ENERGY

Synergies between Gas and Electricity Networks and Markets

Christian Hewicker

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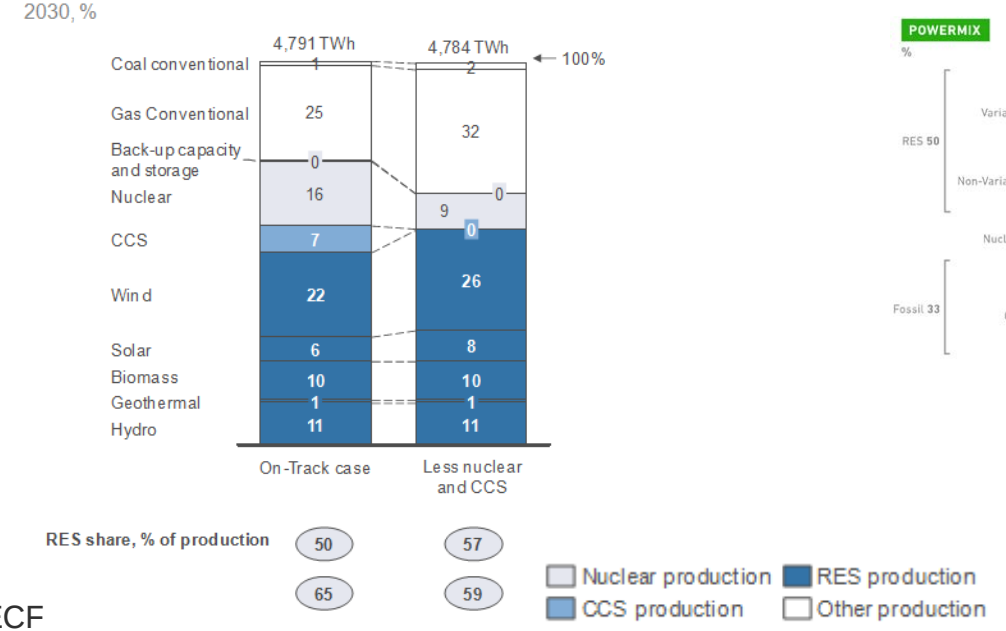
Impact of Power Sector Decarbonisation on European Gas Infrastructure:

Power Perspectives 2030 (2011)

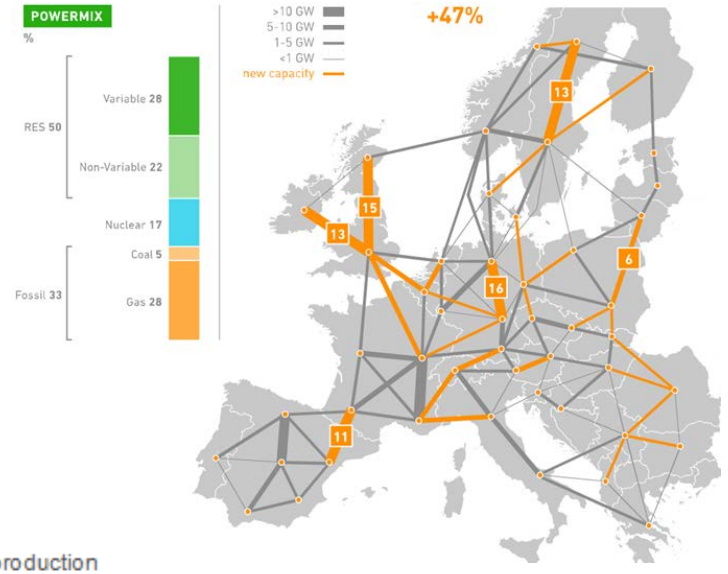
The ECF's Roadmap 2050 studies took a close look at feasibility and impact of decarbonising the European power sector

- Studies commissioned by European Climate Foundation (ECF) in 2010 and 2012
- Both studies were based on the assumption of the EU meeting its 20/20/20 targets and 2050 decarbonisation targets
- Detailed power system simulation were used to explore need for future development of generation structure and transmission network expansion

Generation structure 2030



Transmission expansion 2030



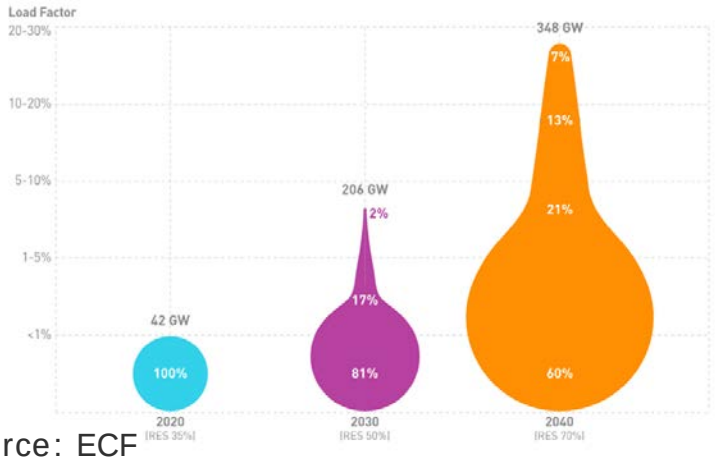
Source: ECF

Despite a much larger role of natural gas in the power sector, European gas consumption may stagnate or even decline

European gas infrastructure influenced by two opposite trends

Strongly growing need for back-up capacity…

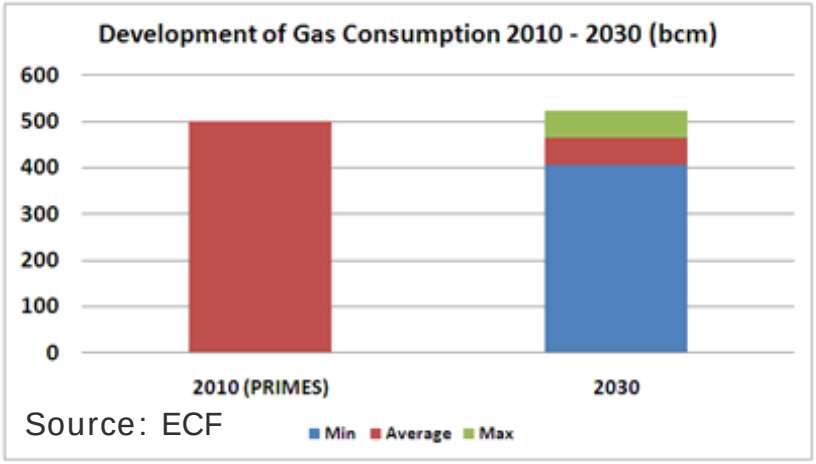
- Major growth of gas-fired generation in most scenarios (up to 80%)
- Coupled with major need for additional back-up capacity



Source: ECF

…but stagnating gas consumption

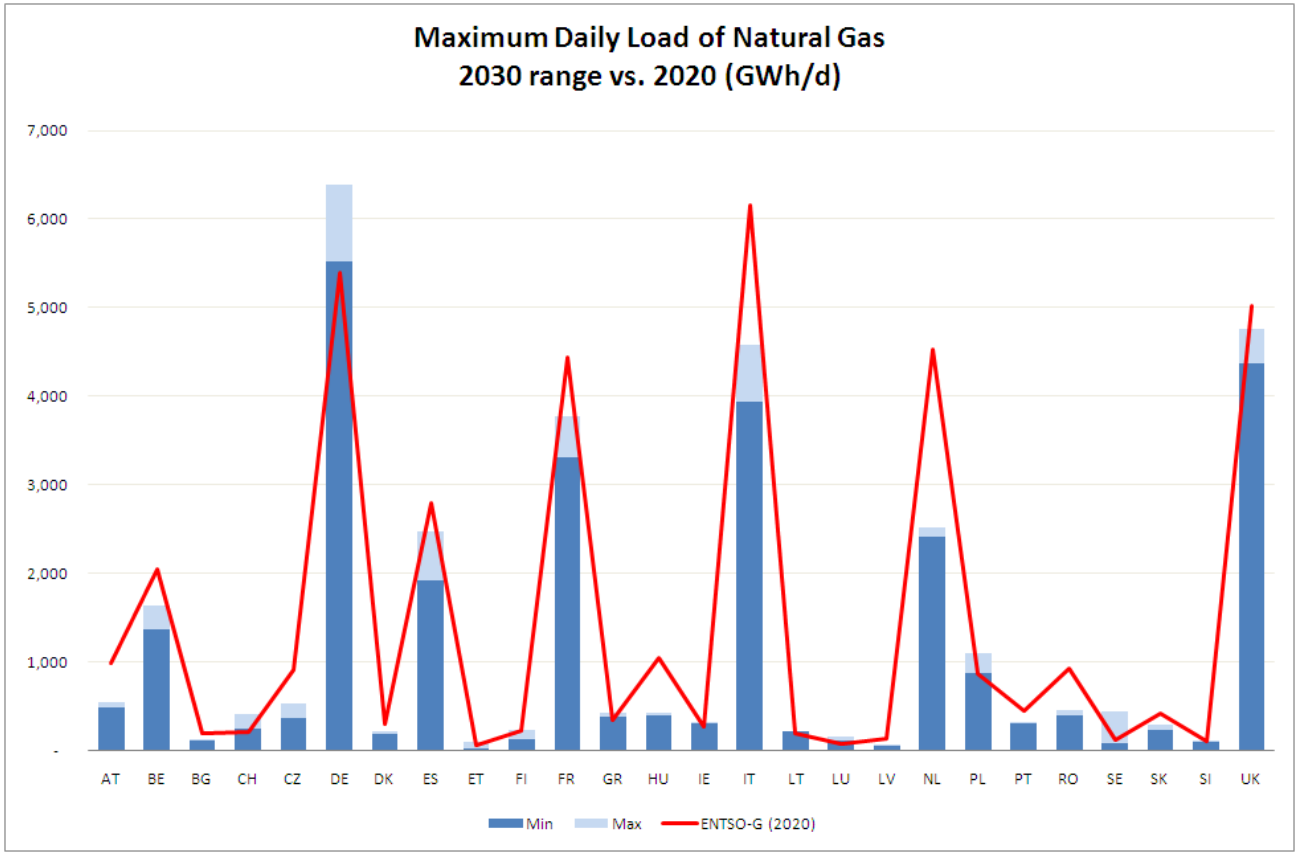
- European gas consumption is stagnating and at best declining
- Caused by decline of residential consumption (energy efficiency + fuel shift)



Source: ECF

Maximum daily demand generally stays at or below ENTSO-G forecasts for 2020, indicating decreasing use of gas infrastructure

Difference in daily gas demand vs. 2020 forecast by ENTSO-G
bcm, 2030



- Despite limited variations at the EU level, substantial variations in annual consumption exist at the national level
- Similar variations can be observed with regards to daily load (see left) and the maximum variation within a day
- Comparison to ENTSO-G forecasts indicates that planned infrastructure for 2020 is sufficient to supply 2030 in most countries

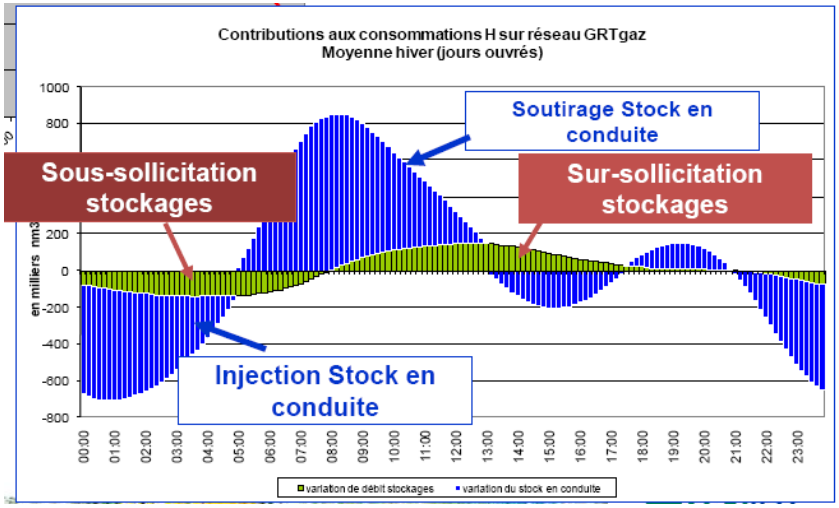
Source: ECF

Simulations show that variability of RES may cause major increase of diurnal flexibility in the gas sector

- Example of France shows a potentially very steep increase in maximum daily swing caused by volatile electricity production, even when neglecting:
  - Uncertainty caused by RES forecast errors
  - Need for local provision of flexibility

Situation today

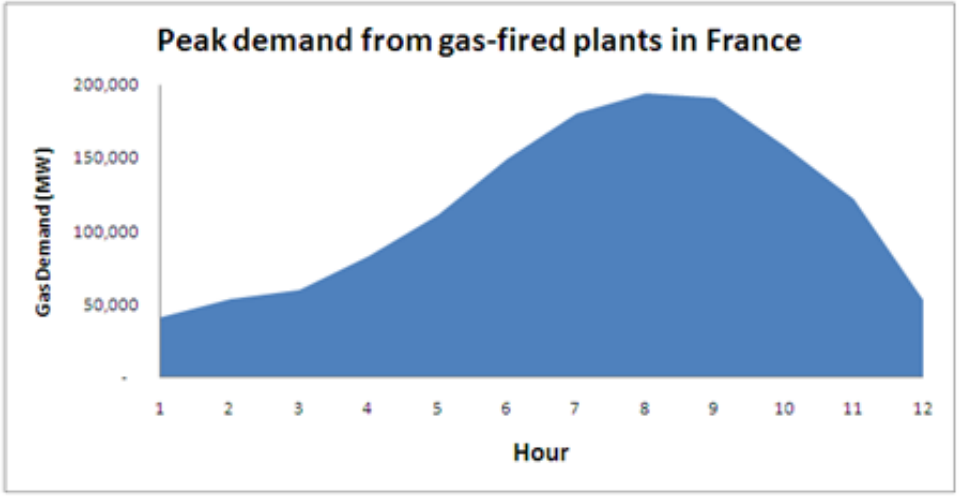
Daily swing of 1.5 million nm^3/h
(total demand, winter average)



Source: GRTgaz

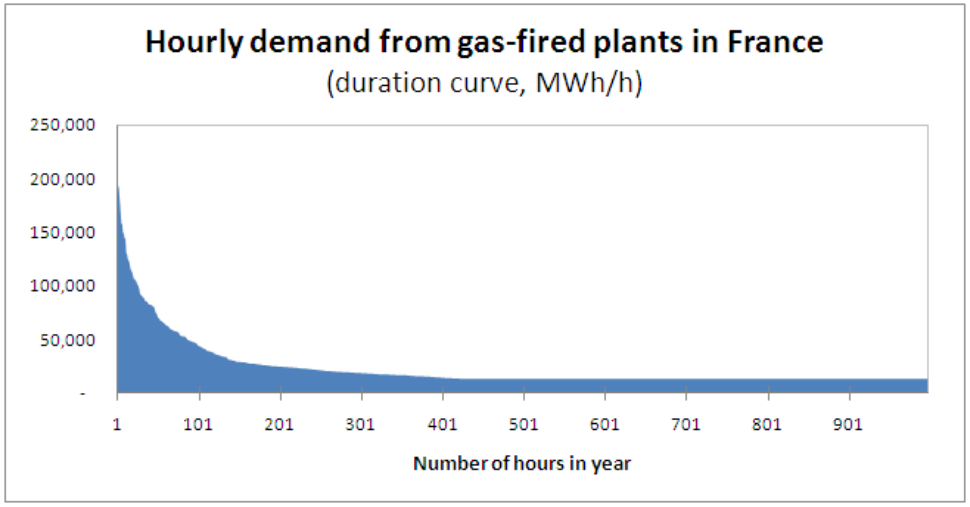
Forecast ECF 2030

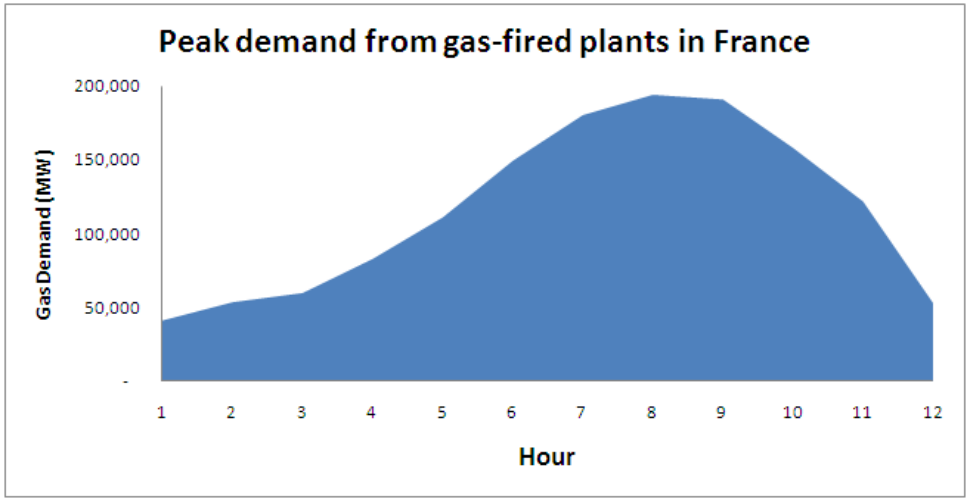
Daily swing of 13.5 million nm^3/h
(peak, excl. residential demand



Source: ECF

Are gas networks truly the best alternative for dealing with extreme but infrequent variability?





Source: ECF

- Much of the additional demand from power generation is caused by OCGTs with an annual utilisation of less than 100 hours
- Minimal load factor implies that it is not economic to invest into either gas infrastructure or additional electricity transmission lines
- From an overall economic perspective, these extreme cases appear to be more suitable for oil-fired OCGTs
- However, the much higher variable cost of oil-fired OCGTs will obviously have an impact on power market prices

Impact of variable RES on European gas and electricity market design?

European Gas and Electricity Balancing Study (2012)

Introduction to European Gas and Electricity Study (DG ENER)

Background

- Expect increasing penetration of renewable energy sources (RES) in the electricity sector
- Gas expected to play a major role to cover the new balancing needs driven by the development of intermittent RES in the near future
- Need to assess compatibility of balancing arrangements in both sectors, resolve potential barriers and identify further synergies to be gained

Objectives

- Identify options for exploiting synergies between gas and electricity balancing
- Analyse potential technical and economic benefits from identified options
- Propose key design elements for electricity and gas balancing markets to exploit synergies
- Propose a tentative roadmap for key design elements in gas and electricity balancing markets

Key Differences Between Gas and Electricity Balancing

- Balancing arrangements need to reflect different physical characteristics:
  - Need for immediate actions requires set of bespoke products in power sector
  - Inherent flexibility of natural gas network facilitates use of standard market products in the gas market

Issue	Electricity Sector	Gas Sector
Needs & objectives	Need to maintain system frequency within strict limits in real time	Inherent storage capability allows for certain range of operational pressures
Balancing process & time horizon	Focus on real time power balance and immediate actions	Focus on cumulative energy deviation and delayed actions (≥ 2 – 4 hours)
Products	Clear sequence of defined services over time	Use of tailor-made products next to commodity trading

Variable RES create challenges for the daily balancing process in three different dimensions

- Although the fundamental issues are similar in both sectors, they partially have a different impact on infrastructure use and needs

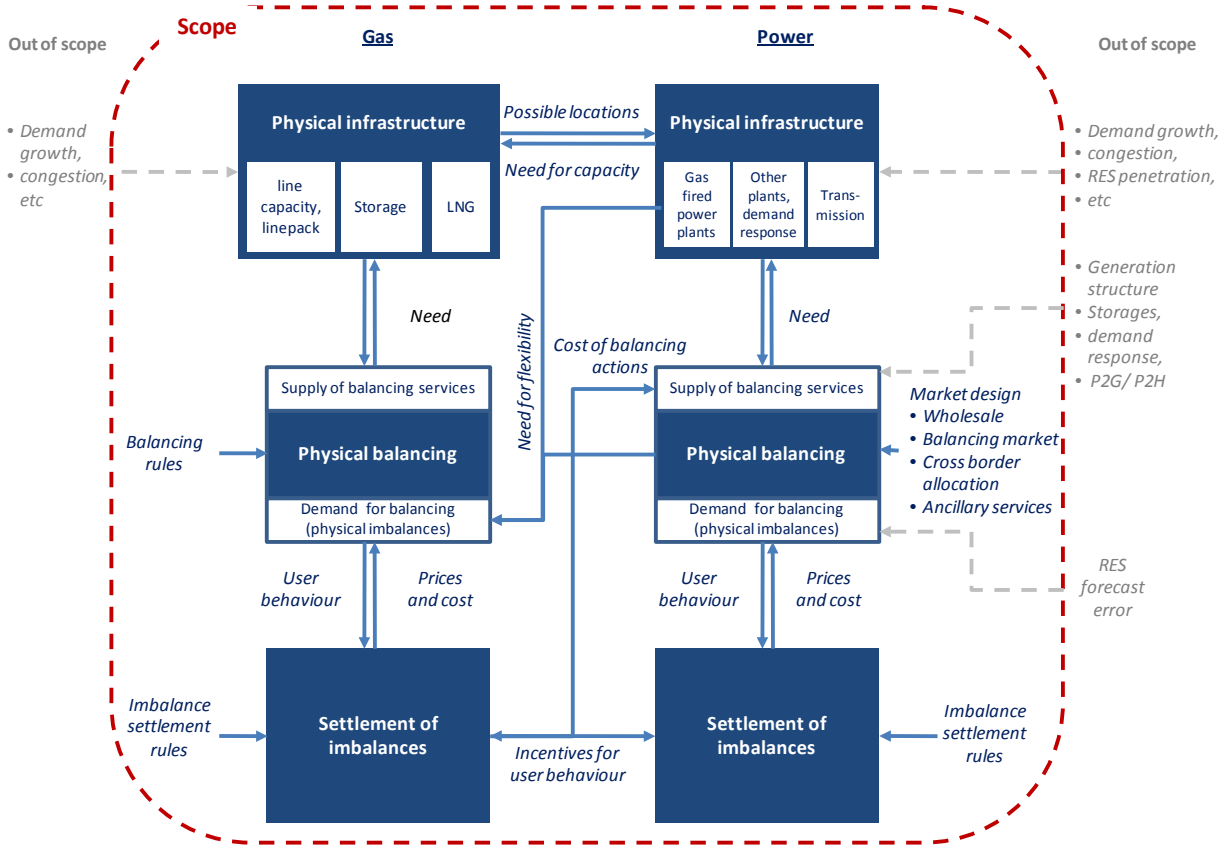
Electricity (Residual load)	Gas
Increasing spread between peak and trough load	Increased diurnal swing
Increased ramp rates	‚Slope' of within-day variations
Increased forecast errors	Additional forecast errors

Note: EGEBS did not consider various other requirements (such as need for sufficient firm capacity) or measures to physically enhance flexibility

Need to consider complex set of interactions in different areas

Different areas and drivers to consider

- Need to consider drivers and inter-dependencies in several areas:
  - Infrastructure
  - Physical balancing
  - Imbalance settle-ment and market arrangements



Overview of Potential Measures Considered by EGEBS

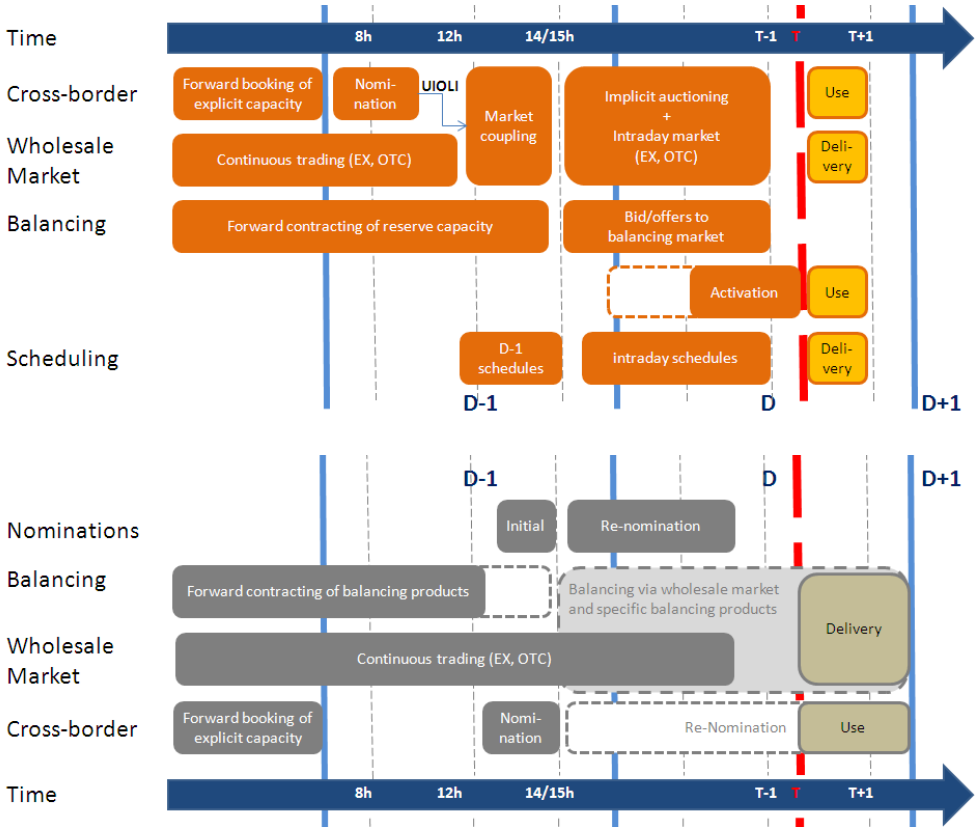
- EGEBS analysed a set of 10 potential measures
- Focus on measures that are related to the daily balancing process and that are not yet (fully) supported by evolving market arrangements

Group	Measure
Measures Related to the Electricity Market	Replacement of Day-Ahead Market Coupling by Intra-Day Capacity Allocation
	Regional Sharing of Operational Reserves
	Intra-day procurement of operational reserves
Measures Related to the Gas Market	Enforcement of firm exit capacities for system-critical power plants
	Inter-Zonal Exchange of Balancing Services by the TSOs
	Within-Day Inter-Zonal Capacity Products
	Within-Day Flexibility Products
	Improved linepack management
Common Issues for the Gas and Electricity Market	Coordinated network / system planning
	Coordinated operational planning

Possible changes to Timing of Market Processes?

- Current market arrangements characterised by different timing for trading of transport capacity, wholesale and balancing products => Scope for harmonisation?
- Even with timing and products, key physical effects will remain:
  - RES forecast errors until shortly before real time in electricity vs. time lag of several hours for physical measures in gas network
  - “Delayed response” of gas network to sudden changes ⇨ must not expose plants used for electricity balancing to excessive gas imbalance risks

Electricity Market



Gas Market

Reflections on Within-Day Flexibility Products

- Balancing actions in the electricity sector focused on last hour before real time
- Gas-fired plants may not be able to correct their position or hedge themselves in gas markets with WDO's, due to re-nomination rights
- Idea of tradeable flexibility product (similar to 'virtual linepack')
- Although promising on first sight, it also leads to some potentially serious risks
- Fundamental conflict between long-term reliability and short-term efficiency gains
- Overall, practical feasibility and efficiency of this option remain questionable

Advantages	Drawbacks / Limitations
• May improve economic efficiency by promoting market-based pricing of balancing resources in gas and electricity market • May signal risk of critical situations to the gas TSOs at an early stage	• Risk of artificial congestion • Scope for liquid markets? • Fundamental conflict between long-term and short-term value of flexibility • Lack of long-term remuneration for flexibility in the power sector vs. additional risks for reliability

EGEBS - Key Conclusions and Recommendations

- Study did not reveal any fundamental conflicts with current target models for both the gas and electricity market
- Although the EGEBS study did recommend several measures, these can largely be implemented within the scope and framework of the evolving framework of Framework Guidelines and Network Codes, and through decentralised actions
- Apart from possible changes in market arrangements, one key area of attention should be steps aimed at further improving the level of coordination for planning and operations between the gas and electricity sector

Interested in more detailed information?

- For further information see:
  - Power Perspectives 2030:

    www.roadmap2050.eu
  - European Gas and Electricity Balancing Study

    http://ec.europa.eu/energy/gas_electricity/studies/doc/20121220_ebegs_final_report.pdf

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Christian Hewicker
Senior Technical Advisor, Head of Section Energy Markets
T +49 228 44690-56
M +49 173 5151953
E christian.hewicker@dnvgl.com

www.dnvgl.com

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