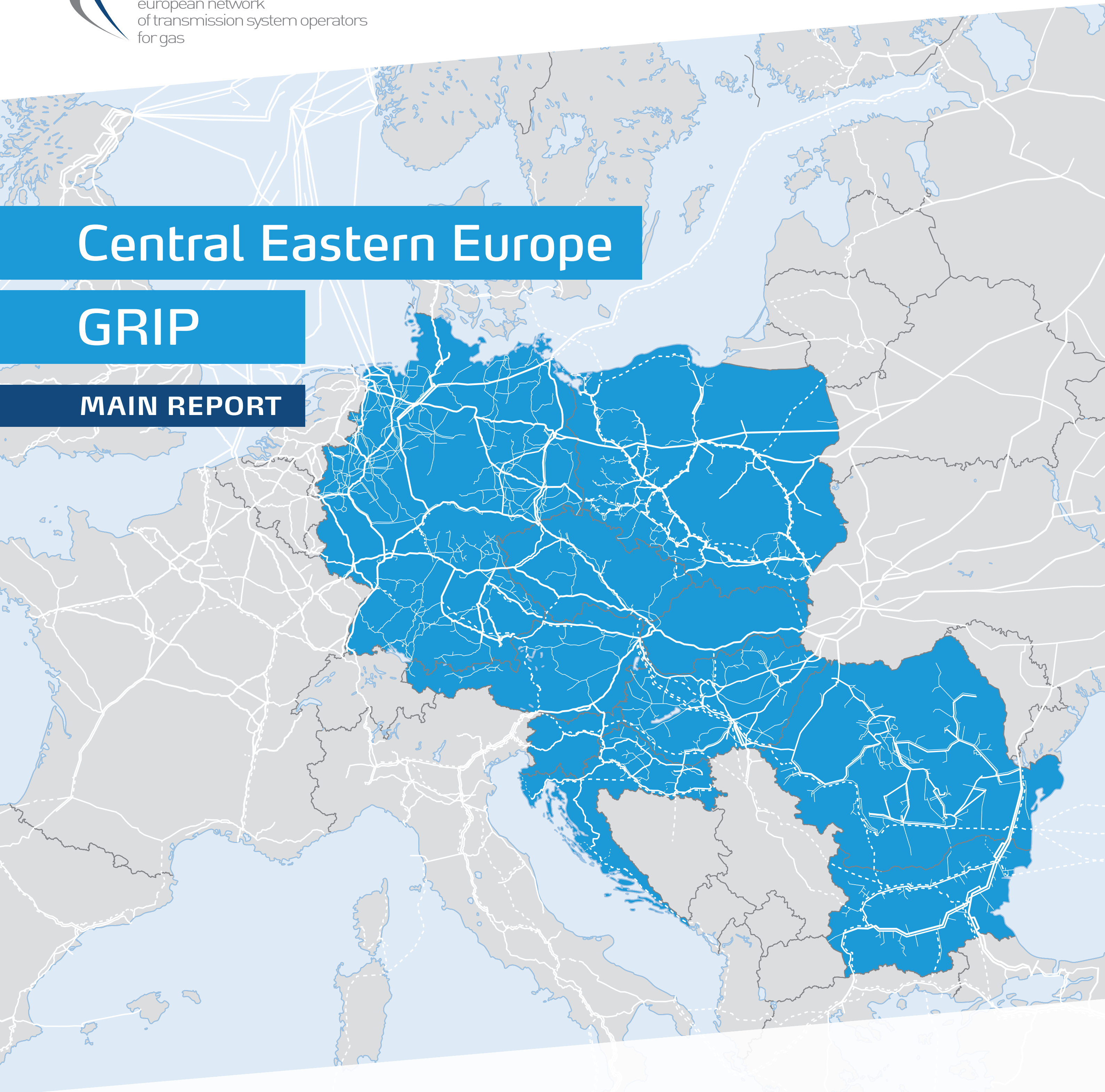
european network
of transmission system operators
for gas

GAS REGIONAL INVESTMENT PLAN 2014–2023



Central Eastern Europe GRIP

MAIN REPORT

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Foreword

On behalf of the TSOs of the region, we are pleased to introduce the CEE GRIP 2014–2023. This is already the second edition of this report which draws from experience gained in a fruitful cooperation between the TSOs from Central-Eastern Europe. Most importantly, it also incorporates proposals and suggestions on the report's development as expressed by stakeholders on previous occasions, especially during the public consultations following the release of the previous CEE GRIP.

The CEE GRIP is intended to deliver a comprehensive outlook of the evolution of the gas infrastructure in the CEE region during the next ten years. This is achieved in particular by taking a closer look into the infrastructure currently in place, as well as to the projects planned for implementation in the near future. Moreover, we are convinced that this plan provides an in depth analysis of market integration and security of supply aspects related to the functioning of the regional gas network.

Image courtesy of Plinovodi d.o.o.

The CEE GRIP develops a comprehensive view which intermediates between the Europe-wide ENTSOG TYNDP and each country's more detailed planning. A view at this level allows considering the specifics of the region:

- The CEE region itself plays a pivotal role in security of supply of Western Europe, both by ensuring a seamless transit and by hosting ample storage facilities which reach beyond the border of the region.
- The CEE region plays also a central role in the market integration, linking Russian gas supplies to Europe, potential new sources of gas in the region (including LNG, gas from the SGC region and shale gas), and two major markets, namely Germany and Italy. As such the cooperation between TSO in the region is crucial to deliver the integrated European market of gas.
- Finally, the CEE region, with its population of 187 million people, has strong market dynamics and according to the Statistical Report 2013 from Eurogas it represents a potential of approx. 39.7 million gas consumers.

We constantly seek to enhance value of the CEE GRIP to our stakeholders. All interested parties are kindly invited to provide comments on the report via public consultation process and within a workshop which are both scheduled by mid-2014. We will use collected feedback as a starting point for our works on the subsequent edition of the CEE GRIP.

We believe that the combined efforts of the TSOs produced a high quality report and hope the readers will find in this report the occasion to get a better view on the chances and challenges associated with the CEE region, and the efforts which the TSOs make to deliver to the market the valuable services necessary for them.

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Executive Summary

Planning and development of gas infrastructure are vital for meeting the obligations under REG 715/2009. The CEE GRIP contributes to the planning process. It provides information on possible evolution of gas infrastructure in the CEE region in the period of 2014–2023. This is achieved by undertaking a wide range of assessments on demand, supply and infrastructure capacity.

The summary sets out key outputs from this CEE GRIP. The findings are provided below in three sections, depending on the subject of analysis:

Infrastructure projects:

- In total, there are 88 gas investment projects planned for implementation in the CEE region in the upcoming decade, including 24 projects with the FID already taken and 64 projects which are on an earlier stage of development (non-FID).
- Implementation of the FID projects will further improve the functioning of the gas network in the region by: upgrading internal pipelines (projects in DE, PL, SK, SI), constructing new cross-border interconnections (SK-HU and RO-BG interconnections), establishing reverse flows on cross-border interconnections (projects in PL and RO), extending UGS facilities (projects in PL) and finally constructing the LNG terminal (project in PL). However, the non-FID projects are essential for full integration of the regional gas infrastructure and providing a physical possibility for a more diversified supply portfolio, including LNG, gas from Norway and the SGC region.

Network Analysis:

- Demand: The demand in the CEE region is expected to increase significantly with a rate between 8 % and 12 % depending on the assumed conditions. The major share of the growth is estimated for the first part of the period, between 2014 and 2018, for the period between 2018 and 2023, the expected increase is rather moderate.
- Supply situation: In the average day scenarios, the situation is sufficient in general, only Poland is expected to have reduced the remaining flexibility in 2018 and 2023 FID. In the non-FID case, the remaining flexibility is sufficient in the entire region.
- Although the design case is the most demanding, only a slight shortage in Poland is expected for the 2018 FID case. Slightly reduced flexibility is expected in some FID cases for Bulgaria, Hungary, Poland and Slovenia. An implementation of the non-FID projects will almost completely mitigate the issue.
- The results of average winter day scenarios suggest that Poland might be affected in 2023, however this can be solved with implementation of non-FID projects.
- For the average summer day, no shortages, but reduced remaining flexibility is predicted for Poland in 2018 and 2023 FID.
- Network Resilience: In the mixed scenarios, the situation under the reference scenario is – besides a 2023 FID shortage in Hungary in the CEE 2W UR/EU AW case – similar to the design case, in the disruption scenario several countries in the region are expected to face partially dramatic shortages: whereas Bulgaria (in 2014 only), Romania and – partially – Hungary are impacted vastly in case on an interruption of supplies via Ukraine in both, the FID as well

as the non-FID case, Poland is the only country expecting shortages in case of a Belarus route disruption for 2014 and 2018 FID and non-FID. Hungary is likely to have reduced remaining flexibility in the FID case. The network resilience is expected to be improved under non-FID cases at the end of the 10-year period analysed in the CEE GRIP.

- Market Integration: Russia has been and will remain the main supplier of the region with a minimum share of 50% in all reference scenarios. The sources Algeria, Libya, LNG or the SGC region, do not play a major role, however the share of LNG and gas from the SGC region is increasing. It is worth noting that especially the average day scenario with minimum Russian deliveries show, that the market integration is at a sound level in the region (more diversified supply portfolio with the share of gas from Russia at the level of approx. 30%), and that the development goes into the right direction, compared to the situation as described in the last edition of the CEE GRIP.

Regional N-1 analysis in the CEE countries:

- The assessment is performed based on two scenarios which foresee the disruption of supply via Ukraine and Belarus in the winter and summer periods. The results show that the disruption of the Ukrainian route is likely to have a negative impact on Bulgaria and Romania in the winter period 2014/2015 and on Croatia in the winter period 2018/2019. However, the realisation of projects at a later stage contributes to positive results in these three countries. The other countries in the CEE region are not affected by interruptions in this scenario (their results are equal to or above 1).
- Due to geographical reasons the analysis of the disruption via Belarus is concentrated on Poland. The calculations for the winter period prove that Poland meets the regional N-1 criterion and the results improve over the time, with projects commissioned in subsequent years.
- All countries in the CEE region achieve good results in case of interruptions in the summer period, as each country is expected to cover gas demand and meet injection requirements of UGS facilities while having at the same time the Ukrainian or Belarusian route fully disrupted for at least 76 days. The only exception is Bulgaria, under the Ukraine disruption in 2014, is not able to inject into UGS facilities. Nevertheless this problem will be solved by commissioning of planned projects in the coming years.

1 Introduction

Image courtesy of GAZ-SYSTEM S. A.

The legislative acts within the Third Energy Package have introduced a number of new measures for the European gas industry to foster the integration of the European gas markets and to promote the cooperation among market participants. The actions taken to meet these objectives are conducted, inter alia, by implementing the provisions set forth in Article 7 of DIR 2009/73 and in Article 12 of REG 715/2009 which provide for further cooperation among TSOs on the regional level by producing GRIPs.

The TSOs from the CEE region submit herewith the CEE GRIP 2014–2023. This is already the second edition of the regional development plan which provides a detailed insight into the natural gas infrastructure in the CEE region. The present report serves to promote transparency by delivering the updated information on technical characteristics of infrastructure currently under operation and investment plans foreseen in the upcoming decade. Additionally, it aims to share meaningful information which can provide further support in the investment process.

Furthermore, the CEE GRIP goal is to provide a focused view on the evolution of demand, supply and capacity developments and to asses and identify current and future investment needs in the CEE region. It also endeavours to capture wider gas market dynamics by looking at aspects linked to supply scenarios, market integration and security of supply on a regional level. These analyses are performed taking into account two key factors:

- The importance of the CEE transmission networks in transporting significant volumes of gas towards the downstream markets in Western Europe.
- Planned investments in the CEE region focused on contributing to the long term goal of creating a fully integrated and competitive European gas market.

The CEE GRIP 2014–2023 builds on the valuable experience gained while drafting the first edition of the report and responds to comments and proposals raised by stakeholders during the consultation process organised after the report's release in 2012 or on other occasions. Therefore, the second edition of the CEE GRIP was prepared to address the following issues:

- Future development and optimisation of the gas transmission infrastructure in the CEE region.
- Analysis of prospects for further integration of the gas markets in the region.
- More detailed network modelling to assess market integration and security of supply.
- Development of a regional approach to SoS demand and supply scenarios.
- Extension of the regional N-1 analysis up to a 10-year period of time.
- Close involvement of all relevant market participants.
- Incorporation of the chapter on investment barriers to infrastructure development in the CEE region.

All improvements and methodological approach incorporated into the CEE GRIP 2014–2023 are described in a more detailed manner in relevant chapters of the report.

The CEE GRIP region covers 10 countries, with the involvement of 18 TSOs. The complete list of countries and TSOs contributing to the CEE GRIP is presented in the table below.

COUNTRY	TSO
INVOLVED TSOs	
AUSTRIA	BOG GmbH
	GAS CONNECT AUSTRIA GmbH
	TAG GmbH
BULGARIA	Bulgartransgaz EAD
CROATIA	Plinacro d.o.o.
CZECH REPUBLIC	NET4GAS, s.r.o.
GERMANY	GASCADE Gastransport GmbH
	Gasunie Deutschland Transport Services GmbH
	Gasunie Ostseeanbindungsleitung GmbH
	GRTgaz Deutschland GmbH
	ONTRAS Gastransport GmbH
	Open Grid Europe GmbH
	terranets bw GmbH
HUNGARY	FGSZ Ltd.
POLAND	Gas Transmission Operator GAZ-SYSTEM S.A.
ROMANIA	Transgaz S.A.
SLOVAKIA	eustream, a.s.
SLOVENIA	Plinovodi d.o.o.

Table 1: The list of TSOs contributing to the CEE GRIP 2014–2023

The works on the second edition of the CEE GRIP were coordinated jointly by BOG GmbH and Gas Transmission Operator GAZ-SYSTEM S.A.

2 Infrastructure Projects

Image courtesy of Plinacro d.o.o.

Infrastructure-related data lays foundation for the CEE GRIP development process. These data represent the gas infrastructure operated by all system operators (being TSOs, LSOs and SSOs) and third party project promoters in the region. They allow for a thorough examination of how the gas infrastructure will evolve in Central-Eastern Europe over the upcoming decade in order to meet the market needs and achieve the objectives enshrined in the EU energy policy.

The data collection process for this CEE GRIP was conducted with full involvement of all relevant stakeholders. The project promoters were offered a possibility to provide project specific information either by updating data given for TYNDP 2013–2022 or by submitting a set of figures on new investment projects. To reach the widest group of project promoters, this process was organised via a call launched by ENTSOG on behalf of TSOs in the period between July and mid-September 2013.

The graph and tables provided below summarise information on gas investments in the CEE region, as indicated by the project promoters, being the TSOs contributing directly to the CEE GRIP or third party project promoters from the region, in their project questionnaires. The questionnaire itself is based on the one prepared for TYNDP 2013–2022 with small improvements incorporated following stakeholder feedback. It allows presenting the characteristics of all types of gas projects (transmission, LNG, UGS) irrespective of their stage of development (FID and non-FID projects).

More detailed data on individual projects can be found in the Annex B – Infrastructure Projects. **The information on investment projects in the region reflects the situation as of 13 September 2013**[1].

Additionally, the Annex F provides the list of PCIs which are located in the CEE GRIP gas networks. Geographical scope of these projects mostly falls within the priority corridor NSI East Gas. The list of PCI projects was adopted by the European Commission on 14 October 2013. Because of this timing, the basic principle applied in the present CEE GRIP is to analyse planned investment projects on an equal basis, so irrespective of their possible priority status as foreseen in REG 347/2013.

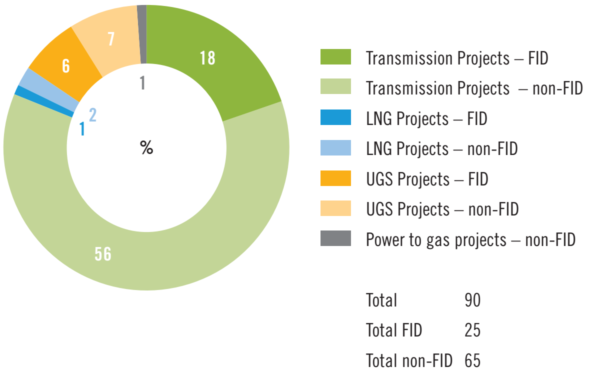

Figure 1: Number of investment projects in CEE GRIP 2014–2023 per type and implementation status

1) For any possible changes in data on planned investments since 13 September 2013, please refer to the project promoter's websites.

PROJECT PROMOTER	PROJECT NAME	CODE	COMMISSIONING
NUMBER OF INVESTMENT PROJECTS IN CEE GRIP 2014–2023			
BULGARTRANSGAZ EAD	Interconnection Turkey-Bulgaria (ITB)	TRA-N-140	2016
	Rehabilitation, Modernization and Expansion of the National Transmission System	TRA-N-298	2017
EUSTREAM, A.S.	Slovakia - Hungary interconnection	TRA-F-016	2015
	System Enhancements – Eustream	TRA-F-017	2017
	Poland - Slovakia interconnection	TRA-N-190	2019
GASUNIE DEUTSCHLAND TRANSPORT SERVICES GMBH	Extension of existing gas transmission capacity in the direction to Denmark – 1. Step	TRA-F-231	2014
	Extension of existing gas transmission capacity in the direction to Denmark – 2. Step	TRA-N-232	2015/2016
	Expansion of Nord Stream connection to markets in western Europe – Exit Bunde - Oude	TRA-N-316	2020
GASUNIE OSTSEE-ANBINDUNGSLEITUNG GMBH	Expansion of Nord Stream connection to markets in western Europe – Entry Greifswald	TRA-N-321	2020
GAS CONNECT AUSTRIA GMBH	Bidirectional Austrian-Czech Interconnector (BACI)	TRA-N-021	2019
GASCADE GASTRANSPORT GMBH	Installing a reverse flow in Mallnow	TRA-F-292	2014
	Installation of Nord Stream onshore project	TRA-F-289	2014
	Extension of GASCADE grid in the context of the Nord Stream (on-shore) project	TRA-N-249	2014
	New net connection from Rehden to Drohne (new covenant from NEP2012)	TRA-N-291	2018
	Expansion of Nord Stream connection to markets in western Europe – Exit Eynatten	TRA-N-324	2022
	Expansion of Nord Stream connection to markets in western Europe – Entry Greifswalder Bodden area	TRA-N-323	2022
GAZ-SYSTEM S.A.	Physical reverse flow on the metering station in Mallnow	TRA-F-326	2013
	Upgrade of gas infrastructure in northern and central Poland	TRA-F-248	2014
	Upgrade of the entry points in Lwówek and Włocławek on the Yamal-Europe pipeline	TRA-N-276	2015
	Gas Interconnection Poland-Lithuania (GIPL)	TRA-N-212	2018
	The North-South corridor in Western Poland	TRA-N-247	2018
	PL - CZ interconnection	TRA-N-273	2019
	PL - SK interconnection	TRA-N-275	2019
	PL - DK interconnection (Baltic Pipe)	TRA-N-271	2020
	Upgrade of PL-DE interconnection in Lasów	TRA-N-274	2021
	The North-South Gas Corridor in Eastern Poland	TRA-N-245	2023
GRTGAZ DEUTSCHLAND	Gernsheim-MIDAL	TRA-F-327	2013
FGSZ LTD.	Local Odorisation – FGSZ	TRA-N-124	2015
	Romanian-Hungarian reverse flow Hungarian section	TRA-N-286	2016
	Slovenian-Hungarian interconnector	TRA-N-325	2017
	Csepel connecting pipeline	TRA-N-019	2018
	Hajduszoboszlo CS	TRA-N-065	2021
	Városföld CS	TRA-N-123	2023
	Városföld - Ercsi - Győr	TRA-N-018	2023
	Ercsi-Szazhalombatta	TRA-N-061	2023
ICGB EAD	Interconnection Greece - Bulgaria	TRA-N-149	2016

PROJECT PROMOTER	PROJECT NAME	CODE	COMMISSIONING
MAGYAR GAZ TRANZIT ZRT.	South Stream Hungary	TRA-F-196	2015
	Slovak-Hungarian interconnector (Vecsés - Szada - Balassagyarmat)	TRA-F-148	2015
	AGRI Pipeline – Hungarian section	TRA-F-195	2023
MINISTRY OF ECONOMY AND ENERGY OF REPUBLIC OF BULGARIA	Interconnection Bulgaria - Serbia	TRA-N-137	2017
NET4GAS, S.R.O.	Bidirectional Austrian Czech Interconnection (BACI)	TRA-N-133	2019
	Poland-Czech Republic Interconnection within the North-South Corridor (STORK II)	TRA-N-136	2019
	Connection to Oberkappel	TRA-N-135	2022
OPEN GRID EUROPE GMBH	Stepwise change-over to physical H-gas operation of L-gas networks	TRA-N-244	2020
	System enhancements, including the connection of gas-fired power plants, storages and the integration of power to gas facilities	TRA-N-243	2020
PLINACRO LTD	Interconnection Croatia/Slovenia (Bosiljevo - Karlovac - Lučko - Zabok - Rogatec)	TRA-N-086	2018
	LNG evacuation pipeline Omišalj - Zlobin (Croatia) - Rupa (Slovenia)	TRA-N-090	2018
	Interconnection Croatia-Bosnia and Herzegovina (South)	TRA-N-302	2018
	LNG main gas transit pipeline (Part of North-South Gas Corridor) Zlobin-Bosiljevo-Sisak-Kozarac-Slobodnica	TRA-N-075	2019
	Interconnection Croatia/Bosnia and Herzegovina (Slobodnica - Bosanski Brod - Zenica)	TRA-N-066	2019
	Ionian Adriatic Pipeline	TRA-N-068	2020
	Interconnection Croatia/Serbia Slobodnica - Sotin (Croatia) - Bačko Novo Selo (Serbia)	TRA-N-070	2023
	Interconnection Croatia-Bosnia and Herzegovina (Licka Jesenica - Rakovica - Trzac - Bosanska Krupa with branches to Bihać and Velika Kladusa)	TRA-N-303	2023
	International Pipeline Omišalj - Casal Borsetti	TRA-N-083	2027
PLINOVODI D.O.O.	CS Kidričevo (3rd unit 3,5 MW)	TRA-F-096	2014
	M2/1 Trojane - Vodice	TRA-F-097	2014
	M2/1 Rogaška Slatina - Trojane	TRA-F-104	2014
	MRS Šempeter – reconstruction	TRA-F-110	2014
	M6 Ajdovščina - Lucija	TRA-N-107	2015
	CS Kidričevo (2nd phase – up to 3 units with total power up to 30 MW)	TRA-N-094	2016
	CS Ajdovščina (3rd unit up to 5 MW)	TRA-N-092	2016
	M9a Lendava - Kidričevo (including CS Kidričevo 3rd phase with up to 5 units of total power up to 80 MW)	TRA-N-098	2016
	M8 Kalce - Jelšane	TRA-N-101	2017
	M3/1c Kalce - Vodice	TRA-N-261	2017
	M3/1b Ajdovščina - Kalce	TRA-N-262	2017
	M3/1a Gorizia/Šempeter - Ajdovščina	TRA-N-099	2017
	M10 Vodice - Rateče	TRA-N-100	2017
	R15/1 Lendava - Kidričevo	TRA-N-112	2018
	M9b Kidričevo - Vodice (including CS Vodice I – 4 units with total power up to 60 MW)	TRA-N-263	2018
	R61 Lucija - Sečovlje	TRA-N-114	2021
	CS Vodice II (on M2/1 pipeline up to 3 units with total power up to 30 MW)	TRA-N-102	2023
	M3 pipeline reconstruction from CS Ajdovščina to Šempeter/Gorizia	TRA-N-108	2023
	M1/3 SLO-A border crossing	TRA-N-109	2023
	CS Ajdovščina (2nd phase – 4th and 5th unit on M3/1 pipeline of total power up to 20 MW)	TRA-N-093	2023

PROJECT PROMOTER	PROJECT NAME	CODE	COMMISSIONING
SOUTH STREAM BULGARIA AD (BULGARIAN SHARE-HOLDER BULGARIAN ENERGY HOLDING EAD)	South Stream Bulgaria – Stage I	TRA-N-308	2015
	South Stream Bulgaria – Stage II	TRA-N-309	2016
	South Stream Bulgaria – Stage III	TRA-N-310	2017
TAUERNGASLEITUNG GMBH	Tauerngasleitung Gas Pipeline Project	TRA-N-035	2018
TERRANETS BW GMBH	Nordschwarzwaldleitung	TRA-N-228	2015
TRANSGAZ	Integration of the transit and transmission system – reverse flow Isaccea	TRA-F-139	2013
	Reverse flow at Negru Voda	TRA-F-142	2013
	Reverse flow on the interconnector Romania - Hungary	TRA-N-126	2013
	RO-BG Interconnection	TRA-F-029	2013
	AGRI Pipeline - Romanian section (East-West Pipeline)	TRA-N-132	2015

Table 2: Summary of transmission projects, including compressor stations, submitted for CEE GRIP 2014–2023, listed by project promoter

GAZ-SYSTEM S.A.	LNG terminal in Świnoujście	LNG-F-246	2014
	Upgrade of the LNG terminal in Świnoujście	LNG-N-272	2020
PLINACRO LTD	LNGRV	LNG-N-082	2017

Table 3: Summary of LNG projects submitted for CEE GRIP 2014–2023, listed by project promoter

BULGARTRANSGAZ EAD	UGS Chiren Expansion	UGS-N-138	2018
	Construction of new gas storage facility on the territiry of Bulgaria	UGS-N-141	2020
GDF SUEZ ENERGY ROMANIA	Depomures	UGS-N-233	2015
HUNGARIAN GAS STORAGE	Pusztaederics – Compressor System Reconstruction	UGS-N-209	2013
	Zsana UGS – Decrease of the minimum injection capacity	UGS-N-234	2016
GDF SUEZ ENERGY ROMANIA	Depomures	UGS-N-233	2015
PGNIG	PMG Husów	UGS-F-202	2014
	PMG Wierzchowice	UGS-F-220	2014
	PMG Brzeźnica	UGS-F-201	2016
	KPMG Mogilno	UGS-F-200	2020
	KPMG Kosakowo	UGS-F-199	2021
	PMG Wierzchowice extension	UGS-N-219	2023*
STORENGY	Peckensen Gas Storage	UGS-F-317	2014
	Peckensen Gas Storage	UGS-N-005	2017

Table 4: Summary of UGS projects submitted for CEE GRIP 2014–2023, listed by project promoter

OPEN GRID EUROPE GMBH	Project study on the integration of Power to Gas (PtG) facilities into the gas transmission system	PRD-N-301	2016

Table 5: Summary of power to gas projects submitted for CEE GRIP 2014–2023, listed by project promoter

* Where this date had not been provided or the date was indicated as "beyond" a particular year of the covered period, an assumption was taken that the commissioning would be at the beginning of 2023, that is, the last year of this CEE GRIP.

3 Methodology

Improvements implemented to the CEE GRIP 2014–2023 compared to CEE GRIP 2012–2021 | Bottom-up approach Sources of Data | Tool | Modelling | Output | Scenarios Regional N-1 formula

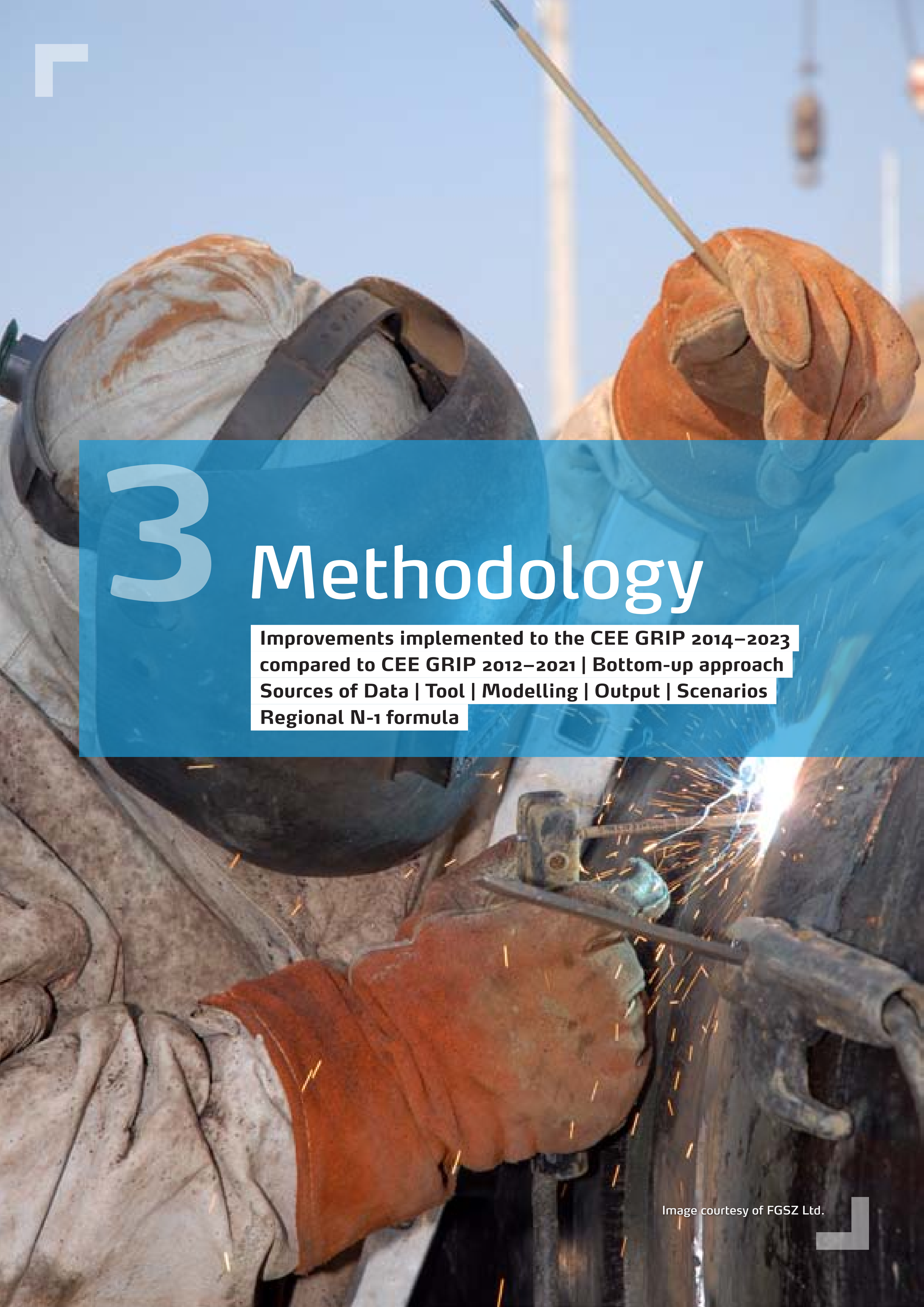

Image courtesy of FGSZ Ltd.

3.1 Improvements implemented to the CEE GRIP 2014–2023 compared to CEE GRIP 2012–2021

The member TSOs of the CEE region understand that the GRIPs shall be a valuable source of information for all stakeholders in the gas market, so the chance has been taken to introduce a number of improvements compared to the previous edition. An overview over the most important changes is given below.

- Further differentiation of demand cases:
  - Introduction of summer and winter average demand.
  - Application of uniform risk (peak demand) once on the whole EU (reference), once with limitation to the CEE region and simultaneous average demand in the rest of EU.
- More detailed implementation of UGS utilization in the model:
  - No utilization under avg. daily demand.
  - Avg. injection under avg. summer demand.
  - Avg. withdrawal under avg. winter demand.
  - Last resort supply under Design Case and Uniform Risk Cases.
- Evolution of Regional N-1 analysis from status quo to a 10-year horizon.

3.2 Bottom-up approach

The GRIPs follow the principle of a bottom-up approach. Compared to the TYNDP which applies a top-down principle, the members of the working group define content, methods, scope and level of details – under consideration of legal requirements – amongst themselves. As all member companies of the CEE working group are actively operating gas transmission systems, the resulting high degree of expertise allows identifying issues leaving space for optimization and further improvement, as well as proactive measures for upcoming challenges in a very efficient way. Furthermore, the GRIPs contribute to translate the overall European network design (namely TYNDP) into a more concrete, regional plan for infrastructure evolution.

3.3 Sources of Data

All data serving as basis for the modelling of the infrastructure in the CEE region have their origin in the TSOs that are members of ENTSOG and in the promoters of third party projects. As it is necessary to model the entire European gas transit network for the analyses, all relevant data have been collected by ENTSOG in a dedicated collection process. This procedure does not only ensure an up-to-date basis, a high degree of consistency of the data and of the analysis of the different GRIP regions, but also guarantees consistency between the GRIPs and the ENTSOG TYNDP.

3.4 Tool

The ENTSOG model is based on:

- Entry and exit capacities of IPs between two countries/balancing zones, as calculated by the responsible TSOs.
- Working gas volume, injection/withdrawal capacities of UGS.
- Send-out capacities of LNG regasification facilities.
- National production capacities.

For the demand/supply analysis, the tool assesses to what extent the IP capacities allow for a balance of European supply and demand.

For resilience testing, the tool reduces the complexity of the European gas network via representing countries/balancing zones/hub areas as nodes, whereas the capacities between two countries/balancing zones/hub areas are combined – applying the "lesser rule" – to arcs with lower and upper flow limit. LNG and UGS capacities are assigned to the respective nodes. Scenarios are then modelled by modifying the weighting of the different arcs. A more detailed description of the ENTSOG Network Modelling tool can be found in the ENTSOG TYNDP 2013 – 2022[1]. A list of all modelled cases can be found in Annex E.

3.5 Modelling

The analyses performed in the CEE GRIP are based on the results of gas flow simulations. The simulation tool provided and operated by ENTSOG analyses the capability of the European gas grid under a number of different scenarios, taking into consideration the development of the infrastructure over the upcoming decade. For this purpose, the investment status (FID/non-FID) of the relevant infrastructure projects is accounted for.

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1) ENTSOG TYNDP 2013 – 2022 is available under the following link:
http://www.entsog.eu/publications/yndp/2013#ENTSOG-TEN-YEAR-NETWORK-DEVELOPMENT-PLAN-2013-2022

Image courtesy of Gasunie

For the **network analysis**, the following demand cases have been defined:

- Design Case (DC)
- Average day: full year (AD)/summer (AS)/winter (AW)
- One/14-day Uniform Risk in the CEE region, winter average in rest of the EU (CEE UR/EU AW; CEE 2W UR/EU AW)

The goal of the analysis is an assessment whether the infrastructure is capable to serve the demand.

For the **network resilience analysis**, the impact of different disruption scenarios on the gas supply is investigated. For this purpose, a disruption of the UA route, the BY route and a simultaneous disruption of both routes is simulated, with both FID and non-FID projects implemented.

As a third step, the **supply source dependencies** and the **supply source mix** of each CEE county are analysed. It is crucial, not only in terms of security of supply, but also in terms of a functioning competition within the market, to gain information on this issue as a basis for further development of the gas transmission system within Europe towards increased overall efficiency and ensuring competitive prices of energy.

3.6 Output

The output of the model is a feasible solution for each simulated case, not exceeding the constraints defined for the single nodes and arcs, if possible. Comparing the resulting flows of each arc with its respective capacity leads to the remaining flexibility within each country/balancing zone/hub area. An analysis of the overall results finally shows:

- Capacity gaps: the analysis shows for which countries in the CEE region existing or planned capacities are not sufficient to cover the respective demand.
- Level of security of supply: this investigation aims on the ability of the gas transmission network under disruption scenarios and/or extreme climatic conditions to provide sufficient volumes of natural gas respectively what amount of capacity reserves – or in other words: remaining flexibility – are still available in each country.
- Degree of market integration: the analysis shows the reach of natural gas originating from each supply source into the gas network of the CEE region. It shows different possible evolutions of the supply mix impacted by factors such as reserves, their accessibility, the evolution of national demand of exporting countries and the existence of alternative markets competing with Europe. Market integration is directly influenced by the supply source dependence/supply mix for each country and vice versa.
- Supply mix per zone/country: in this analysis, the share of gas from the different sources for each CEE country is investigated. For market integration, SoS and supply source analysis, different supply patterns, including disruption scenarios, have been applied.

It shall be emphasized that all the above mentioned parameters of interest are very much depending on each other.

One important issue to point out is that the modelling and the respective analysis only show **physical potential** for further development of the European gas network. Therefore, a lack of capacities resulting from inconsistencies of different market models or regulatory regimes is not taken into consideration. Furthermore, it has to be assumed that the gas networks' capacities are utilized in an (almost) optimum way. Suboptimum utilization, be it due to contractual requirements, economical constraints (spread of gas prices) or whatsoever reasons cannot be taken into account. **The CEE GRIP is a comprehensive analysis of physical capacities of the installed and planned gas transmission infrastructure, not of its in-fact utilization.**

3.7 Scenarios

The modelling was performed for 90 types of cases, modelled according to the following infrastructure configurations:

- Existing infrastructures plus projects for which FID has been taken.
- The same infrastructures as above plus non-FID projects.

As already mentioned in the infrastructure projects chapter, the PCI status of projects has not been taken into consideration in the modelling in this edition of the CEE GRIP.

For the purposes of the CEE GRIP only three years were modelled, i.e. 2014, 2018 and 2023. The results for these years sufficiently represent the evolution over the whole period 2014–2023.

Scenarios have been defined via various demand conditions:

- Reference scenarios:
  - Average day.
  - Average summer day.
  - Average winter day.
  - Design case.
  - Single uniform risk day in whole CEE.
  - Two-week uniform risk in whole CEE.
- Market integration: average day under:
  - Maximum RU share.
  - Maximum NO share.
  - Maximum DZ share.
  - Maximum LY share.
  - Maximum LNG share.
  - Minimum LNG share.
  - Minimum RU share.
- Security of Supply:
  - CEE single uniform risk day under disruption via UA.
  - CEE single uniform risk day under disruption via BY.
  - CEE single uniform risk day under simultaneous disruption via BY and UA.
  - CEE two-week uniform risk under disruption via UA.
  - CEE two-week uniform risk under disruption via BY.
  - CEE two-week uniform risk under simultaneous disruption via BY and UA.

Under uniform risk scenarios, no limitation to UGS deliverability has been considered. The LNG terminal deliverability stays at 80 % keeping the ability to send-out gas under peak demand conditions. Under average daily demand/supply, the ENTSOG model does not consider any withdrawal or injection, as such simulations stand for the simulations of the whole year assuming storage neutrality. For the average summer day scenario, average injection has been assumed, whereas for the winter counterpart, average withdrawal has been taken into consideration. More details are given in the table below.

SITUATIONS	PIPE IMPORTS	LNG	UGS
SUPPLY SOURCES			
1-DAY DESIGN-CASE OR 1-DAY UNIFORM RISK	The maximum reached on one day during the last 3 years	Import component is equal to the Average Winter Supply. The remaining send-out is used as last resort	Last resort supply
14-DAY UNIFORM RISK	The highest average of 14 consecutive days during the last 3 years	Import component is equal to the Average Winter Supply. Additional send-out based on the maximum use of stored LNG	Last resort supply
1-DAY AVERAGE	Average shares by source of the different supply import sources in the European yearly balance of last 3 years, applied to the required imports. When the supply coming from one source is limited by the intermediate potential supply scenario, the corresponding missing volume is divided between the remaining sources proportionally to their ability to increase their level i.e. how far they are from reaching their own intermediate supply potential scenario.		Not used
1-DAY AVERAGE SUMMER	Based on the 1-day average – decreased by source to represent the seasonal swing. The seasonal swing in gas supply has been estimated as the average seasonal swing of the last 3 years for each source.		The total injected volume for Europe has been defined as 80 % of the WGV (based on the average use of the last 3 years), and divided by balancing zone proportionally to the injection capacity.
1-DAY AVERAGE WINTER	Based on the 1-day average – increased by source to represent the seasonal swing. The seasonal swing in gas supply has been estimated as the average seasonal swing of the last 3 years for each source.		Average withdrawal equals average injection (country by country) of the average summer.
1-DAY – MIXED CASES	Minimum: Supply by source and route as resulting of the 1-day Average Maximum: As the 1-day Design Case		Min: value in average winter Max: withdraw availability (linked to stock level)
2-WEEK – MIXED CASES	Minimum: Supply by source and route as resulting of the 1-day Average Maximum: As the 14-day Uniform risk		Min: value in average winter Max: withdraw availability (linked to stock level)

Table 6: Supply situations applied in the CEE GRIP 2014–2023

Under every situation, aggregated national production at European level is set in the 90-100 % range of its maximum deliverability.

3.8 Regional N-1 formula

The N-1 analysis was prepared for two scenarios of total supply disruption through Ukraine and Belarus. The supply corridors were defined by the route from the source to each country and flows to neighbouring countries were determined as the rest of the gas amount after satisfaction of the demand in the given country. Each particular analysis was prepared for the following winter periods: 1.10.2014–31.3.2015, 1.10.2018–31.3.2019, 1.10.2022–31.3.2023 and summer periods: 1.4.–30.9.2014, 1.4.–30.9.2018, 1.4.–30.9.2023. The formulas are presented below together with an explanation of all parameters. The analysis only takes into consideration the infrastructure capabilities, as it assesses the infrastructure standard, not the supply standard.

3.8.1 WINTER

From each country, entry capacities at each IP, as well as withdrawal capacity of storage facilities, national production, domestic demand and exit capacities to neighbouring countries were used for regional N-1 calculation. After a matching/correction of entry and exit capacities of each IP (lesser rule), the surplus of gas is allocated to neighbouring countries to meet the domestic demand in countries which are "in need". The N-1 value for winter is calculated for each country by setting the IPs of the main supply corridor to zero or to minimum volume that an upstream country (next or nearer to Ukraine/Belarus transport to relevant IP) is able to export. If the investigated country has a surplus of gas after satisfying its demand for sharing, the gas is then allocated to downstream countries, where necessary. These values are used for N-1 calculation as entries for a particular country. In case the value is equal to or above 1, it means that the respective country is able to cover its own demand in case a disruption via Ukraine or Belarus. Under the assumption that UGS facilities are filled up during the summer period (as N-1 calculation is assessing the infrastructure not supply standard), the maximum deliverability has been applied, the stock levels of UGS, as well as the duration of the disruption have not been taken into consideration in the winter formula.

$$N-1_{WINTER} = \frac{\sum_{i=2}^{n} E\_CB_i + E\_UGS + E\_P}{X\_DOM} \geq 1$$

3.8.2 SUMMER

In addition to the data for entry capacities, the working gas volumes and maximum injection capacity to UGS of each country were also used for the calculation of regional N-1 and UGS injection in the summer period. The formula is set to determine how long the disruption can last without endangering the ability to cover demand and/or to fill the storage facilities. After a matching/correction of entry and exit capacities of each IP (lesser rule) the surplus of gas is allocated to neighbouring countries to meet their domestic demand. The N-1 value for summer is calculated for each country by setting the IPs of the main supply corridor to zero or to minimum volume that an upstream country (next or nearer to Ukraine/Belarus transport to relevant IP) is able to export. If the investigated country has a surplus of gas for sharing after satisfying its demand, the gas is then allocated to downstream countries, where necessary. These values are used for N-1 calculation as entries for each particular country.

$$\sum \mathrm{E\_OUT}_{X,SUMMER} = \sum_{i=2}^{n} E\_CB_i + E\_P - X\_DOM \geq 0$$

ABBREVIATION	EXPLANATION
E_CB_i	All cross-border capacities in flow direction on supply corridor *i* without or with reduced biggest one (Ukraine/Belarus disruption) – mcm/d
E_P	Production entry capacity – mcm/d
E_UGS	UGS Entry Capacity (withdrawal) – mcm/d
X_DOM	Domestic seasonal peak daily demand (1 in 20) – mcm/d
E_OUT_X	Remaining sources to fulfil the demand in neighbouring countries – mcm/d
$\sum E\_OUT_X$	Remaining sources to fulfil the demand in neighbouring countries and for injection to UGSs – mcm/d

Table 7: Explanation of the abbreviations in the Regional N-1 formula

4 Assessment Results

Reference Scenarios
Network Resilience – Security of Supply

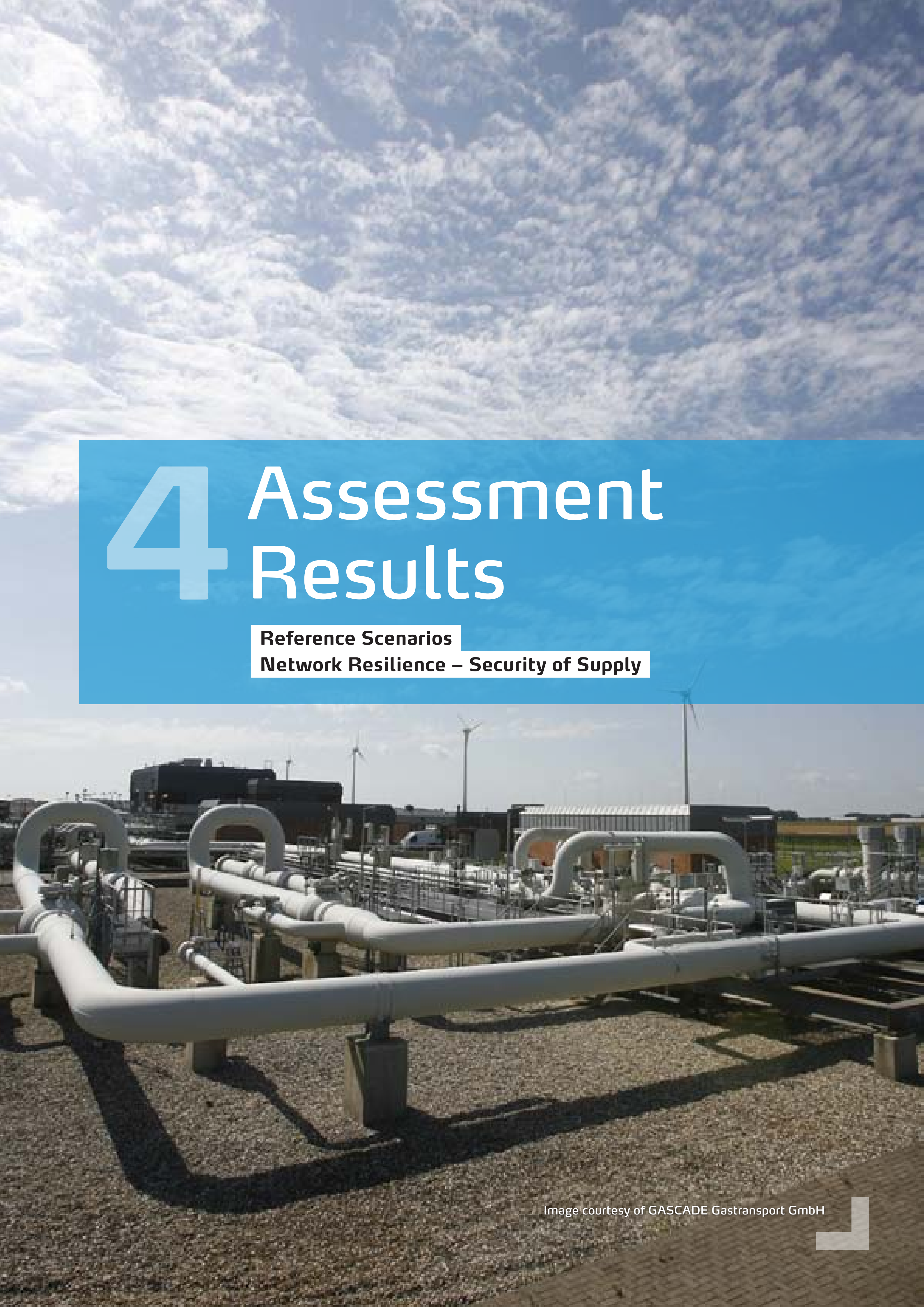

Image courtesy of GASCADE Gastransport GmbH

GENERAL NOTE

In the following chapter, the results of the network analysis are described. One important thing to mention is that all results are based on a mathematical model, which finds one of various possible solutions for the set of constraints. As modelling always means reducing complexity of the described reality to an extent allowing for feasible preparation as well as calculation time on one hand while maintaining a certain accuracy of the results on the other hand, not all parameters are taken into consideration. Thus, for example, shale gas, the injection of bio-methane, and hydrogen/methane from power-to-gas facilities have not been taken into consideration for national production data, as the respective volumes are either insignificant or the future perspective is still unclear. Also the development of gas demand in the single countries is based on historical data on the one the hand, on the other hand the figures are result of different prognosis and extrapolations. Therefore there is no guarantee for the assessment results to exactly show future developments. As mentioned already in the chapter on methodology, in the CEE GRIP the physical/hydraulic potential of the gas network is analysed, therefore also price driven gas flows are not taken into consideration.

NATIONAL PRODUCTION

As the handling of national production in the model does – other than in reality – not limit the consumption to the respective producing countries, but also allows for export, an overview over the national production capacity is given below.

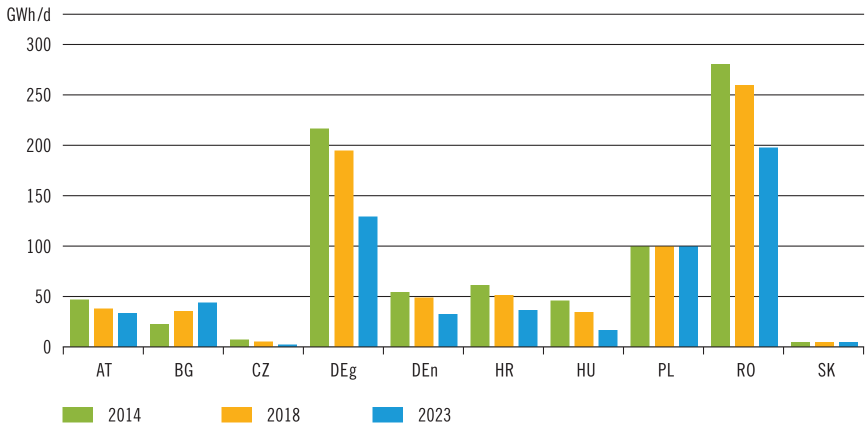

Figure 2: Evolution of the national production capacity

The main producer in the region is Romania, with capacities between 280 and 200 GWh/d, followed by Germany (Gaspool) with capacities between 217 and 130 GWh/d and Poland (approx. 100 GWh/d). Austria, Bulgaria, Germany (Netconnect), Croatia and Hungary have production capacities between 30 and 60 GWh/d. In the Czech Republic and in Slovakia, national production does only play a minor role. Slovenia is the only country in the region without production facilities.

4.1 Reference Scenarios

4.1.1. AVERAGE DAY

Demand

Under average day conditions, the total demand in the CEE region amounts for 4,421 GWh/d in 2014, 4,861 GWh/d in 2018 and 4,959 GWh/d in 2023. In the charts below, the demand evolution per country is displayed, as well as the cumulated demand in the CEE region.

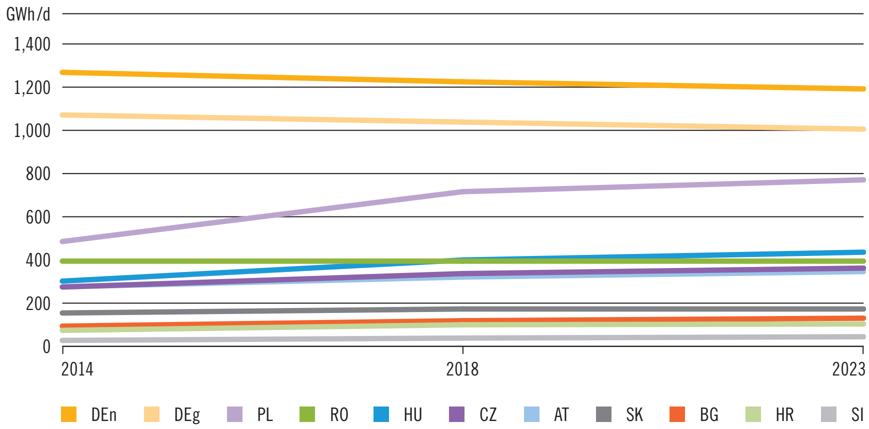

Figure 3: Evolution of the demand by country/balancing zone under the average day conditions

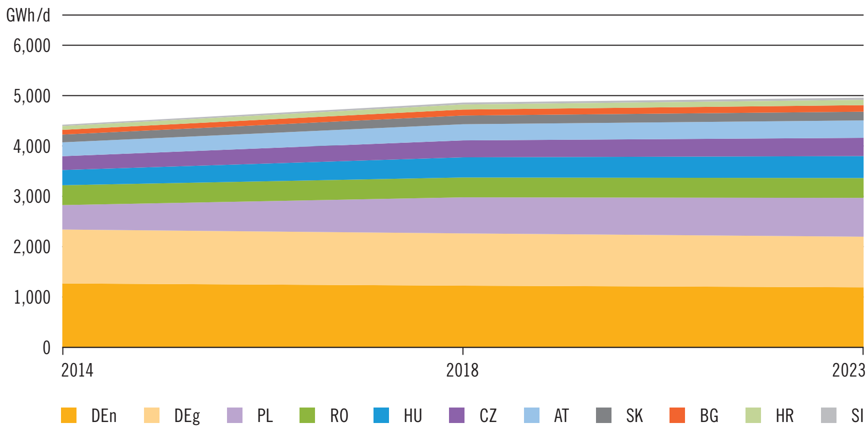

Figure 4: Evolution of the cumulated demand under the average day conditions

It is worth noticing that according to the German nTYNDP[1] 2013 the demand of both German balancing zones is decreasing by about 142 GWh/d in total (-6 %), although Germany is together with Poland still responsible for more than half of the CEE gas demand. Poland is showing the biggest absolute increase in demand with 286 GWh/d (almost 60 %) between 2014 and 2023. Only the Slovenian demand growth with an increase of 61 % is higher in relative terms. The demand situation in

1) Refers to the German national Ten Year Network Development Plan (see www.netzentwicklungsplan-gas.de)

Romania (+/-0%) and Slovakia (+11%) is almost stable, whereas the rest of the CEE countries show an increase between 25% and 45%, being 27% on average over the 2014–2023 period for the whole region. A detailed overview is given in the table below.

COUNTRY	2014 [GWH/D]	2018 [GWH/D]	2023 [GWH/D]	2014 to 2018	2018 to 2023	2014 to 2023
AT	275	321	346	16.56%	7.95%	25.82%
BG	94	119	130	26.82%	9.92%	39.39%
HR	74	100	104	34.77%	3.78%	39.87%
CZ	275	337	362	22.59%	7.54%	31.84%
DEg	1,071	1,038	1,005	-3.07%	-3.17%	-6.14%
DEn	1,268	1,225	1,192	-3.46%	-2.68%	-6.05%
HU	302	400	436	32.38%	9.07%	44.39%
PL	485	716	771	47.60%	7.63%	58.86%
RO	395	395	395	0.00%	0.00%	0.00%
SK	155	173	173	11.97%	0.00%	11.97%
SI	28	38	45	39.18%	15.85%	61.24%

Table 8: Evolution of the demand by country/balancing zone under the average day conditions

Supply

The supply analysis shows that under average day conditions each country can cover its demand. The remaining flexibility for each country to be supplied lies above 20% for the whole region with implementation of FID projects, with the exception of Poland which has an 11% remaining flexibility in 2018 and 4% in 2023. By implementing the non-FID projects, Poland would also increase the remaining flexibility in its gas grid to over 20% for both 2018 and 2023.

Supply sources

As shown in the chart below, Russia is the main supplier for the region, providing 69% of the supply in 2014 and increasing to around 77% in 2023. National production in the region decreases from 24% in 2014 to 14% in 2023. The share of Norwegian gas is almost constant during the period with around 6.8%. LNG plays only a minor role with shares up to 1.8% and 3% in the FID and non-FID scenarios in 2023, respectively. The gas originating from the SGC region has a maximum share of around 1%.

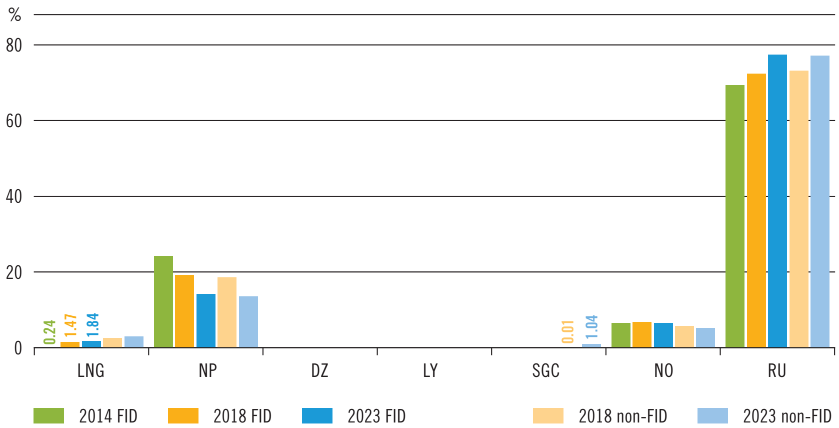

Figure 5: The share of supply sources in the CEE region under the average day conditions

4.1.2 AVERAGE SUMMER DAY

Demand

Assuming an average summer day in the CEE region, the total demand develops from 2,940 GWh/d in 2014 to 3,299 GWh/d in 2023. In the charts below, the demand evolution per country and the cumulated demand is displayed.

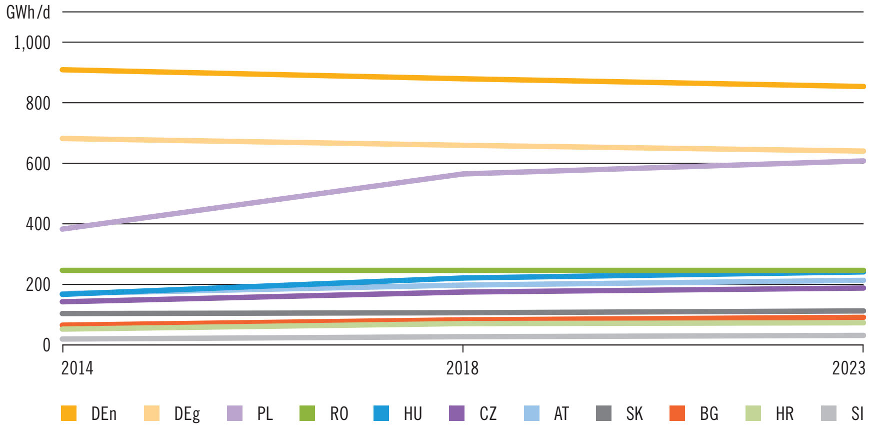

Figure 6: Evolution of the demand by country/balancing zone under the average summer day conditions

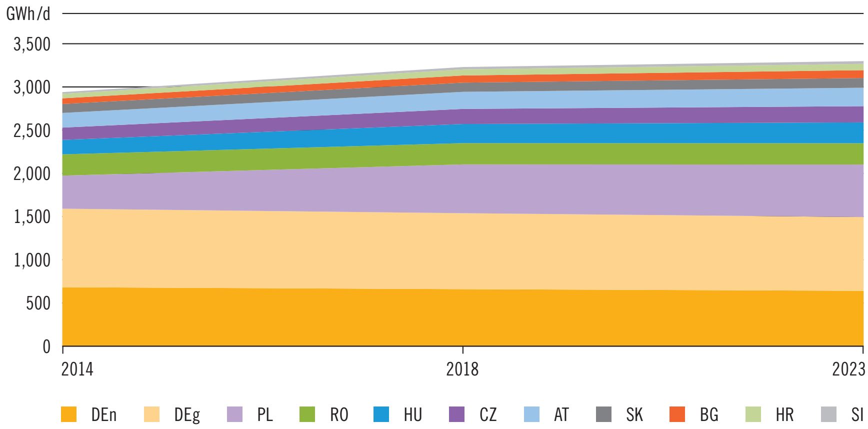

Figure 7: Evolution of the cumulated demand under the average summer day conditions

As the "Average Summer Day" and "Average Winter Day" scenarios are derived from the "Average Day", the relative shares and demand changes are identical as above.

Supply

Under average summer day conditions each country can cover its demand easily. The remaining flexibility for each country to be supplied lies above 20 % for the whole region with implementation of FID projects, with the exception of Poland which has 17.7 % remaining flexibility in 2018 and 9.7 % in 2023. By implementing also the non-FID projects, Poland would increase the remaining flexibility in its gas grid to over 20 % for 2018 and 2023.

Supply sources

Russia is again the main supplier for the region, providing 64 % of the supply in 2014 and increasing to around 72 % in 2023. National production in the region decreases from 26.4 % in 2014 to 16 % in 2023. The share of Norwegian gas is almost constant during the period with around 9.1 %. LNG plays only a minor role with shares up to 1.8 % and 3 % in the FID and non-FID scenarios in 2023, respectively. The gas originating from the SGC region has a share lower than 0.1 % and is only expected to be available under non-FID cases in Bulgaria.

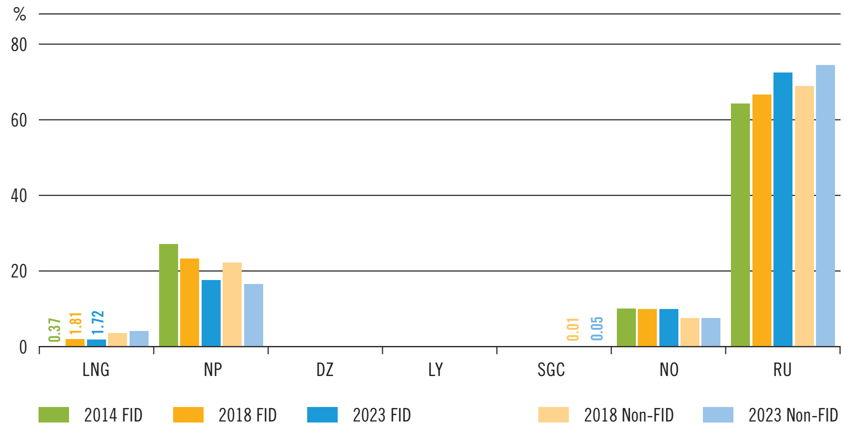

Figure 8: The share of supply sources in the CEE region under the average summer day conditions

4.1.3. AVERAGE WINTER DAY

Demand

Assuming an average winter day in the CEE region, the total demand develops from 5,980 GWh/d in 2014 to 6,693 GWh/d in 2023. In the charts below, the demand evolution per country as well as the cumulated demand in the region is displayed.

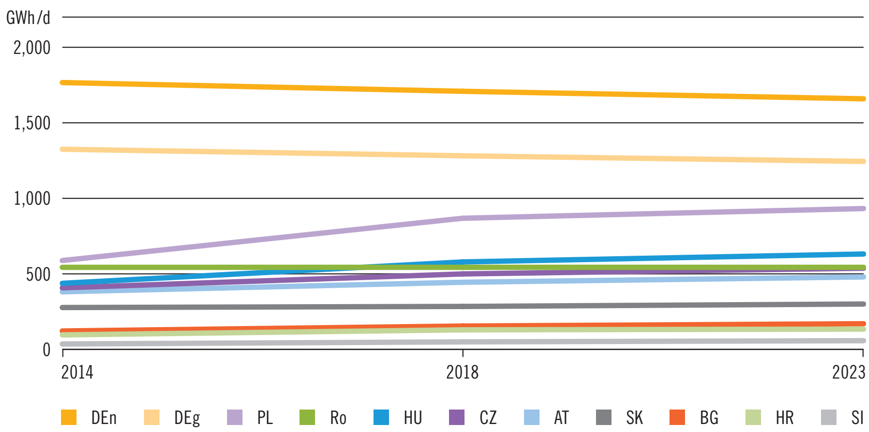

Figure 9: Evolution of the demand by country/balancing zone under the average winter day conditions

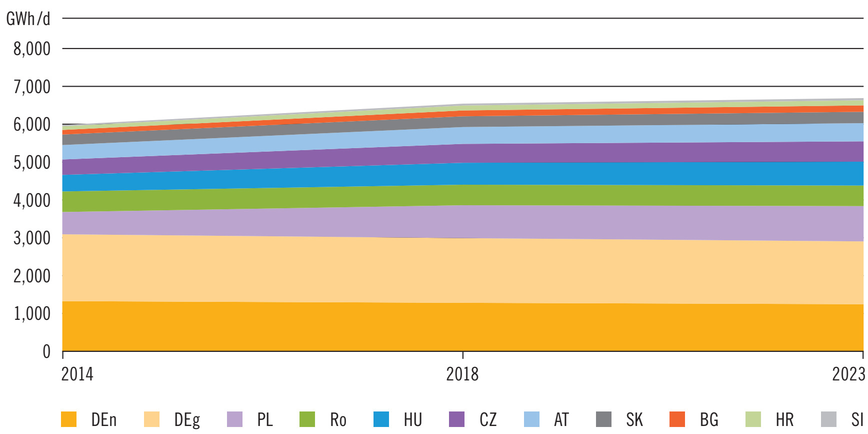

Figure 10: Evolution of the cumulated demand under the average winter day conditions

As the "Average Winter Day" and the "Average Summer Day" scenarios are derived from the "Average Day", the relative shares and demand changes are identical as above.

Supply

Under average winter day conditions, each country can cover its demand easily in 2014 as well as 2018. The remaining flexibility for each country to be supplied lies above 20 % for the whole region with implementation of FID projects. For 2023, only the Polish network is expected to show a shortage of 0.24 % (2.21 GWh/d), which can be mitigated by implementation of the non-FID projects.

Supply sources

Russia is again the main supplier for the CEE region, providing 55.3 % of the supply in 2014 and increasing to around 61.6 % in 2023. National production in the region decreases from 17 % in 2014 to 11 % in 2023. The share of gas from underground storages decreases slightly from 23.4 % in 2014 to 19.3 % in 2023, assuming the FID case. In the non-FID case, the share would decrease to around 19.5 % in 2018 and remain almost constant in the following years. The share of Norwegian gas is slightly increasing from 4.4 % in 2014 to 6.4 % in 2023 in the FID case. In the non-FID case it would decrease from 4.6 % in 2018 to 3.7 % in 2023. LNG plays only a minor role with shares up to 1.7 % and 2.5 % in the FID and non-FID scenarios in 2023, respectively. The gas originating from Algeria and Libya has a share lower than 0.2 %. The share of gas from the SGC region is expected to be around 1.2 % in 2023 in the non-FID case.

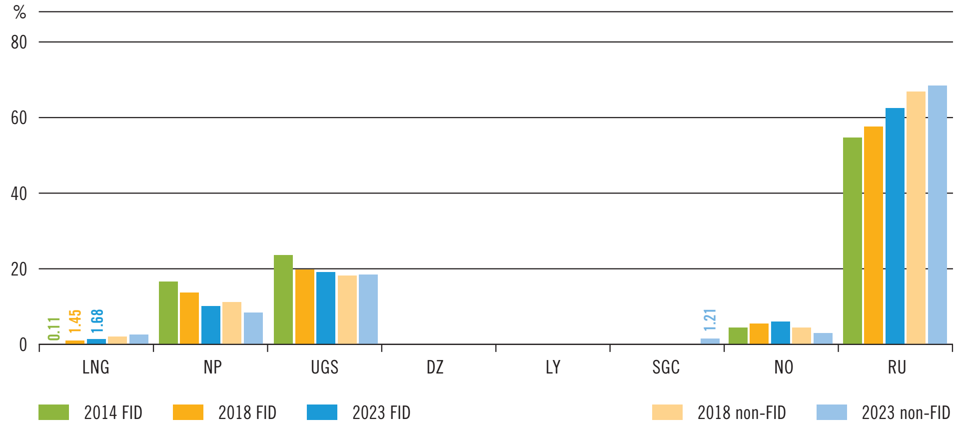

Figure 11: The share of supply sources in the CEE region under the average winter day conditions

Storage

The storage connections in this scenario show sufficient remaining flexibility, only the capacity from Austrian storage facilities towards Germany has to be operated at full load, meaning without residual capacity, in 2014, as well as in the 2023 non-FID case. Apart from the connection of storages in Slovakia towards Austria (8 %), remaining flexibility is above 20 % in all analysed storage arcs.

4.1.4 DESIGN CASE

Demand

Under Design Case conditions, which are of all checked reference scenarios the most challenging, the overall demand in the CEE region increases from 9,773 GWh/d in 2014 to 10,427 GWh/d in 2018 and to 10,561 GWh/d in 2023. As in the above described scenarios, again Germany is the only country showing a decrease in demand, being 6.1 % between 2014 and 2023. Slovenia (+60.1 %), Poland (+53 %), Croatia (+40.5 %), Bulgaria (+38 %) and Hungary (+25 %) show a significant increase of demand, whereas Austria, the Czech Republic and Slovakia can expect moderate increase rates with 16 %, 14 % and 12 %, respectively. The demand in Romania remains constant over the whole period.

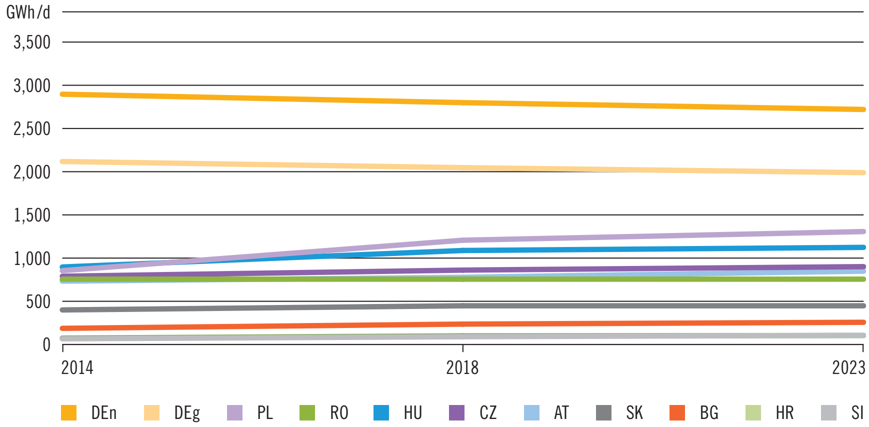

Figure 12: Evolution of the demand by country/balancing zone under the design case conditions

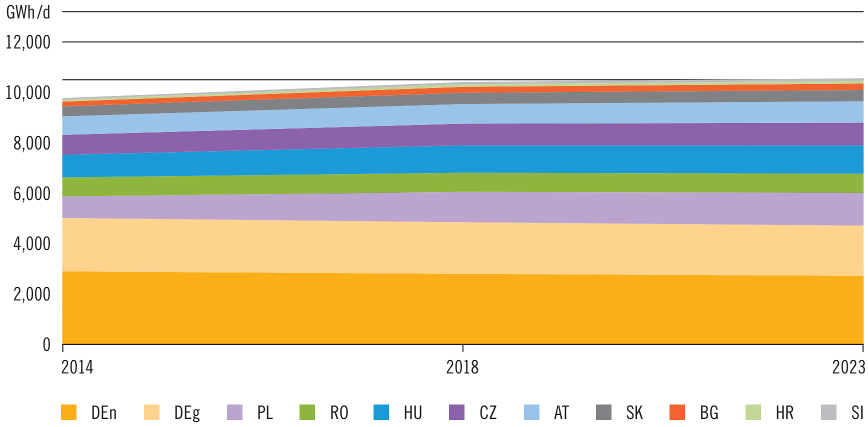

Figure 13: Evolution of the cumulated demand under the design case conditions

Supply

The supply situation in the region under design case conditions is almost sufficient. In 2014, only Bulgaria (16.6 %) and Poland (15 %) show a remaining flexibility lower than 20 %. In 2018, assuming the FID-case, only Poland suffers from a slight shortage of 1.41 % (remaining flexibility of 14.2 % in 2018 non-FID), which disappears in 2023 in the FID (7 %), as well as non-FID case (> 20 %). The remaining flexibility of Hungary is expected to be at the level of 13.6 % in 2018, 8 % in the 2023 FID-case and > 20 % in the non-FID case.

Supply Sources

Also under Design Case conditions and FID case, Russia remains the main supplier for the CEE region, providing 56.4 % of the supply in 2014 and around 52 % in 2018 and 2023. Assuming the non-FID case, the shares would be 68 % in 2018 and 73 % in 2023. The share of national production in the region is around 12 % in 2014 and 2018, decreasing to 9 % in 2023. For the non-FID case, its share will amount to 9.6 % in 2018 and 8,2 % in 2023. The share of gas from underground storages increases by around 3 % between 2014 and 2018, as well as between 2018 and 2023, being initially 28 % in 2014, assuming the FID case. In the non-FID case, the share would decrease to around 16.5 % in 2018 and 11.2 % in 2023. The share of Norwegian gas remains at around 3.3 %. LNG plays only a minor role with shares up to 1.4 % and 2.7 % in the FID and non-FID scenarios in 2023, respectively. The gas originating from Algeria and Libya has a share lower than 0.3 %. The share of gas from the SGC region is expected to be around 2 % in 2023 in the non-FID case.

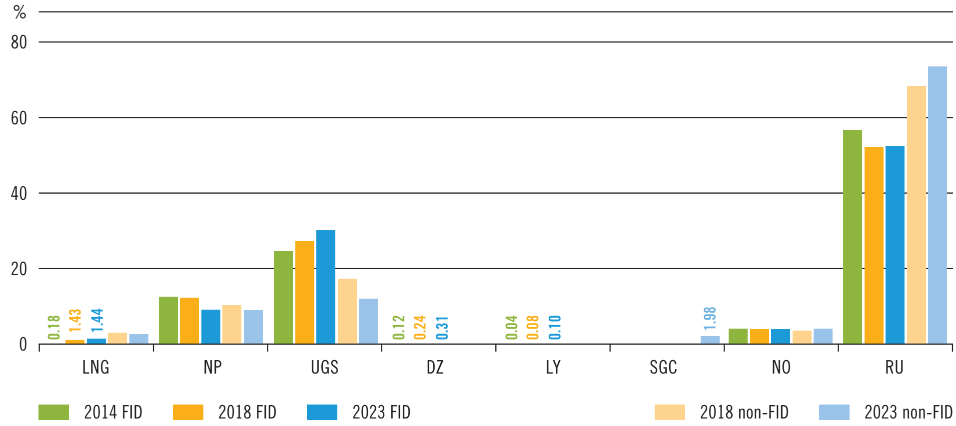

Figure 14: The share of supply sources in the CEE region under the design case conditions

Storage

The storage connections in this scenario show sufficient remaining flexibility in 2014. In 2018 (FID case), Croatian, Hungarian and Polish underground storage connections are expected to be operated at full load (no remaining flexibility), whereas in 2023, Poland is expected to have around 8.6 % of remaining flexibility. In the non-FID cases, the remaining flexibility of the storage connections would be >20 % in the entire CEE region.

4.1.5 SINGLE UNIFORM RISK DAY IN WHOLE CEE REGION, AVERAGE WINTER DAY IN THE REST OF THE EU

Under the single day uniform risk scenario, the overall demand in the CEE region increases from 7,736 GWh/d in 2014 to 8,447 GWh/d in 2018 and 8,616 GWh/d in 2023. Germany is the only country showing a decrease in demand, being 6.1 % between 2014 and 2023. Slovenia (+62 %), Poland (+59.6 %), Croatia (+40.5 %), Bulgaria (+37.5 %) and Hungary (+20 %) show a significant increase of demand in this scenario, whereas Austria, the Czech Republic and Slovakia are likely to show moderate increase rates with 15.7 %, 14 % and 12 %. The demand in Romania remains constant over the whole period.

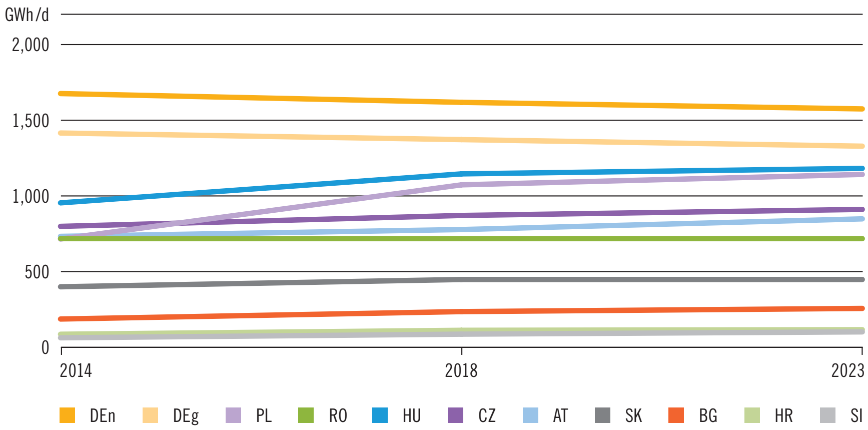

Figure 15: Evolution of the demand by country/balancing zone under the single uniform risk day conditions

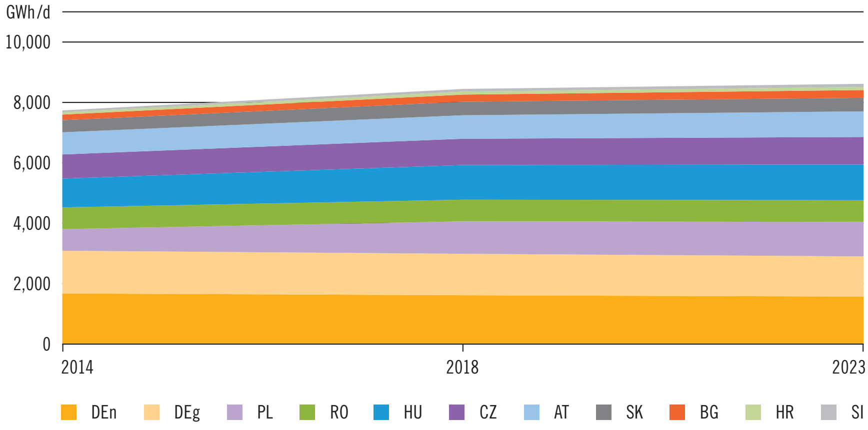

Figure 16: Evolution of the cumulated demand under the single uniform risk day conditions

Supply

In the 2014 FID case, Hungary shows with a value of 15.7 % a remaining flexibility lower than 20 %. In 2018 FID, the remaining flexibility of the Hungarian network decreases to 7.3 %, recovering to 19.36 % in 2023 due to the utilisation of national UGS reserves. Poland's remaining flexibility of 11.1 % in 2018 FID increases to 18.7 % in 2023. Slovenia's remaining flexibility would drop to 9.7 % in 2023, in the FID case. With implementation of the non-FID cases, all the CEE countries would have a remaining flexibility higher than 20 % in 2018, as well as in 2023.

Supply Sources

Also under CEE UR/EU AW conditions and FID case, Russia remains the main supplier for the region, providing around 50 % of the supply in 2014 and 2018, as well as around 52.6 % in 2023. In the non-FID case, the share would be around 58 % in 2018 and 2023. The share of national production in the region is around 16.7 % in 2014, 14.7 in 2018, decreasing to 10.5 % in 2023. For the non-FID case, its share is expected to be at the level of 11 % in 2018 and 9 % in 2023. The share of gas from underground storages in the FID case decreases from 29 % in 2014 to 27.8 % in 2018 and later on increases to 30 % in 2023. In the 2018 non-FID case, the share would decrease to around 24.5 % and to 23 % in 2023. The share of Norwegian gas remains at around 4.7 % in the FID case and 3.5 % in the non-FID case. LNG plays only a minor role with shares up to 1.9 % and 3.8 % in the FID and non-FID scenarios in 2023, respectively. The gas originating in Algeria and Libya has a share lower than 0.45 %. The share of gas from the SGC region is expected to be around 2.5 % in the 2023 non-FID case.

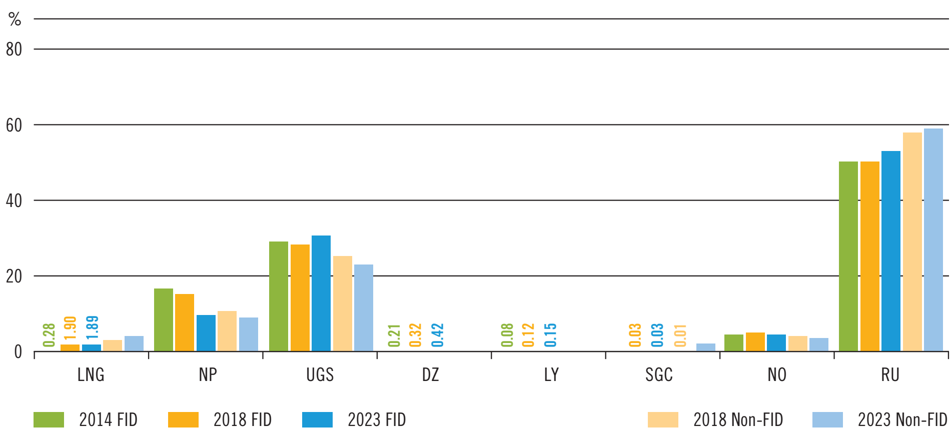

Figure 17: The share of supply sources in the CEE region under the single uniform risk day conditions

Storage

In 2014, Bulgarian storage connection is being operated at full load, leaving no remaining flexibility. Hungary has remaining flexibility of 12 %, in all other CEE countries the value is above 20 %. In 2018 and 2023 (FID case), Bulgaria, Croatia and Hungary have no remaining flexibility left in their storage connections. Poland's remaining flexibility is expected to be 14.5 % in 2018, but will increase to > 20 % in 2023 again. In the non-FID case, all countries would show remaining flexibility higher than 20 % for their storage connections.

4.1.6 TWO-WEEK UNIFORM RISK DAY IN WHOLE CEE REGION, AVERAGE WINTER IN THE REST OF THE EU

Under the two-week uniform risk day scenario, the overall demand in the CEE region increases from 7,769 GWh/d in 2014 to 8,055 GWh/d in 2018 and 8,217 GWh/d in 2023. Germany is the only country showing a decrease in demand, being 6.1 % between 2014 and 2023. Slovenia (+66 %), Poland (+62 %), Croatia (+40.5 %), Bulgaria (+37 %) and Hungary (+26.5 %) also show a significant increase of demand in this scenario, whereas Austria, the Czech Republic and Slovakia are likely to show moderate increase rates with 15.8 %, 15.6 % and 12.1 %. Again, the demand in Romania remains constant over the whole period.

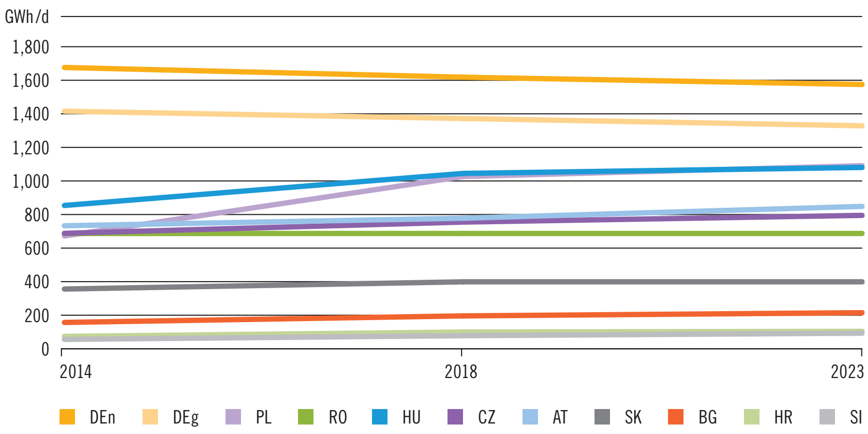

Figure 18: Evolution of the demand by country/balancing zone under the two-week uniform risk day conditions

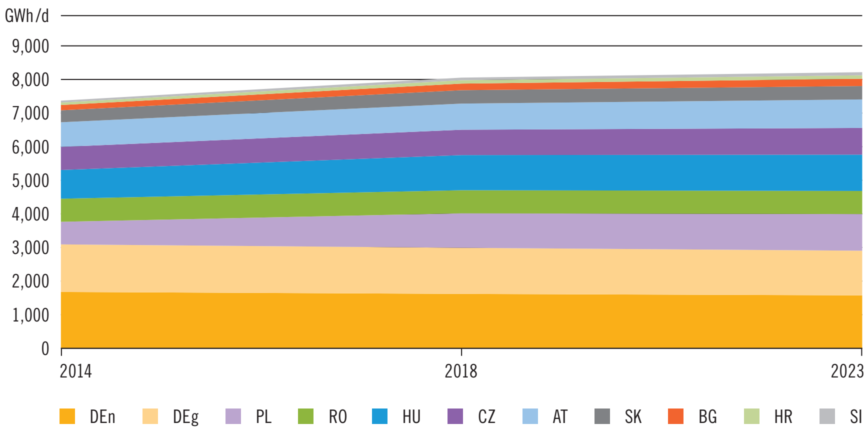

Figure 19: Evolution of the cumulated demand under the two-week uniform risk day conditions

Supply

The supply situation in the region under the two-week uniform risk day scenario is sufficient in 2014, as all countries have remaining flexibility of more than 20 %. In 2018 (FID case), only Hungary (12.7 %) and Poland (12.3 %) show a remaining flexibility lower than 20 %. In 2023, assuming the FID-case, Croatia (18.4 %), Poland (19.17 %) and Slovenia (13 %) show a remaining flexibility of less than 20 %. In the non-FID case, the remaining flexibility would be higher than 20 % in all CEE countries in 2018 as well as 2023.

Supply Sources

Also under CEE 2W UR/EU AW conditions, Russia remains the main supplier for the region, providing around 51 % of the supply in the FID case. In the non-FID case, the shares would be around 60 % in 2018 and 61.5 % in 2023. The share of national production in the region is around 16.6 % in 2014, 14.9 % in 2018, followed by 11.8 % in 2023. For the non-FID case, its shares are expected to be at the level of 11 % in 2018 and 9 % in 2023. The share of gas from underground storages in the FID case increases from around 27 % in 2014 and 2018 to almost 30 % in 2023. In the 2018 non-FID case, the share would decrease to around 22.5 % and to 21 % in 2023. The share of Norwegian gas remains at around 4.5 % in the FID case and 3.5 % in the non-FID case. LNG plays only a minor role with shares up to 1.6 % and 3 % in the FID and non-FID cases in 2023, respectively. The gas originating in Algeria is estimated to be around 0.8 % in 2023 (FID), while Libyan gas has a share lower than 0.3 %. The share of gas from the SGC region is expected to be around 2.5 % in 2023 in the non-FID case.

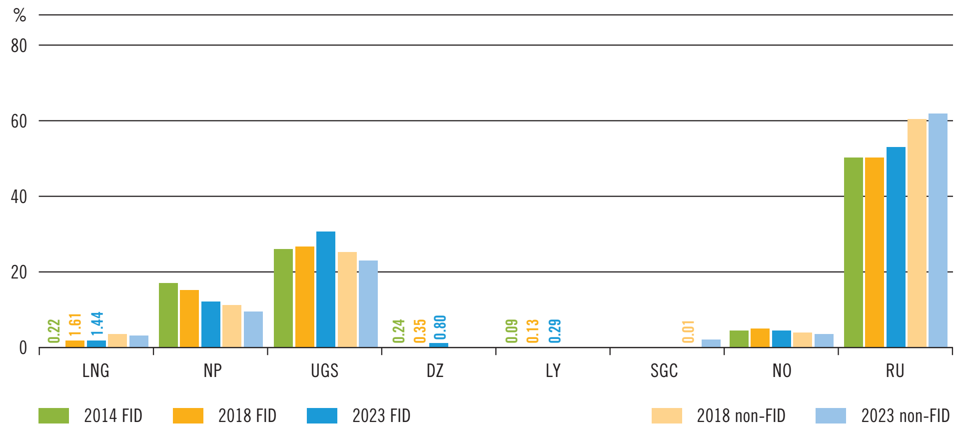

Figure 20: The share of supply sources in the CEE region under the two-week uniform risk day conditions

Storage

The situation of storage connection utilization is quite similar to the single uniform risk day in the CEE region. In the FID case, Bulgaria has no remaining flexibility left in its UGS connections in 2014. Hungary shows a remaining flexibility of 11.1 %. In the rest of the CEE countries, the remaining flexibility is higher than 20 %. In 2018, storage connections are expected to be operated at full load (0 % remaining flexibility) in Bulgaria, Croatia and Hungary. Poland and Slovakia still have a remaining flexibility of 14.4 % and 17.1 %, respectively. In 2023, Bulgaria, Croatia, Hungary and Poland are without remaining flexibility, whereas Slovakia shows 18.4 % flexibility. In the non-FID case, only the remaining flexibility of Slovakia is slightly below 20 %, being 17.1 % in 2018 and 17,3 % in 2023.

4.1.7 MARKET INTEGRATION

In the analysis of market integration, the parameter of interest is the potential reach of gas from different sources under application of various different supply source weightings, or in other words, the dependence of single countries on different supply sources. Market integration scenarios illustrate different possible evolutions of the supply mix impacted by factors such as reserves, their accessibility, the evolution of national demand of exporting countries and the existence of alternative markets competing with Europe. For market integration scenarios, different supply source deliverabilities were used. "Full Minimisation" (min RU, min LNG) in the context of the GRIP means a modelling approach aiming at minimising supply from each source separately, in order to identify Supply Source Predominance, and replacing it with the corresponding volume from the remaining sources in such a way that the maximum minimisation of the analysed supply is achieved. "Targeted Maximisation" (max RU, NO, …) on the other hand means a modelling approach aiming at maximising supply from each source separately as to reach each Zone; the decrease of each other supply is done in proportion to its share in the Reference Case and with the Minimum Potential scenario used as a limit. The use of an import route is a result of the modelling. The maximisation or minimisation of source deliveries always refers to the deliveries dedicated to the entire European Union. Therefore an impact on the CEE region is not inevitable, as increased deliveries of one source do not necessarily reach the CEE region, but can already be consumed in upstream countries.

An overview over the gas delivered to the entire EU per source and case is given in the tables below.

		ORIGIN					
		RU	NO	LY	DZ	SGC	LNG
2014 FID	min LNG	728	2,450	354	1,801	–	655
	min RU	188	1,759	354	1,438	–	3,883
2018 FID	min LNG	1,062	2,245	354	1,801	–	1,055
	min RU	427	1,651	354	1,517	–	4,360
2023 FID	min LNG	1,094	2,317	354	1,801	–	1,157
	min RU	440	1,788	354	1,517	–	4,514
2018 NON-FID	min LNG	1,627	2,160	354	1,801	–	991
	min RU	486	1,596	354	1,517	–	4,747
2023 NON-FID	min LNG	2,152	2,306	354	1,899	201	526
	min RU	362	1,198	354	1,591	214	5,643

Table 9: Minimum deliveries of gas in [GWh/d] to the EU per source under the market integration assessment

		ORIGIN RU	NO	LY	DZ	SGC	LNG
2014 FID	max DZ	520	1,630	263	1,164	–	2,196
	max LNG	475	1,399	263	950	–	3,418
	max LY	520	1,630	336	950	–	2,196
	max RU	817	1,550	263	950	–	2,196
	max NO	520	2,094	263	950	–	2,196
2018 FID	max DZ	744	1,665	283	1,335	–	2,714
	max LNG	658	1,090	283	971	–	4,924
	max LY	744	1,665	336	1,020	–	2,714
	max RU	1,126	1,558	283	1,020	–	2,714
	max NO	674	2,118	283	1,020	–	2,714
2023 FID	max DZ	752	1,637	293	1,543	–	2,982
	max LNG	705	881	293	1,009	–	5,597
	max LY	752	1,736	336	1,115	–	2,982
	max RU	1,223	1,392	293	1,115	–	2,982
	max NO	752	2,094	293	1,115	–	2,982
2018 NON-FID	max DZ	1,398	1,535	252	1,335	–	2,519
	max LNG	1,120	1,021	252	869	–	4,924
	max LY	1,440	1,561	336	910	–	2,519
	max RU	1,624	1,485	252	910	–	2,519
	max NO	1,396	2,065	252	910	–	2,519
2023 NON-FID	max DZ	1,709	1,336	227	1,543	139	2,943
	max LNG	1,390	813	227	929	134	5,605
	max LY	1,884	1,346	336	929	139	2,943
	max RU	3,662	974	112	629	69	2,383
		1,552	2,106	227	929	139	2,943

Table 10: Maximum deliveries of gas in [GWh/d] to the EU per source under the market integration assessment

4.1.7.1 Average Day – minimum RU

Supply mix

Under minimized deliveries of Russian gas, the respective shares of Russian gas and the shares of gas from national production show almost opposite developments. Russian gas is expected to increase from 28.3 % in 2014 to 33.8 % in 2018 and 41.7 % in 2023 in the FID case, whereas in the non-FID case, its share is almost constant with 30 %. National production on the other hand is expected to decrease from almost 36 % in 2014 to 29.6 % in 2018 and 22.3 % in 2023 in the FID- as well as the non-FID case. Norwegian gas has a relatively constant share between 19 % and 20 % in the FID and non-FID case. The same is true for the share of Libyan deliveries, although it moves around a lower level, between 2.15 % and 1.5 %. Algerian gas, on the other hand, is expected to have a share of 6.6 % in 2014, decreasing to 4.7 % in the 2023 FID-case. In the non-FID case, the share remains at 5 %. LNG contributes to the replacement of Russian gas with a share of 7.9 % in 2014, increasing to 9.7 % in 2023 FID. By implementing the non-FID projects, the share would be pushed to 14.1 % respectively 17.2 % in 2018/2023.

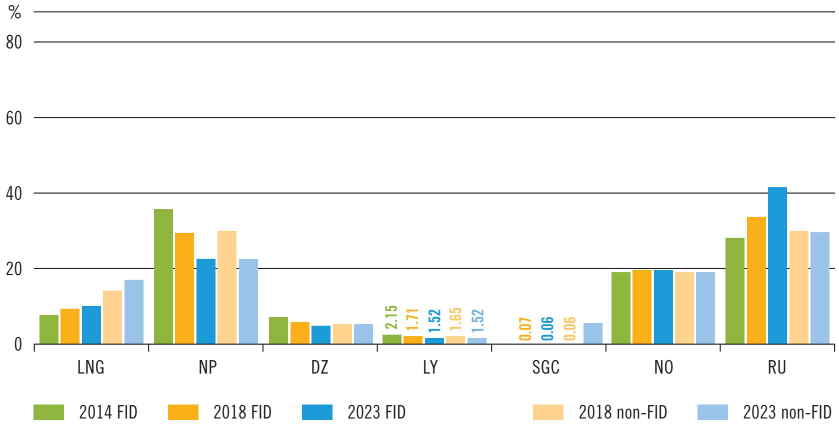

Figure 21: The share of supply sources in the CEE region under minimum deliveries of gas from Russia and the average day conditions

Supply

The demand of the CEE region, which remains constant in all average day scenarios, can be covered in the whole CEE region. Besides Poland in the 2018 and 2023 FID-case (10.7 % and 4 %, respectively), all countries have left more than 20 % remaining flexibility. In the non-FID cases, the remaining flexibility increases over 20 % in the whole CEE region.

4.1.7.2. Average Day – minimum LNG

Supply mix

With a minimization of LNG deliveries, the share of Russian gas would climb to 74 % in 2014, further increasing to 78.1 % in 2018 and 81 % in 2023. In the non-FID case, the 2018 share is expected to be 81 %, further increasing to 82.6 % in 2023. Again, the share of gas from national production is behaving contrary, decreasing from 20.2 % in 2014, to 15.8 % in 2018 and 11.5 % in 2023. In the non-FID case, the expected shares for both 2018 (13.7 %) and 2023 (11.5 %) are one percent lower. LNG would play a minor role with up to 1.4 % in 2023 FID.

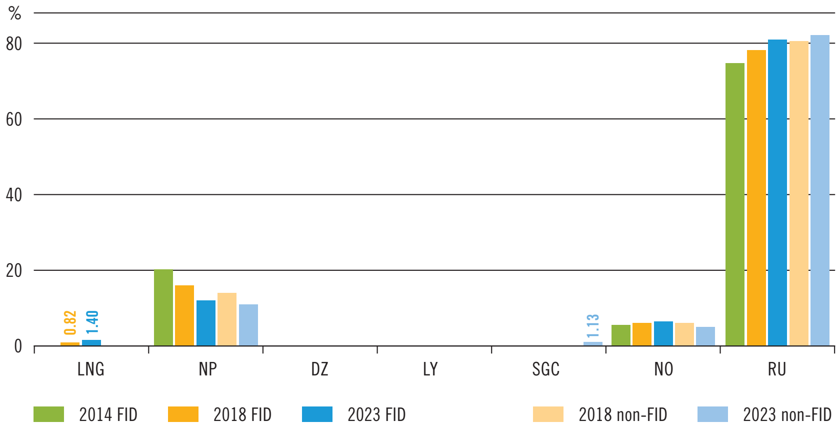

Figure 22: The share of supply sources in the CEE region under minimum deliveries of LNG and under the average day conditions

Supply

Also under minimum LNG deliveries, Poland is expected to have remaining flexibility of 10.7 % in 2018 and 4 % in 2023 FID. With implementation of the non-FID projects, the value is expected to be above 20 % in the entire CEE region.

4.1.7.3 Average Day – maximum RU

Supply mix

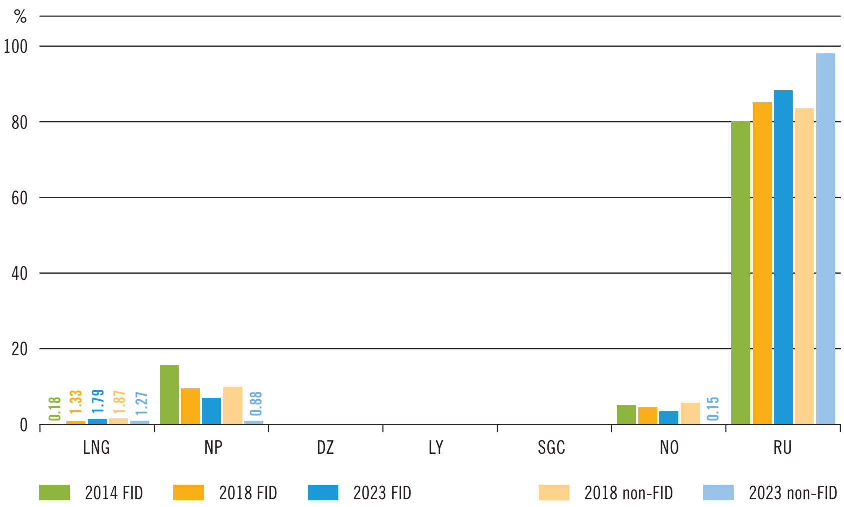

Figure 23: The share of supply sources in the CEE region under maximum deliveries of gas from Russia and under the average day conditions

Under maximum RU supply, the share of Russian gas in the CEE region is 80.3 % in 2014, 84.5 % in 2018 and 88 % in 2023 in the FID case. A full implementation of the non-FID projects would lead to 83 % share in 2018 and almost 100 % in 2023. Such a high share in 2023 non-FID is a result of potential commissioning of large import pipeline projects, like South Stream. National production shows a contrary development with a share of 15 % in 2014, decreasing to 7 % in 2023. In the non-FID case, for 2018 a share of around 10 % is expected. Russian gas seems to replace the decreasing share of national production. A similar behaviour can be observed in the FID case concerning the share of LNG (0.2 % in 2014 to 1.8 % in 2023) and Norwegian gas (4.6 % in 2014 to 3.4 % in 2023). In the non-FID case, Norwegian gas plays a role only in 2018 with a share of 5 %.

Supply

The demand of the CEE region, which remains constant in all average day scenarios, can be covered in the whole CEE region. Besides Poland in the 2018 and 2023 FID-case (10.7 % and 4 %, respectively), all countries have left more than 20 % remaining flexibility. In the non-FID cases, the remaining flexibility increases over 20 % in the whole CEE region.

4.1.7.4 Average Day – maximum LNG

Supply mix

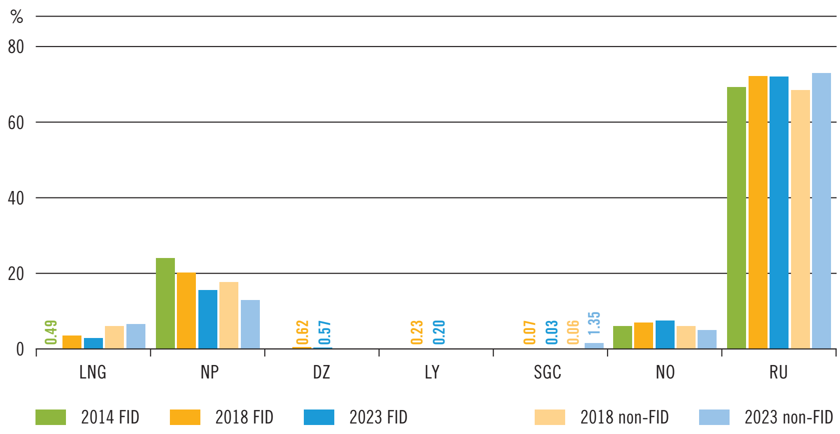

Figure 24: The share of supply sources in the CEE region under maximum deliveries of LNG and the average day conditions

Under maximum LNG utilization, Russia is still the main supplier of the region, having a share between 69.5 % and 72 %. The share of national production is expected to decrease from 24 % in 2014 to 16 % in 2023, while in the non-FID case, its share is around 3 % lower (18 % in 2018, 13.3 % in 2023). The share of Norwegian gas moves between 6 % in 2014 and 7 % in 2023 in the FID case, in the non-FID case between 6.3 % in 2018 and 5.2 % in 2023. LNG is expected to contribute around 4 % in 2018 and 2023 after 0.5 % in 2014, in case of implementation of the non-FID projects the share would be around 7 % in 2018 - 2023. The SGC gas would have a share of 1.3 % in 2023 non-FID.

Supply

The demand of the CEE region can be covered in the whole CEE region. Poland is expected to have reduced remaining flexibility of 10.7 % in 2018 (FID) and almost no remaining flexibility (0.2 %) in the 2023 FID-case, but would be > 20 % with implementation of the non-FID projects. All other countries have left more than 20 % remaining flexibility.

4.1.7.5 Source predominance

In order to visualize the impact of variation of different source deliverability and make them comparable, in the tables below the shares of the various sources are displayed for the min/max RU and min/max LNG scenarios together with the shares of the reference scenario are given. The variation of the LNG deliveries has only limited impact on the distribution of the different source shares compared to the reference scenario. Also the maximisation of Russian deliverability is mainly impacting the share of national production. Under minimized Russian deliveries on the other hand, the shares of almost all other sources increase in order to satisfy the CEE gas demand. Taking into consideration that in all the market integration scenarios analysed no CEE country suffers from shortages, the market integration in the region is already on a good level, and is likely to be even improved in future by upcoming projects.

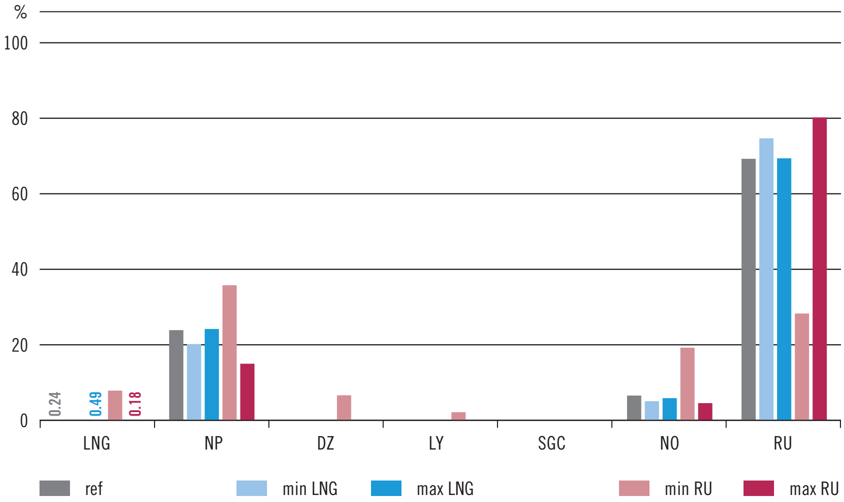

Figure 25: Source predominance in the CEE region under reference scenario and min/max RU, min/max LNG cases in the 2014 FID case

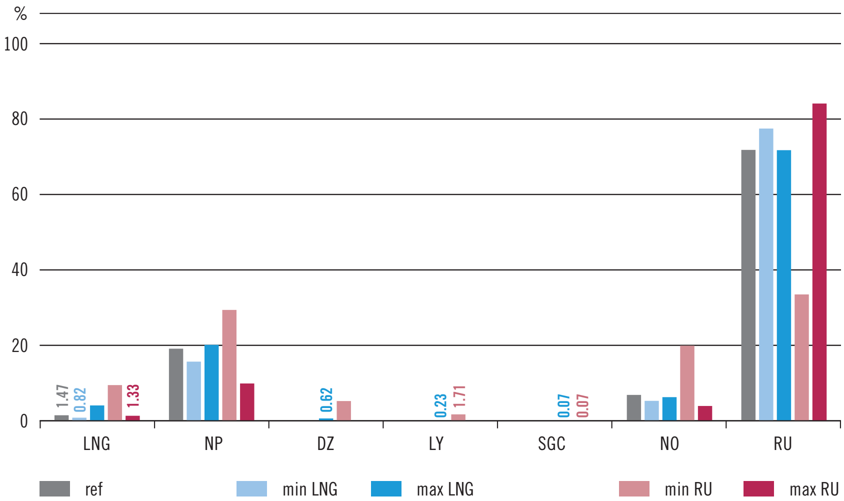

Figure 26: Source predominance in the CEE region under reference scenario and min/max RU, min/max LNG cases in the 2018 FID case

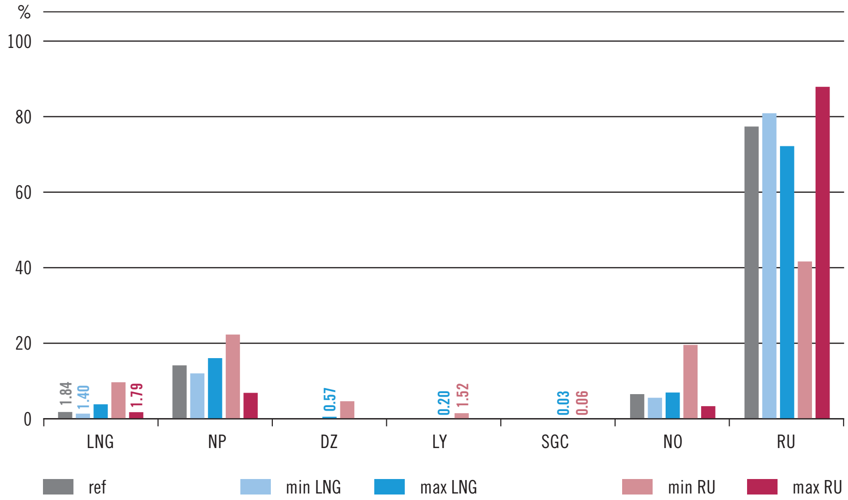

Figure 27: Source predominance in the CEE region under reference scenario and min/max RU, min/max LNG cases in the 2023 FID case

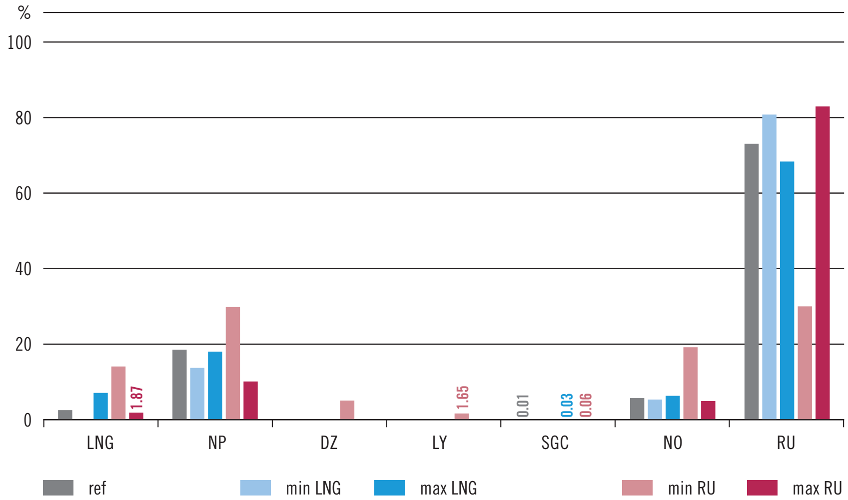

Figure 28: Source predominance in the CEE region under reference scenario and min/max RU, min/max LNG cases in the 2018 non-FID case

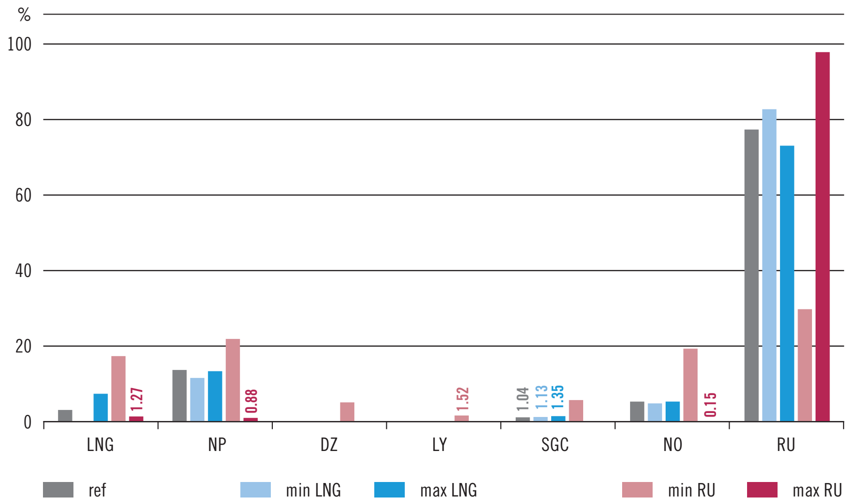

Figure 29: Source predominance in the CEE region under reference scenario and min/max RU, min/max LNG cases in the 2023 non-FID case

4.1.7.6 Average Day – maximum NO, DZ, LY

Supply mix

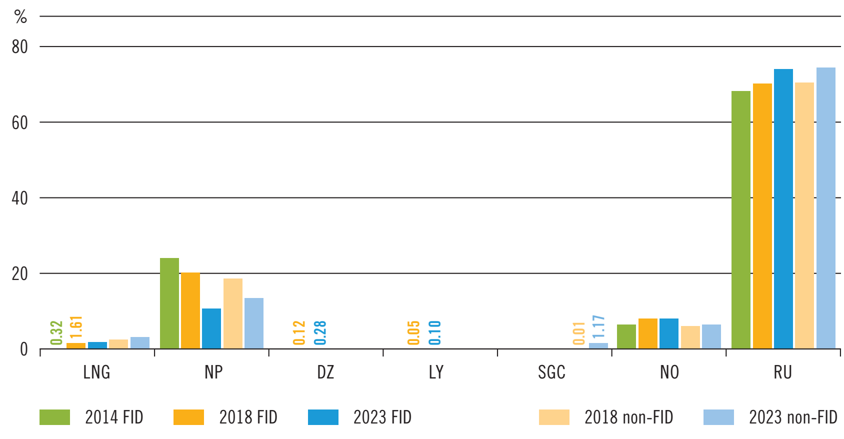

Figure 30: The share of supply sources in the CEE region under maximum deliveries of gas from Norway and the average day conditions

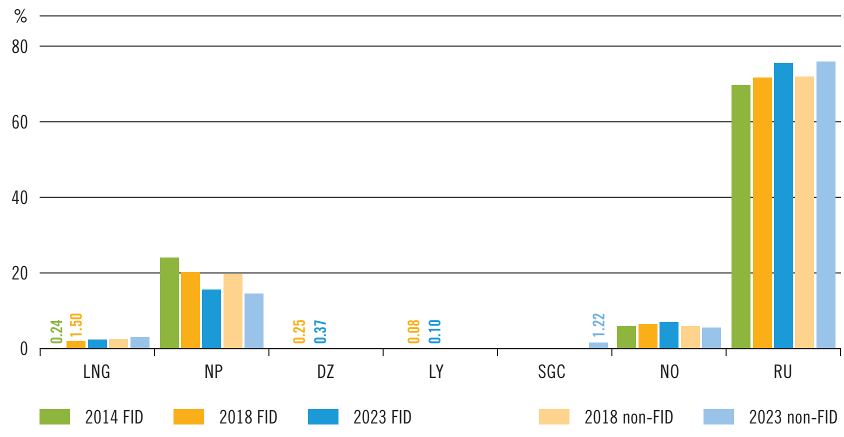

Figure 31: The share of supply sources in the CEE region under maximum deliveries of gas from Algeria and under the average day conditions

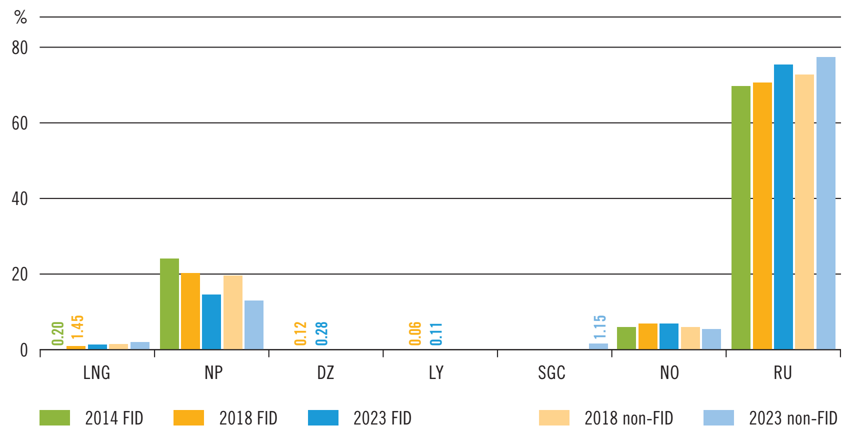

Figure 32: The share of supply sources in the CEE region maximum deliveries of gas from Libya and the average day conditions

The maximum NO, DZ and LY scenarios under average day demand conditions only differ marginally from each other, in terms of supply mix, as well as in terms of supply situation. Therefore, the average shares together with a maximum standard deviation over the scenarios are presented. Russia is the main supplier of the region again, with shares of on average 69 % in 2013, 70.8 % in 2018 and 75.8 % in 2023, the standard deviation [s^2] being <0.77 %. In the 2018 and 2023 non-FID case, the average share would be 71.9 % and 75.8 %, respectively, with a standard deviation of 0.57 % and 1.24 %, respectively. Norwegian gas is expected to slightly increase from 6.5 % in 2014 to 7.2 % and 7.35 % (s^2<0.97 %). Gas from the SGC region only plays a very limited role in the 2023 non-FID case with on average 1.15 % and s^2<0.04 %. Gas from national production has a share of avg. 24 % in 2014, decreasing to 20.3 % in 2018 (19.4 % non-FID) and 15.3 % in 2023 (13.8 % non-FID), with a standard deviation of less than 0.4 %. LNG has its highest share with 2.15 % in 2023 (3 % non-FID, standard deviation <0.47 %), and gas from Algeria in none of the cases exceeds a share of 0.37 %.

Supply

The demand of the CEE region can be covered in each CEE country. Besides Poland in the 2018 and 2023 FID-case (10.7 % and 4 %, respectively), all countries have left more than 20 % remaining flexibility in all three cumulated scenarios. In the non-FID cases, the remaining flexibility increases over 20 % in the whole CEE region.

Supply predominance

Compared to the reference case, a maximization of NO, DZ or LY gas deliveries towards the EU has no significant impact on the supply mix within CEE region, as shown in the tables below.

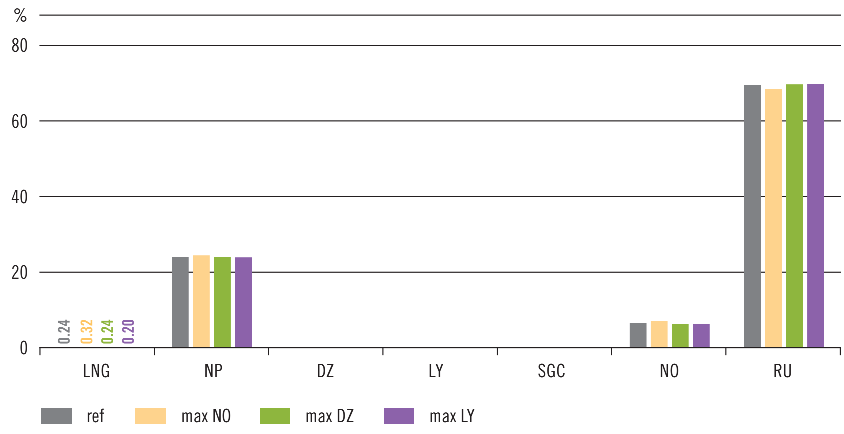

Figure 33: Source predominance in the CEE region under reference scenario and max NO, DZ, LY cases in the 2014 FID case

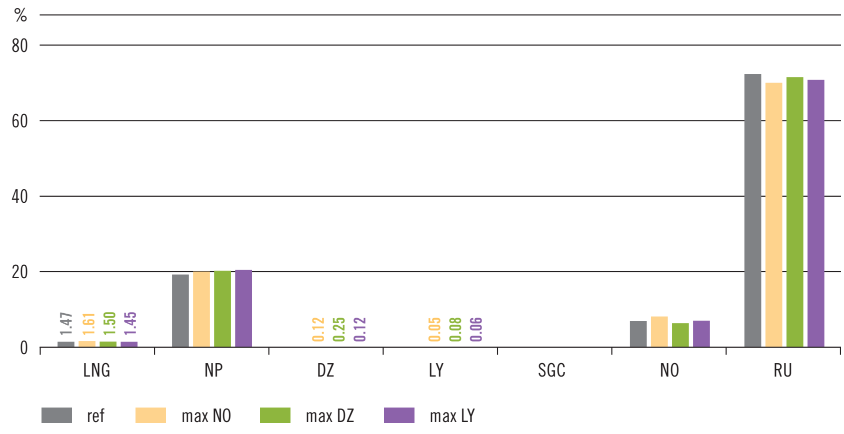

Figure 34: Source predominance in the CEE region under reference scenario and max NO, DZ, LY cases in the 2018 FID case

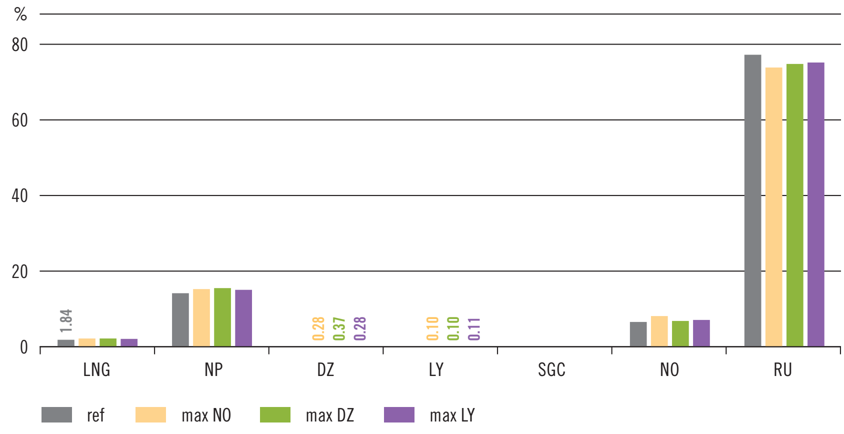

Figure 35: Source predominance in the CEE region under reference scenario and max NO, DZ, LY cases in the 2023 FID case

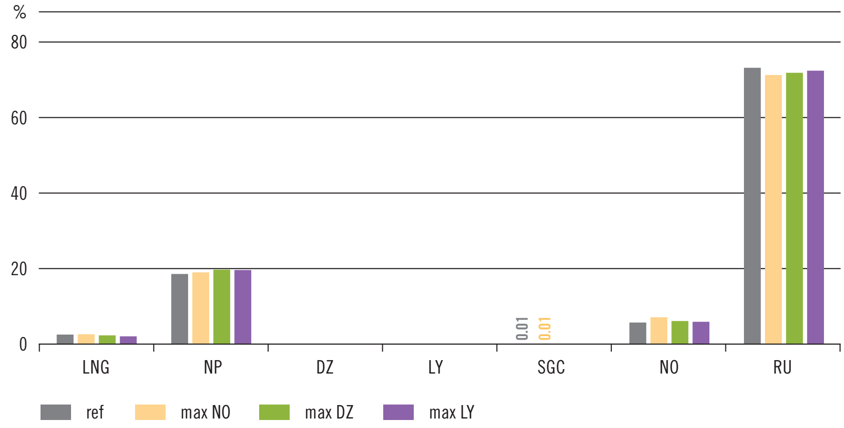

Figure 36: Source predominance in the CEE region under reference scenario and max NO, DZ, LY cases in the 2018 non-FID case

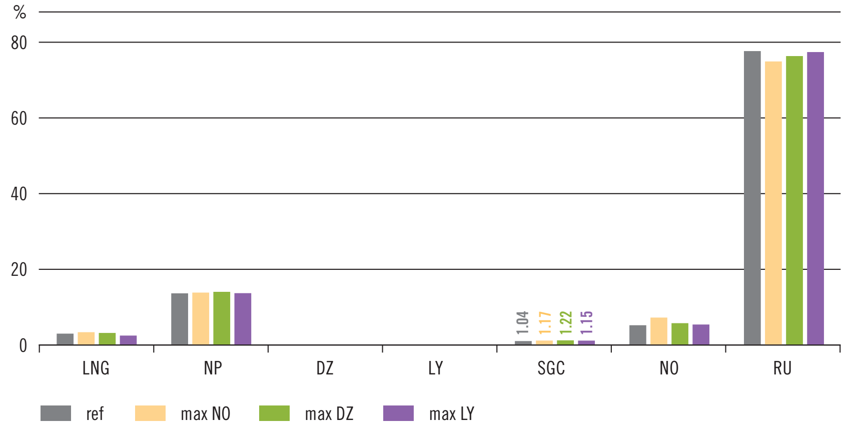

Figure 37: Source predominance in the CEE region under reference scenario and max NO, DZ, LY cases in the 2023 non-FID case

4.2 Network Resilience – Security of Supply

4.2.1. SINGLE UNIFORM RISK DAY IN WHOLE CEE REGION, AVERAGE WINTER DAY IN THE REST OF THE EU

In the following scenarios, the impact of supply disruptions during a single uniform risk day in the CEE region is investigated. For the rest of the EU, average winter day conditions are assumed. As Russia is under all types of reference conditions the main supplier of the region, an interruption of the Ukraine route, of the Belarus route, as well as of a simultaneous disruption of both routes is taken into consideration. The demand figures are the same as for the respective reference case.

COUNTRY	2014	2018	2023
AT	733	777	848
BGN	187	236	257
HR	74	100	104
CZ	799	871	911
DEg	1,415	1,372	1,328
DEn	1,676	1,618	1,574
HU	954	1,145	1,182
PL	715	1,073	1,142
RO	718	718	718
SK	400	448	448
SI	63	87	102

Table 11: Evolution of gas demand [GWh/d] by country/balancing zone under the single day uniform risk scenario

Demand

As already described above, under the single day uniform risk scenario, the overall demand in the CEE region increases from 7,736 GWh/d in 2014 to 8,447 GWh/d in 2018 and 8,616 GWh/d in 2023. Germany is the only country showing a decrease in demand, being 6.1 % between 2014 and 2023. Slovenia (+62 %), Poland (+59.6 %), Croatia (+40.5 %), Bulgaria (+37.5 %) and Hungary (+20 %) also in this scenario show a significant increase of demand, whereas Austria, the Czech Republic and Slovakia are likely to show moderate increase rates with 15.8 %, 15.6 % and 12.1 %. Again, the demand in Romania remains constant over the whole period. The absolute numbers are given in the table on the left.

4.2.1.1 Disruption via Ukraine

Supply situation

The supply situation in Austria, Croatia, the Czech Republic, Germany (GasPool, as well as NetConnect) and Slovakia is sufficient, with a remaining flexibility above 20 % in the FID as well as non-FID-case over the entire period. Bulgaria is expected to face a dramatic shortage in 2014 (-67 %), but with implementation of FID projects, the shortage will be removed from in 2018 onwards and sufficient capacity is established. Poland is expected to suffer from a slight shortage (-0.16 %) in 2018 FID only, although the remaining flexibility is lower than 10 % in 2014 (17.3 %) and 2023 FID (9.7 %). In the non-FID case, the remaining flexibility would increase to over 20 % only in 2023, after a value of 16.6 % in 2018. The situation in Slovenia is relaxed in 2014 and 2018 (FID as well as non-FID), only in the 2023 FID case, the remaining flexibility would go down to 9.7 %, but would increase to a value far beyond 20 % by implementing the non-FID projects.

Shortages from -0.15 % in 2014, -18.41 % in 2018 to -23.45 % in 2023 are expected to occur in Hungary. The implementation of the non-FID projects would remove the shortage 9.43 % in 2018, 3.53 % in 2023). Hungary profits in this situation from the utilisation of its national UGS reserve. For Romania, a tense situation is expected: for 2014, the shortage is estimated to -14.7 %, for 2018 and 2023, FID as well as non-FID, -13.2 % respectively -18.8 % are expected.

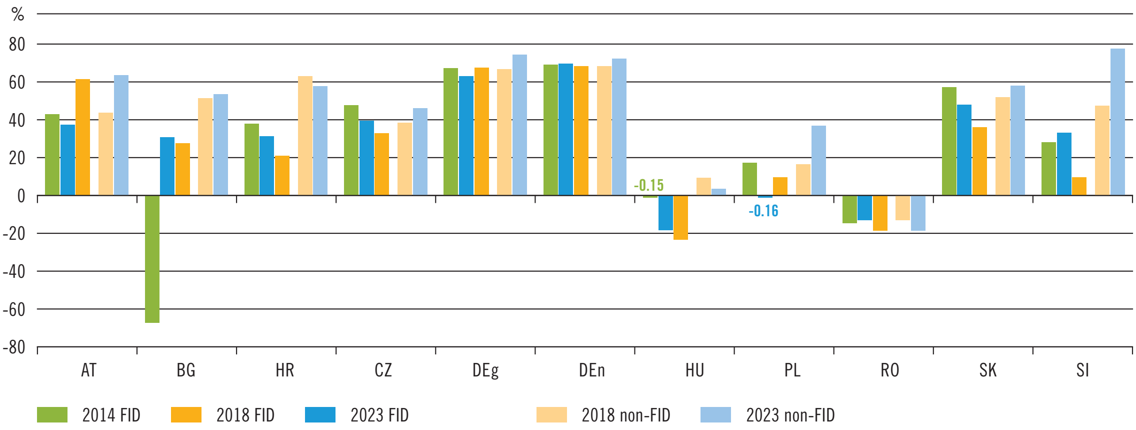

Figure 38: Infrastructure remaining flexibility by country/balancing zone under the disruption via Ukraine and the single day uniform risk conditions

Source shares

As the disruption of the deliveries via Ukraine line means a cut of a major import route for Russian gas, the respective share is reduced accordingly (8.75 % in 2014, 15.6 % in 2023 FID, around 37 % in 2018 and 2023 non-FID). As Russian gas is mainly replaced by gas from UGS, its share is relatively high with around 60 % in 2014 and round 56 % in 2018 FID, in 2023 FID. In the non-FID case, it decreases from 39 % in 2018 to 37 % in 2023. The share of national production decreases from 22.5 % in 2014 to 19.3 % in 2018 and 14 % in 2023 (16 % in 2018 in non-FID and 12.8 % in 2023 non-FID) – an increase of on average 4.6 % compared to the reference case. A detailed overview over the supply source shares per country and year is given in the tables below.

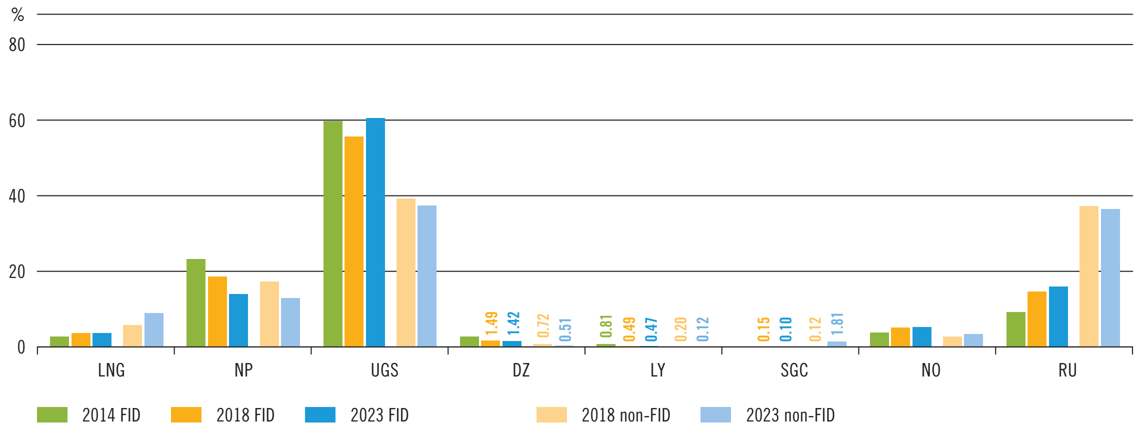

Figure 39: The share of supply sources in the CEE region under the disruption via Ukraine and the single day uniform risk conditions

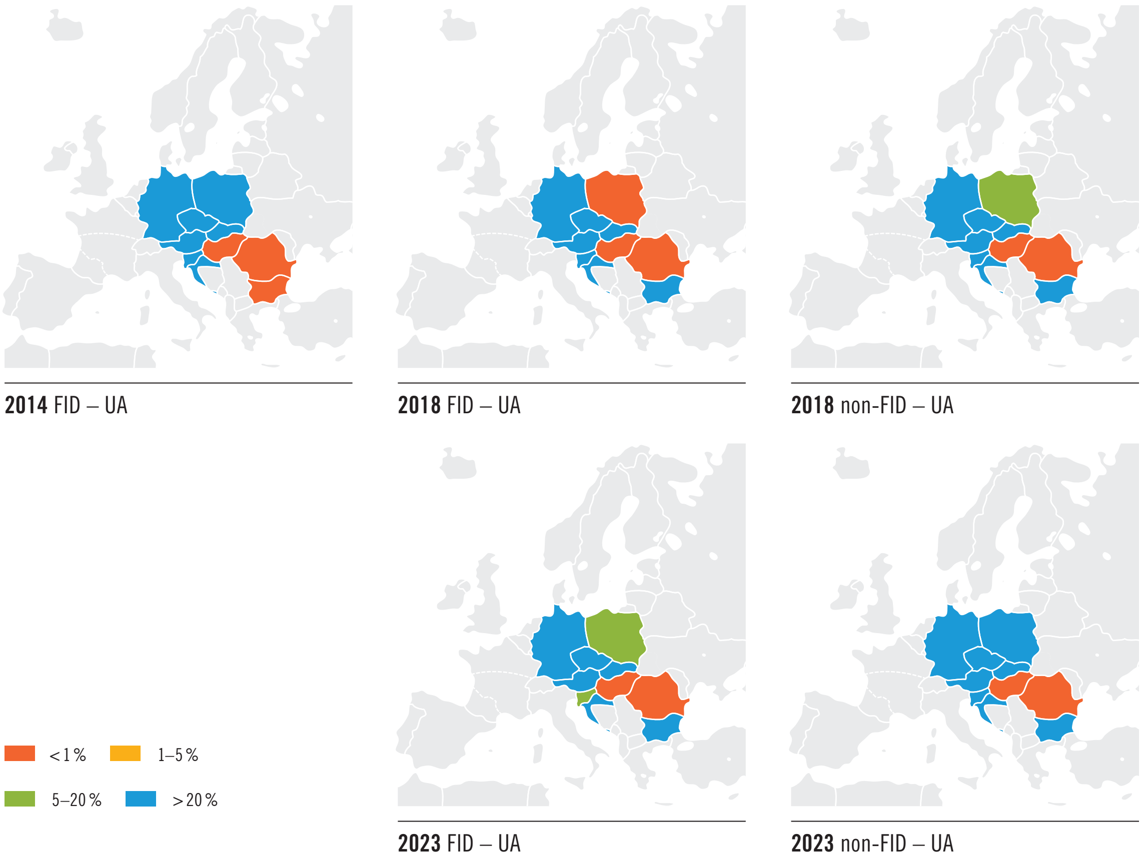

Figure 40: Remaining flexibility by country under under the disruption via Ukraine and the single day uniform risk conditions

Storage connections

In the FID-case, most of the storage connections are used to withdraw at full load, meaning without remaining flexibility. Except for Germany, with remaining flexibility of more than 20 % in the entire period, the connection in Croatia in 2014 and the connection of Austrian storages towards Germany in 2018 show a value > 20 %. The situation is a bit more relaxed in the non-FID case. Here, Bulgarian, German, Croatian storage connections, as well as the connection of Slovakian storages towards Austria have left more than 20 % flexibility, the value of Austrian storage connections is 12.2 % in 2018. The picture is similar in 2023, where the Croatian connection has no more flexibility left, the Polish UGS connection increases to 3.6 % and the value for Austria climbs beyond 20 %.

4.2.1.2 Disruption via Belarus

Supply situation

Compared to the Ukraine route disruption, the impact of a Belarus line disruption has direct impact only on Poland, as it is the only country in the CEE region which is directly connected to BY. Poland is expected to have a shortage of around -7 % in 2014, which would be reduced to -3.6 % in 2018. In 2023 a value of 7.1 % (FID) and over 20 % (non-FID) is expected. In Hungary, the only other country with less than 20 % remaining flexibility in the FID case, remaining flexibility decreases from 15.7 % in 2014 to 1.7 % in 2023.

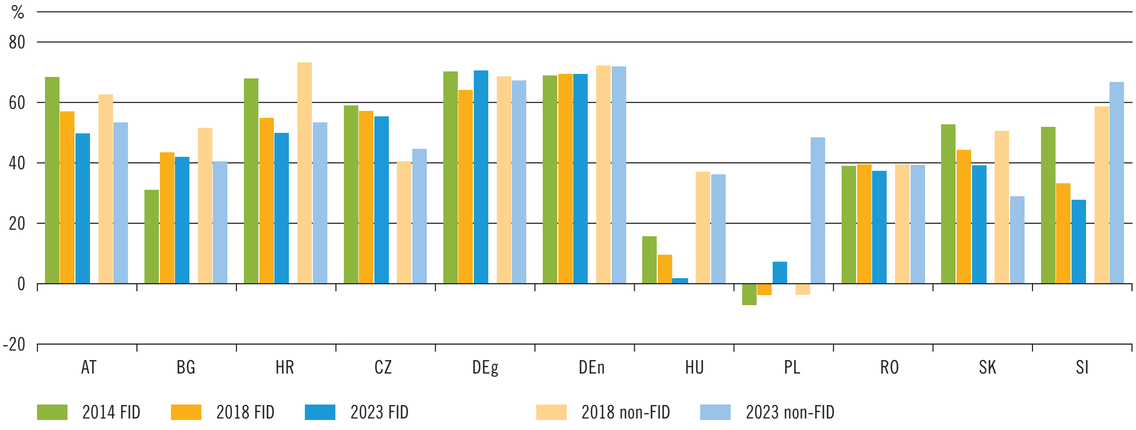

Figure 41: Infrastructure remaining flexibility by country/balancing zone under the disruption via Belarus and the single day uniform risk conditions

Source shares

The disruption of the supplies via Belarus means a cut of the share of Russian gas by 5 % in 2014 and 2.5 % in 2018 FID, compared to the reference case. In 2023 FID, no significant difference to the reference scenario can be found. In the non-FID case, the RU share with 53.7 % would be 4 % lower than in the reference scenario in 2018. In 2023, with a plus of 20 % compared to reference, 78.3 % are expected. The share of gas from UGS is around 3 % higher (FID) with 32 % in 2014, 30.5 % in 2018 and 33.2 % in 2023. In the non-FID case, in 2018 28 % are expected, followed by a significant decrease to 9 % in 2023.

The share of gas from national production would amount to 17.3 % in 2014, 16.3 % in 2018 and 9.3 % in 2013. In the non-FID case, for 2018 12.7 % and for 2023 4.4 % are expected.

A detailed overview over the supply source shares per year is given in the tables below. In the attached maps, the supply situation in the single CEE countries is indicated.

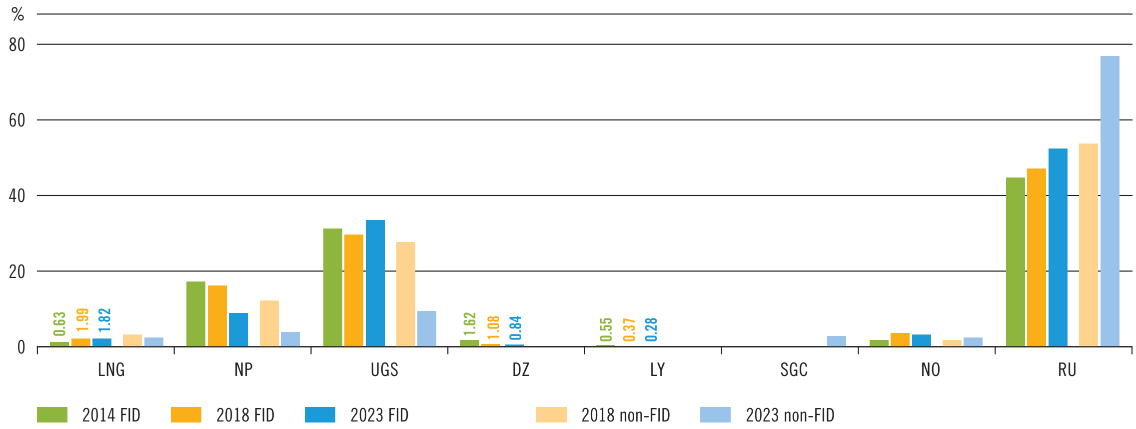

Figure 42: The share of supply sources in the CEE region under the disruption via Belarus and the single day uniform risk conditions

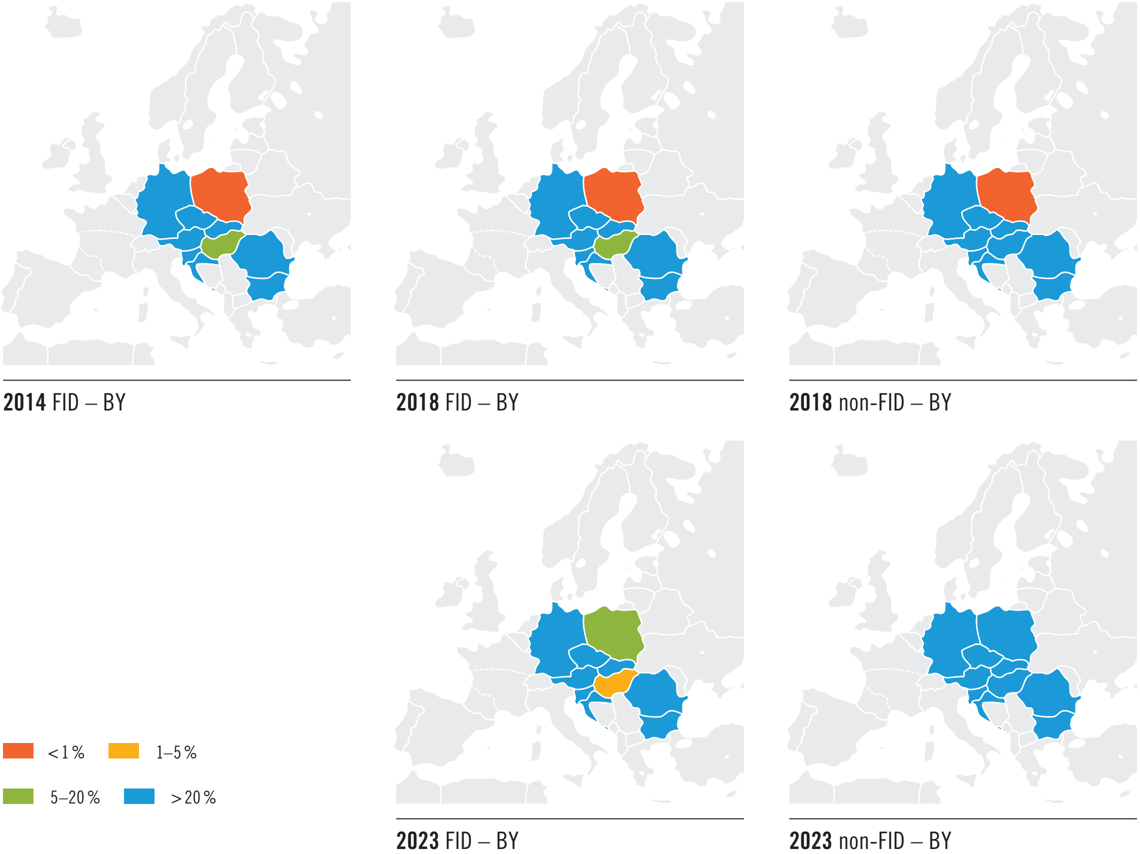

Figure 43: Remaining flexibiliy by country under the disruption via Belarus and the single day uniform risk conditions

Storage connections

No remaining flexibility for the entire period in the FID case is left in the UGS connections of Hungary, Poland and Romania. Croatia expects a reduction from over 20 % in 2014 to 0 % in 2018 and 2023, whereas Bulgaria has no remaining flexibility left in 2014, but is likely to increase to > 20 % in 2018 and 2023. For Austria, a full load operation of UGS connections towards Germany is expected for 2023. For the non-FID case, the Czech Republic, Poland, Romania and the connection of Austrian UGS towards Germany are expected to have 0 % remaining flexibility. In 2018, Hungary can expect 4.8 % remaining flexibility, while in 2023, all UGS connections are expected to have more than 20 % remaining flexibility.

4.2.1.3 Simultaneous disruption via Ukraine and Belarus

Supply situation

The supply situation under a simultaneous Ukraine and Belarus route interruption in Austria, Croatia, the Czech Republic, Germany (GasPool, as well as NetConnect) and Slovakia is sufficient, with a remaining flexibility above 20 % in the FID as well as non-FID-case over the entire period. Like in the Ukraine disruption scenario, Bulgaria is expected to face a dramatic shortage in 2014 (-67 %), but with implementation of FID projects, the shortage will be remedied from 2018 onwards. Poland is expected to suffer from a shortage of -26 % in 2014 and -16.4 % in 2018 FID. In 2023 FID, the remaining flexibility is expected to be increased to 9.7 %. In the non-FID case, the remaining flexibility is expected to be at a level of more than 20 % only in 2023, after 16.2 % in 2018. The situation in Slovenia is relaxed in 2014 and 2018 (FID as well as non-FID), only in the 2023 FID case, the remaining flexibility would go down to 9.7 % which would be increased to a value far beyond 20 % by implementing the non-FID projects.

Shortages of -0.15 % in 2014, -18.41 % in 2018 to -23.45 % in 2023 are expected to occur in Hungary. The implementation of the non-FID projects would remove the shortage, increasing the remaining flexibility to 9.43 % in 2018 and to 3.53 % in 2023. Hungary profits in this situation from the utilisation of its national UGS reserve. For Romania, a tense situation is expected: for 2014, the shortage is estimated to -14.7 %, for 2018 and 2023, FID as well as non-FID, -13.2 % respectively -18.8 % are expected.

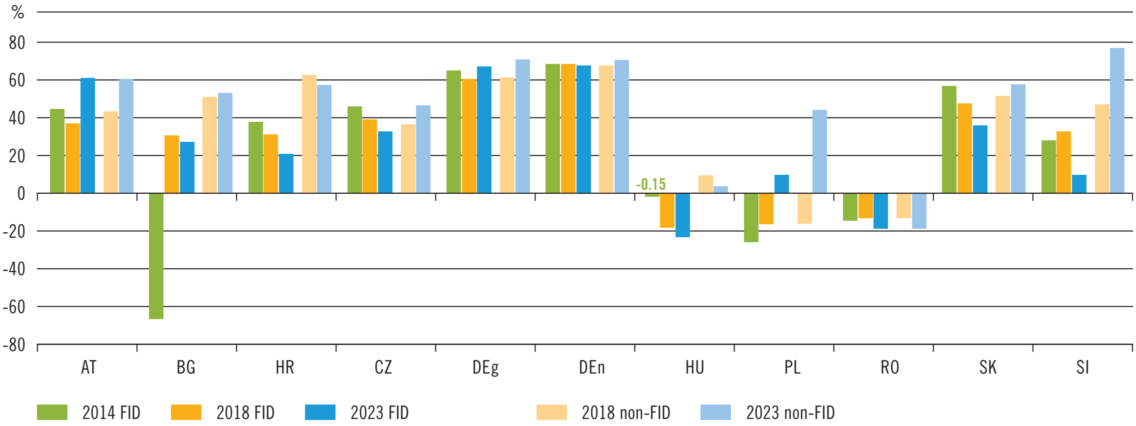

Figure 44: Infrastructure remaining flexibility by country/balancing zone under the simultaneous disruption via Belarus and Ukraine and the single day uniform risk conditions

Source shares

As the simultaneous disruption of deliveries via Ukraine and Belarus line means the worst case of an import route disruption for Russian gas, the respective share is reduced accordingly (6.11 % in 2014, around 12 % in 2018 and 15.6 % in 2023 FID, 32.9 % in 2018 non-FID and 34.8 % in 2023 non-FID). As Russian gas is mainly replaced by gas from UGS, its share is relatively high with around 62 % in 2014, 58 % in 2018 FID and round 60 % in 2023 FID. In the non-FID case, it decreases from 42.3 % in 2018 to 38 % in 2023. The share of national production decreases from 23.4 % in 2014 to 19.5 % in 2018 and 14 % in 2023 (16.3 % in 2018 in non-FID and 13.1 % in 2023 non-FID) A detailed overview over the supply source shares per year as well as the supply situation in the single CEE countries is given in the table and maps below.

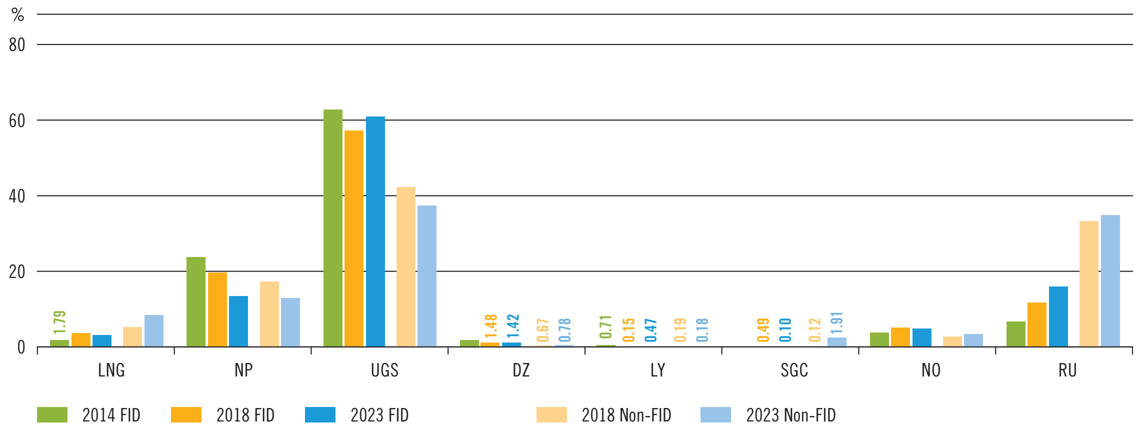

Figure 45: The share of supply sources in the CEE region under the simultaneous disruption via Belarus and Ukraine and the single day uniform risk conditions

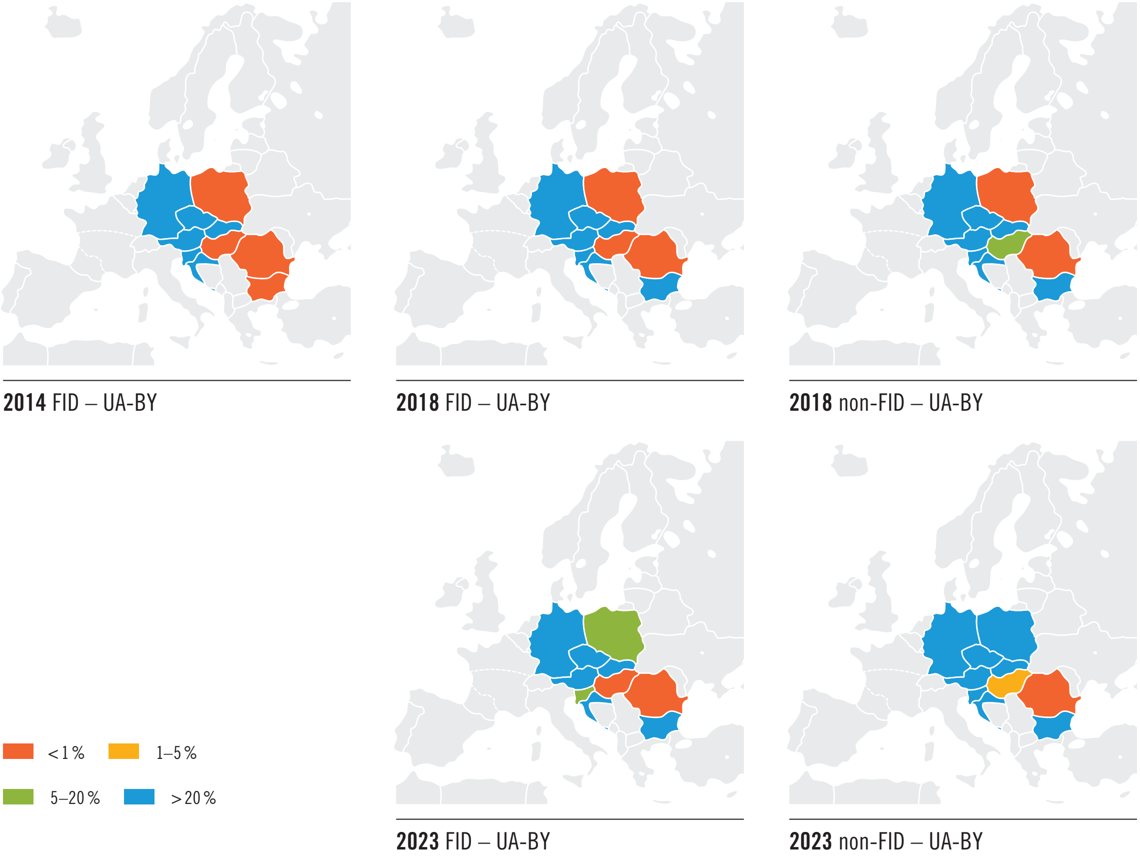

Figure 46: Remaining flexibility by country under the simultaneous disruption via Belarus and Ukraine and the single day uniform risk conditions

Storage connections

In the FID case, most of the storage connections are used to withdraw at full load, meaning without remaining flexibility. Except for Germany, with remaining flexibility of more than 20 % in the entire period, the connection in Croatia in 2014 and the connection of Austrian storages towards Germany in 2018 show a value > 20 %. The situation is a bit more relaxed in the non-FID case. Here, Austrian, Bulgarian, German and storage connections, as well as the connection of Slovakian storages to Austria have more than 20 % flexibility left. The value of the Croatian storage connection is 49 % in 2018, in 2023 there is no more flexibility left.

4.2.2 TWO-WEEK UNIFORM RISK DAY IN WHOLE CEE REGION, AVERAGE WINTER DAY IN THE REST OF THE EU

Demand

As already described under the respective reference scenario, the overall demand in the CEE region under the two-week uniform risk day conditions increases from 7,769 GWh/d in 2014 to 8,055 GWh/d in 2018 and 8,217 GWh/d in 2023. Germany is the only country showing a decrease in demand, being 6.1 % between 2014 and 2023. Slovenia (+66 %), Poland (+62 %), Croatia (+40.5 %), Bulgaria (+37 %) and Hungary (+26.5 %) also in this scenario show a significant increase of demand, whereas Austria, the Czech Republic and Slovakia are likely to show moderate increase rates with 15.8 %, 15.6 % and 12.1 %. Again, the demand in Romania remains constant over the whole period.

COUNTRY	2014	2018	2023
AT	733	777	848
BG	157	196	215
HR	74	100	104
CZ	688	755	795
DEg	1,415	1,372	1,328
DEn	1,676	1,618	1,574
HU	854	1,045	1,080
PL	672	1,026	1,090
RO	687	687	687
SK	356	399	399
SI	56	78	93

Table 12: Evolution of gas demand [GWh/d] by country/balancing zone under the two-week uniform risk day scenario

4.2.2.1 Disruption via Ukraine

Supply situation

The supply situation in Austria, the Czech Republic, Germany (GasPool as well as NetConnect) and Slovakia is sufficient, with a remaining flexibility above 20 % in the FID, as well as non-FID-case over the entire period. Croatia (18.4 %) and Slovenia (13 %) are below 20 % in 2023 FID only. Poland is expected to have a very low, but still positive value in 2018 FID (18.2 % in 2018 non-FID), but is likely to increase its remaining flexibility to 9.8 % in 2023 (>20 % in 2023 non-FID). Whereas Hungary (FID: 6.41 % in 2014, -14.76 % in 2018, -20.34 % in 2023; non-FID: 15.76 % in 2018, 9.17 % in 2023) is suffering from shortages in 2018 and 2023 FID, Romania (FID: -14.8 % in 2014, -20 % in 2018, -25.9 % in 2023; non-FID: -13.3 % in 2018, -19.1 % in 2023) is expected to face shortages in the FID, as well as the non-FID case over the entire period. Bulgaria would have sufficient (>20 %) remaining flexibility only with the implementation of the non-FID projects.

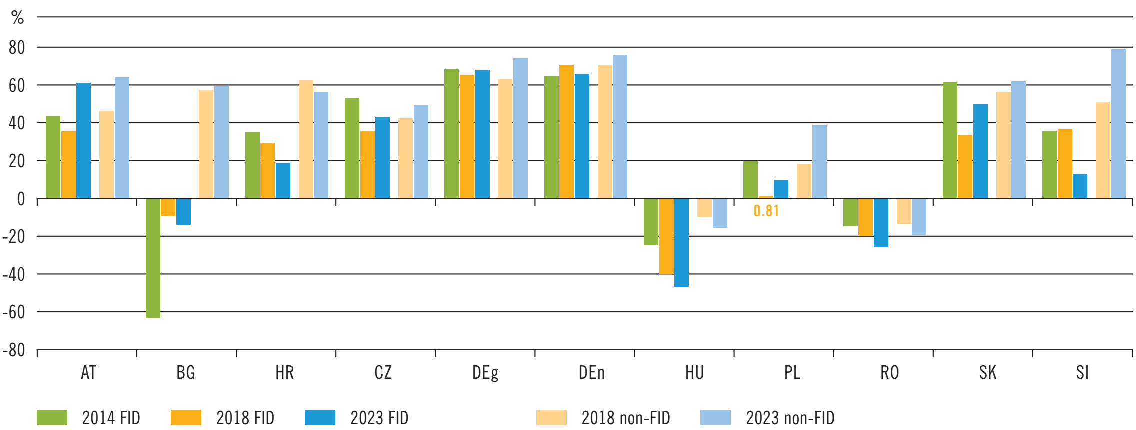

Figure 47: Infrastructure remaining flexibility under the disruption via Ukraine and the two-week uniform risk day conditions

Source shares

The major cut of the import route of Russian gas reduces the respective share to 9.2 % in 2014, 15.7 % in 2018 and 14.9 % in 2023 FID, to around 26.3 % in 2018 and to 40.5 % in 2023 non-FID. As Russian gas is mainly replaced by gas from UGS, the respective share is relatively high with around 60 % in 2014 and 2023 FID, in 2018 FID round 55.6 %. In the non-FID case, it decreases from 45 % in 2018 to 35.4 % in 2023. The share of national production decreases from 22.7 % in 2014 to 19.2 % in 2018 and 14.5 % in 2023 (17.2 % and 13.5 %, respectively in 2018 /2023 non-FID) – an increase of on average 4.8 % compared to the reference case. A detailed overview over the supply source shares per country and year is given in the tables below.

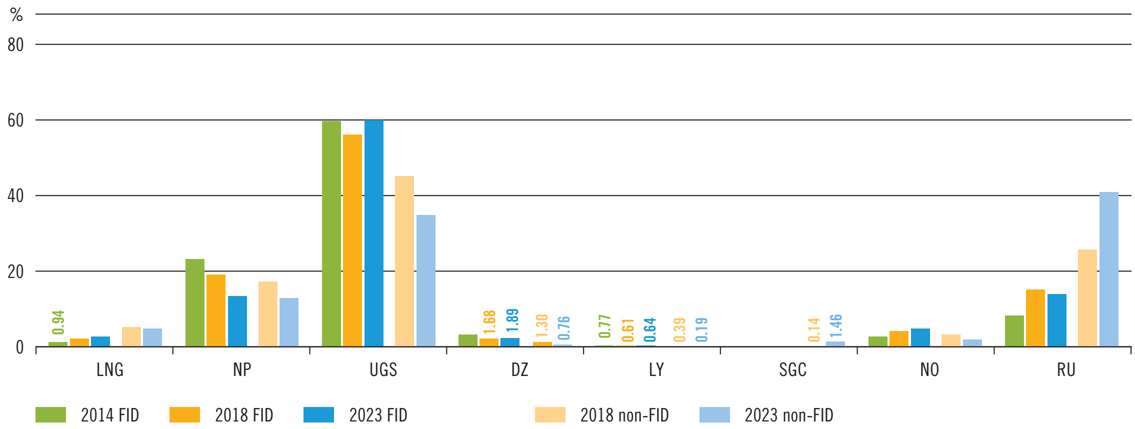

Figure 48: The share of supply sources in the CEE region under the disruption Ukraine and the two-week uniform risk day conditions

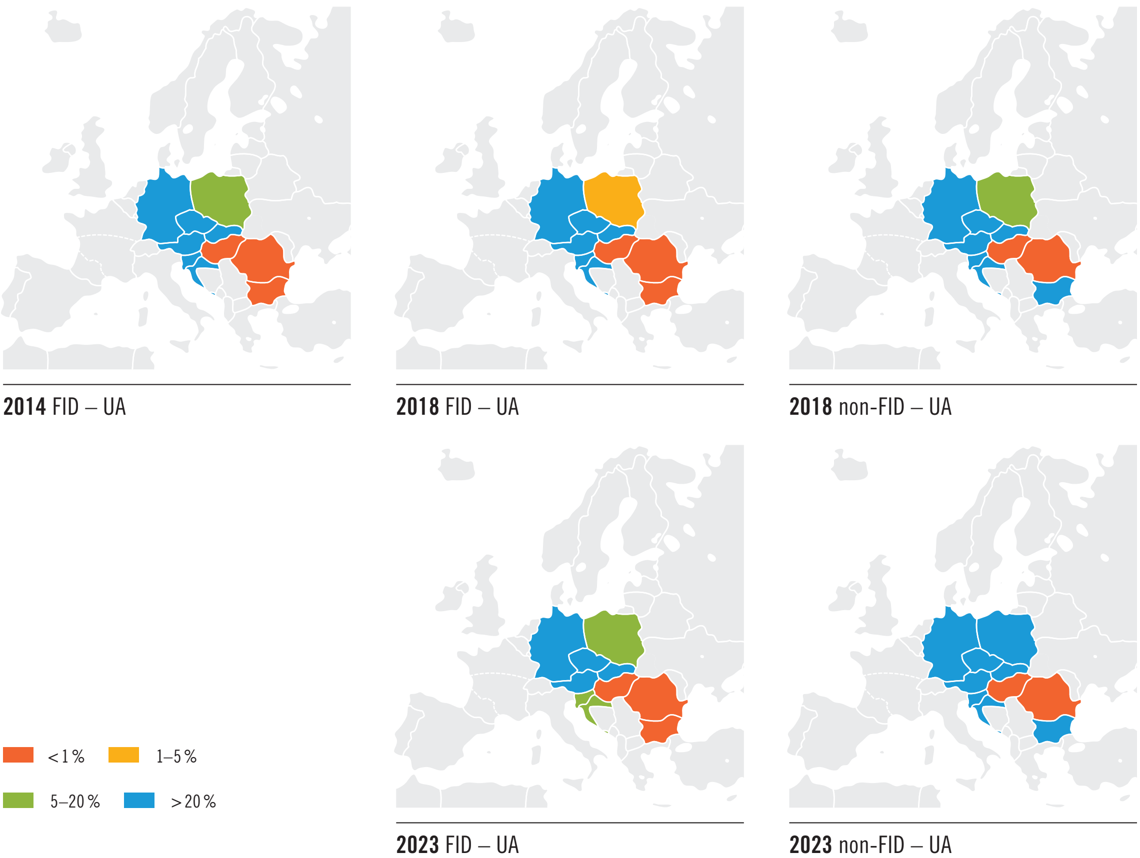

Figure 49: Remaining flexibility by country under the disruption via Ukraine and the two-week uniform risk day conditions

Storage connections

In the FID-case, most of the storage connections are used to withdraw at full load, meaning without remaining flexibility. The Czech Republic has little remaining flexibility of 2.4 % left in 2018. Except for Germany, with remaining flexibility of more than 20 % in the entire period, the connection in Croatia in 2014 shows a value >20 %. The UGS connections in Austria are at a remaining flexibility of around 5 % in 2014 and 2018, but also at 0 % in 2023. The storage connection towards Germany is operating at full load in 2014, 20 % remaining flexibility in 2018, but again at only 1 % in 2023. Also in the non-FID case, the situation is quite stressed. Here, German and Croatian storage connections as well as the connection of Slovakian Storages towards Austria have more than 20 % flexibility left in 2018 as well as 2023. The remaining flexibility of Austrian and Bulgarian storage connections is >20 % in 2023, Poland has left 1.3 %. All other UGS connections are operating at full load.

4.2.2.2 Disruption via Belarus

Supply situation

Also during a two-week uniform risk period in CEE, compared to the Ukraine route disruption, the impact of a Belarus line disruption has only direct effects on Poland, as it is the only country in the CEE region which is directly connected to BY. Poland is expected to have a shortage of around -5.9 % in 2014, which would be reduced to -3 % in 2018 (-3.65 % non-FID). In 2023 a value of 7.2 % (FID) respectively >20 % (non-FID) is expected. In Hungary, flexibility recovers from 12.7 % in 2018 to 21.5 % in 2023. Croatia and Slovenia are the only other countries with less than 20 % flexibility in the FID case (18.4 and 13 %, respectively).

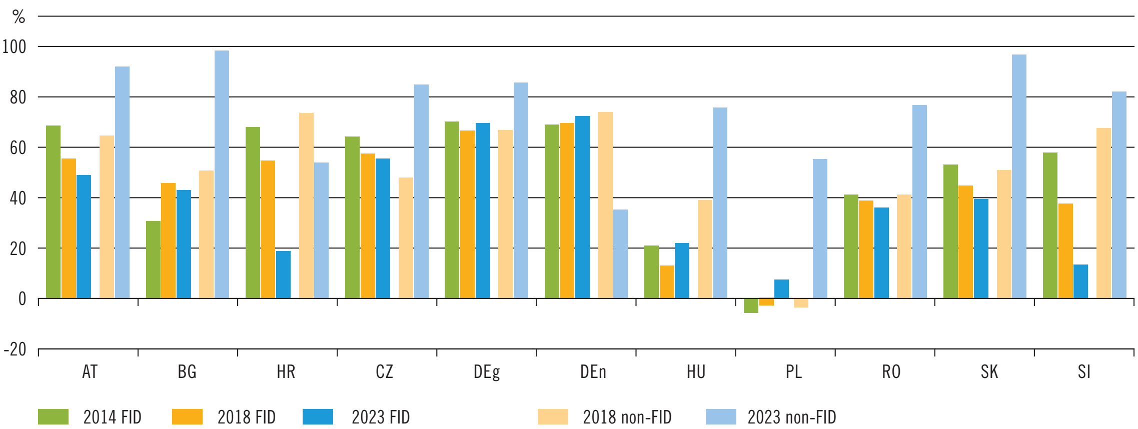

Figure 50: Infrastructure remaining flexibility under the disruption via Belarus and under the two-week uniform risk day conditions

Source shares

The disruption of the Belarus line means a cut of the share of Russian gas by 6 % to 45.8 % in 2014 and by 3.8 % to 47.3 % in 2018 FID, compared to the reference case. In the 2023 FID scenario, with 50.6 % a difference of only 1.2 % to the reference scenario can be found. In the non-FID case, the RU share with 52.8 % would be 7.1 % lower than in the reference scenario in 2018. In 2023, with a plus of 13.7 % compared to reference, 75.3 % are expected. The share of gas from UGS is around 4 % higher (FID) with 30.7 % in 2014, 1.5 % higher with 28.5 % in 2018 and with 32.4 % in 2023 around 2.8 % higher than in the reference scenario. In the non-FID case, for 2018 24.6 % are expected, followed by a significant decrease to 11.46 % in 2023.

The share of gas from national production would amount to 17.8 % in 2014, 15.8 % in 2018 and 9.6 % in 2013. In the non-FID case, the values will be 16 % in 2018 and 5 % in 2023.

A detailed overview over the supply source shares per year as well as maps indicating the supply situations are given in the tables below.

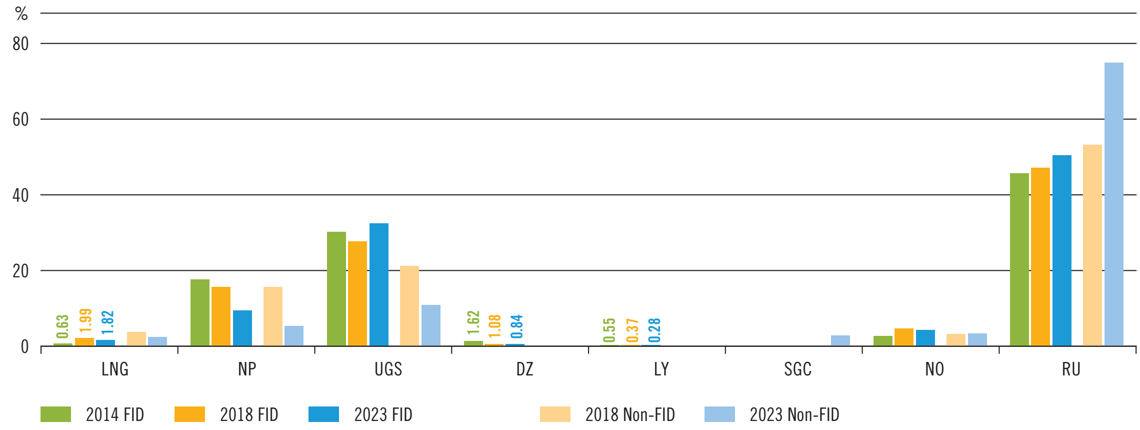

Figure 51: The share of supply sources in the CEE region under the disruption Belarus and the two-week uniform risk day conditions

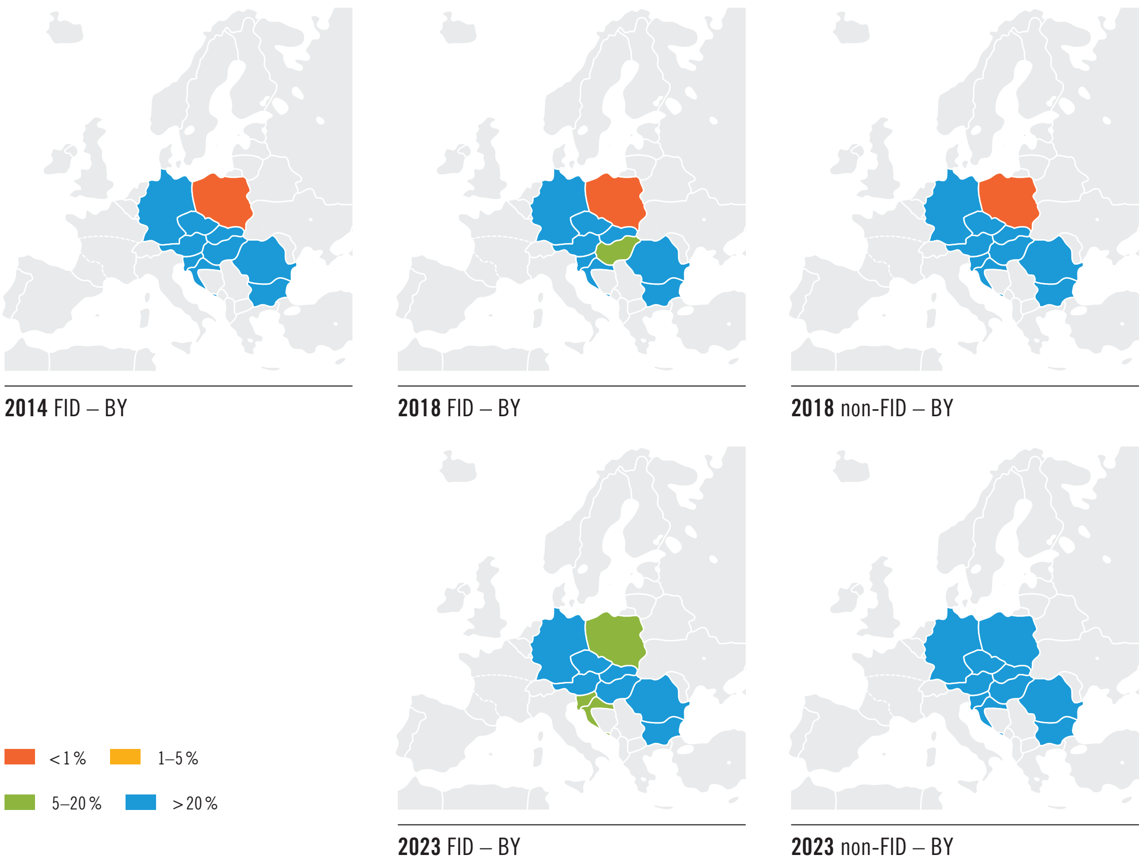

Figure 52: Remaining flexibility by country under the disruption via Belarus and the two-week uniform risk day conditions

Storage connections

Unlike in the single day uniform risk scenario, not only Hungary, Poland and Romania have no remaining flexibility left in their UGS connections for the entire period in the FID case, also Bulgaria withdraws from UGS at full load. Croatia expects a reduction from over 20 % in 2014, to 0 % in 2018 and 2023. For Slovenia, the values are around 17 % to 18 % over the entire period, in the FID, as well as in the non-FID case.

For the non-FID case, Hungary, Poland Romania are expected to have 0 % flexibility in 2018, but in 2023, all UGS connections (besides Slovenia, as mentioned), have more than 20 % remaining flexibility.

4.2.2.3 Simultaneous disruption via Ukraine and Belarus

Supply situation

The supply situation in Austria, the Czech Republic, Germany (GasPool as well as NetConnect) and Slovakia is sufficient, with a remaining flexibility above 20 % in the FID, as well as non-FID-case over the entire period. Croatia (18.4 %) and Slovenia (13 %) are below only 20 % in 2023 FID. Poland is expected to have a shortage of 20 % in 2014, but will continuously improve its situation in the FID scenario (-16.2 % in 2018, -4.7 % in 2023). In the non-FID scenarios for 2018 a shortage of -16.9 % is expected, which would be removed by 2023, having a flexibility of more than 20 %. Hungary (FID: 6.41 % in 2014, -14.76 % in 2018, -16.4 % in 2023; non-FID: 15.76 % in 2018, 9.17 % in 2023) is suffering from shortages in 2018 and 2023 FID, Romania (FID: -14.8 % in 2014, -20 % in 2018, -25.9 % in 2023; non-FID: -13.3 % in 2018, -19.1 % in 2023) is expected to face shortages in the FID, as well as the non-FID case over the entire period. Bulgaria, under implementation of the FID projects suffering from shortages during the entire period (-63 % in 2014, -9 % in 2018, -13.8 % in 2023), would have sufficient (>20 %) remaining flexibility with the implementation of the non-FID projects.

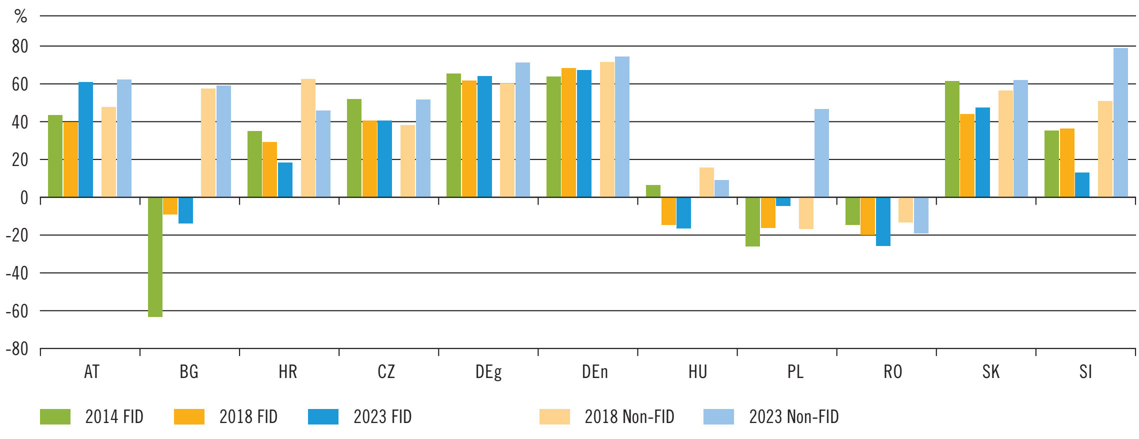

Figure 53: Infrastructure flexibility under the simultaneous disruption via Belarus and Ukraine and under the two-week uniform risk day conditions

Source shares

The simultaneous cut of the two dominant import routes for Russian gas reduces the respective share to 5.5 % in 2014, 1.8 % in 2018 and 12.4 % in 2023 FID, to around 23.5 % in 2018 and to 38.6 % in 2023 non-FID. As Russian gas is mainly replaced by gas from UGS, its share is relatively high with around 63 % in 2014 and 2023 FID, in 2018 FID round 57.4 %. In the non-FID case, it decreases from 47.3 % in 2018 to 37.5 % in 2023. The share of national production decreases from 23.5 % in 2014 to 20.1 % in 2018 and 14.85 % in 2023 (17.5 % and 12.6 % respectively in 2018 /2023 non-FID). A detailed overview over the supply source shares per year as well as maps indicating the supply situations is given below.

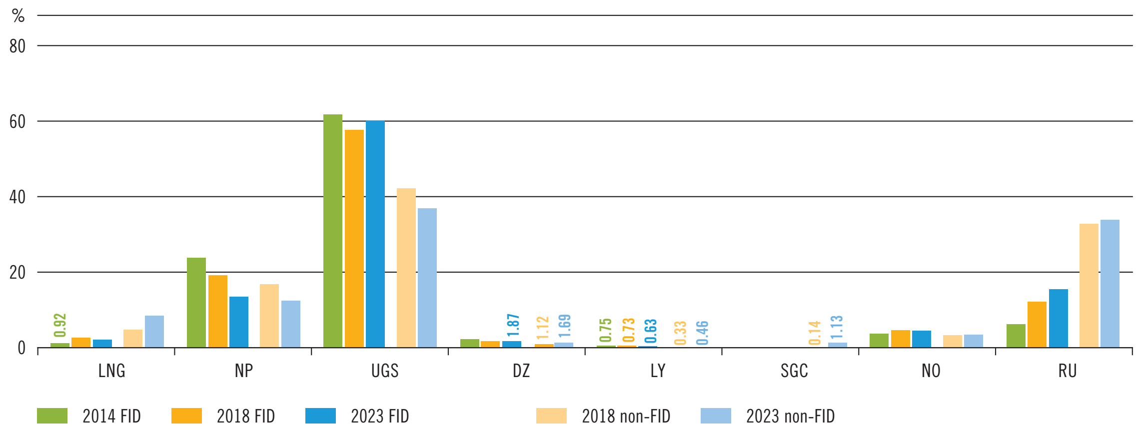

Figure 54: The share of supply sources in the CEE region under the simultaneous disruption via Belarus and Ukraine and under the two-week uniform risk day conditions

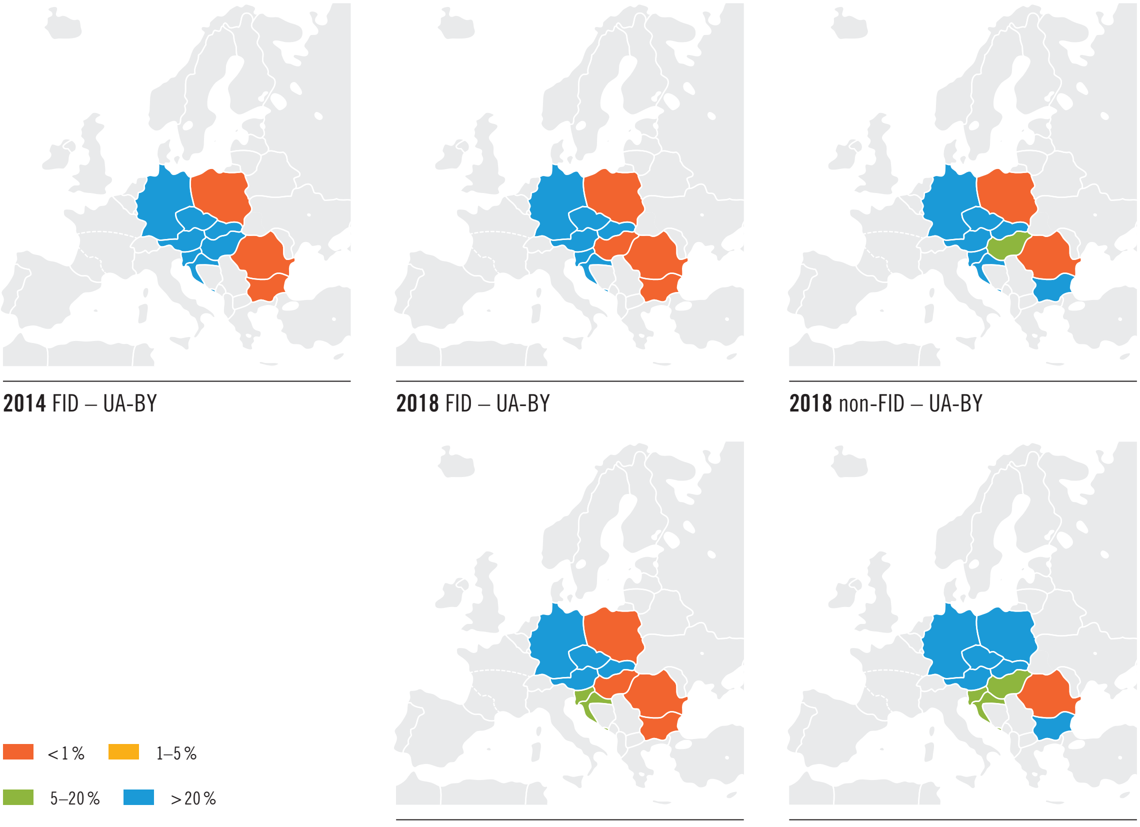

Figure 55: Remaining flexibility by country the simultaneous disruption via Belarus and Ukraine and the two-week uniform risk day conditions

Storage connections

In the FID-case, almost all of the storage connections are used to withdraw at full load, meaning without remaining flexibility. In the FID scenarios, Austria has as little remaining flexibility as 5 % left in its storage connection in 2014 and 25.8 % towards Germany in 2018. The Czech Republic has remaining flexibility of 2.4 % left in 2018. Except for Germany, with remaining flexibility of more than 20 % in the entire period, the connection in Croatia in 2014 shows a value > 20 %. Also in the non-FID case, the situation is quite tense. Here, German storage connections as well as the connection of Slovakian Storages towards Austria have more than 20 % flexibility left in 2018 as well as 2023. The storage connection of Croatia is above 20 % in 2018, decreasing to 13.8 % in 2023. The remaining flexibility of Austrian and Bulgarian storage connections is > 20 % in 2023. All other UGS connections are operating on full load.

5 REGIONAL N-1 ANALYSIS

Supply Corridors | Disruption via Ukraine
Disruption via Belarus

Image courtesy of GAZ-SYSTEM S. A.

The CEE countries have a significant sensitivity on gas supply disruption through Ukraine or Belarus. Therefore, the participating TSOs decided to prepare the regional N-1 analysis.

The assessment is based on the capacities at IPs and resulting residual capacities for neighbouring countries through supply corridors within the region. The supply corridors and results for each country are described below. Compared to the previous edition of the CEE GRIP the analysis was extended to a ten year period and the results for the winter periods 2014/2015, 2018/2019, 2022/2023 and the summer periods 2014, 2018 and 2023 are presented in this chapter.

5.1 Supply Corridors

5.1.1 AUSTRIA

The supply corridors on the following picture show the main supply corridor for Austria which is under normal condition through Ukraine and Slovakia through the IP Baumgarten (marked as AT1). Other supply corridors in case of supply disruption through Ukraine, but also under normal conditions, are through Germany marked as AT2 and through Italy AT3. The remaining capacity that could be used for gas transmission to Slovakia, Hungary and Slovenia in a Ukraine disruption scenario was used as the input for the evaluation of regional N-1 calculation for Slovakia, Hungary and Slovenia correspondingly. In 2019 the start of operation of a new interconnector between Austria and the Czech Republic is envisaged.

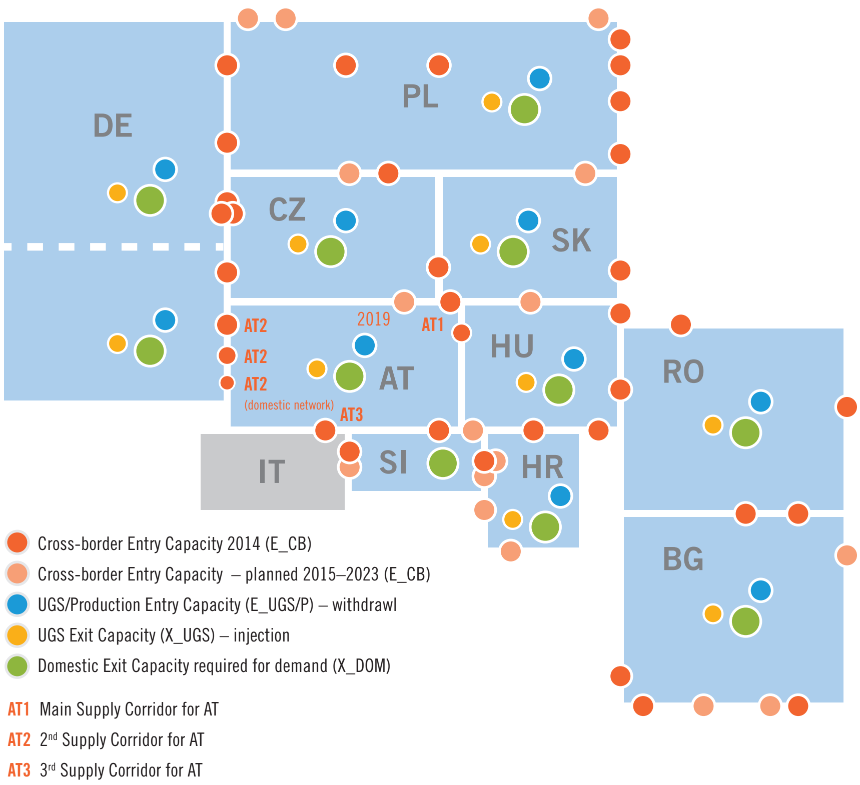

Figure 56: N-1 in CEE Region – AT

5.1.2 BULGARIA

The following picture shows the main supply corridor for Bulgaria which is under normal condition through Ukraine, Moldova and Romania (marked as BG1). Other supply sources in case of supply disruption through Ukraine are through the existing IP with Greece marked as BG2 that acts as reverse flow as of the beginning of 2014 in line with the requirements of REG 994/2010. Since the start of 2014 a new interconnection with Romania is planned to be in operation and other new three cross border interconnection projects after 2015.

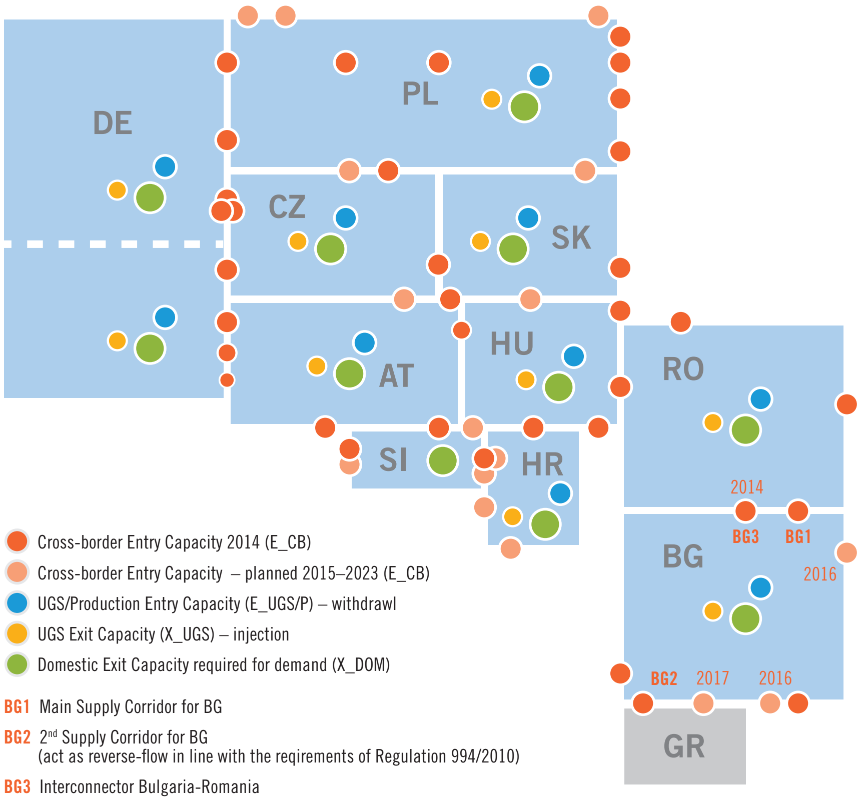

Figure 57: N-1 in CEE Region – BG

5.1.3 CROATIA

The supply corridor on the following picture shows the main supply corridors for Croatia which are through Slovenia (HR1) and Hungary (HR2). Both supply corridors are for domestic demand at the moment. Croatia has its own gas production and the underground gas storage so it is not entirely dependent on import. After 2019 Croatia will become a transit country thanks the finishing of the LNG terminal and the Ionian Adriatic Pipeline.

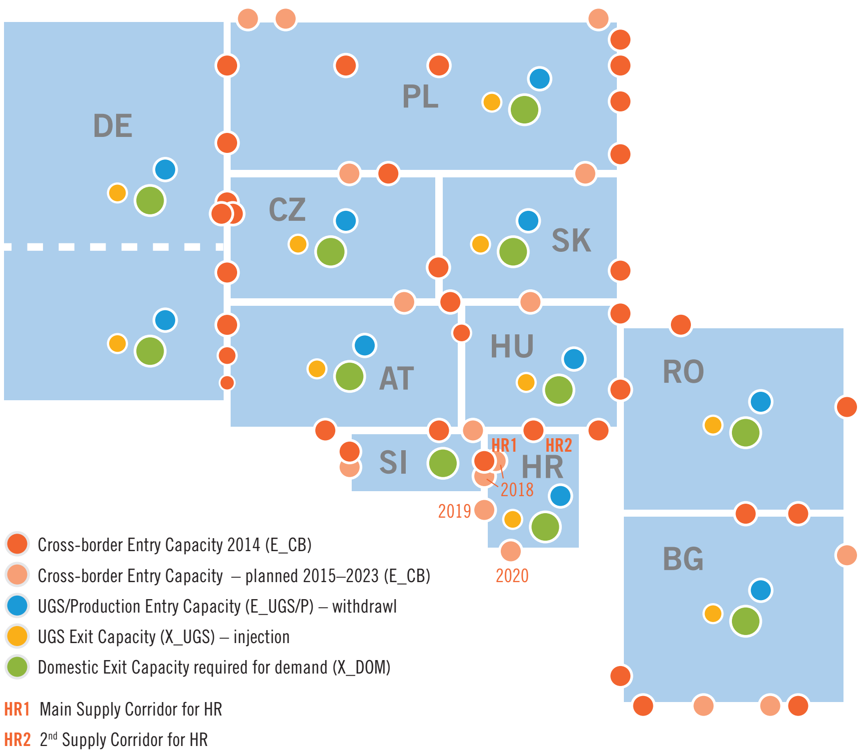

Figure 58: N-1 in CEE Region – HR

5.1.4 THE CZECH REPUBLIC

The supply corridor on the following picture shows the main route of gas for the Czech Republic which is under normal condition through Ukraine and Slovakia (marked as CZ1). Other supply corridors in case of supply disruption through Ukraine are through Germany (marked as CZ2 and CZ3). The remaining capacity that could be used for gas transmission to Slovakia and Poland in such disruption scenario was used as the input for the evaluation of regional N-1 for Slovakia and Poland correspondingly. Two investment projects will be commissioned after 2019 which are planned as part of the North-South gas corridor. The projects will build better connection with Poland and first connection with Austria.

Figure 59: N-1 in CEE Region – CZ

5.1.5 HUNGARY

The picture below illustrates the supply corridors for Hungary. The main supply corridor is from Ukrainian direction which delivers most of the import gas under normal conditions (marked as HU1). The second supply corridor through Austria is marked as HU2, which is also of great importance. The third supply corridor through Croatia is marked as HU3. The interconnector between HU and HR has been designed as bi-directional, however, due to incomplete investment on the HR side (lacking compressor station) currently it is only capable to offer firm capacity from HU towards HR. Through the increased use of the compressor station on the HU side (which necessitates a pressure management agreement between the TSOs) the capability of firm capacity from HR to HU of about half of the entire capacity of the interconnector could be created. The HU TSO is ready to implement this temporary solution until the necessary investments are made on the HR side to ensure full HR > HU capability.

In case of supply disruption on the Ukrainian/Hungarian interconnector, the main import supply corridor is the HU 2.The remaining capacity that could be used in case of supply disruption (Ukraine) is supply from the Hungarian storages and domestic production points. During the Ukraine disruption Hungary is the main supply direction of gas for Romania. A supply corridor H4 will start in Q1/2014. The reverse flow in direction RO > HU will start with a minimum capacity and will increase to planned full capacity (51 GWh/d) in 2016. In 2015 a new cross border point will be commissioned between Hungary and Slovakia. A new interconnector is under preparation between Slovenia and Hungary, the estimated commissioning at Hungarian side is 2017 and at Slovenian side is one year later.

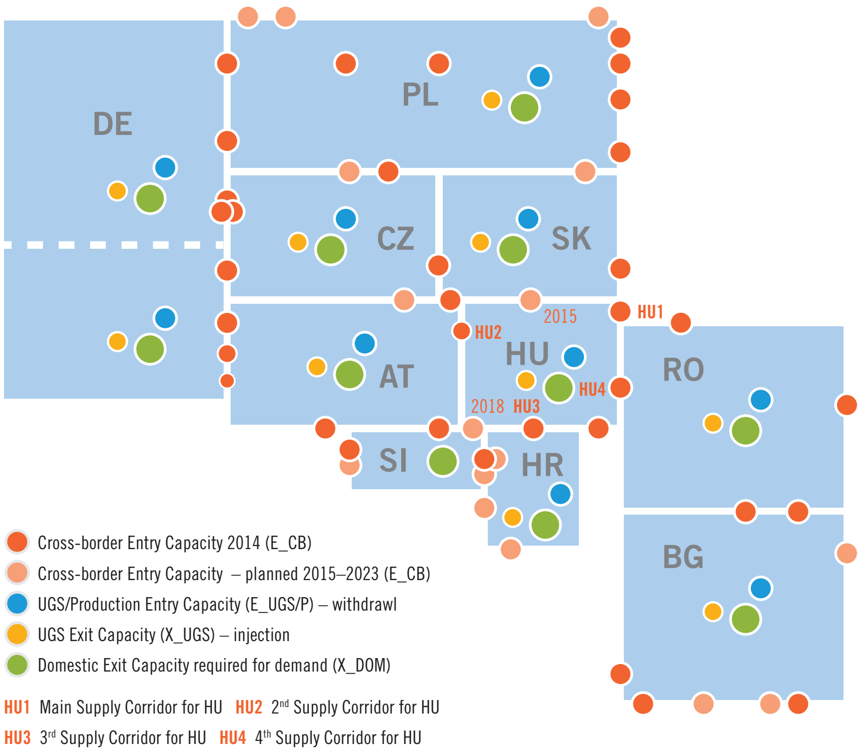

Figure 60: N-1 in CEE Region – HU

5.1.6 POLAND

The picture below illustrates the main supply corridors for Poland. Under normal conditions they run through Belarus (marked as PL1) and Ukraine (PL2). Additionally, the gas market in Poland might be supplied by means of interconnections with Germany and the Czech Republic (marked as PL3 and PL4 correspondingly). In 2014 the LNG terminal in Świnoujście will be finished. Commissioning of new interconnection projects with the Czech Republic and Slovakia are planned for 2019. The cross border project with Lithuania (GIPL) and Denmark are planned to be put in operation in 2021 and 2020, respectively.

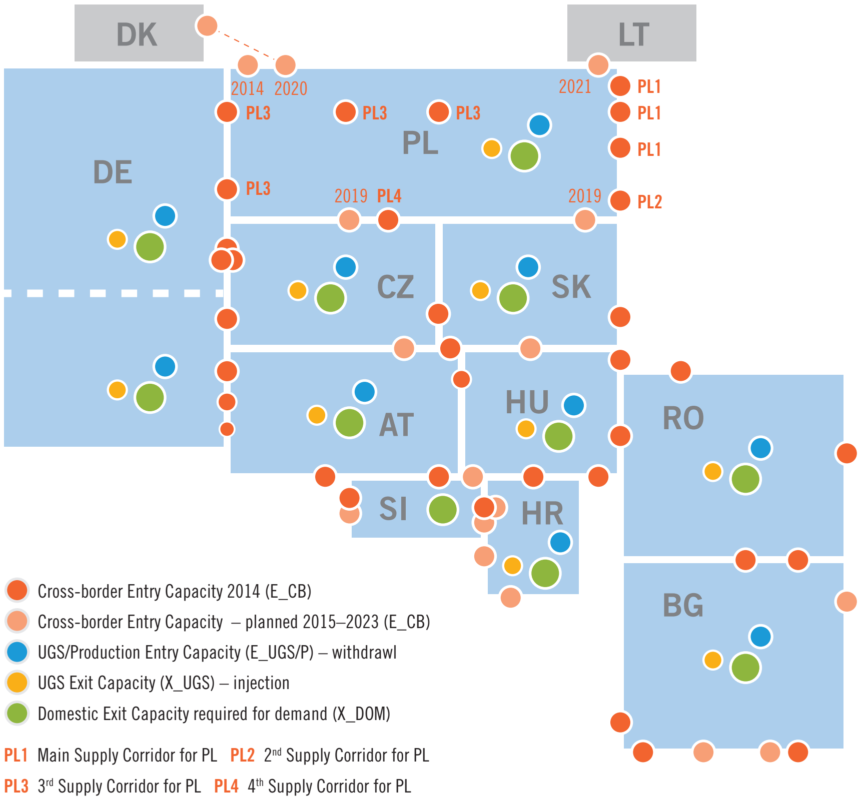

Figure 61: N-1 in CEE Region – PL

5.1.7 ROMANIA

The following picture shows the main supply corridor for Romania which is under normal condition through Ukraine (marked as RO1). In case of total Ukraine disruption, the sole remaining supply corridor for Romania is through Hungary (RO2), however Romania has a significant indigenous production of natural gas. From the beginning of 2014 new interconnection with Bulgaria is in operation.

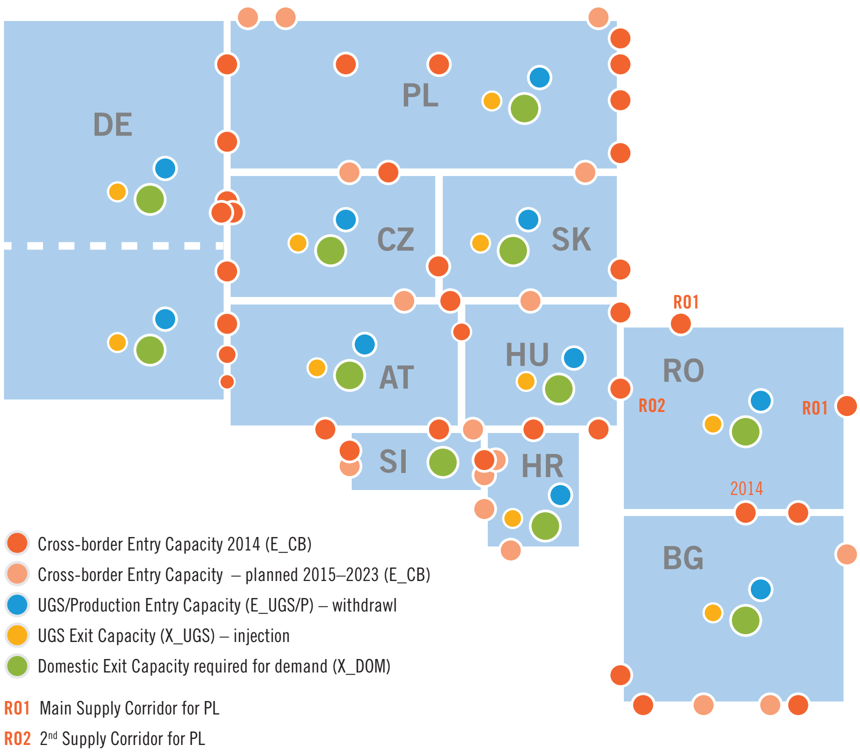

Figure 62: N-1 in CEE Region – RO

5.1.8 SLOVAKIA

Taking into account the position of Slovakia on the gas route from Russia, it is obvious that the main supply corridor enters the country at the UA/SK border. In the event of a Ukraine disruption reverse flows become to play an important role for supplying Slovakia. Other (2nd and 3rd) Supply Corridors, in case of supply disruption through Ukraine, are through the Czech Republic marked as SK2 and through Austria SK3. In 2015 and 2019 is planned commissioning of cross border projects with Hungary and Poland.

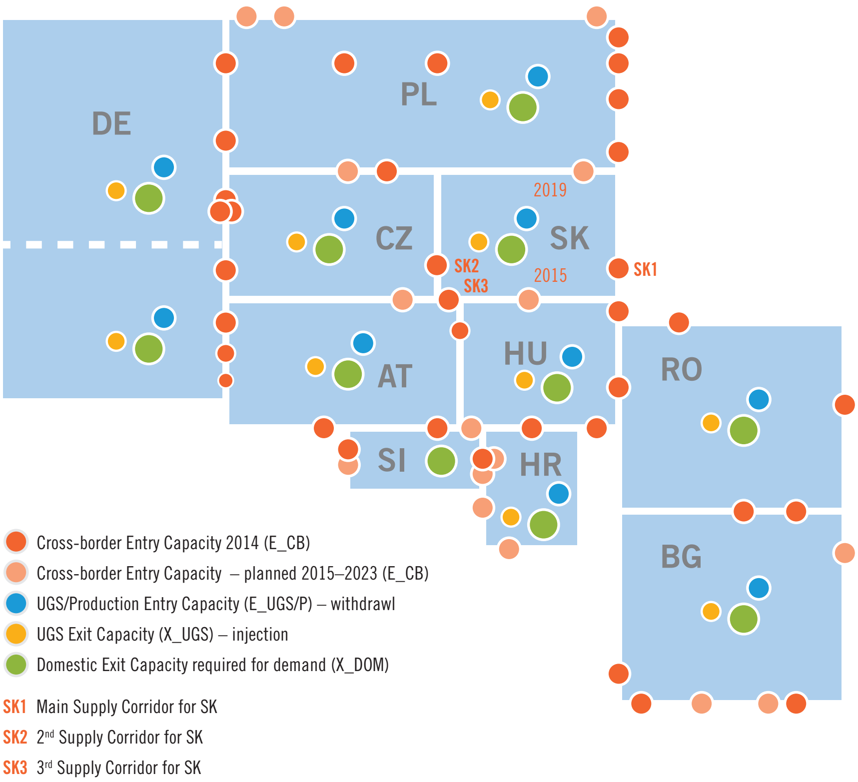

Figure 63: N-1 in CEE Region – SK

5.1.9 SLOVENIA

The supply corridor on the following picture shows the main supply corridor for the Slovenia. Under normal condition it is through Austria (marked as SI1). Other supply corridor in case of supply disruption through Ukraine is through Italy (marked as SI2). In these days Slovenia is the main gas supply direction for Croatia, but in the future there will be possibility to supply Slovenia through Croatia or Hungary. Slovenia is also the only country in the CEE region that has no UGS facility.

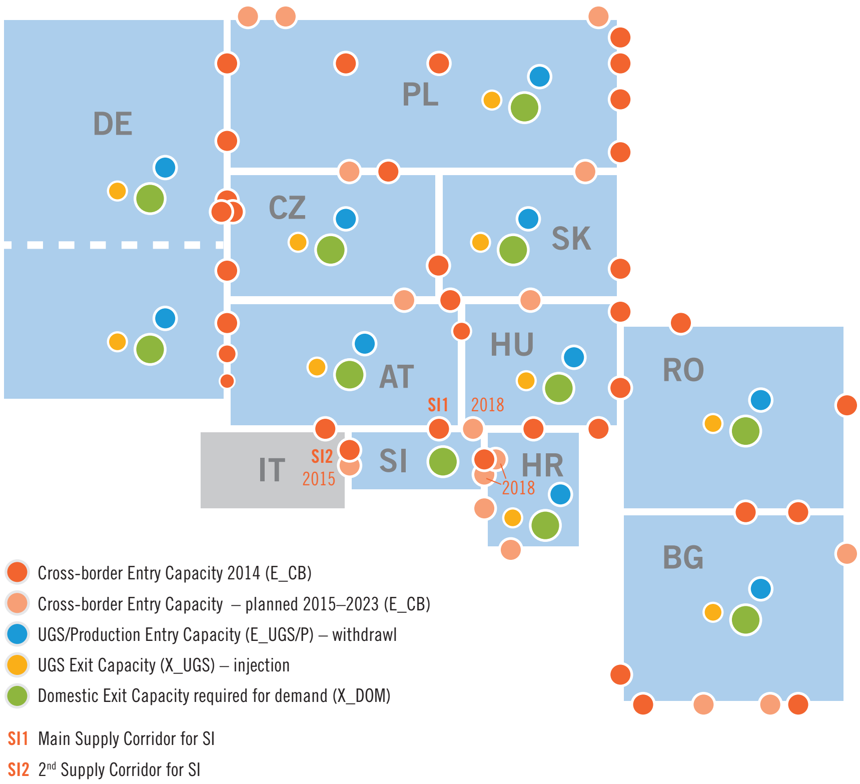

Figure 64: N-1 in CEE Region – SI

5.2 Disruption via Ukraine

During the winter period 2014/2015 when the Ukraine disruption is applied a problem was identified in Bulgaria and Romania. In winter period 2018/2019 was detected problem in Croatia due to expected decrease in national production for the next years. And no CEE country has any trouble to cover the domestic demand during the Ukraine disruption in the last analysed winter period 2022/2023. It is mainly due to the implementation of all new planned investment projects. The results for the countries of the CEE GRIP region are presented in the following table.

COUNTRY	N-1 WINTER FORMULA		
	1.10.2014 – 31.3.2015	1.10.2018 – 31.3.2019	1.10.2022 – 31.3.2023
AUSTRIA	2,6327	2,7364	3,0200
BULGARIA	0,4840	1,8684	1,7430
CROATIA	1,0000	0,9748	1,2361
CZECH REPUBLIC	2,7786	2,5512	2,6887
HUNGARY	1,0494	1,0138	1,0363
POLAND	1,2243	1,0452	1,3175
ROMANIA	0,8414	1,0000	1,0084
SLOVAKIA	2,9404	2,8304	3,1222
SLOVENIA	2,3850	1,5922	1,3811

Table 13: Results of regional N-1 formula in the winter period in case of the disruption via Ukraine

The analysis for the summer 2014 period resulted in the identification of possible problem in Bulgaria, as Bulgaria is not able to inject into UGS facilities during the Ukraine disruption. But this problem will be solved by commissioning of planned projects in the next years. Potential problems to inject into UGS facilities were also identified in Hungary and Romania, but only if the disruption lasts more than 76 and 116 days respectively.

In summer period 2018 the potential problems to inject into UGS facilities were detected in Hungary, Poland and Croatia, but only if the disruption lasts longer than 94, 96 and 155 days.

During the last summer period 2023 there was a potential problem to inject into UGS facilities just in Hungary. This potential problem will appear only if the Ukraine disruption takes longer than 106 days.

Most of identified problems can be solved by implementing new planned investment projects. Potential problems with filling of UGS facilities in Hungary are caused by the fact that Hungary is a transit country and during the disruption is helping neighbouring countries which do not have enough gas for satisfying their domestic demand. Mainly Romania is dependent on supply of gas through Hungary if the Ukraine route is disrupted. The problem can be solved by increasing storage capacity in Hungary and/or Romania. However the some potentials problems were identified it is highly unlikely that the supply disruption via Ukraine would take so long.

5.3 Disruption via Belarus

Due to geographical reasons the analysis of the disruption via Belarus (including the Yamal-Europe Pipeline and IPs Wysokoje and Tietierówka) during the winter periods 2014/2015, 2018/2019 and 2022/2023 is concentrated mainly on Poland which is mostly affected by this kind of disruption. The calculations prove that Poland meets the N-1 criterion and its results improve in the upcoming 10 years with the implementation of the planned investment projects. The other countries in the region are not affected. Their systems works in business as usual regime during Belarus disruption and their N-1 results for this case are above 1. This means all countries of the CEE region have enough capacities to satisfy their domestic demand and also for the transit to neighbouring countries over the whole 10-year period.

The results for particular countries of the CEE region, which are affected by Belarus disruption, are presented in the following table.

COUNTRY	N-1 WINTER FORMULA		
	1.10.2014 – 31.3.2015	1.10.2018 – 31.3.2019	1.10.2022 – 31.3.2023
AUSTRIA	no effect	no effect	no effect
BULGARIA	no effect	no effect	no effect
CROATIA	no effect	no effect	no effect
CZECH REPUBLIC	no effect	no effect	no effect
HUNGARY	no effect	no effect	no effect
POLAND	1,1783	1,0120	1,4205
ROMANIA	no effect	no effect	no effect
SLOVAKIA	no effect	no effect	no effect
SLOVENIA	no effect	no effect	no effect

Table 14: Results of regional N-1 formula in the winter period in case of the disruption via Belarus

All countries in the CEE GRIP region score well in the assessment of N-1 formula in the summer periods. The transmission networks are capable of covering domestic demand and meeting the injection requirements of UGS facilities even in highly improbable scenarios, assuming the disruption period of two months or more. This is case of Poland which has enough capacity to sustain the disruption period of approx. 123 days in 2014 and of approx. 57 days in 2018. A slightly worse result for Poland for the summer period 2018 is caused by an expected significant increase in domestic demand. This is solved by the extension of the LNG terminal in Świnoujście and the commissioning of planned new PL-CZ interconnection (STORK II), PL-SK interconnection and Baltic Pipe in subsequent years. The analysis of summer period 2023 confirms that all countries in the CEE region are able to inject fully their UGS facilities even if the disruption period is extended up to the whole summer period.

6 Main Barriers to Infrastructure Investments

National Regulatory Framework | Permit Granting
Market | Financial | Political

Image courtesy of FGSZ Ltd.

Prospects for the development of natural gas market in the CEE region, as outlined in the Assessment Results chapter, make the infrastructure development a priority issue. The gas infrastructure in the region still requires significant investment tasks to be completed with the aim to expand national networks and connect them into one truly integrated regional gas grid. The achievement of this objective, however, will depend largely on mitigation of barriers to infrastructure development.

It is worth noting that the realisation of gas investments in the CEE region encounters a number of difficulties that may result in delays in many instances. In extraordinary cases, they may even cause termination of the investment by its project promoter. Having this in mind, the purpose of this chapter is to summarise the main barriers that hamper and prolong investments in the gas system in the CEE region and to formulate measures which could streamline the investment process. The barriers are divided into several groups related to regulatory, market, financing and political issues. It needs to be underlined that these barriers do not represent a complete list and they may vary from country to country.

6.1 National Regulatory Framework

The establishment of a stable and predictable regulatory framework adjusted to specific circumstances and needs of a given system has a primary importance for implementing the natural gas infrastructure projects. The regulatory framework in place should encourage the long term investment with appropriate cost recovery and rate of return reflecting capital and operational risk and, herewith, enable TSOs to develop and maintain their grids in line with the principles of security of supply and market integration.

When evaluating the level of revenues, a short term view focusing on revenue reduction shall be replaced with a long term vision focused on a sustainable regulatory framework mitigating risk profile of the industry. Too low revenues or frequent and unpredictable changes of a regulatory framework increase the risk profile of the industry and, herewith, increase the capital costs or even lead to stranded investments. In order to ensure financeability of the natural gas infrastructure projects, it shall be taken into account that investors always evaluate potential investment opportunities with risk-weighted expected returns.

The investments in natural gas infrastructure are capital intensive and, therefore, high regulatory uncertainty can represent a major barrier to investment projects and can lead to the project's delay or may even trigger a decision of not undertaking an investment. Having this in mind, the regulatory framework should stimulate the implementation of projects by granting incentives to mitigate associated risks and to ensure stable and favourable regulatory arrangements over the project's lifetime.

In certain cases a cross-border cost allocation mechanism can be a tool to support realisation of cross-border projects with the PCI status by mitigating asymmetric distribution of costs and benefits between operators and their national markets.

6.2 Permit Granting

Formal and legal procedures that precede construction works are often the most complex and time consuming stage throughout the investment process. In many cases, permit granting process causes major obstacles to gas infrastructure development in the CEE region and is responsible for most delays in project implementation. The most crucial barriers in this respect include:

- Changes and contradictions in national legislation;
- Delays in implementation of EU regulations into national legislations;
- The obligation to lead a number of administrative proceedings before different authorities in order to obtain necessary approvals, decisions and opinions. The need for better coordinating authority if the project crosses a number of districts;
- Difficulties in obtaining the access to land;
- Lack of binding time limits for administrative procedures that may lead to their extension;
- Blocking of procedures (i.e. tender results);
- Excessive requirements regarding early stages of project plan development;
- Long duration of court proceedings.

Legal actions taken to simplify and streamline the permit granting process should be promoted. Swift implementation of the recently adopted REG 347/2013 may have a significant impact on setting enhanced standards for the PCI projects. However, it needs to be emphasised that the best practices in the permit granting process should be applied also to other projects of regional and national importance, as they all are a precondition to a properly functioning gas market in the CEE region.

Effectiveness of solutions to be introduced based on the REG 347/2013 will depend on its consistent implementation. Therefore, steps should be taken to ensure, in particular in the current transitional period, that organisation of permit granting process as resulting from different schemes applied in neighbouring countries streamlines the implementation of cross-border projects.

6.3 Market

The degree of market development and natural gas transmission system varies considerably within the EU. Apart from countries with mature markets with a highly meshed transmission system and a diversified portfolio of supplies, there are countries that require further investments to create a fully competitive and diversified market. Countries in the CEE regions are such an example. But not all projects supporting diversification of sources and security of supply may be designed in a fully market-based manner. This follows from the fact that the suppliers book capacity to meet the market demand and, consequently, do not see it as their responsibility to fund the additional capacity which is not needed from market view but is required to ensure the security of supply in the case of an emergency situation.

Additionally, a tendency towards increasingly shorter booking commitments has been observed, whereas long-term capacities bookings normally underpin investments in new gas infrastructure. The development of a competitive gas market results at present in opting for the most favourable solutions in the short and medium term. On the other hand, a free market is not possible without an efficient infrastructure that enables the access to a number of supply sources. In such circumstances a new model for the planning and implementing gas projects is indispensable. However, the design of such model should envisage support from regulatory authorities (i.e. methods to reduce risk for project promoters) and the EU, in case of projects of European interest.

The current conditions on the European gas market influence behaviour of market participants in utilising UGS facilities whose inventories are currently at low levels in some countries in the CEE region. Such situation poses a risk of guaranteeing uninterrupted supplies for gas consumers in the peak demand periods and may increase requirements for transmission infrastructure so as to design it for much higher peak capacities due shorter injection and withdrawal periods.

6.4 Financial

Economic crisis in many EU member states increases the challenges for investors in securing sources of funding. Therefore, the access to direct support (e.g. EU grants via CEF and ERDF) and innovative financial mechanisms (e.g. equity participation and support to infrastructure funds, loan guarantees, leveraging loan finance from international financial institutions and targeted) is of primarily importance.

6.5 Political

Inconsistent or partially contradictory political messages on the role of natural gas in the long-term perspective may have a direct effect on whether the market feels confident to invest. Natural gas has been labelled as a bridging fuel, however it needs to be noted that its role in the EU's energy mix may well extend beyond 2030 and remain significant also in 2050.

This potential should be utilized given, among other things, favourable carbon footprint of natural gas. Investments in natural gas infrastructure should be promoted especially as natural gas is the most environmentally-friendly fossil fuel that paves the way for an efficient and competitive transition into a low-carbon energy system in Europe. This is especially the case of the CEE region.

7 Conclusions

Demand Evolution | Supply Situation
Supply Mix, Network Resilience, Market Integration
Regional N-1 Analysis in the CEE Countries
Implementation of investment projects

Image courtesy of NET4GAS, s.r.o.

The analyses conducted within the CEE GRIP 2014–2023 concentrate on a closer look at the development of natural gas infrastructure in the CEE region during the upcoming decade.

The central focus of this regional development plan is to assess the functioning of currently existing networks and the prospects for their further expansion in the near future. The analysis was performed based on a number of supply and demand assumptions which were aimed at testing the networks under normal and emergency situations, including the most demanding ones that result from severe climatic conditions and disruption scenarios.

The summary of key findings of this CEE GRIP is presented in the following paragraphs, reflecting particular subject of analysis.

DEMAND EVOLUTION

The increase of demand in the CEE region is expected to be significant with a rate of around 12 % in the EU-wide under the AD, AS, AW, DC scenarios. The growth rate in the (mixed) CEE UR/EU AW single day and two-week scenarios is a bit lower with around 11.5 % increase, respectively. The major share of the growth is estimated for the first part of the period, between 2014 and 2018, for the timespan between 2018 and 2023, the expected increase is rather moderate.

DEMAND SCENARIO	2014 [GWH/D]	2018 [GWH/D]	2023 [GWH/D]	Δ 2014–2018 [%]	Δ 2018–2023 [%]	Δ 2014–2023 [%]
AVERAGE DAY	4,421	4,861	4,959	9.95	2.02	12.17
AVERAGE SUMMER DAY	2,940	3,230	3,299	9.86	2.14	12.21
AVERAGE WINTER DAY	5,980	6,543	6,690	9.41	2.25	11.87
DESIGN CASE	9,772	10,410	10,561	6.53	1.45	8.07
CEE 2W AW	7,369	8,055	8,217	9.31	2.01	11.51
CEE UR AW	7,736	8,447	8,616	9.19	2.00	11.38

Table 15: Summary of forecasted demand under all scenarios in the CEE region

Slovenia and Poland show the biggest increase with around 60 %, followed by Hungary, Croatia and Bulgaria with rates between 44 % and 39 % in the EU-wide demand scenarios and 40 % to 24 % in the mixed scenarios, respectively. The Czech Republic with demand growth of 31 % and 15 %, respectively, Austria with around 25 % and 15 %, as well as Slovakia with 12 % to 8 % represent the middle field. The only country with an expected decrease of demand is Germany with around -6 %.

SUPPLY SITUATION

In the average day scenarios, the situation is sufficient in general, only Poland is expected to have around 10 % flexibility in 2018 and around 4 % in 2023 FID case (approx. 1 % in the AD and max LNG scenario). In the non-FID case, the remaining flexibility exceeds 20 % in the entire region.

Although the design case is the most demanding one, only a slight shortage (-1.4 %) in Poland is expected for the 2018 FID case. Flexibility levels between 5 % and 20 % occur in some cases in Bulgaria, Hungary, Poland and Slovenia. An implementation of the non-FID projects is expected to almost completely mitigate the issue.

The results of average winter day scenarios suggest that Poland might be affected in 2023 FID case (-0.3 %), however this can be solved with implementation of non-FID projects.

No shortages are expected for the average summer day, but still the remaining flexibility is below 20 % in Poland in 2018 (17.7 %) and 2023 (9.7 %) in the FID scenarios. In the non-FID cases the remaining flexibility is over 20 % in the whole CEE region.

The picture is a bit different in the mixed scenarios. Although the situation under the reference scenario is – besides a 2023 FID shortage in Hungary in the CEE 2W UR/EU AW case – similar to the design case, in the disruption scenario several countries in the region are expected to face partially dramatic shortages: whereas Bulgaria (in 2014 only), Hungary and Romania are impacted vastly in case on an interruption of supplies via Ukraine in both, the FID as well as the non-FID case, Poland is the only country expecting shortages in case of a Belarus route disruption for 2014 and 2018 FID and non-FID. Hungary is likely to have reduced flexibility in the FID case. The network resilience is expected to be improved under non-FID cases at the end of the 10-year period analysed in the CEE GRIP.

Image courtesy of GASCADE Gastransport GmbH

SUPPLY MIX, NETWORK RESILIENCE, MARKET INTEGRATION

Russia has been and will remain the main supplier of the region with a minimum share of 50 % in all reference scenarios. Storages (where applied in the model) and national production play a significant role as well. The expected decrease of national production is mainly compensated by Russian gas. Norwegian gas share normally is under 10 %, except in case of minimum Russian deliveries where the Norwegian share is almost 20 %, which is almost double the LNG share. In case of disruptions, Russian gas is mainly substituted by gas stored in UGS.

All other sources, be it Algeria, Libya, LNG or the SGC, do not play a major role, however their share is slightly increasing. Nevertheless, especially the average day scenario with minimum Russian deliveries show, that the market integration is at a sound level in the region, although there is space for improvement.

In terms of Network Resilience, it can clearly be seen that especially the countries located in eastern part of the CEE region along the historical import routes via Ukraine and Belarus are impacted by interruptions. In case of a Ukraine route disruption, mainly Bulgaria, Hungary and Romania suffer from shortages. An interruption of the Belarus line mainly impacts Poland, whereas a simultaneous disruption of both routes potentially has impact on Poland, Romania, Bulgaria and Hungary. As the FID as well as the non-FID timelines show, the concerned countries are aware of the issue and successfully plan measures to mitigate the impact of disruptions.

REGIONAL N-1 ANALYSIS IN THE CEE COUNTRIES

The calculation of regional N-1 formula was assessed assuming disruption of gas supplies via Ukraine and Belarus both in the summer and winter periods. Interruptions of the Ukrainian route are expected to have a negative impact on Bulgaria and Romania in the winter period 2014/2015 and on Croatia in the winter period 2018/2019. However, the implementation of proposed projects in subsequent years contributes to the increase of N-1 value above 1 in these countries. Disruption of supplies via Belarus effects, due to geographical reasons, only Poland but the results of assessments prove positive over the entire time range.

All countries in the CEE region obtain satisfactory results of the N-1 calculations in the summer period, as each country is expected to cover gas demand and meet injection requirements of UGS facilities while having at the same time the Ukrainian or Belarusian route fully disrupted for at least 76 days. The only exception is Bulgaria during Ukraine disruption scenario in 2014. There was identified a possible problem with inability to inject into UGS facilities. This problem is fully solved by the commissioning of the planned projects in the following years.

IMPLEMENTATION OF INVESTMENT PROJECTS

The results of analyses performed in the CEE GRIP 2014–2023 indicate that security of supply and market integration considerations are amongst the main drivers for future evolution of gas infrastructure in the CEE region. In this context it is worth noting that transmission, LNG and UGS projects with the FID status, as submitted for this GRIP, are expected to enhance the functioning of the regional network by increasing interconnectivity between national infrastructures and granting the access to a more diversified supply portfolio. However, it is up to non-FID projects that are essential for creating a fully integrated gas grid in the CEE region with infrastructure allowing for flexible transport of gas, depending on conditions on the markets.

In addition, it needs to be emphasised that the ability to deliver these projects will depend on how barriers to infrastructure development are mitigated. The analysis of barriers present in the CEE region suggest that issues related to national regulatory framework, permit granting, market and financing might have a negative impact on timely development of gas projects. Furthermore, to ensure appropriate conditions for investments in the gas infrastructure in the EU, support should be given to actions which are aimed at the development of a clear energy strategy of the EU which acknowledges a substantial role to be played by natural gas in the energy mix in the mid and long-term future.

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Definitions

Number formatting	Comma (,) is used as a 1,000 separator Point (.) is used as decimal separator
1-day Uniform RiskDemand Situation	A daily demand Situation forecasted under the same risk of a climatic occurrence close to 1-in-20 years
14-day Uniform Risk Demand Situation	A 14-day average daily demand Situation forecasted under the same risk of a climatic occurrence close to 1-in-20 years
Average Day Demand Situation	A daily average demand Situation calculated as 1/365 th of an annual demand
Design-Case Demand Situation	A high daily demand situation used by TSOs in their National Development Plans to determine the resilience of their system and needs for investment
Full Minimisation (Min RU, LNG)	A modelling approach aimed at minimising supply from each source separately, in order to identify Zone Supply Source Dependence, and replacing it with the corresponding volume from the remaining sources in such a way that the maximum minimisation of the analysed supply is achieved
Targeted Maximisation	A modelling approach aimed at maximising supply from each source separately as to reach each Zone; the decrease of each other supply is done in proportion to its share in the Reference Case and with the Minimum Potential scenario used as a limit. The use of an import route is a result of the modelling
FID project	A project where the respective project promoter(s) has (have) taken the Final Investment Decision
Non-FID project	A project where the Final Investment Decision has not yet been taken by the respective project promoter(s)
Network Resilience	A notion related to the capability of a network to ensure supply demand balance in High Daily Demand Situations, including also under Supply Stress
Reference Case	The Case that extends the historical (last three years) trend of supply over the 10-year period covered by the GRIP; where new import pipe/LNG terminal projects are planned to come on stream the supply is adjusted in proportion to the last applicable supply situation
Remaining Flexibility	A notion related to the assessment of Network Resilience; it refers to the ability of a Zone to offer additional room for supply arbitrage; the value of the Remaining Flexibility is benchmarked against defined limits to identify potential capacity gaps
Case	A combination of a demand and supply situation, infrastructure cluster and the respective time reference
Scenario	A set of assumptions related to a future development which is the basis for generating concrete value sets covering demand or supply

Abbreviations

AD	Average day demand
AS	Average summer demand
AW	Average winter demand
BACI	Bidirectional Austrian-Czech Interconnector
BEMIP gas	Baltic Energy Market Interconnection Plan in gas
CEE 2W UR/EU AW	Two-week Uniform Risk Day in whole CEE Region, Average Winter Day in the rest of the EU
CEE 2W UR/EU AW	14-day Uniform Risk in the CEE region, winter average in rest of the EU
CEE GRIP	Central-Eastern Europe Gas Regional Investment Plan
CEE UR/EU AW	Single Uniform Risk Day in whole CEE Region, Average Winter Day in the rest of the EU
CEF	Connecting Europe Facility
CS	compressor station
DC	Design Case
DEg	GASPOOL
DEn	NetConnect
DIR 2009/73	Directive 2009/73/EC of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC
EC	European Commission
ERDF	European Regional Development Fund
EU	European Union
FID	final investment decision
GIPL	Gas Interconnection Poland-Lithuania
IP	interconnection point
ITB	Interconnection Turkey-Bulgaria
LNG	Liquefied natural gas
LSO	LNG System Operator
MEET	Bulgarian Ministry of Economy, Energy and Tourism
MW	megawatt
NEP	Netzentwicklungsplan
NP	national production
NSI East Gas	North-South gas interconnections in Central Eastern and South Eastern Europe
PCI	projects of common interest
REG 347/2013	Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009
REG 715/2009	Regulation (EC) No 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005
REG 994/2010	Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC

SGC	Southern Gas Corridor
SoS	security of supply
SSO	Storage System Operator
TGL	Tauerngasleitung
TSO	Transmission System Operator
UGS	Underground Gas Storage

Country Codes (ISO)

Albania	AL
Algeria	DZ
Austria	AT
Azerbaijan	AZ
Belarus	BY
Bulgaria	BG
Croatia	HR
Czech Republic	CZ
Denmark	DK
Germany	DE
Greece	GR
Hungary	HU
Italy	IT
Libya	LY
Lithuania	LT
Norway	NO
Poland	PL
Romania	RO
Russia	RU
Slovakia	SK
Slovenia	SI
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