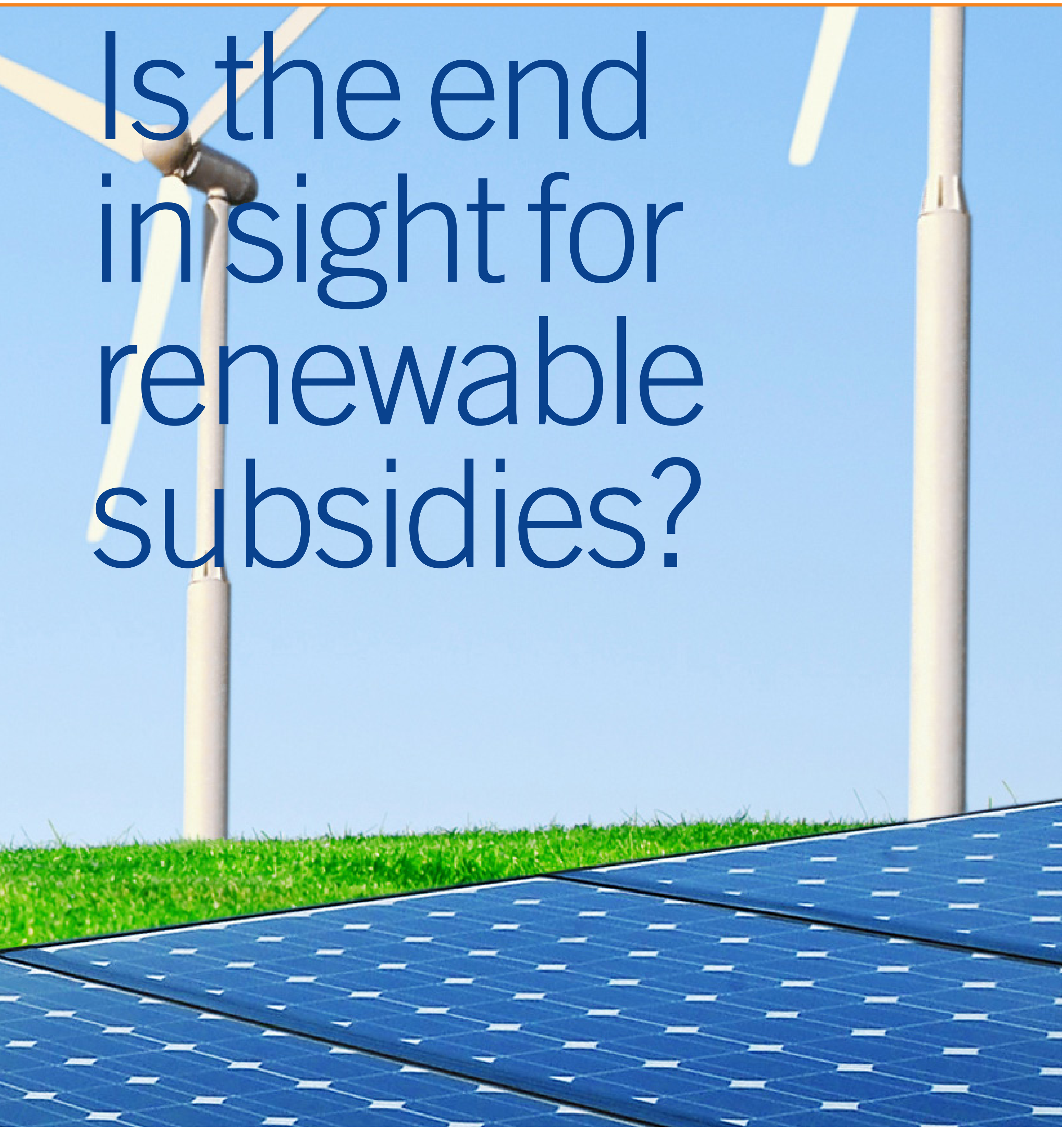
PÖYRY POINT OF VIEW - OCTOBER 2014

Is the end in sight for renewable subsidies?



Wholesale grid parity of solar and wind

Rapidly falling costs of wind and solar mean that these technologies could soon be competitive against conventional coal or gas power stations, potentially ushering in a new era of unsubsidised renewables. In this Point of View, we examine when that might happen, and what the implications could be.

WHAT IS 'GRID PARITY'?

Grid parity occurs when an emerging technology such as wind or solar can produce electricity at the same levelised cost as buying power from the grid. This has long been regarded as the 'holy grail' of the renewables industry, as when grid parity is reached, market forces (rather than subsidies) would drive large scale deployment.

However, given that different consumers pay different prices for electricity, there are different definitions of grid parity, depending on what price is compared:

- **Retail grid parity** occurs when the levelised cost of wind or solar falls below the retail price of electricity (for example, the price at which a typical household buys electricity). Since the retail price includes transmission and distribution costs, retail margins, as well as taxes and often renewables subsidies, the price paid is high and reaching grid parity is hence easier.
- **Wholesale grid parity** occurs when wind or solar becomes competitive with wholesale price and hence with large-scale power generation – such as gas, coal or nuclear power stations. Since the wholesale price is much lower than the retail price, this requires the cost of renewables to fall further.

Although retail grid parity will be reached sooner than wholesale parity (and in some countries has already been reached) many of the advantages may be short-lived as they stem from the way in which the fixed costs of the system (such as the cost of the grid) are shared. For example, a move to charging grid fees for consumers based on peak consumption (per kW) rather than on energy (per kWh) would quickly remove much of the advantage that solar gains. Equally, a move to charging based on time of day rather than average monthly or quarterly prices may quickly erode many benefits of selling surplus electricity back to the grid.

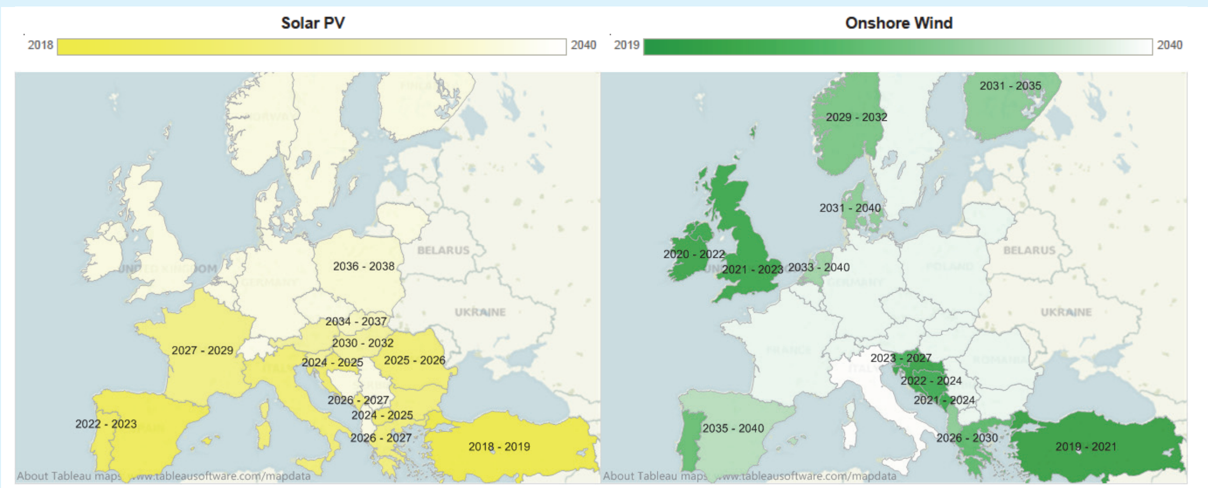
For this reason we focus this article on wholesale grid parity, as the point when solar or wind can compete with conventional power stations is likely to be transformative.

WHERE MIGHT GRID PARITY HAPPEN FIRST?

Grid parity of renewables technologies is geography specific as:

- available wind and solar resources differ significantly across different locations;

FIGURE: EXPECTED YEAR OF GRID PARITY ATTAINMENT



"A system where wind and solar become competitive with wholesale market prices will mark a massive shift in the evolution of these technologies."

- installation and operating costs of wind and solar vary from location to location; and
- electricity prices vary by country or region depending on relevant generation mix, fuel and carbon prices, and short-run marginal cost of marginal generators in the system.

In Europe, there is much more sun in the south, and wind in the north, so we would expect these to be the dominant factors driving grid parity. However, the cost of electricity is also crucial, as whether a country has a system dominated by hydro (leading to low prices) or gas (currently leading to high prices) is vital. Thus a country with high electricity costs and excellent solar or wind resource is likely to be first for large-scale deployment of solar or wind without subsidies.

WHEN MIGHT GRID PARITY BE REACHED?

We have conducted a detailed analysis to assess when wind and solar will reach grid parity across Europe by applying our state-of-the-art electricity market model BID3. BID3 is the leading European electricity market simulation software[1] for modelling the dispatch of all generation on the European network.

Country specific wind and solar output profiles based on wind speed data of a 20x20 km grid and solar radiation data of a 30x30 km grid were applied. A pragmatic learning rate of these renewable technologies was also considered. Furthermore, our analysis is centred on wholesale electricity prices based on Pöyry analysis.

Solar PV achieves wholesale grid parity ahead of onshore wind, while offshore wind and solar CSP would not reach grid parity during the analysis period spanning 2014 – 2040. Assuming falling capital costs, countries in Southern Europe will first attain grid parity for solar PV, primarily due to high solar irradiance. Spain would achieve solar PV parity as early as 2021 followed by Portugal (2022) and Italy (2025 to 2032 depending on specific region). 5% higher capex for solar PV would delay the grid parity by one to three years as represented by the upper value of the grid parity range in the figure.

Onshore wind is expected to achieve wholesale grid parity in a very limited number of countries before 2030. In case of relatively lower onshore wind capex, Ireland will achieve grid parity in 2020 followed by Great Britain in 2021 primarily due to high achievable onshore wind load factors in these countries. A 10% higher onshore wind capex would delay the grid parity by two to four years as represented by the upper value of the grid parity range in the figure.

In Turkey, grid parity is gained for solar PV (2018) and onshore wind (2019) ahead of any other European country due to higher wholesale electricity prices in the country.

Note that uncertainties involving cost (capex and opex) of renewable technologies and fuel (coal, oil and gas) as well as carbon prices can accelerate or delay the time when grid parity is expected to be reached.

IMPLICATIONS OF REACHING GRID PARITY

Reaching grid parity for a given renewable technology means that it can now compete with other conventional technologies, mainly coal and gas-fired power stations, without subsidies. This could lead to accelerated deployment of such a technology provided there are no investment, supply chain, policy or regulatory constraints.

Based on our analysis, we have found that on achieving grid parity an additional 220GW of solar PV mostly in Southern Europe and 40GW onshore wind across Europe can be built in the absence of above mentioned constraints.

So what prevents even higher deployment of renewables? One of the main factors is that of revenue cannibalisation: as the share of renewables rapidly grows in a system, it puts a downward pressure on wholesale electricity prices. In particular, large amounts of solar PV can depress prices during the midday peak so that they fall below night-time prices.

In the most extreme scenarios, the wholesale price drops to zero during the day – the strongest possible signal that no further solar is required on the system.

While the above factors lead to lowering the wholesale electricity prices, large penetration of wind and solar can also result in curtailment of surplus wind and solar energy when the sum of intermittent generation and other must-run generation in the system at a given time exceeds concurrent demand. Consequently the achievable load factors of wind and solar will reduce associated with loss of revenues. Such situations are more likely to occur in systems with very limited energy storage facilities.

At high penetration of renewables due to the combined effect of falling wholesale electricity prices and reduced (achievable) load factor of wind and solar, a threshold level of these technologies will be reached beyond which further addition of wind and solar capacity will not allow adequate revenues to self-sustain.

CLOSING COMMENT

A system where wind and solar become competitive with wholesale market prices will mark a massive shift in the evolution of these technologies. We would expect to see large-scale deployment (unhindered by changes in regulation or government whim), with solar mainly in southern Europe and onshore wind in Northern Europe.

Although factors such as planning permission and public acceptance may reduce deployment, the ultimate cap on deployment levels would be the capture price effect – by building more wind or solar, they reduce prices and hence become uneconomic.

Ultimately, the goal of wholesale grid-parity of renewables remains a long way off, and unless there is a further shift in capital or deployment costs, most large-scale renewables deployment in the next 20 years will remain subsidised.

[1] BID3 simulates all 8760 hours per year, with multiple historical weather patterns, generating hourly wholesale prices for each country for each future modelled year, and dispatch patterns and revenues for plants in Europe. Further information: www.poyry.com/bid3

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