



OSG THOUGHT
MICHAELMAS TERM 2016



How will changes in Technology and Policy Affect Competition in the Energy Market?

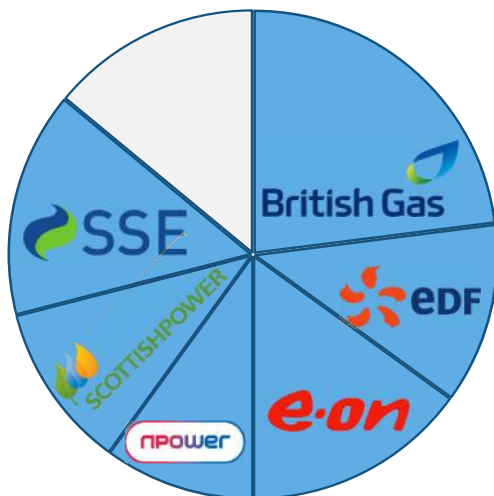
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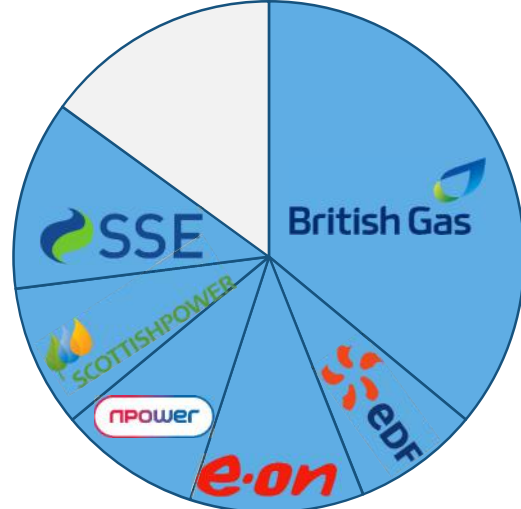
Current Market Conditions

The Big Six dominate the UK market for energy, with 86% of electricity supply and 85% of gas supply

UK Electricity Supply Market Shares, Q2 2016¹



UK Gas Supply Market Shares, Q2 2016²

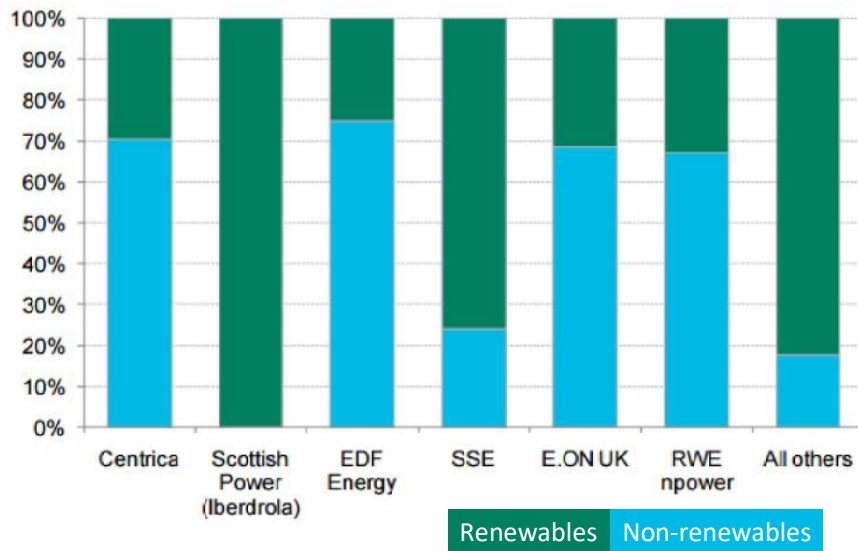


¹ Ofgem (2016) Electricity supply market shares by company: Domestic (GB) [1]

² Ofgem (2016) Gas supply market shares by company: Domestic (GB). [2]

The Big Six are generally adding less new capacity in renewables than smaller new entrants as a proportion of the total

Gross capacity addition mix since 2006 (%)¹



- Four out of the Big Six's new capacity is mostly in non-renewables.
- Scottish Power and SSE focus on renewable energy for new capacity.
- This is in line with smaller producers of energy, which have added over 80% of new capacity by expanding renewables.

¹ Bloomberg New Energy Finance (2012) UK BIG 6 UTILITY INVESTMENT TRENDS [3]

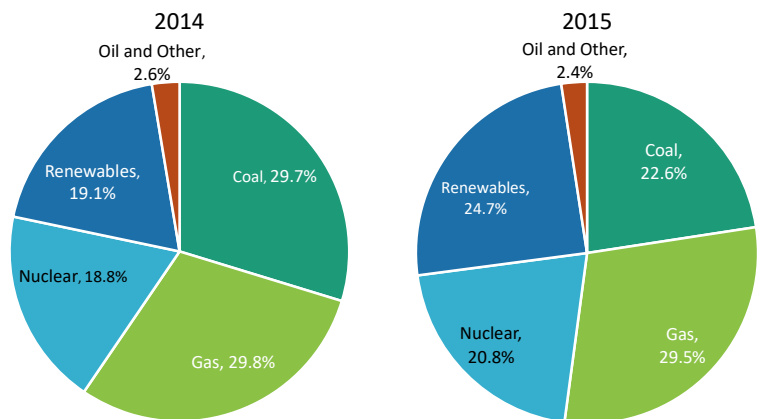
Changes in Technology

Renewable sources are growing rapidly due to technological advances

Energy production from all renewable (non-finite) sources of energy increased by 29% from 2014 to 2015.

Offshore wind increased by 30% year-on-year and onshore wind increased by 24%

Photovoltaic (PV) solar saw 86% growth from 2014. PV production is still less than 10% of overall renewable production and thus less than 2.5% of overall production.



Comparison of UK electricity generation source by share in 2014 and 2015¹

Once the tipping point of renewable production being viable without subsidy is reached, the renewable sector will witness exponential growth due to the absence of uncertainty in government policy

¹ Edie Newsroom (2016) *The UK's ever-changing energy mix: 2015 in charts* [4]

Solar generation is becoming increasingly cost-competitive

Solar patents from the 1970s are expiring¹

Mass-production of solar panel modules by international conglomerates

Maturing supply chain and development of accessible grid

More new entrants are investing in developing solar technology

Significant cost decline – a **4kWp** residential system cost £5,000 in 2015 as opposed to £15,000 in 2011²

Further soft/implementation cost reductions³

The long-term trend for PV solar prices (per kWh) is a decline of 2.4% each year. Module costs are declining at 10% a year.⁴

Levelised cost by year of commission, £/MWh



Solar's **levelised cost** in the UK until 2030. Large reductions in price will quickly erode the currently non-competitive solar's cost disadvantage⁵

¹ Deaton, J. (2016) *The little-known reason renewable prices are dropping*. [5]

² CompareMySolar (2017) *CompareMySolar UK* [6]

³ Office of Energy Efficiency and Renewable Energy (2017) *Soft costs*. [7]

⁴ Farmer, J.D. and Lafond, F. (2016) 'How predictable is technological progress?', *Research Policy*, 45(3), pp. 647–665. [8]

⁵ DECC (2013) *Electricity Generation Costs 2013*. [9]

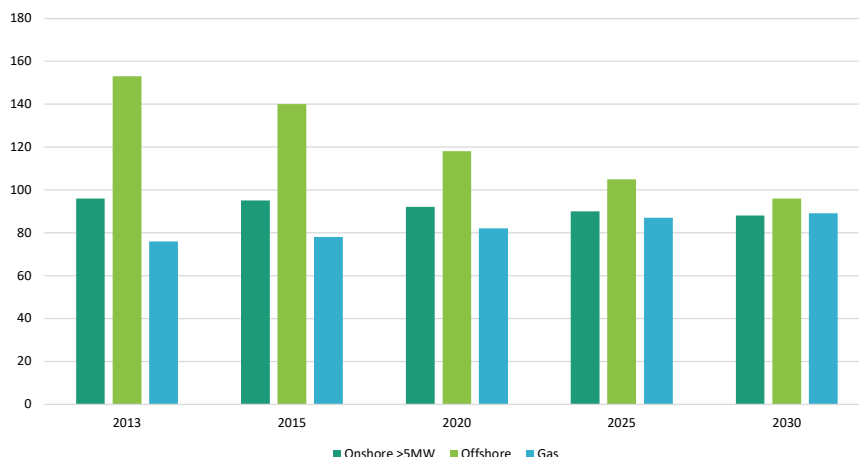
The same is true for wind energy

Wind energy will continually become cheaper due to technological improvements (such as improved efficiency of conversion of energy to electricity).

Supply chains for wind energy are expected to become more mature and efficient.

This has led to smaller firms being more able to challenge Big Six for market share as they become price-competitive

Levelised costs by year of commission, £/MWh



Onshore and offshore UK wind's levelised cost (with gas for comparison).

Onshore wind is and will remain more price-competitive than offshore, but offshore wind will see a much greater annual decline in its cost – 0.49% per year for onshore compared to 2.19% for offshore¹

1 DECC (2013) *Electricity Generation Costs 2013*. [9]

Renewable sources are becoming more dependable

The following three factors are causing renewables to become more reliable:

1) **Capacity factors** of renewables and fossil fuels converging¹

- **The capacity factor of renewables is increasing** due to improved efficiency allowing electricity generation even in suboptimal conditions
- **Fossil fuels are seeing reduced capacity factors** – companies are choosing to use renewables where possible

2) Renewables form mutually reinforcing networks

- Solar energy and wind energy complement one another (solar energy production is high when wind production is low) – the development of a smart grid will further increase the reliability of a diverse renewable portfolio²

3) Storage technologies are improving

- LAES system – stores energy in the form of liquid air³
- Silicon solar storage – 10 times more efficient than previous systems⁴

Companies utilising renewable energies are now eroding advantages that the Big Six suppliers had in dependability – this has promoted competition.

1 Randall, T. (2015) *Solar and wind just passed another big turning point*. [10]

2 Yale University (2012) *Wind and solar energy can be a powerful combination in New York state* [11]

3 Energy Storage Association (2017) *Liquid air energy storage (LAES)*. [12]

4 The Institution of Engineering and Technology (2016) *Molten silicon offers tenfold improvement to solar energy storage* [13]

Microgeneration will further expand UK energy supply, resulting in enhanced competition

Microgeneration is now possible and viable even for urban households. Huge reductions in the installation price of rooftop solar panels and other inputs are making microgeneration of energy attractive even without subsidy.¹

Residential storage technologies are improving, allowing them to make use of their own energy throughout the day.

Microgeneration has many competitive advantages, including the fact that there is no need for a profit mechanism, and the reduction in distribution or network costs.

- How is this affecting competition?

These changes are empowering households and are reducing the effective monopoly power that members of the established Big Six tend to have. Increasing supply means lower prices for consumers.

That said, the lack of economies of scale does increase marginal cost somewhat relative to conventional energy suppliers.

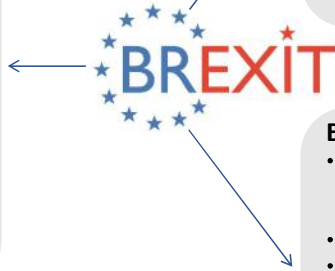
¹ CompareMySolar (2017) *CompareMySolar UK*. [6]

Changes in Policy

UK renewables policy is now uncertain following Brexit

EU Regulations on renewables

- UK will be released from its renewable energy targets under the EU Renewable Energy Directive, potentially giving the government more freedom in the design of renewable energy support regimes
- While in the EU, UK was legally obliged to reach the target set by EU dictating that 30% of electricity demand needs to be generated by 2020
- Therefore, Brexit is likely to lead to a decrease in renewables investment and is directly linked to a reduction in renewables subsidies
- Low CO2 emission will suffer through the replacement of legally-binding targets in favour of a carbon economy



European Grid Integration

- Brexit vote means that UK grid will not be integrated with the Europe-wide energy grid or the integration will be significantly delayed
- The integration of grids would bring a number of suppliers to the UK energy market, thereby automatically increasing the competition within the UK market
- It can be postulated that the decision will reinforce the position of the big 6 on the UK market and barriers to entry

EU institutions and funding

- Total European Investment Bank investments in the UK economy came to EUR 7 billion in 2015 and some of the projects are still awaiting completion
- Majority of supported investments were in the renewables sector
- The funding was substantial for development of small-scale projects executed by new entrants
- Therefore, a temporary decrease in renewables investments is expected, thereby promoting dominance of the Big 6

The regulator (Ofgem) is imposing implicit constraints on competition

Regulations that insulate companies from certain costs, thereby dulling incentives to improve efficiency

- Charging suppliers for electricity transmission losses – the amount charged is constant regardless of generators location and thus results in distortion of competition
- Settlement systems for gas and electricity – the suppliers are charged according to a predetermined profile and thus there is no motivation to increase the energy output in high-demand time periods

Regulations and technical constraints that limit the scope of competition

- The allocation of CfDs – DECC have a freedom of uncompetitive allocation process that may have resulted in allocation of funds into low efficiency projects
- Constraints on the prepayment customers – there is limited flexibility on tariffs within the prepayment infrastructure
- The Ofgem's RMR reforms -- restrict competition on domestic customers by imposing a "simple choice" structure, thereby decreasing the number of tariffs that can be offered to customers

Government support and subsidies for renewables are scaling down - Subsidy cuts are offsetting price reductions

Currently available subsidies for renewable energy generators

Renewables Obligation (RO)

- The generous RO scheme has been introduced in order help UK reach the goal for 15% renewable energy generation by 2020 by the EU standards.
- On basis of ROs each MWh of renewable energy received a constant subsidy regardless of the technology used.
- Therefore the generator has 2 sources of income from:
 - the obtained obligation,
 - sale of electricity.
- The RO program will be terminated in forthcoming April (2017)

Contracts for Difference (CfD)

- On basis of CfD the generator is paid by the government the difference between the price of generating electricity from a low carbon source and the average price of electricity in the UK market
- The CfD are to completely substitute the RO program in 2017
- In contrast to ROs that provided constant, predictable subsidy, subsidies from the CfD program will be adapted to current prices of:
 - renewables-generated,
 - fossil fuels-generated energy prices

Feed-in-Tariffs (FIT)

- FIT is a scheme designed to promote the uptake of small-scale renewable and low-carbon electricity generation technologies.
- Small-scale generators (up to 5MW) are paid for producing and exporting excess energy from sources such as photovoltaics or wind into national grid.
- Changes that have been recently introduced limit the number of supported installations

The changes to the forms of governmental support described above are likely to reinforce entry barriers to the renewables energy market and decrease the number of new small-scale generators. Thus, we believe that they will enhance the position of the big 6 on the market, thereby weakening the competition.

Market Outlook

In the long run, renewables will achieve grid parity, and will be more competitive and favourable than non-renewables

- Changes in government subsidies and Brexit are short term factors that create uncertainty.
- Long term factors that affect the methods of the energy production are more significant:



Cheaper renewable energy increases competitiveness against fossil fuels, even without subsidies.



Technological improvements (e.g. energy storage) makes renewables as reliable as non-renewables.



Independent microgeneration will be easily accessible to households and small businesses.



Considering emissions-reductions targets, unlikely that future policy will favour fossil fuels.

Possible Strategies

One way the Big Six can maintain its market share is to reconsider its portfolio in the energy sources to invest in

Strategy:

- Reallocate some investment from fossil fuels to renewables.
- Lag between investment and production – start investment now.
- Develop core competency in renewables whilst stretching fossil fuels for as long as possible.

Scottish Power¹

- Strategy: “sustainable, greener energy future”
- Focused on renewables for 15 years
- Emphasis on innovation and new technology
- Onshore and offshore windfarms, with smart network links

¹ Scottish Power Ltd (2017) *Strategic outlook 2016-2020*. [14]

The Big Six can invest in emerging technologies that make use of their core competencies

Strategy:

Use existing brand-recognition, core competencies and financial resources to expand into new markets



Electric Vehicles

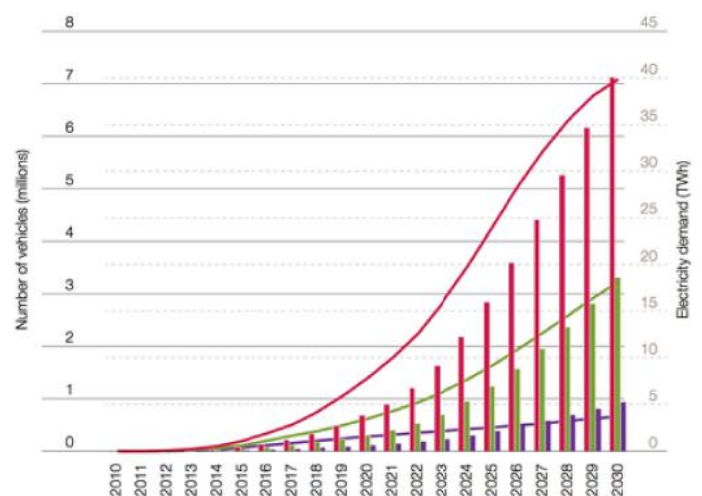
Require network of charging stations that could be supplied by the Big Six



Microgeneration

Requires and maintenance services. The Big Six could acquire or build a company to provide these.

Number of electric vehicles in all three scenarios ¹



¹ National Grid (2012) *UK Future Energy Scenarios* [15]

New Entrants can gain a foothold in energy markets investing in renewables, and by using new technologies

Strategy:

- Invest in renewable energy production rather than fossil fuels.
- Outcompeted by larger firms' economies of scale with fossil fuels.
- Renewables less dependent on economies of scale
- Begin investing now. Secure first mover advantage, and establish firm by the time of grid parity.
- Uncertainty: effect of Brexit on integration of national grids – use advances in smart grids to supply more clients.

New entrants can work with communities to ensure that backlash from renewable energy production does not hinder progress

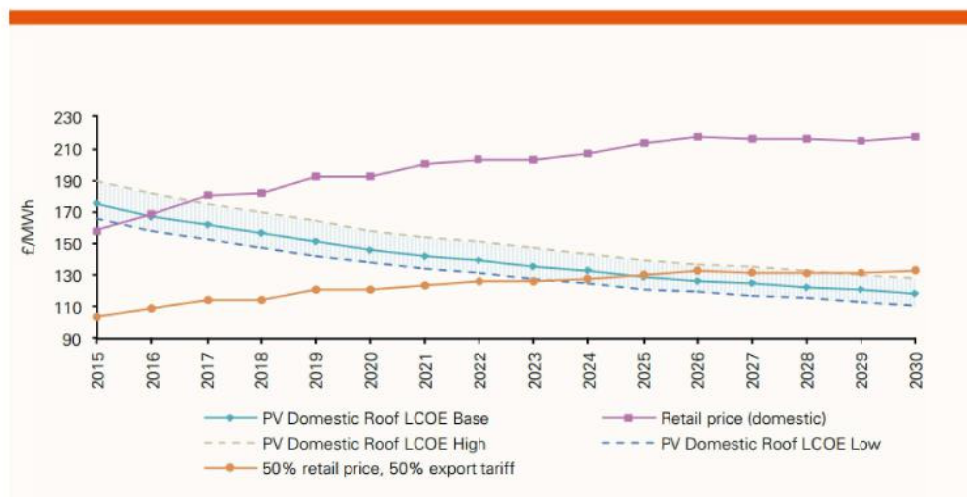
Strategy:

- Involve local communities, building support where renewable energy is produced.
- Profit sharing with local community – will help raise funds.
- Account for the externalities – deal with unfavorable public opinion (wind farms) by energy sharing.
- Explore sharing economy (microgeneration, local markets).

Appendices

Appendix 1: Grid Parity for Solar PV

Domestic PV LCOE versus electricity tariff comparators¹



¹ KPMG (2015) UK solar beyond subsidy: The transition.

Appendix 2 – UK's first unsubsidised wind energy project

Some projects are now producing renewable energy at a marginal cost below that of the market price – enabling them to survive without subsidy. One such project, run by Good Energy, promises to deliver subsidy-free onshore wind energy, having raised the necessary capital from local people who will receive a share of the profits from the wind farm (made possible by a 50% increase in generation capacity through adoption of new technology).¹



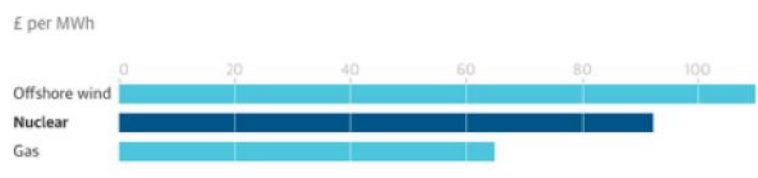
¹ Harvey, F. (2016) *Good energy promises UK's first subsidy-free windfarm* good energy promises UK's first subsidy-free windfarm.

Appendix 3 - Promotion of Nuclear Energy

The new Hinkley point C in Somerset project has been confirmed by Theresa May six weeks after being unexpectedly placed under review. Confirming the project has caused a lot of controversy as the deal was struck when government was reducing support for cheaper (over 43% of the DECC budget goes towards nuclear waste storage), safer, and more reliable renewables.

The decision contradicts the recently adopted policy that supposedly aims at reducing the renewables subsidies in order to release low-income households from the burden of supporting the low CO₂ generation techniques. Meanwhile, the financial commitment to the extension of the Hinkley nuclear plant is equivalent to 4 years' worth of subsidies for the whole solar sector. Therefore, the decision makes no economic sense and is perceived as a turnaround from the promotion of renewables

Comparison of energy generation costs



Appendix 4: Sources

- [1] Ofgem (2016) *Electricity supply market shares by company: Domestic (GB)*. Available at: <https://www.ofgem.gov.uk/chart/electricity-supply-market-shares-company-domestic-gb> (Accessed: 3 January 2017).
- [2] Ofgem (2016) *Gas supply market shares by company: Domestic (GB)*. Available at: <https://www.ofgem.gov.uk/chart/gas-supply-market-shares-company-domestic-gb> (Accessed: 3 January 2017).
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- [5] Deaton, J. (2016) *The little-known reason renewable prices are dropping*. Available at: <https://thinkprogress.org/the-little-known-reason-renewable-prices-are-dropping-194f74e23316#.l16s04o8k> (Accessed: 3 January 2017).
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- [7] Office of Energy Efficiency and Renewable Energy (2017) *Soft costs*. Available at: <https://energy.gov/eere/sunshot/soft-costs> (Accessed: 11 January 2017).
- [8] Farmer, J.D. and Lafond, F. (2016) 'How predictable is technological progress?', *Research Policy*, 45(3), pp. 647–665.
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- [11] Yale University (2012) *Wind and solar energy can be a powerful combination in New York state*. Available at: <http://environment.yale.edu/yer/article/wind-and-solar-energy-can-be-a-powerful-combination-in-new-york-state#gsc.tab=0> (Accessed: 3 January 2017).
- [12] Energy Storage Association (2017) *Liquid air energy storage (LAES)*. Available at: <http://energystorage.org/energy-storage/technologies/liquid-air-energy-storage-laes> (Accessed: 3 January 2017).
- [13] The Institution of Engineering and Technology (2016) *Molten silicon offers tenfold improvement to solar energy storage*. Available at: <https://eandt.theiet.org/content/articles/2016/10/molten-silicon-offers-tenfold-improvement-to-solar-energy-storage/> (Accessed: 3 January 2017).
- [14] Scottish Power Ltd (2017) *Strategic outlook 2016-2020*. Available at: http://www.scottishpower.com/pages/strategic_outlook_2016_2020.aspx (Accessed: 3 January 2017).
- [15] National Grid (2012) *UK Future Energy Scenarios*. Available at: <http://www.nationalgrid.com/NR/rdonlyres/C7B6B544-3E76-4773-AE79-9124DDBE5CBB/56766/UKFutureEnergyScenarios2012.pdf> (Accessed: 3 January 2017).
- [16] KPMG (2015) *UK solar beyond subsidy: The transition*. Available at: <http://www.r-e-a.net/upload/uk-solar-beyond-subsidy-the-transition.pdf> (Accessed: 3 January 2017).
- [17] Harvey, F. (2016) *Good energy promises UK's first subsidy-free windfarm*. Available at: <https://www.theguardian.com/environment/2016/mar/02/good-energy-promises-uks-first-subsidy-free-windfarm> (Accessed: 3 January 2017).

Glossary

Photovoltaic (PV) solar: Modules which utilise solar radiation to generate electricity, as opposed to generating heat.

Kilowatt peak (kWp): The maximum output power possible for a solar panel system – the power achieved under optimal conditions.

Kilowatt hour/ Megawatt hour (kWh/MWh): Units of energy, consisting of the power (kW or MW) of an energy-generation facility and the length of time for which it is operational (measured in hours).

Levelised cost: The average lifetime production cost of an energy-generation facility – incorporating the cost of construction, maintenance and decommissioning.

Capacity factor: The percentage of a power plant's maximum potential that's achieved over time



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