Balancing Study

Shipper's Meeting
December 20, 2011

Presentation of Interim Results

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Vienna, December 20, 2011

Experience you can trust.

Agenda

- General and Regulatory Background
- Country Comparison
- Network Simulations
- Status Quo and Further Progress

General and Regulatory Background

Requirements for (within-day) balancing result from a number of issues, mainly related to deviations between inputs and off-takes

- Balancing is required to maintain network integrity, i.e. to ensure that pressure ranges remain within acceptable operational limits
- Need for balancing may be triggered by several issues:
  - Difference between planned/expected and actual input / off-take
  - Diurnal profile of consumers
  - Diurnal profile of exchanges with neighbouring market areas
  - Network constraints within the market area [(a)]
  - Quality issues [(b)]

[(a)] – Relevant for network operators; [(b)] – Not considered in this study

General and Regulatory Background

Balancing arrangements must strike a balance between the objectives of cost-reflectiveness and the need for a liquid market

- Different balancing periods have been advocated in practice:
  - Hourly balancing – since imbalances are caused by hourly deviations
  - Cumulative balancing – given that network pressure is impacted by the cumulative imbalance over time
  - Daily balancing – in order to ensure compatibility with daily trading products
  - Ideally, the balancing period should furthermore correspond to the average transport time in a given market area – which does however vary widely between countries and networks
- On the market side, it is also important to note that shippers may not have access to required sources of flexibility (or not on reasonable terms)

General and Regulatory Background

Overall requirements on gas balancing rules defined by Article 21 of Regulation (EC) No 715/2009 (Gas Regulation)

- Article 21 of the Gas Regulation stipulates that balancing rules:
  - Shall be fair, non-discriminatory, and market-based;
  - Shall be based on objective criteria and market principles;
  - Reflect the resources available to the TSO.
- In addition, Article 21 requires that TSOs:
  - Provide sufficient, well-timed and reliable information on the balancing status of users to enable network users to balance (Article 21, 2);
  - Apply imbalance charges that are cost-reflective to the extent possible, whilst providing appropriate incentives on network users for balancing (Article 21, 3);
  - Endeavour to harmonise and streamline balancing structures and imbalance charges in order to facilitate gas trading (Article 21, 4).

General and Regulatory Background

Further principles have been detailed by the "Framework Guidelines on Gas Balancing in Transmission Systems" [(a)]

- Framework Guidelines (FG) have been developed by ACER in accordance with Article 6(2) of the Gas Regulation
- Framework Guidelines define main principles with regards to:
  - Roles and responsibilities of network users and TSOs
  - Buying and selling of flexible gas and balancing services by TSOs
  - Balancing period and nomination procedures
  - Imbalance charges
  - TSO information provision obligations
  - Cross-border cooperation
- Provision of the FG to be detailed by ENTSO-G Network Code

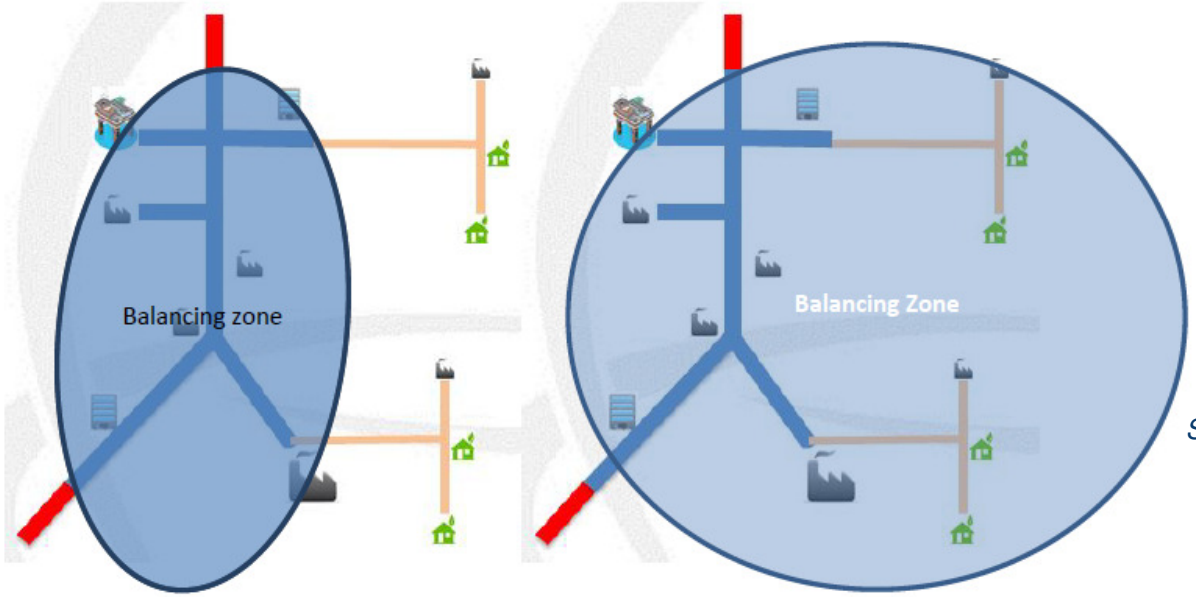
[(a)] - FGB-2011-G-002, 18 October 2011

General and Regulatory Background

A Balancing Zone may consist of more than one system and is balanced by the combined actions of network users and the TSO.

Only the entries from storage and LNG into the transmission system as well as the exits from the transmission system into storage are part of the balancing zone.

Distribution systems may be part of the balancing zone.

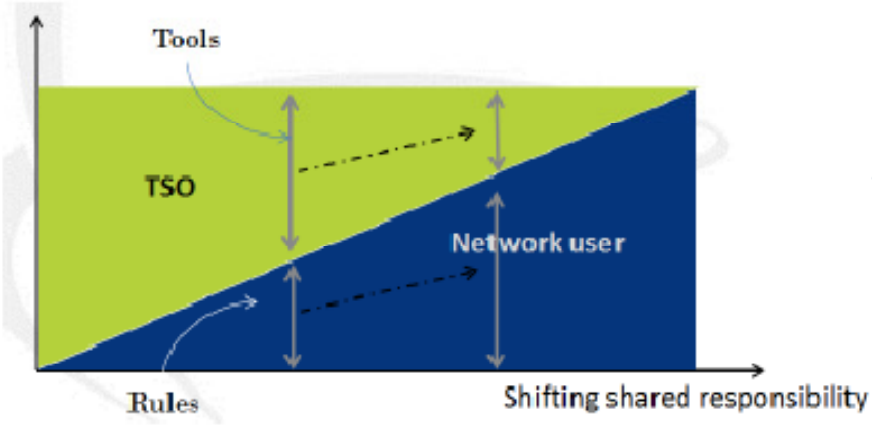


Source: ENTSO-G. Gas Balancing Launch Documentation BAL0125-11

- The framework guidelines on gas balancing are established for gas transmission systems.
- The Network Code to be developed by ENTSO-G will be based on a balancing zone which can be solely a transmission system or include distribution systems.

General and Regulatory Background

Roles and responsibilities for balancing to be shared between TSOs and network users in accordance with market development^^



Source: ENTSO-G. Gas Balancing Launch Documentation BAL0125-11

- Network users take primary responsibility for balancing their portfolios by matching their inputs and off-takes during the balancing period
- Both network users and TSOs shall have access to a traded market, based upon a virtual trading point within an exit/entry system
- Role of the TSO in gas balancing shall be minimized through incentives for network users to balance their inputs and off-takes

General and Regulatory Background

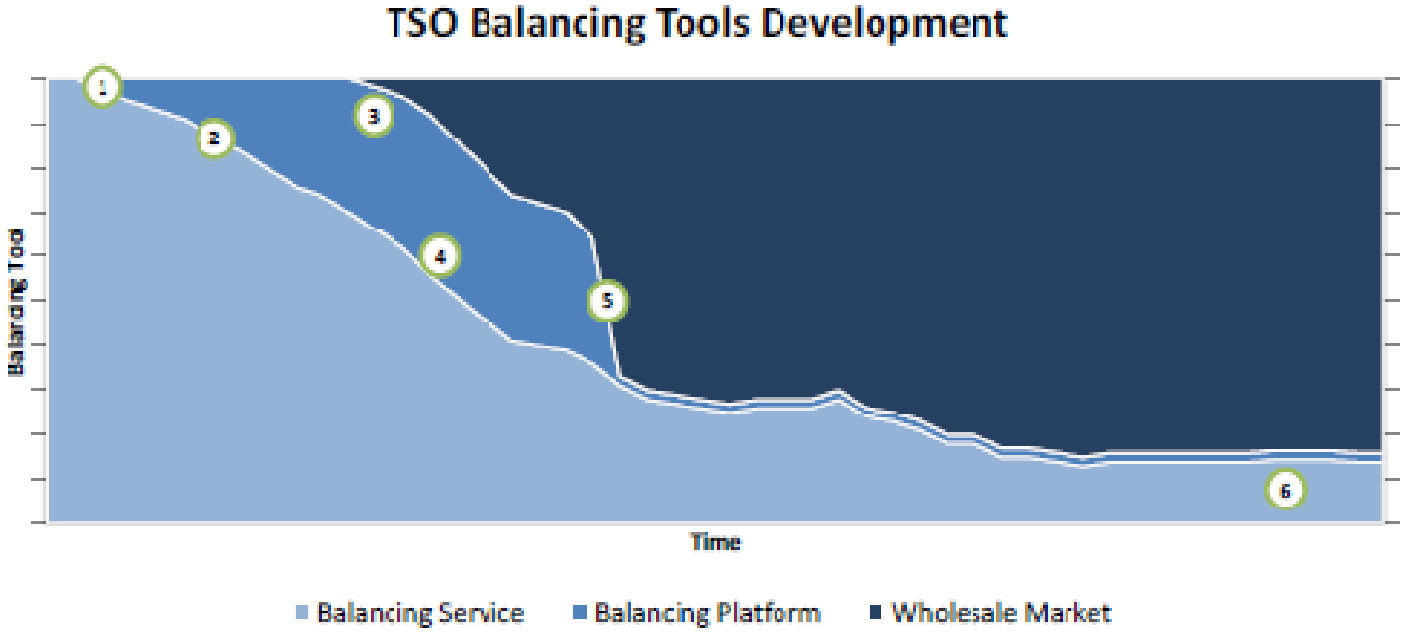
TSOs need to be able to buy and sell gas but may also be entitled to buy specific balancing services

- TSOs are generally entitled to buy and sell flexible gas and, where necessary, also other 'balancing services'
- TSOs are required to procure flexible gas and balancing services:
  - With a view to minimizing the cost of balancing the system
  - Through the general wholesale gas market where possible, although dedicated balancing platforms may be used for an interim period
  - By giving preference to within-day products
  - By using standardized products as far possible
- TSOs shall be cost neutral in relation to their balancing activities
- NRAs may incentivize TSOs to procure efficiently

General and Regulatory Background

FG acknowledge the need for balancing services and separate balancing platforms, at least as a transitional step

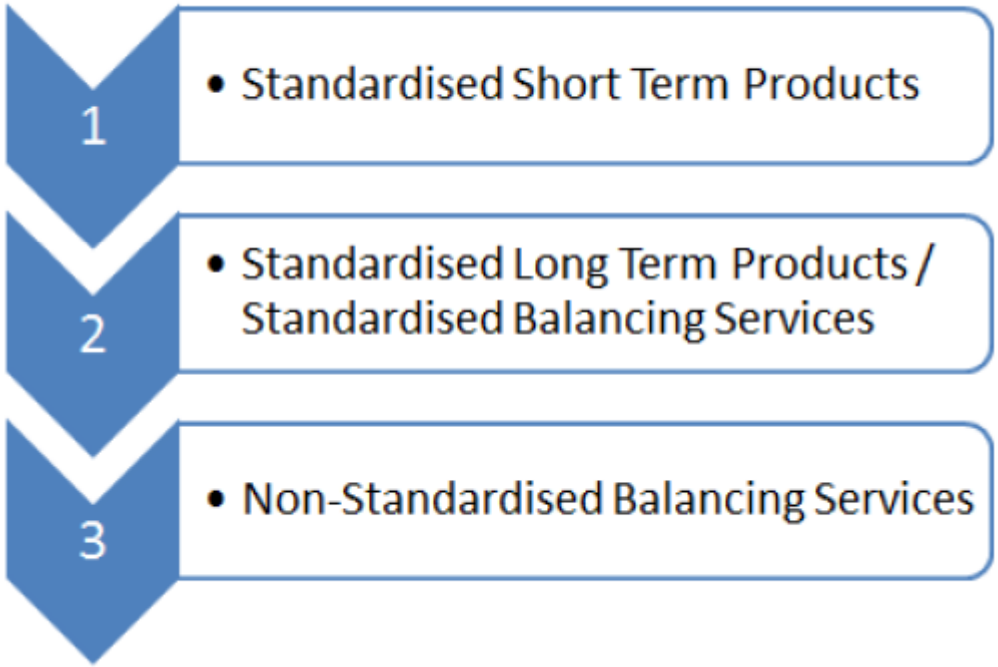
- Clear preference for procurement through general wholesale market
- However, balancing platforms may be required, e.g. to develop liquidity
- Balancing services ideally to be limited to temporal / locational constraints



Source: ENTSO-G. Gas Balancing Launch Documentation BAL0125-11

General and Regulatory Background

Based on the FG, ENTSO-G furthermore assumes a clear priority for the use of different mechanisms for daily balancing



Source: ENTSO-G. Gas Balancing Launch Documentation BAL0125-11

General and Regulatory Background

Framework Guidelines require introduction of standardized daily balancing period with financial cash-out at the end of the day

- Balancing Period is defined as a daily interval equivalent to the gas day (i.e. 5:00 to 5:00 UTC in “winter” and 4:00 to 4:00 UTC in “summer”)
- Imbalance settlement shall be based on financial cash-out at the end of each balancing period:
  - Network users are settled for any deviations between their inputs into and off-takes from the balancing zone;
  - Network users are subject to imbalances charges based on the deviations;
  - Imbalance quantities shall be financially settled at the imbalance price to determine the network users imbalance charge; and
  - Each network user’s portfolio position shall be reset to zero.

General and Regulatory Background

To provide proper incentives for balancing, TSOs may impose within-day obligations, but within the framework of daily balancing

- TSOs may impose additional within-day obligations on network users only in case balancing actions are required during the day
- Within-day obligations may be introduced with a view to ensuring system integrity and minimizing the need for balancing actions by the TSO, subject to the following conditions:
  - Requires provision of sufficient information to network users in order to enable them to comply with such obligations
  - TSO may impose a charge for failing to meet such within-day obligations
  - However, such charges must not undermine the principle of a daily balancing regime and shall only be a “small proportion” of any imbalance charges
  - Obligations must not create undue barriers to cross-border trade or new entrants

General and Regulatory Background

Tolerances can be introduced as an interim step where network users do not have access to a liquid short-term wholesale gas market.

- Generally foreseen only where TSOs do not procure balancing gas through general wholesale market
- Tolerances available for network users should meet the following criteria:
  - To reflect system flexibility and user needs
  - Imbalances within tolerances may or may not be free of imbalance charges
  - Possible differentiation by categories of network users, but should not discriminate in particular against network users with smaller gas portfolios
- Note trade off between enabling easy access for new small entrants and common treatment for all network users.

General and Regulatory Background

Imbalance charges shall be generally based on price of balancing gas, although administered prices or proxies for market prices may be used

- FG establish several conditions on imbalance charges:
  - To be related to the cost of balancing gas (where possible)
  - Shall provide incentives on network users to balance their portfolios
    BUT: Avoid barriers for entry or development of competitive markets
- Where balancing gas is procured through a public market platform, imbalance charges shall be set on the marginal price of balancing gas (weighted average of gas traded in case no balancing gas was needed)
- In an interim period, imbalance charges may be based on an administered price or a proxy for market prices
- Imbalance charges may include a “small adjustment” to incentivize network users to balance their portfolios

General and Regulatory Background

Summary of main requirements resulting from the Gas Regulation and the Framework Guidelines on Gas Balancing

- FG establish the following key requirements of particular relevance for the future Austrian balancing system:
  - Balancing zone shall cover at least one entire entry-exit zone (may or may not include distribution)
  - Requirement of daily balancing with financial cash-out
  - Option of additional within-day obligations, but:
    - Only possible where balancing actions are required during the day
    - Charges to remain 'small' in relation to imbalance charges at end of day
  - Imbalance charges to be based on marginal costs of balancing gas (where procured through public market platform)
  - Avoid discrimination against new entrants and/or small network users

General and Regulatory Background

Within the context of the FG, the new Austrian Gas Act includes more specific requirements for the future gas balancing arrangements

- Imbalance settlement for distribution zones to be carried out by balance group coordinator (GWG §87)
- Potentially different balancing arrangements for transport grid (e.g. GWG §62, Abs. 1, lit. 30)
- DSO responsible for procurement of balancing gas at the VP via the balance group coordinator (GWG §18 Abs. 1, lit. 8, 22)
- Preference for procurement of balancing gas at the VP (§18 Abs. 1, lit. 8)
- Balancing gas shall preferably be procured via the balance group coordinator (GWG §18 Abs. 1, lit. 22)

Agenda

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- Status Quo and Further Progress

Country Comparison

Analysis has covered current balancing arrangements in eight other European countries, many of which have experienced recent changes

- Apart from neighbouring countries, the analysis of balancing arrangements has also been extended to France and the Netherlands
  - Czech Republic (procurement from wholesale market since 2010)
  - France
  - Germany (transition to daily balancing in 2008)
  - Hungary (start of balancing platform in 2010)
  - Italy (start of balancing platform in 2012)
  - The Netherlands (new system as of 2011)
  - Slovakia
  - Slovenia (new system in 2012?)

Country Comparison

Except for Austria and the Netherlands, all other countries apply daily balancing, in some cases with hourly or cumulative incentives

	Balancing period			Within-day	Comments
	Hourly	Daily	Other	obligations	
Austria (D)	✓				Domestic transport and distribution networks
Austria (T)		✓			Transit pipelines
Czech Republic		✓	Monthly		Daily and monthly settlement Special treatment of old transit contracts
France		✓		✓	New within-day constraints for volatile consumers
Germany		✓		✓	Hourly incentives and tolerances for large customers
Hungary		✓			
Italy (new)		✓			
Netherlands			Cumu-lative		No fixed balancing period; imbalances are settled in each hour when the TSO has to engage into balancing transactions
Slovakia		✓	Monthly		Daily and monthly settlement for domestic market Transit flows settled in kind (daily)
Slovenia		✓	Monthly		Complemented by cumulative account settled on a monthly basis

Country Comparison

Almost all countries grant network users some type of tolerances, irrespective of length of balancing interval

	Tolerance			Comments
	Hourly	Daily	Other	
Austria (D)	-	-	-	
Austria (Tr)		✓		
Czech Republic		✓	Monthly	• Daily tolerances differentiated by E/E point and daily % use • Shippers may trade unused tolerances ex-post
France		✓	Cumu-lative	• Tolerances vary by market area and capacity booking • Specific constraints and tolerances for highly fluctuating consumers (mainly CCGT)
Germany	✓			• Tolerances vary by size / type of consumer
Hungary		✓		• Equal to 2% of nominated input
Italy		✓		• Tolerances depend on size of supply portfolio
Netherlands	-	-	-	
Slovakia		✓	Monthly	• No tolerances for transmission network
Slovenia		✓	Cumu-lative	• Daily and cumulative imbalance tolerance as share of transmitted quantities of natural gas

Country Comparison

Except for Slovakia and Slovenia, all countries make use of market mechanisms, but balancing platforms prevail

	Wholesale market	Balancing platform	Flexibility contracts	Comments
Austria (D)		✓		
Czech Republic	✓		✓	1. OTE's Intraday energy market 2. Flexibility contracted by the TSO
France	✓			Balancing market has been replaced by / integrated into wholesale gas market
Germany	✓	✓	✓	Use of different instruments by different TSOs
Hungary		✓	✓	Including use of option contracts
Italy (new)		✓		
Netherlands		✓		
Slovakia				Exclusive use of line pack (and storage)
Slovenia			✓	Contracts with importers

Country Comparison

Besides Austria, 4 other countries use market based prices, whilst the other rely on indexation to wholesale market prices

	Market-based price	Indexed price	Admin. price	1- / 2-price	Comment
Austria (D)	✓			1	• Volume weighted average price of balancing gas
Austria (Tr)			✓		• Compensation in kind + fixed penalties
Czech Republic		✓		2	• Compensation in kind within tolerances • Daily price linked to EEX-NCG • Monthly charges based on monthly import prices
France	✓			1 / 2	• Mix of 3 different prices, based on volume-weighted average price of balancing gas
Germany		✓	✓	2	• Based on a basket of reference prices • Penalties based on daily imbalance price
Hungary	✓				• Volume weighted average price of balancing gas
Italy	✓			1	• Marginal price of balancing gas
Netherlands	✓			1	• Marginal price of balancing gas
Slovakia (D)		✓		2	• Linked to monthly price of imported gas • Compensation in kind on transmission network
Slovenia		✓		2	• Linked to monthly price of imported gas • Mark-up for imbalances outside tolerance

Country Comparison

Additional penalties are applied to imbalances outside the define tolerance levels

	Additional penalties	Comments
Czech Republic	✓ (explicit)	Step-wise penalty function depending on system imbalance
France	implicit	Increasing difference to basic imbalance price
Germany	✓ (explicit)	Penalties on hourly deviations outside tolerances
Hungary	✓ (explicit)	Regulated penalties
Italy	-	
Netherlands	implicit	TSO may add dual 'incentive component' to imbalance prices
Slovakia	-	
Slovenia	-	

Country Comparison

Basic balancing arrangements are supplemented by specific rules for certain customer categories in several countries

- Czech Republic:
  - Special treatment of ‘old’ transit contracts
- Germany:
  - Tolerances and penalties vary by category, i.e.
    a) Pure daily balancing for small consumers (SLP)
    b) Daily balancing with limited tolerance on hourly nominations for large consumers (> 300 MW), storage, cross-border points
    c) Choice between b) or daily balancing with tolerance between nomination and average hourly off-take for consumers with hourly metering (< 300 MW)
- France:
  - Specific tolerances (capacity need, intra-daily variation) and constraints defined for customers with highly fluctuating load (mainly CCGT)
    (which may buy additional flexibility from TSO)

Country Comparison

Experience with the new Dutch balancing system

- High costs of implementation (IT, Real-Time metering etc.)
- Smooth functioning of all systems to date
- Very few interventions by the TSO during the summer

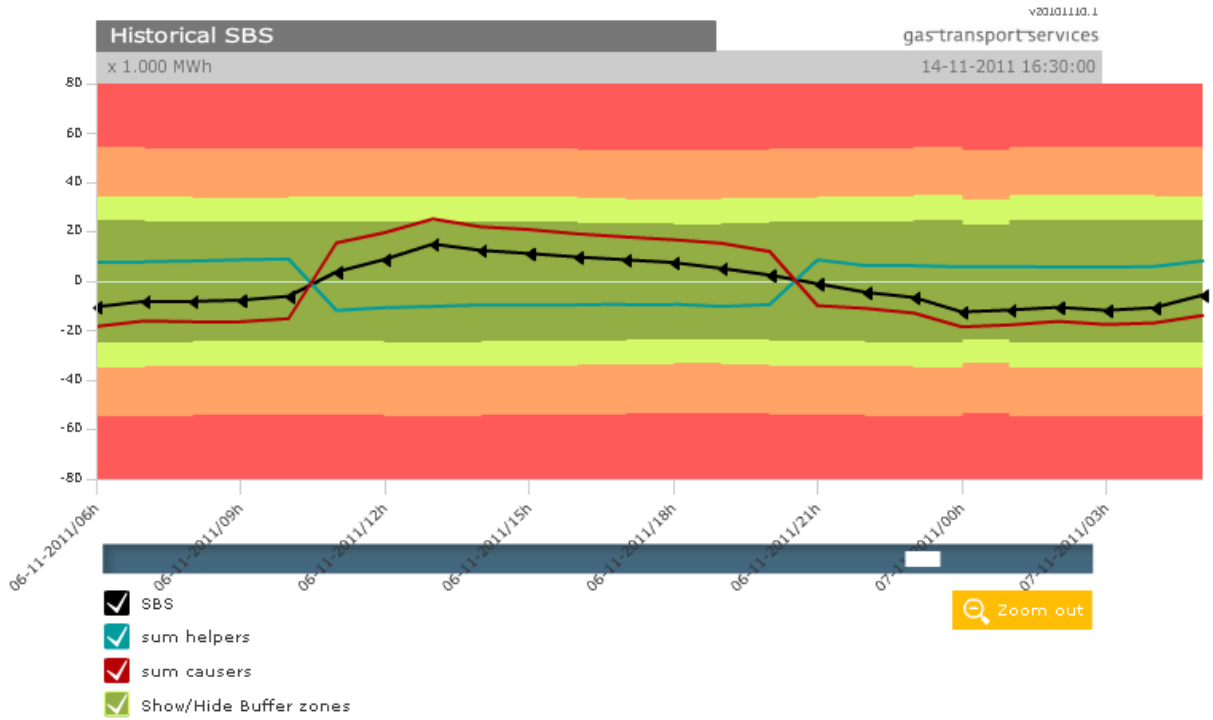
=> Shippers obviously were able and sufficiently incentivised to stabilise the system themselves.

- Effects on (large) consumers not clear yet
  (some large consumers have indicated to set up their own balancing groups or change their balancing group).

Country Comparison

Experience with the new Dutch balancing system

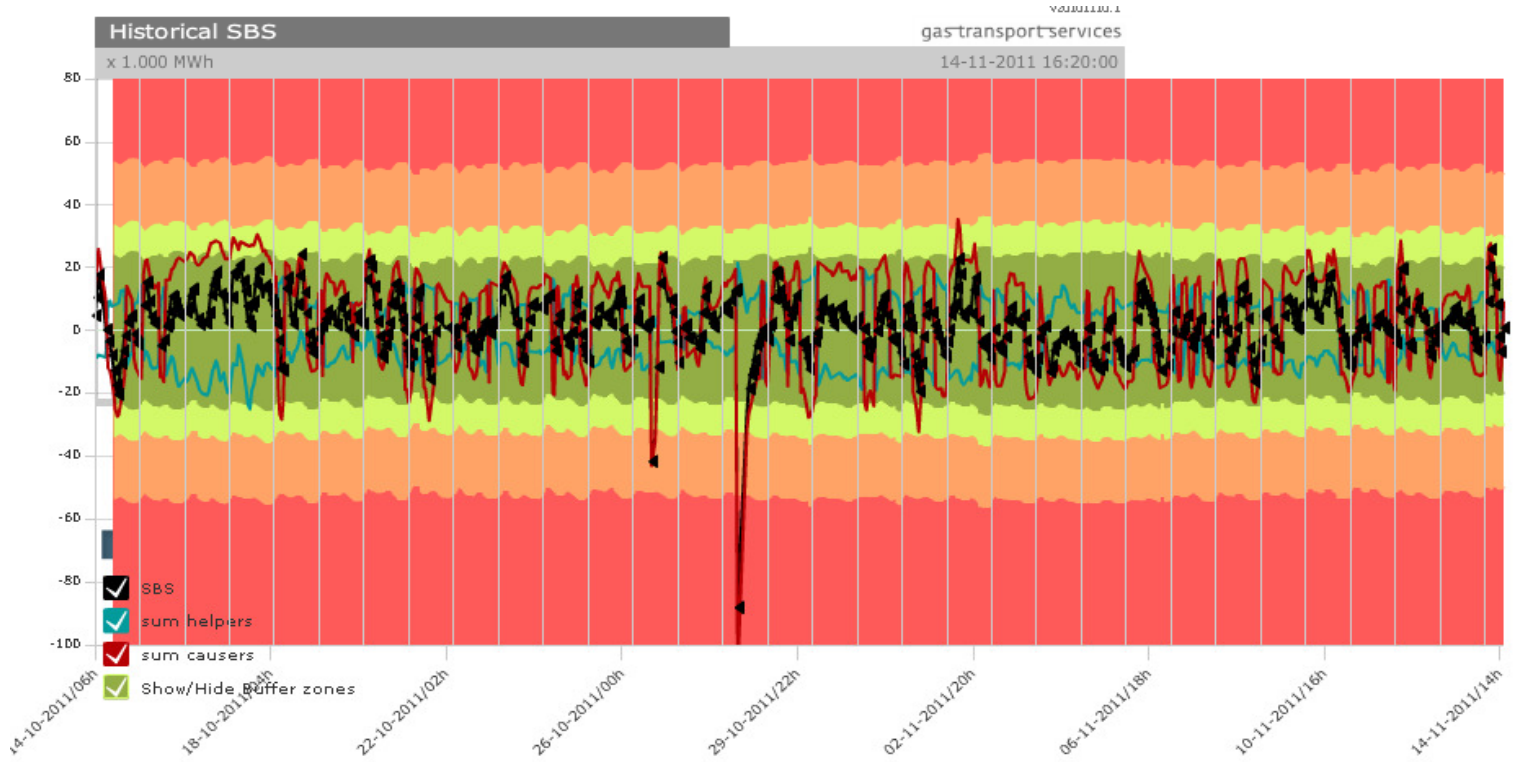
- Results show clear reaction of market towards system imbalance (predictable daily profile?)



Country Comparison

Experience with the new Dutch balancing system

- Example: System is in imbalance within ‘neutral buffer’ only!



Country Comparison

Experiences from Germany – Balancing Levy has increased due to a number of factors.

Levy account

The balancing energy levy is charged to cover the losses expected in connection with the use of control and balancing energy. All revenues and costs related to control and balancing energy use are booked to a levy account. The balance is calculated from all accounts receivable/payable that are debited/credited to the levy account in accordance with GABi Gas.

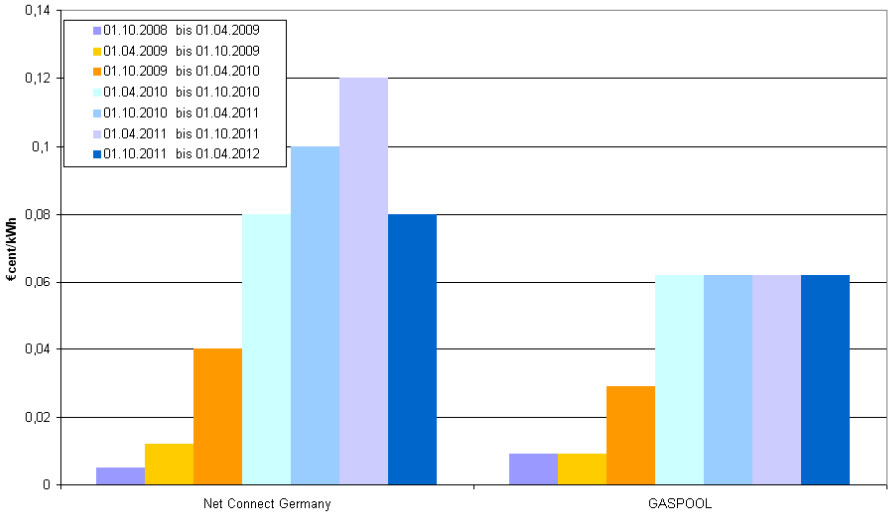
+Revenues from balancing energy sales
+Balancing energy revenues
+Revenues from structuring charges
+Revenues from balancing energy levy
+Revenues from shortfall quantities
+Interest earned

-Expenditures on balancing energy purchasing
-Balancing energy expenditures
-Expenditures on excess quantities
-Interest charges

= Change in account balance

Source: Net Connect Germany

Balancing Energy and Balancing Levy



Source: Gaspool, NCG

- Cost of procurement different from market conditions.
- Misuse of SLP allocation at DSO level.
- Forwarding effects from former periods (Mehr-, Mindermengen).
- Arbitrage of RLM nomination against balancing energy.

KEMA

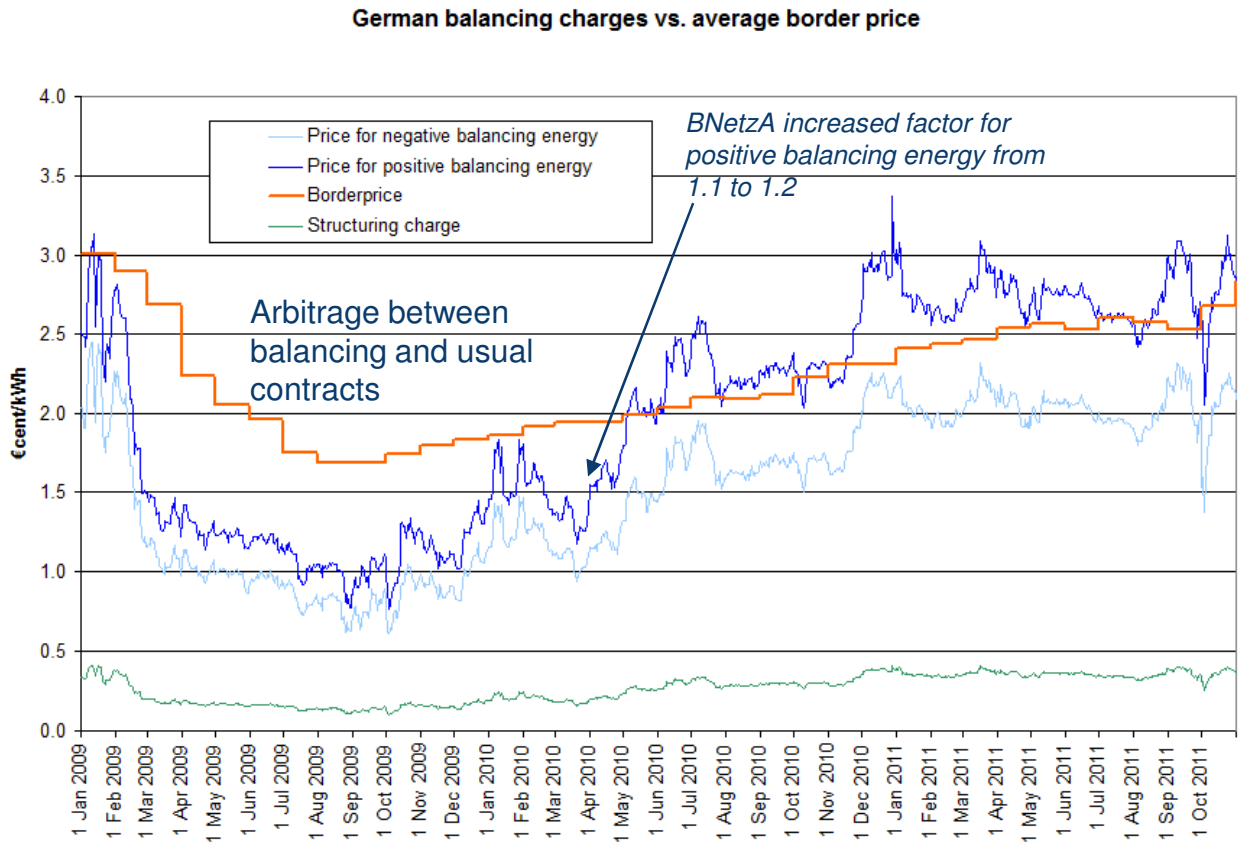
Changes in balancing system so far

Experiences from Germany –GABi Gas System is undergoing continuous adaptation to meet market needs and prevent arbitrage.

- Notifications
  1. Replace APX Gas UK NBP in GABi basket with OCM SAP (Oct. 2008)
  2. Method to replace index (Dec. 2008)
  3. Data clearing for transition period (May 2009)
  4. Amendments due to high demand of balancing energy (Mar 2010): Among others:
     - Replace NBP by GPL
     - Increase factor for positive balancing energy to 1.2
  5. Daily EEX reference price instead of settlement price (July 2011)
- Consultations following report on balancing (April 2011)
  - Reduction of 5% post-day Tolerance (acc. to § 23 Abs. 2 S. 2 GasNZV) to zero (Aug. 2011) closed
  - Expansion of balancing energy levy towards RLMoT, RLMNEV, and import and storage entry and exit points.
  - Further transparency measures
  - Introduction of symmetrical adjustment factor for negative balancing energy 0.8.

Addressing Arbitrage

Experiences from Germany –BNetzA reviewed the price factor for positive balancing energy in 2010 to avoid arbitrage



In the balancing monitoring report 2011 the BNetzA indicated to reduce the factor for negative balancing energy to 0.8 because to establish symmetry between the price for positive and negative balancing energy: It has refrained from it so far.

See also: Evaluationsbericht Regel- und Ausgleichsmarkt (Report „balancing“) p. 31, BNetzA 2011

KEMA

Country Comparison

Country comparison reveals different degrees of compatibility with ‚FG target model' and highlights necessary change in Austria

- With the notable exception of the Netherlands and Austria, all other countries already comply with the principle of daily balancing
- Despite significant progress towards market-based balancing, almost all countries still are at an 'interim stage' towards the desired target model
- Austria, Slovakia and the Czech Republic are the only countries that differentiate between domestic transport and international transit
- With regards to Austria, the only obligatory change seems to be related to a transition from hourly to some form of daily balancing
- In addition, the current pricing structure and the use of a balancing platform do not correspond to the target structure but are explicitly acknowledged by the FG as an interim solution

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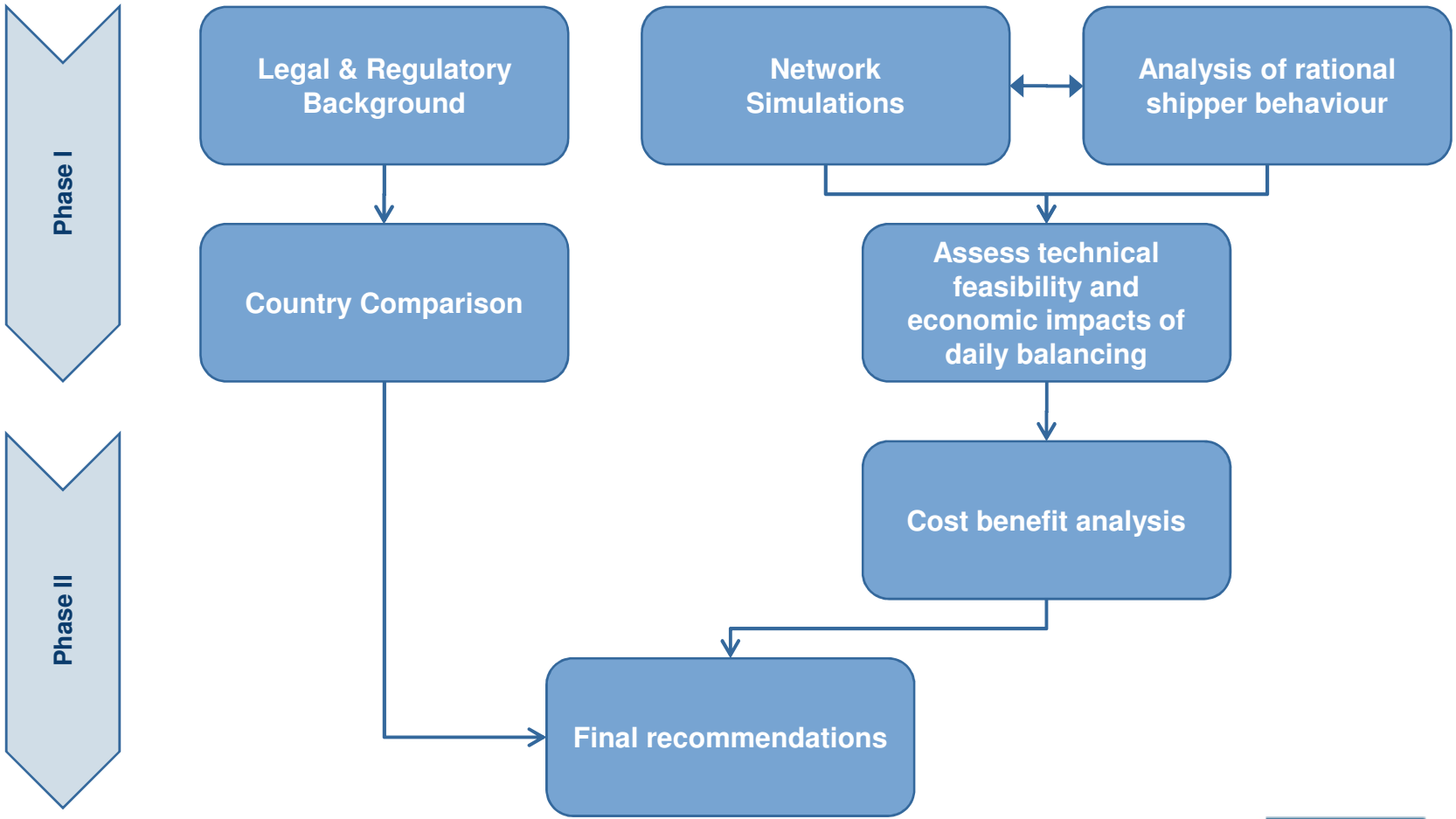
Network Simulations

Network Simulations represent an essential element of the overall analysis within this project



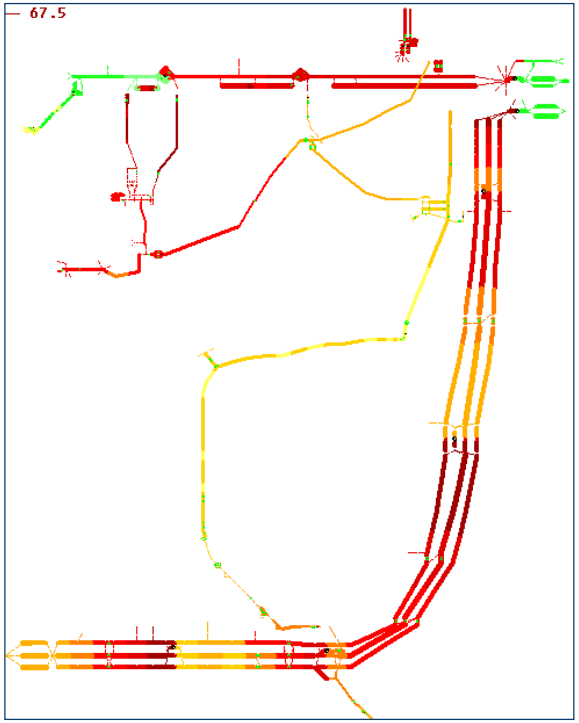
Network Simulations

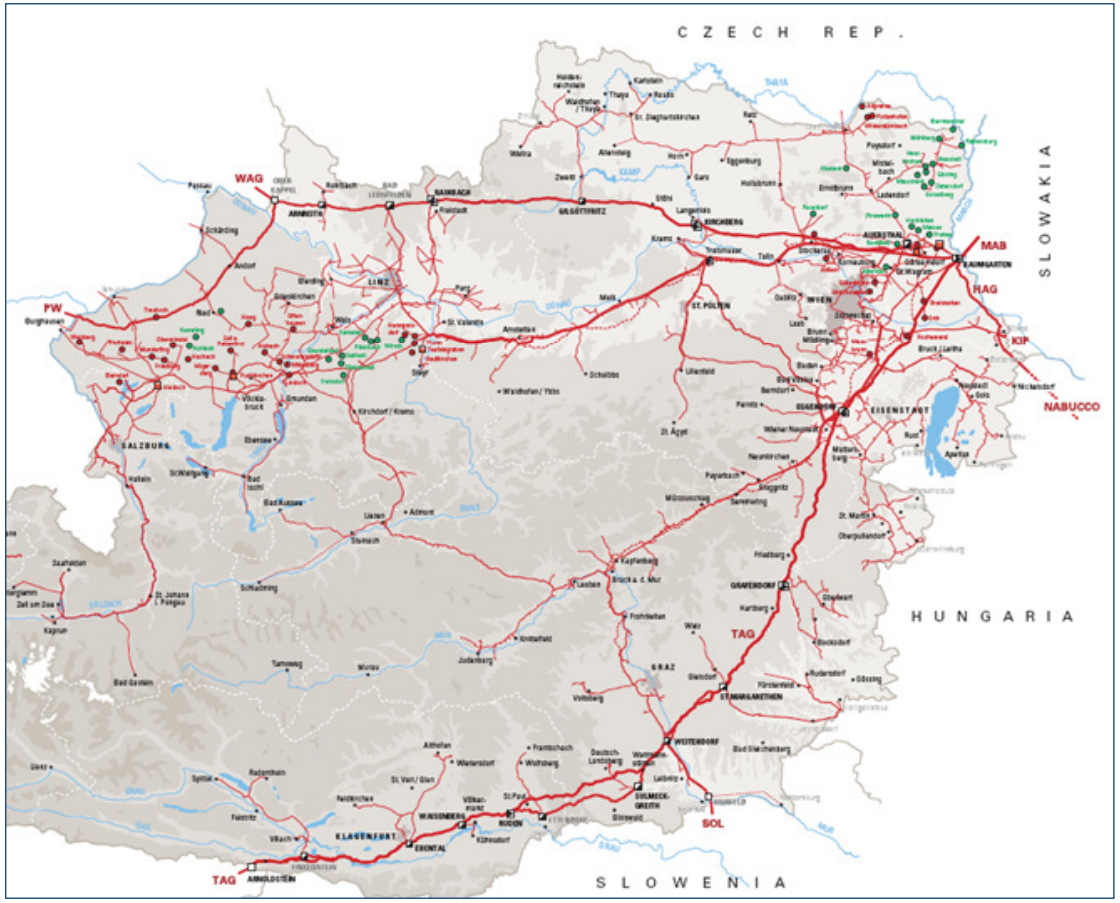
Network simulation aim at assessing the physical feasibility and impact of different balancing regimes for the Austrian gas networks

- Network simulations shall analyze a number of key requirements as well as the potential changes of possible changes in the balancing regime:
  - Maintaining operational pressures within technical and contractual limits
  - Movement of flow zero points.
  - Additional storage flexibility demand
  - Additional compression costs

Network Simulations

Scope of the network model covers the entire Austrian transport grid in the Eastern market area (including those operated by AGGM)



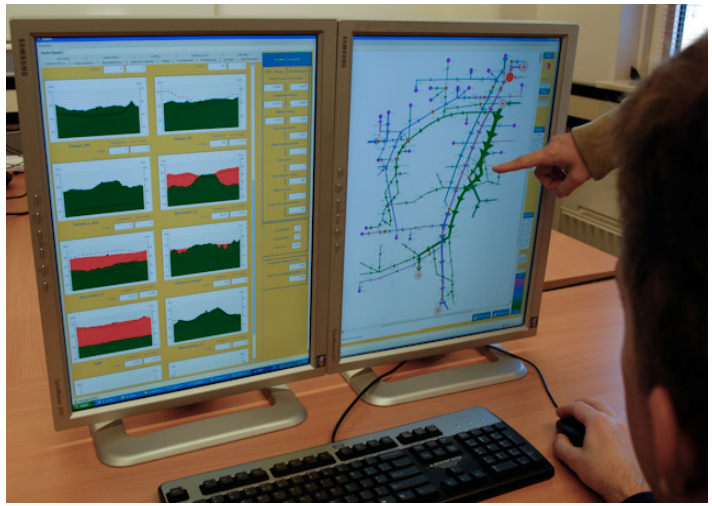


Source: OMV

Network Simulations

Network simulation are based on the combined use of flow simulations and a dedicated operation optimization tool

- Flow simulations carried out in common network simulation software that is widely used in the industry (SIMONE)
- Additional use and interaction with decision support tool for gas dispatching developed by KEMA
  - System operates the network “like a physical operator”, not like a flow simulator
  - Cost optimal combination of compression, blending and supply flexibility.
  - 24 hours rolling horizon, hourly resolution
  - Output fed back to simulator regime:



Network Simulations

In a first step, KEMA has been building physical models of the Austrian transport networks (OGG, BOG, TAG, AGGM)

- Network companies have been providing data to KEMA
- KEMA has been building models of each individual network
  - Models of TAG, WAG have been built (SIMONE can find a feasible solution)
  - Models of AGGM and PVS still under construction.
- Ongoing validation process in cooperation with network companies
  - Discuss of remaining data issues (clarifications) and agree on remaining limitations of network model
  - Review of network model by network companies (based on rerun of historic cases)
  - Fine-tuning of individual network models

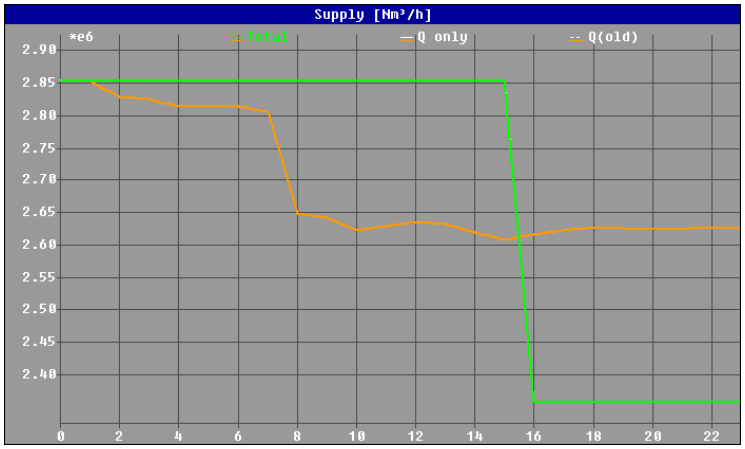
Network Simulations

KEMA will create an integrated model of the Austrian gas transport network, which will be used to analyze different flow scenarios

- Once the individual network models have been validated, they will be merged into an integrated model of the Austrian gas transport network
  - Will result in a single network model that cover the entire transmission grid in the Eastern market area
  - Still requires some clarification to ensure proper connections and settings
- Resulting network model will then be used to simulate the feasibility and impact of different flow patterns that may be experienced in a new balancing system (see below), e.g.:
  - 'Flat' rather than profiled inputs at entry points
  - Variation of diurnal profile at cross-border points

Network Simulations

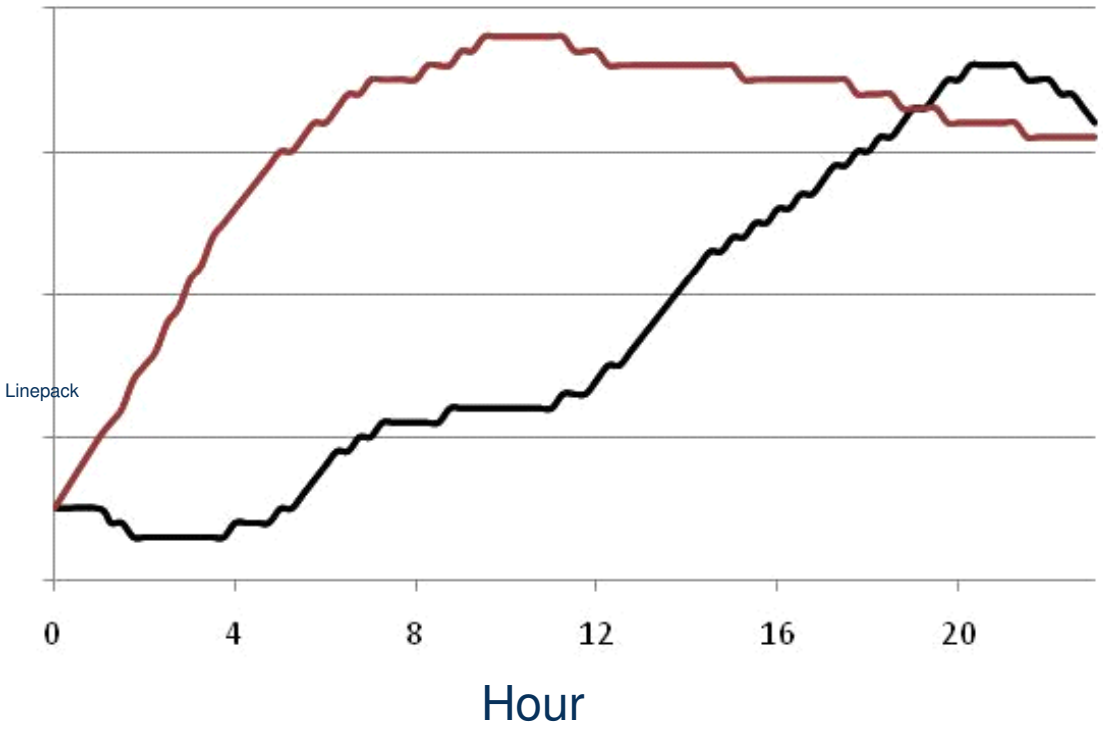
Example: Impact of different entry flow on pressure at entry point



- Orange curves shows historic input at entry point on a given day
- Green curve shows a step function flow with the same daily volume

Network Simulations

Example: Resulting impact on line pack in transport system



Example for evolution of linepack over a 24 h period for an individual line segment

Black – original

Red – after modification

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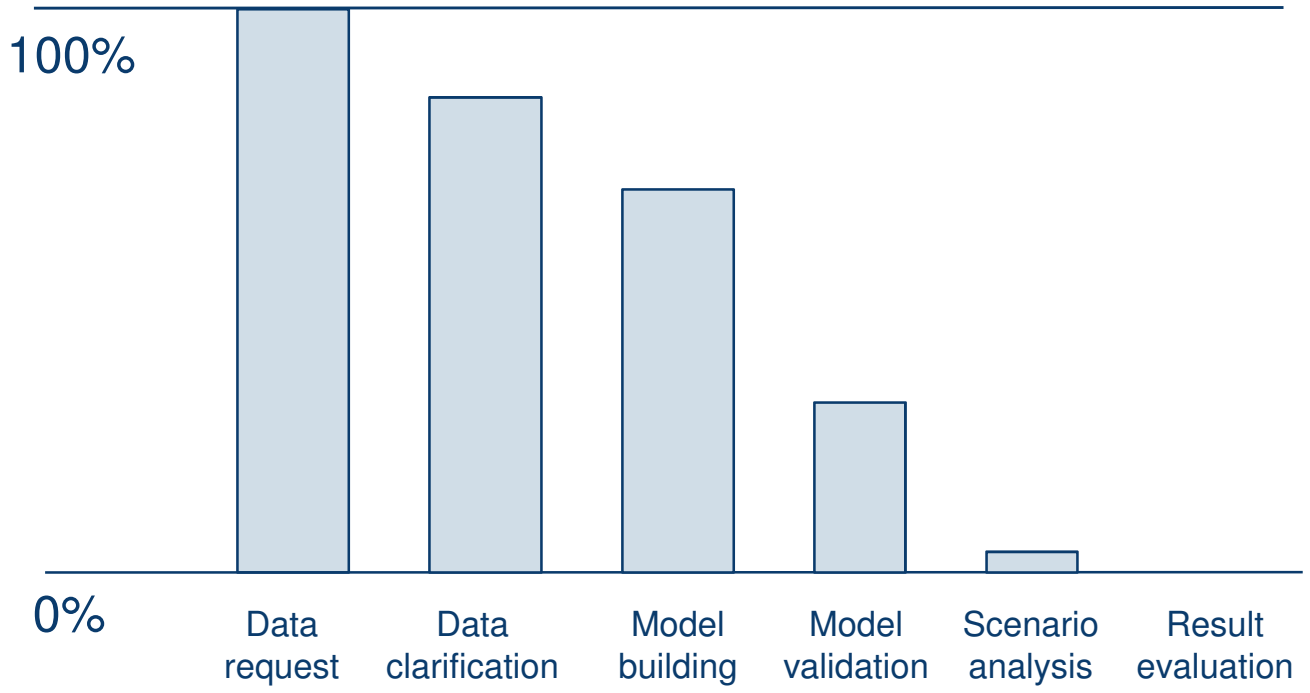
Status Quo and Further Progress

Whilst the preparation of the network model is progressing, further efforts are required before further analysis

- Indicative view (as of December 14)



Status Quo and Further Progress

The main part of the analysis will then assess the impact of different flow pattern, which may occur in different balancing systems

- Transition to different balancing systems is likely to influence the nominations by network users, e.g.
  - Incentive to inject flat daily bands to avoid costs of diurnal profile
  - Potential risk of 'exporting' flexibility to neighboring markets
  - Impact of potential within-day tolerances and penalties
  - Impact on different customer categories and supply portfolios
  - Influence of existing contractual arrangements at cross-border points?

Status Quo and Further Progress

Intention to study several different approaches for a new balancing system

- In a first step, we will focus on the two extremes:
  - Pure hourly balancing (Status quo DSO)
  - Pure daily balancing
- In a second step, we intend reviewing various hybrid models that combine elements of daily, hourly and cumulative balancing
  - Application of within-day penatlies and tolerances (hourly or cumulative)
  - Possible differentiation by customer group
- Option of an integrated balancing model for the TSO and DSO level

Status Quo and Further Progress

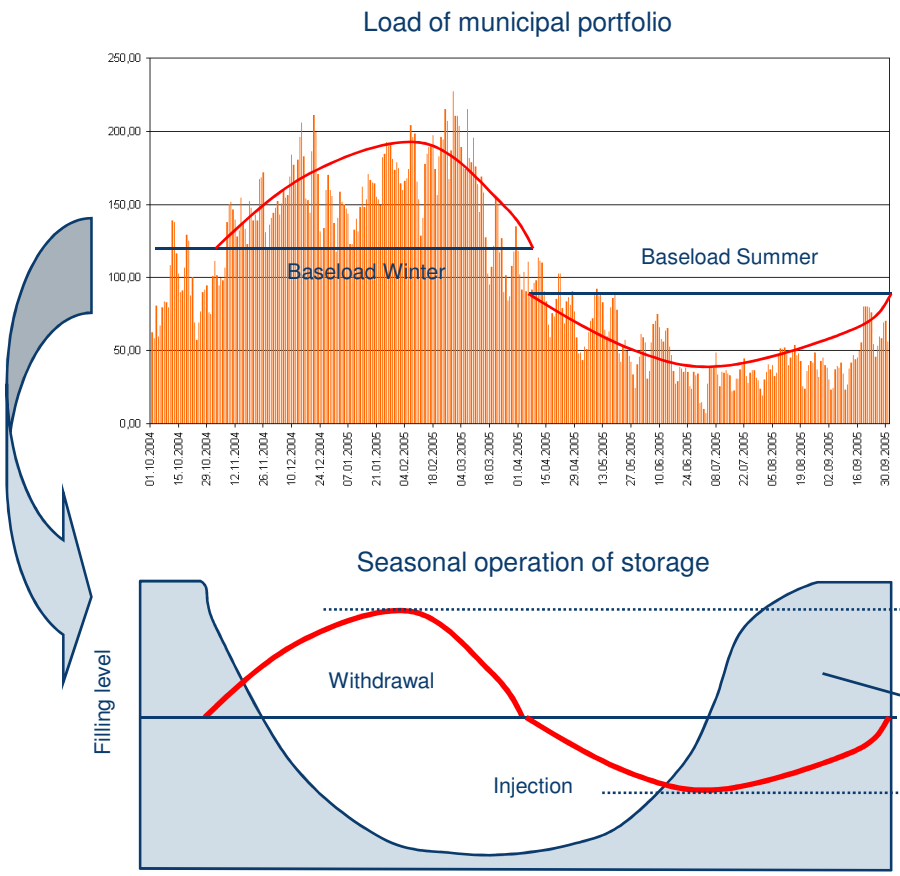
To assess the behavior of shippers, we will assess the potential costs and savings from different flow patterns

- Consideration of individual customer categories and mixed supply portfolio
- Analysis subject to some uncertainty and simplifications
  - Do not know 'true' composition of supply portfolios
  - Do not know available flexibility for different portfolios
  - Analysis based on assumption of rational behavior
- Need to estimate the cost of creating diurnal profiles
  BUT: Gas market based on daily products

=> Suggest using available storage products and tariffs to derive estimates for the costs of flexibility

Status Quo and Further Progress

Storage costs is an opportune means to structure within-Day.
But in Austria storage is seasonal not short term.



- A typical procurment strategy would comprise the purchase of baseload products and load structuring with storage products.
- While storage might be used for seasonal structure, it will also provide for daily or hourly balancing.

Cost-elements of storage

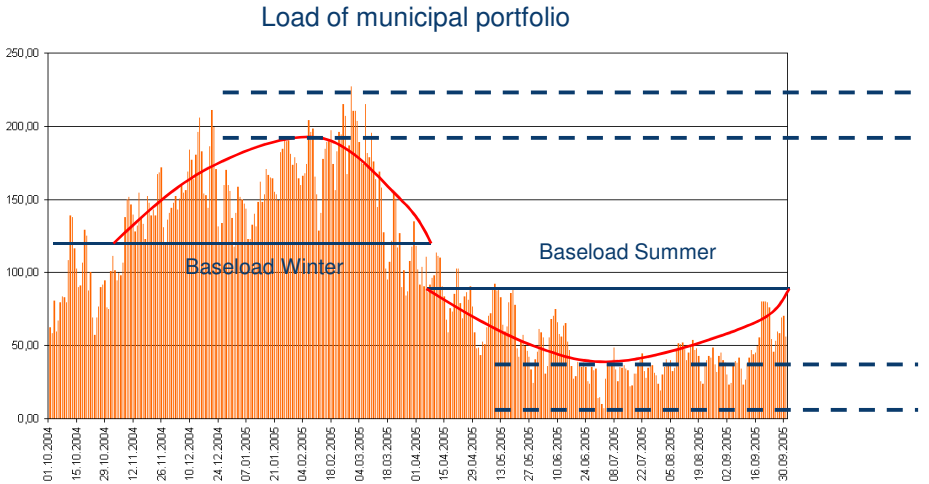
Withdrawal capacity [€/(kWh/h)/h]

Working Gas volume [€/GWh]

Injection capacity rate [€/(kWh/h)/h]

Status Quo and Further Progress

For a shipper, flexibility can be generated by using seasonal storage with additional withdrawal and injection capacity



Additional withdrawal capacity for daily/hourly balancing in Winter

Additional injection capacity for daily/hourly balancing in summer

Percentage of storage cost allocated to daily or hourly balancing		Percentage of withdrawal capacity used for daily balancing				
		50%	40%	30%	20%	10%
Percentage of injection capacity used for daily balancing	50%	40%	36%	31%	26%	22%
	40%	37%	32%	28%	23%	18%
	30%	34%	29%	24%	20%	15%
	20%	30%	25%	21%	16%	11%
	10%	27%	22%	17%	13%	8%

Calculation based on similar storage structures at E.ON storage 7 Fields and Wingas storage Haidach

Status Quo and Further Progress

Example calculation on costs of diurnal flexibility for different customer groups

All in €cent/kWh

Strukturing for household load with 2000 Bh	Share of withdrawal capacity used for daily structuring				
Share of injection capacity used for daily structuring	50%	40%	30%	20%	10%
50%	0.10	0.09	0.08	0.07	0.05
40%	0.09	0.08	0.07	0.06	0.05
30%	0.08	0.07	0.06	0.05	0.04
20%	0.07	0.06	0.05	0.04	0.03
10%	0.06	0.05	0.04	0.03	0.02

Strukturing for industry load with 5000 Bh	Share of withdrawal capacity used for daily structuring				
Share of injection capacity used for daily structuring	50%	40%	30%	20%	10%
50%	0.06	0.05	0.05	0.04	0.03
40%	0.05	0.05	0.04	0.03	0.03
30%	0.05	0.04	0.04	0.03	0.02
20%	0.04	0.04	0.03	0.02	0.02
10%	0.04	0.03	0.03	0.02	0.01

Strukturing for industry load with 7500 Bh	Share of withdrawal capacity used for daily structuring				
Share of injection capacity used for daily structuring	50%	40%	30%	20%	10%
50%	0.03	0.03	0.02	0.02	0.02
40%	0.03	0.03	0.02	0.02	0.01
30%	0.03	0.02	0.02	0.02	0.01
20%	0.02	0.02	0.02	0.01	0.01
10%	0.02	0.02	0.01	0.01	0.01

Quelle: Eigene Berechnung.

Households require more withdrawal capacity …..

….while industry primarily needs injection capacity.

Thank you for your attention!

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