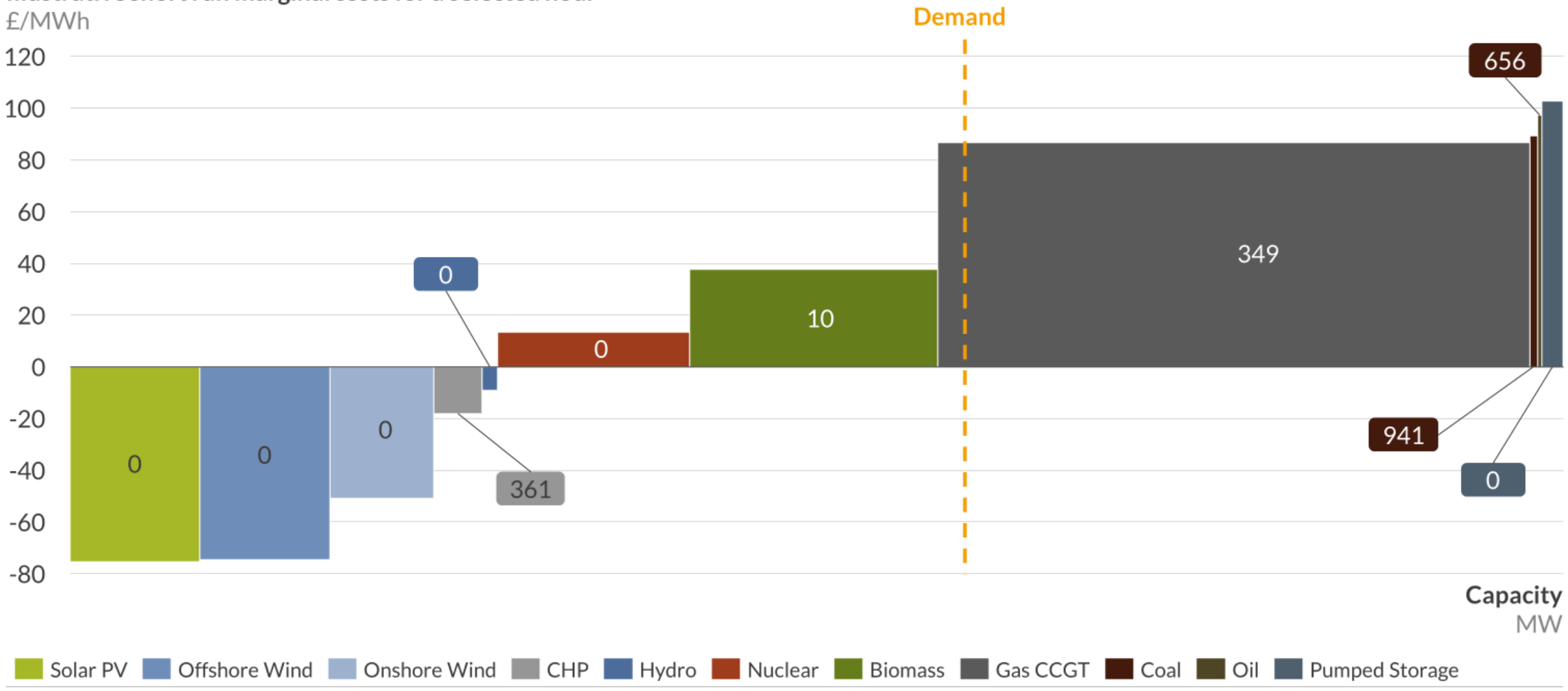
Illustrative short run marginal costs for a selected hour[1]



1) Numbers inside the blocks represent the technology's carbon emissions in gCO_2/kWh.

Source: Aurora Energy Research

Start by identifying the carbon intensity of the marginal generator displaced as an additional 1 MW is added to the system

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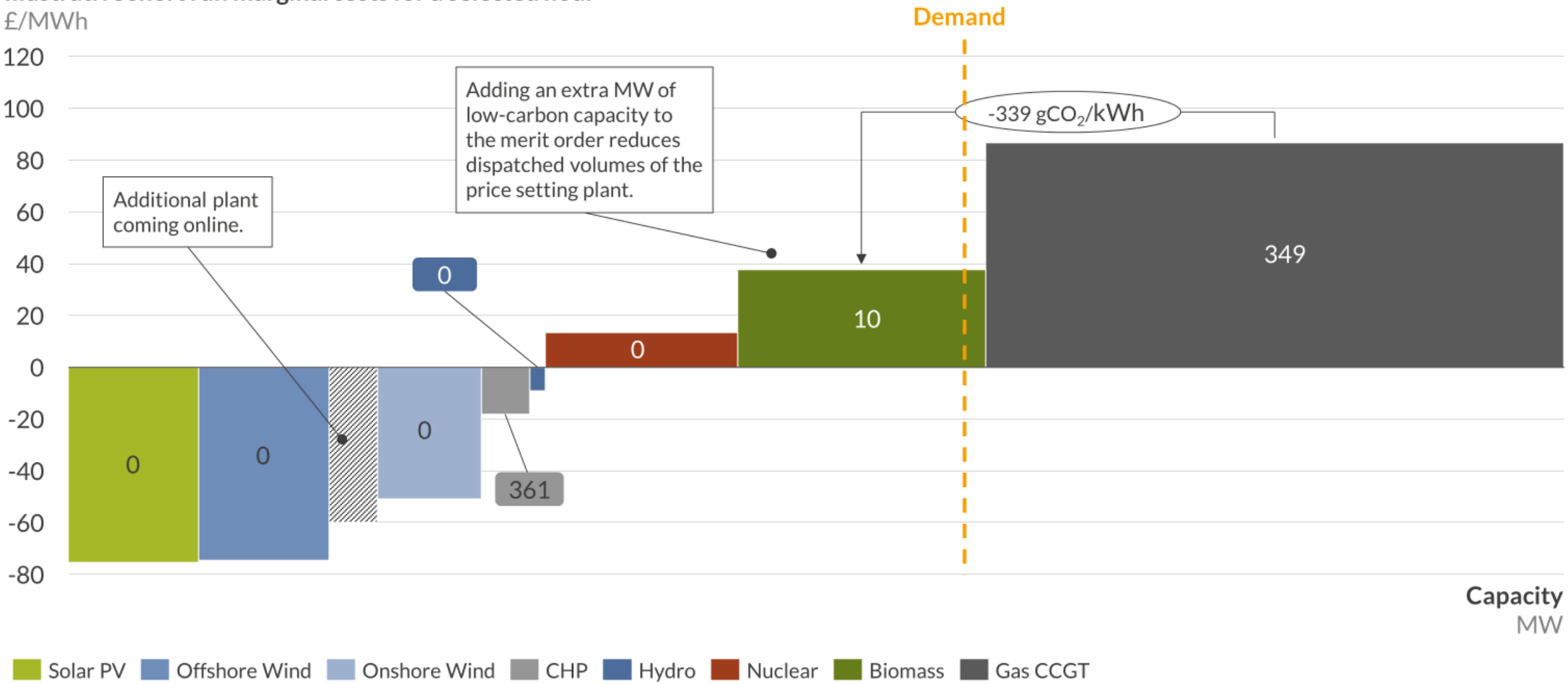

1) Numbers inside the blocks represent the technology's carbon emissions in gCO_2/kWh.

Source: Aurora Energy Research

Carbon intensity is often higher at the margin than the system average, due to high penetration of renewables in the mix

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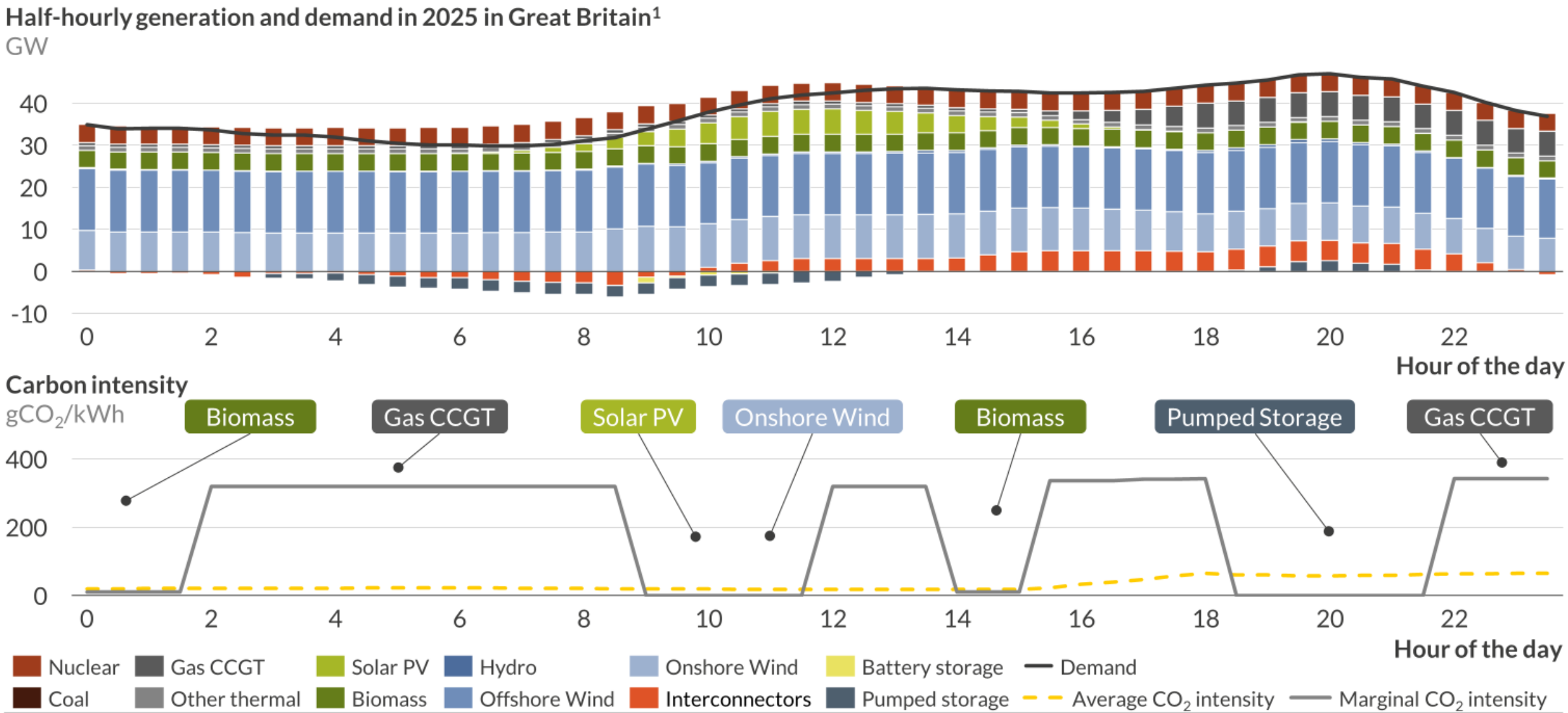

1) Illustrative day in spring.

Source: Aurora Energy Research

Renewables offer a higher carbon saving if they run during hours with high Marginal Carbon Intensity

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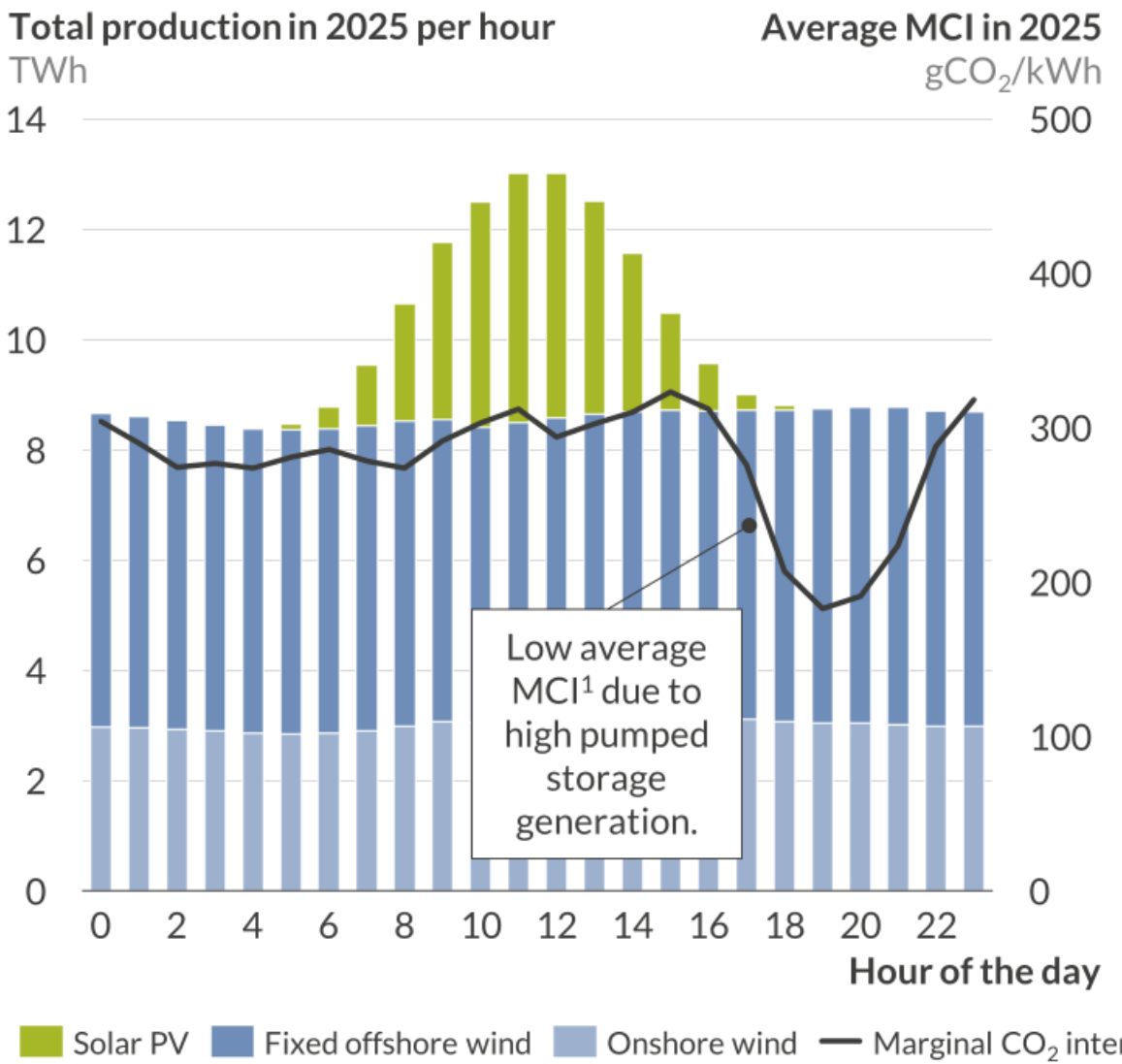

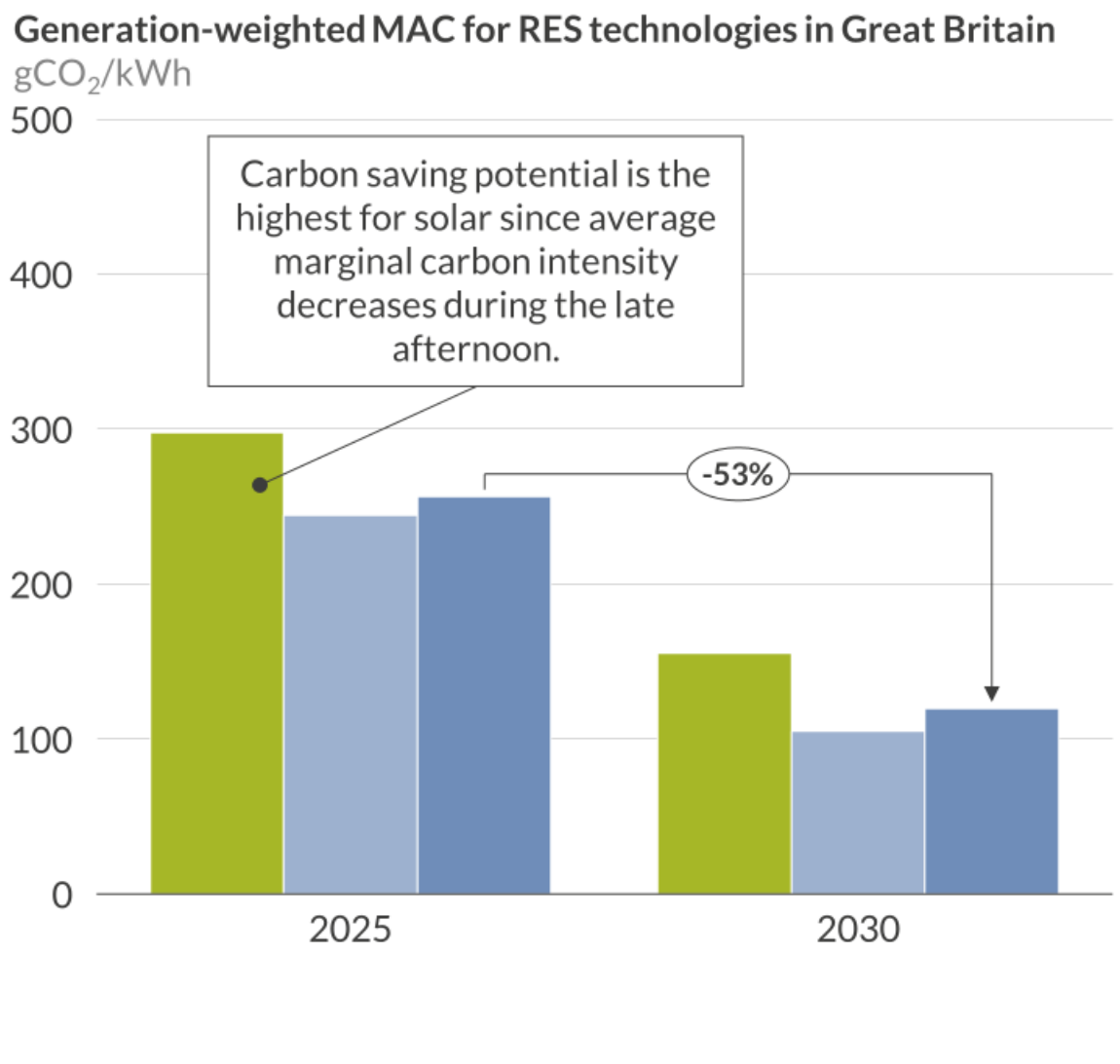

1) Marginal Carbon Intensity, referring to the carbon intensity of the marginal price plant.

Source: Aurora Energy Research

Sites which are less correlated to the fleet secure a premium both in capture price and carbon savings

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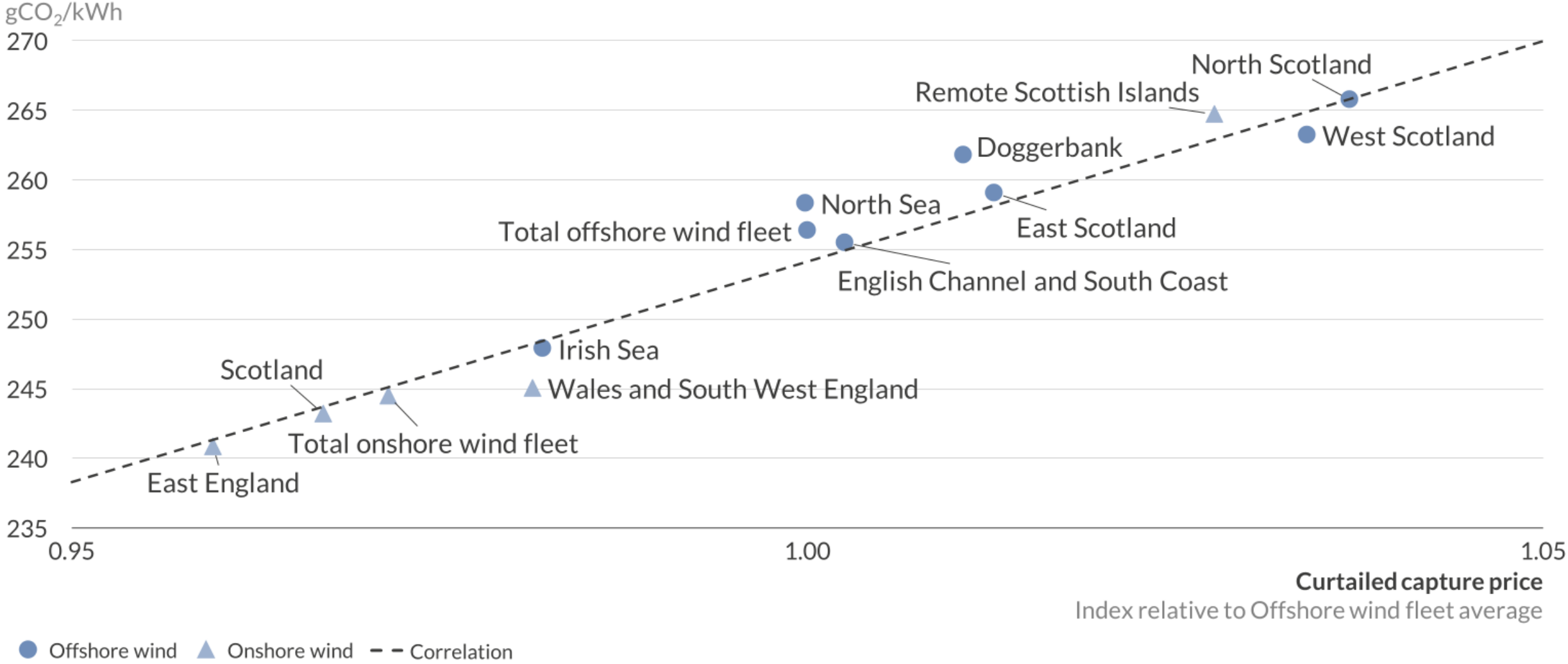
Generation-weighted average Marginal Avoided Carbon in Great Britain, 2025



Source: Aurora Energy Research

When the grid is constrained, renewables are curtailed and thermal plants are brought on to the system, raising the Marginal Carbon Intensity

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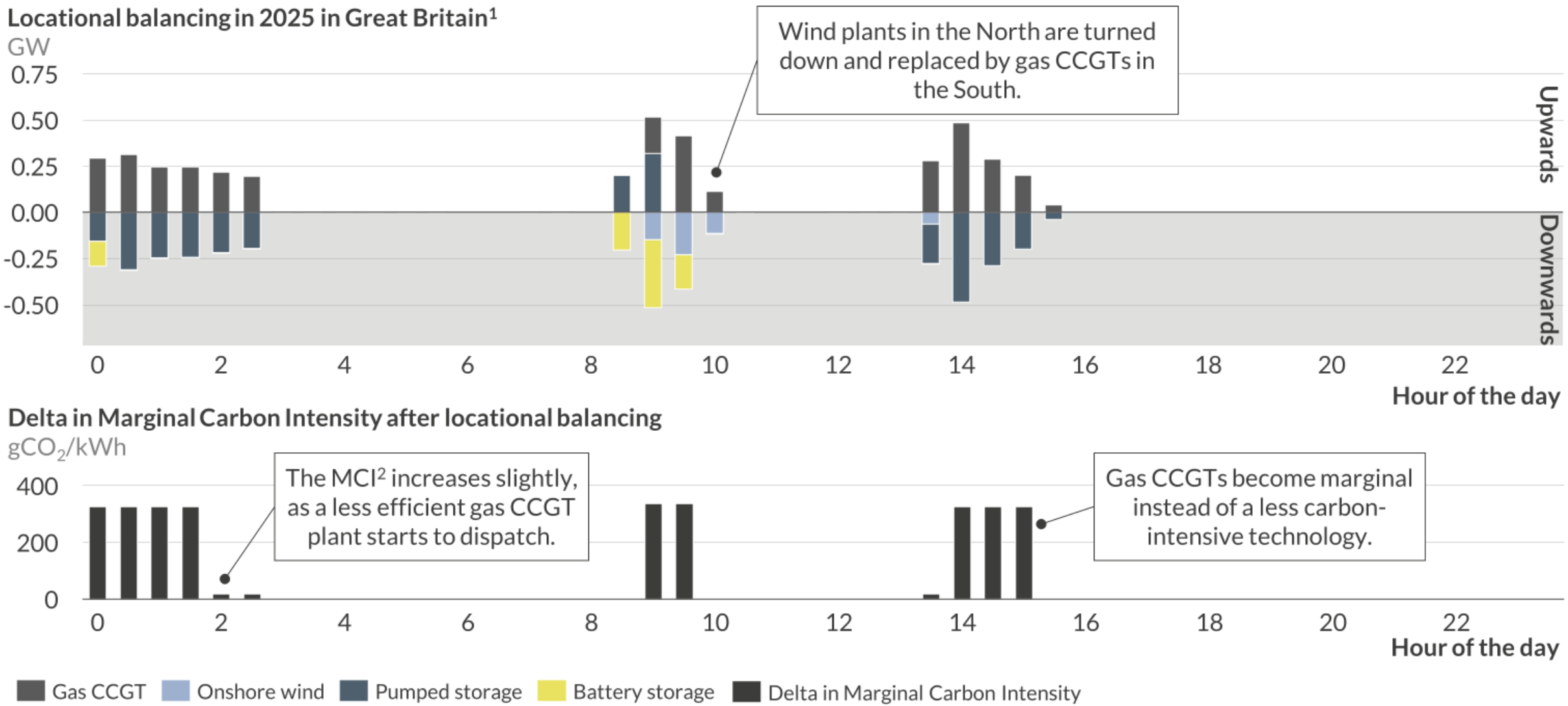

1) Illustrative day in spring; 2) Marginal Carbon Intensity, referring to the carbon intensity of the marginal price plant.

Source: Aurora Energy Research

A wind farm in Scotland has a lifetime MAC of 9,500 tCO_2/MW, avoiding more carbon than a site in East England despite grid constraints

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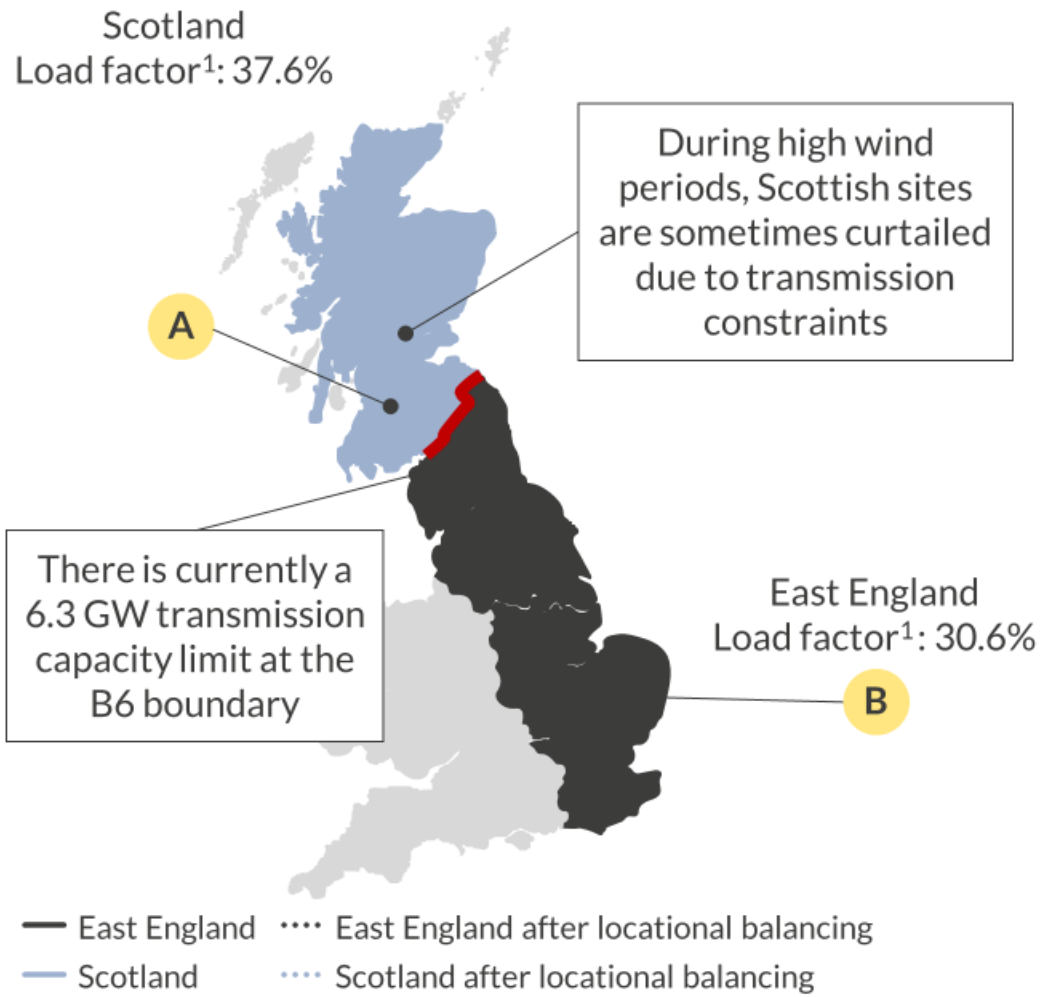
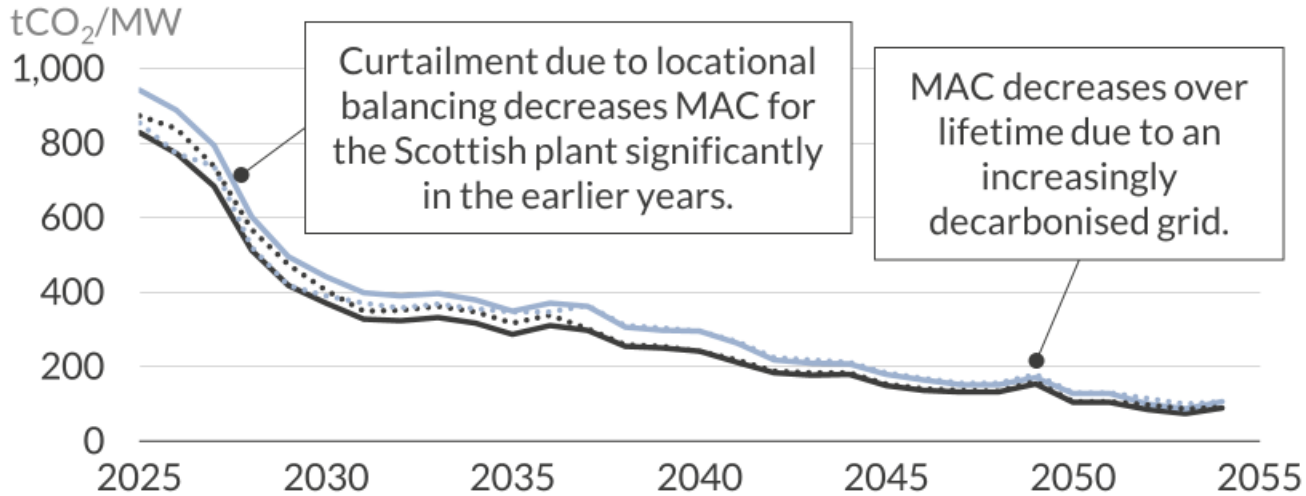
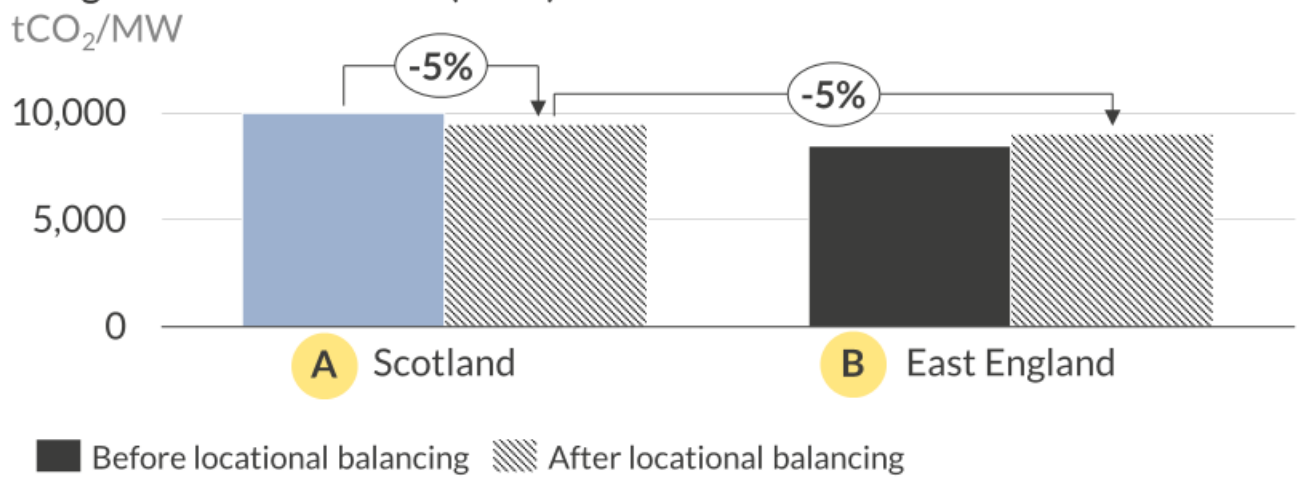
Location of selected onshore wind plants in Great Britain



MAC per year and asset before and after locational balancing



Marginal Avoided Carbon (MAC) over lifetime



1) Before curtailment and locational balancing.

Source: Aurora Energy Research

Key takeaways

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1 Marginal Avoided Carbon (MAC) represents how much carbon can be saved by adding an additional Megawatt of low-carbon capacity of a given technology to the power system. The carbon saving depends on when the plant is dispatching, and the marginal carbon intensity of the system in these periods.

2 With an MAC of 285 gCO_2/kWh in 2025, solar delivers higher carbon savings than onshore or offshore wind in GB as generation is focused in periods of higher carbon intensity. The MAC of wind and solar technologies halves between 2025-2030 as the grid is decarbonised.

3 The more decorrelated an asset's generation profile is compared to the rest of the renewable fleet, the larger carbon benefit to the system, as the system's Marginal Carbon Intensity is higher in hours when fewer renewable assets are dispatching.

4 Periods of high renewables production can lead to grid curtailment, with thermal plants brought on to the system raising marginal carbon emissions in these periods. This can increase or decrease the MAC of a renewable project, depending on the extent to which it suffers from grid constraints.

Source: Aurora Energy Research


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