



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

Participant	Institute
Adrien Saint-Pierre	University of Manchester
Christos Ordoudis	DTU
Daniel Burke	UC Dublin
Erik Delarue	KU Leuven
Jakob Peter	EWI Cologne
John Paul Deane	UC Cork
Juha Kiviluoma	VTT
Kai Heussen	DTU
Kenneth Bruninx	KU Leuven
Kenneth Van den Bergh	KU Leuven
Meysam Qardan	Imperial College London
Modassar Chaudry	University of Cardiff
Nico Keyaerts	Florence School for Regulation
Simeon Hagspiel	EWI Cologne
Stephen Clegg	University of Manchester
Steve Heinen	UC Dublin
Thomas Kallabis	Universität Duisburg-Essen
Waquas Ahmed Bukhsh	DTU

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.

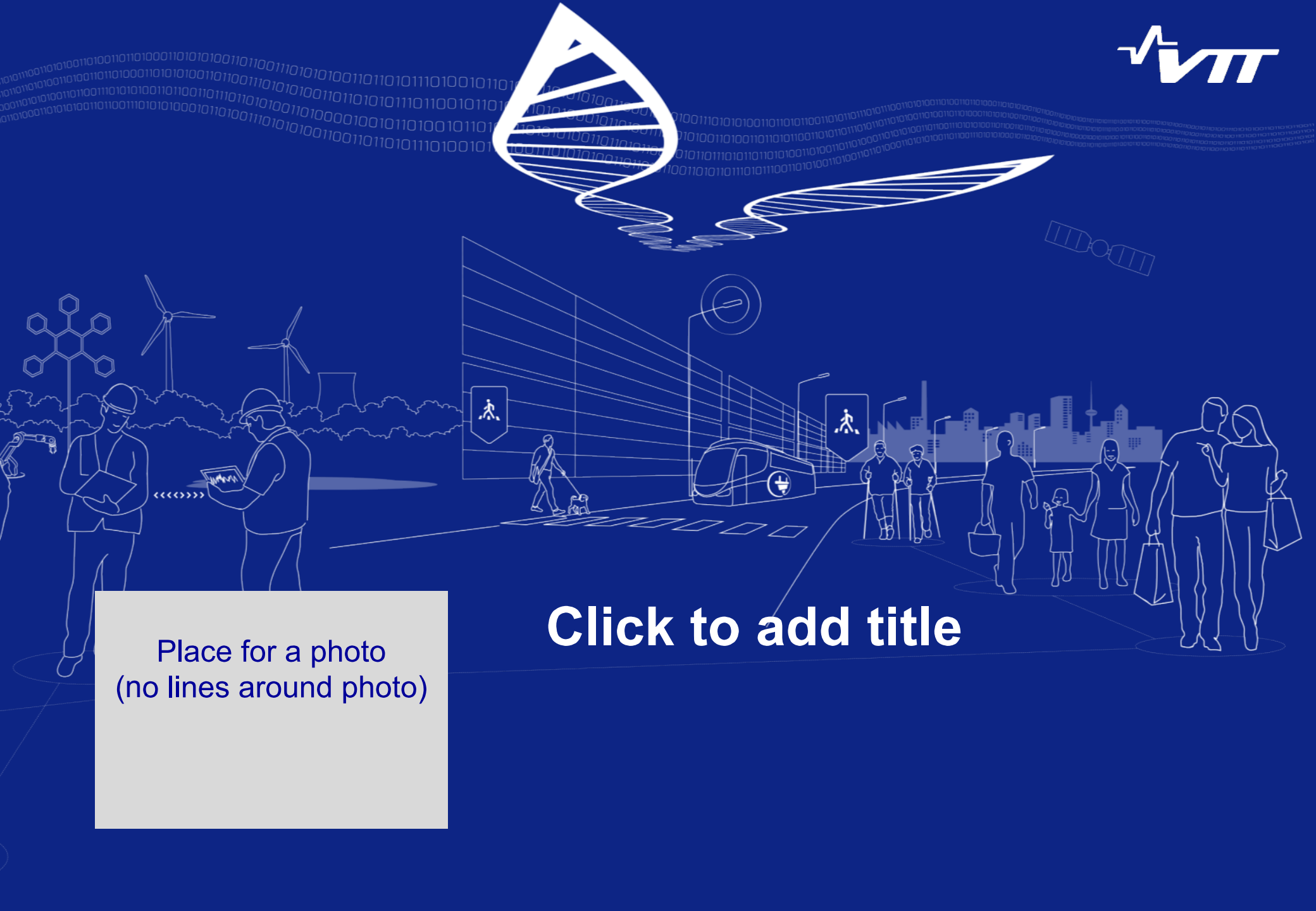
- How well a model with and without endogenous gas prices performs?
 - Doing ok on average and variance levels of power prices
 - Also power sector impacts on the gas prices (VG as a price driver)
- The advantage of integration is to find out dynamics

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?

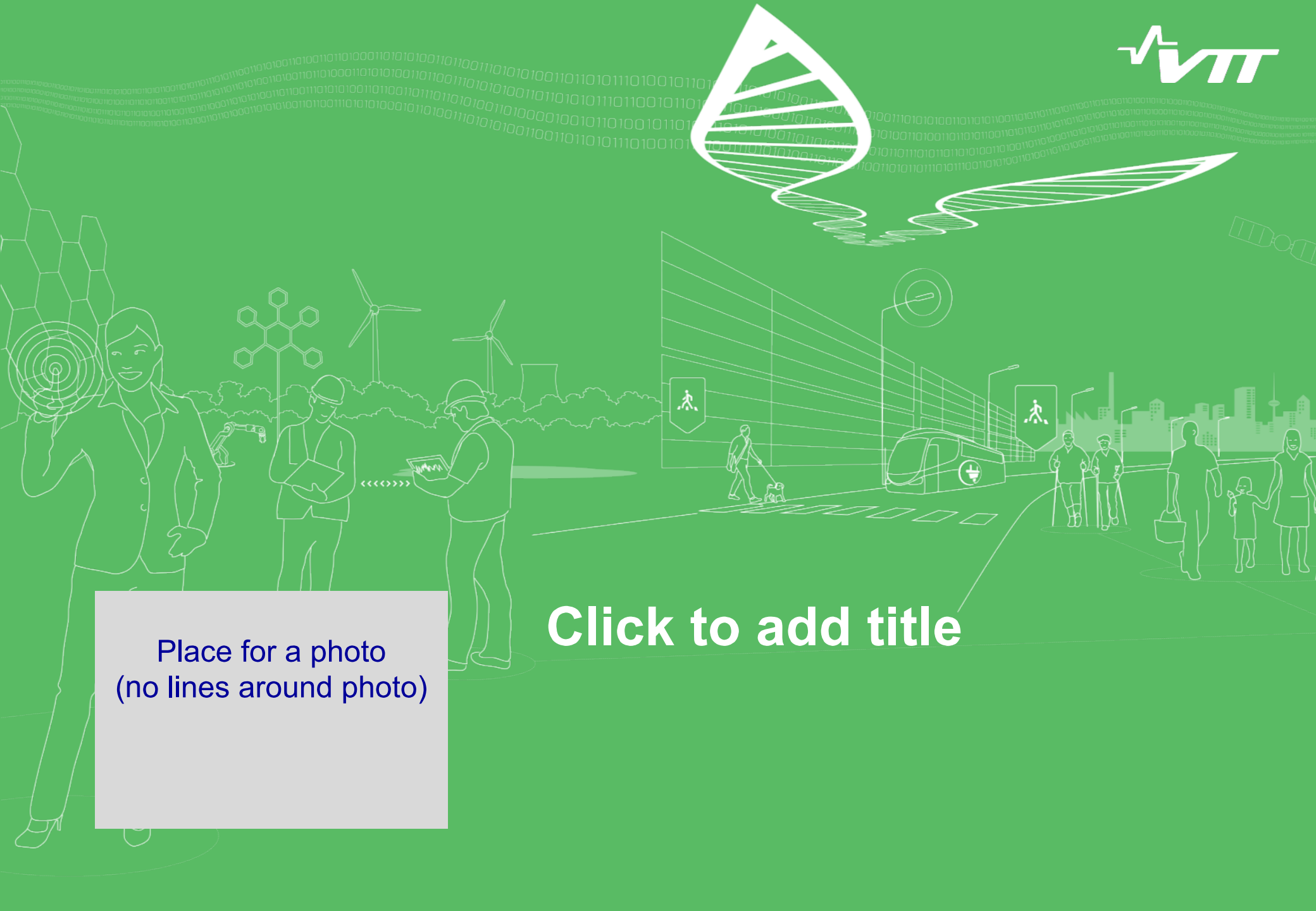
- Reference list of articles related to gas/electricity

		Short/Operational			Long/Planning	
		min	hours	days	season	years
Technical	Now					
	After 2025					
Market and regulation	Now					
	After 2025					



Place for a photo
(no lines around photo)

Click to add title



Place for a photo
(no lines around photo)

Click to add title



TECHNOLOGY «FOR» BUSINESS

