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for gas

ADDENDUM TO THE

ENTSOG UNION-WIDE **SECURITY OF SUPPLY SIMULATION REPORT**

OCTOBER 2020

Contents

1. Introduction

This document is an addendum to the Union-wide simulation of gas supply and infrastructure disruption scenarios (SoS simulation) report published on October 25, 2017. Since Report publication, plenty of major infrastructures have been commissioned across the Europe beneficial to security of gas supply. After the request from Gas Coordination Group members, scope of re-simulation was defined. Based on assumptions agreed by GCG (listed further in this document), ENTSOG performed data collection (same data as used in the Winter Supply Outlook 2020/2021) and performed simulations.

This study considers 3 scenario disruptions defined in 2017 SoS Simulations based on the major infrastructure investments commissioned in 2019 (Balticconnector between Finland and Estonia and a new import capacity from Russia via Turkey to Bulgaria):

	Risk Group	*#*	*Disruption scenario*
Eastern gas supply	*Ukraine*	*1*	*Disruption of all imports via Ukraine*
	North-Eastern	*5*	*Disruption of all imports to the Baltic states and Finland*
	Trans-Balkan	*6*	*Disruption of the largest infrastructure to the Balkan region*

2. Assumptions

As far as possible, assumptions are taken from SoS Report 2017. In case of infrastructure data, model is using up to date information to perform simulations in currently operating infrastructure (data collection started from May 11th, 2020 until mid-June) environment and considering actual supply potentials.

For every disruption scenario historical high demand winter situation was used (defined in SoS 2017)

This study considers 3 disruption cases (same as in SoS 2017)

- Short disruption: simulation of peak day with disruption – simulated on 15 February
- Medium-term disruption (2 weeks): simulation of 2-week cold spell with disruption (all scenarios), and additionally simulation of 2-week cold spell with disruption and observation until end of March (Scenario 6)
- Longer disruption (2 months): simulation of disruption from 1 January to 28 February (in case of Scenario 1 and 5)

Modelling

- Supply
    - Underground storage: storage level is set at beginning of the winter on the extreme low level (82% across EU, 42,7% in LV) defined in SoS 2017, but using present working gas volumes of gas storage infrastructure in Europe (1,109 TWh) (Source: Winter Supply Outlook 2020/2021)
    - Cross-border solidarity schemes in the EU: a cooperative behaviour in line with SoS regulation is simulated

- Different gas supply potential are defined in line with TYNDP 2020 Scenario Report https://www.entsos-tyndp2020-scenarios.eu/
- National Production values are based on the data provided by TSOs for Winter Supply Outlook 2020/2021 data collection

- Demand

  Demand values submitted by TSOs and used for SoS 2017 simulations.

- Infrastructure: the infrastructure level used for the simulation corresponds to the European infrastructure of May 2020 when data was collected.

3. Results

The results are presented considering cold winter demand:

- Without disruptions (to check whether any impact on some countries could be attributed to the climatic conditions and not the supply route disruption)
  - Whole Winter: from October to March
  - 2 Week cold spell: from 15 to 28 of February
  - Peak Day: the 15 of February

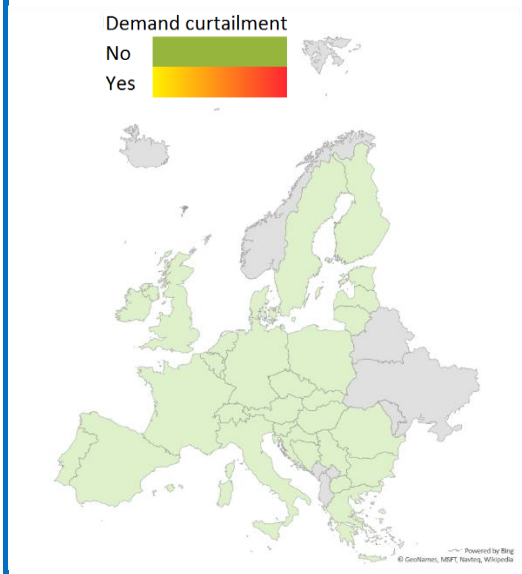
- with disruptions
  - Longer disruption (2 months): simulation of disruption from 1st of January to 28th of February
  - Medium-term disruption (2 weeks): simulation of 2-week cold spell with disruption - 15 to 28 of February
  - Short disruption: simulation of peak day with disruption – 15 of February

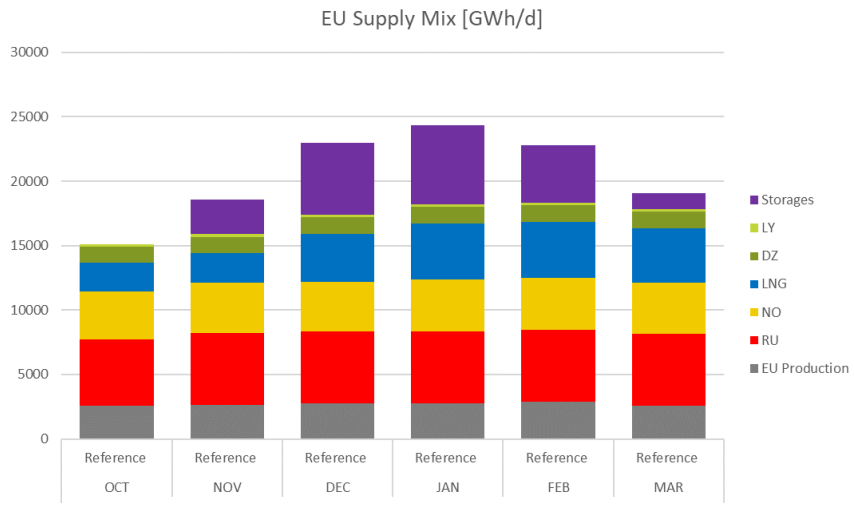
4. Results analysis

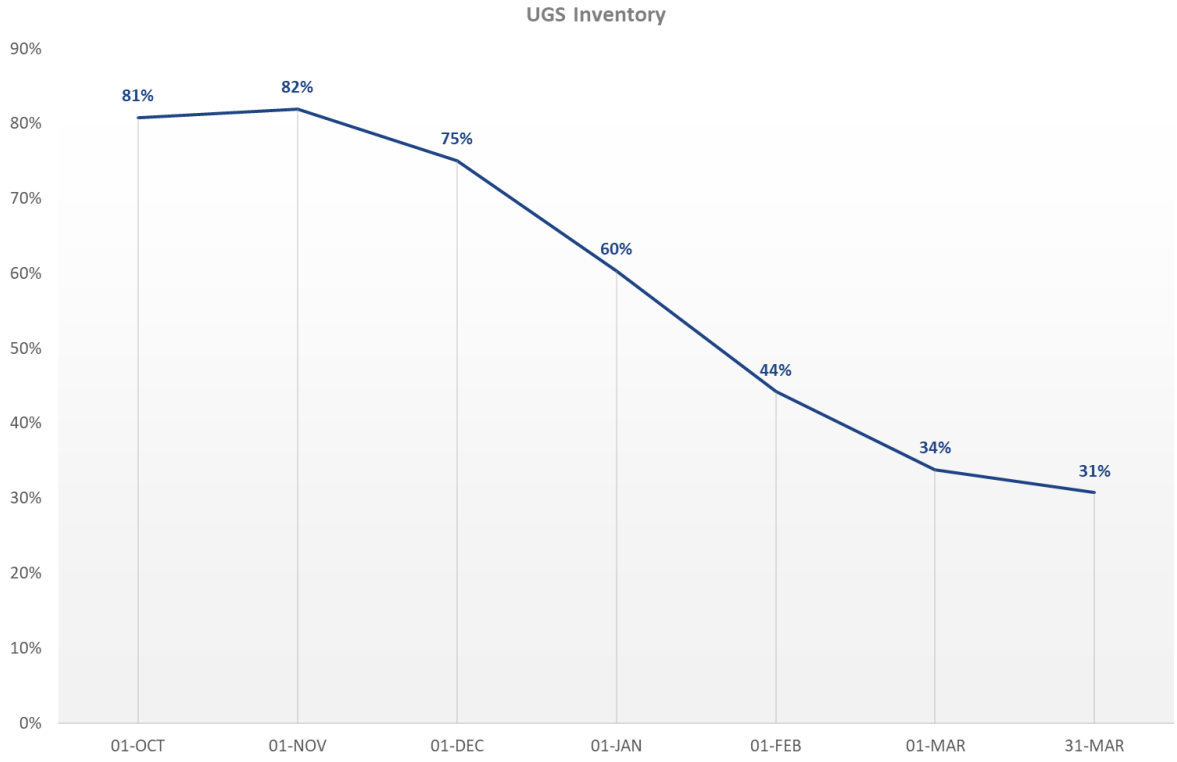
REFERENCE SCENARIO COLD WINTER	REFERENCE CASE (COLD WINTER)
Risk group:	Not applicable
Scenario duration:	No disruption

Simulation results

Whole winter







REFERENCE SCENARIO COLD WINTER

REFERENCE CASE (COLD WINTER)

Supply

Storages: Filling level ends around 31% on 31 of March at EU which means that all European countries reach the target of their working gas volume (WGV). In general, gas is still injected in the storages in October and withdrawal is observed in all countries from November to March. High withdrawal is observed during month with highest demand: December, January and February.

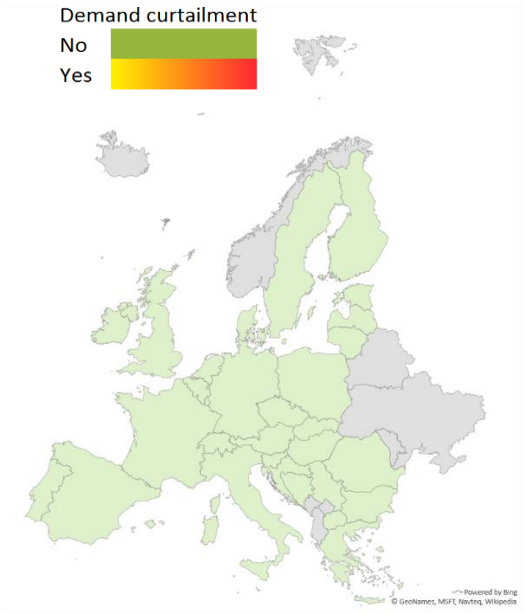
Pipeline and LNG supplies: Supplies are used at the maximum level defined at supply potential for whole winter. Thanks to additional investments and huge LNG market development in recent years there is flexibility to satisfy demand in case of disruptions event. Capacity bottlenecks, lack of sufficient interconnections or even region isolation might limit possibility of demand satisfaction.

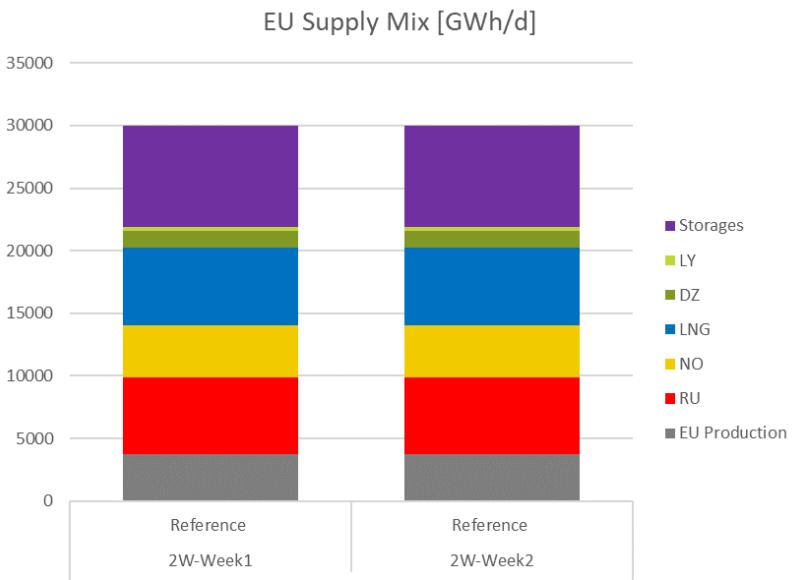
Demand

No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

2-week / 20 years –Simulated from 15 to 28 February





Supply

Storages: used at their maximum withdrawal capacities in Bulgaria, Hungary, Latvia and Serbia. In other countries, still additional usage possible.

Pipeline and LNG supplies: Supplies are used at the maximum level defined at supply potential for whole winter.

Demand

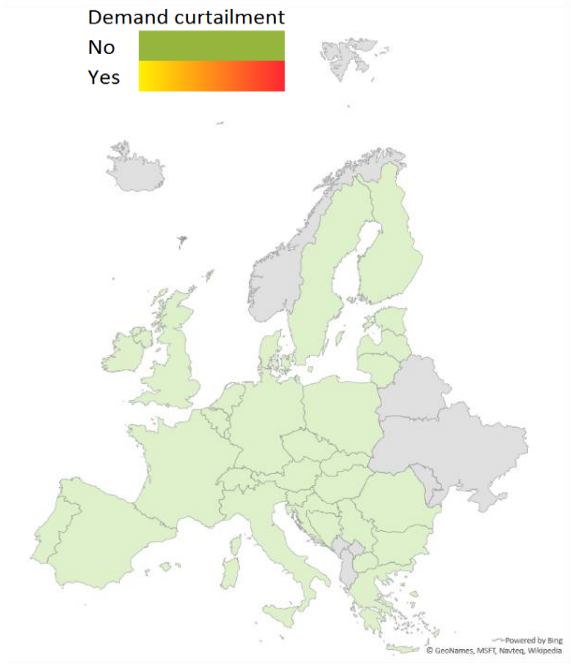
No country is exposed to demand curtailment.

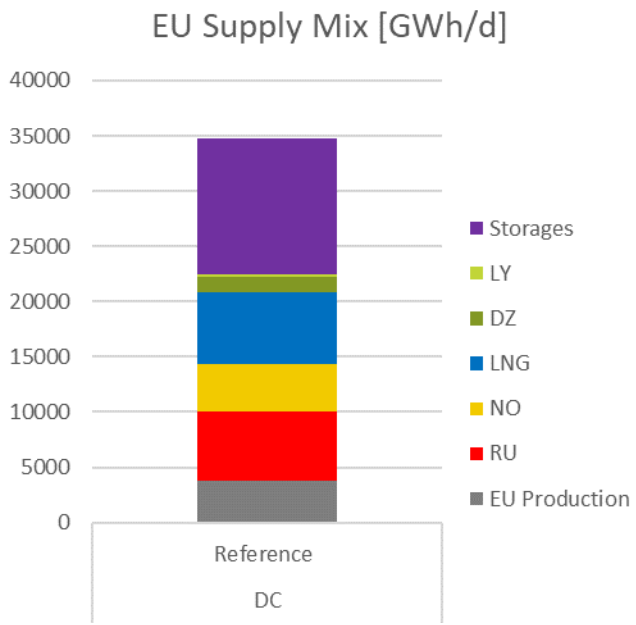
Exports to Ukraine (UA) can be maintained.

REFERENCE SCENARIO COLD WINTER

REFERENCE CASE (COLD WINTER)

Peak day (DC) / 20 years – 15 February.





Supply

Storages: used at their maximum withdrawal capacities in Bulgaria, Croatia, Hungary, Latvia and Serbia. In other countries still additional usage possible.

Pipeline and LNG supplies: Supplies are used at the maximum level defined at supply potential for whole winter.

LNG Tank: In total LNG tanks can provide the maximum send out. Therefore, the LNG supply reach up to 100% of it send out capacity in February peak day

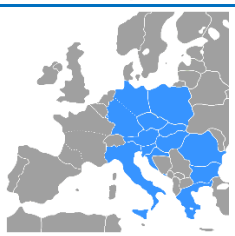
Demand

No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

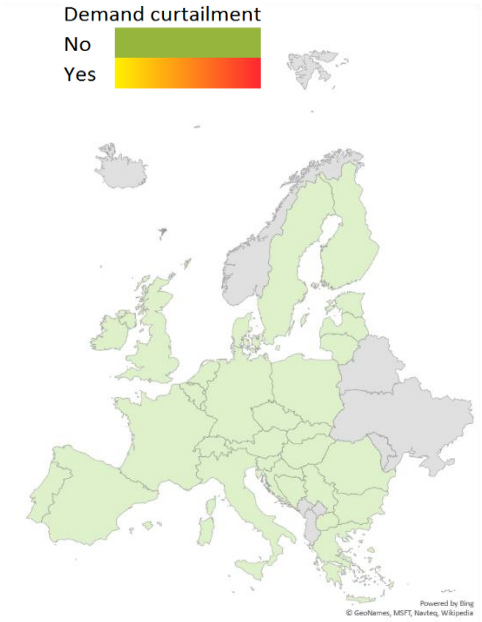
1. Disruption of all imports to EU via Ukraine

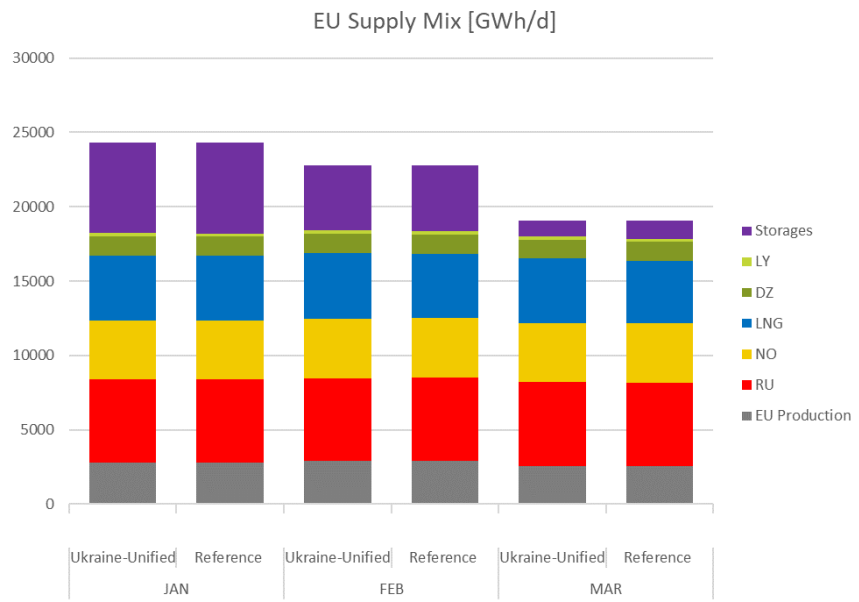
Risk group:	Eastern gas supply – Ukraine
Austria, Bulgaria, Croatia, Czech Republic, Germany, Greece, Hungary, Italy, Luxembourg, Poland, Romania, Slovenia, Slovakia	
Scenario duration:	2 months (1 January – 28 February)

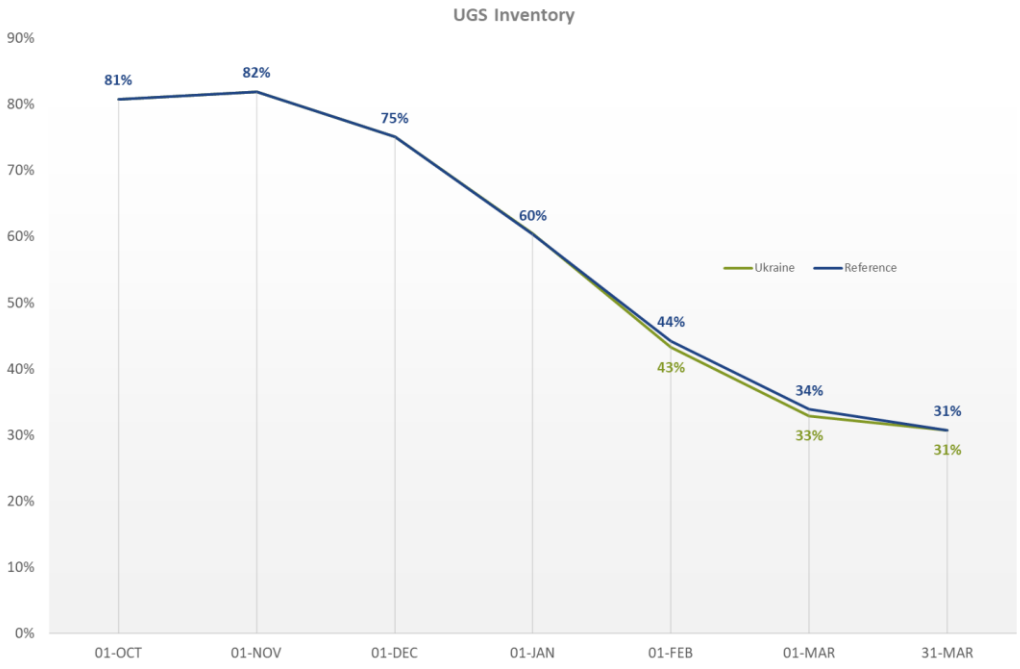


Simulation results

January – March







1. Disruption of all imports to EU via Ukraine

Supply

Storages: Storage usage very similar to Reference situation with slightly small usage during whole period (around 21 TWh less in total).

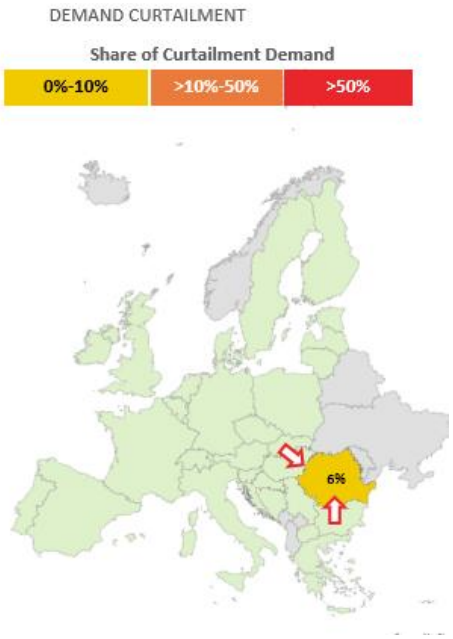
Pipeline and LNG Supplies: The flows from Russia remained almost at the same level thanks to other available routes (Belarus, Nord Stream and Turk Stream). Imports from Norway remained at same level and LNG slightly increased.

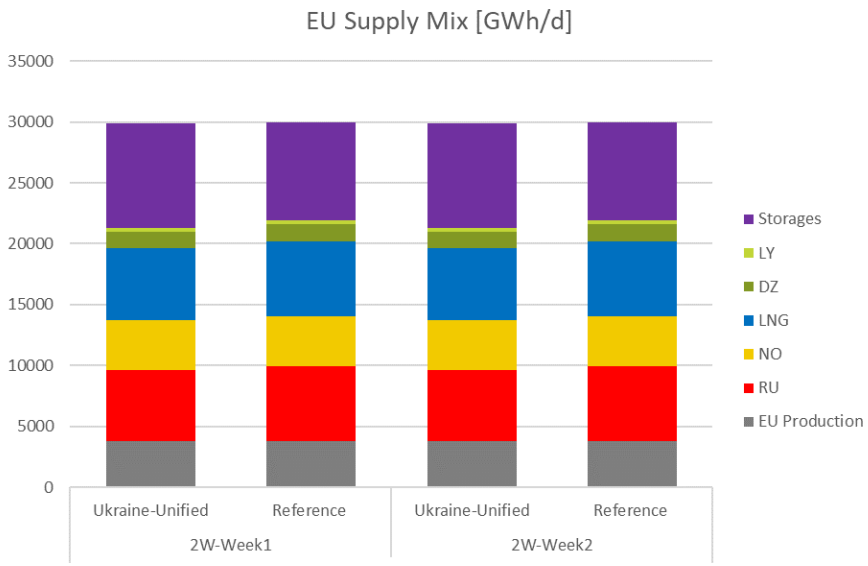
Demand

No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

2-week / 20 years – Simulated from 15 to 28 February





Supply

Storages: Higher use of storage during 2-week cold spell. The storage in Croatia, Hungary, Romania and Slovakia are used at their maximum withdrawal capacities. Bulgaria and Serbia in this Risk Group are not using storages at all, thanks to the Turk Stream supply.

Pipeline and LNG supplies: The flows from Russia decreased slightly comparing to Reference situation. Gas is transported using other alternative routes (Belarus, Nord Stream and Turk Stream). The import from the other sources cannot be increased as already used to their maximum due to the climatic situation (Norway, Algeria, Libya). LNG import decreased slightly.

LNG tanks: LNG can provide extra capacity during both weeks.

1. Disruption of all imports to EU via Ukraine

Demand

Results of the simulation indicate risk of Demand Curtailment in Romania.

Risk group demand each week	Demand curtailment week 1 in Romania	Demand curtailment week 2 in Romania
13,601 GWh/d	14.6 GWh/d	41.7 GWh/d

Curtailment in Romania is different in week 1 and 2 because of different use of gas storage. Withdraw capacity from gas storages depends on a fill rate – when level of gas in storage is decreasing, withdraw capacity is limited. In week 1st withdraw capacity is slightly higher than in week 2.

Exports to Ukraine (UA) can be maintained using SK route.

Infrastructure limitations:

Situation in this risk group is improved by implementation of Turk Stream and other investments in the region. Curtailment occurs because of not sufficient gas interconnections making possible to secure gas flow to Romania.

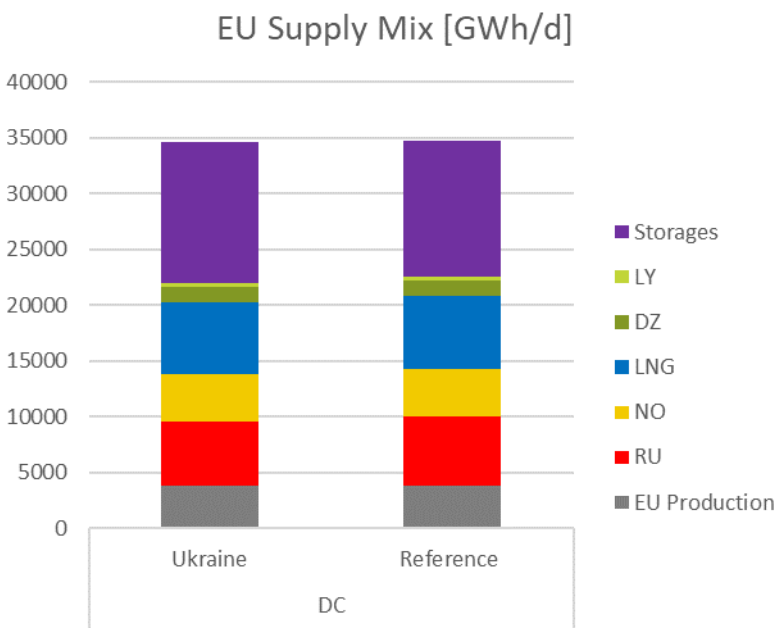
Limited exposition to demand curtailment in Romania due to infrastructure limitations:

Romania has no other possibilities to import gas to country, Bulgaria and Hungarian interconnections are fully used and gas flow from storages is at maximum possible level.

No neighbouring country can further help mitigating the situation as the curtailment is infrastructure related. Ukraine export is not changing situation because of the same reason – it is performed through different route.

Note: The simulation does not consider demand flexibility that could help mitigating the situation (adaptation of demand to possible high gas prices).

Peak day (DC) / 20 years – simulated on 15 February



Supply

Storages: Higher use of storage during Peak day. The storage in Croatia, Hungary, Romania and Slovakia are used at their maximum withdrawal capacities. Bulgaria and Serbia in this Risk Group are not using storages at all, thanks to the Turk Stream supply.

Pipeline and LNG supplies: The flows from Russia decreased slightly comparing to Reference situation. Gas is transported using other alternative routes (Belarus, Nord Stream and Turk Stream). The import from the other sources cannot be increased as already used to their maximum due to the climatic situation (Norway, Algeria, Libya).

LNG tanks: LNG can provide extra capacity.

Demand

Results of the simulation indicated risk of Demand Curtailment in Romania.

Risk group demand	Demand curtailment in Romania
16,065 GWh/d	71.6 GWh/d

Exports to Ukraine (UA) can be maintained using SK route.

Infrastructure limitations:

Situation in this risk group is improved by implementation of Turk Stream and other investments in the region. Curtailment occurs because of not sufficient gas interconnections making possible to secure gas flow to Romania.

Exposition to demand curtailment in Romania due to infrastructure limitations:

Romania has no other possibilities to import gas to country, Bulgaria and Hungarian interconnections are fully used and gas flow from storages is at maximum possible level.

No neighbouring country can further help mitigating the situation as the curtailment is infrastructure related. Ukraine export is not changing situation because of the same reason – it is performed through different route.

Note: The simulation does not consider demand flexibility that could help mitigating the situation (adaptation of demand to possible high gas prices).

Results analysis

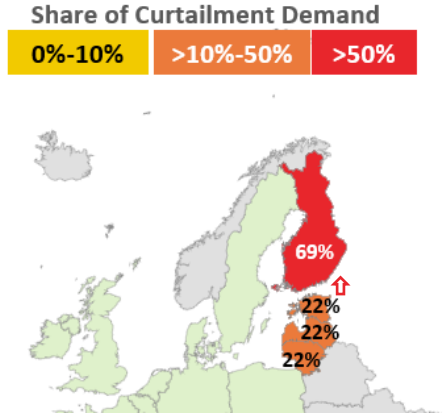
Infrastructure limitations expose South-Eastern Europe to demand curtailment risk in case of Ukraine supply route disruption. Nevertheless, significant improvement (since 2017) is observed, and risk of demand curtailment is limited in terms of scale and area of influence.

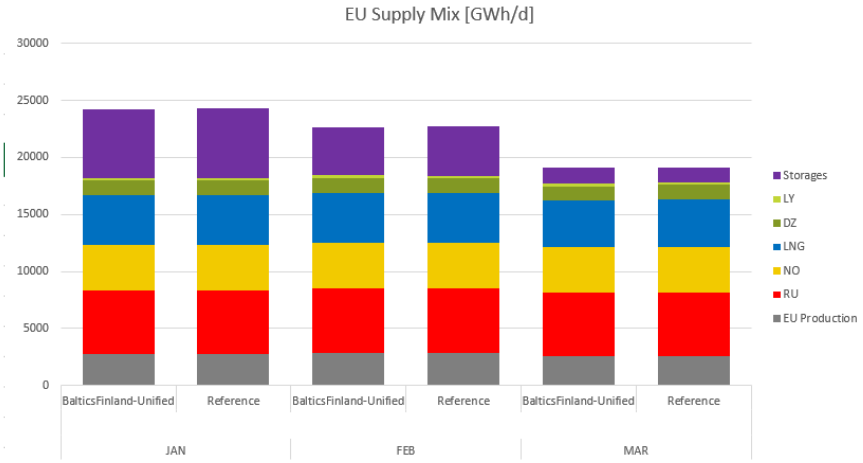
5. Disruption of all imports to the Baltic States and Finland

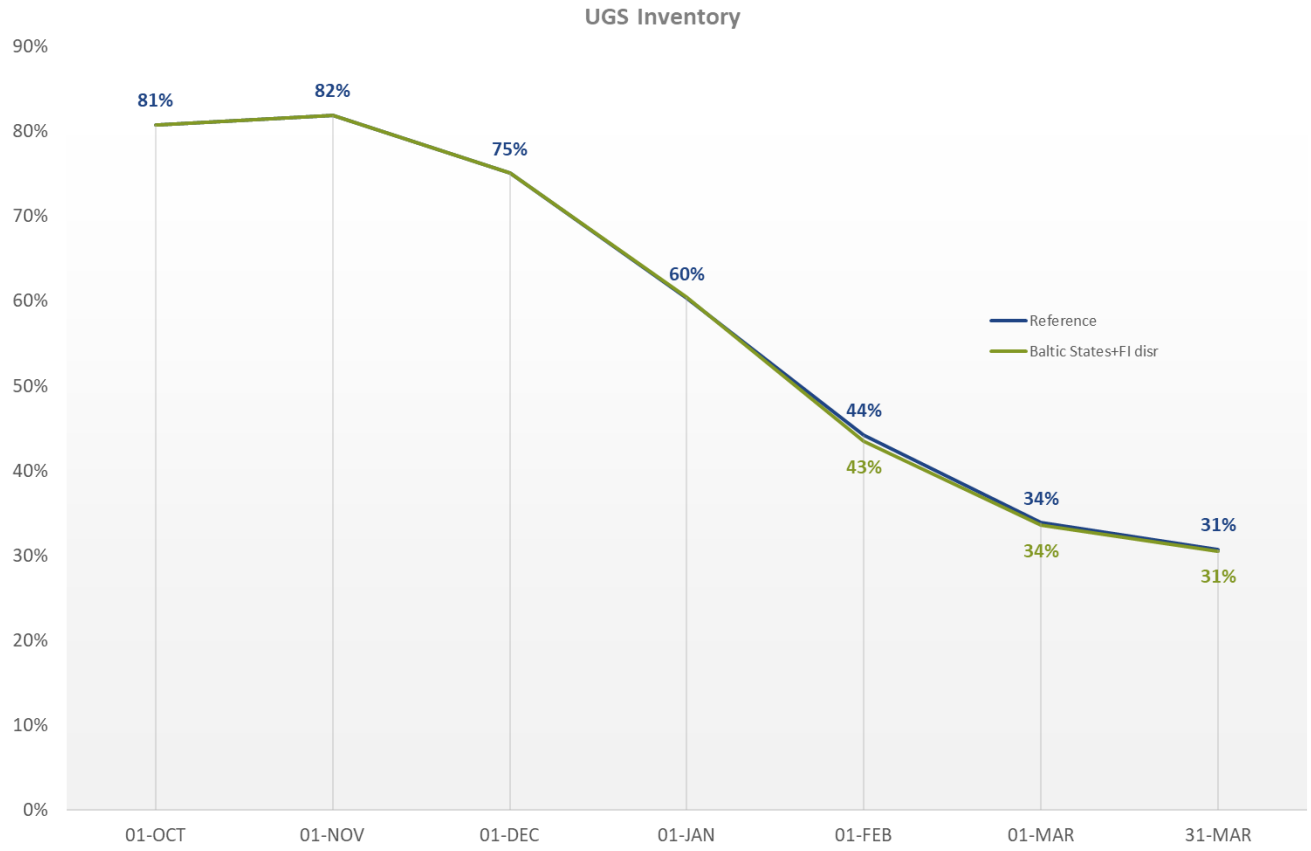
Risk group:	Eastern gas supply – North-Eastern
Estonia, Finland, Latvia, Lithuania	
Scenario duration:	2 months (1 January – 28 February)

Simulation results

January – March







5. Disruption of all imports to the Baltic States and Finland

Supply

Storages: Higher use of Latvian storage in January and February, up to maximum technical possible flow (3.5 TWh of additional gas flow from Inčukalns UGS in total).

Pipeline and LNG Supplies: LNG flows to Lithuania up to maximum possible capacity. Commissioning of Balticconnector pipeline allows Finland and the Baltic States to cooperate efficiently up to maximum technical possibility.

Demand

Results of the simulation indicated risk of Demand Curtailment in Finland, Estonia, Latvia and Lithuania in case of disruption of all imports to the Baltic states and Finland. Demand Curtailment is observed only in January and February.

Country	Demand curtailment JAN	Demand curtailment FEB
Finland	90.8 GWh/d	111.5 GWh/d
Estonia	1.5 GWh/d	7.4 GWh/d
Latvia	1.6 GWh/d	21.0 GWh/d
Lithuania	2.0 GWh/d	13.3 GWh/d

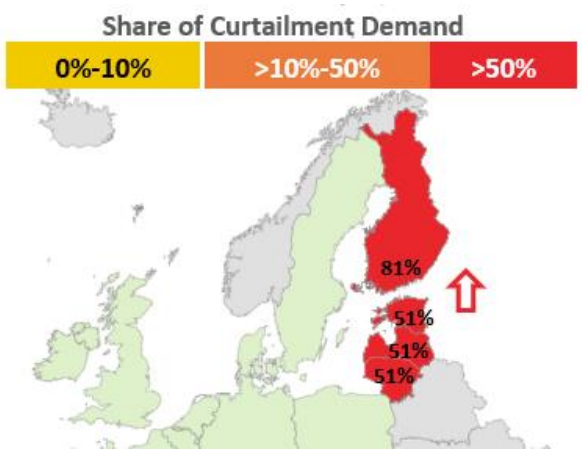
Within the risk group:

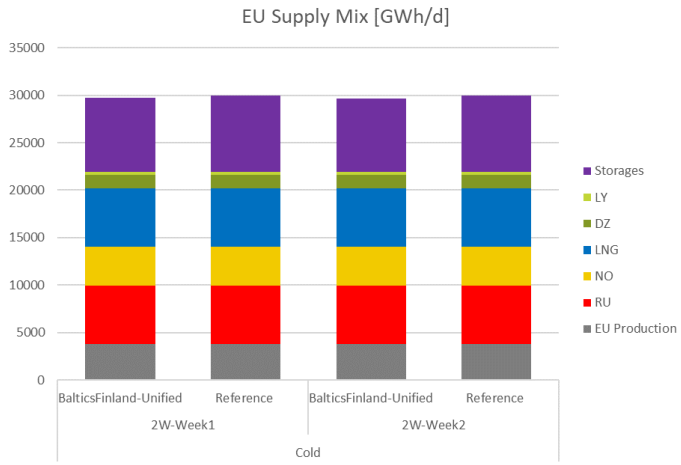
	Risk group demand	Demand curtailment
JAN	365.76 GWh/d	116.6 GWh/d
FEB	325.40 GWh/d	132.6 GWh/d
MAR	322.41 GWh/d	0 GWh/d

Demand curtailment in February is higher than in January (even if demand in Risk group is lower) because of different use of gas storage. Withdraw capacity from gas storages depends on the fill rate – when level of gas in storage is decreasing, withdraw capacity is limited. January withdraw capacity is higher than in February.

5. Disruption of all imports to the Baltic States and Finland

2-week / 20 years – Simulated from 15 to 28 February





Supply

Storages: Higher use of Latvian storage, up to maximum technical possible flow. Rest of the Europe is using less storages as more gas from Russia reaching them through different routes (this gas originally was delivered to Baltic states and Finland – import from Russia remain at the same level as in Reference case.

Pipeline and LNG Supplies: LNG flows to Lithuania up to maximum possible capacity. Commissioning of the Balticconnector pipeline allows Finland and the Baltic States to cooperate efficiently up to maximum technical possibility.

Demand

Results of the simulation indicated risk of Demand Curtailment in Finland, Estonia, Latvia and Lithuania in case of disruption of all imports to the Baltic States and Finland.

Country	Demand curtailment week 1	Demand curtailment week 2
Finland	173.6 GWh/d	173.6 GWh/d
Estonia	27.3 GWh/d	29.5 GWh/d
Latvia	50.1 GWh/d	52.7 GWh/d
Lithuania	61.4 GWh/d	64.0 GWh/d

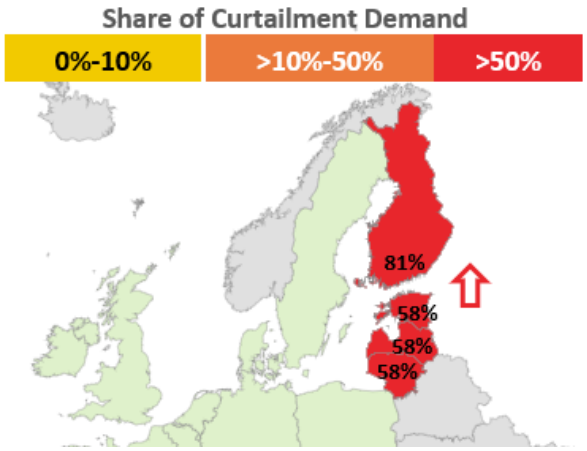
Within the risk group:

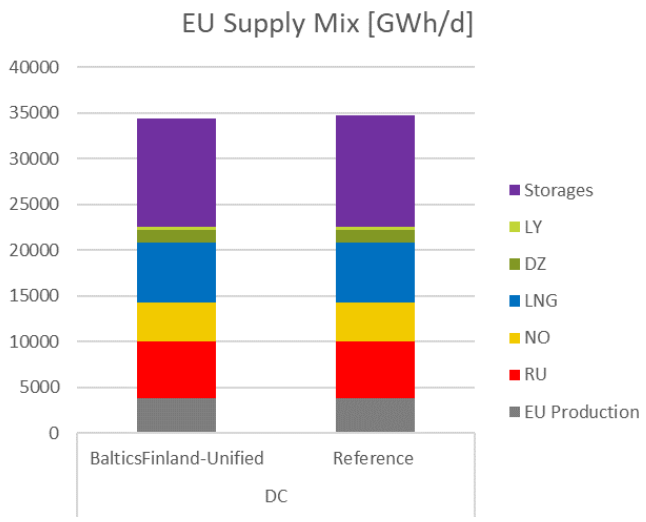
Risk group demand each week	Demand curtailment week1	Demand curtailment week 2
509.0 GWh/d	312.4 GWh/d	319.8 GWh/d

Demand curtailment in week 1 is higher than in week 2 because of different use of gas storage. Withdraw capacity from gas storages depends on a fill rate – when level of gas in storage is decreasing, withdraw capacity is limited. Week 1 withdraw capacity is slightly higher than in Week 2.

5. Disruption of all imports to the Baltic States and Finland

Peak day (DC) / 20 years – simulated on 15 February





Supply

Storages: Higher use of Latvian storage, up to maximum technical possible flow. Rest of the Europe is using less storages as more gas from Russia reaching them through different routes (this gas originally was delivered to Baltic states and Finland – import from Russia remain at the same level as in Reference case.

Pipeline and LNG Supplies: LNG flows to Lithuania up to maximum possible capacity. Commissioning of the Balticconnector pipeline allows Finland and the Baltic States to cooperate efficiently up to maximum technical possibility.

Demand

Results of the simulation indicated risk of Demand Curtailment in Finland, Estonia, Latvia and Lithuania in case of disruption of all imports to the Baltic states and Finland.

Country	Demand curtailment
Finland	193.6 GWh/d
Estonia	40.8 GWh/d
Latvia	78.2 GWh/d
Lithuania	87.0 GWh/d

Within the risk group:

Risk group demand	Demand curtailment
596.3 GWh/d	399.6 GWh/d

Results analysis

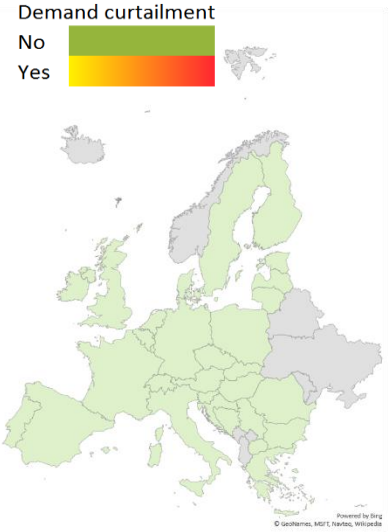
The Baltic States and Finland disruption simulations allows to observe risk of demand curtailment in Finland, Estonia, Latvia and Lithuania. Those countries are isolated from rest of Europe, but implementation of the Balticconnector allows gas to flow from the Baltic States to support Finland which was not possible in 2017. The Balticconnector still has not reached full design capacity yet. This additional capacity will enable further support to Finland.

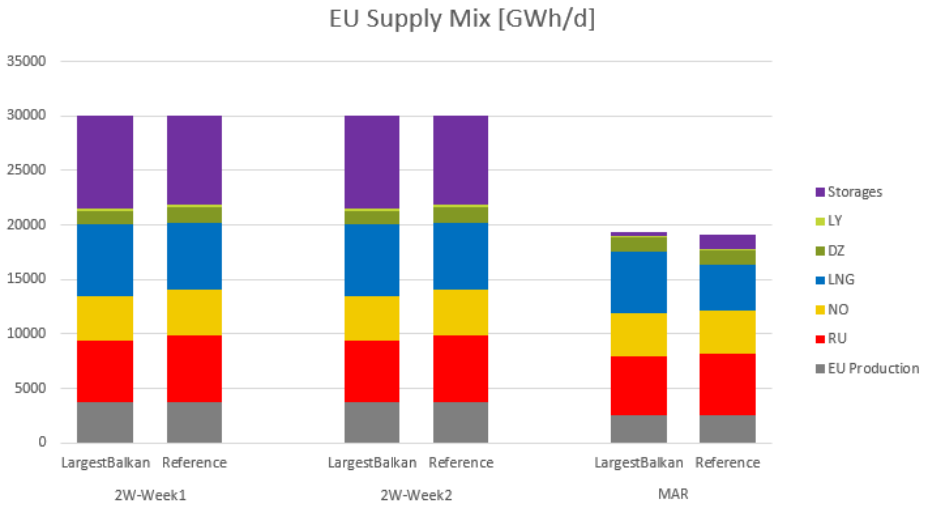
6. Disruption of the largest infrastructure to the Balkan region

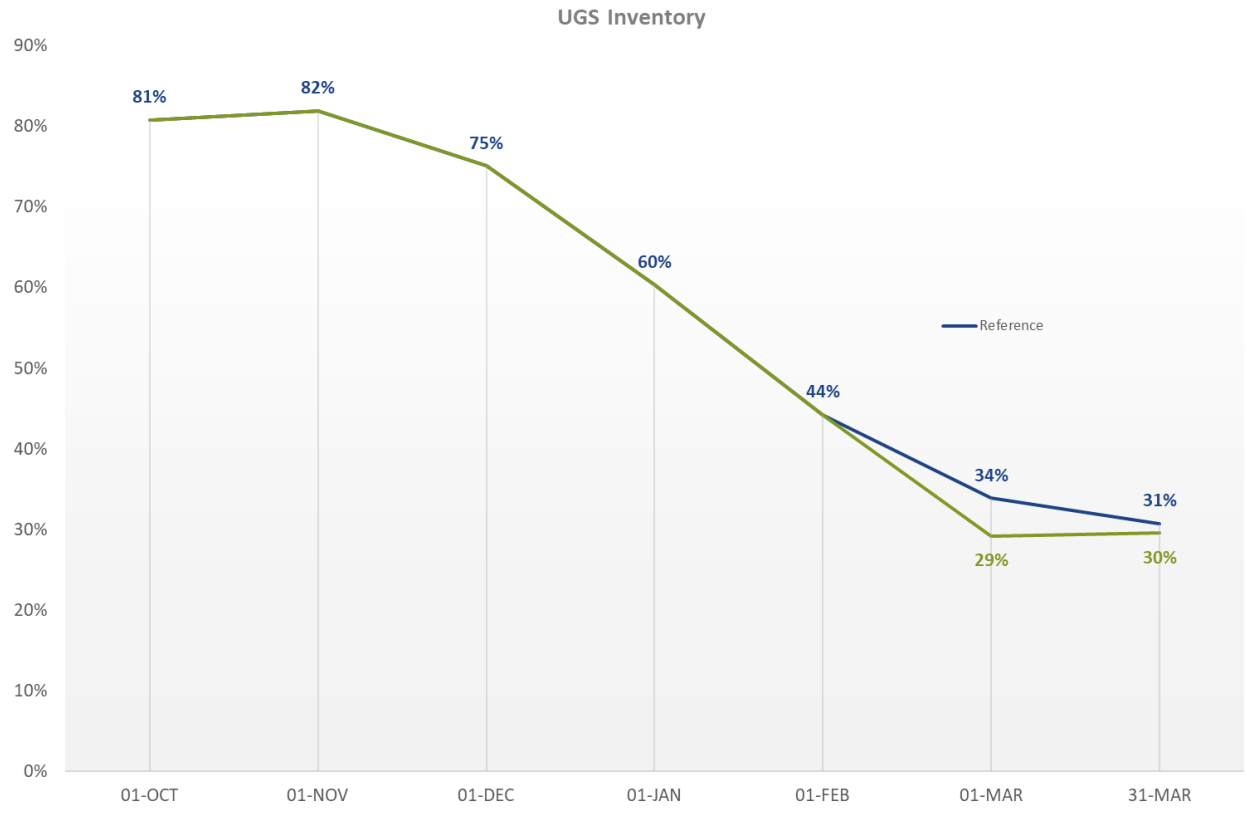
Risk group:	Eastern gas supply – Trans-Balkan
Bulgaria, Greece, Romania	
Scenario duration:	2 weeks cold spell (15 February – 28 February) + March

Simulation results

2week cold spell + March







6. Disruption of the largest infrastructure to the Balkan region

Supply

Storages: Higher use of storages during 2-week period. Gas storages across Europe can still reach 30% level at the end of Winter.

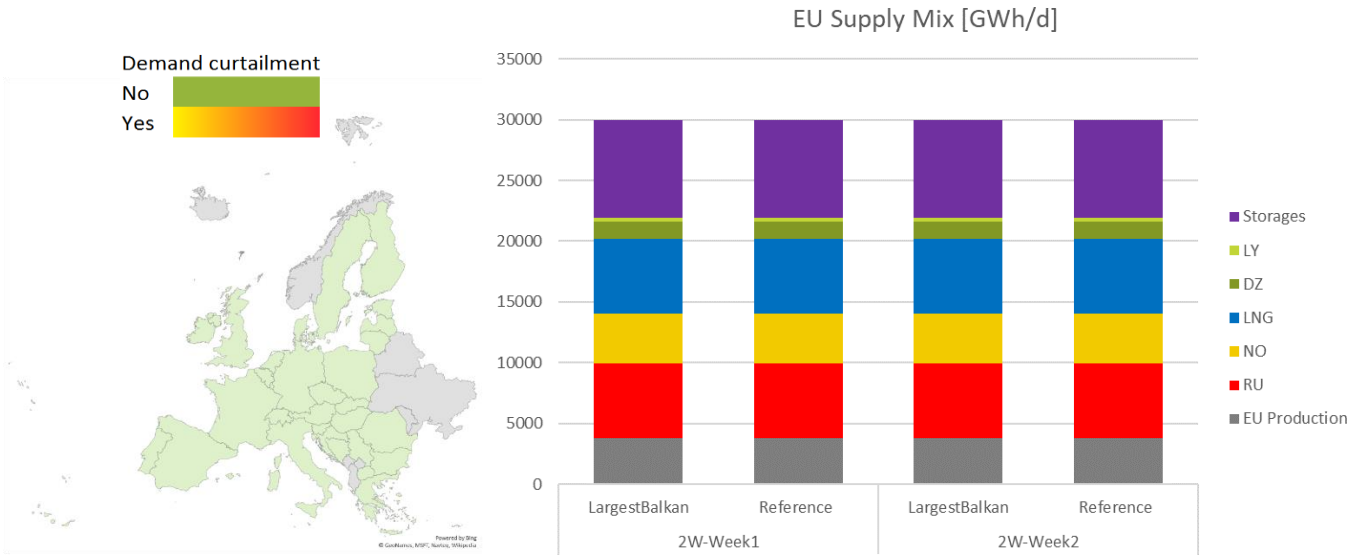
Pipeline and LNG Supplies: Higher usage of LNG comparing to the Reference situation and lower usage of RU, DZ and LY gas.

Demand

No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

2-week / 20 years – Simulated from 15 to 28 February



Supply

Storages: Exactly the same usage of storages as in Reference situation.

Pipeline and LNG Supplies: Same supply structure as in case of Reference situation – gas originally flowing through Trans Balkan Pipeline can be delivered to Bulgaria via Turk Stream.

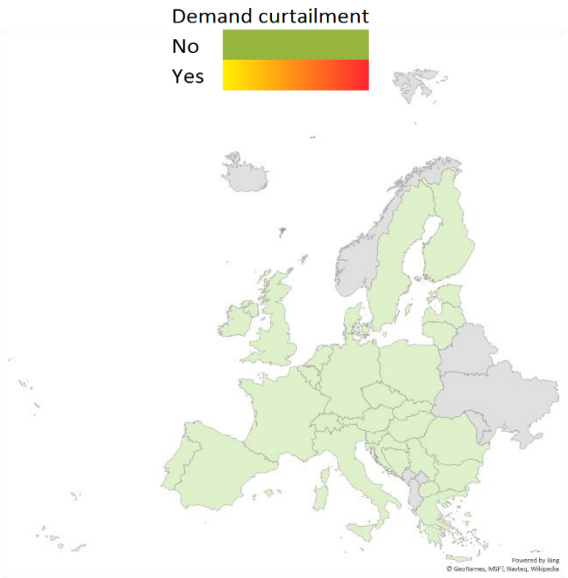
Demand

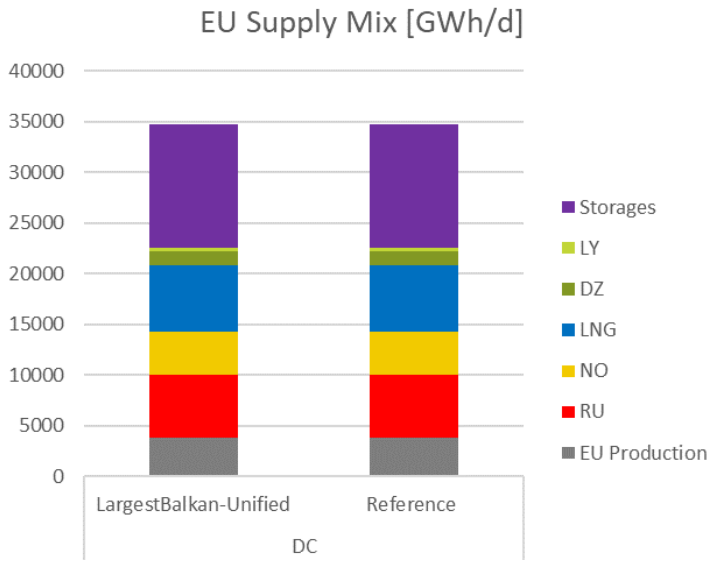
No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

6. Disruption of the largest infrastructure to the Balkan region

Peak day (DC) / 20 years – simulated on 15 February





Supply

Storages: Exactly the same usage of storages as in Reference situation.

Pipeline and LNG Supplies: Same supply structure as in case of Reference situation – gas originally flowing through Trans Balkan Pipeline can be delivered to Bulgaria via Turk Stream.

Demand

No country is exposed to demand curtailment.

Exports to Ukraine (UA) can be maintained.

Results analysis

The simulation of the disruption of the largest infrastructure to the Balkan region shows no risk of demand curtailment in the region. Countries that were exposed to demand curtailment in 2017 simulation now are protected by the infrastructure development in the region (Turk Stream, increase of LNG terminal capacity in Greece and others).

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Co-Authors Kacper Żeromski and Louis Watine

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ENTSOG AISBL
Avenue de Cortenbergh 100 | 1000 Brussels, Belgium
Tel. +32 2 894 51 00

info@entsog.eu | www.entsog.eu