Curtailed renewables in GB and Ireland

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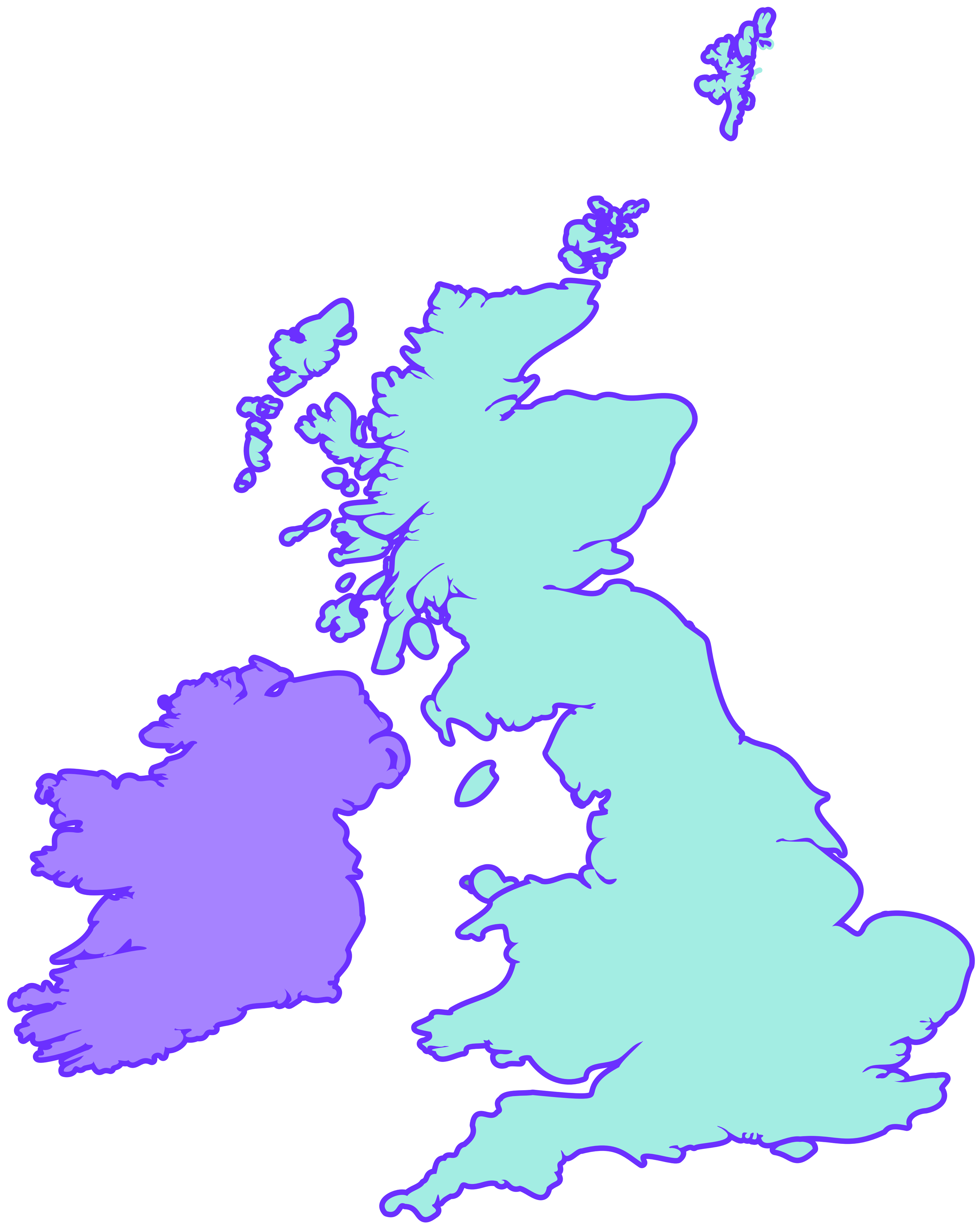
Highlights from H1 2025



Irish Single Energy Market

Total volume of curtailed electricity	905GWh
Curtailment volumes: H1 2025 vs H1 2024	-3%
Curtailed wind energy in Northern Ireland	22%
Increase in Irish solar curtailment since 2022	7x

Great Britain

Total volume of curtailed electricity	4.6TWh
Curtailment volumes: H1 2025 vs H1 2024	+15%
Total cost of curtailment payments	£152m
Northern Scotland accounted for	
Total curtailed volume	86%
Total Costs	76%

Executive summary

For decades, renewable generation capacity in Great Britain (GB) and Ireland has been increasing substantially. Driven by growing concerns around the climate crisis, wind and solar power account for an ever-rising proportion of electricity generation in both markets.

However, for a variety of reasons, not all of the power available from these renewable sources is making it to end consumers. Much of the volume is being curtailed[1], meaning it is switched off at source. This contributes to increased energy bills.

In order to understand the real impacts of these actions, this report investigates and quantifies both the volume of curtailed renewable power, as well as the costs associated with those curtailment actions, in both the British and Irish power markets.

Over time, the volume of curtailed renewables across GB and Ireland has increased dramatically. Much of the curtailed volume is located in areas of weaker grid infrastructure, as physical constraints on the transmission system mean that no matter how much power is produced in a given area, only a certain amount of power can flow through the network at any one time.

In Scotland alone, the amount of wind energy curtailed in the first six months of 2025 could have met the combined electricity demand consumption of all Scottish domestic household consumers for that six-month period.

Over the same period, enough wind and solar generation has been curtailed on the island of Ireland to meet all domestic electricity consumption in County Dublin from January to June 2025.

To meet the ambitious net zero targets set out by the governments of the UK and Republic of Ireland, greater amounts of renewable generation are required to come onstream than ever before. For this renewable generation to be utilised effectively, energy policy needs to take a holistic view that will ensure the system can maximise the value of renewable electricity.

Great Britain

Current situation

In GB, the system operator (NESO) is able to use a tool called the Balancing Mechanism (BM) to balance supply and demand in real-time. This is a crucial tool because if the system is too far out of balance, then blackouts and outages could occur. In practice, this means turning generation up when more power is needed to meet demand and turning it down where there is an oversupply of power compared to demand. As generators in the BM are providing a net benefit to the system by generating either more or less power when requested, they are paid for these actions, meaning there is an associated cashflow.

The BM can also be used to solve locational issues. Due to there being finite grid infrastructure, there can be bottlenecks when moving power from the place it is generated to where it is used. This is most clearly seen in GB when comparing Scotland and London.

London is a significant demand centre, requiring a lot of power. However, one of the country's biggest generation centres is in north Scotland where conditions are favourable for windfarms. Transferring the power from north to south therefore not only relies on sufficient power grid infrastructure, but must also take into account energy lost as power is transferred through the cables. In instances like this, the BM can be used to turn down generators on one side of the bottleneck (e.g wind farms in Scotland) and turn others up (e.g. gas plants near London) on the other side.

Scotland has a low population density and a windy climate. This makes it attractive to developers of wind farms who want to locate their renewable power generation where they will provide the most value.

The result is that a large number of wind farms have been built in Scotland and off the Scottish coast.

However, many of the same attributes that make Scotland attractive to wind developers mean that there is little power demand in Scotland compared to England. Therefore, much of the electricity generated by Scottish wind farms is sent via the grid into England.

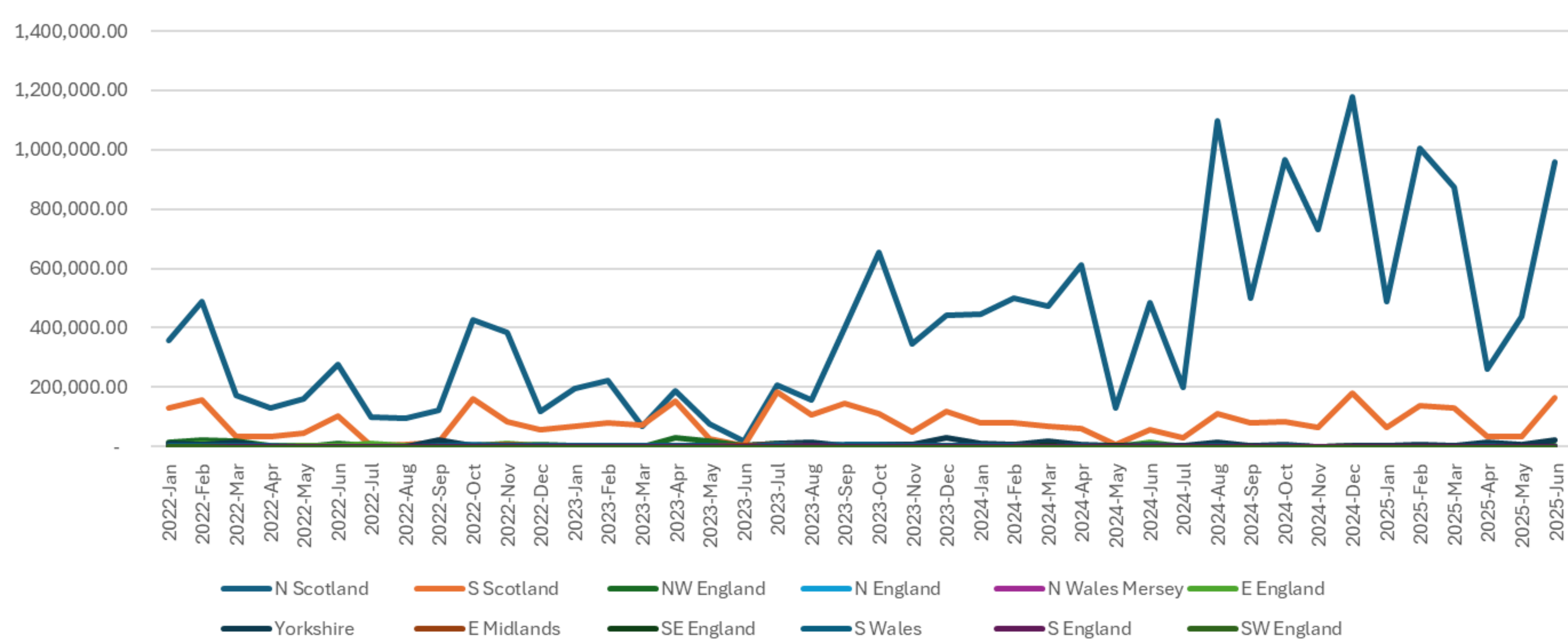
With limited grid infrastructure to transfer this power, wind generators in Scotland are therefore often turned down in the BM. One of the key physical constraint areas is the border between the SSEN and Scottish Power transmission areas. This roughly divides north and south Scotland. The boundary bisects the two halves with Glasgow and Edinburgh in the southern half. Another important area of congestion is the border between Scotland and England.

The region of northern Scotland has seen the most curtailed renewable volume of any region in Great Britain by far. As increasing amounts of wind generation capacity have come online, total curtailment of wind output in northern Scotland has reached almost 50% of what is available in some months. Over 4TWh (Terawatt hours) of wind power in northern Scotland was switched off in the first half of 2025 at a cost of over £116m. This would be enough to power all Scottish domestic electricity demand over the six-month period[2], representing around 37% of all the energy from wind that could have been used. This means that only 63% of the energy which could have been generated made it to the grid.

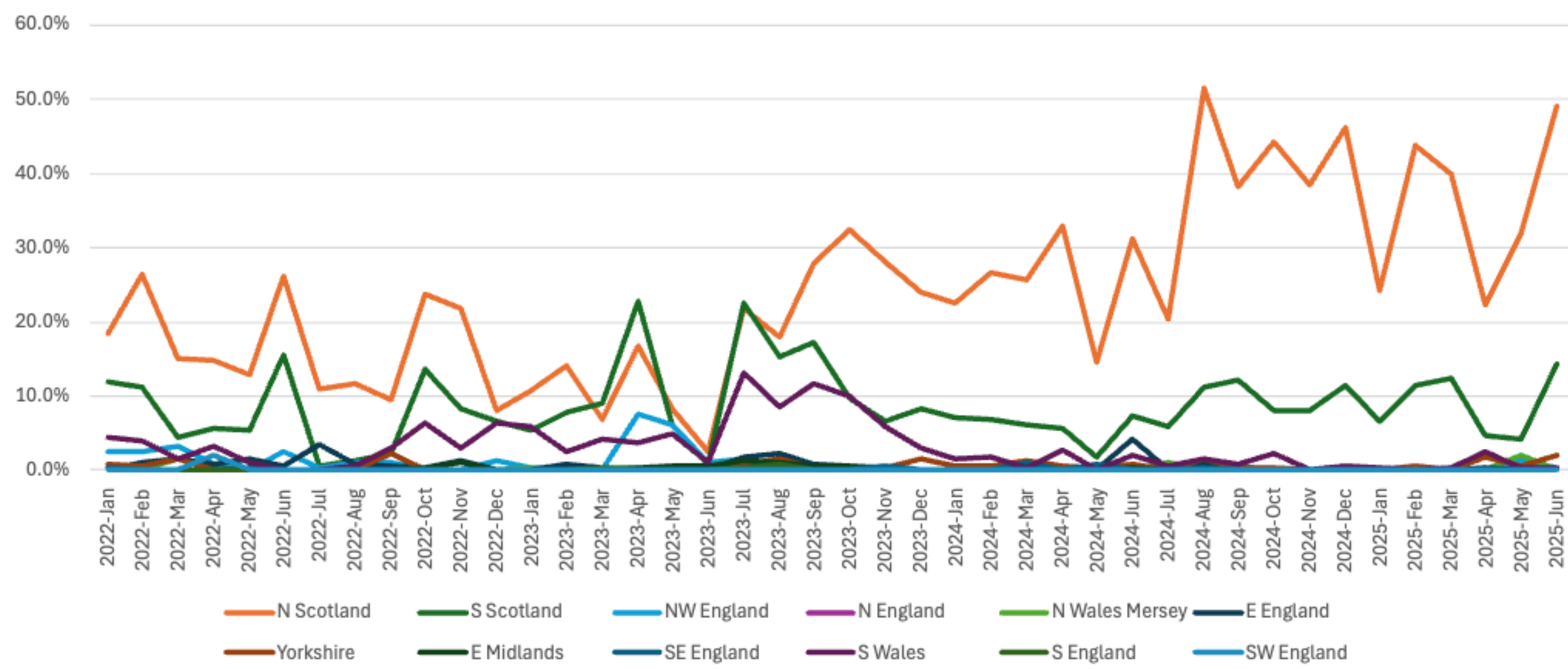
Total volume of downward wind balancing actions Jan-Jun 2025 (MWh)

Nothern Scotland	Southern Scotland	North-West England	North Wales and Merseyside	East England	Yorkshire	South-East England South	South-East England	South Wales	South England
4,026,138	562,511	6,262	3,073	2,885	52,565	702	511	1,658	27

Volume of curtailed wind by month (MWh)



Proportion of available wind curtailed by location



Because most wind farms in GB are in receipt of subsidies, NESO will, in most cases, pay the wind farms a value similar to that of their subsidies to turn down. This is because they would otherwise lose that revenue by reducing their output. These payments are paid for by energy consumers as part of their electricity bill.

Analysis shows that tens of millions of pounds are spent each month to reduce the electricity output from renewable generators in GB. In the first six months of 2025, over £116m was paid to wind farms in northern Scotland, the region where renewable curtailment is most prevalent.

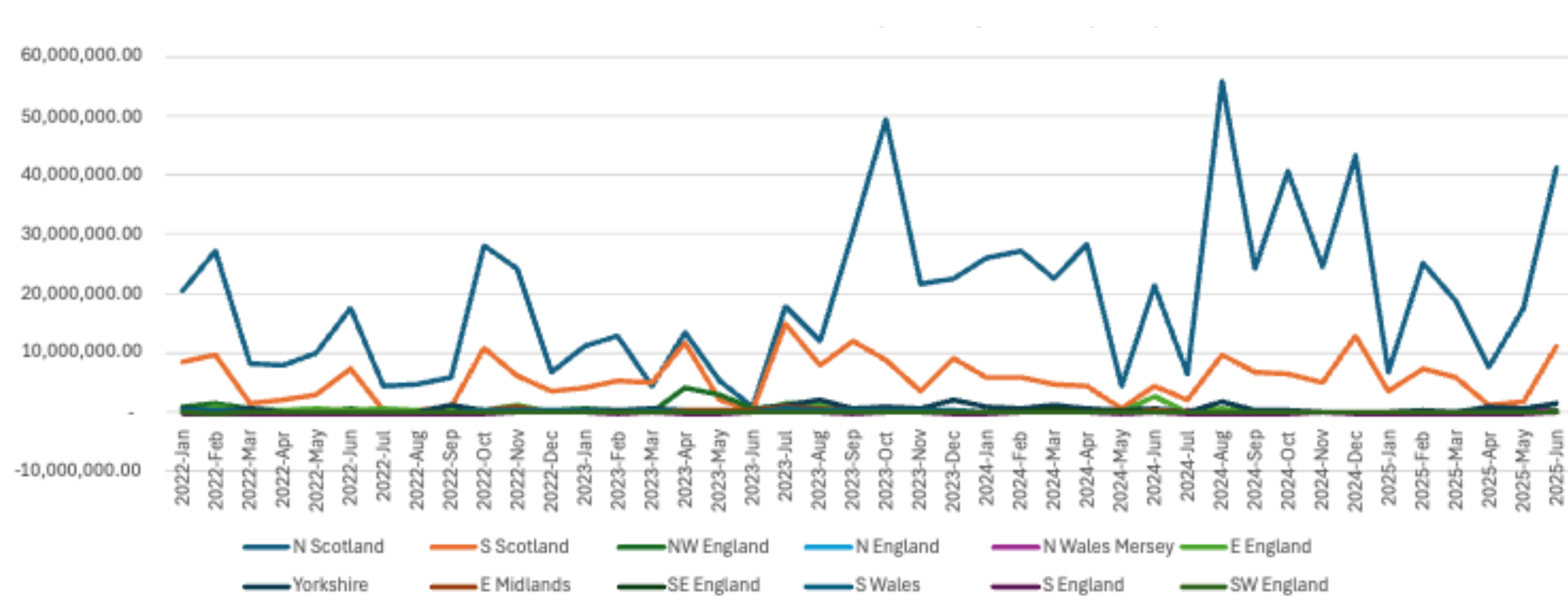
	Total cost of downward balancing actions in Northern Scotland	Total volume of downward balancing actions in Northern Scotland (MWh)
2022 Jan - Jun	£ 91,205,055.37	1,585,751.97
2022 Jul - Dec	£ 73,893,189.47	1,244,079.00
2023 Jan - Jun	£ 47,807,191.04	765,522.29
2023 Jul - Dec	£ 154,111,474.80	2,203,995.94
2024 Jan - Jun	£ 130,176,121.52	2,642,789.24
2024 Jul - Dec	£ 195,085,628.27	4,673,777.04
2025 Jan-Jun	£ 116,818,876.42	4,026,137.62

The costs of balancing the system are ultimately fed back to the consumer in the form of a tariff on their energy bills. NESO are obliged to balance the system using the lowest-cost solutions available to them, but even with this mandate, such expensive balancing actions are still required given the physical constraints of the system.

Although balancing costs remain high in northern Scotland, the figures for the first half of 2025 represent a reduction compared with similar periods in 2024.

The table above shows that even as greater levels of curtailment volumes have been required in H1 2025 compared to H1 2024, the total cost of curtailment payments has reduced. This is due to increasing numbers of wind farms coming online since 2024, including the Moray West farm, which creates increased competition in balancing pricing.

Total cost of wind downward dispatch by month (GBP)



Forward outlook

The issue of renewable curtailment and its associated costs has caused much debate, most notably in the recent discussion around zonal pricing in GB. Some market participants have argued that a zonal market could have helped solve the problem of renewable curtailment by encouraging demand to relocate in areas of higher curtailed renewable volumes, where electricity would be cheaper. It may also have sent stronger signals to investors to build generation capacity in areas of fewer curtailed renewable volumes, where their power could be sold at higher prices. The government has decided to opt for a reformed national market which aims to solve locational issues through stronger regional differentials in transmission network charges and connection costs, rather than splitting GB into several regional wholesale markets.

However, the rollout of wind projects in Scotland is not currently expected to slow down. In the Scotwind leasing rounds in 2022, 20 offshore wind projects acquired seabed rights in Scottish waters[3]. Should all these projects be completed, almost 30GW of additional wind generation capacity would be added to the Scottish grid. These projects alone would increase the total Scottish wind generation capacity more than threefold. If local flexibility and grid capacity were to remain at current levels, curtailment volumes and costs could rise by a similar order of magnitude.

The UK government has commissioned NESO to develop the Strategic Special Energy Plan (SSEP) which aims to offer a system-level view of infrastructure planning, including generation, demand and grid buildout for the future. The SSEP is due to be published in 2026, giving guidance on what the energy system can be expected to look like.

Curtailment to solve bottleneck issues via the BM is not the only way for renewables to be turned down.

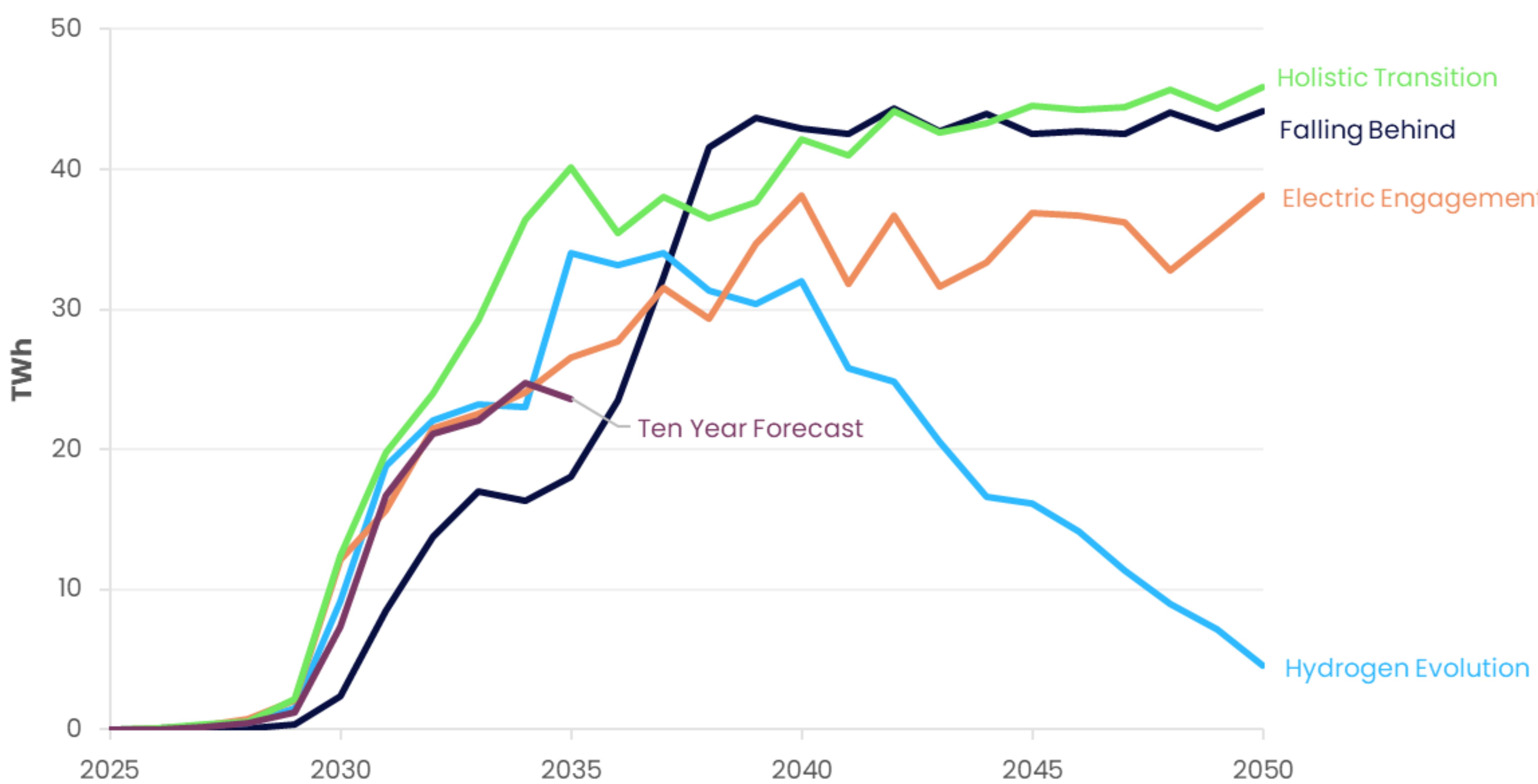
Renewable assets can self-curtail if economic conditions are not favourable enough for them to generate. The subsidy contracts for most existing grid-scale wind farms are designed to ensure that there would have to be an oversupply of renewable energy for an extended period before it was economically favourable for the wind farms to self-curtail. However, most of the assets coming on stream in the future will have stricter subsidy rules, meaning that any period of renewable oversupply and negative pricing in the wholesale market would result in renewable units losing their subsidy payments, encouraging them to simply switch off without needing to be instructed to do so by NESO. This could, in theory, save consumers money as fewer curtailment payments may need to be made. However, project developers and investors would also need to factor this into revenue projections.

Periods of self-curtailment are expected to be driven by weather conditions, for example on particularly windy or sunny days where renewable generation can supply most, if not all, the power required to meet demand. This is due to a phenomenon known as revenue cannibalisation. This describes a scenario where, for example, conditions are so sunny that power demand is being met by solar generation. Therefore, each extra MWh of generation produced by solar is valued at a lower price in the wholesale market, until prices eventually go negative, causing these assets to switch off (self-curtail). Otherwise, they would be paying to generate power.

This cannibalisation effect is likely to result in a much more significant volume of renewable energy being self-curtailed in future. In its forward-looking Future Energy Scenarios publication, NESO suggests that volumes of renewable self-curtailment could rise to ~35-40TWh per year by 2040[4]. However, this could drop by 2050 depending on the development of electrified demand (including electric vehicles, heat pumps and more) as well as the hydrogen rollout.

These figures do not include the system-constrained curtailment volumes we have seen historically.

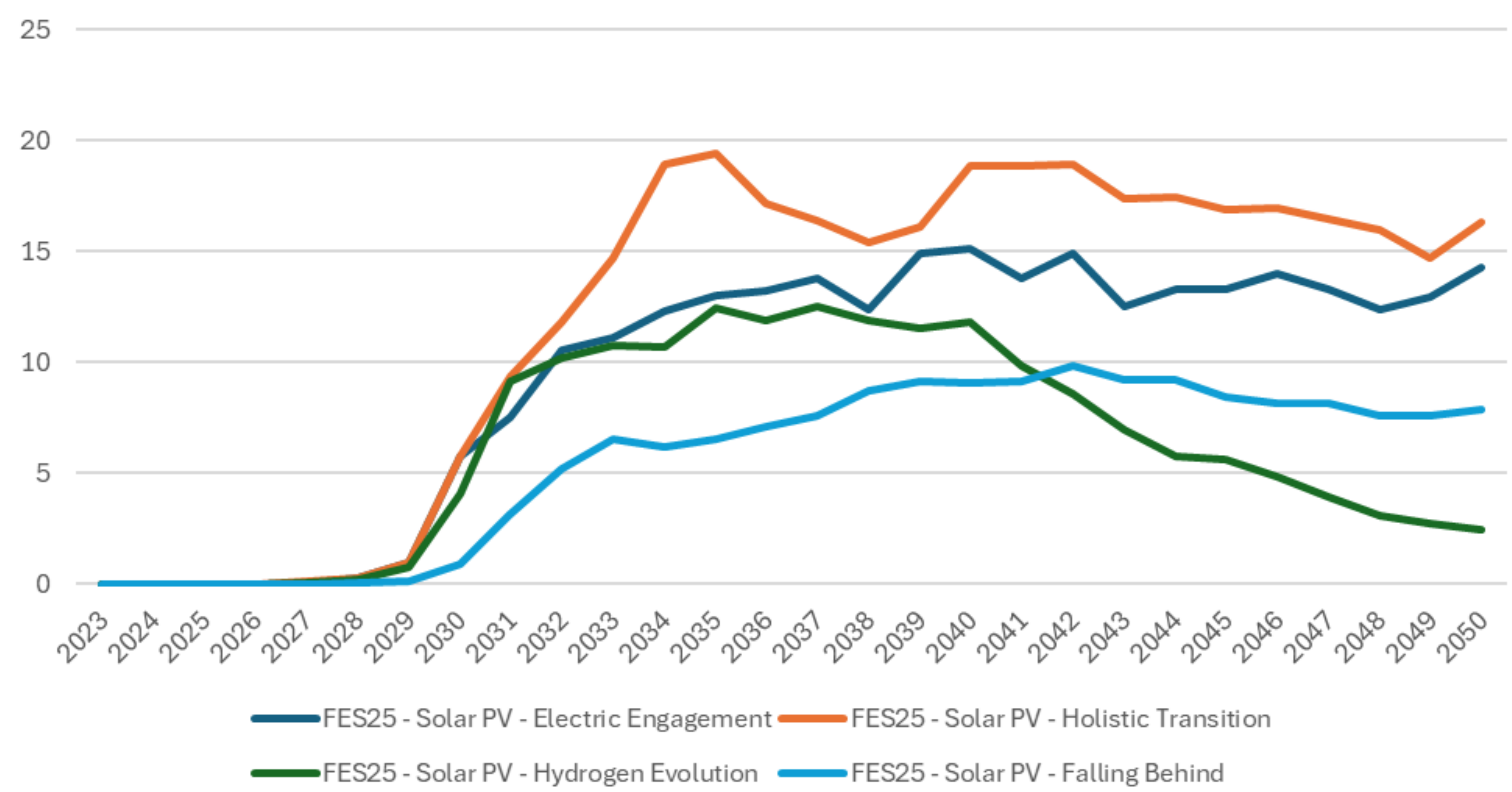
Renewable power curtailment per year (TWh): NESO forecast from Future Energy Scenarios



While grid-scale solar curtailment in the BM is currently very rare, with less than 1GWh being turned down over the last three years, the self-curtailment of solar may increase substantially over the coming years. NESO suggests that solar self-curtailment volumes could rise to ~10-20TWh by 2040.

Should the minimum threshold for mandatory participation in the BM be lowered in future (as the government indicates) this would also allow NESO greater control over a wider number of solar assets for balancing purposes. This could further increase the volumes of renewable curtailment.

Solar curtailment per year (TWh)



Ireland

Current situation

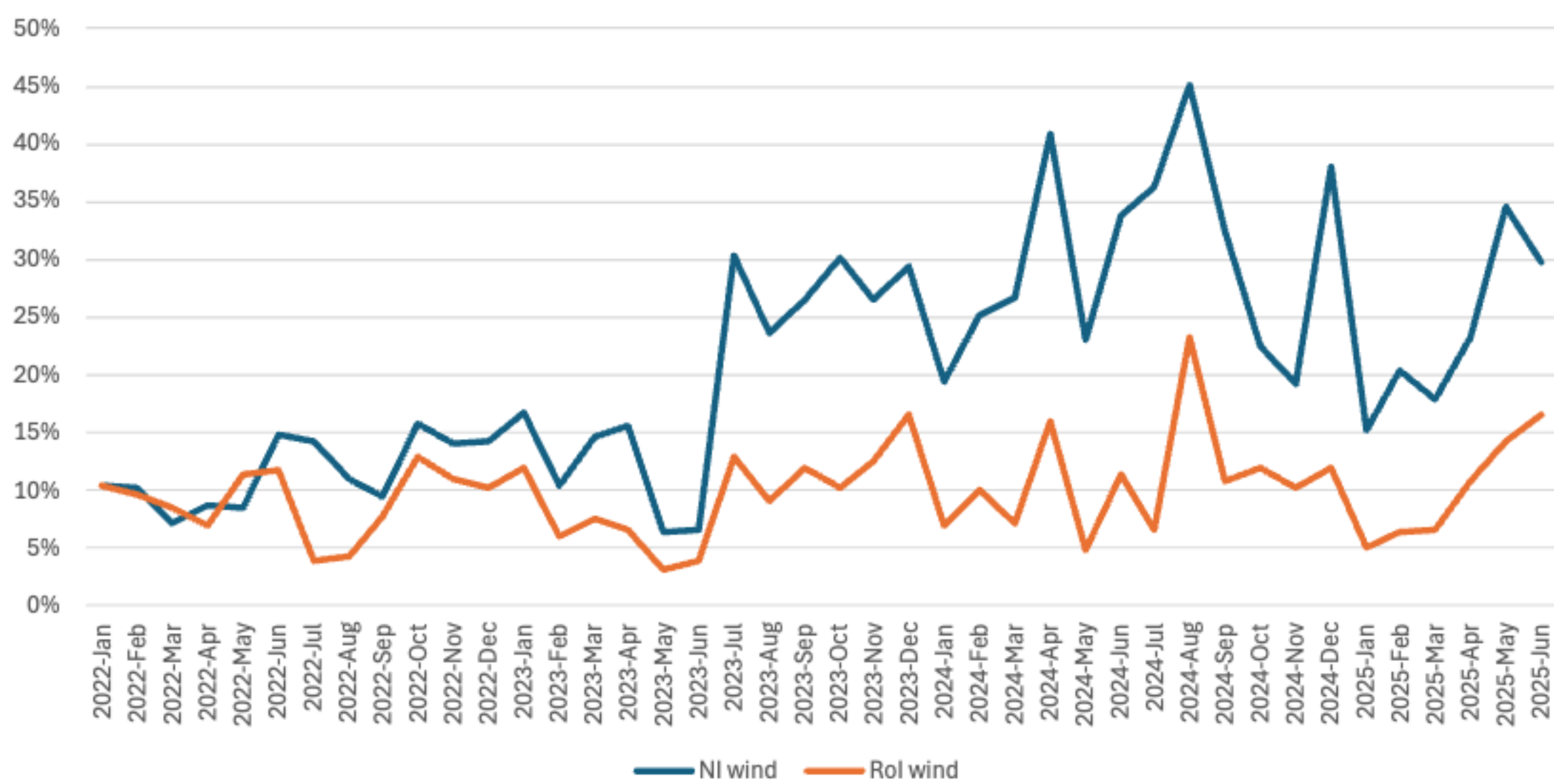
In the all-island Single Electricity Market (SEM) in Ireland, many of the same issues around constraints that are present in GB are relevant. Much like Scotland, Ireland has a windy climate and a low population density, making it attractive to developers of renewables. Also, like Scotland, the grid infrastructure that connects areas of supply and demand is limited.

Consequently, there are large volumes of renewables that are curtailed due to either system-level reasons or due to local network constraints[5]. Wind is the renewable resource that is most commonly curtailed, particularly in Northern Ireland. Over the first six months of 2025, over 900GWh of energy was turned down from renewables across the island of Ireland. This is estimated to be more than the total electricity demand of all domestic consumers in County Dublin over the six-month period[6].

	Northern Ireland		Republic of Ireland	
	Wind	Solar	Wind	Solar
Total downward balancing volumes Jan-Jun 2025 (MWh)	299,199	11,073	517,235	77,652
Percentage of available electricity switched off Jan-Jun 2025	22%	16%	9%	13%

More wind generation has been curtailed in the Republic of Ireland (ROI) than in Northern Ireland (NI) but this is due to the larger installed capacity of wind farms in ROI compared to NI. In NI, more electricity from wind farms has been curtailed as a proportion of the total available to the system.

Curtailed wind generation as a proportion of availability



In the first six months of 2025, around 22% of the available wind energy in NI did not make it to the system and was switched off. This is lower than the 33% average of the previous six-month period. One of the primary drivers for this drop is the connection of the new Greenlink interconnector, which began commercial operations in early 2025.

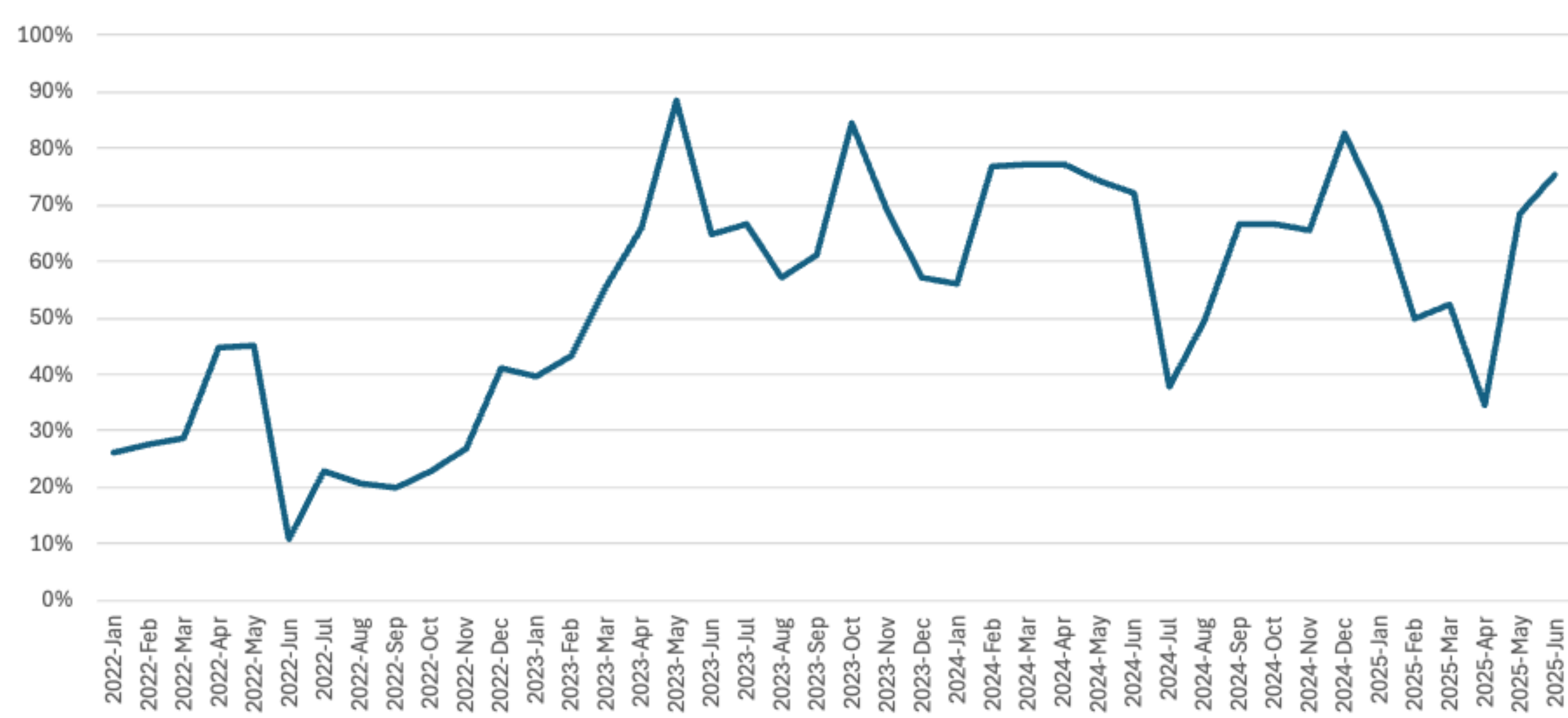
Utilisation of the Moyle interconnector, importing power from Scotland to NI, has dropped in favour of increased imports through Greenlink (from Wales into ROI) due to the more favourable loss factor (power which is lost as it is moved across the interconnector) when transferring power through the newer cable. As a result, there is a greater demand requirement in NI that is not being met by imports, resulting in less curtailment for wind farms whose energy can be consumed locally.

However, the volume of curtailed wind in NI remains much higher than it was before 2023. In part, this is due to the continuing decline of demand in NI and the increased wholesale power price differential between GB and Ireland. With increased levels of power imports from GB into Ireland, including imports through Moyle, there has been less of a local requirement for power in NI than historically observed.

Power exports from NI into ROI are limited due to the finite capacity of the transmission infrastructure between the two jurisdictions. This forms a key bottleneck within the Irish market, as power can often not be efficiently transferred from where it is generated to where it is used.

The majority of the renewables turned down in NI did not make it onto the system due to issues moving power from NI to ROI. Over 61% of all the curtailed renewables in NI were turned down due to this reason in the first six months of 2025. This is lower than the peak level of 75% renewable curtailment observed in the first half of 2024. Again, the Greenlink interconnector is a key factor that facilitated the drop for H1 2025.

Proportion of curtailed NI wind due to constraints with ROI



In ROI, the greatest change in balancing for renewables has been the recent surge in solar generation capacity. With a rising number of grid-scale solar assets coming online, solar power has been used more extensively in balancing the Irish system and so the volume of curtailed renewables has increased accordingly.

In June 2025, around 24GWh of power from solar was curtailed. This is almost seven times higher than the ~3.5GWh in June 2024. Although this currently represents a small proportion of the overall generation mix in Ireland, solar power in the Republic is seeing a dramatic acceleration in buildout which is reflected in the balancing volumes.

Forward outlook

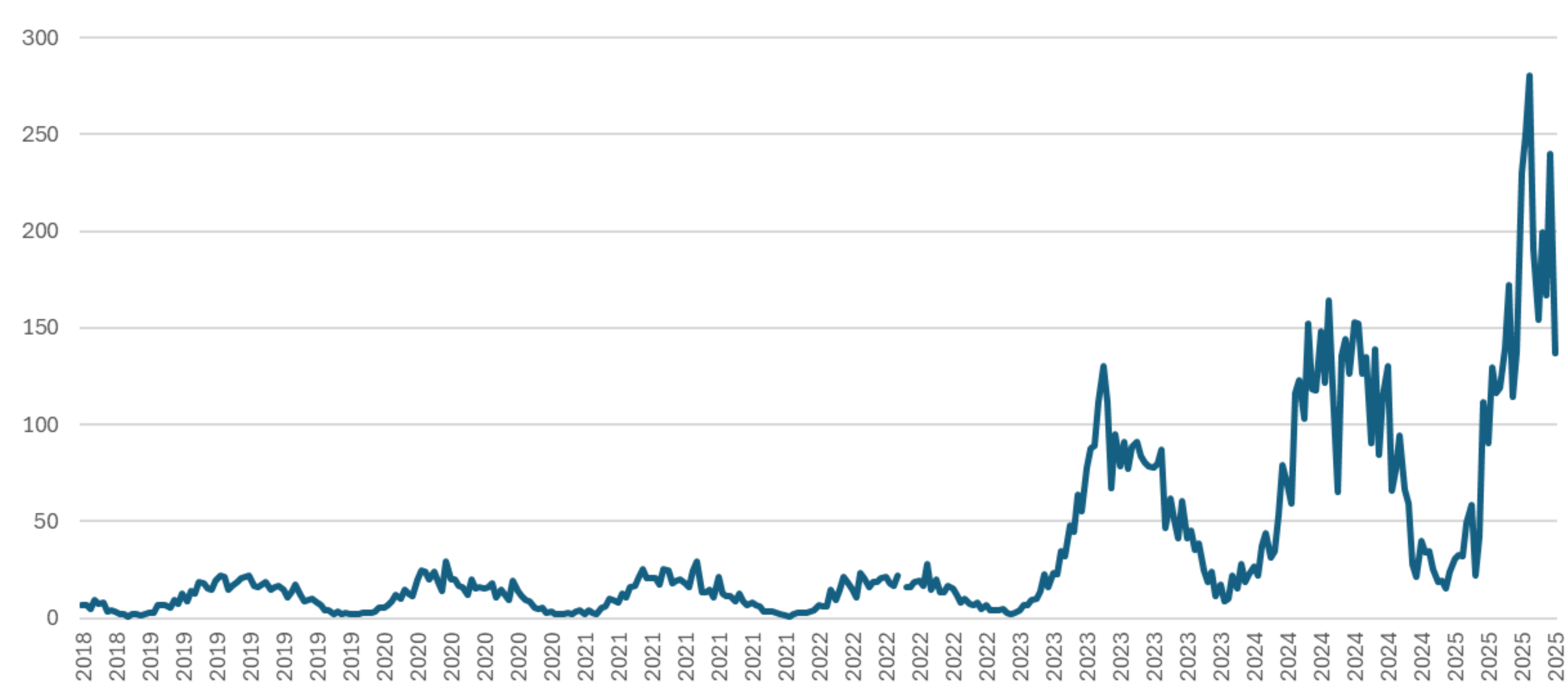
Over the coming years, a number of fundamental changes to the Irish market will likely change the makeup of curtailment volumes and the associated costs. The first change, expected to come some time in 2025, is a change to how the market handles the prioritisation of renewables. Under the existing market rules, renewable assets such as wind and solar have priority dispatch, meaning that they will be scheduled to run if they are available and will only be switched off if curtailment is required for system-level reasons. As such, they are priced into the balancing market at zero, meaning there is no cashflow directly associated with instructing renewable units for balancing purposes.

However, once this pending rule change is implemented, newer renewable assets will no longer have priority and will need to price themselves into the balancing market competitively. This will introduce a cashflow for their balancing actions but also allow for a more competitive environment with the whole market, potentially reducing balancing costs overall.

The second large upcoming change is the introduction of the North-South interconnector, expected to go live in 2026. This cable will ease the bottleneck moving power between the NI and the Republic by providing additional transmission capacity. The result will likely be reductions in curtailment volumes for renewable assets in both jurisdictions.

However, the continuing rise in utility scale solar generation capacity, which has risen by an order of magnitude in the last three years, may counteract this to a degree. Solar generation is quickly becoming a very significant component in the Irish energy mix, as evidenced by the sevenfold increase in downward dispatch volumes from June 2024 to June 2025. If the buildout continues at a similar pace to the past several years, the total solar downward dispatch volume could rise to be higher than that of wind in a matter of years.

Irish solar metered output from balancing units (MW)



Conclusion

The analysis paints a clear picture. Curtailed volumes of electricity are rising on average and may continue to do so as more renewable capacity comes online in both GB and Ireland. Now is the time for government to come together with industry and build the holistic view of policy which will enable the optimal siting of generation, sufficient investment in grid infrastructure and the correct investment signals to help alleviate grid constraints. The Strategic Spatial Energy Plan (SSEP) and the wider reformed national market workstream will be key to achieving these aims in GB.

Unless policymakers pay attention to the need to marry renewable power with public systems and infrastructure, then an outdated transmission network could continue to drive up consumer bills as NESO, Eirgrid and SONI are forced to operate networks potentially unfit for the net-zero future.

Footnotes and methodology

1. "Curtailed renewables" is defined in this report as generation from either wind or solar assets which could have been used but was turned down in the balancing market for any reason. This means that embedded and behind-the-meter generation are not considered. Neither are self-curtailing renewables that reduced output due to economic reasons or the size of their grid connection.

Note that the cost figures detailed in this report account for the costs associated with turning down renewables. Balancing actions to solve system level issues will often result in additional actions turning generation up elsewhere in the system to make up for the lost energy. These additional costs are not considered in this report.

To calculate curtailment volumes in GB, the accepted by-unit balancing volumes as published by Elexon were aggregated using a mapping of BMU ID codes and asset details such as location. Cashflows were produced using by-unit balancing pricing data from Elexon.

It was assumed that the generation from assets' Final Physical Notifications (FPNs) as published by Elexon would have been available in an unconstrained system.

The cutoff date for data processing was 4th July 2025. Any updates to historic data at source after this date will not be accounted for in this report.

2. Assumptions around average household energy usage based on Ofgem estimate of 2,700kWh per year/ 1350kWh for six months: https://www.ofgem.gov.uk/average-gas-and-electricity-usage

Total Scottish domestic household consumption estimated by multiplying Ofgem average usage figure (1,350kWh) by 2.7m Scottish dwellings according to housing statistics sourced from Scottish Government: https://www.gov.scot/news/housing-statistics-for-scotland-2022-23/

3. Scotwind leasing round results: https://www.crownestatescotland.com/scotlands-property/offshore-wind/scotwind-leasing-round

4. Future Energy Scenarios 2025: https://www.neso.energy/publications/future-energy-scenarios-fes

5. In the SEM, there is a distinction made between curtailment and constraints. Curtailment is downward balancing dispatch due to system-level reasons of renewable oversupply. Constraints are downward balancing dispatch volumes required due to issues moving power around the local network. These are handled differently from a financial point of view. For the purposes of this report, both are referred to as "curtailment" for the sake of consistency of comparison with GB.

To calculate curtailment volumes in the SEM, by-unit balancing volumes as published by SEMO were aggregated using a mapping of SEMO ID codes and asset details including jurisdiction. Constraint volumes broken down by reason for curtailment were published at the same source and were aggregated in the same manner. It was assumed that all the generation from assets' availability forecasts published by SEMO would have been available in an unconstrained system.

6. Irish housing data assumptions sourced from Central Statistics Office: https://www.cso.ie/en/releasesandpublications/ep/p-cpr/censusofpopulation2022-preliminaryresults/housing/

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