KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

Impact of Nord Stream on Parallel Gas Transmission Infrastructure in Slovakia

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Host: Malaysian Gas Association

Host Sponsor: PETRONAS

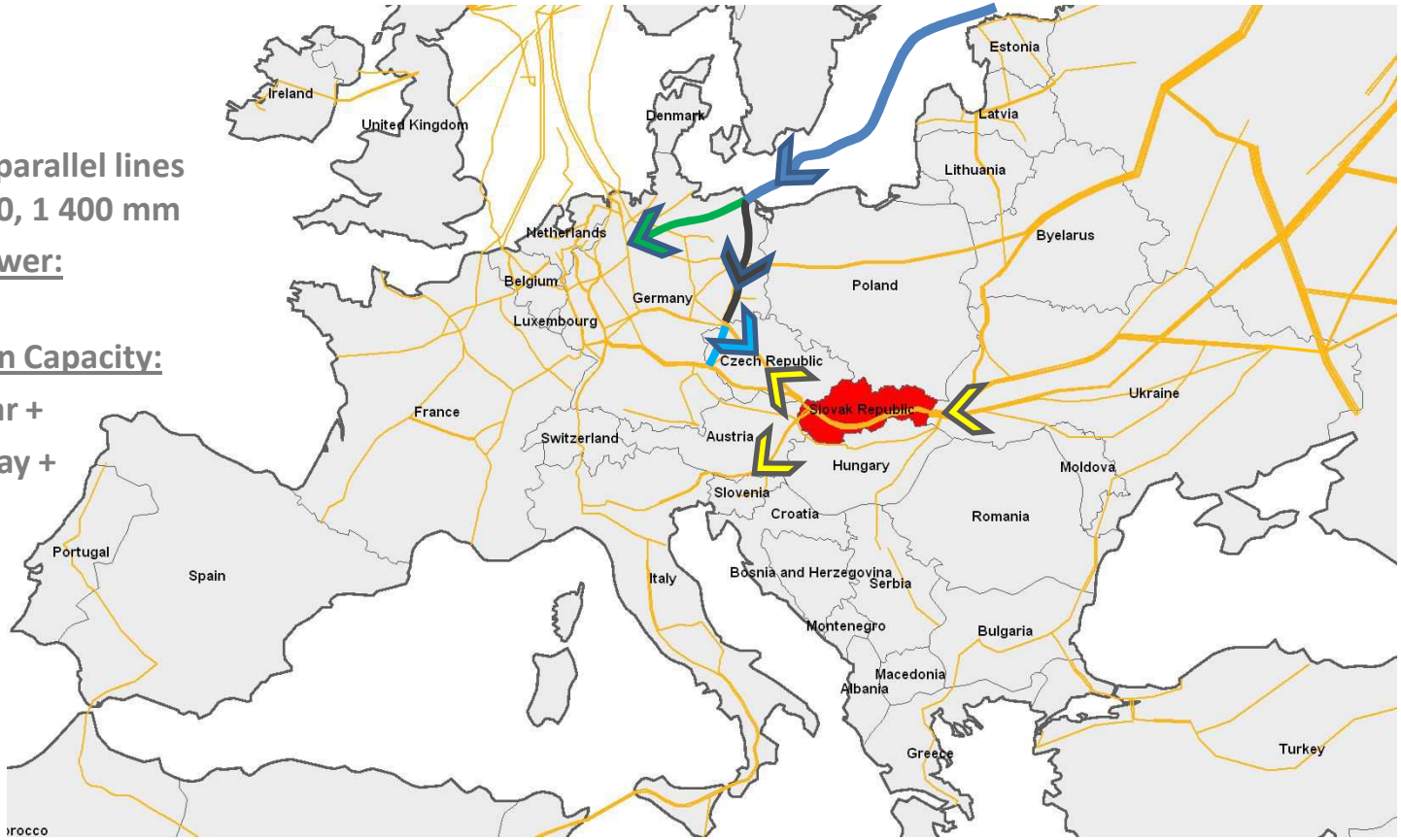
Key European gas transmission infrastructure before Nord Stream

- **Eustream operates** a high-pressure gas transmission system that is interconnected with major European trunk lines in Ukraine, the Czech Republic and Austria.
- The transmission system operated by Eustream has proven to be **a reliable part of the European gas transmission infrastructure**.

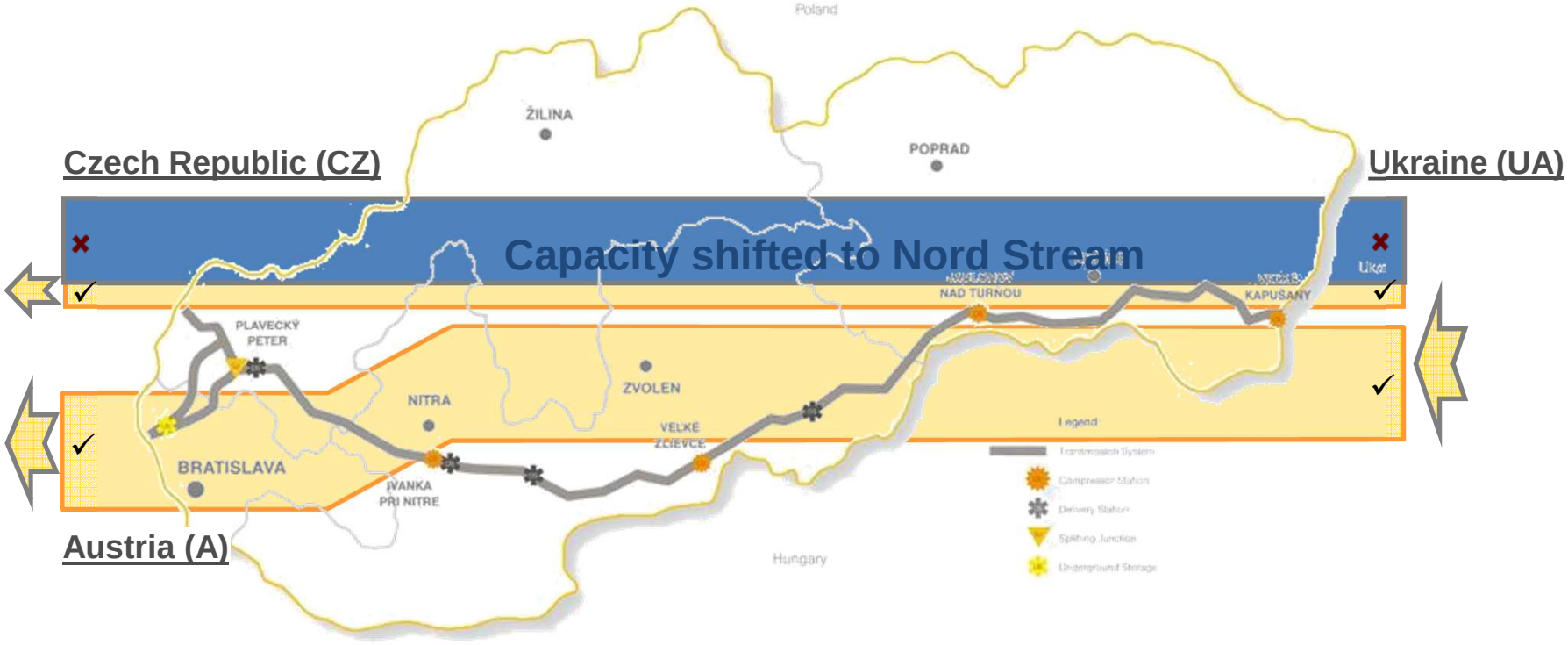
Pipelines:
2200 km +
from 4 to 5 parallel lines
90% @ 1 200, 1 400 mm

Installed Power:
1 000 MW

Transmission Capacity:
90 bcm/Year +
290 mcm/Day +

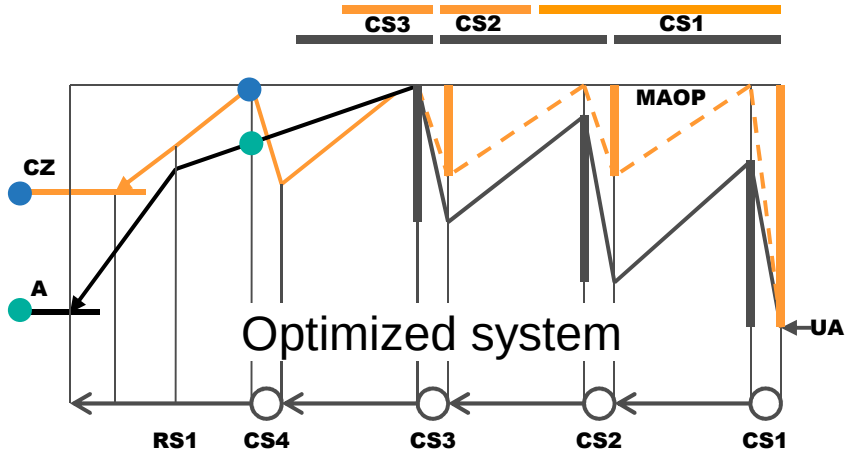


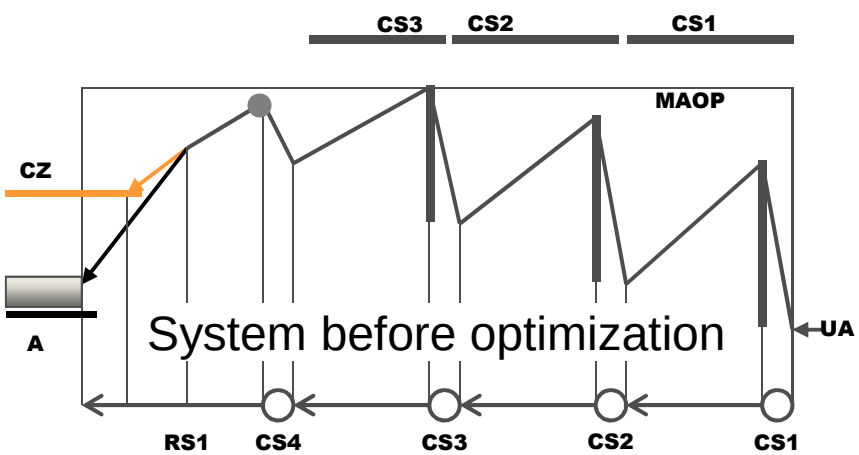
Impact of Nord Stream



- In order to address the impact of Nord Stream and to adapt the system for new legislation on emission limits, the overall optimization of gas transmission infrastructure was launched in 2005.
- The optimization was divided into the following two main parts:
  - ✓ Optimization of strategic pipeline infrastructure (2005 - 2008).
  - ✓ Optimization of the compressor fleet (2005 - 2016).

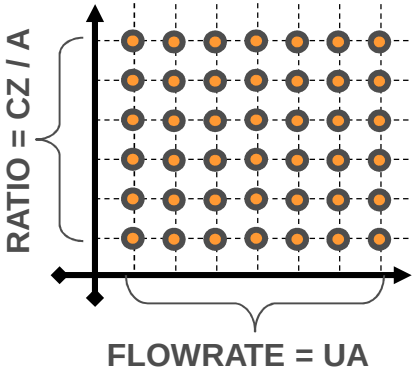
Main principles of overall optimization



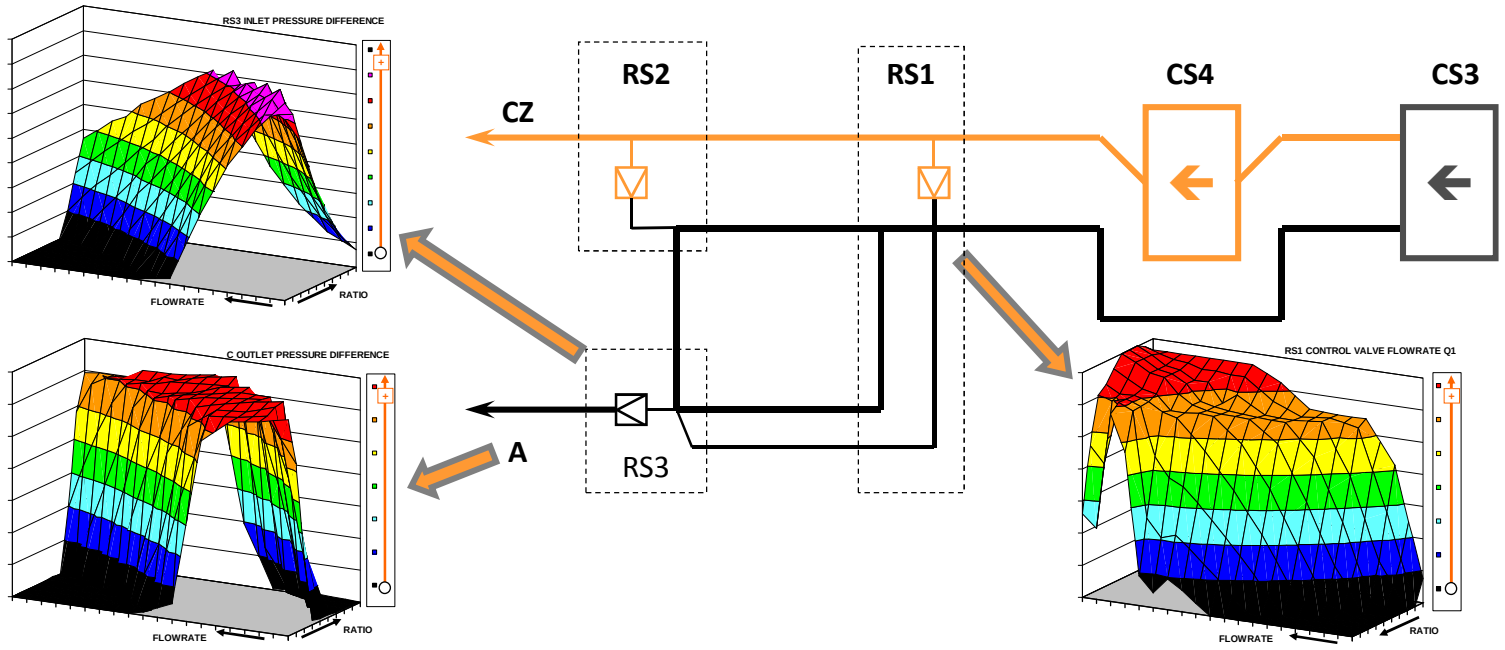


- Two main outlets with different contractual pressure.
- Two output pressures at last compressor station.
- Observance of both contractual pressures concurrently.
- Required pressure reserve at outlets under our control (for a certain interval).
- Changes of transmission mode covered by both compressor units and regulator station control.
- High pressure ratio of the CS1 enables the use of the maximum operating pressure (MAOP) of pipelines and so reduces the required power downstream.
- The highest level of power reduction is at compressor station CS2.

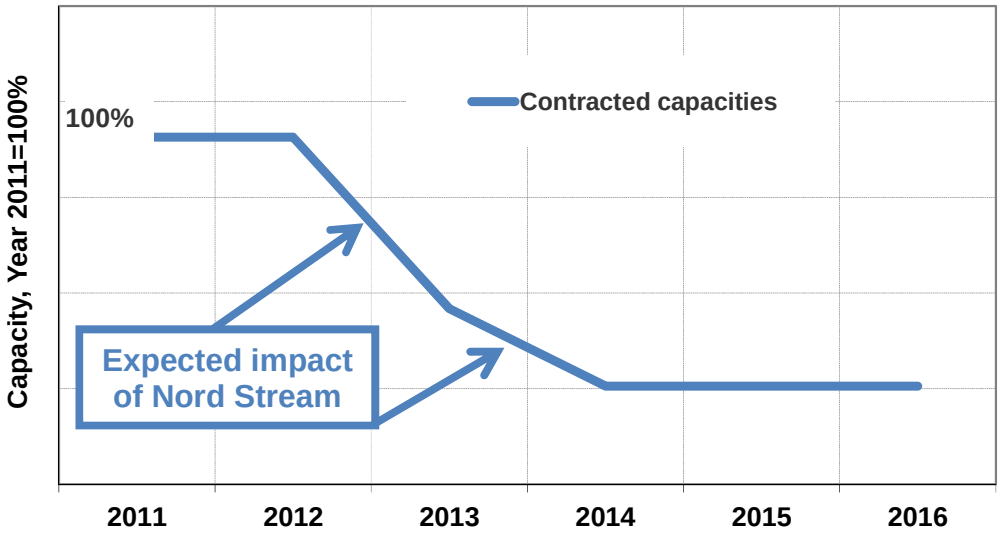
Optimization of strategic pipeline infrastructure

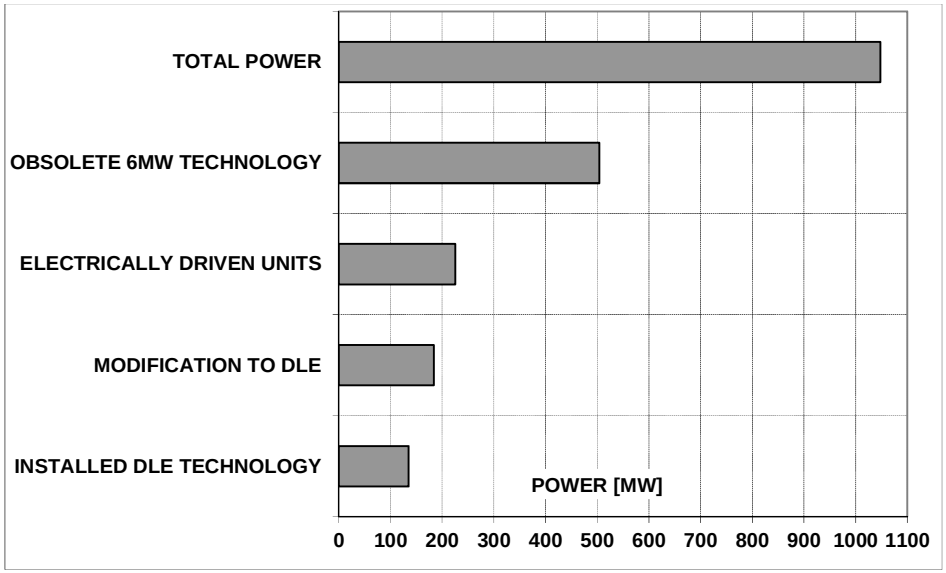


- Designing and optimizing the pipeline infrastructure was carried out using the grid method.
- The calculation grid was determined based on the trend from previous years and the expected change in gas transmission.
- Hydraulic simulations for both unified and split hydraulic mode were carried out for each individual grid point.



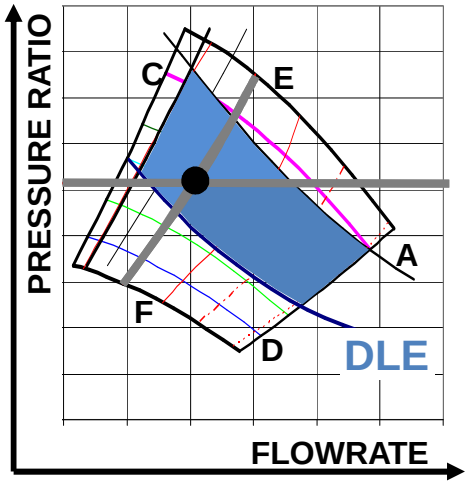
Optimization of the compressor fleet





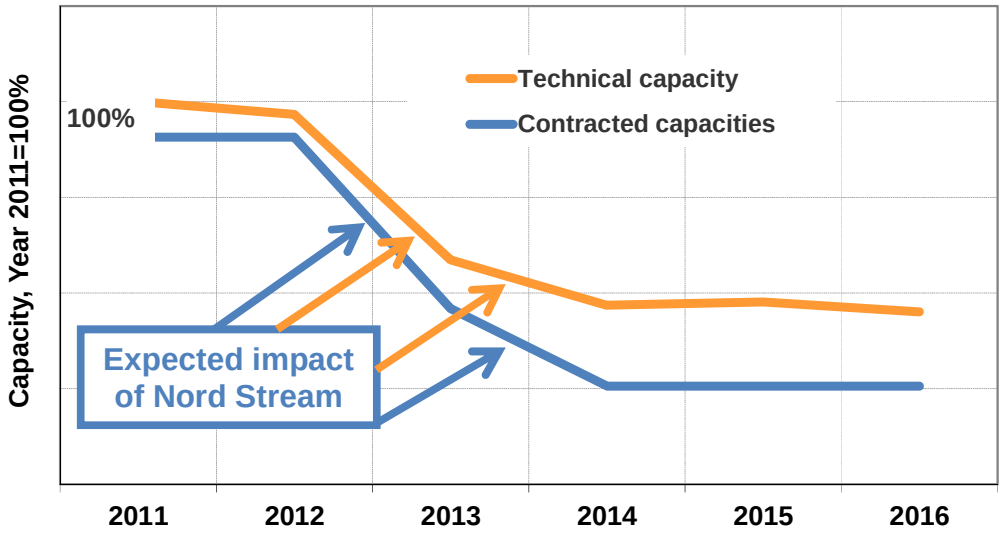
- In the first phase the reduction of installed power is possible under the conditions of new contracts.
- The second phase of power reduction is based on optimizing compressor stations operation while taking both the hydraulic analyses and experience of transmission system operation into account.
- The main recommendation of the optimization was to replace the 6MW technology required for transmission by new units with an output power of 23 – 33 MW.

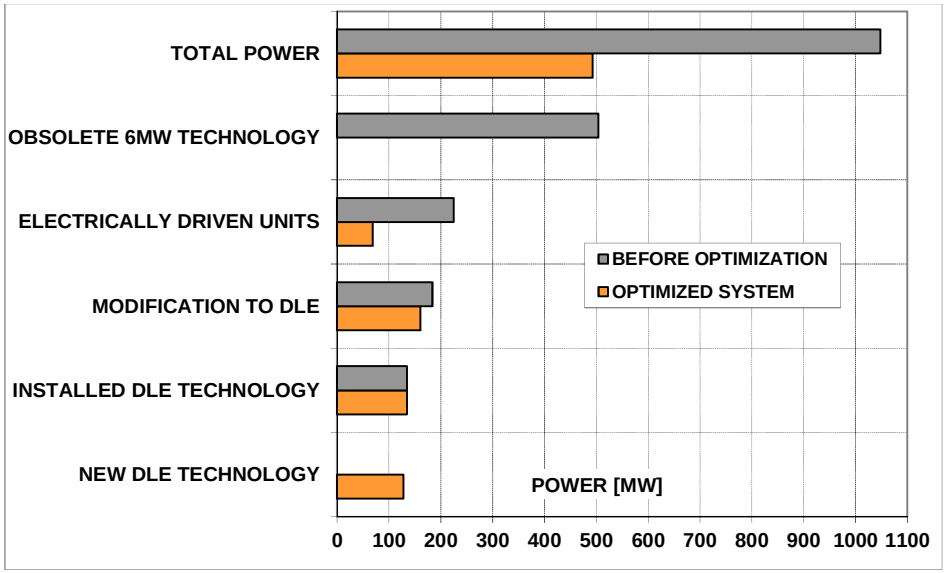
Parallel cooperation of large compressor units



- Utilization of compressor units with 23-33 MW of power puts an emphasis on parallel cooperation in connection with the operational range of the Dry Low Emissions (DLE) combustion technology.
- When compared to the standard annular combustor, the DLE technology additionally has a limited effective area of operation, which is usually guaranteed at loads higher than 70%.
- This issue leads to a narrower operational area of the compressor units.

Results of optimization





- The expected total **power reduction is approximately 50%** of the current aggregated power.
- The maximum **technical capacity** of the system with reduced power will be **higher than 75%** of the current technical capacity.
- This capacity will provide sufficient reserve from both a medium and long term perspective.
- The gas pipeline infrastructure was fully maintained and there is great flexibility in terms of **increasing the technical capacity to its previous level.**
- This increase **must be based on demand** regarding transmission capacity in future.

Increasing gas transmission flexibility

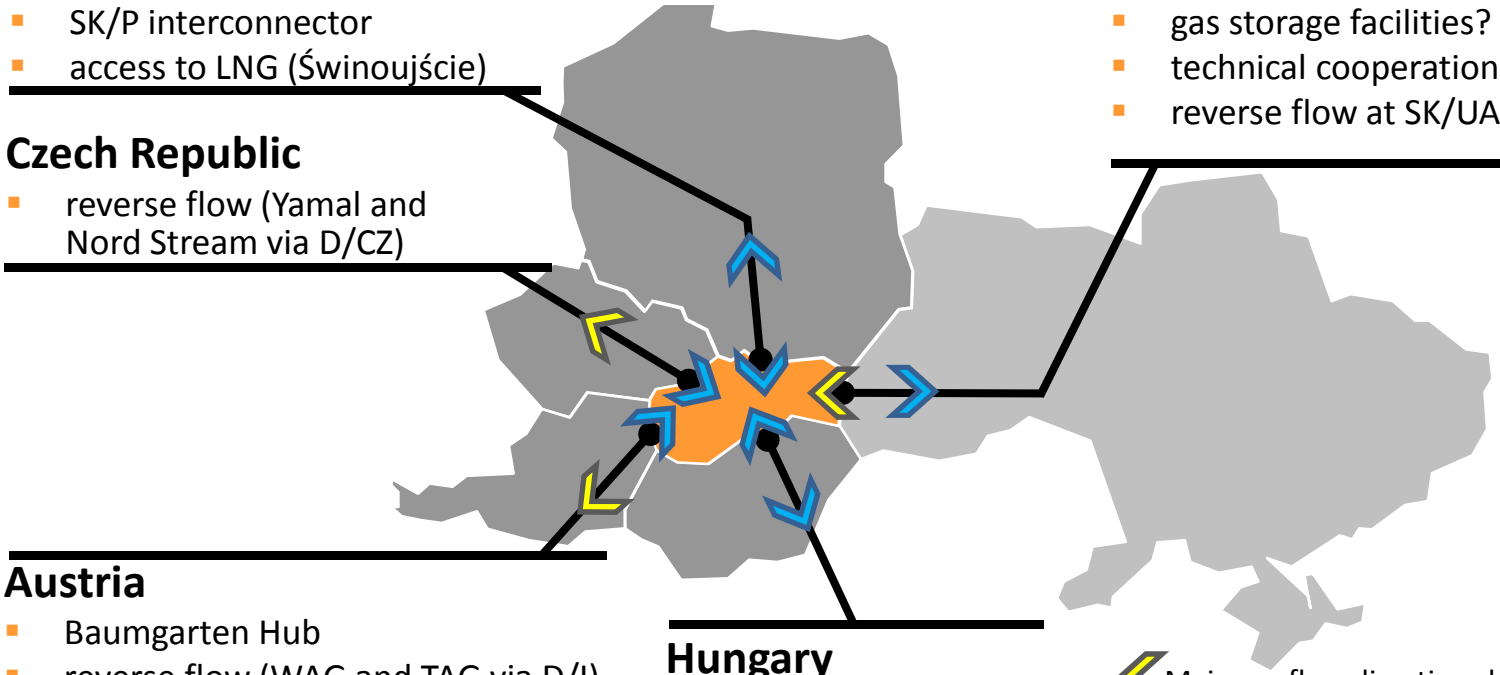
Poland
- SK/P interconnector
- access to LNG (Świnoujście)

Czech Republic
- reverse flow (Yamal and Nord Stream via D/CZ)

Austria
- Baumgarten Hub
- reverse flow (WAG and TAG via D/I)

Hungary
- SK/H interconnector
- access to LNG (Krk)

Ukraine
- gas storage facilities?
- technical cooperation SK/UA?
- reverse flow at SK/UA border?



Main gas flow directions before Nord Stream

Development driven by Nord Stream

- **The new major gas infrastructure projects represent the driving force of existing transmission systems development.**
- **In order to be competitive with new parallel gas transmission routes, the optimization of existing routes is a must.**