Gas/power task force

2nd meeting of iiESI
Juha Kiviluoma
VTT Technical Research Centre of Finland
Research Task Force on Gas-Electricity market modelling

- Task force convened yesterday 10-13:00
- Two working groups in two sessions discussing possible research questions on
  - Real-world challenges at gas-electricity interface and/or benefits of integrated approach
  - Modelling approaches: status of model development (commercial models, research models), challenges with mathematical formulation, data sources
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<th>Participant</th>
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Degrees of freedom between gas and power

- Power plants using natural gas; including CHP
- Power-to-gas
  - Can utilize surplus of variable generation
  - Offers also seasonal storage
- Dual heat source (households, commerce, industry)
- Dual fuel gas compressors to increase flexibility; dual fuel de-compression pre-heaters
- Gas vs. electricity in future transport
Common constraints for gas and power

- Security of supply
- Greenhouse gas emission limits
- Weather:
  - Short term variability and uncertainty of wind/PV vs. gas price
  - Long term (annual/seasonal) variations in wind/PV/hydro and the storage capability of gas system; impact of climate change on power
Relevant time-scales

- Does gas need the fastest time scales?
  - The speed of light vs. gas flow speed → probably not, but where’s the boundary?
  - Minute level not required. Hourly modelling seems to be adequate.
- Dispatch
  - Gas more forward looking (hours to days ahead)
- Seasonal planning
- Investment planning / policy
Relevant geographical scales

- Natural gas is global through LNG setting the price and through partial substitubality with coal
- Power is regional, but fuel prices are often globally derived
  - Power grids have relatively clear boundaries that can be used to contain the analysis
- Gas grids are very integrated with geographically few sources and a very large number of sinks spread out much more evenly
- On general the European gas grid has little congestions at the moment, but there are some areas with local congestions
Research questions

- Market alignment for gas and electricity. How do you monetize the potential flexibility of the gas system?
- At what level you should handle the gas grid congestions? Regulatory or markets? Nodal prices for gas?
- Is a time step of one day good enough for gas in the future?
  - Smart metering, demand response for gas may have limited benefit. Could be useful in local issues or at a local level.
- When should linepack (gas compression in the gas grid) limits be included in the integrated dispatch level models?
  - Impact of linepack in transmission level is important for distribution level.
  - Gas grid distribution level hydraulic flow may be important, not so much at transmission level
- Will there be new technological challenges for operation of the gas network with increased variability? E.g. methane leaking of gas networks with more variable use?
More research questions

- Decreasing gas consumption due to:
  - More energy efficient appliances
  - Better insulation decreases
  - More variable generation
  - Coal prices low at least right now

- Can the gas grid deliver in the future, when gas will be used less?
  - How to pay for capital investments and for O&M?
    - Flexibility, capacity and energy payments?
  - How do you preserve something you might need in 20 years, the path to power-to-gas?
  - Would partial de-commissioning be an option?
  - Could we accept less reliability in the gas grid? Economic evaluation of combined power/gas reliability?
  - Where to socialize the cost of the ’underutilization’ of gas grid? Problem of allocation
Still increasing number of research questions

- What should be the role of power-to-gas in future?
  - How much gas grid we should have in that case?
  - Challenges in turning the gas grid to work two ways? Gas quality?
  - Industrial use of hydrogen?
  - How to transition?

- Storage capability of gas networks in Europe and the cost of expansion of storage capability?
  - E.g. UK approximately 1.5 days of use in the gas grid
  - Germany has separate storage of 60-90 days

- How to ensure security of supply in terms of institutional design? The role of markets and regulation.
  - Capacity/system adequacy during peak demand
  - Long term security of supply
  - Resilience of the system to interruptions is important
Almost infinite set of research questions

- Long term modelling issues / What are long term natural gas (fossil fuel) prices in the future?
  - Cost estimates for gas extraction are difficult
  - Prices might not reflect the cost due to strategic importance
  - Gas has a global scale price formation due to LNG trade
    - Models capable of analysing strategic behaviour are important
  - Greenhouse gas limits can drive gas/coal prices down
  - How do you realistically estimate gas prices because policy uncertainty is so important? High share of gas price is tax…
  - Extensive fuel price scenarios? Or just couple of reasonable relations between coal and gas prices?
  - Long term model useful for policy and planning analysis.
  - Can highlight consequences and inform policy

- Global models…
  - How to include variability (chronology)?
  - Global model are useful for gaining insight into trends and geopolitical (Policy makers)
  - Global models give endogenous prices
Modelling issues

- Solving to certain gap when gas/electricity have been combined can lead to less optimal power, since gas is easier to solve and can carry lot of weight in the objective function.

- Data availability and quality for gas?
  - ENTSO-G has good accessible data. Connecting power plants to certain pipelines is difficult.
  - The data integrity of gas demand? Residential demand data can be very difficult to get. Temperature dependency of gas demand?
  - Demand response for gas?

- Calculation times for integrated models?
  - For Ireland and Belgium, did not impact calculation time much (no physical line pack).

- Gas storage modelling is useful, existing techniques may be borrowed from hydro modelling.

- Less granularity could be better in order to perform more sensitivity
Modelling issues cont.

- How well a model with and without endogenous gas prices performs?
  - Doing ok on average and variance levels of power prices
  - Also power sector impacts on the gas prices (VG as a price driver)
- The advantage of integration is to find out dynamics
US lessons

- Totally different system due to the availability of shale gas
- Production cost of gas is important in US, whereas Europe that is not known (Russia)
- Could gas grid capacity become a constraint if there is rapid expansion of gas power plant capacity in Europe as well?
- Reference list of articles related to gas/electricity
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