3rd Technical Workshop:
Gas Market Design and Natural Gas Transmission Grid Codes

The EU Experience of Gas Storage Operation. Technology, Market, Regulation.

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Vilnius, May 22nd, 2018
AGENDA

A. Overview of technology
B. Storage development in the European Union
C. Economic analysis – theory and EU practice
D. Regulatory approaches – theory and EU practice
E. The role of storage towards security of supply
OVERVIEW: WHAT IS STORAGE

• Storage activity performs injection of natural gas into facilities when supply > demand, and extraction (withdrawal) when demand > supply

• Usually the injection/withdrawal process is a seasonal cycle: injection during summer, and extraction during winter

• It is cheaper to store gas near markets than to build larger pipelines if production wells are “far away”

• Short-term cycles and non-cyclical operation driven by commercial opportunities are increasingly common, notably in advanced markets
OVERVIEW: TECHNOLOGY

• Facilities: underground geological formations (depleted oil/gas fields, aquifers, and salt cavities), LNG sites.
• Strong technical links with production activities (know-how, equipment, sites).
• Storage activity is characterized by:
  – medium-term horizon in development (2-6 years)
  – long-term horizon in operation (20-40 years)
  – high capital intensity
  – limited economies of scale
Storage site scheme (depleted fields or aquifers)
OVERVIEW: PERFORMANCES

• Storage facility performance: space, injection and withdrawal rates (deliverability)
• May increase performance by raising pressure within limits
• Deliverability also increases with more wells
• Peak deliverability falls as working gas is used up
  – Low deliverability at end of winter season
OVERVIEW: STORAGE TYPES

- Depleted fields: large space / slow injection and withdrawal
  - Depleted fields are by far the most dominant and cheapest if available
- Aquifers: similar, more costly
  - require larger investment, notably in non-recoverable gas needed to achieve reservoir pressure (base or cushion gas)
- Salt cavities: less space, faster injection and withdrawal
  - higher costs than other depleted fields and aquifers
- LNG: little space, slow injection, fast withdrawal (mostly used for peak shaving, short term cycling)
  - LNG facilities are far smaller by space but more flexible and fast
Storage plants by type in EU28, 2016:

### Working Gas (Bcm)

- Aquifer: 67.2
- Depleted field: 16.8
- Other: 15.2
- Salt cavern: 4.4

### Withdrawal capacity (Mcm/day)

- Aquifer: 914.7
- Depleted field: 631.9
- Other: 254.5
- Salt cavern: 78.6
OVERVIEW: STORAGE FUNCTIONS

• Flexibility / load management
  – Seasonal fluctuations
  – Demand peaks
  – Weekly cycle
  – Daily cycle

• Balancing of transmission networks

• Emergency reserve in case of supply failures

• Curbing price fluctuations (buffer role)

• Exploiting price fluctuations (commercial or speculative role)
COMPETING FLEXIBILITY TOOLS

• Production flexibility
  – most effective if close to market, e.g. in U.K., Netherlands
  – production wells are normally less flexible

• Import flexibility
  – most effective if close to market, e.g. from Norway into NW Europe
  – normally more expensive, but this may change for mature infrastructure

• Linepack
  – usually a substitute for short-term swings only

• Customer interruptions
  – notably of power producers, large industry
STORAGE AND OTHER FLEXIBILITY TOOLS IN ADVANCED MARKETS

• Virtual storage (or parking)
  – A market service offering similar performances but based on a combination of flexibility tools
  – Market players are interested in the performance of services rather than on how these are provided

• Spot gas markets
  – may provide flexibility services in a better way even if users do not know how

• Regulation of storage only - rather than of flexibility services - may distort the market and prevent innovation
POLICY ANALYSIS OF STORAGE: MAIN ISSUES

• Is storage adequately provided by markets?
• Is regulation necessary, or is there enough competition?
  – Between storage companies
  – By other flexibility services
  – Is regulated monopoly more efficient (cheaper) than under competition?
• Should some “strategic” inventories be mandatory to ensure security of supply?
DO MARKET PLAYERS PROVIDE STORAGE? (1)

• The private sector tends to provide seasonal storage to cope with demand fluctuations (*intrinsic value*):
  – as a function of winter-summer spreads
  – (in fact, also) as a function of available flexibility alternatives

• The private sector tends to provide (mainly fast, low-cost) facilities to cope with short-term market volatility (*extrinsic value*)
  – Mainly LNG tanks and salt caverns
Storage development in REGULATED and Negotiated regimes

Data in Million Standard Cubic Meters. Source: Gas Storage Europe
DO MARKET PLAYERS PROVIDE STORAGE? (2)

- Total EU available WG increased by 50% between 2006 and 2016 – whereas both consumption and production declined
- Similar development in regulated and negotiated regimes
- In some cases facilities are used mostly by foreign markets, e.g. Western Austrian sites by Germany
DO MARKET PLAYERS PROVIDE STORAGE? (3)

• In the past, several integrated companies provided relatively large storage capacity
  – May have overstated risk of supply cuts,
  – Could pass through costs to users

• Hence incumbents may have inherited lower cost facilities

• Newcomers may have invested more after market liberalization, as TPA to existing sites (controlled by incumbents) was difficult

• But, building facilities is only half of the story. They must be refilled every year!
WHAT DRIVES STORAGE FILLING?

- Winter/summer spread
  - Generally declining since 2007
- Hub price volatility
- Availability and costs of other flexibility sources
  - Part of production flexibility was recently lost in DE, NL, UK, DK
  - Expiration of long term contracts may reduce the opportunity to use import flexibility
- Legal storage obligations (policy measures)
REGULATION VS. COMPETITION

- Negotiated prices work only if competition is provided by other storage operators or other flexibility
- If substitutes are weak, TPA regulation is necessary
- Gas storage is a potentially competitive industry, but in practice it may be an essential facility
- Most European countries moved from high-market concentration to growing cross-border competition, as access to pipelines became easier
Most EU Member States have chosen Regulated TPA (12/19).
But MSs under Negotiated TPA have 67% of capacity.
Some countries have hybrid elements, e.g. negotiated access subject to security-related obligations (e.g. France, Czech Rep., Denmark).
MARKET DESIGN AND LEGAL REQUIREMENTS

• Storage has long been bundled with transport
• Bundled service may be more efficient but less transparent, discourage competition
• Few transmission operators still control storage (e.g., Italy, Spain, Belgium); most sites controlled by gas suppliers
• European Directive (2009/73/EC):
  – TPA to storage required
  – TPA may be negotiated or regulated
  – Legal, functional and administrative unbundling
• Guidelines of Good Practice issued by European regulators (non binding)
THE PRICE EVOLUTION

• If competition works, prices should converge

• Average prices of “bundles” up by 49% between 2004 and 2012 (based on 10 countries)
  – Some convergence achieved, dispersion decreased

• Higher prices for new, costly facilities (e.g. small salt caverns, aquifers)

• Low prices in some (but not all) Central & Eastern Member States, due to lower historical costs

• Some variability of prices (including for regulated sites) may be due to sharp differences in cushion gas valuation

• Regulated storage prices increased more, no longer cheaper (on average 5% more pricey than negotiated, as of 2012)
Storage prices in REGULATED and Negotiated regimes

Analysis limited to comparable sites and «bundled» products, i.e. annual storage with injection/withdrawal capacity aligned with average site performance
Source: REF-E, EC Project, 2015
LATE MARKET EVOLUTION

- Prices generally declined in the last five years
- Differentiated products increasingly offered
- Capacity more often allocated by auctions
- Prices of storage products sometimes related to W-S spreads
- Operators see reduced margins:
  - sometimes seeking regulatory protection
  - Some facilities mothballed due to lack of demand
SHOULD GAS STORAGE BE MANDATORY FOR SOS?

• YES:
  – Profit-oriented players may underestimate risk of supply disruptions
  – The visible (intrinsic+extrinsic) value of storage is only a part; insurance value neglected
  – Security of supply burden may fall on consumers

• NO:
  – Storage obligations are expensive, and risk is often overstated by authorities
  – Suppliers are interested in keeping flows going and will properly insure against outages
  – Strategic storage & obligations may be ineffective as some commercial storage is “crowded out”
STORAGE-RELATED SECURITY OF SUPPLY MEASURES

- Storage obligations: Minimum levels to be filled by suppliers and/or TSOs, usually before winter season
  - Required in ES, FR, DK, PL, SK, HU, BG, CZ
  - Mandatory inventories not for general market usage
- Strategic storage: separate sites/volumes controlled by government
  - Required in IT, HU
- In other countries, reserve role is played by commercial rather than strategic storage
## STORAGE-RELATED SECURITY OF SUPPLY MEASURES: SELECTED EXAMPLES

<table>
<thead>
<tr>
<th>Member State</th>
<th>Total mandatory storage obligation (Latest available, TWh)</th>
<th>Total strategic storage (Latest available, TWh)</th>
<th>Total mandatory storage (% of 2013 consumption)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0,0</td>
<td>0,0</td>
<td>0%</td>
</tr>
<tr>
<td>Germany</td>
<td>0,0</td>
<td>0,0</td>
<td>0%</td>
</tr>
<tr>
<td>United Kingdom</td>
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<td>0%</td>
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<td>Czech Republic</td>
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<td>Poland</td>
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<td>0,0</td>
<td>5%</td>
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<tr>
<td>Denmark</td>
<td>2,3</td>
<td>0,0</td>
<td>5%</td>
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<tr>
<td>Spain</td>
<td>18,1</td>
<td>0,0</td>
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<td>France</td>
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<tr>
<td>Hungary</td>
<td>23,8</td>
<td>12,6</td>
<td>24%</td>
</tr>
</tbody>
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Source: REF-E and others on behalf of EC, 2014
COULD MORE STORAGE REDUCE COSTS OF CRISES? (1)

- ENTSOG (2014) “Stress Test” study shows that in the worst analyzed scenarios (6 months without Russian gas, followed by a cold spell):
  - LNG plays largest role in matching disruption (33%)
  - followed by storage (28%)
  - Total gas deficit: 22%, almost entirely covered by more costly fuels
  - In case of crisis, LNG and other spot prices tend to increase and stay high

Japan (Fukushima) 2011-12

Ukrainian crisis, January 2009
COULD MORE STORAGE REDUCE COSTS OF CRISES? (2)

• Using more gas purchased before the crisis at lower prices
• Larger storage endowments tend to soften price spikes
• EC Study (by REF-E and others, 2015):
  – Calculated costs and benefits of extending Storage Measures for SoS throughout the EU
  – Costs of generalized Storage obligations and strategic storage are always larger than probability-weighted benefits at EU level, even for high assumed probabilities (5% prob. of all-Russian disruption)
THANKS FOR YOUR ATTENTION!

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