Gas Flows and Gas Prices in Europe: What is the Impact of Nord Stream 2

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M/Wasser M/Bäder M/Strom M/Fernwärme M/Erdgas M/net

Why analysis of global gas markets at SWM?

- Electricity: generation, distribution, sales
- Natural gas: production, transport, distribution, sales
- District heating: generation, distribution, sales
- Water: collection, distribution, sales
- Swimming pools: indoor pools, open-air pools, saunas, ice skating
- Mobility: subway, tram, bus, cycle rental system, etc.
- Telecommunications: Internet, phone and TV with fibreoptic technology

WEGA delivers gas flows and gas price development

- WEGA is the abbreviation of '**We**ltweites **Ga**smarktmodell'
- Worldwide model in daily resolution 2018-2040
- Goal of optimization → cover the demand in each zone/country/hub at each day at minimized costs

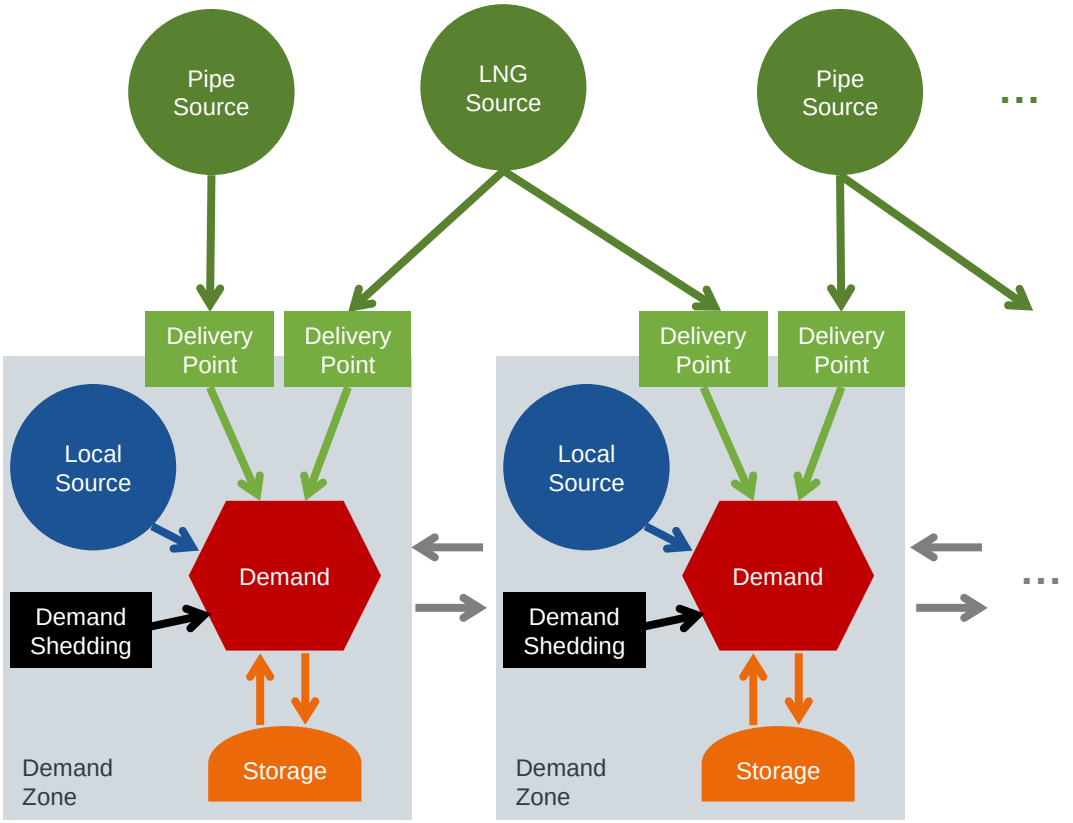
- The model was developed by PÖYRY Management Consulting (here: Pegasus)
- Linear Programming with Xpress from FICO
- Source code and dataset was purchased by SWM
- **The complete dataset was modified by SWM → Results are an own view of SWM**

Modification of parameters by SWM

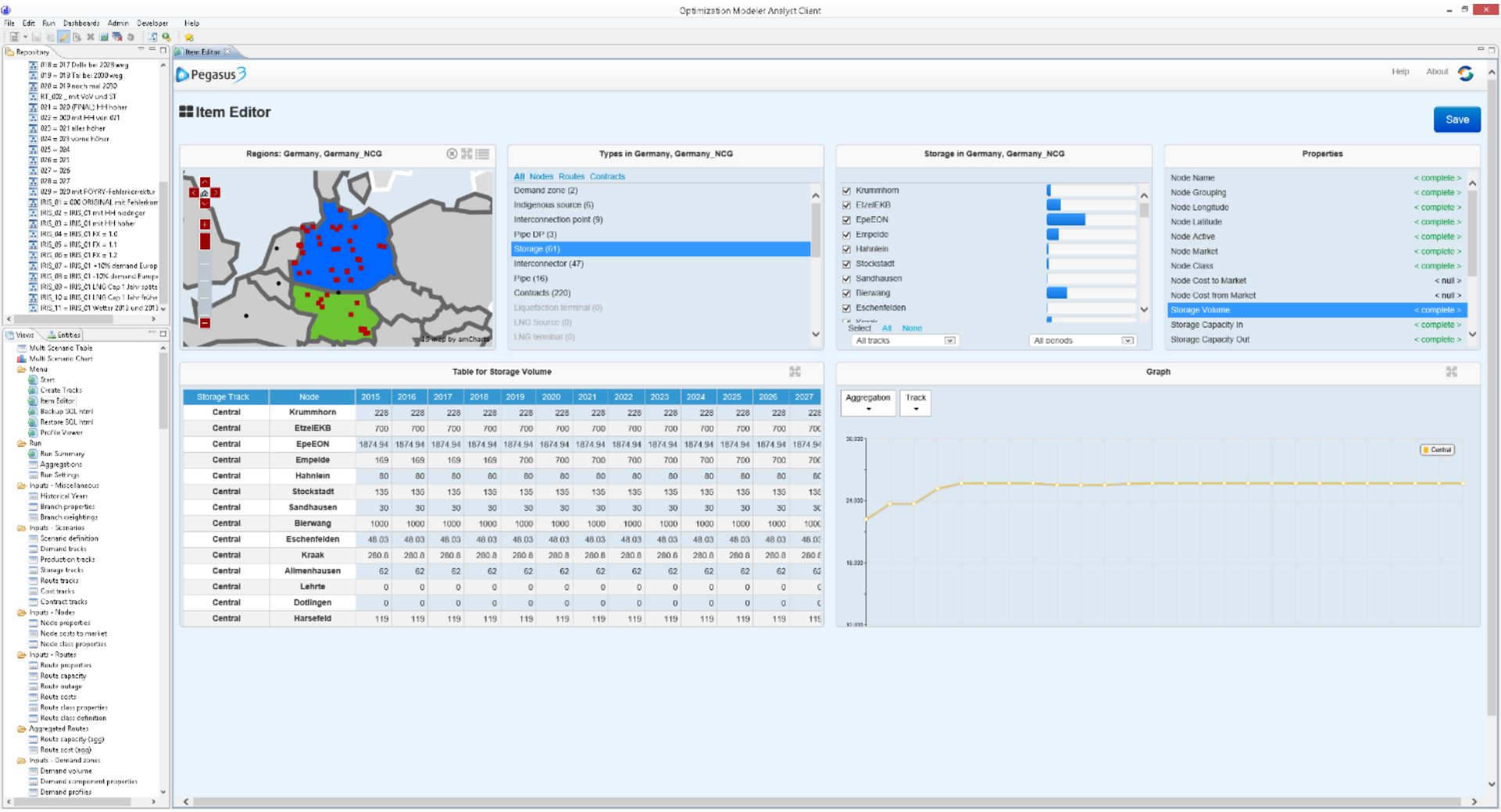
- Oil price and EUR/USD exchange rate
- Pipelines, Interconnections
- LNG terminals
- Storages
- Gas demand / own fundamental electricity model
- Costs (commercial databases for CAPEX, OPEX, transport costs)
- Contracts (CEDIGAZ, BNEF LNG contract database)
- Production volumes and flexibility of gas fields
- Actual gas flows and backtesting

Worldwide gas market as a grid of nodes and edges

- Source: pipeline or LNG
- Source: indigenous production
- Source: demand shedding
- Delivery point: pipeline or LNG
- Demand zone: country / region / rest of the world
- Storage: in demand zone
- Interconnection: between demand zones



User interface of WEGA



Nord Stream 2

- Two strings
- Capacity 55 bcma

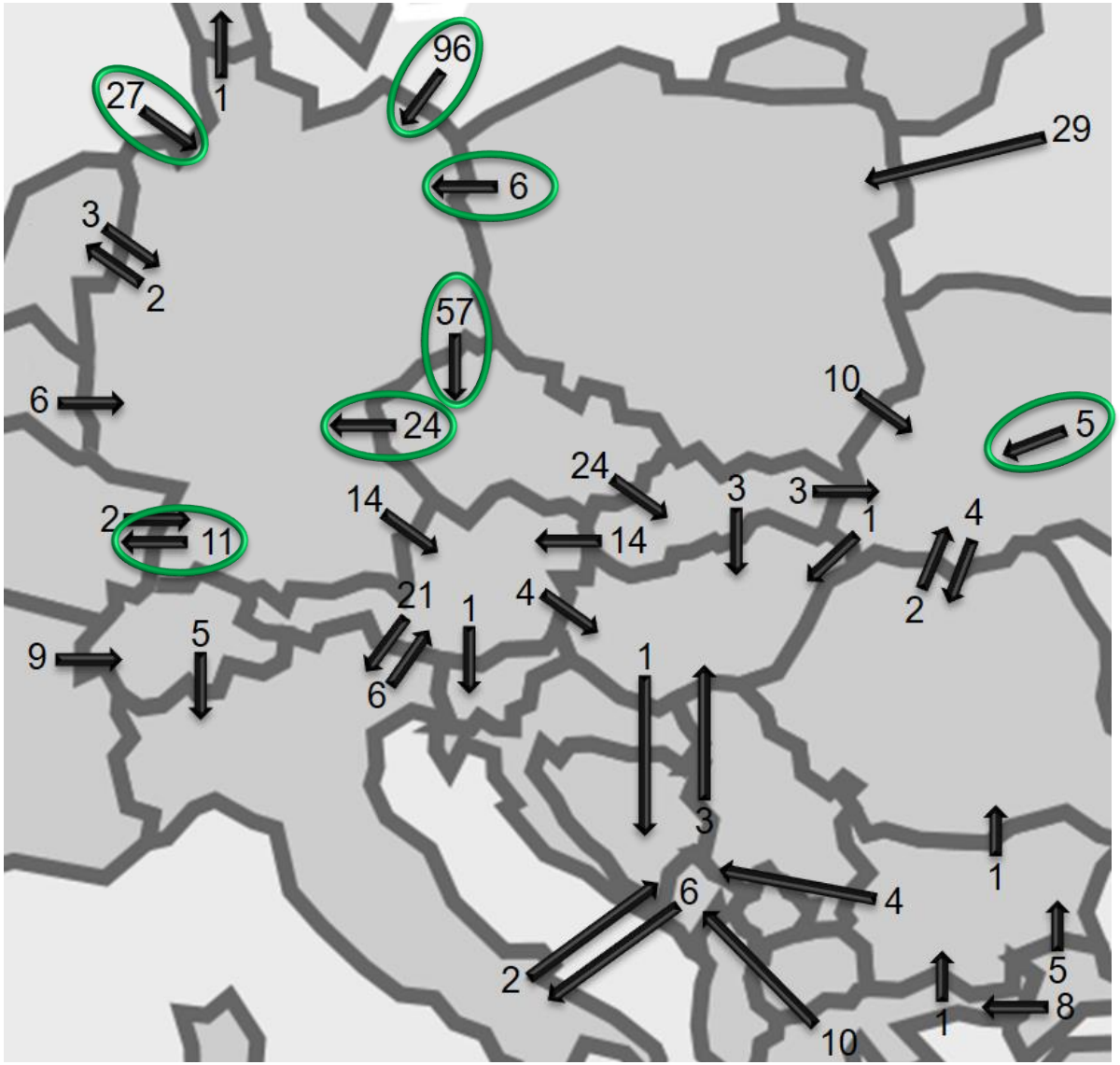
- European gas demand -15% until 2040
- Transit flows Ukraine limited, but > 0

Nord Stream 2 AG; www.nord-stream2.com/en/pdf/document/125

- Calculated average price difference in EUR_{2017}/MWh on wholesale gas prices in the period of 2020 till 2040 if Nord Stream 2 would not be built

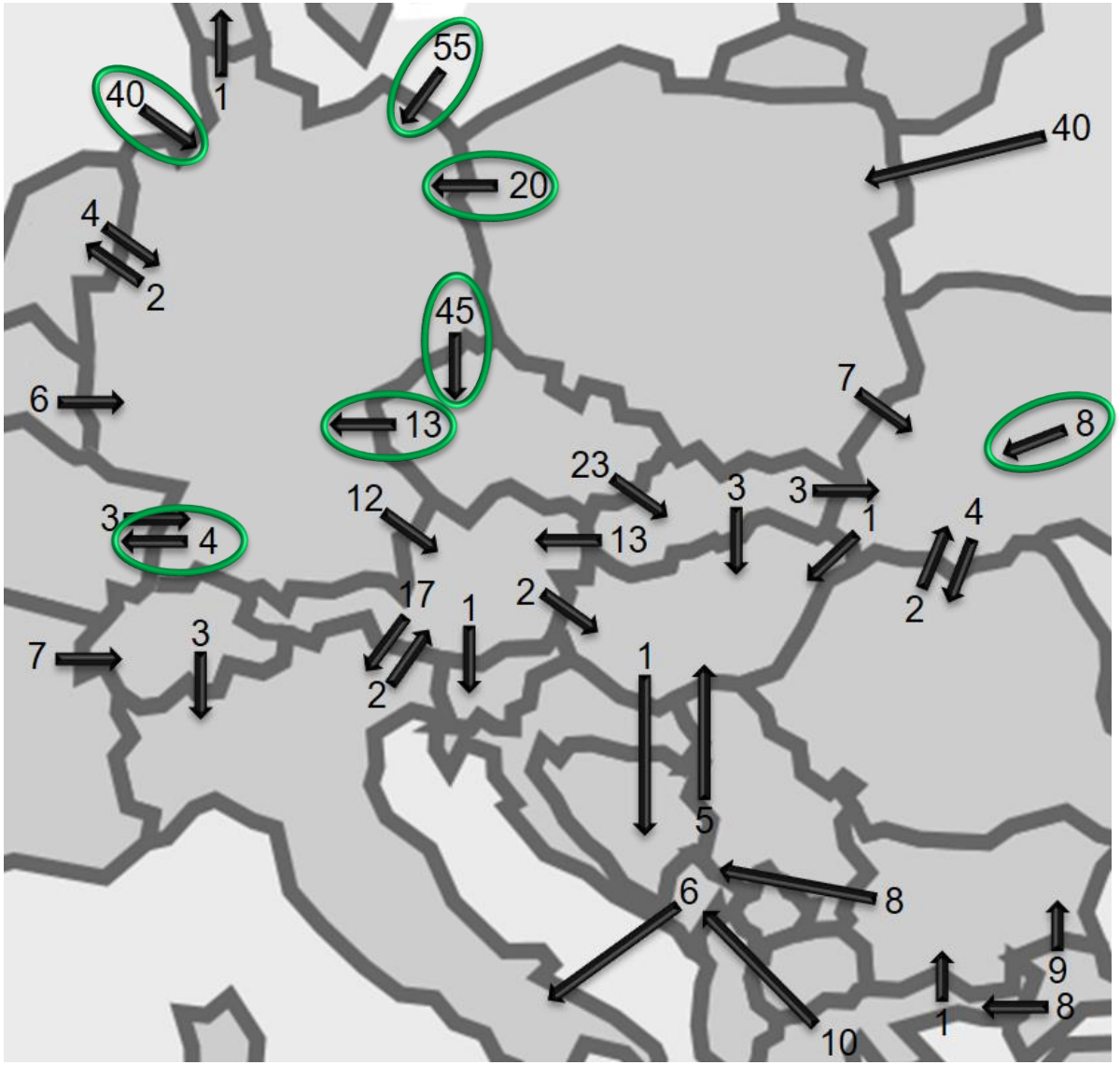
United Kingdom	France	Nether-lands	Germany	Czech Republic	Poland	Italy	Bulgaria	Romania
0.66	0.70	0.79	0.80	0.89	0.70	0.55	0.39	0.15

Pipeline flows in 2028 with Nord Stream 2



rounded volumes in bcm; only gas flows ≥ 1 bcma

Pipeline flows in 2028 without Nord Stream 2



rounded volumes in bcm; only gas flows ≥ 1 bcma

Conclusion

- With North Stream 2 in the presented Base Case
  - North Stream 2 is not fully utilized on an annual level
  - Gas flows from Norway to Germany are directed to Northwest Europe
  - Ca. 20 bcm of LNG are pushed out of the merit order in Northwest Europe in 2028
  - More transit flows via Germany (+17 bcm in 2028)
  - Less gas flows from Poland to Germany (-14 bcm in 2028)
  - Moderate reduction of wholesale gas prices in Europe

- Transit contract between Gazprom and Naftogaz expires; uncertainty about transit flows via Ukraine in long-term
- Transit flows via Ukraine are only a last option for Russia

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