LCP's analysis of opportunities for flexible assets

The term 'flexibility' is widely discussed but what does the term actually mean and where are the areas of growth in the market?

January 2020

Introduction

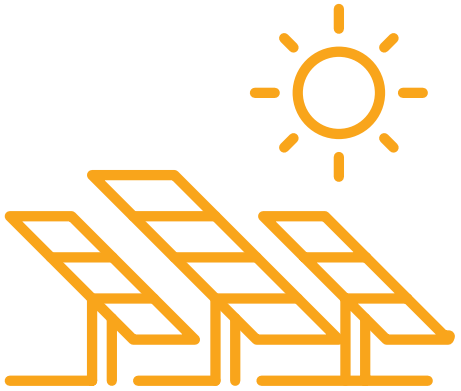
The increasing levels of intermittent renewable generation on the power system present some significant challenges. The recent Contracts for Difference (CfD) auction awarded contracts for 5.5GW of offshore wind with the Offshore Wind Sector Deal setting an ambition of building 30GW by 2030. To maintain a stable system there is an increasing requirement for generation with the ability to adjust its output rapidly and at very short notice. This flexible generation is key to enabling greater levels of renewable penetration on the system.

With much more of the market being driven by weather conditions we see revenue moving away from the longer-term wholesale market with a much greater emphasis on the intraday, balancing and ancillary services markets in the future.

To understand the requirement for flexibility in the future requires a modelling approach that incorporates a wide range of intermittency and demand profiles to capture events that have a small probability of occurring where flexible assets will be needed most. LCP's EnVision model achieves this through stochastic analysis, where each year is simulated many times under a wide range of weather conditions.

In the rest of this analysis we examine some of the key areas where the increase in intermittent renewables may present opportunities for flexible generation. We look at this from a fundamentals perspective – looking at different types of flexibility in turn and how the requirement for each type is likely to evolve as large volumes of intermittent generation is absorbed onto the system.

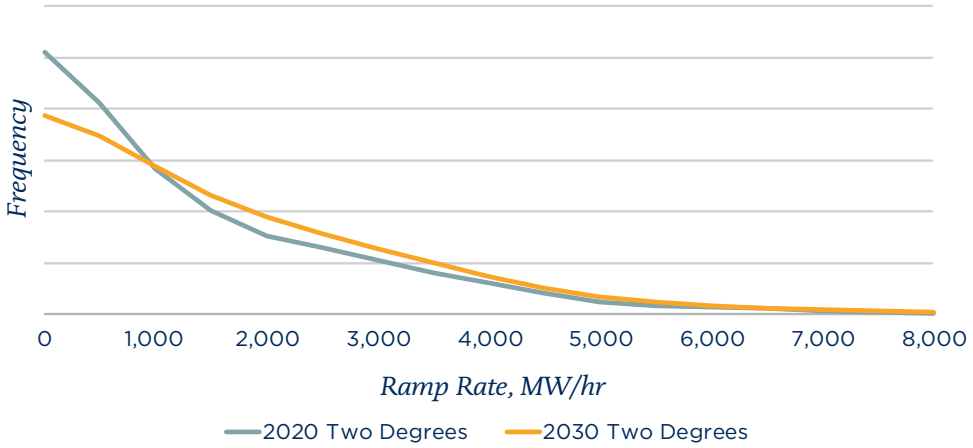
We have used National Grid's projections for 2030 under its Two Degrees scenario to illustrate this, overlaying historical weather patterns to look at extreme example periods.



Ramping Requirement

Ramping is defined as the need to increase generation quickly to meet changes in demand or generation. **The graph shows that there's an increase in the need for ramping in 2030** (in orange) compared to the requirement in 2020 (in grey) and as renewables continue to deploy this trend is set to continue. If forecasts are reliable this requirement can be predicted and provided by conventional generation.

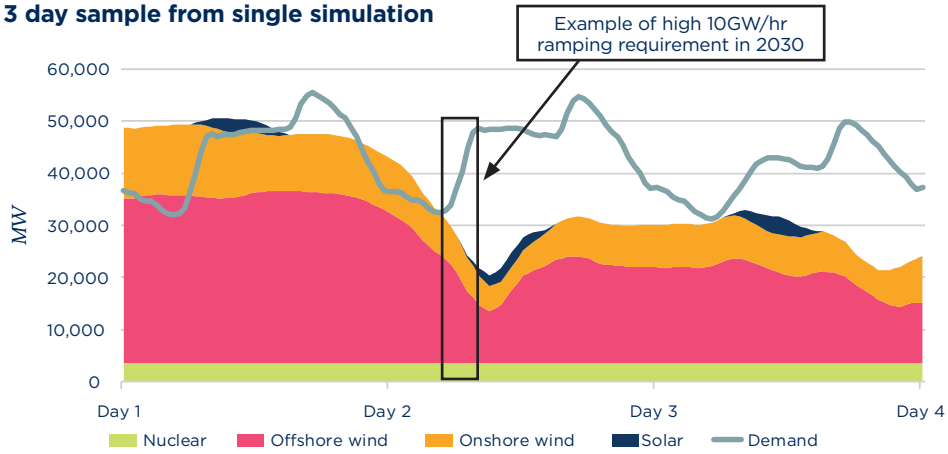
Distributon of ramp rate requirement (FES 2019 Two Degrees)

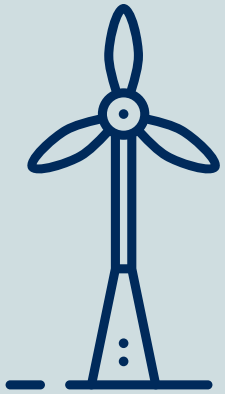


Digging into the data a little deeper we can see where **the most extreme ramping periods occur with the main driver in this example being caused by increases in demand and a decrease in wind generation.**

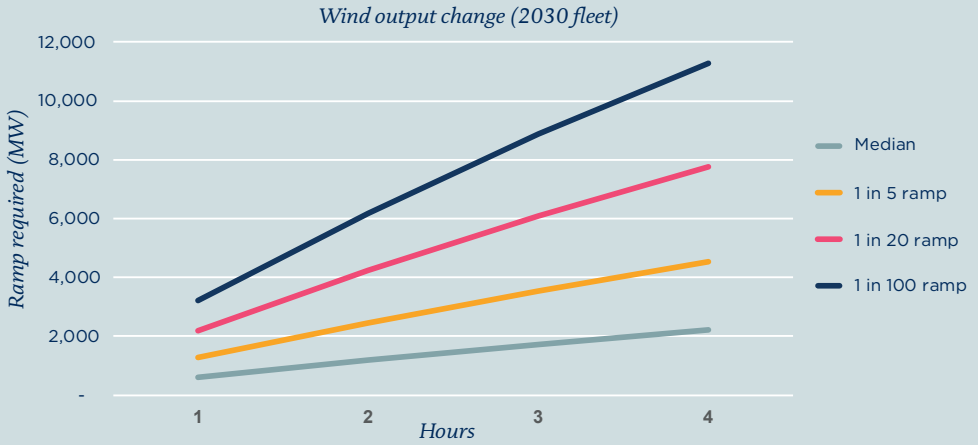
Periods where solar generation decreases don't tend to drive the largest ramps as these decreases don't typically coincide with the highest demand or wind periods (which occur over winter when solar output is reduced).

3 day sample from single simulation





Interestingly, the UK's large diversely-located wind fleet means **changes to wind generation occur over several hours reducing the level of ramp requirement over these periods.** The graph shows the ramp rate under different scenarios with the grey line showing the median ramp requirement with the other lines progressively showing increased ramp requirement but reduced likelihood of these events happening.

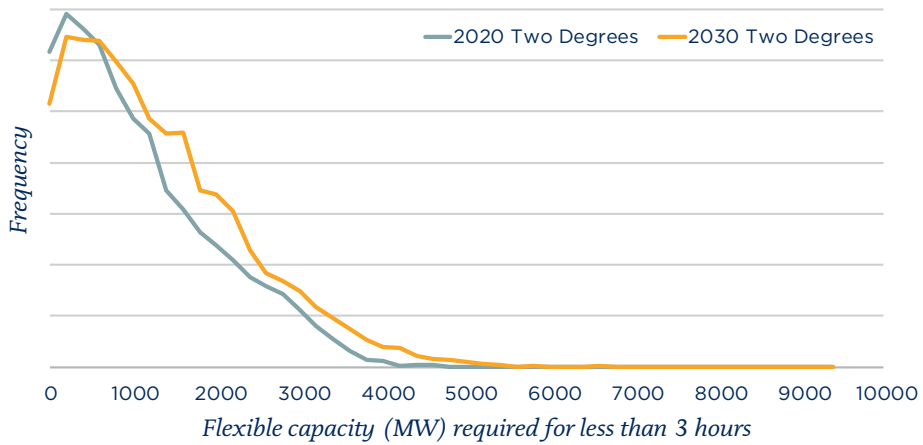


Peak turn-ups

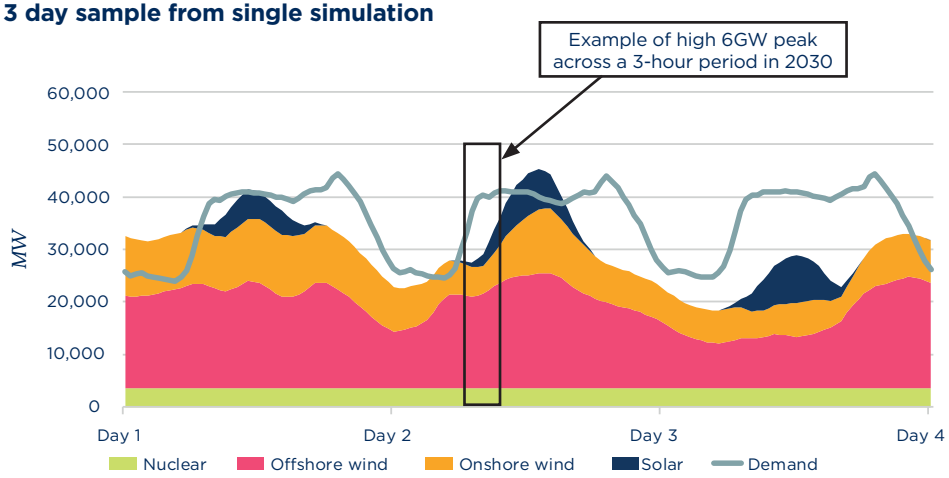
The magnitude of peak turn-ups, defined here as periods where net demand peaks for 3 hours or less, also increases through to 2030. As with the ramping requirement **we expect the magnitude of peak turn-ups to continue to increase as renewables continue to deploy.**

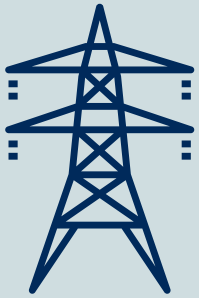
Extreme periods often occur in mornings where demand ramps up before solar and wind, or in evenings where demand ramps down after generation falls. **Rarely do we see more than 5GW of capacity required to turn-up for such short period in 2030**, even under high renewable scenarios.

Peak turn-ups requirement (FES 2019 - Two Degrees)



3 day sample from single simulation

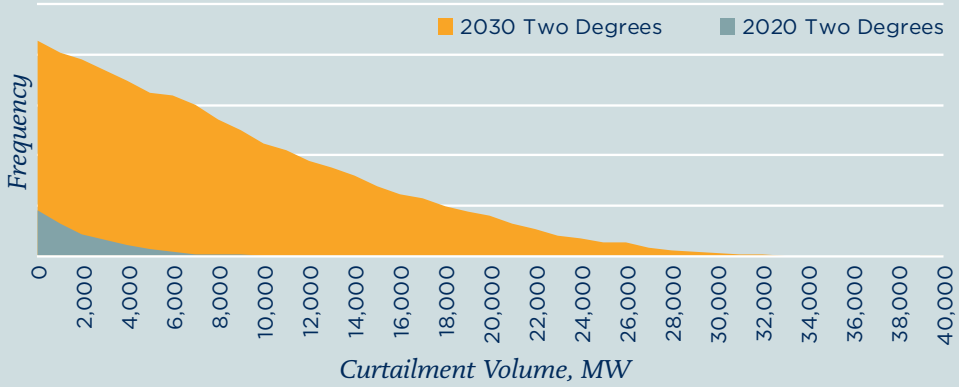




Curtailment of Renewables

When we look at **high renewable scenarios in 2030 we see high levels of curtailment with c. 30GW of wind and solar needing to be turned off on some days** (in orange) compared to a relatively small amount being curtailed in 2020 (in grey). Interconnection and demand turn-up can alleviate this problem, but this also presents a big opportunity for storage technologies – particularly ones with longer-duration.

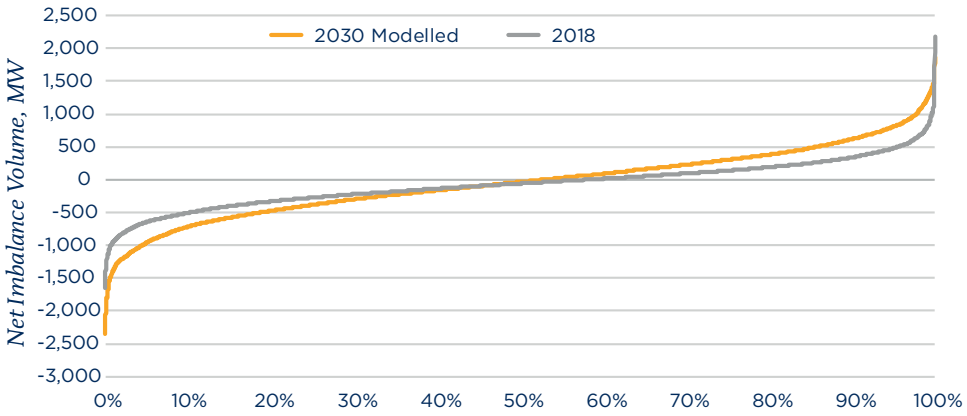
Renewable generation curtailment volumes (FES 2019 - Two Degrees)



Balancing Market

Imbalance volumes are set to significantly increase by 2030 due to renewable penetration. However, forecasting improvements are likely to alleviate this to some degree. But even with a 20% forecasting improvement and a diverse renewable mix, imbalance volumes are likely to increase by 50%-100%. **Up to 8GW of flexible plant will be required to turn-up/down in the most extreme cases** meaning there is likely to be significant value in the Balancing Market in the future.

Net Imbalance Volumes (20% forecasting improvement)



Frequency Response

Firm Frequency Response (FFR) is another key market for flexible generators. With gas reciprocating engines, batteries and Demand Side Response (DSR) capacity all expected to increase over the next decade we expect to see these smaller flexible units taking a larger share of the contracts resulting in an increased level of competition for a service with limited potential for growth in the near term.

The amount of response that needs to be procured by National Grid is based on the largest in-feed loss. **This requirement is set to increase in the future but is ultimately capped by the commissioning of larger units (such as new nuclear plant).** Smaller increases may also be seen due to revision of the SQSS standards following the partial black-out on the 9th August 2019, with the potential for standards being revised to account for the loss of additional embedded generation and the reliability of frequency response providers.

Conclusion

The flexibility requirement for peak turn ups and ramping will increase modestly out to 2030 with further growth expected as intermittent renewable capacity grows. But there is the potential for cannibalisation of prices across markets which is a sensitivity that needs to be considered when building new assets.

Turn down flexibility or footroom will be more important in the future as significant levels of renewables need to be curtailed meaning there's an opportunity for interconnectors or storage to utilise this excess power.

LCP has explored the key drivers for flexible assets in the future with potential changes to the ramping requirement, peak turn-ups, curtailment of renewables, balancing market and frequency response all modeled in this analysis.

A fundamentals driven approach should be used to assess value in flexibility markets to ensure these revenue streams materialise.

Contact us

For more details on LCP's flexibility modelling please contact

Chris Matson
Partner
Chris.Matson@lcp.uk.com
+44 (0)20 7432 0674

Kyle Martin
Head of Market Insight
Kyle.Martin@lcp.uk.com
+44 (0)20 3824 7430