

Energy security in a decarbonising system

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Decarbonisation post-Paris

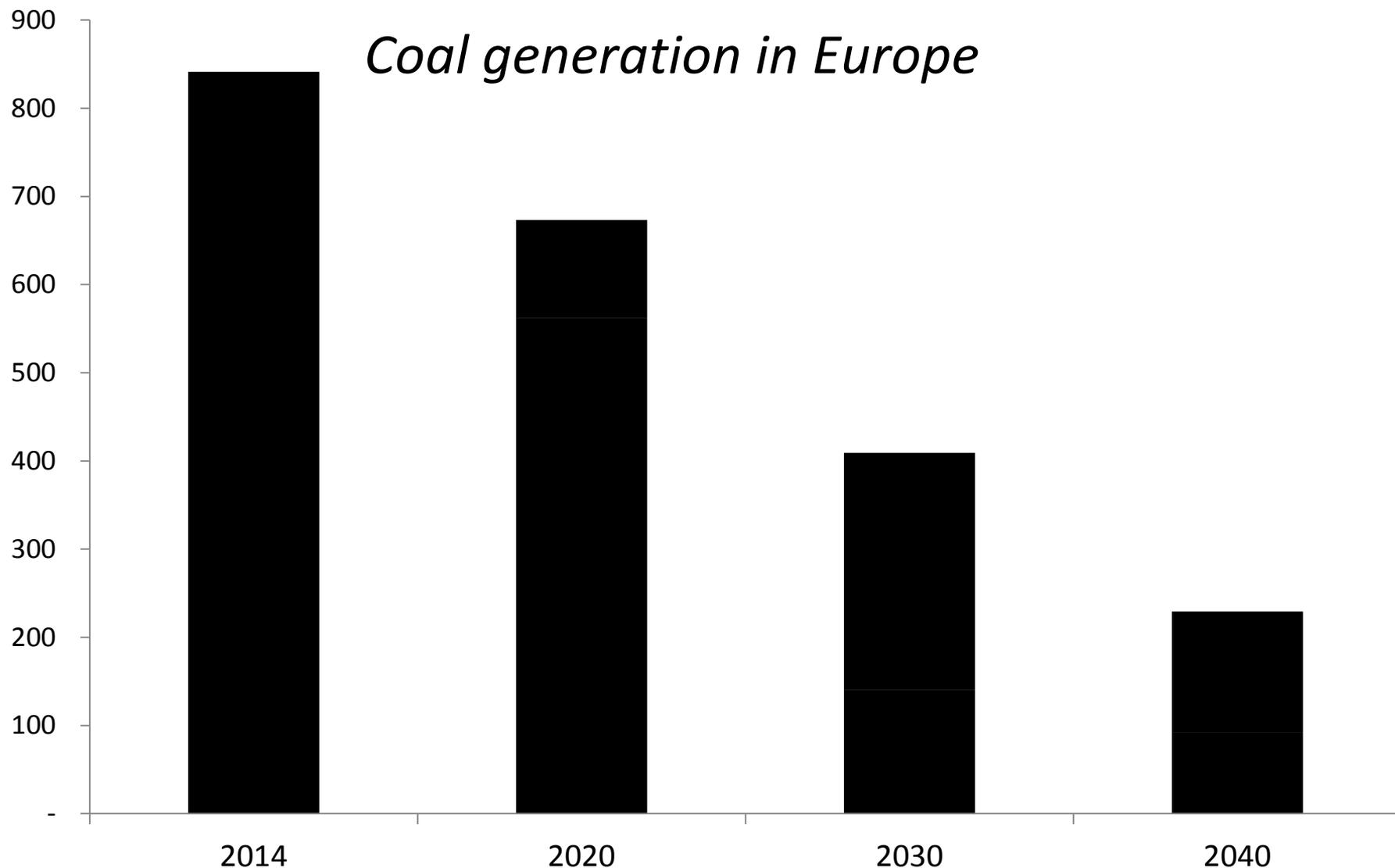
... but there's a tough climb still ahead



We made it to the base camp...

This is either the last decade of EU coal or the last decade of any hope for 2 degrees

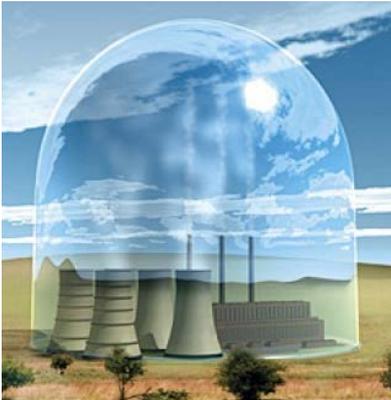
Coal generation in Europe



A centralised, dispatchable low carbon system is possible, but are we on track for



A nuclear renaissance?



A meaningful contribution from CCS?



*Dispatchable renewables
(biomass, geothermal)
overcoming all barriers?*

Energy storage solutions in a high carbon system



The ability to integrate renewables is improving but there are unanswered questions at very high shares

Demand side
Response



Is the low hanging fruit scalable?

Transmission
interconnection



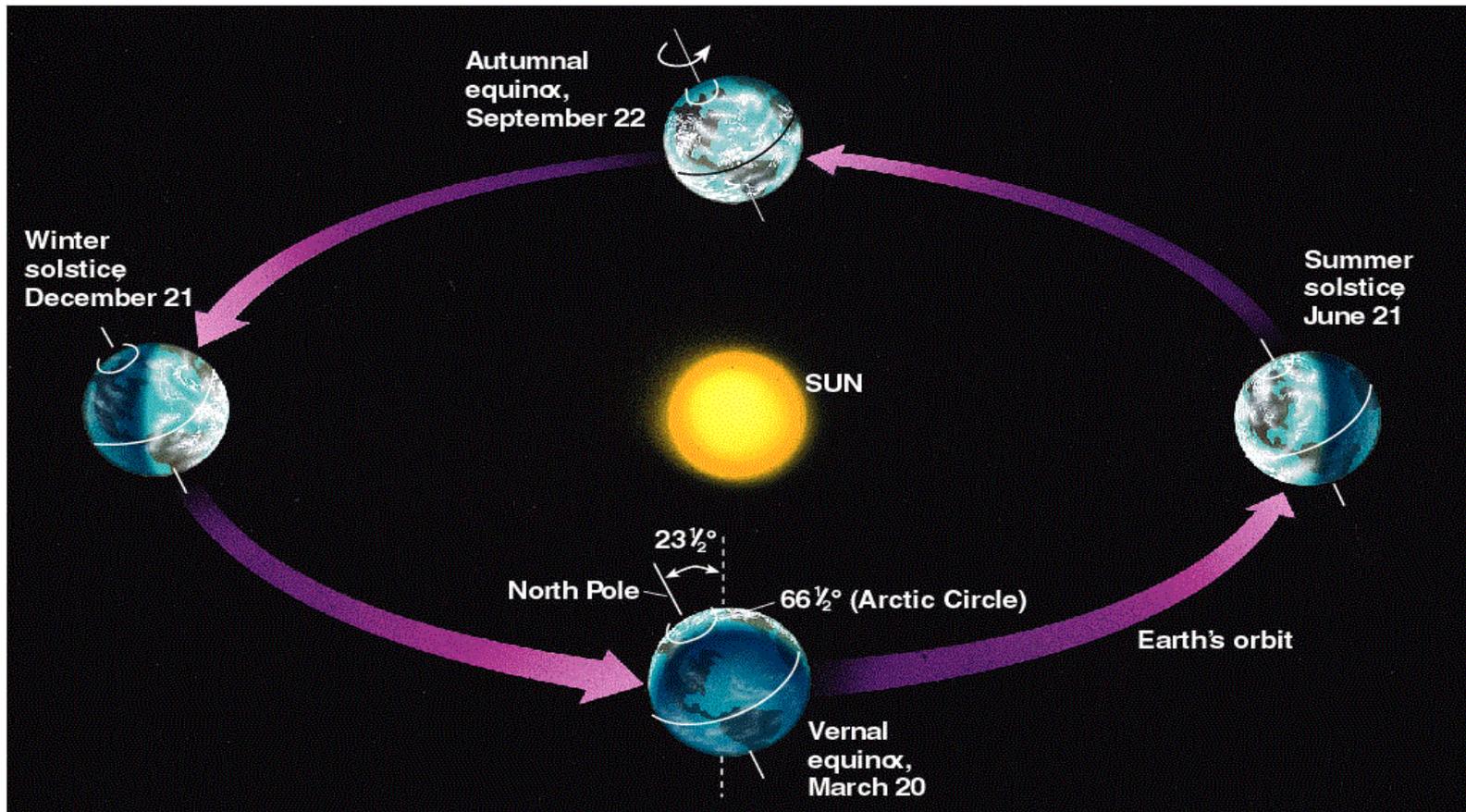
*Is the Supergrid politically
feasible?*

Energy storage



*Can smart pricing overcome
consumer convenience?*

Seasonal imbalance of the solar resource



At 40 – 50 latitude (New York, London, Beijing, Tokyo) up to 85% of PV production is between 15th March and 15th October

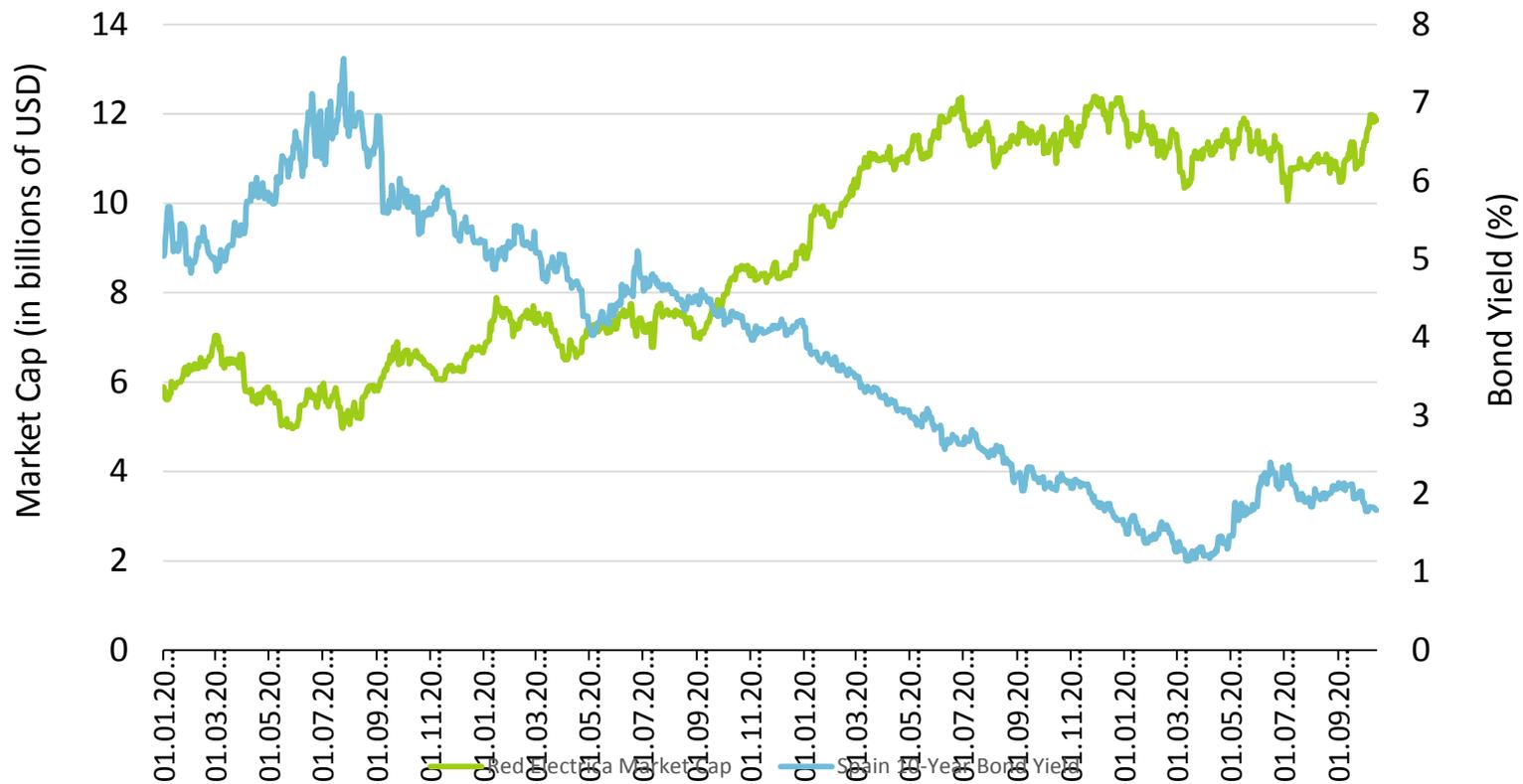
Renewables and decentralised generation are not the same thing



*All wind and the majority of solar investment do not serve
self consumption*

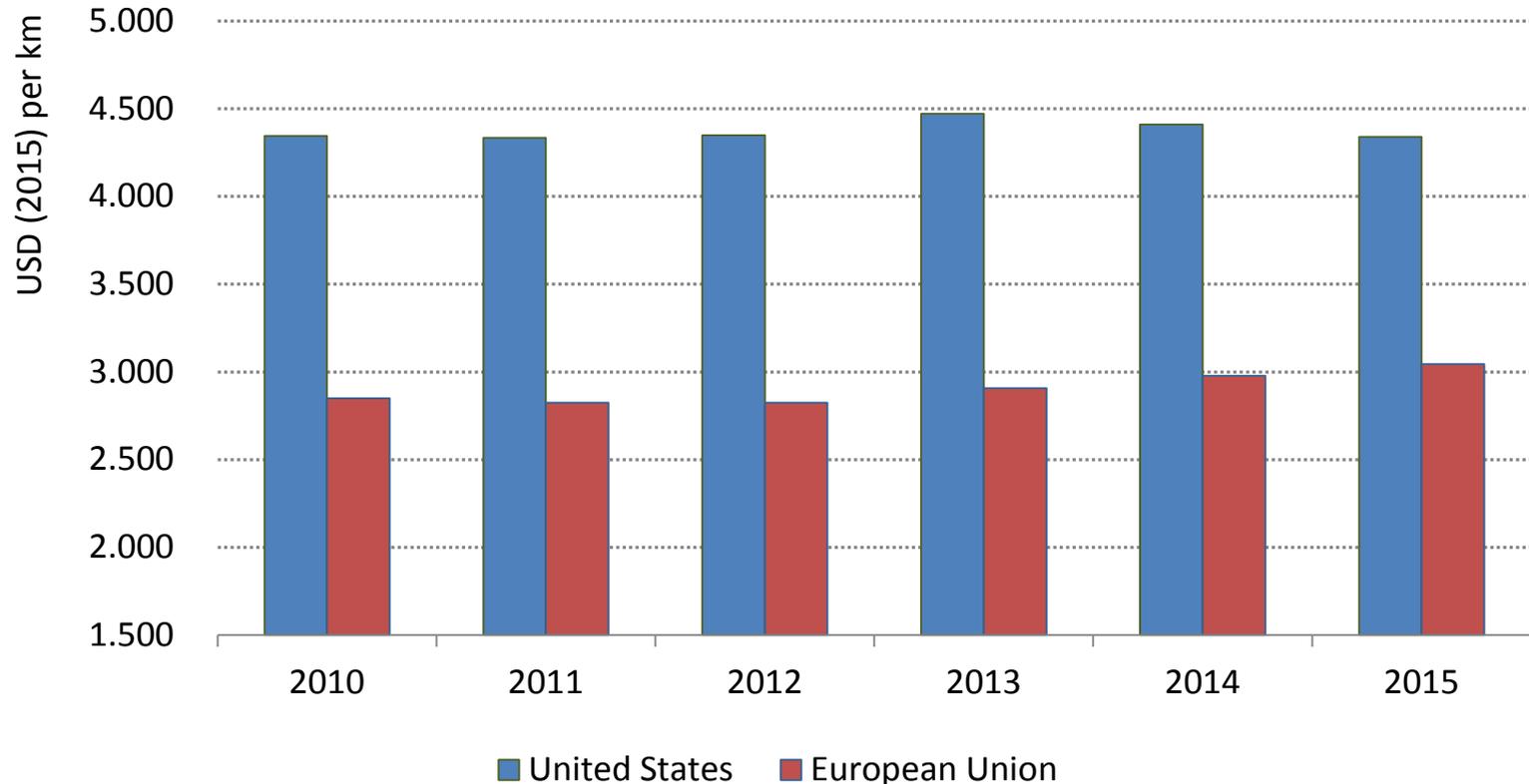
Quantitative easing raises the value of network assets

Red Electrica Market Cap and Spain 10-year bond yields, 2013-2016



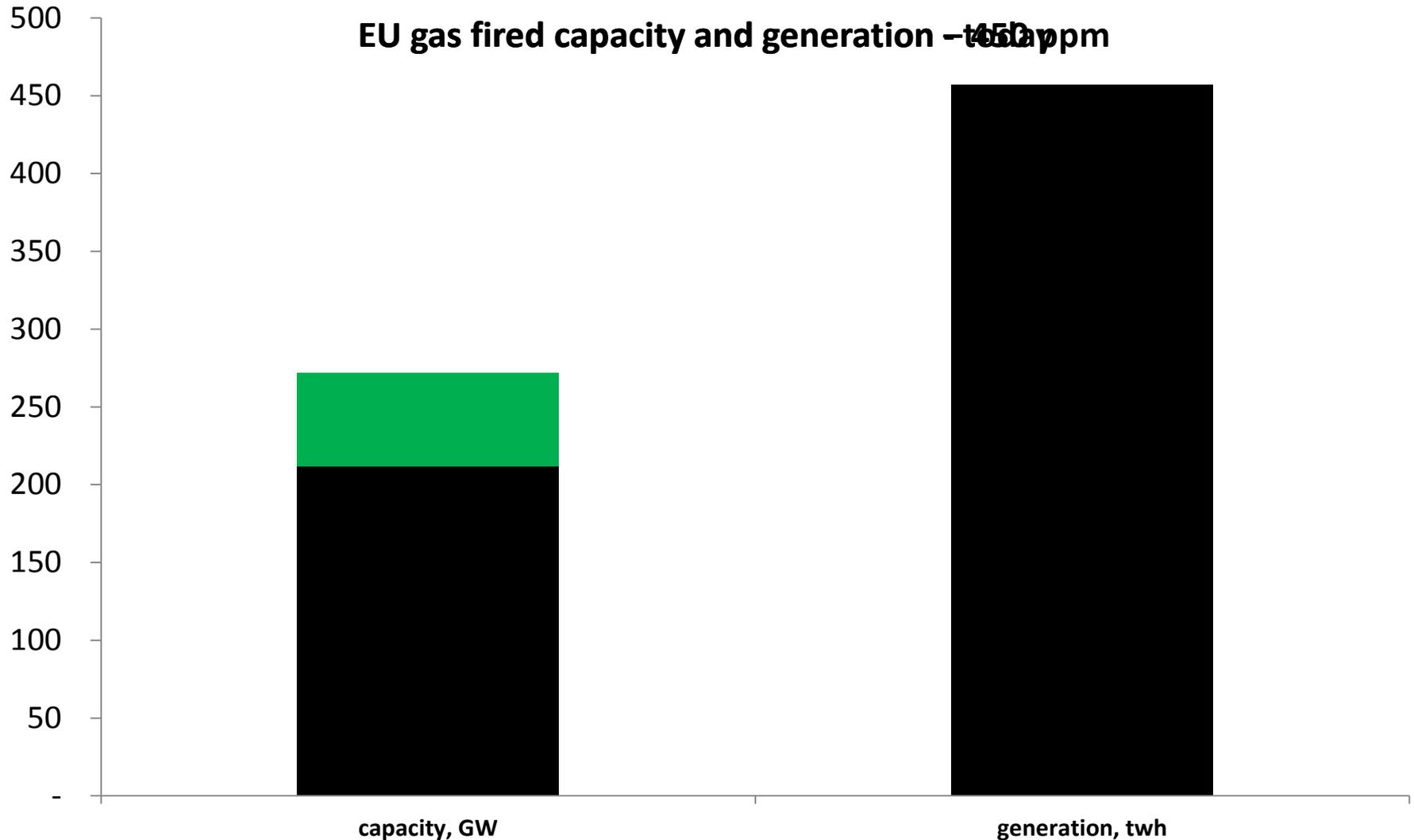
Despite attractive valuations, physical investment is stagnating

Electricity networks investment per total network length, 2010-15



Most renewable deployment is integrated into a legacy network

Flexible gas turbines remain essential to keep the lights on



Can electricity security remain at a nation state level?



- **Electricity rather than fossil fuel flows**
- **Large potential synergies from renewable geography**
- **Adequacy and flexibility value of interconnections**

Supply security risks remain relevant



Gas production or infrastructure affected by conflict or terrorism

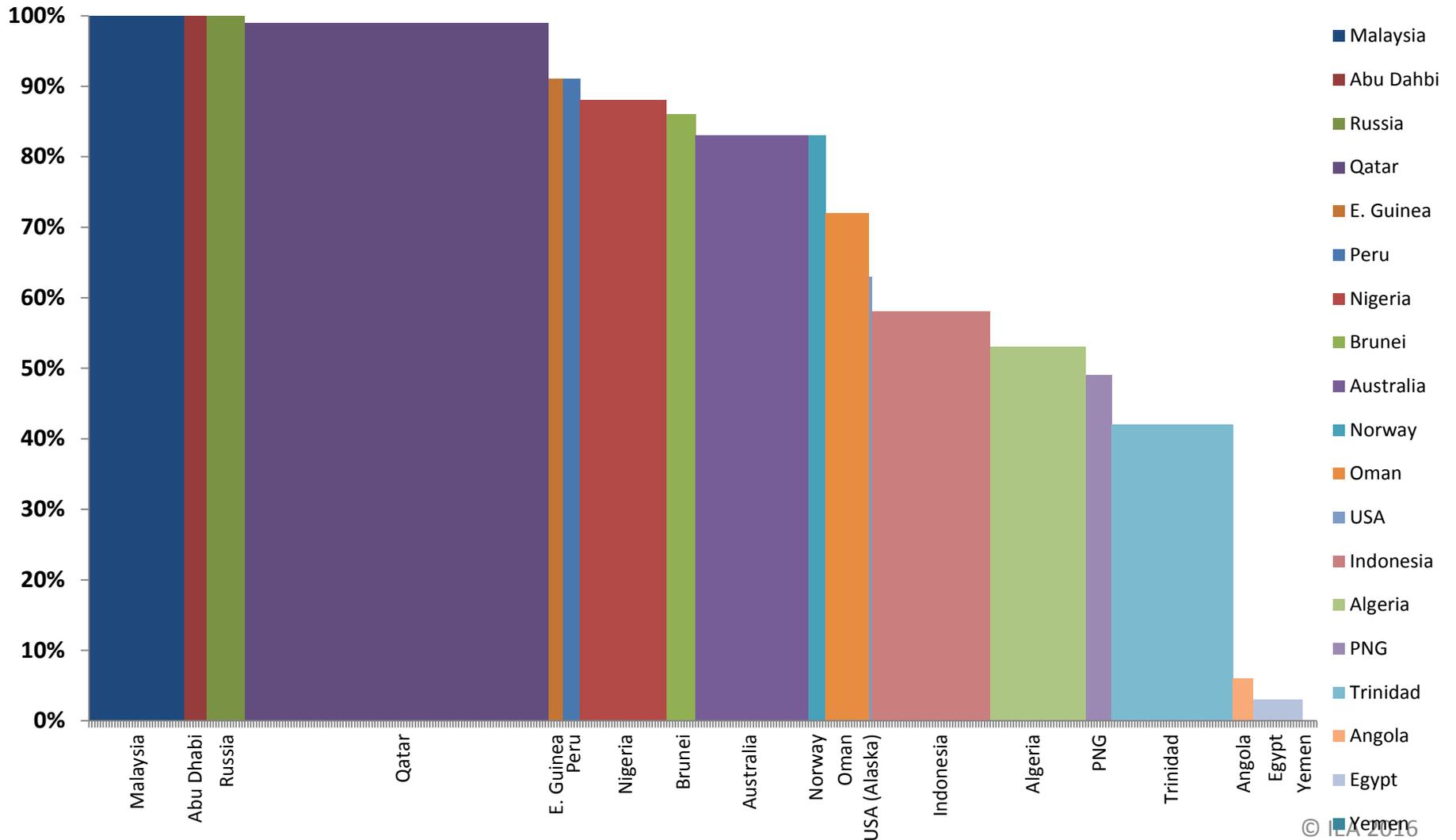


Conflict with potential gas supply security implications



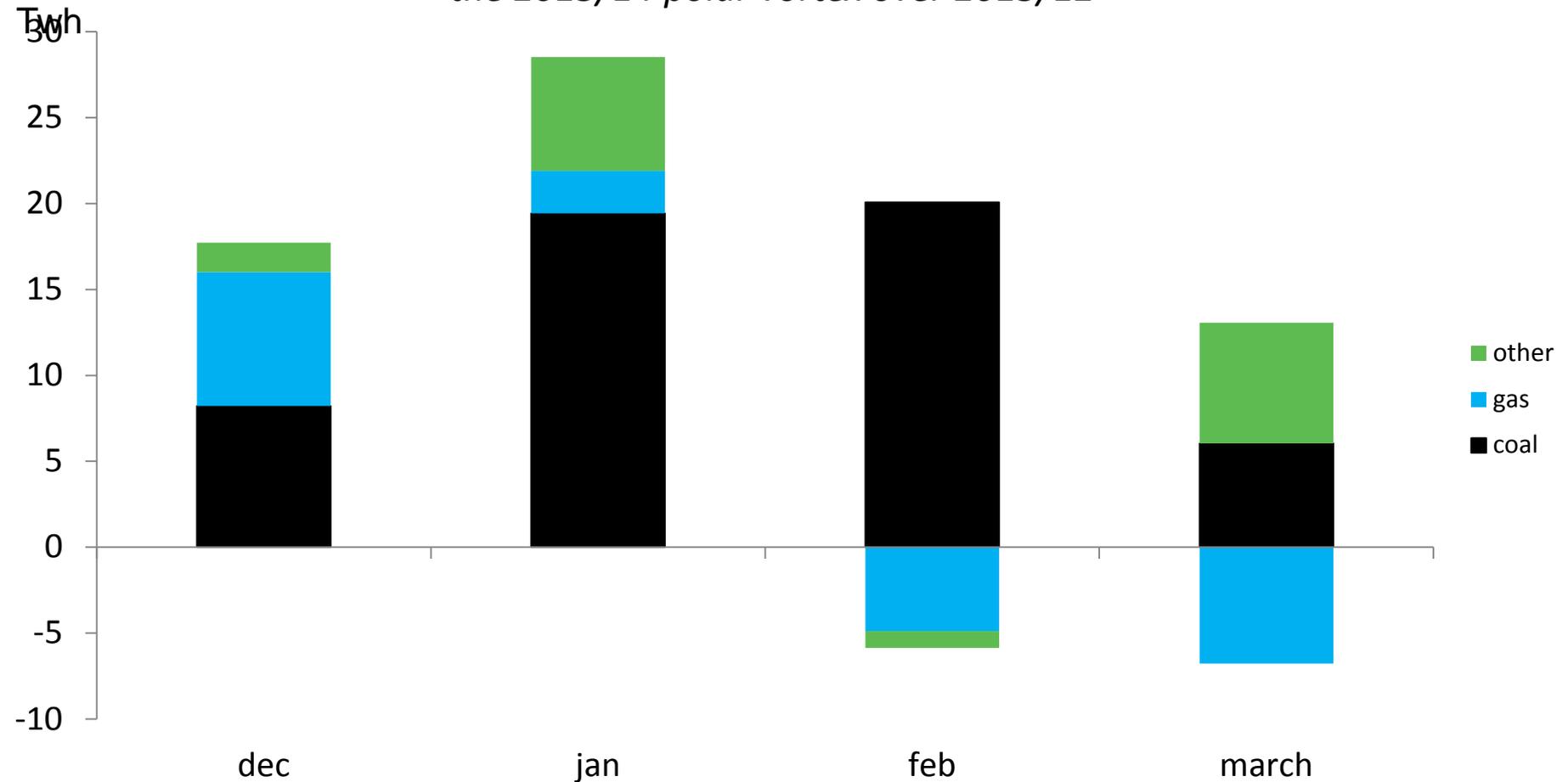
LNG: the illusion of excess capacity

Capacity utilization of LNG exporters



Coal to gas switch and energy security: the US polar vortex 2013/14

Incremental US power generation during the 2013/14 polar vortex over 2013/12



2011/14: European coal plants keeping the lights on in Japan

