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# **3<sup>rd</sup> 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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VIS Consultants

Vilnius, May 22<sup>nd</sup>, 2018



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## 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



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## 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



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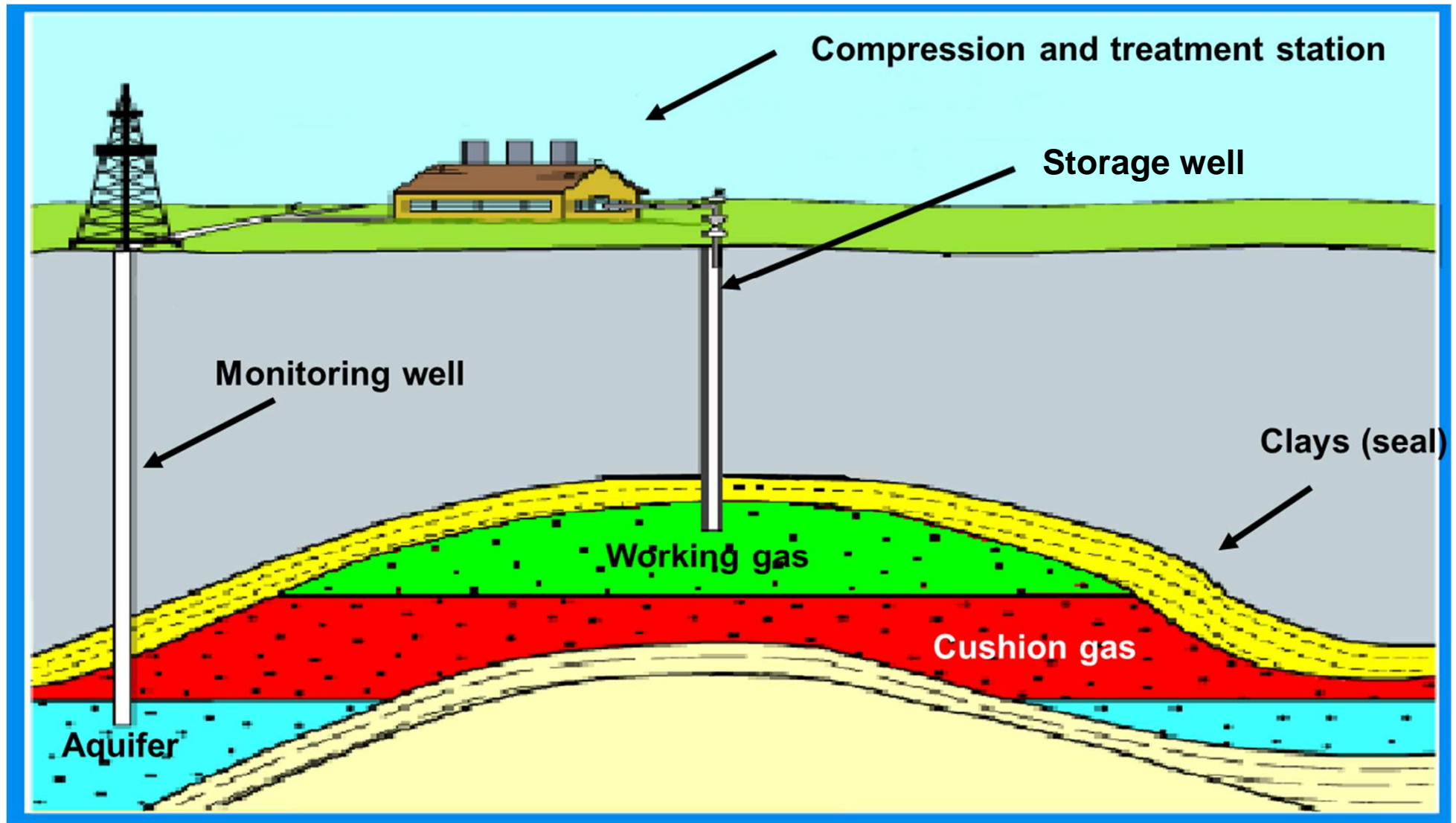


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## OVERVIEW: TECHNOLOGY

- 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)





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## 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





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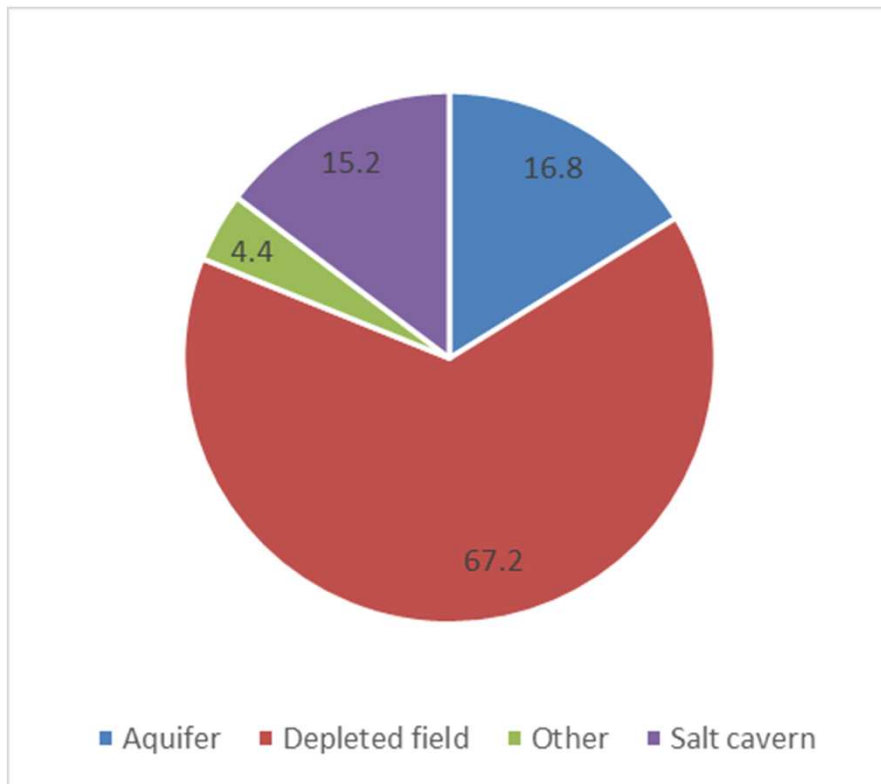
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## OVERVIEW: STORAGE TYPES

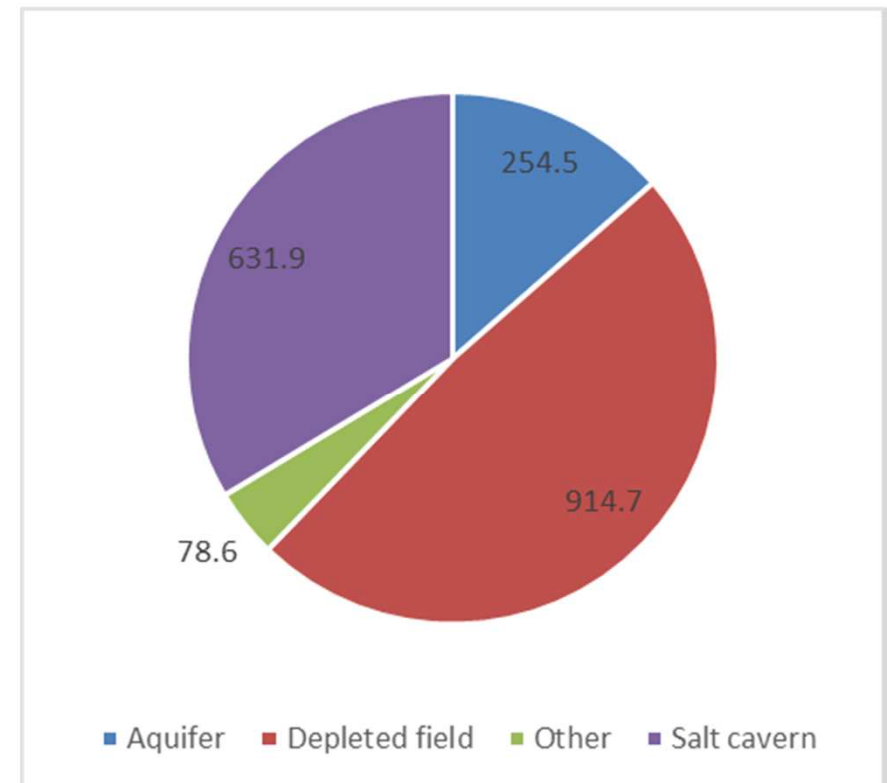
- Depleted fields: large space / slow injection and withdrawal
  - Depleted fields are by far the most dominant and cheapest if available
- Aquifers: similar, more costly
  - require larger investment, notably in non-recoverable gas needed to achieve reservoir pressure (base or cushion gas)
- Salt cavities: 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)



### Withdrawal capacity (Mcm/day)







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## 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)



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## 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



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## 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



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## 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?



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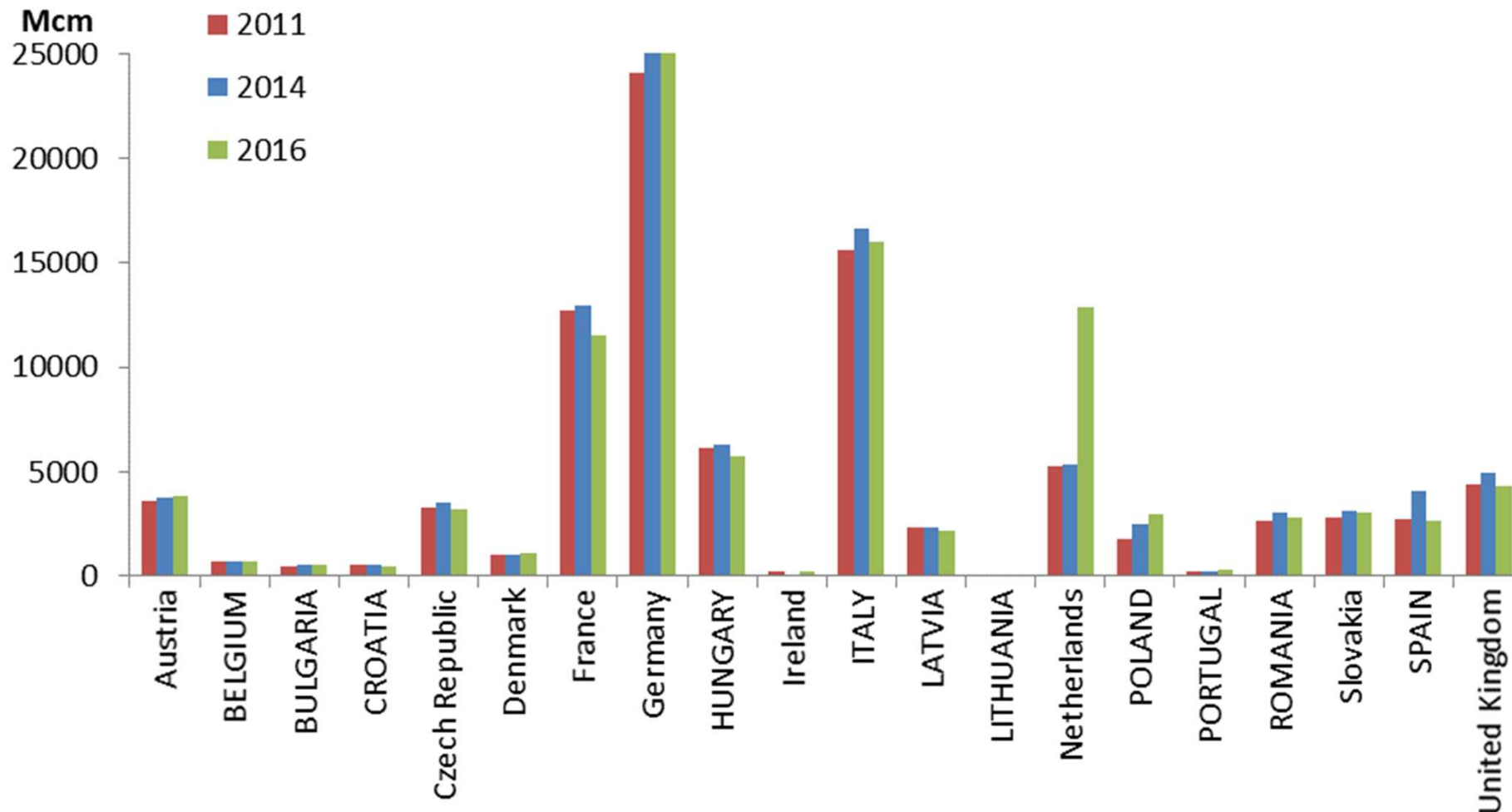
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## DO MARKET PLAYERS PROVIDE STORAGE? (1)

- 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





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## 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



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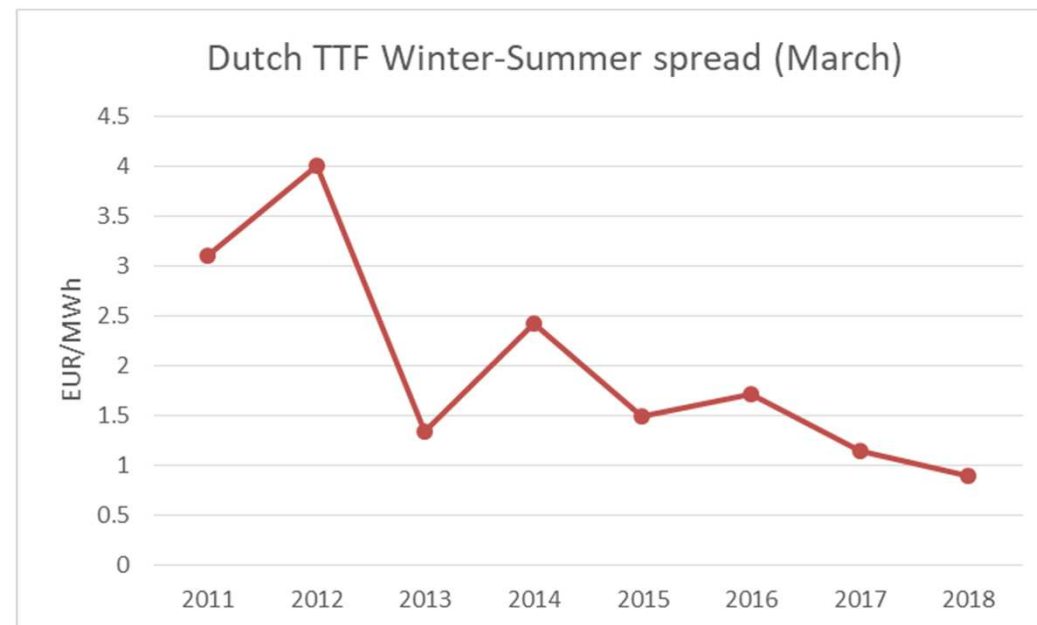
## DO MARKET PLAYERS PROVIDE STORAGE? (3)

- 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)





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## 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

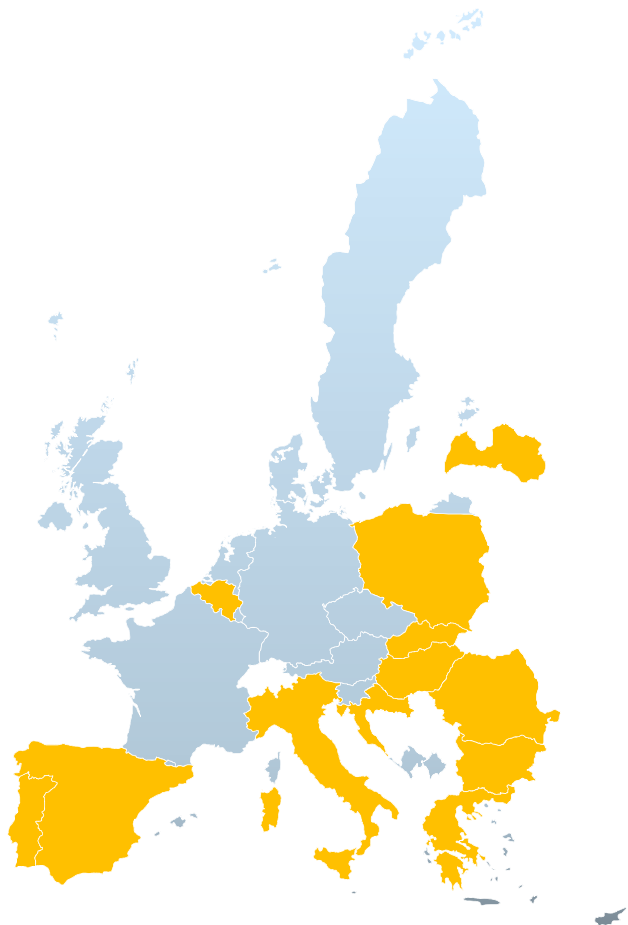


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## REGULATORY REGIMES



- 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)



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## 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)





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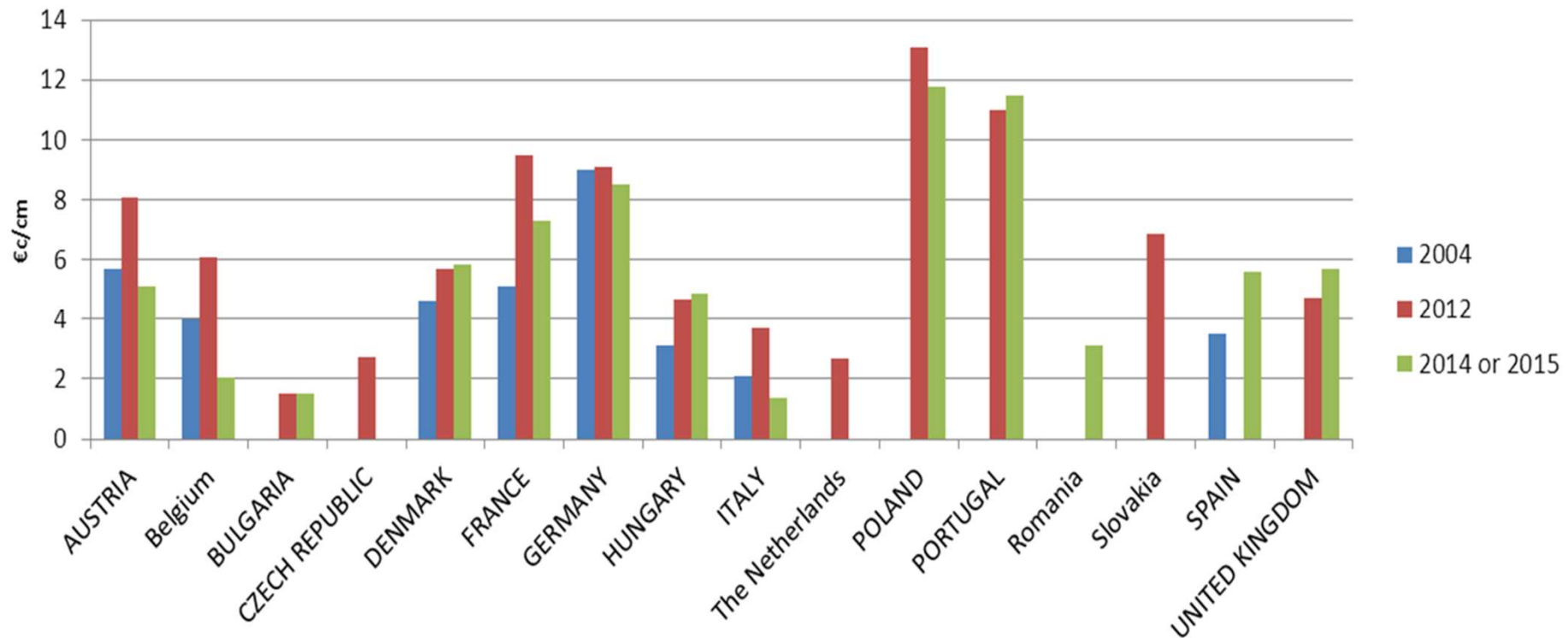
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## THE PRICE EVOLUTION

- 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



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## 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

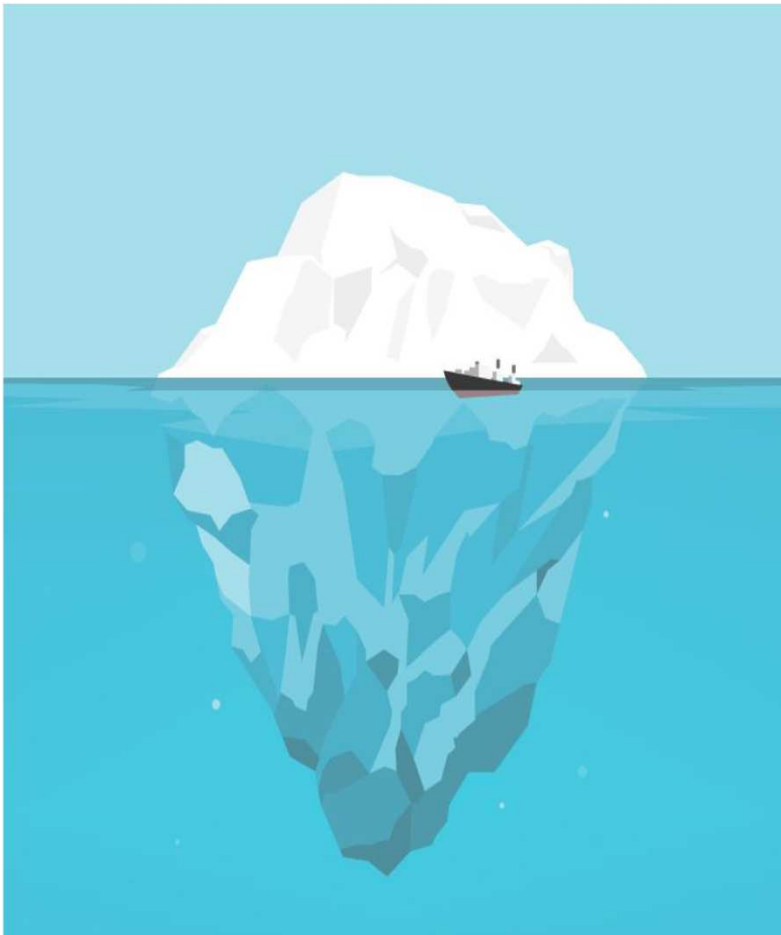


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## SHOULD GAS STORAGE BE MANDATORY FOR SOS?



- 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”



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## 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

Member State	Total mandatory storage obligation (Latest available, TWh)	Total strategic storage (Latest available, TWh)	Total mandatory storage (% of 2013 consumption)
Austria	0,0	0,0	0%
Germany	0,0	0,0	0%
United Kingdom	0,0	0,0	0%
Czech Republic	2,3	0,0	3%
Poland	9,3	0,0	5%
Denmark	2,3	0,0	5%
Spain	18,1	0,0	5%
Italy	0,0	48,3	7%
Bulgaria	2,6	0,0	9%
France	97,9	0,0	20%
Hungary	23,8	12,6	24%

Source: REF-E and others on behalf of EC, 2014

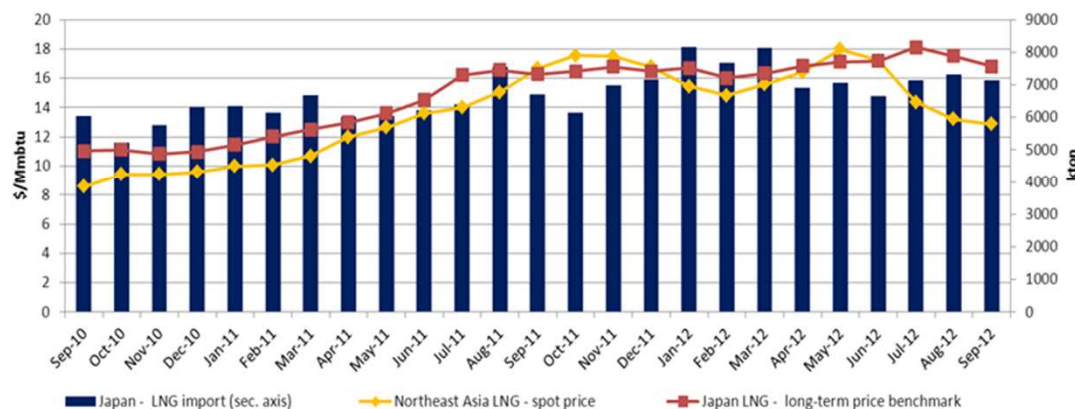




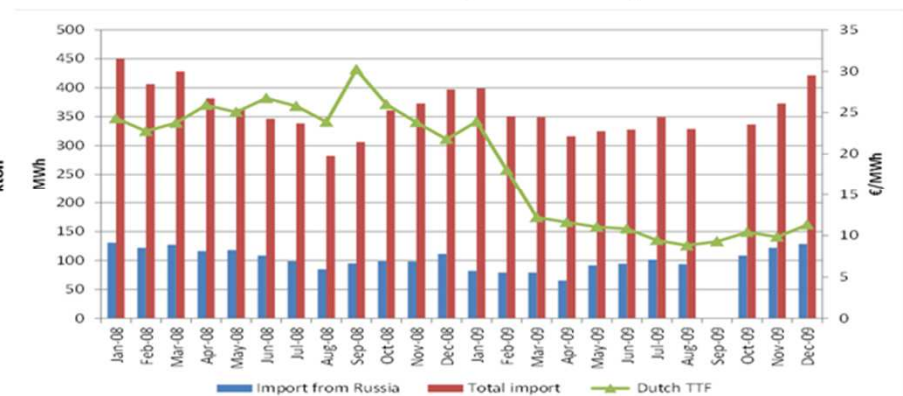
## COULD MORE STORAGE REDUCE COSTS OF CRISES? (1)

- 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





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## 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)



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**THANKS FOR YOUR ATTENTION!**

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