

AURORA
Battery
Conference
LONDON 2024



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AURORA KEYNOTE
DOWN TO THE WIRE(S):
HOW CAN GRID DEPLOYMENT MAKE OR
BREAK A BESS INVESTMENT CASE IN GB?

Setting the scene

- What do recent commitments mean for renewables and grid development in the coming decade?
- Where can locational value be found now?
- How does Aurora capture locational value in its Central view?

Grid outcomes and battery economics

- Where are the best locations for battery siting in the future?
- How sensitive is this locational value for batteries under different network deployment scenarios?

Impact of accelerated renewables development

- How does locational value for batteries evolve as renewables deployment scales to meet the new government's ambitious targets?

Despite increased momentum, 2030 targets are nigh impossible, though a plausible acceleration of renewables can achieve 63% of Labour targets

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1 The Labour government is seeding further momentum for the energy transition...

Labour lifts Tories' 'absurd' ban on onshore windfarms

Jul 2024

Saga of 'monstrous' solar farm ends with approval

Government increases AR6 budget to over £1.5 billion

Open letter on the reformed regulatory framework on connections

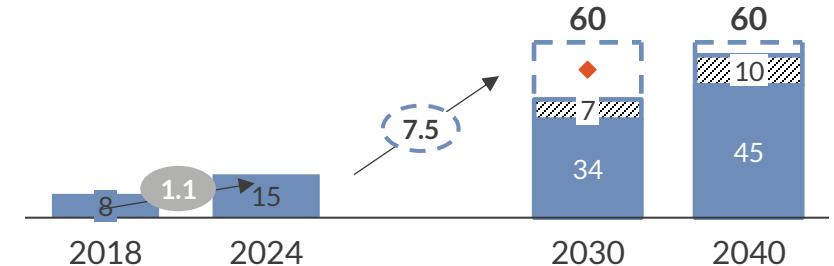
Nov 2024

Advice on achieving clean power for Great Britain by 2030

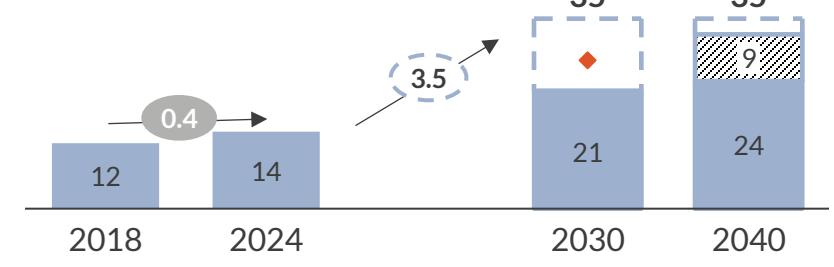
2 ...but Aurora sees government targets for 2030 as unachievable, though some accelerated development is possible

Labour government's 2030 targets, Aurora Central and Plausible Acceleration
GW, GW/yr

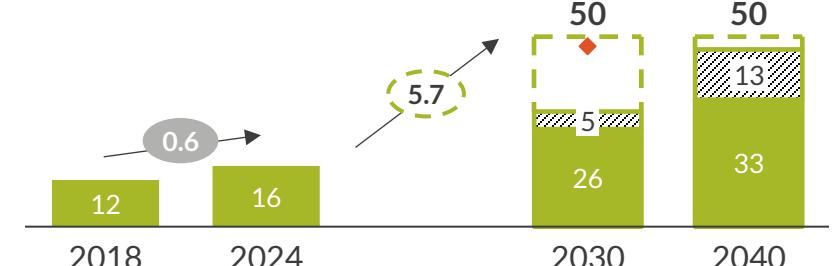
Quadruple Offshore Wind



Double Onshore Wind



Triple Solar PV



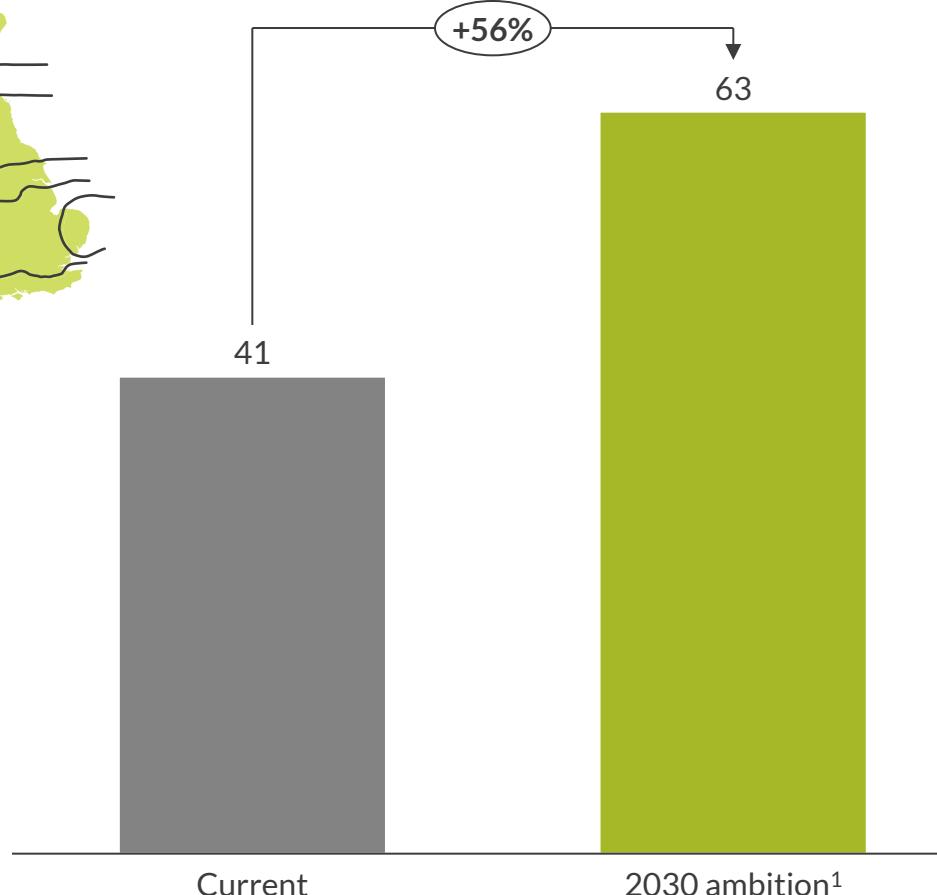
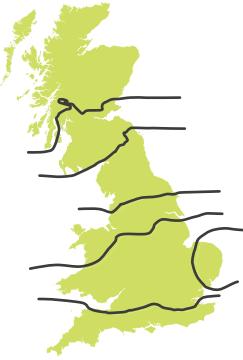
Legend: Labour (blue), Plausible acceleration (green), Aurora Central (grey), NESO CP2030¹ (red)

1) NESO's Clean Power 2030 Further Flex and Renewables scenario.

Alongside increasing renewables deployment, ambition for grid delivery is high, but may not be met due to planning and other delivery challenges

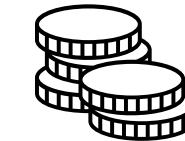
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Boundary network transfer capacity by 2030¹
GW

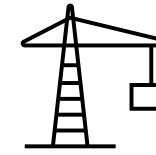


1

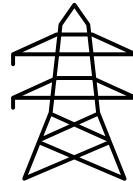
Significant scale up in financing and deployment of lines are required to meet CP2030 ambitions...



£18.1 billion
est. CAPEX to
2030



80 works must
be delivered to
reach CP2030



~5,500km of new
lines by 2030

2

...Which requires major acceleration of planning and materials deployment



5 year reduction in
grid delivery
timelines required²



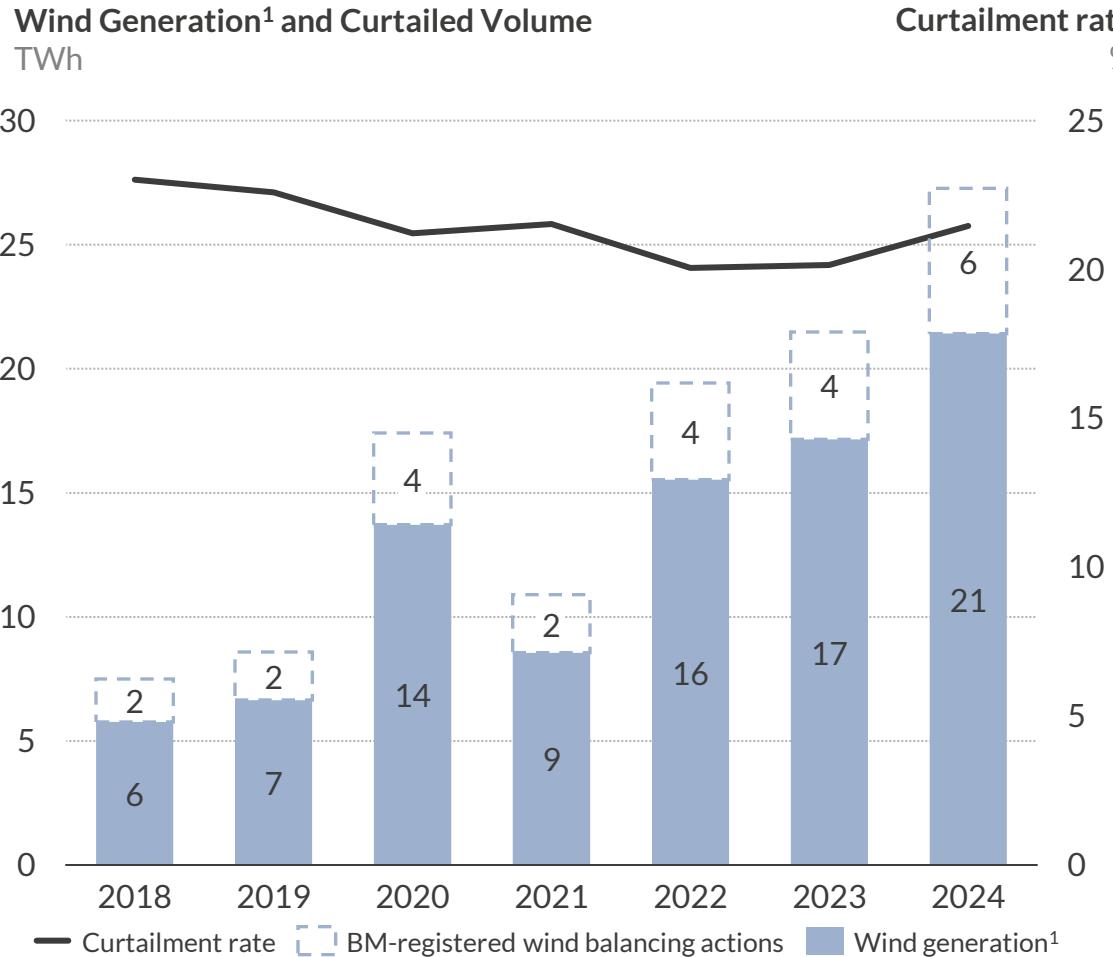
1.1 million tonnes of
additional steel requirement
by 2030, up from 0.4 million
tonnes in 2025 for ASTI³

¹) 2030 boundary transfer capacity in line with Beyond 2030 targets between key constrained boundaries; including B4, B6, B7a, B8, SC1 and EC5 boundaries. 2) Recommendation from of the Transmission Acceleration Action Plan (TAAP). 3) Requirement for line build and upgrades under ASTI (Accelerated Strategic Transmission Investment)

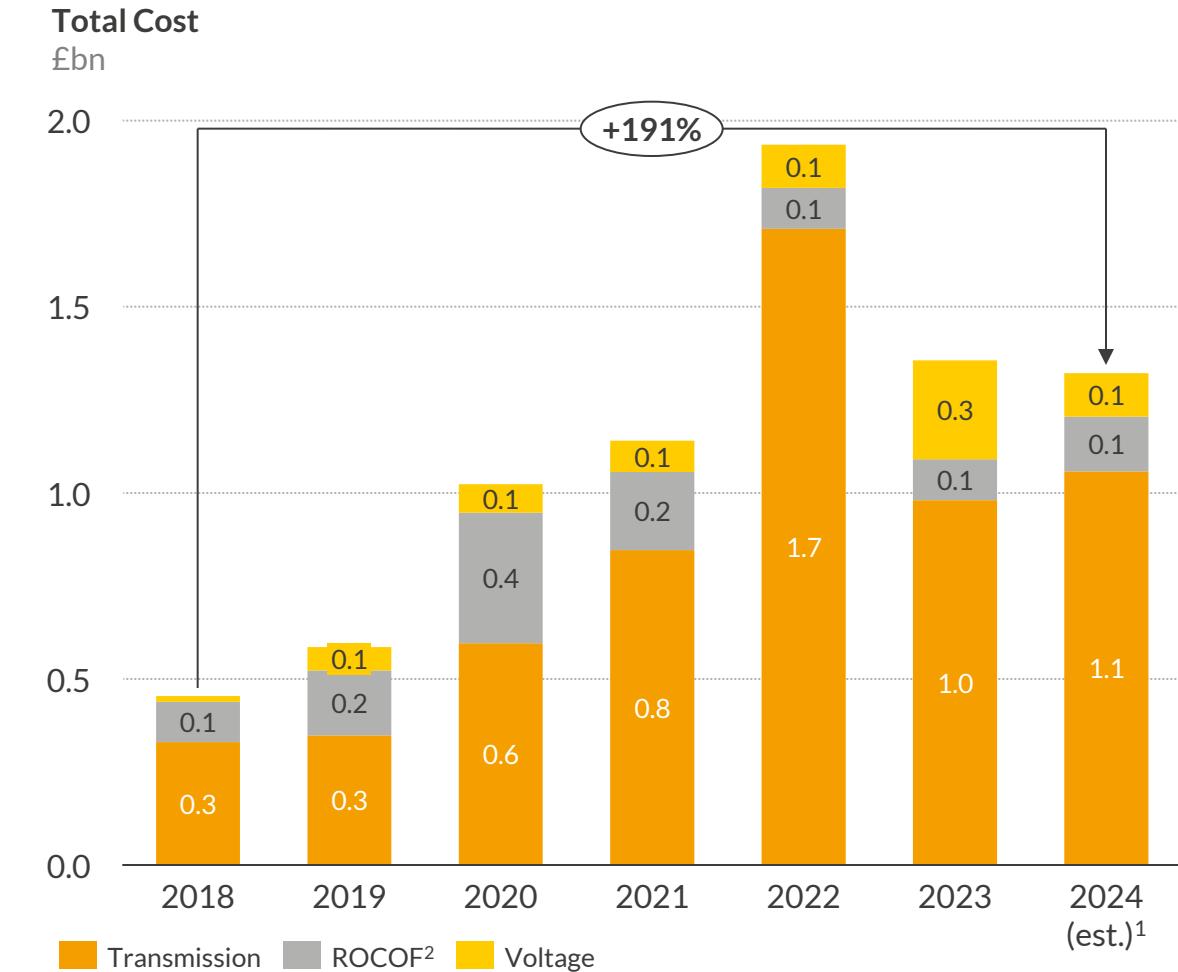
Sources: Aurora Energy Research, NESO, DESNZ

At present, northern wind generation is driving up constrained volumes and increasing system costs....

1 Wind generation growth has driven up constrained volumes...



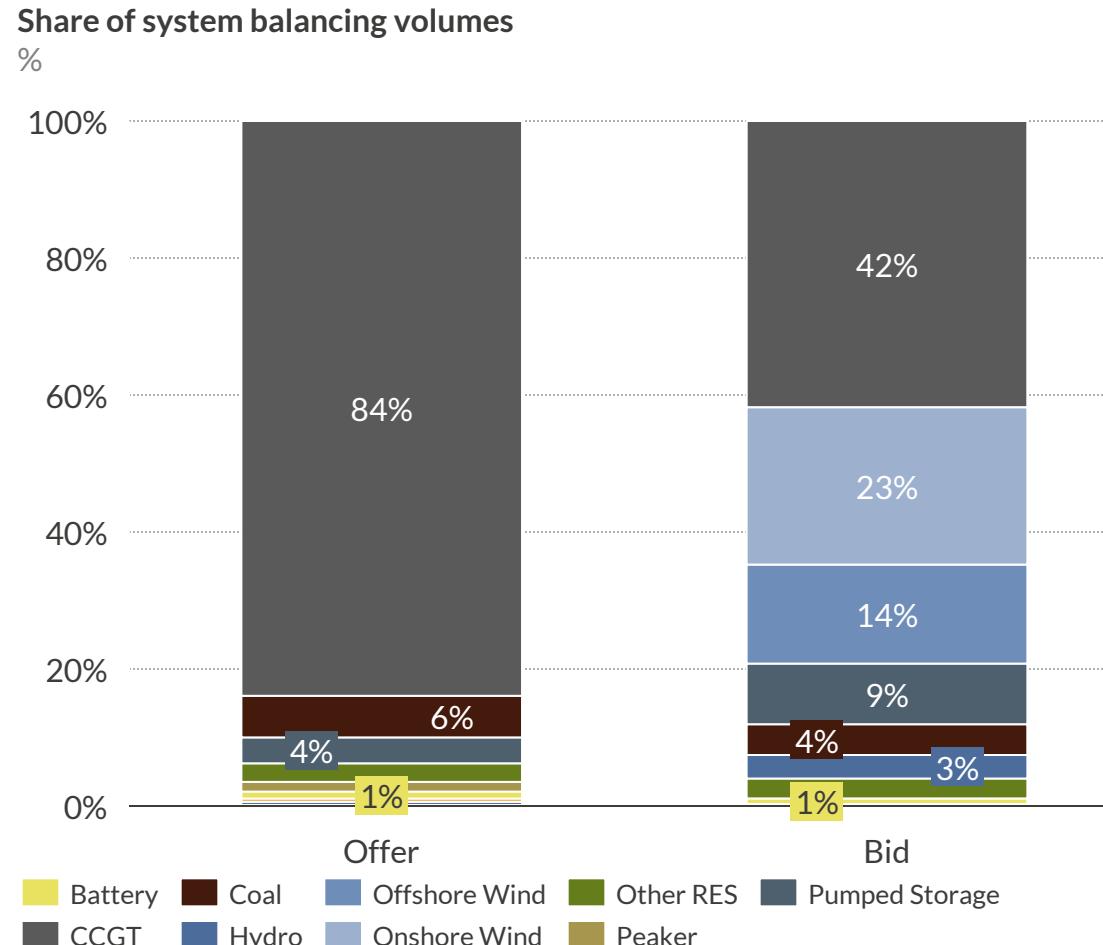
2 ...As a result, constraint costs have risen steadily



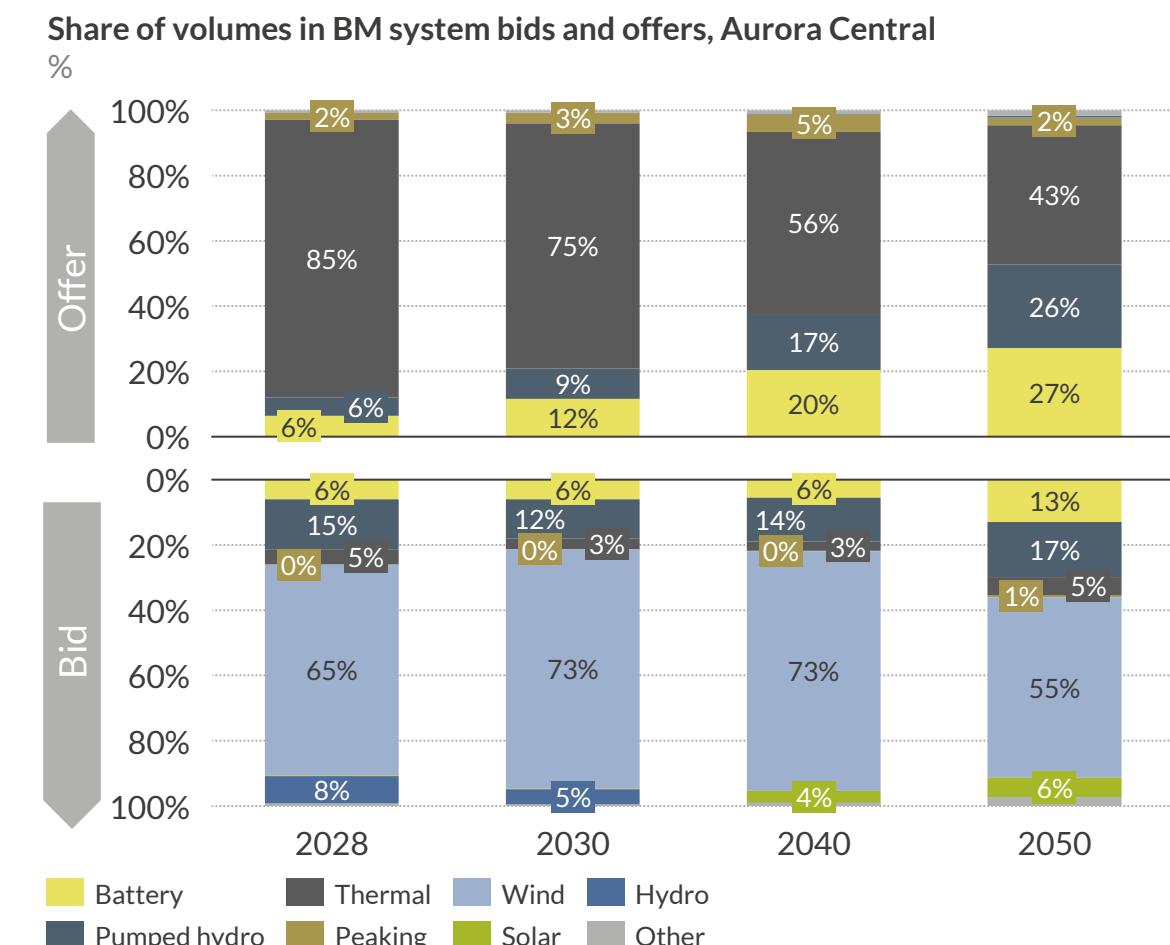
1) Generation based on Final Physical Notification (FPN) for BM-registered wind. 2) Rate of Change of Frequency.

....As these costs and volumes increase, locational value is achieved by CCGTs, but some value will shift to batteries as the system decarbonises

3 CCGTs captured the most locational value from system balancing in 2023



4 Though dispatch reform will allow some value to shift to batteries



What happens to battery business cases if we transform GB into a transmission superhighway or turbines crowd behind stagnant boundaries?

1 Key industry concerns

2 Market scenario outcomes

3 Plausible grid build outs and asset economics



How does battery locational value evolve under different network build-out scenarios?



How resilient is battery locational value to increased renewables deployment? How does this change under different grid scenarios?

Aurora Central Market Scenario

Aurora's best view of the evolution of the GB power system, incorporating a conservative view of currently stated policies, achieving 55% of Labour 2030 targets

Optimistic

Assumes full delivery of all options proposed¹

Base

Aurora's most likely network build scenario, represents a partial delay of network delivery

Pessimistic

Reflects significant non-delivery of network

Aurora Accelerated Renewables Market Scenario

Aurora's highest plausible renewables build scenario, which achieves 63% of Labour 2030 targets

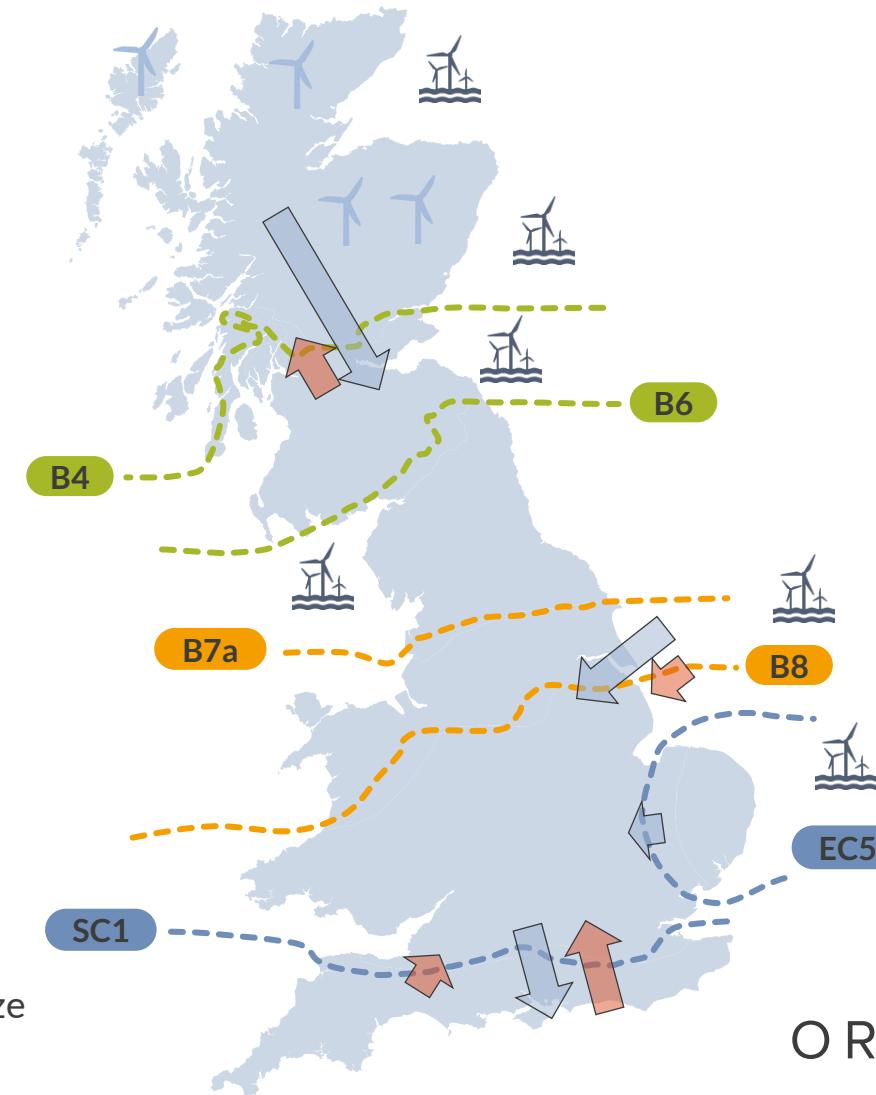
Optimistic

Base

ORIGIN CHRONOS

¹) Proposals as outlined in 'Beyond 2030'

Aurora Central considers the six key transmission boundaries in GB, capturing the impact of grid/renewables delivery on re-dispatch and costs



- Net power flow, proportional to arrow size
- Network constraint boundaries

Setting the scene

Grid outcomes and battery economics

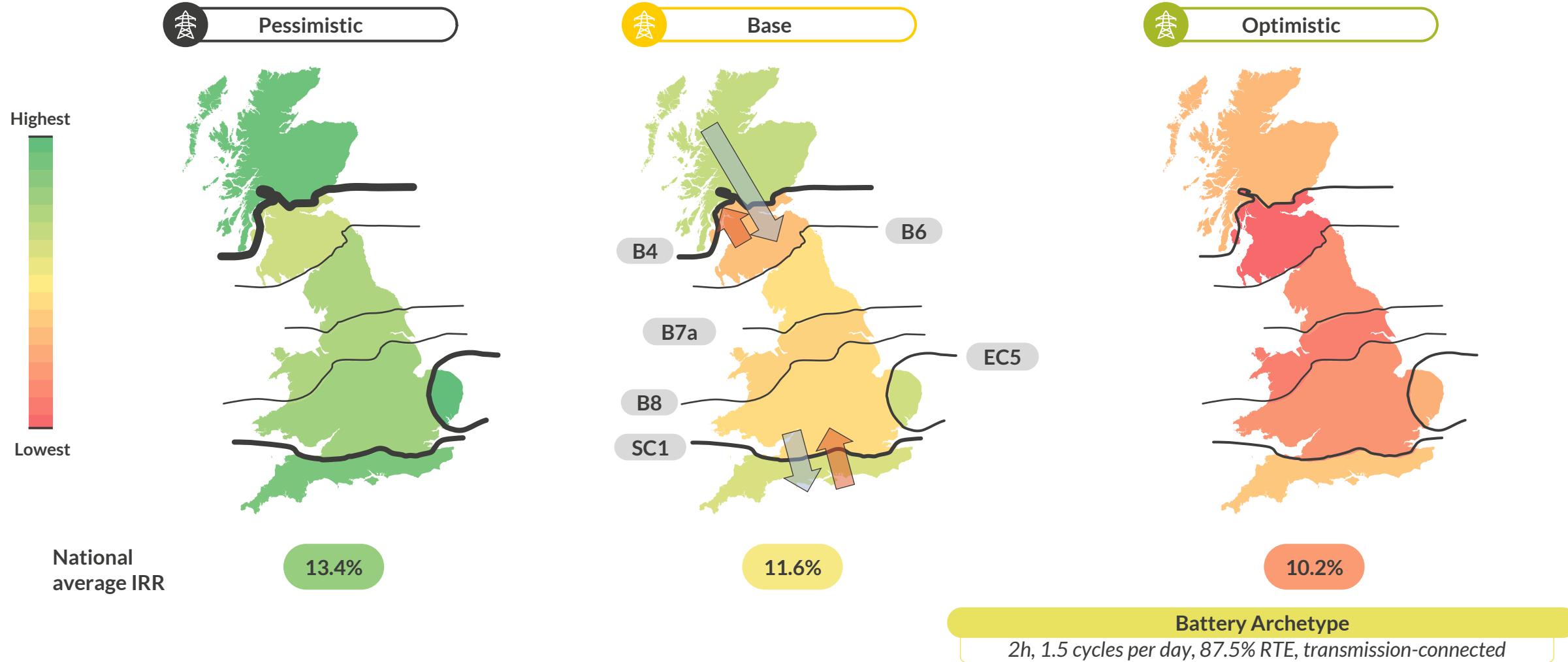
Impact of accelerated renewables development

- Where are the best locations for battery siting in the future?
- How sensitive is this locational value for batteries under different network deployment scenarios?

A major delay of grid build increases fleet-average battery IRR by 1.8pp, while full delivery reduces fleet-average IRR by 1.4pp

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Aurora Central

15-year Battery IRRs¹ with 2028 COD year

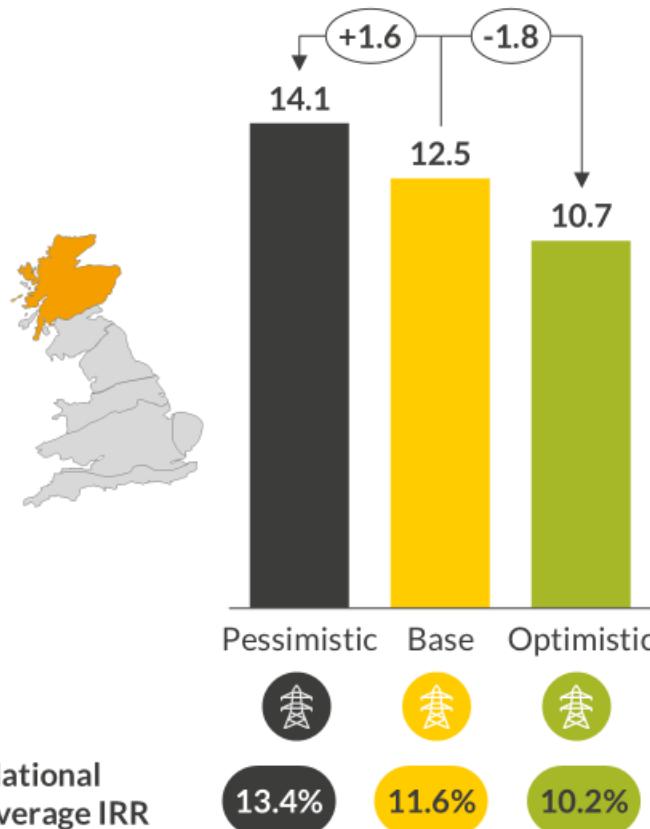


1) 2h duration, 1.5 cycle per day target, modelled with degradation and 15-year operational lifetime. Pre-tax real 2023 IRR.

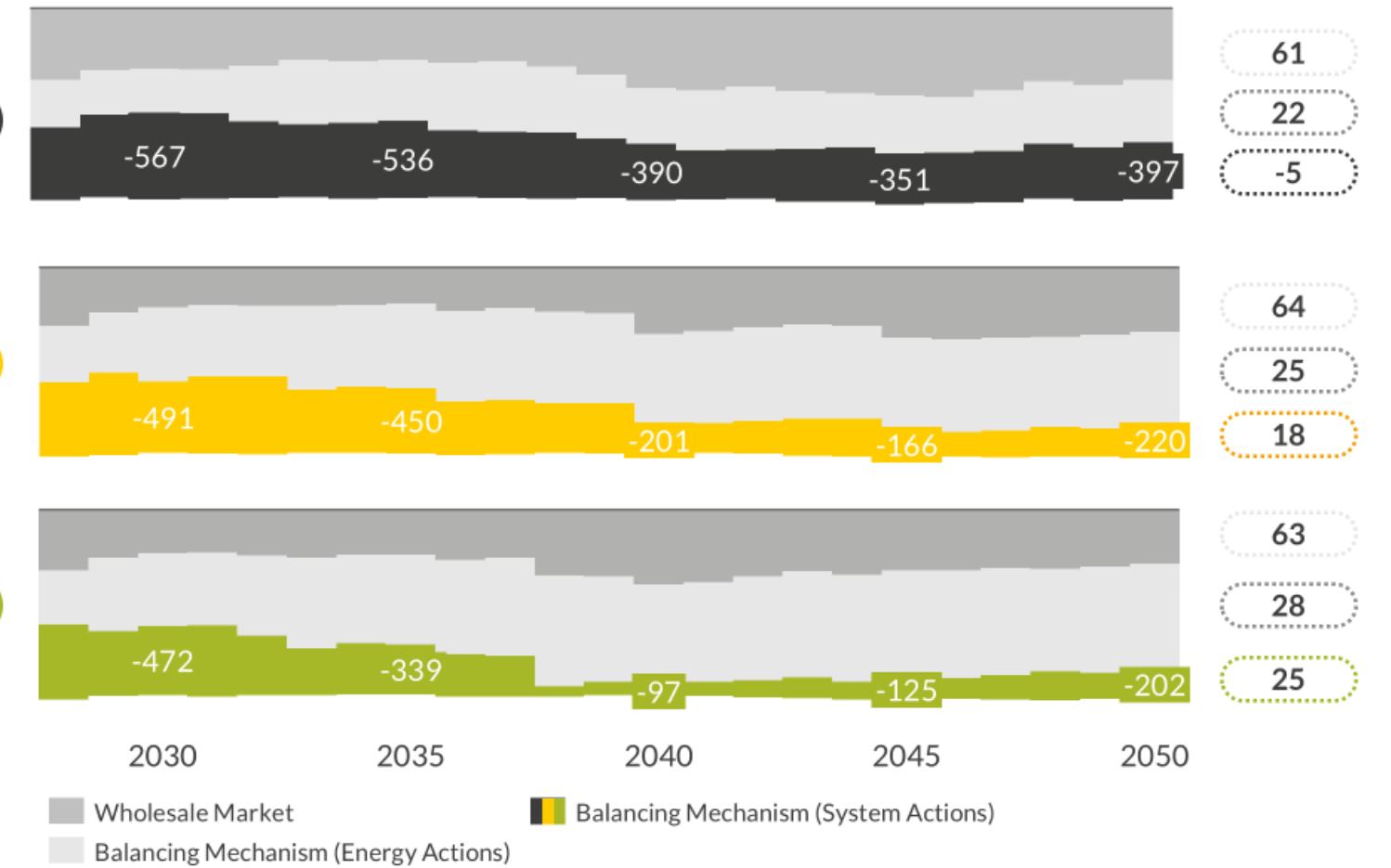
Slow grid delivery increases IRRs 1.6pp above Central due to increased constraints, while grid delivery can make locational value disappear

A U R A

15-year Battery IRR¹ for 2028 COD year
% (pre-tax, real 2023)



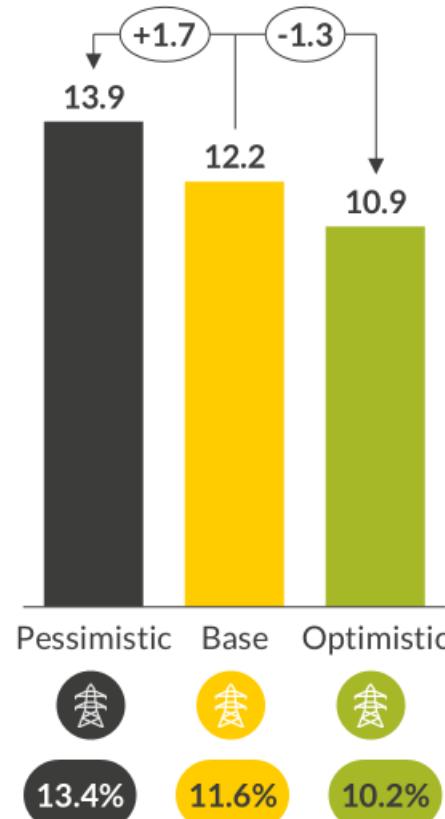
Battery Charging Utilisation Hours



¹) 2h duration, 1.5 cycle per day target, modelled with degradation and 15-year operational lifetime. Pre-tax real 2023 IRR.

Offers to turn up behind an S. England constraint stay consistently high without grid delivery, providing a 1.7pp benefit to IRR

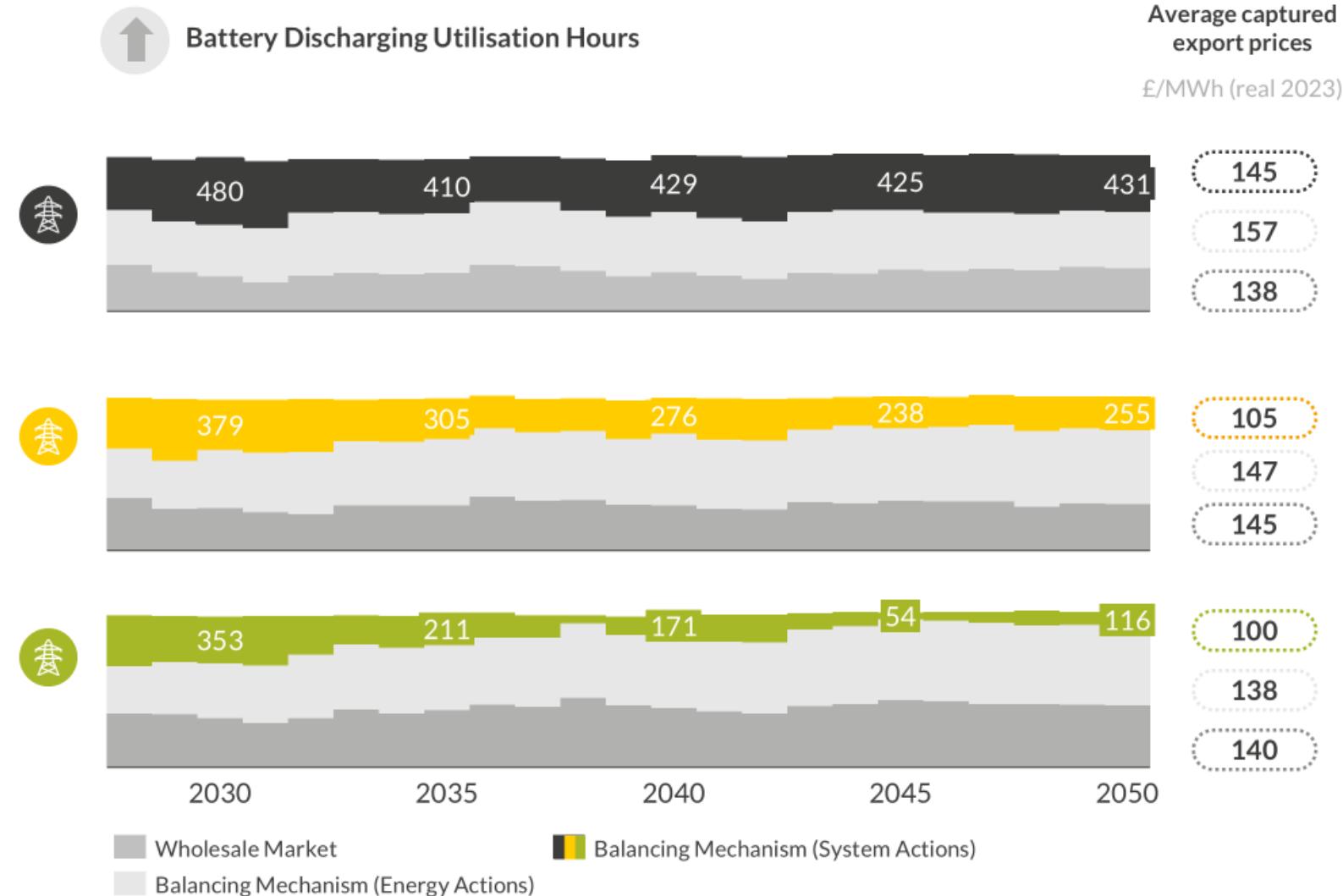
15-year Battery IRR¹ for 2028 COD year
% (pre-tax, real 2023)



+1.7

-1.3

Battery Discharging Utilisation Hours

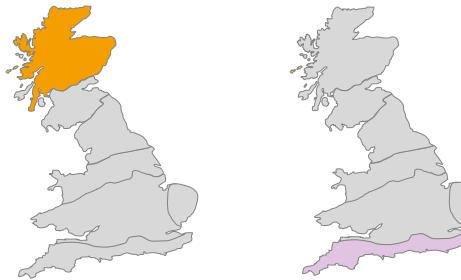


1) 2h duration, 1.5 cycle per day target, modelled with degradation and 15-year operational lifetime. Pre-tax real 2023 IRR.

Batteries coming online in the next three years are best sited in N. Scotland, while S. England becomes more attractive in the 2030s

15-year Battery IRR¹
% (pre-tax, real 2023)

Entry year

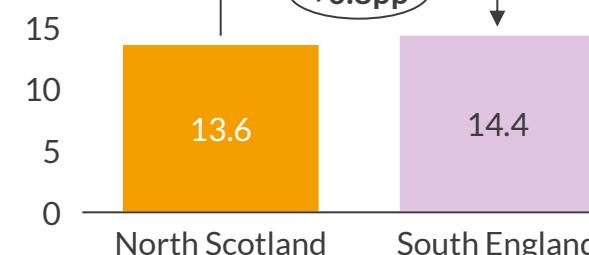


2028



2032

10% lower CAPEX



Undegraded Battery Total Gross Margins
£/kW (real 2023)

2028 difference

+15%

2035 difference

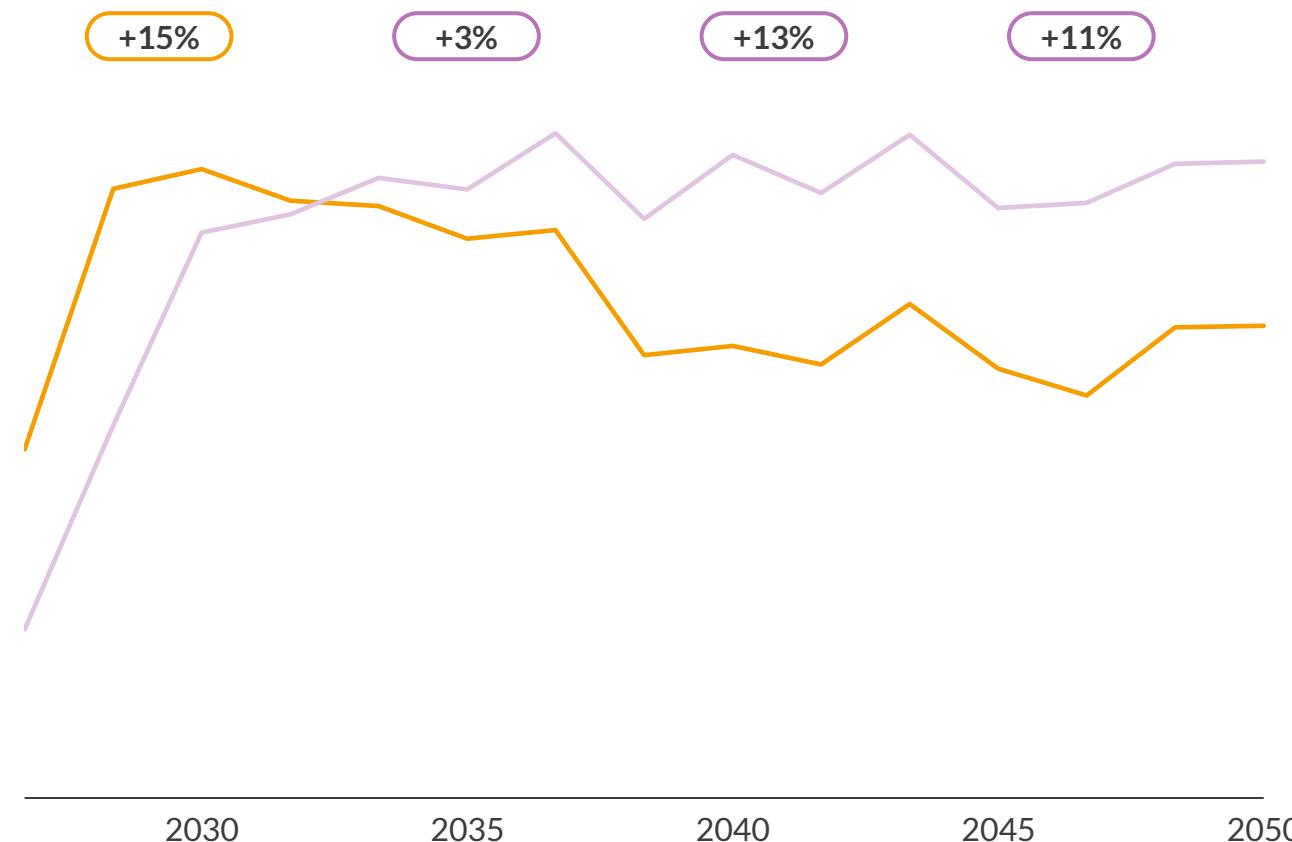
+3%

2040 difference

+13%

2045 difference

+11%



1) 2h duration, 1.5 cycle per day target, modelled with degradation and 15-year operational lifetime. Pre-tax real IRR.

Setting the scene

Grid outcomes and
battery economics

Impact of accelerated
renewables development

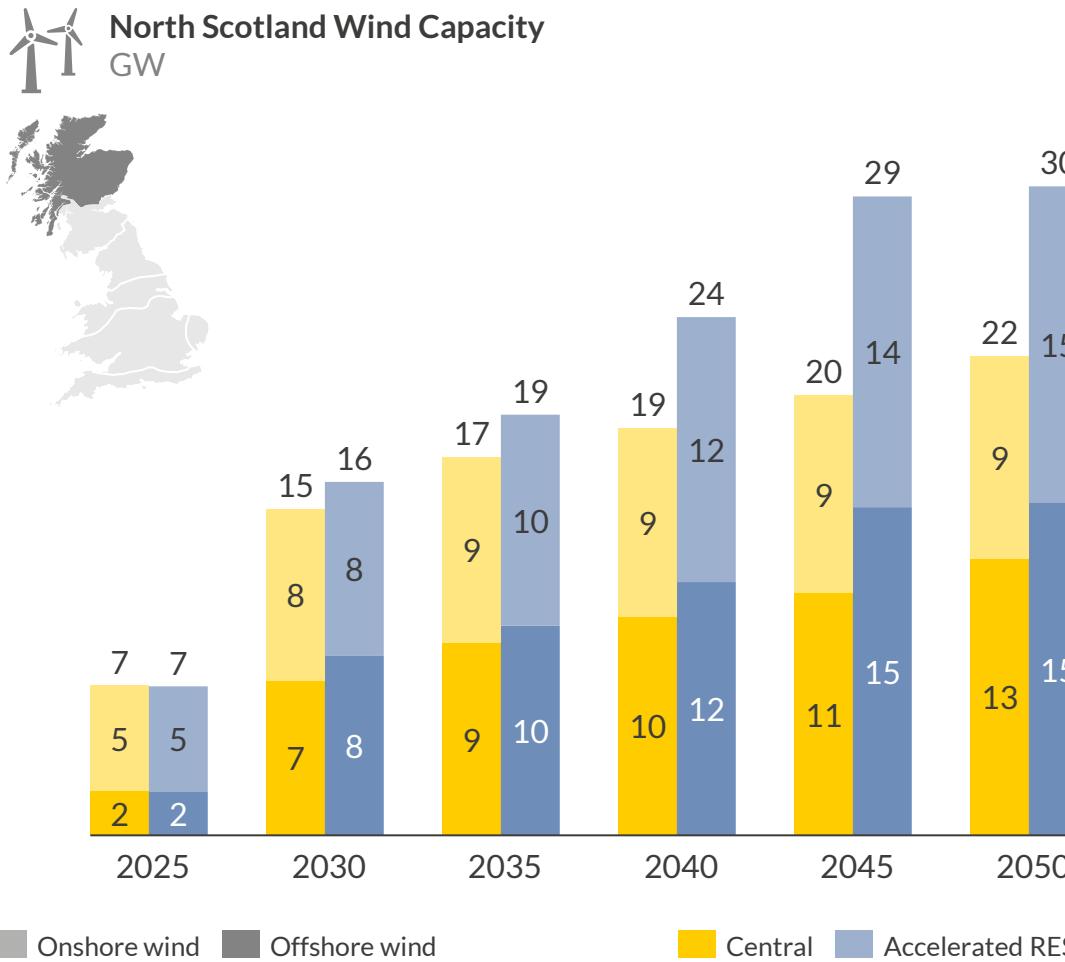
- How does locational value for batteries evolve as renewables deployment scales to meet the new government's ambitious targets?

Accelerated renewables deployment results in a 28% increase in constrained volume in N. Scotland by 2029

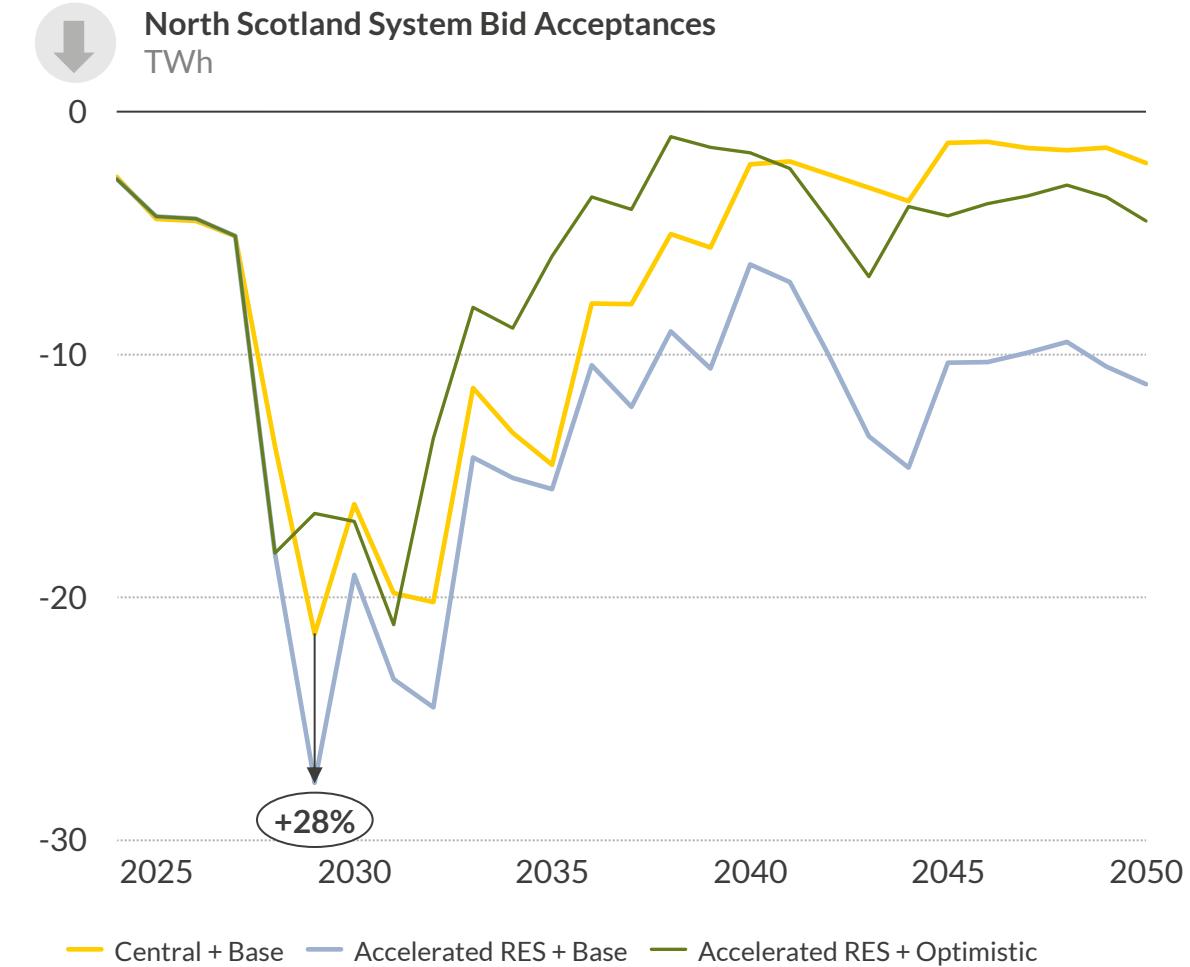
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Accelerated Renewables

1 A plausible acceleration sees a slow ramp up in wind growth rate...



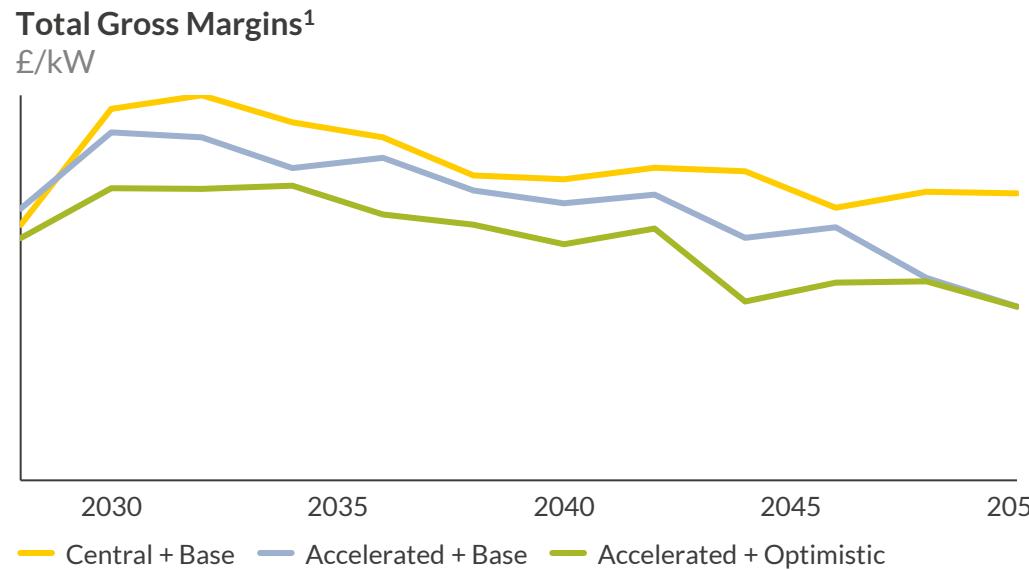
2 ...Such that constraints increase relative to Central from 2029 onwards



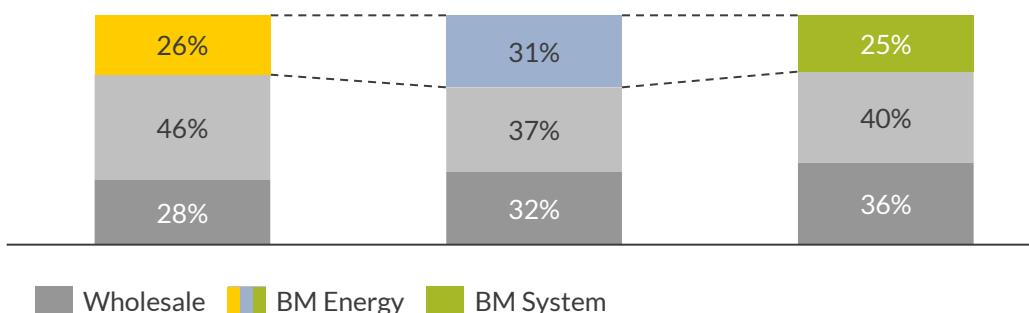
Additional locational value from constraint trading does not mitigate against risk of reduced spreads with an accelerated renewables build out

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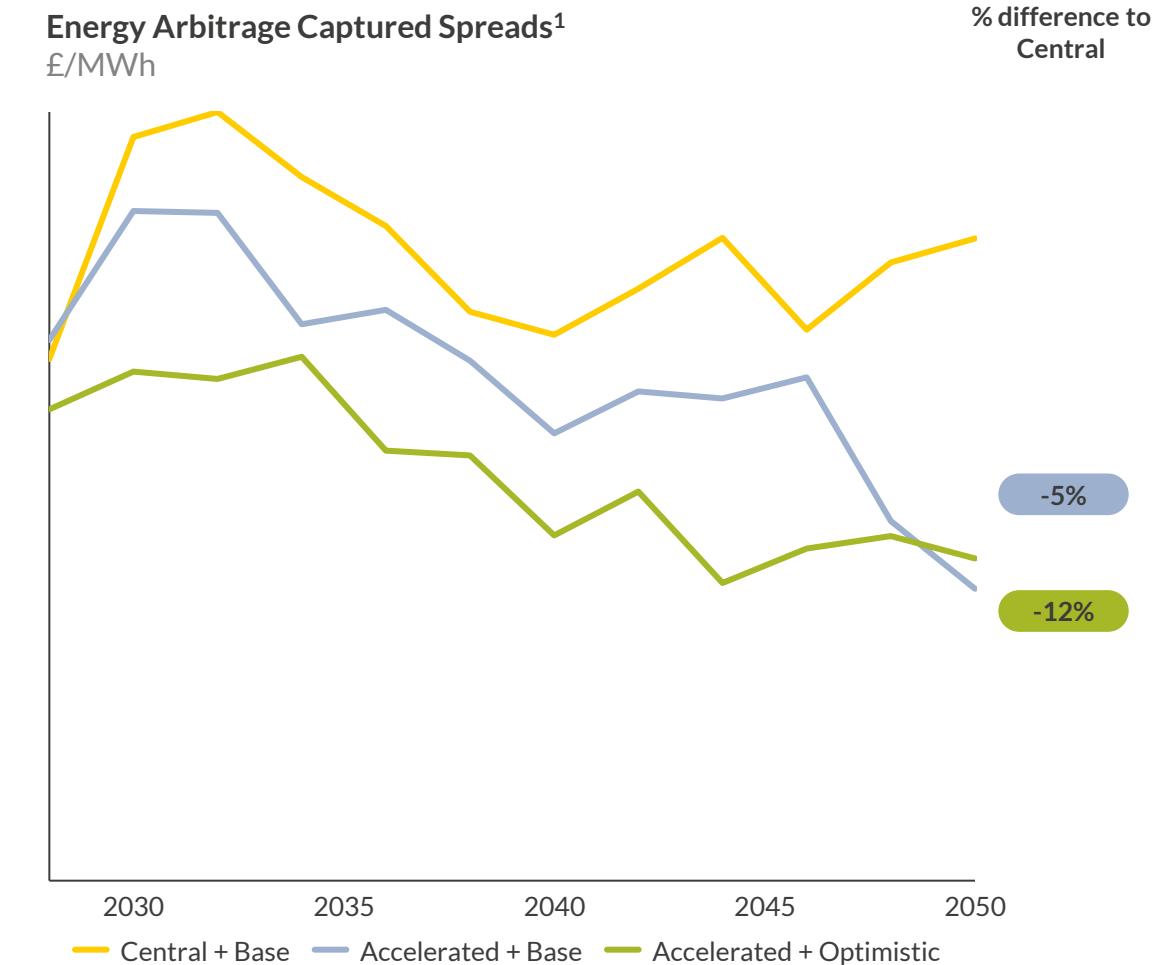
- 1 Increased renewables decreases gross margins by £3/kW/year with base grid and £10/kW/year if we deliver all quoted lines...



Charging hours distribution



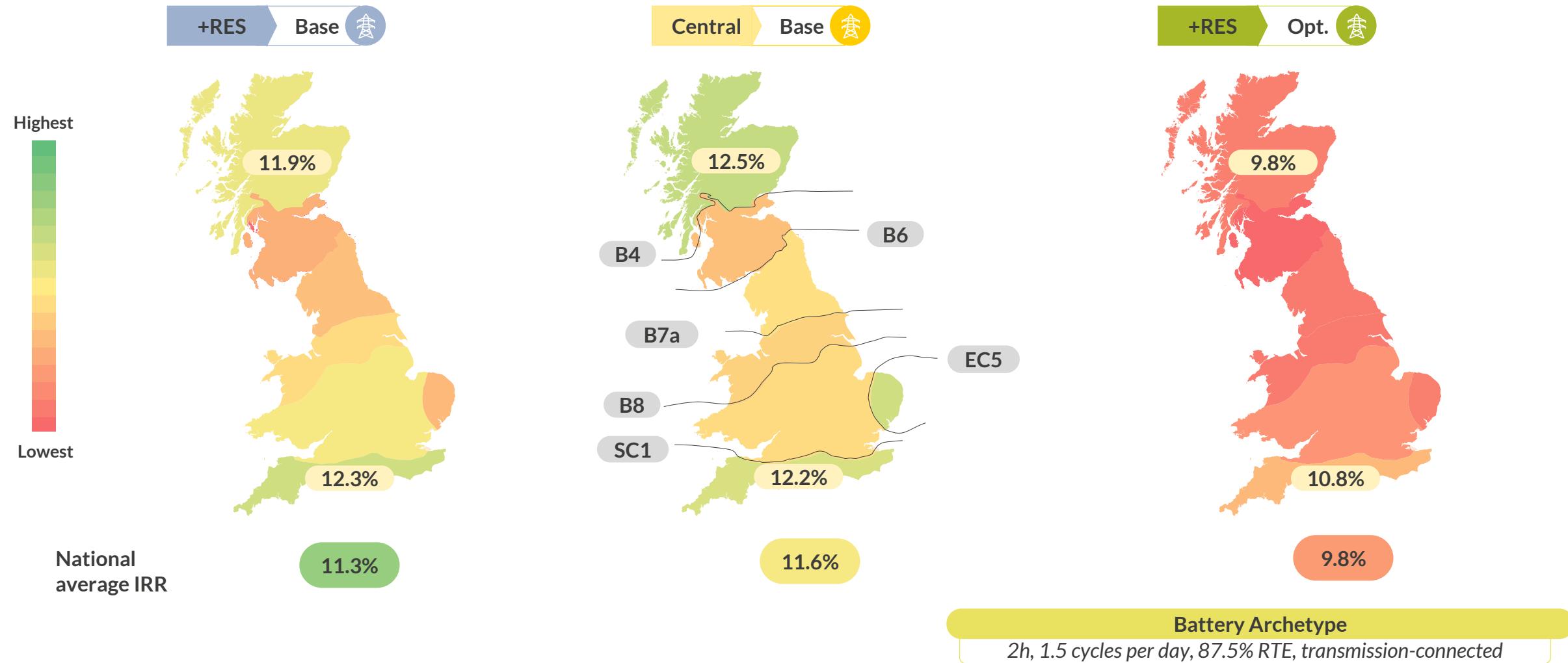
- 2 ...With locational value eroded by renewables depressing pricing in all markets



1) 2h duration, 1.5 cycle per day target, 87.5% RTE, transmission-connected. Undegraded margins and captured spreads shown

Accelerating renewables and grid development drops battery IRRs by 1.7pp due to lower system costs and wholesale price cannibalisation

A U R ☀ R A

15-year Battery IRRs¹ with 2028 COD year

1) 2h duration, 1.5 cycle per day target, modelled with degradation and 15-year operational lifetime. Pre-tax real 2023 IRR.

Battery siting on both sides of key transmission constraints can enable higher returns relative to a national average, however timing and national renewables ambitions are key risk factors that can make or break a business case

- 1** For batteries entering in 2028, locational value increases IRR relative to the national average by more than 2pp in both N. Scotland and S. England
- 2** Locational value is driven both by increased bids/offers and capture spreads, with the value of discharging to service local demand adding more value than cheap charging on a pound-for-pound basis
- 3** For the remainder of the decade, N. Scotland offers the biggest locational advantage, though this shifts to S. England in the early 2030s once grid build out relieves constraints on the B4 boundary
- 4** If we accelerate renewables build out, constrained volumes increase quickly, though cannibalisation of the power price and timely grid delivery are the major downside risks to battery economics

