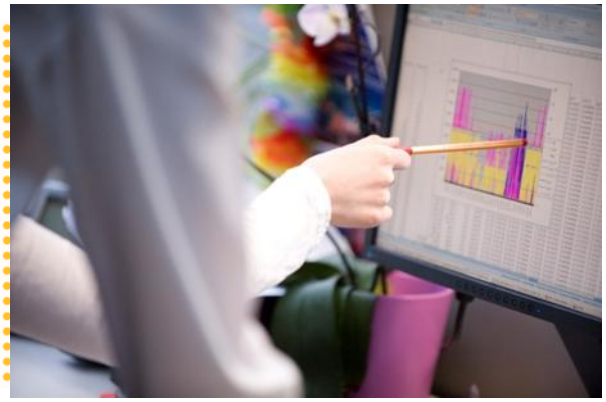
EWI Security of Supply Update

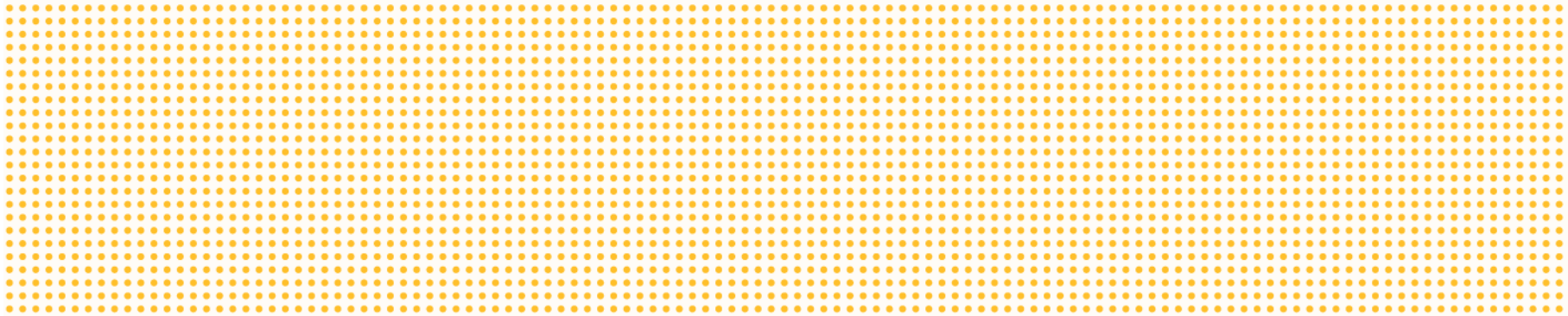
Simulation of current gas market developments in Europe with a special focus on Germany

Cologne| 09.03.2015 | Dr. Harald Hecking, Simon Schulte, Florian Weiser



Energiewirtschaftliches Institut der Universität zu Köln

1. Introduction

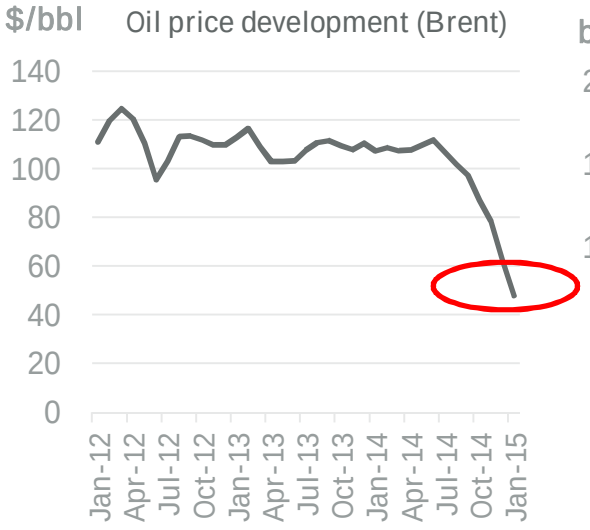


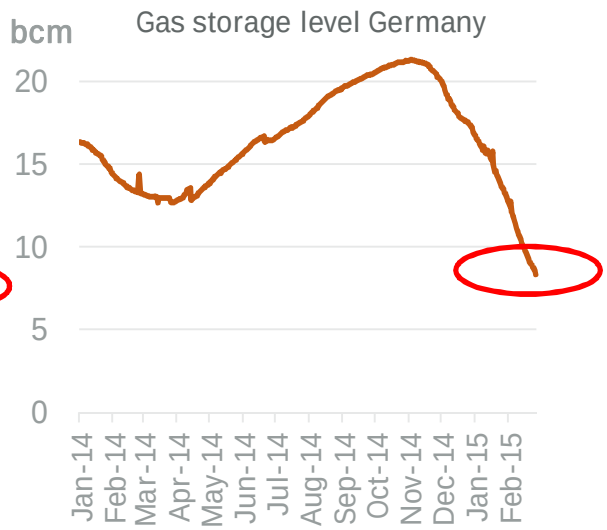
Low gas storage levels because of low oil prices

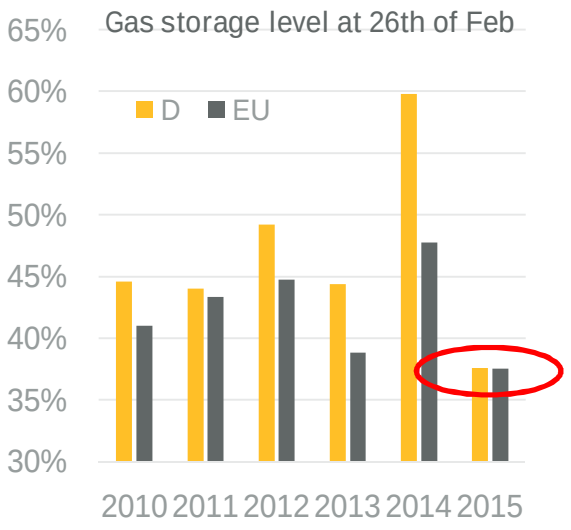
Oil market developments foster withdrawals from gas storages

- Significant part of long-term gas import contracts based on oil-indexation
- Price adjustments after 3 or 6 months, thus low contract-prices expected
- Traders have incentives to sell gas now

Gas storage in Germany and in Europe on a lower level than usually at the end of February.







Sources: World Bank (2015), own calculations based on GIE (2015)

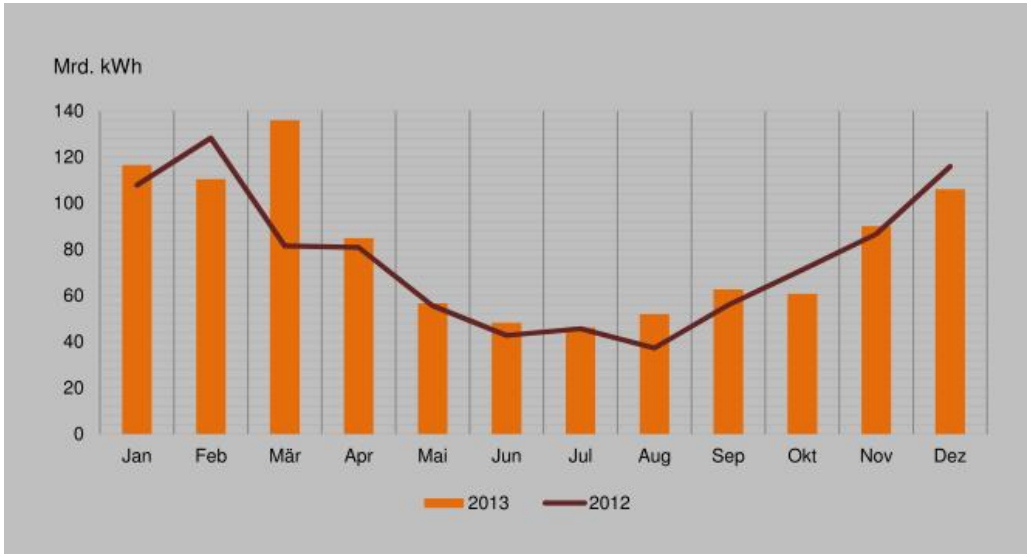
Risks for European gas supply

Risk factor 1: Ongoing gas dispute between Russia and Ukraine

"Therefore, gas delivery to Ukraine in the ordered amount of 114mcm will lead to a complete cessation of Russian gas supplies to Ukraine in just two days, which creates serious risks for gas transit to Europe." (Alexei Miller, Gazprom)

Risk factor 2: Low temperatures in March

- In March 2013, average daily gas demand in Germany stood at 410 mcm/d

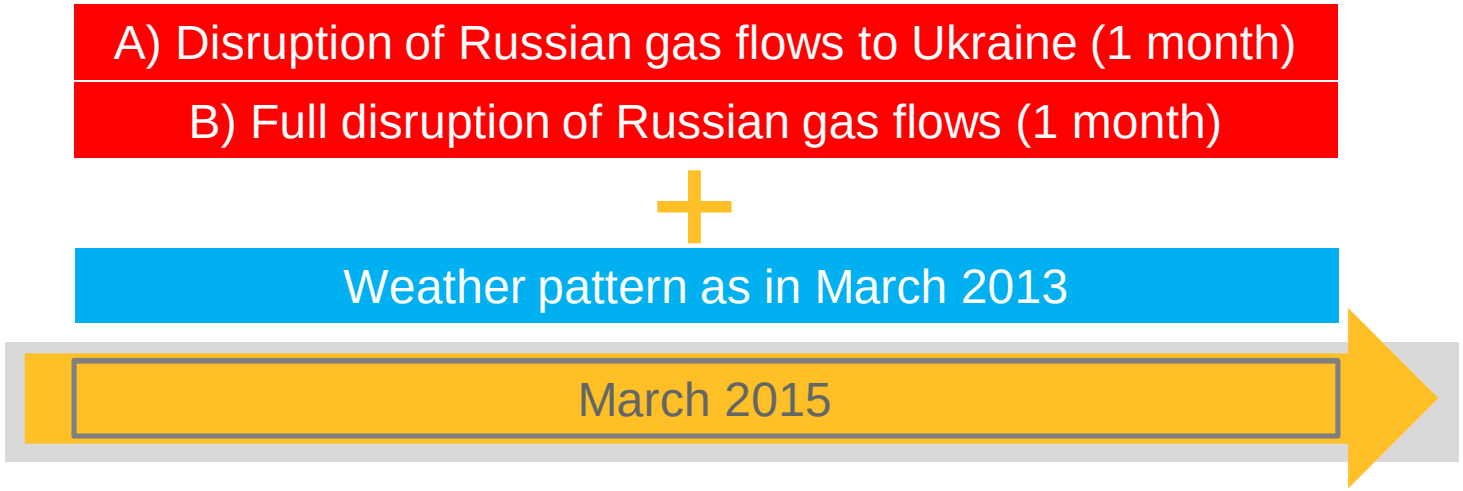


Source: AGEB Quartalsbericht (2014)

Simulation of disruption scenarios

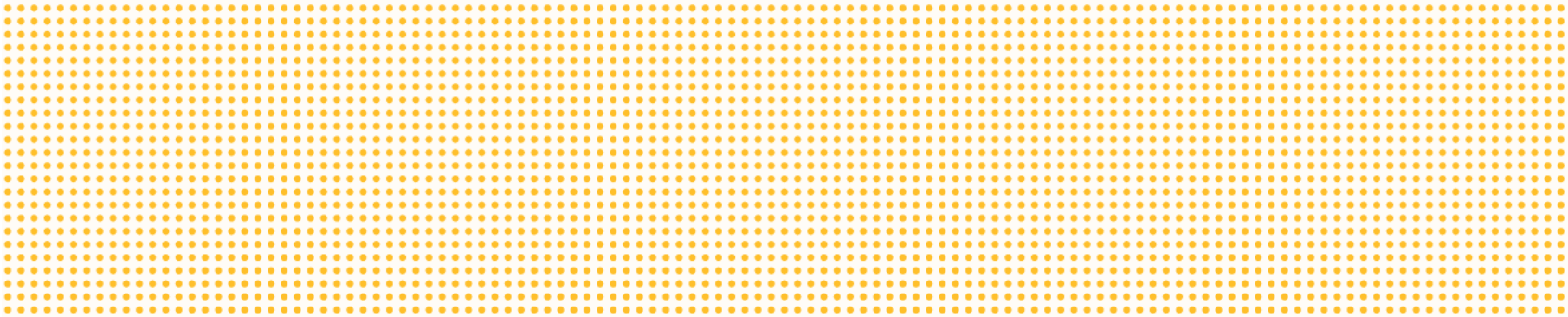
Methodology

- Use of the European gas market simulation model TIGER
- Simulation of two disruption scenarios (A and B) for 2015
  - current low storage levels
  - 1 month disruption starting on March 1st.
- Assuming a high gas demand as in March 2013



Is gas supply in Europe secure in March 2015?

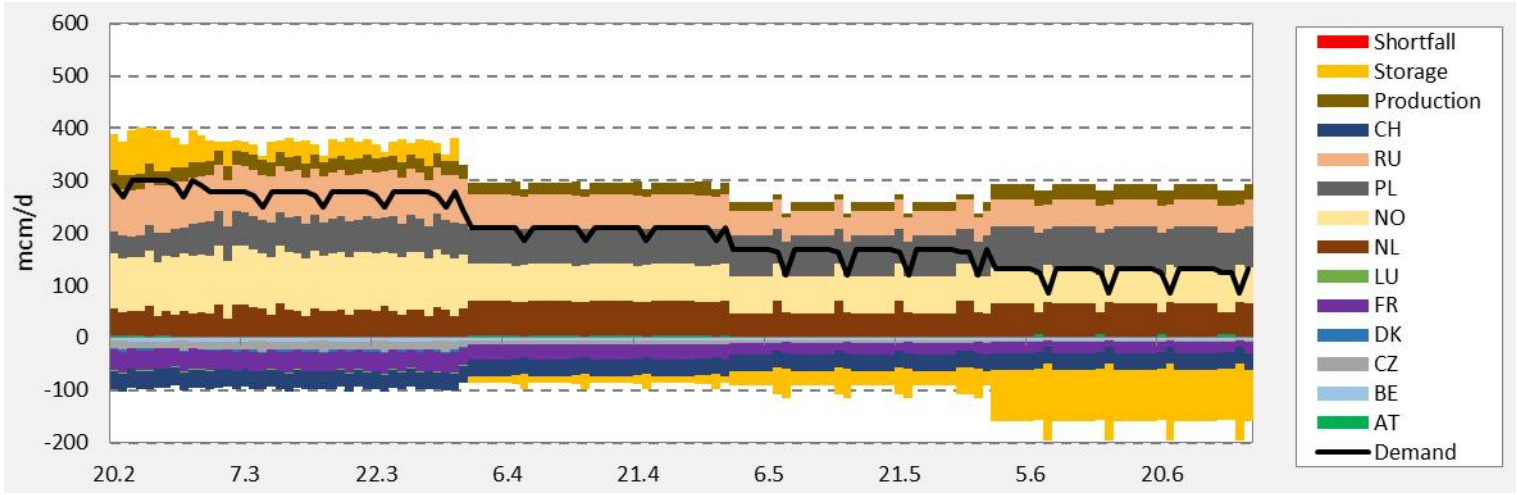
2. Results



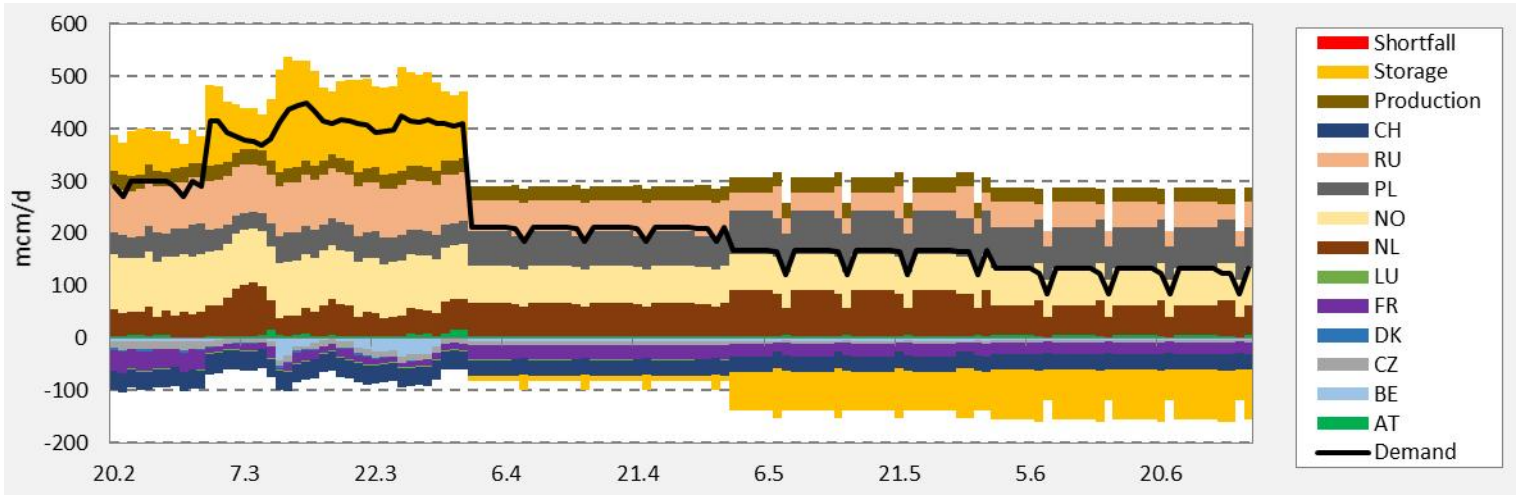
No disruption of Russian gas flows

German gas supply structure 2015

Normal situation



March cold spell

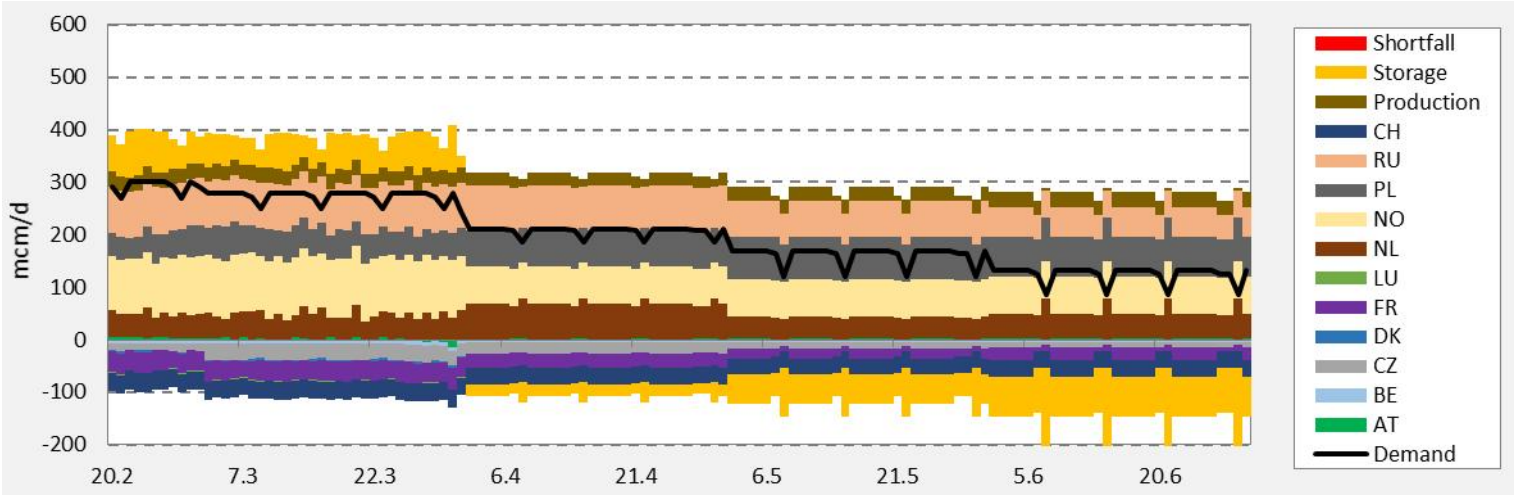


- Despite low storage levels, a March cold spell would not cause any supply problems in DE
- German gas storages would contribute up to 200 mcm/d

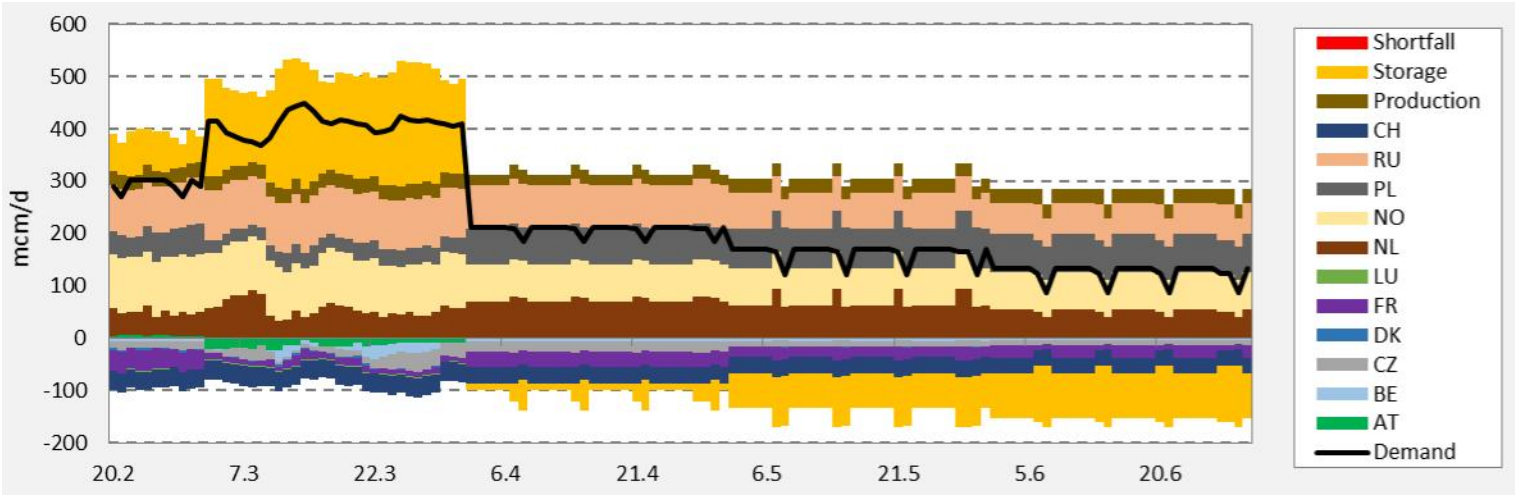
A) Disruption of Russia-Ukraine gas flows

German gas supply structure 2015

RU-UKR disruption + normal weather



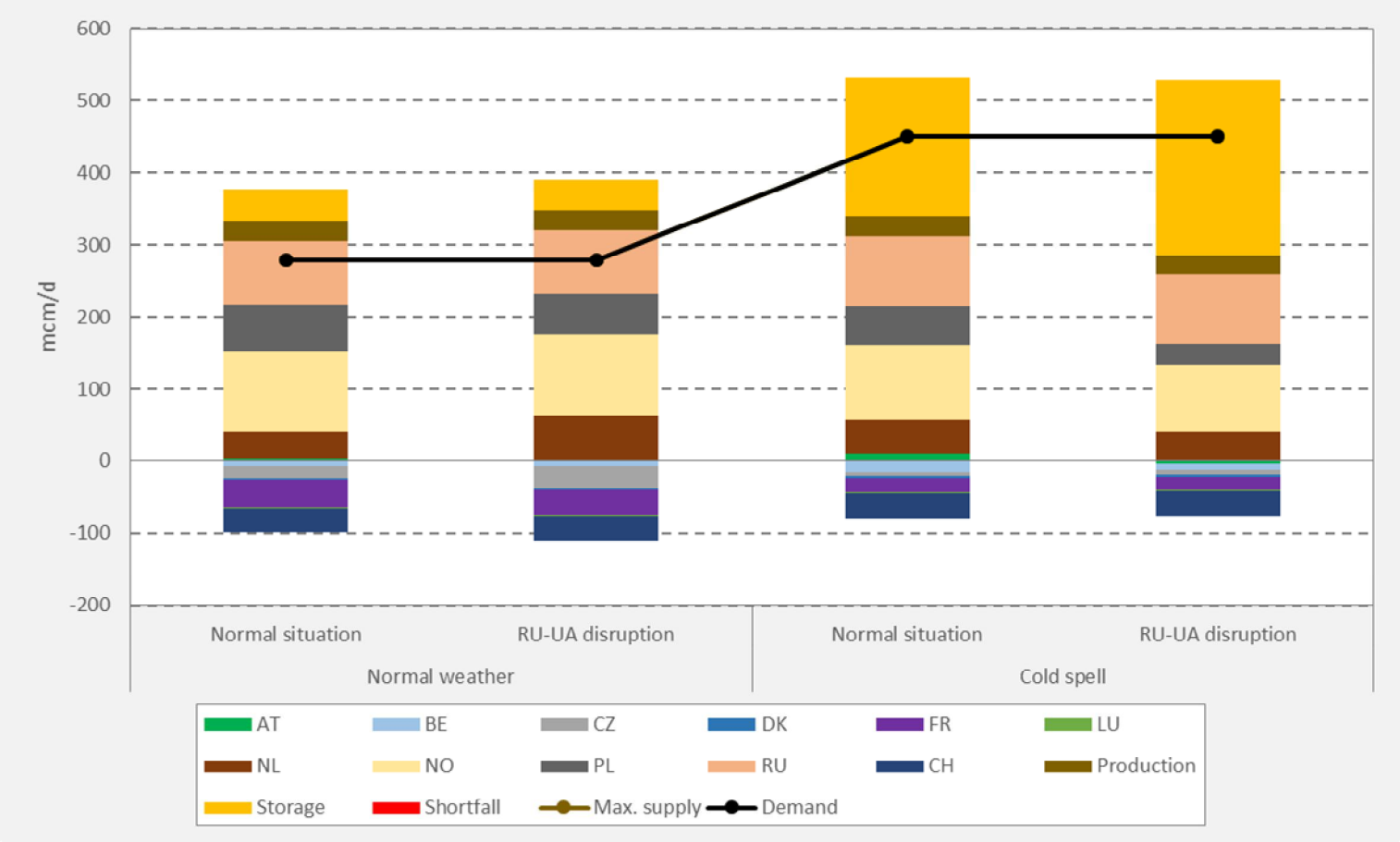
RU-UKR disruption + March cold spell



- In a Russia-Ukraine disruption plus March cold spell, German gas demand could be satisfied
- German gas storages and increased Nord Stream imports secure supplies
- Higher gas flows to Austria (via Oberkappel & Burghausen) and Czech Republic (via OPAL)

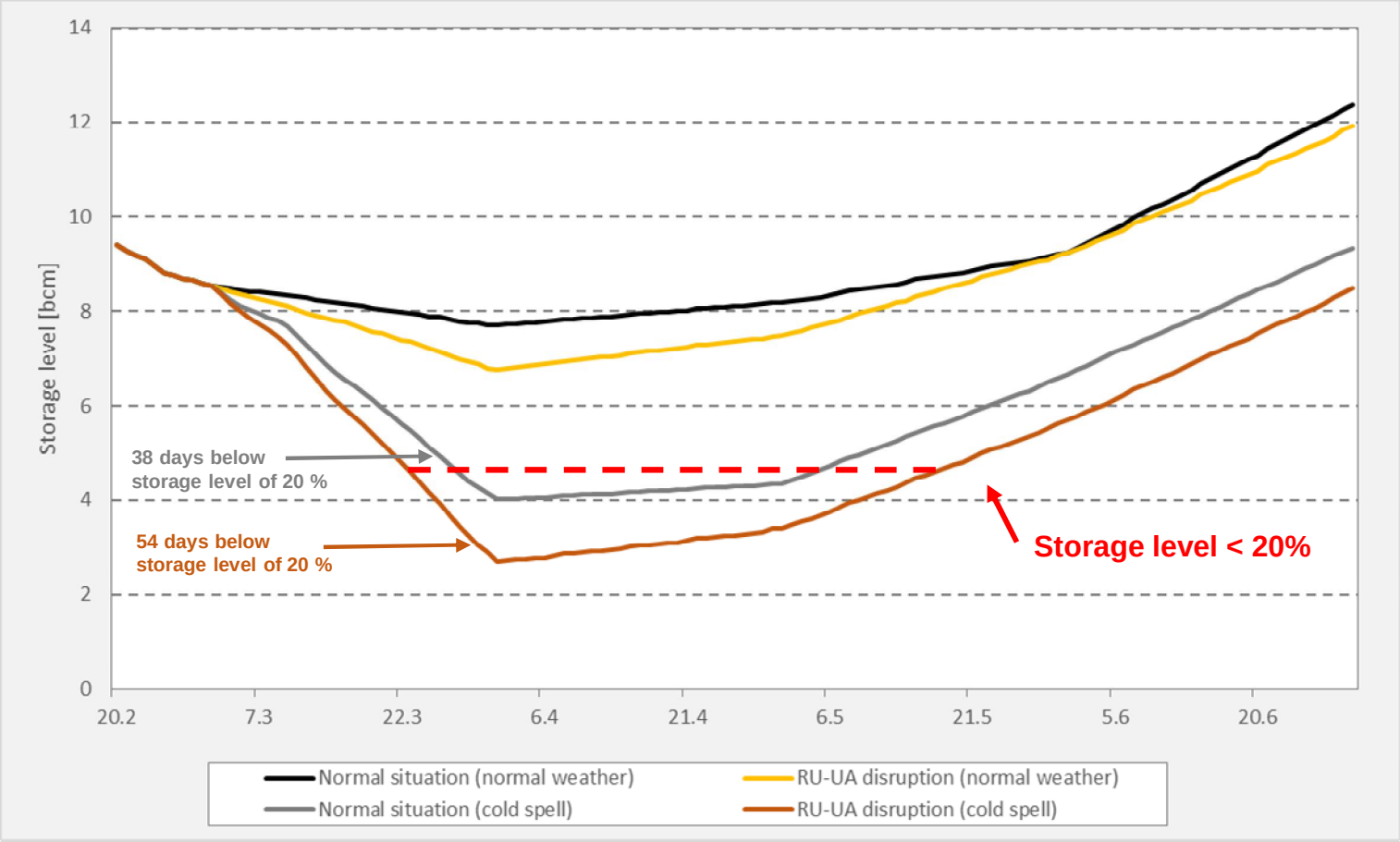
A) Disruption of Russia-Ukraine gas flows

Gas balance Germany on March peak day



- In a Russia-Ukraine gas flow disruption plus March cold spell, German gas storages contribute ca. 250 mcm on the peak demand day.

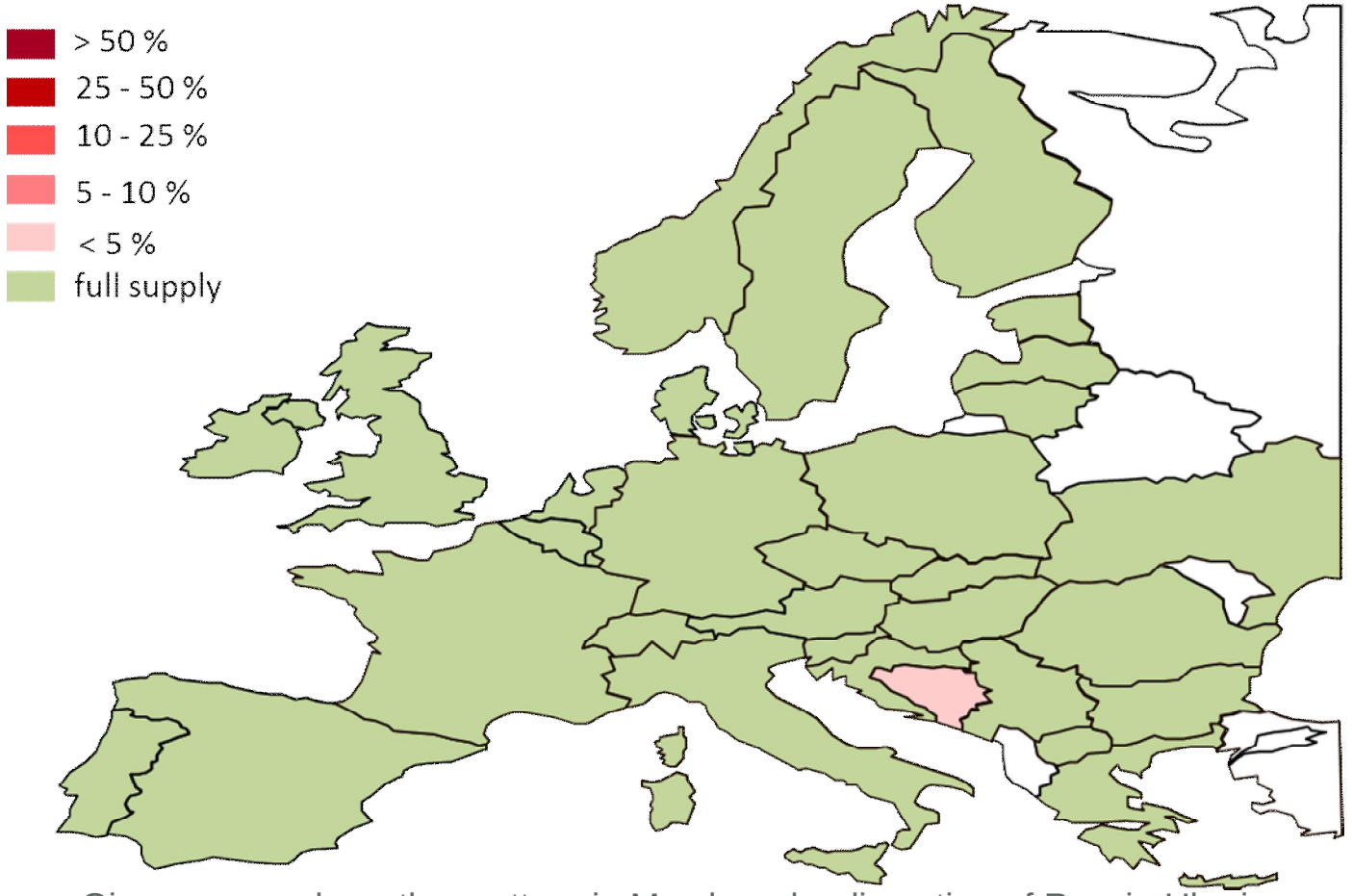
A) Disruption of Russia-Ukraine gas flows



- In a disruption of Russian-Ukraine gas flows German gas storages would reach critical filling levels
- Average storage levels would be below 20% for 54 days
- Depending on individual storage properties, low filling levels for a too long time period could cause problems with the geological stability of the storage

A) Disruption of Russia-Ukraine gas flows

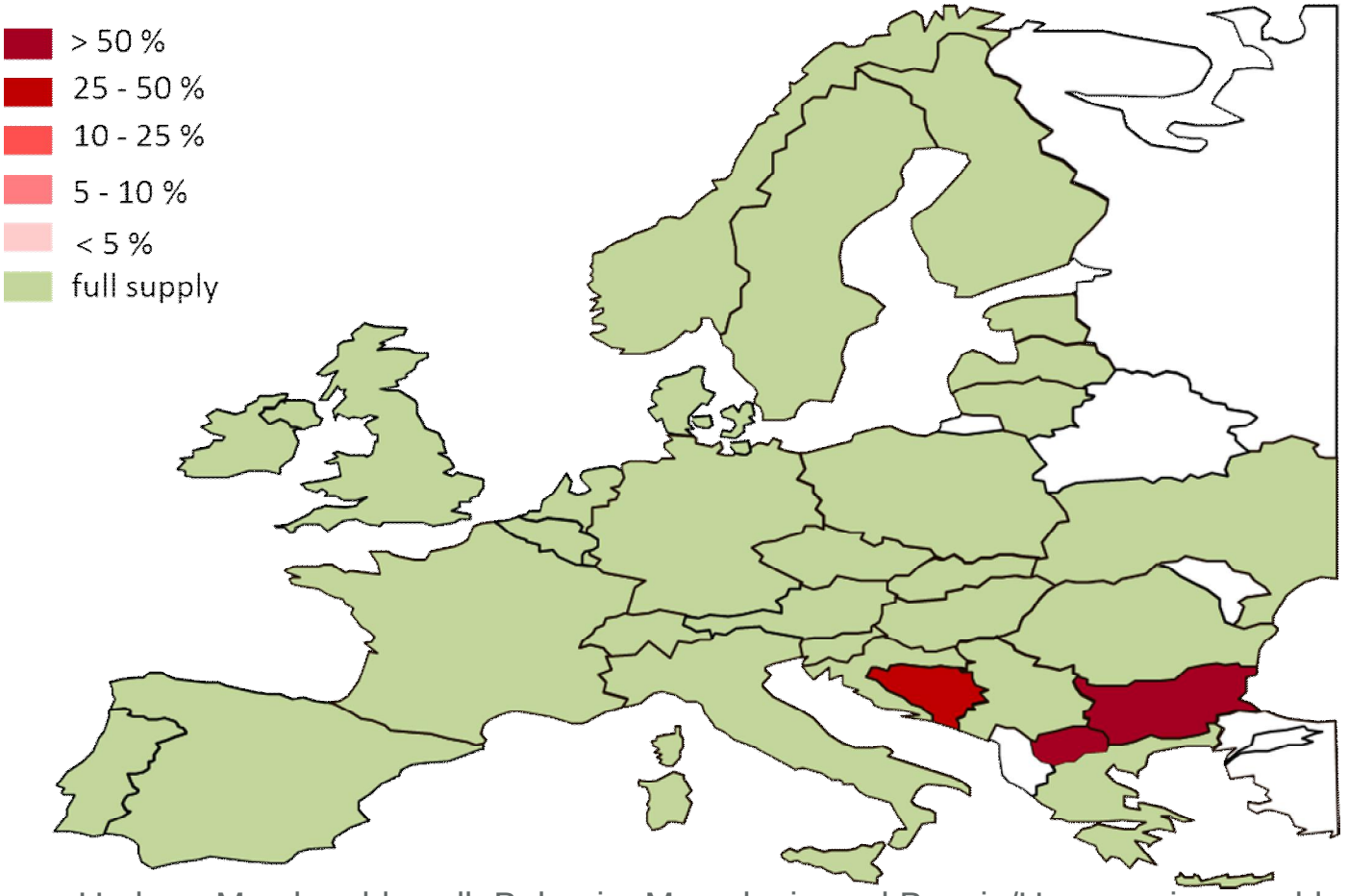
Maximum daily supply shortfall (normal weather)



- Given a normal weather pattern in March and a disruption of Russia-Ukraine gas flows, gas supplies could be secured in Europe by increased storage withdrawals and reverse flows

A) Disruption of Russia-Ukraine gas flows

Maximum daily supply shortfall (March cold spell)

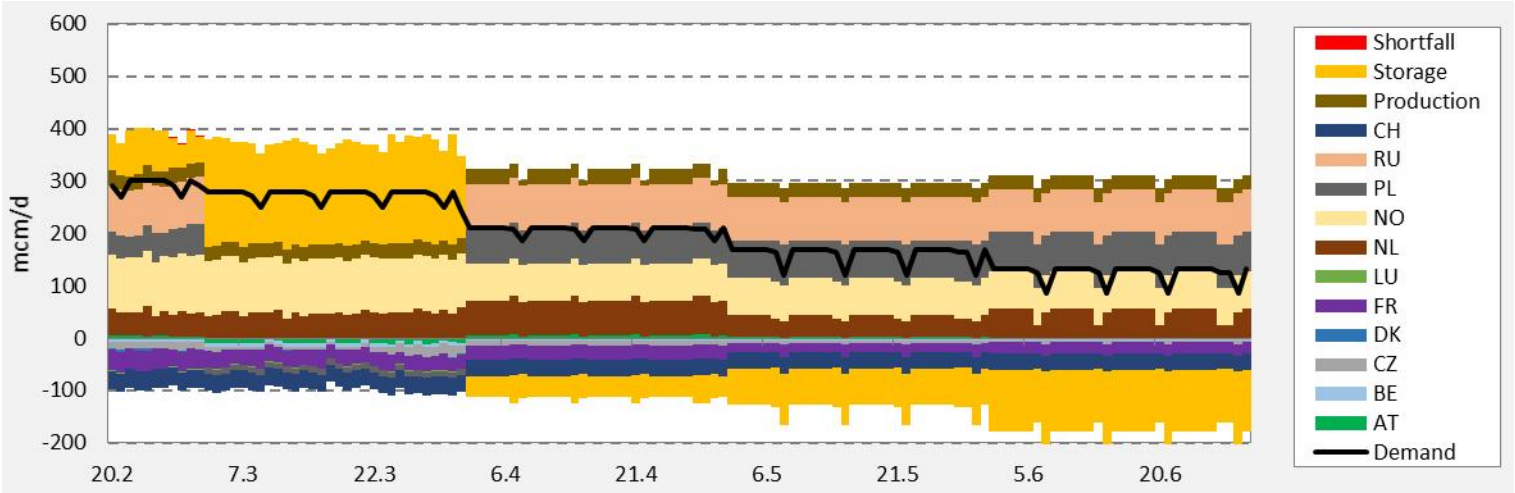


- Under a March cold spell, Bulgaria, Macedonia and Bosnia/Herzegovina would suffer from serious supply shortfalls with some days in March when shortfalls would exceed 50% (BG), 100% (MK) und 28% (BA)
- Other countries such as Hungary, Slovakia or the Ukraine benefit from their (compared to the demand) large storage capacities and reverse flows

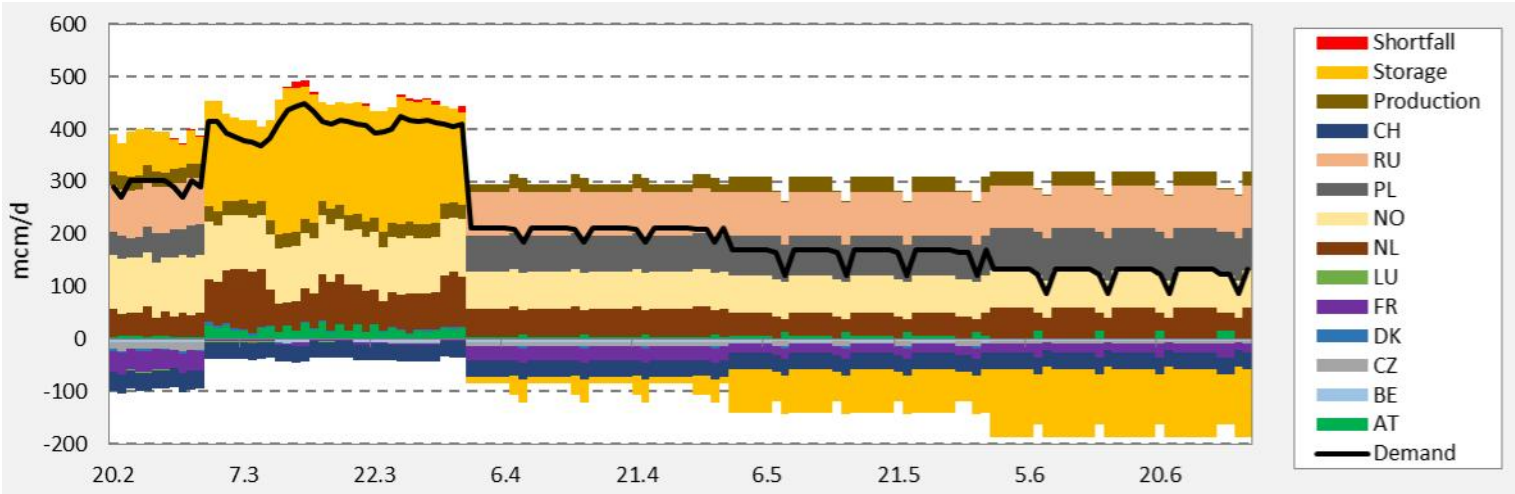
B) Full disruption of Russian gas flows

German gas supply structure 2015

Full RU disruption + normal weather



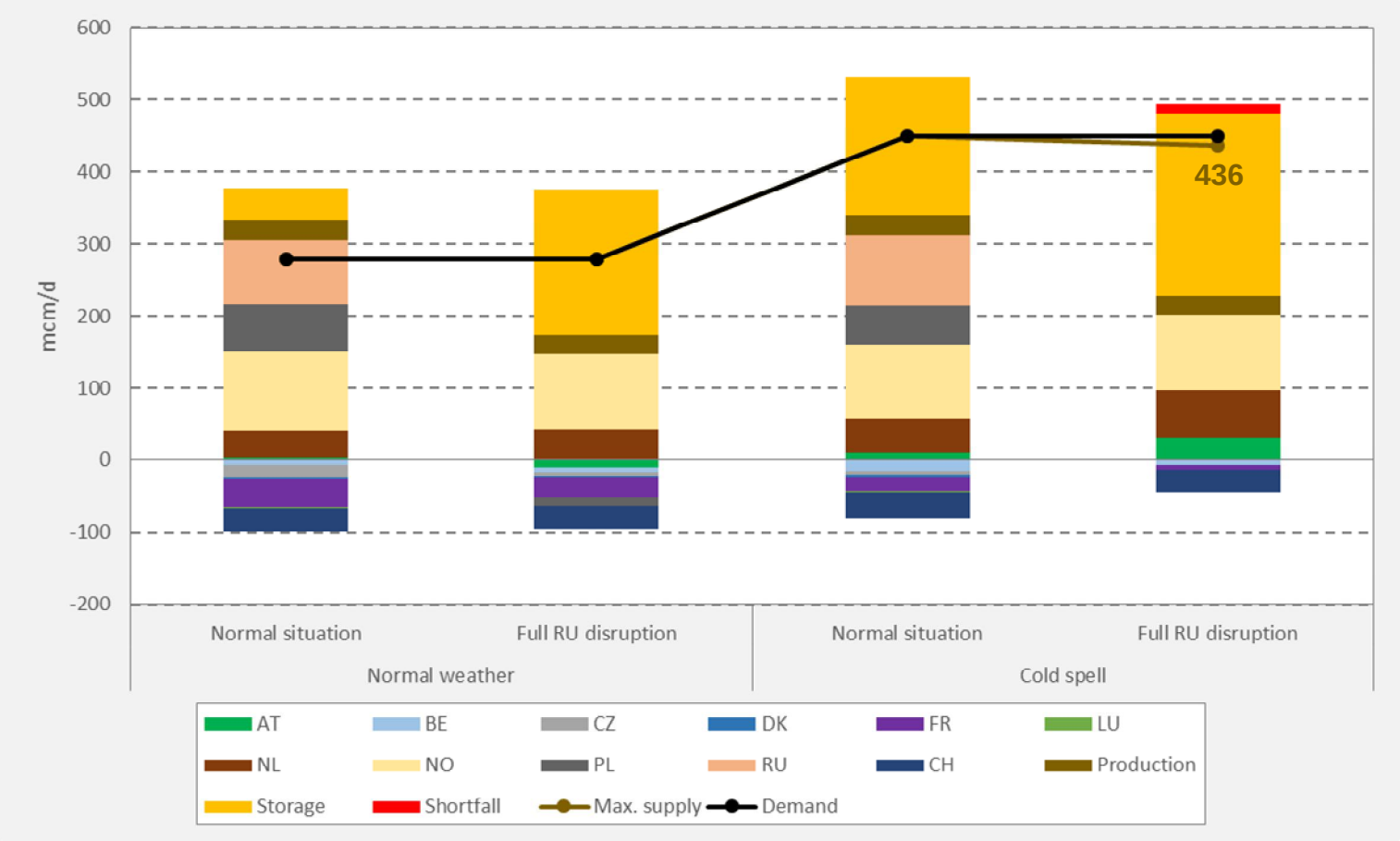
Full RU disruption + March cold spell



- In a full disruption of Russian exports (normal weather), German gas storages would fill the gap
- Assuming additionally a March cold spell, German gas demand could not be fully supplied
- Increased imports from NL and AT plus storage withdrawals would help to limit shortfalls

B) Full disruption of Russian gas flows

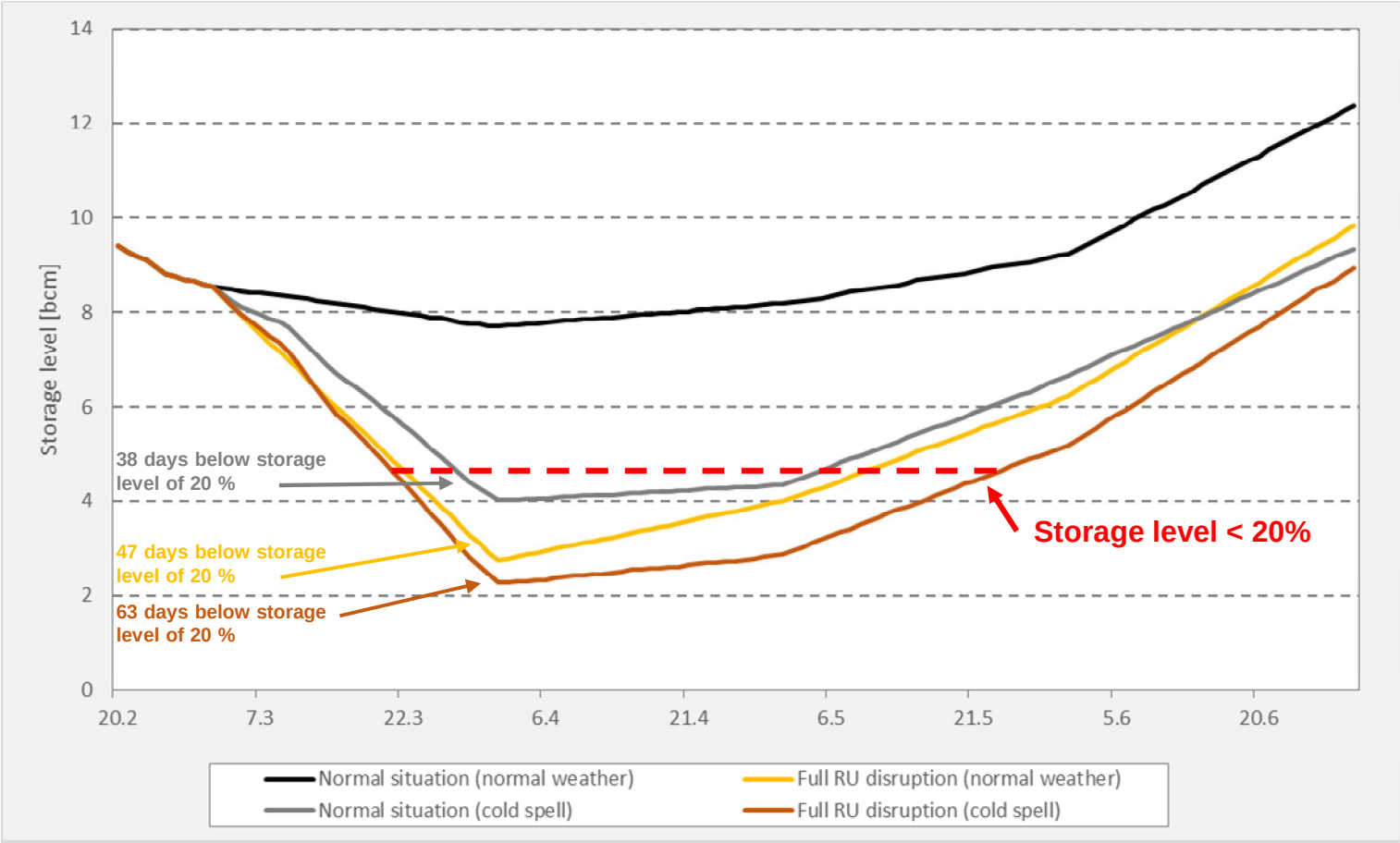
Gas balance Germany on March peak day



- In either a 1-month full disruption of Russian gas or in a March cold spell, German gas demand would be secure, mainly because of increased storage withdrawals (ca. 200 mcm/d)
- In a full disruption of Russian gas plus a March cold spell, the German gas market could be supplied with a maximum of 436 mcm/d, with German storages contributing roughly 270 mcm/d.

B) Full disruption of Russian gas flows

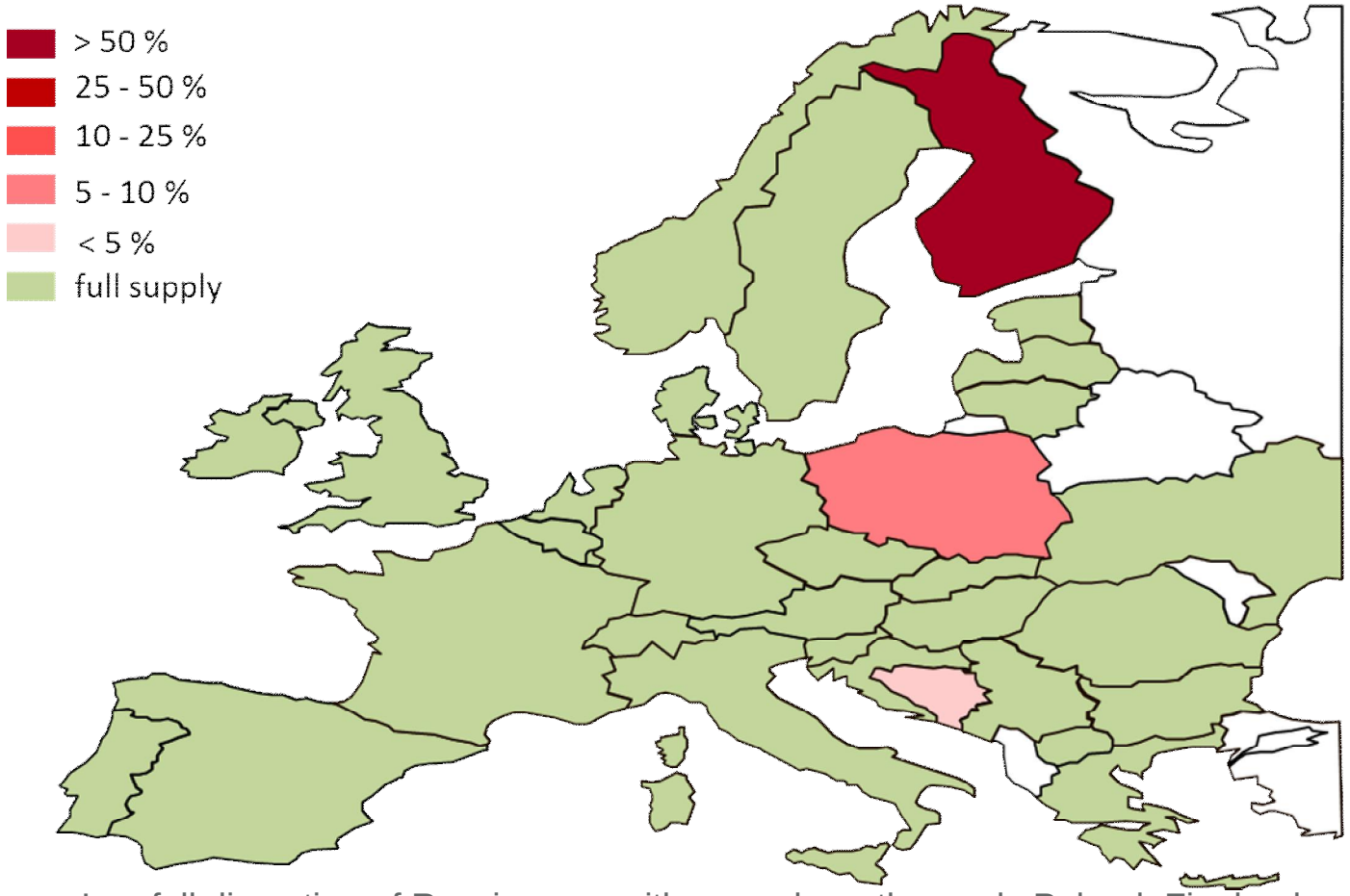
Storage levels in Germany reach critical levels



- In a full disruption of Russian gas flows German gas storages would reach critical filling levels
- For 63 days, average storage levels would be below 20%, for 3 days even below 10%
- Depending on individual storage properties, low filling levels for a too long time period could cause problems with the geological stability of the storage

B) Full disruption of Russian gas flows

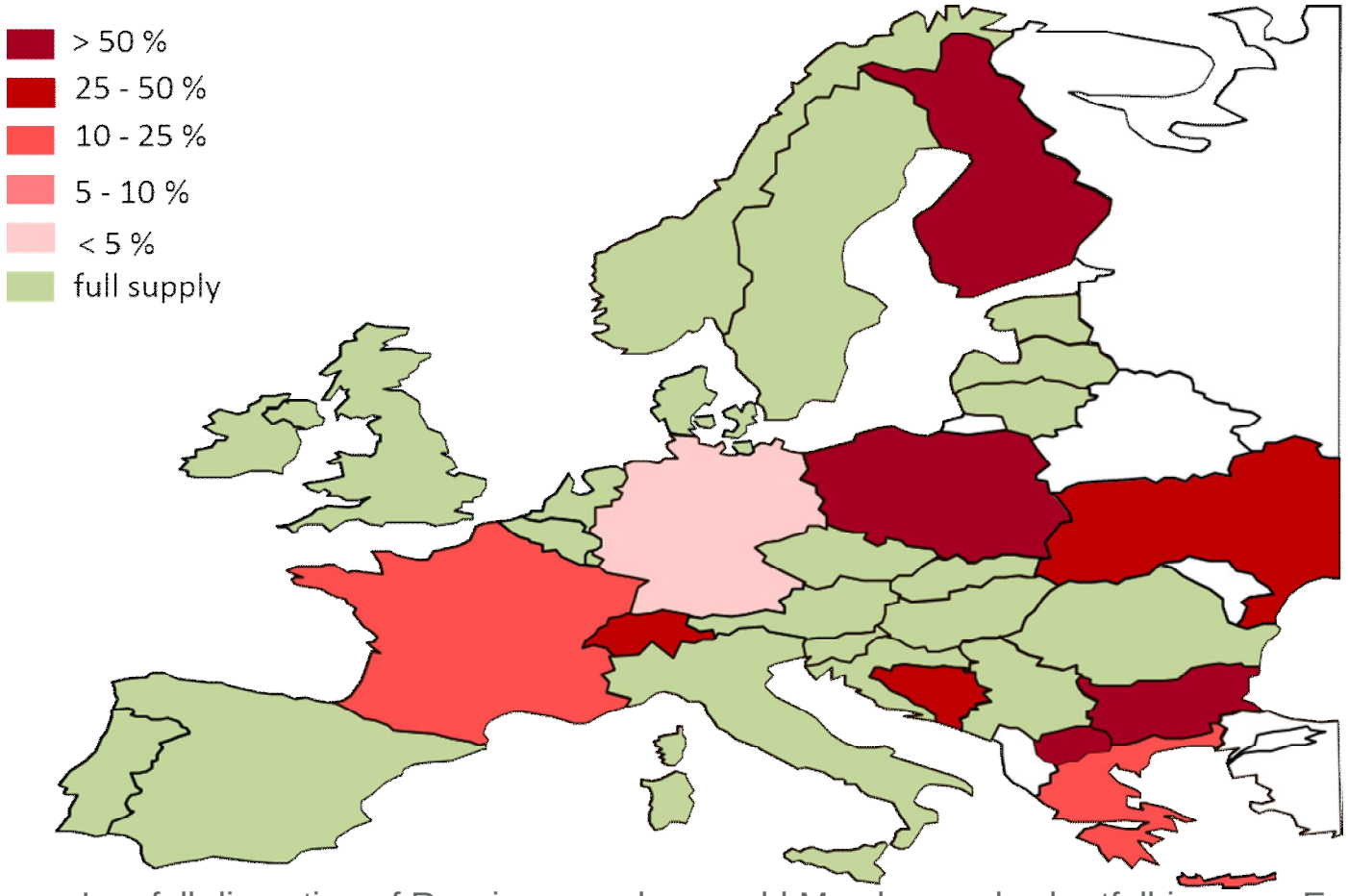
Maximal daily supply shortfalls by country (normal weather)



- In a full disruption of Russian gas with normal weather, only Poland, Finnland and Bosnia/Herzegovina would be affected.

B) Full disruption of Russian gas flows

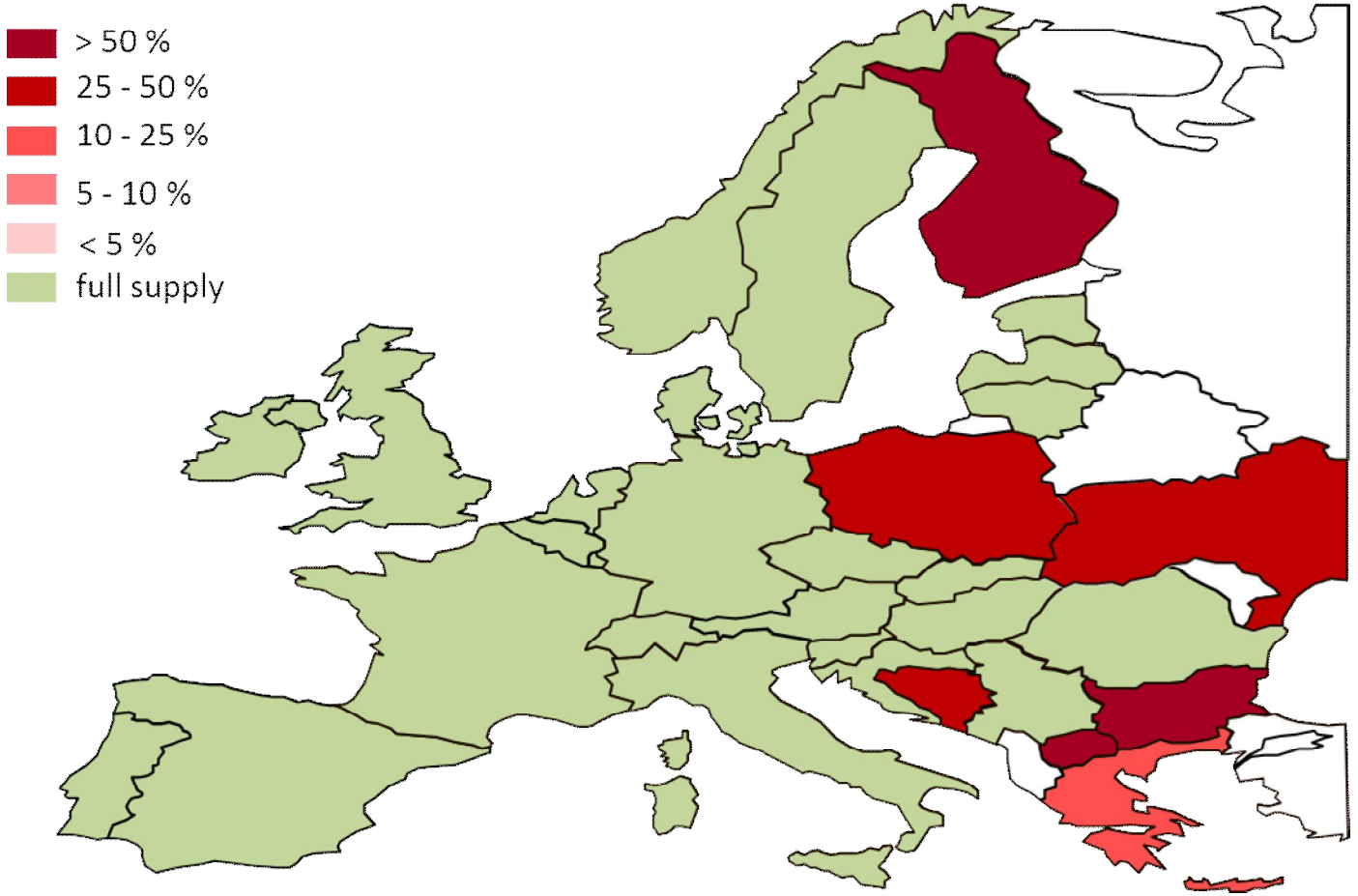
Maximal daily supply shortfalls by country (March cold spell, current LNG volumes)



- In a full disruption of Russian gas plus a cold March, supply shortfall in many European countries could occur (assuming current levels of LNG imports to Europe).
- Countrywise supply problems could increase/decrease with different cold spell gas demand assumptions

B) Full disruption of Russian gas flows

Maximal daily supply shortfalls by country (March cold spell, additional LNG imports available after 10 days)



- Assuming additional LNG imports arriving in Europe 10 days after the disruption starts, supply problems would occur in Eastern Europe, whereas Western and Central Europe were fully supplied
- LNG availability (in particular the time lag until additional ships reach Europe) is crucial to the supply situation

Which factors could alter the picture?

Uncertainty of events

- Colder/warmer weather (hence, gas demand) in different countries/regions, especially during March cold spell
- Additional disruptions of gas infrastructure

Uncertainty of behavior

- Longer/shorter duration of a disruption of Russian gas
- Will European countries really perfectly cooperate (as assumed)?

Limited data

- Higher/lower production flexibility for certain gas fields (e.g. Groningen field)
- More/less flexibility from LNG imports (position of LNG vessels not modelled)
- Local infrastructure specifics in certain countries (could cause regional supply problems)
- Fuel switching to other primary energy
- Minimum filling level of certain storages because of geological stability

3. Conclusion

Conclusion

Germany

- A 1 month **Ukraine transit disruption** would not cause any supply problems for Germany even during a very cold March
- Supply would also be secure during a 1 month **full disruption** of Russian gas deliveries with normal weather conditions because of gas storages
- In a very cold March as in 2013, a 1 month **full disruption** of Russian gas deliveries would cause minor supply shortages (ca. 3% of daily demand) with gas storages providing most of the needed gas
- However, gas storages would reach critical levels, signaling that securing supply would stress the gas system to the utmost

Europe

- In a 1 month **Ukraine transit disruption** with a cold March Bulgaria, Bosnia/Herzegovina and Macedonia would suffer from supply shortages
- Many countries including Ukraine itself would secure supply by increased storage withdrawals and reverse flows
- During a 1 month **full disruption** of Russian gas deliveries with a March cold spell, gas supply in many Eastern European countries would fall short, Ukraine included
- France‘s security of supply heavily relies on additional LNG imports

Thank You for Your Attention

Any Questions or Remarks?

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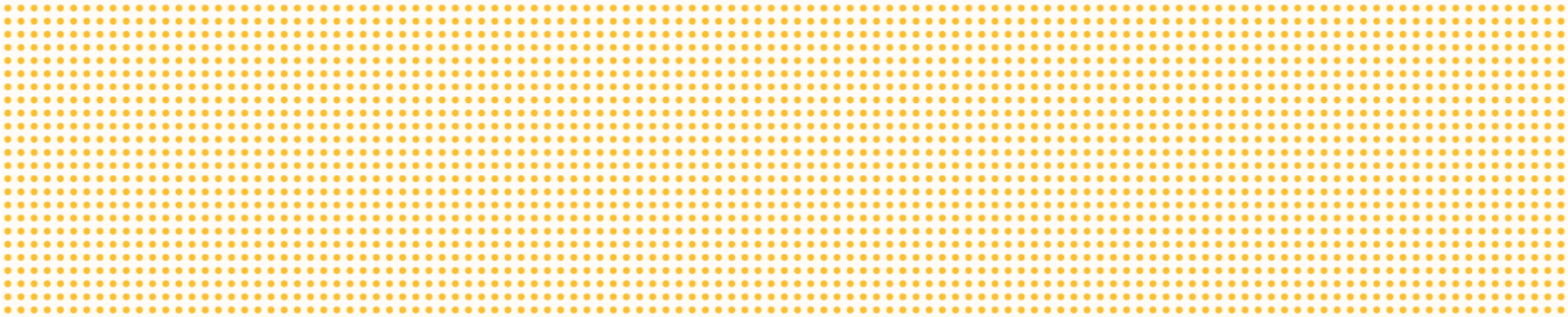
Appendix – Assumptions



Assumptions

Demand during the cold spell in March

	Normal weather		Cold spell	
Country	Peak demand (mcm/d)	Average demand (mcm/d)	Peak demand (mcm/d)	Average demand (mcm/d)
DE	279	273	450	409
DK	14	14	20	15
FR	181	178	240	181
BE	68	65	85	65
NL	137	135	182	142
IT	267	263	287	237
GB	274	270	351	298
CZ	35	35	40	33
HU	39	38	47	36
SI	3	3	4	3
ES	113	110	112	86
PT	15	15	15	13
PL	61	61	73	72
AT	31	30	41	37
SK	14	14	19	17
UA	175	175	210	209
BG	12	12	15	14
GR	13	13	16	15
RO	44	44	53	53

Assumptions

LNG availability

- LNG availability: 54,5 bcm/y and 166 mcm/d
- Two sensitivities:
  1) No additional LNG imports available during March
  2) Additional LNG imports available 10 days after the disruption starts