BRITISH INSTITUTE OF ENERGY ECONOMICS

PÖYRY

RENEWABLES AND CCGTS: COMPETITORS OR COMPLEMENTARY?

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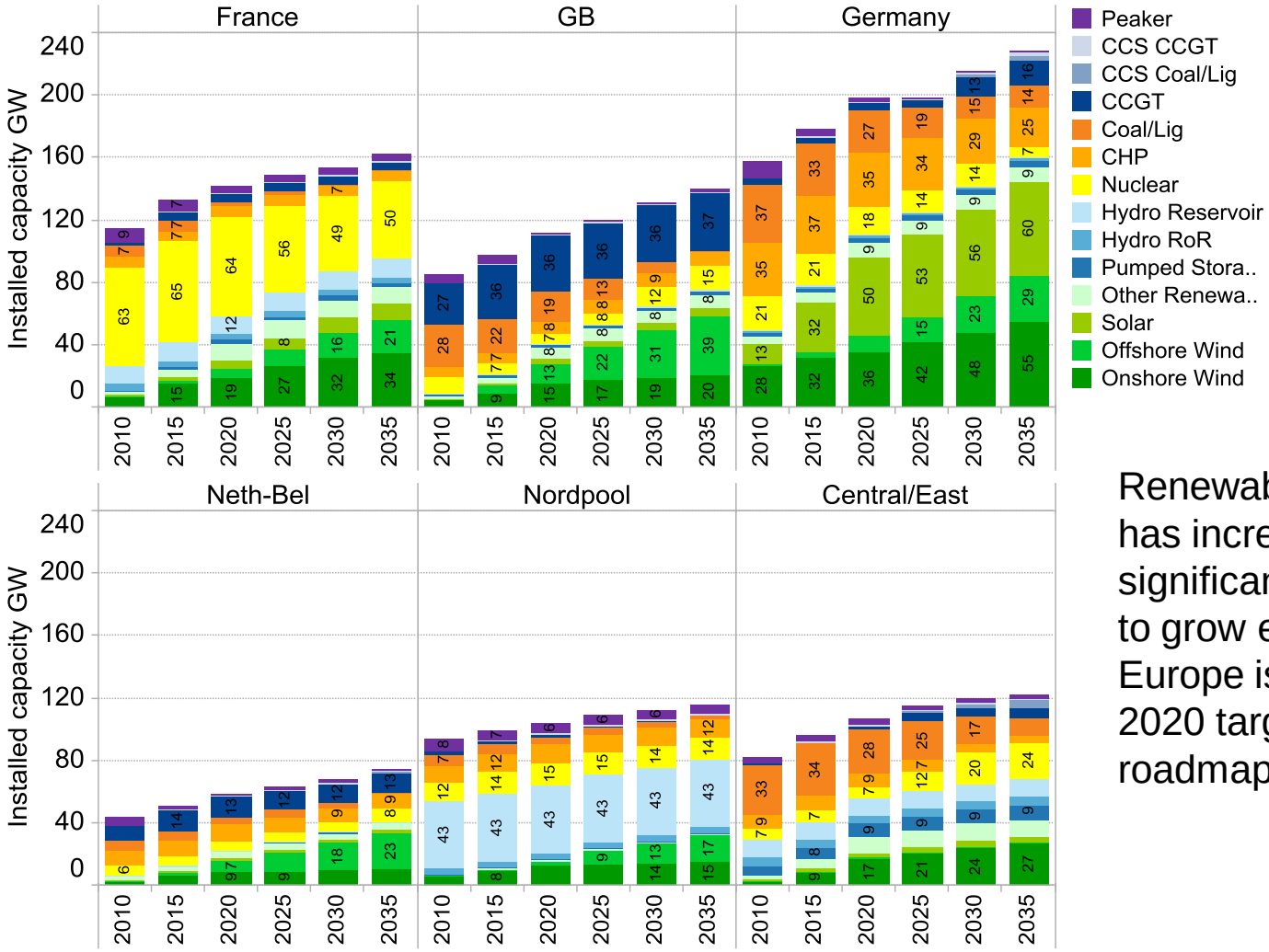
RAPID DEVELOPMENT OF RENEWABLES IS TRANSFORMING THE WAY WE GENERATE ELECTRICITY

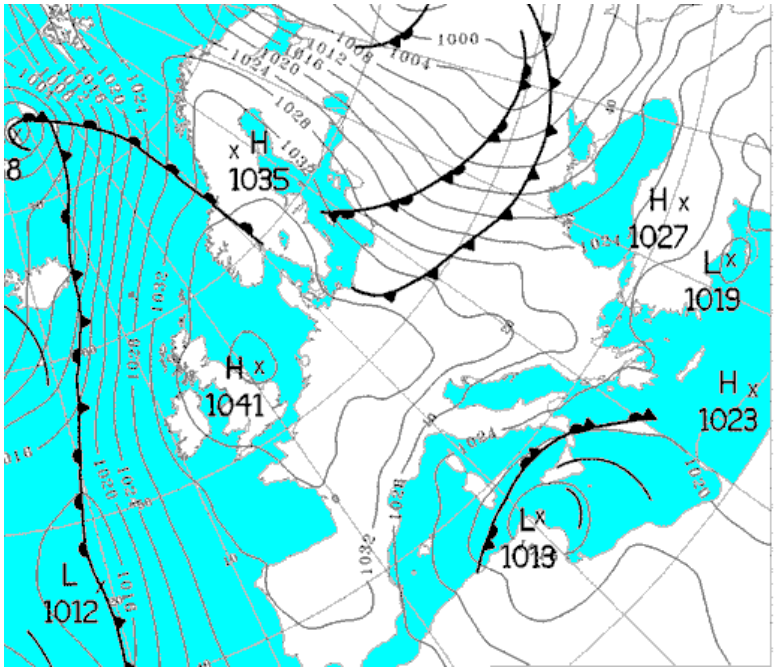


Renewable generation has increased significantly, but is set to grow even faster if Europe is to meet the 2020 targets and the roadmap to 2050

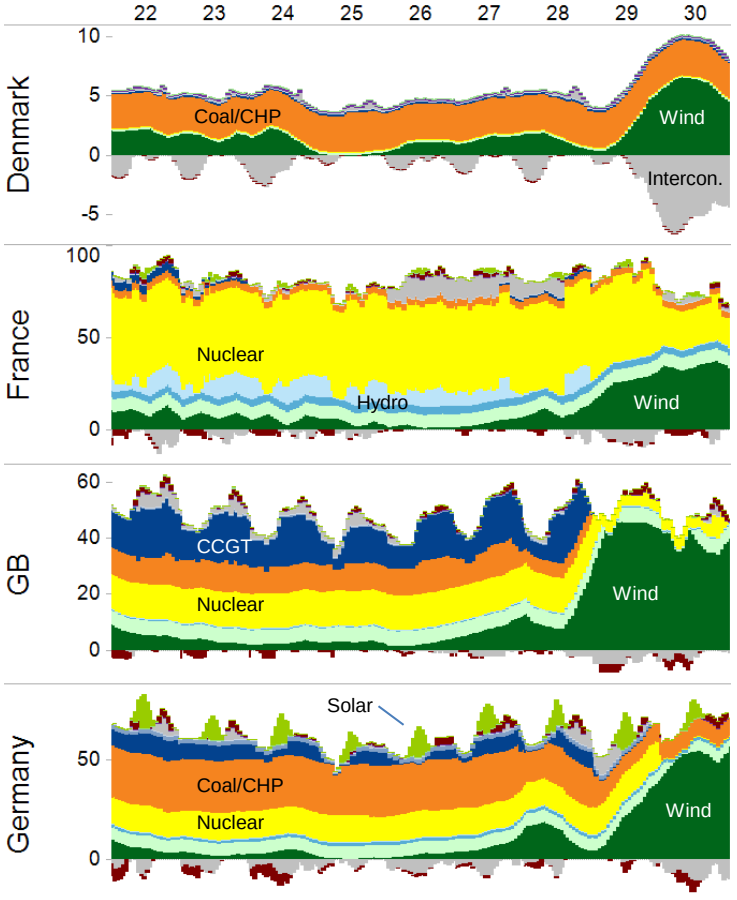
INTERMITTENCY AND IMPACT ON THERMAL GENERATION

There is considerable intermittency in wind generation, and periods of calm cover the entire area at the same time – impact on other generation

Weather patterns for 25 December 2006

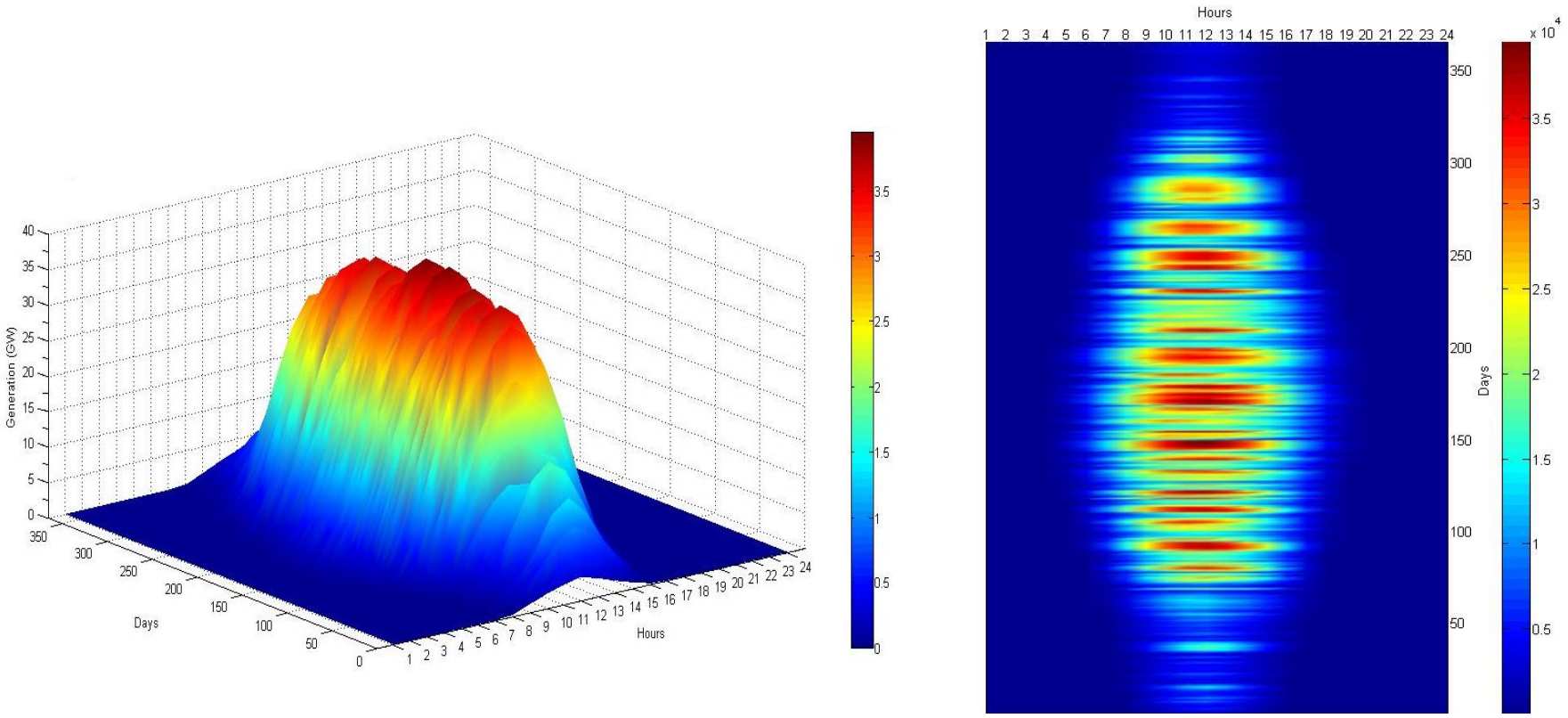


Generation 22-30 Dec 2030



SOLAR INTERMITTENCY

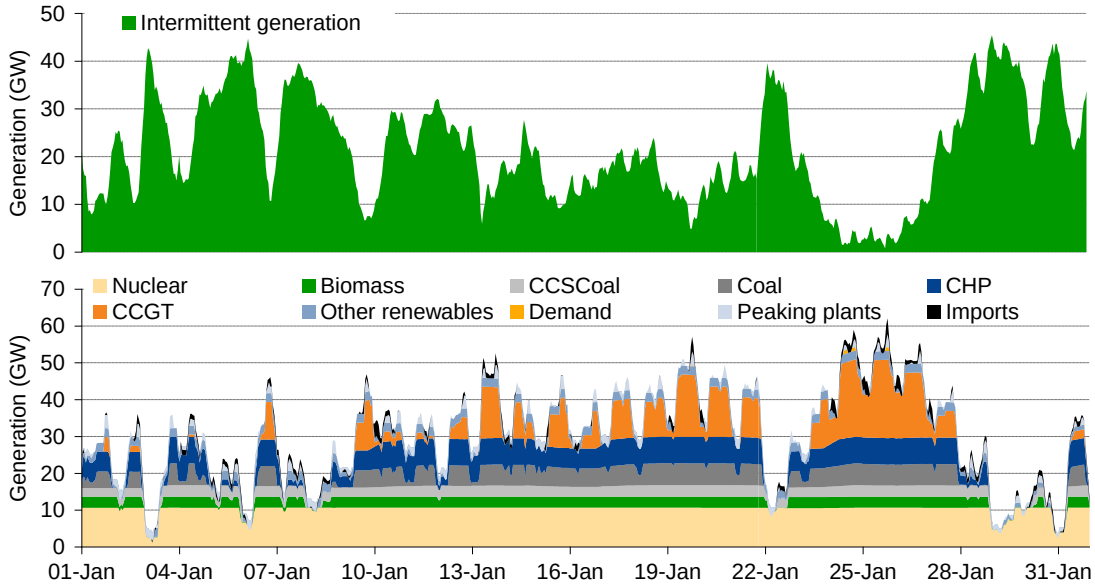
An example of Germany in 2020 shows how variable solar generation is. There is a seasonal profile (winter/summer), a daily profile (midnight/midday) and variation due to cloud cover



Daily output based on historical weather pattern for year 2005 and capacity year 2020: focus on Germany

INTERMITTENT RENEWABLES HAVE AN IMPACT ON OTHER FORMS OF GENERATION

Snapshot of GB generation – January 2030[1]

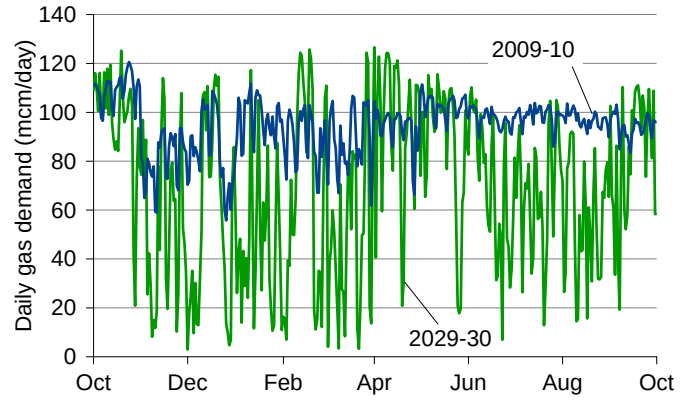


- If we fast-forward to 2030, there are times when electricity demand will be met almost entirely by renewable sources
- However, there are also times when it is not!
- As a result renewables and CCGTs compete day by day, but are complementary over longer periods

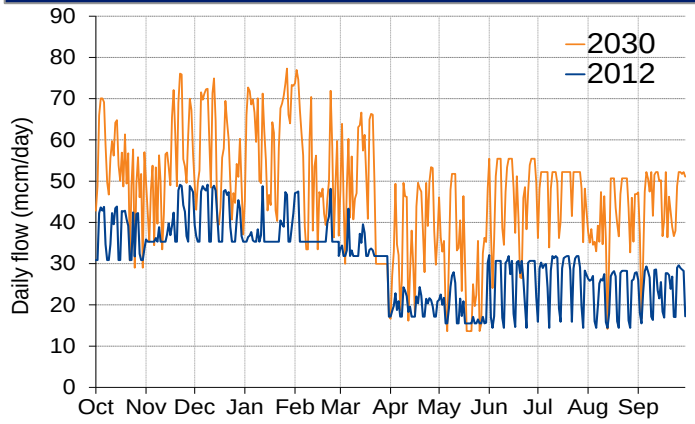
1. Assuming weather patterns from January 2000

INTERMITTENT ELECTRICITY SUPPLY RESULTS IN INTERMITTENT GAS DEMAND

Gas demand for power generation – GB



Gas demand for power generation – Netherlands

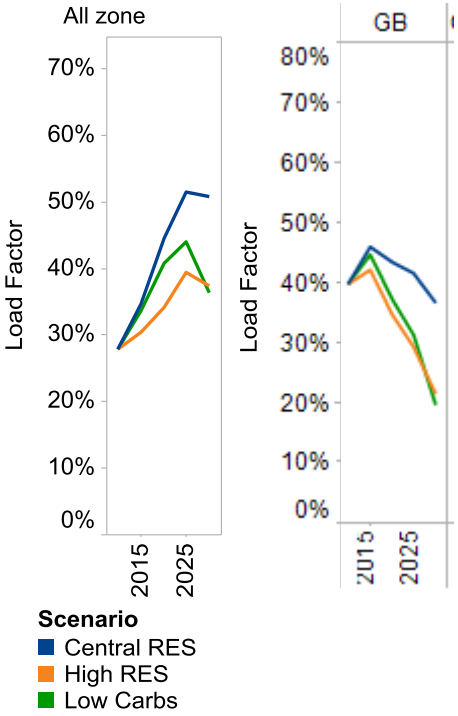


- As CCGTs respond to intermittent generation from wind and solar sources, gas demand becomes more volatile
- Consequently, gas demand becomes less predictable affecting portfolio balancing for CCGTs in liquid zones and dedicated contracts to supply CCGTs in less liquid markets
- CCGTs will need to ensure that they have the physical and contractual flexibility required to operate in an uncertain world
- In Great Britain and the Netherlands, there is an increase in the gas demand from power generation, showing there is a requirement for further generation even after strong renewable growth

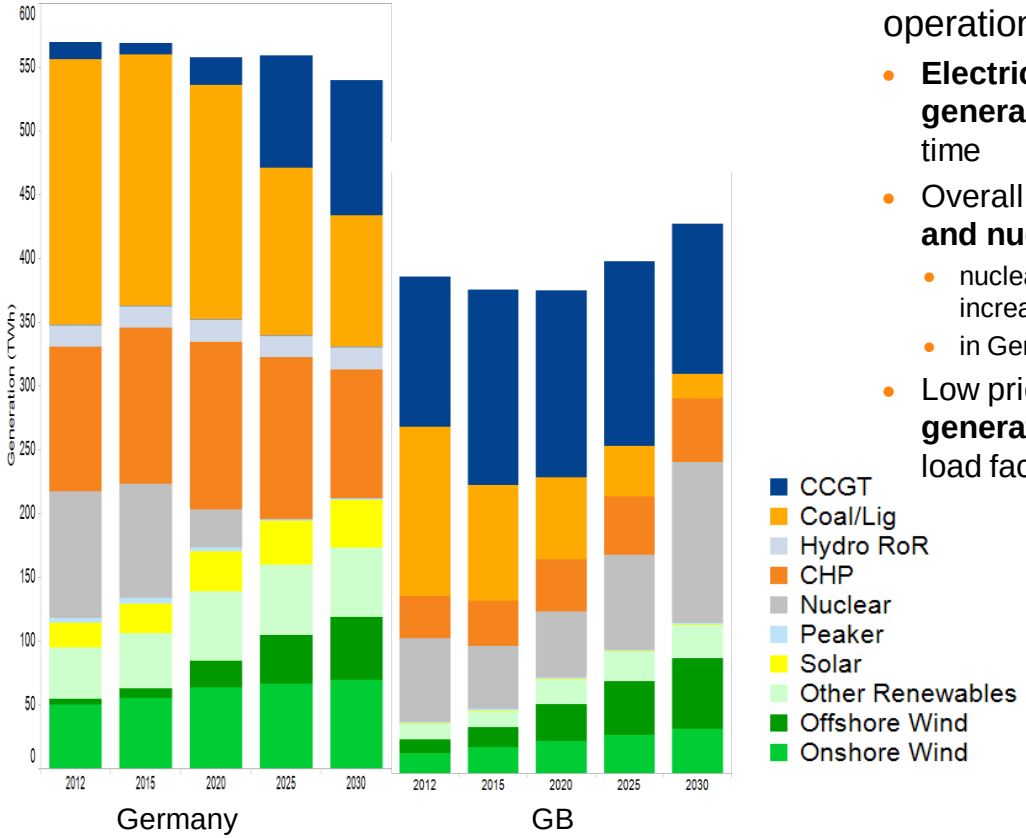
CCGT LOAD FACTORS

Counter intuitively, CCGT load factors could improve in most countries alongside increasing renewable generation, partly because they are so low today…

Average European load factor



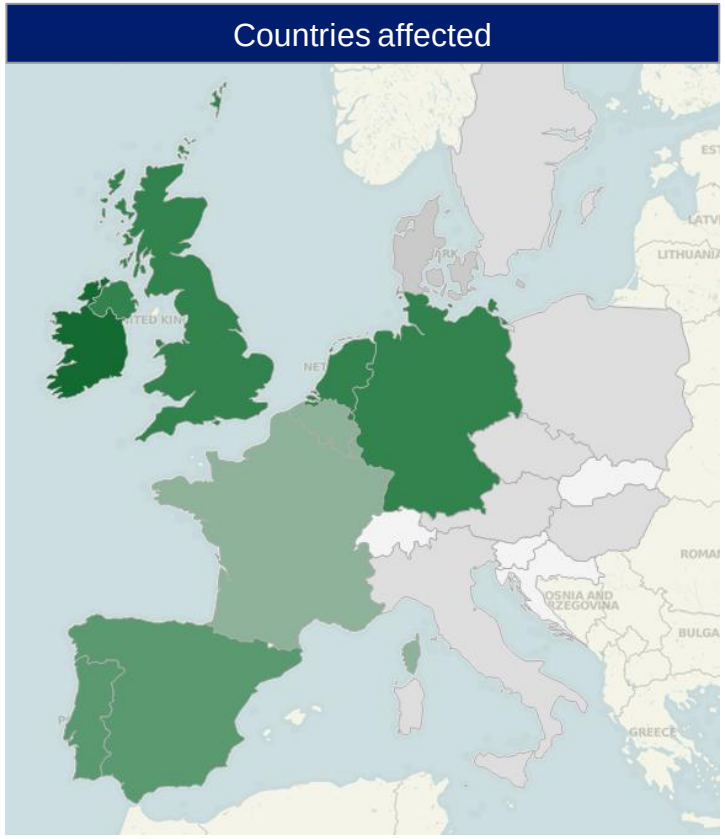
Electricity generation in Germany and GB



- Three factors drive CCGT operation:
  - **Electricity demand** is **generally** increasing over time
  - Overall reduction in **coal and nuclear** capacity
    - nuclear in GB falls before increasing
    - in Germany it reduces to zero
  - Low priced **renewable generation** reduces CCGT load factors

Coal includes both coal and lignite plants but not CHPs.

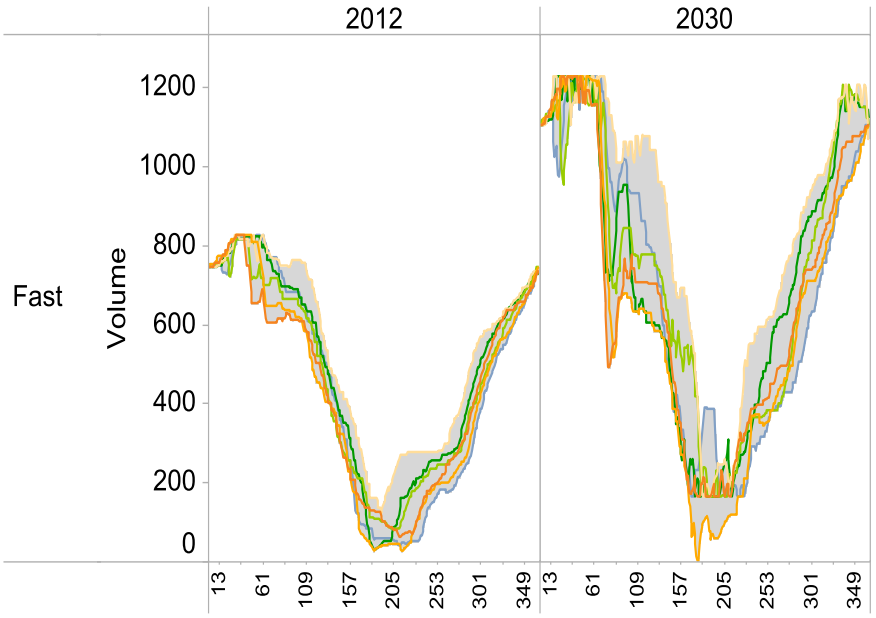
WHICH COUNTRIES ARE MOST AFFECTED BY GAS INTERMITTENCY?



- The impact of gas intermittency is strongest in the Atlantic countries where CCGTs make up a significant proportion of the installed generation **AND** there are plans for strong growth in installed wind capacity
- In most of the Atlantic countries, CCGT output responds on average to at least 50% of the wind change
- Low correlations in rest of Europe are mainly explained by:
  - (Very) limited wind installed capacity; including **Italy**
  - Mix of other responding sources (e.g. coal and interconnection for Denmark)

HOW DOES GAS SUPPLY RESPOND TO INCREASINGLY VOLATILE DEMAND?

Example storage utilisation for Germany



- Fast-cycle gas storage is well positioned to manage the day-to-day effects of changes in gas demand
- As a consequence fast-cycle storage utilisation increases as gas demand becomes more volatile
- In all the scenarios we examined, there **is** a requirement for additional gas storage in Europe, but that the real need does not occur for another 10 years or so
- The increase in additional working gas volume required is in the region of 10-15bcm by 2030

CONCLUSIONS

- Increasing renewable generation leads to less predictable running patterns for thermal generation plant including CCGTs
- As a consequence, gas demand becomes more volatile in many of the largest gas consuming countries in Europe
- The gas market is well positioned to be able to cope with the increasingly volatile demand in the short-term and with a modest level of investment to meet the demands in the long-term
- CCGTs and renewables might compete on a day by day basis, but overall there is a role for both within a low carbon generation mix.

POYRY CONDUCTED A MULTI-CLIENT STUDY IN GAS INTERMITTENCY

- **Overall objective:**
  - **'How will the impact of intermittent electricity generation affect wholesale gas markets in Europe?'**

- We studied the four following topics:
  - Market and investment
  - Storage and flexibility
  - System operation issues
  - Regulation

- Founders and Members:

gasunie, GRTgaz, VATTENFALL, Statoil, EGL networking energies, eni, RWE, DELTA the multi-utility company, BKW, DONG energy, e·on, EDF

Countries investigated

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