Natural Gas Security of Supply in the Danube Region

Background paper

Contribution of the Danube Region to the debate on the Energy Union

Draft Final

Regional Centre for Energy Policy Research

May 2015

SZÉCHENYI 2020

HUNGARIAN GOVERNMENT

European Union
Cohesion Fund

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Introduction

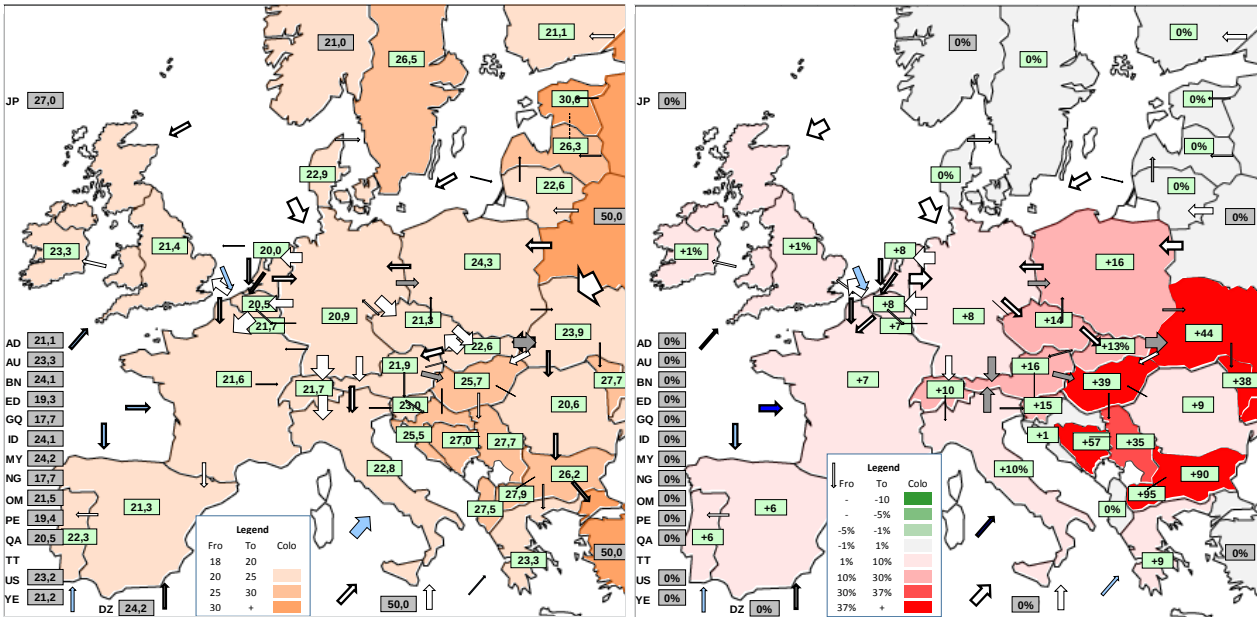
Energy Union is proposing to strengthen natural gas security of supply by enforcing existing measures and more concentrated financial support on the infrastructure. In this paper we analyse how the following measures can help to increase SOS in the DR:

1. Enabling reverse flow on existing pipelines
2. Better interconnectivity through PCIs
3. More LNG flows to Europe

Simulations are carried out by the European Gas Market Model of REKK. The vulnerability due to supply shocks is modelled by a 100% supply cut on all Ukrainian pipelines in January. Outcomes of the security scenario simulations are compared to a normal (without shock) reference case of EU.

The 2015 reference scenario in normal and SOS circumstances can be seen in Figure 1.

Figure 1 2015 Reference scenario: wholesale natural gas prices (€/MWh) in normal scenario (on the left) and January price increase (%) in a security of supply crisis scenario (on the right)



On the left the green boxes depict the modelled yearly average wholesale gas prices as of 2014-15. The colour of the countries indicates the price level. The Danube region is clearly more expensive than the rest of Europe and it is still clear that differences within the region exist. The countries more interconnected with Western Europe and hence to more liquid wholesale markets perform better. The physical congestion on HAG (between Austria and Hungary) still prevents the Balkan region to trade on Western European hubs, and the dominance of one single supplier is reflected in higher prices. The gap between Western and Eastern prices is however closing, mainly due to the fact that many Russian contracts in the region have been renegotiated in the last few years. Ukraine benefits from the new reverse flow deliveries through Slovakia (in the modelling it is also fully utilized), while Romania is less dependent on external sources, thanks to the domestic production that can supply almost fully the decreasing Romanian demand.

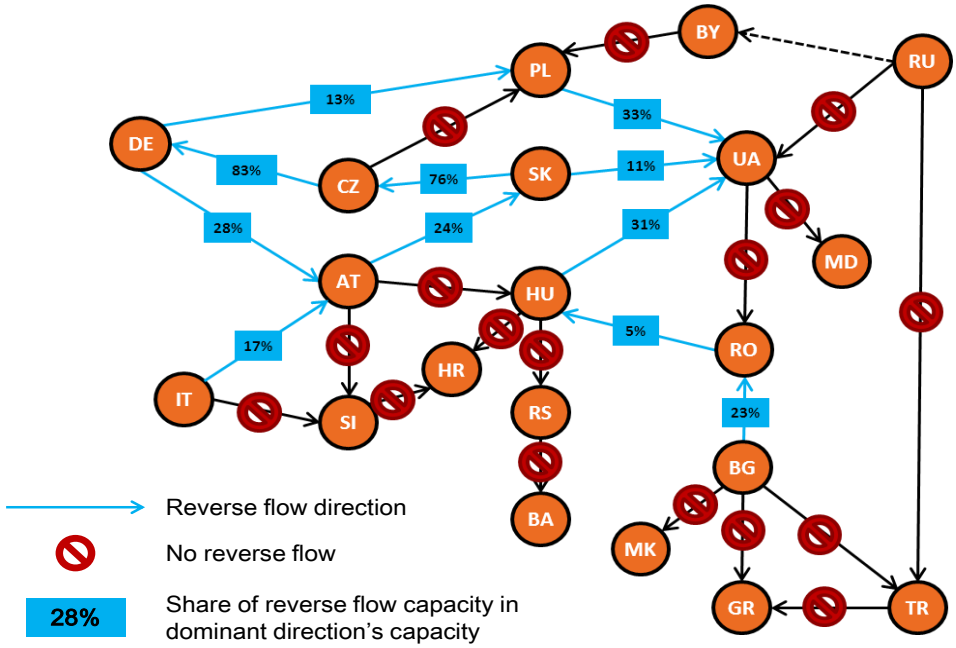
The vulnerability due to supply shocks is modelled by a 100% supply cut on all Ukrainian pipelines in January. The picture on the right hand side is illustrating this scenario. Green

boxes depict the price increase in % compared to the January prices in reference normal scenario. Again, the Danube Region is more vulnerable than Western Europe, and the same countries that have in the normal scenario higher prices experience sharper price increase in a supply shock. Bulgaria is still not interconnected with any of the neighbors (flows from Romania can only supply the Russian long term deliveries), and Bulgarian storage capacity is limited. The reverse flow to Ukraine (from Poland, Slovakia and Hungary) gets congested in an SOS situation but still cannot serve the Ukrainian winter needs. Hungary has developed substantial cross border capacities since 2009 (HU-HR, HU-RO, HU-UA; additional HU-SB interconnection) and due to this good interconnectivity experiences a very high price increase, because the neighboring countries price increase spills over to Hungary. The interconnector between Romania and Moldova is still not operational, and Moldova as a gas island is also experiencing a huge price increase in a supply shock.

The effect of physical reverse flow in SOS situations

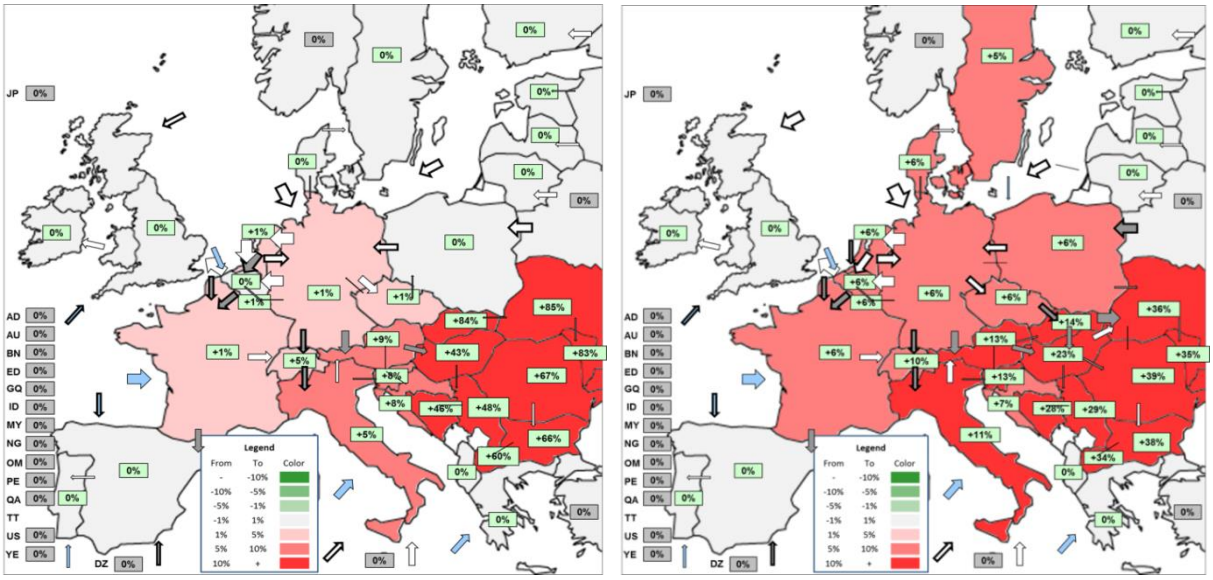
One of the main achievements of the Security of Supply regulation is the obligation to allow physical reverse flow on all EU-EU borders. This obligation (with a deadline of 2014) has been only partially fulfilled. As the picture illustrates, the reverse flow option is completely blocked on the Trans-Balkan pipeline (TR to BG and further to RO, MV, UA) almost completely on TAG (IT to AT) and Yamal (DE to PL), and the smaller cross border pipelines in the Balkan also work in one direction only. The reverse flow from RO to Hungary has been operational since 2014, but the capacity is only 5% of the main direction capacity.

Figure 2 Reverse flow directions, in% of dominant direction



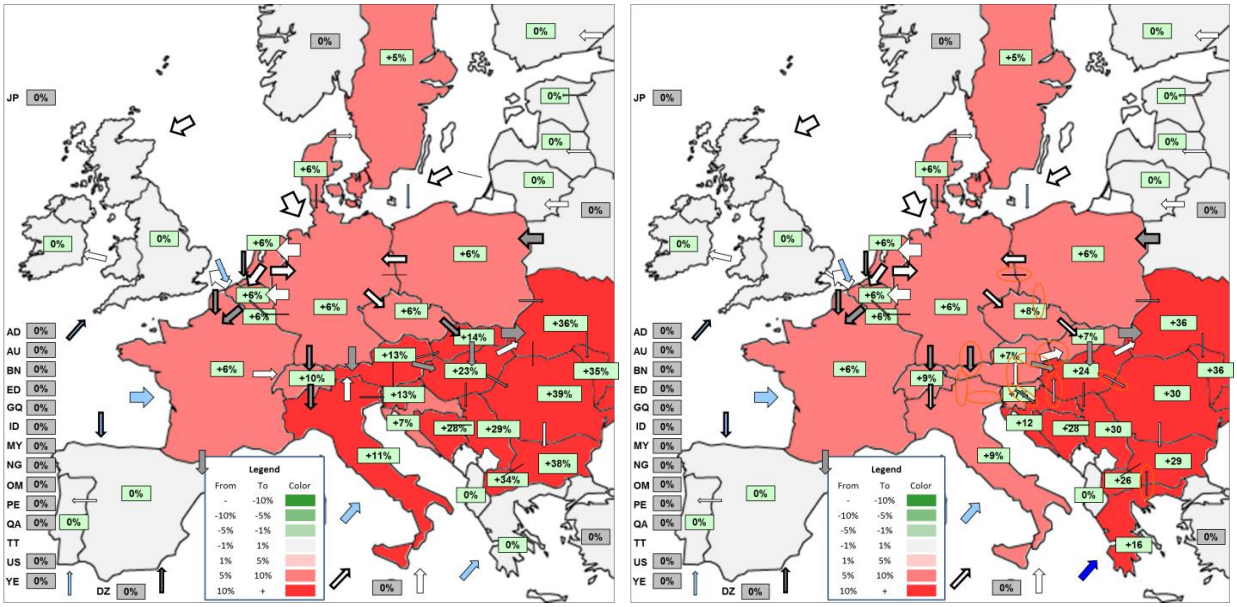
The TSOs asked for exemption from their respective regulators not to comply with the reverse flow obligation. This might be justified if the pipeline would never been used or the cost of the investment is exceeding the potential benefits. The next modelling exercise adds some modelling information to this discussion. Figure 3 shows the price effect of new infrastructure built since 2009.

Figure 3 Price increase in Europe due to a 100% supply cut in January on all Ukrainian pipelines in 2009 scenario (on the left) and in 2015 scenario (on the right)



On the left we see a 100% January cut on all Ukrainian pipelines on the 2009 infrastructural setting of Europe, with most of the big transmission pipelines in the East working only in one direction. The average price increase in the Danube Region in a theoretical modelling of 2009 would have been in the range of 1%-85%. Adding the reverse flows by 2015 the price increase range in the DR is decreasing to 6% to 39%. This means that due to better interconnectivity the Western European gas markets solidarity towards central and Eastern Europe is reflected in the risk of higher prices in a demand shock situation.

Figure 4 Price increase in Europe due to a 100% supply cut in January on all Ukrainian pipelines in 2015 scenario (on the left) and in 2015 scenario with 100% reverse flow (on the right)



Adding further new reverse flow capacities to the region does not bring benefits in the magnitude that we experienced from 2009 to 2015. The most important projects have already

been realized. There are two projects that bring benefits under normal circumstances: the extension of the reverse flow from AT to SK together with the DE-AT expansion still brings benefits. In the SOS runs more projects experience flows in the crisis: GR-BG, RO-HU and HR-HU. The rest of the projects exemption from the reverse flow obligation might be justified.

1. Table: Usefulness of additional reverse flows (modelling result)

	Scenario		
	Normal	Short-term SOS	Long-term SOS
DE-AT expansion	x	x	x
SI-AT			
IT-AT expansion			
SI-IT			
HR-SI			
DE-PL expansion			
PL-CZ			
AT-SK expansion	x	x	x
GR-BG		x	x
RO-HU			x
HR-HU		x	x
HU-AT			

Analysis of short-term and long-term selected PCI project

In the followings we analyse the price effect of short-term and mid-term PCI project in the security of supply scenario. As before we simulate a 100% supply cut in January on all pipelines through Ukraine. We also analyse the effect of the Hungarian strategic stock release.

Figure 5 January price increase in reference SOS scenario

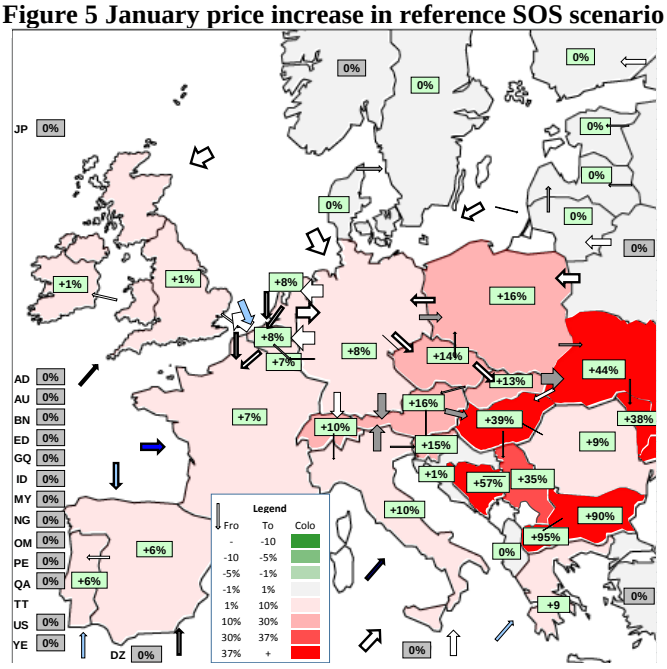


Table 2 January price increase in reference SOS scenario

Price increase compared to normal reference (%)		SOS reference	REF +Storage
Market	Jan normal (€/MWh)	%	%
BG	26,5	90%	90%
BA	27,5	57%	45%
UA	24,3	44%	37%
HU	27,4	39%	27%
MV	28,2	38%	32%
SB	30,3	35%	25%
AT	23,7	16%	16%
SI	25,0	15%	15%
CZ	22,3	14%	14%
SK	23,5	13%	13%
RO	23,2	9%	8%
DE	23,0	8%	8%
HR	26,5	1%	1%
DR average	25,4	33%	30%
Whole Europe	26,3	17%	16%

There is a significantly higher wholesale gas price increase in the DR countries (33%) than in whole Europe (17%). There are however only 6 countries that are affected more than the European average. These are: Bulgaria, Bosnia and Herzegovina, Ukraine, Hungary, Moldova and Serbia. When releasing the strategic gas stocks in HU (1,2 bcm) damages in Bosnia, Ukraine, Hungary, Moldova, Serbia would be lower.

Out of the most affected countries only Bulgaria cannot benefit from the strategic storage stocks. Romania would not benefit directly, but flows from Romania to Hungary would be smaller and that is why the Romania price increase would also be a bit smaller.

Figure 6 Price effect of short-term PCI projects in SOS scenario

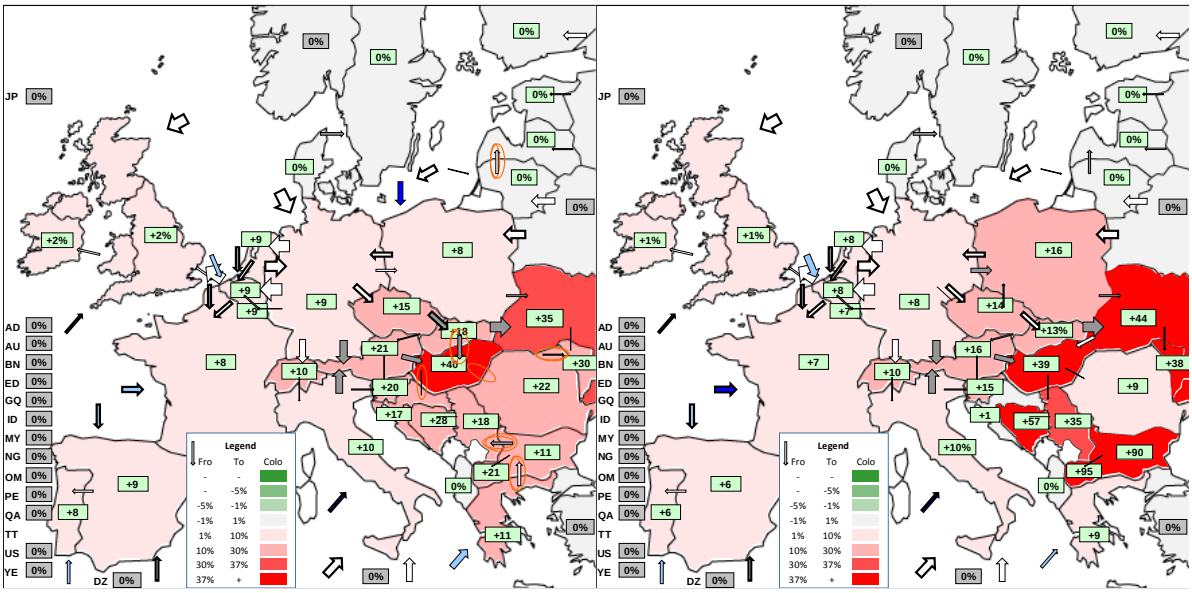


Figure 7 Short term PCI SOS January price increase with (on the right) and without (on the left) Hungarian strategic storage released

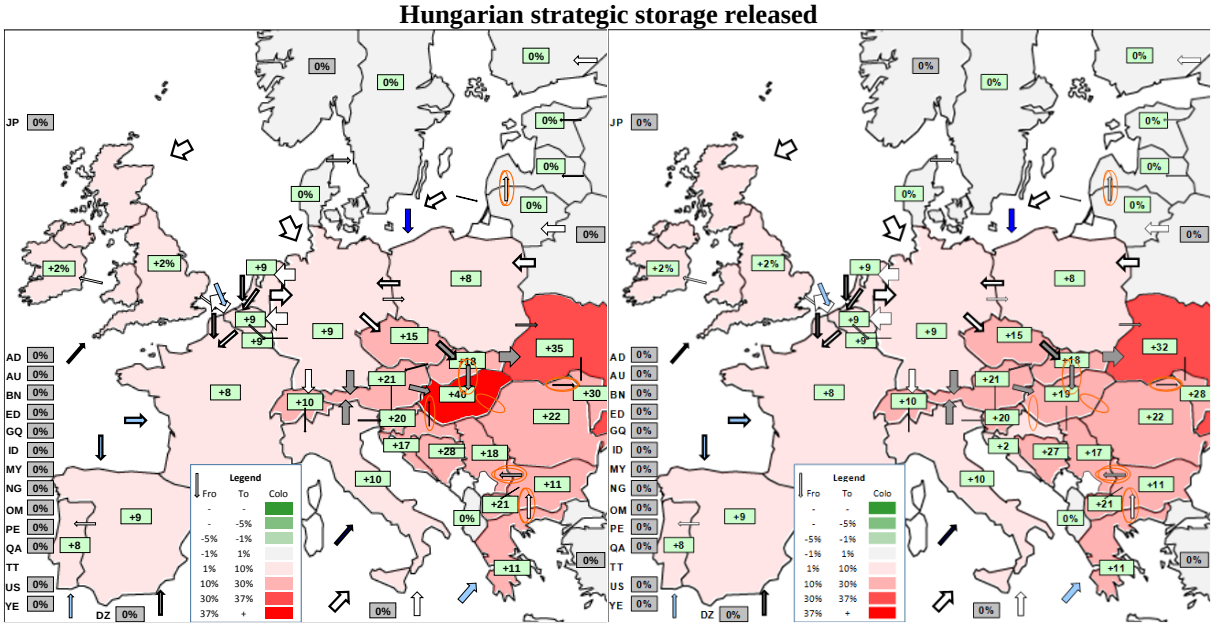
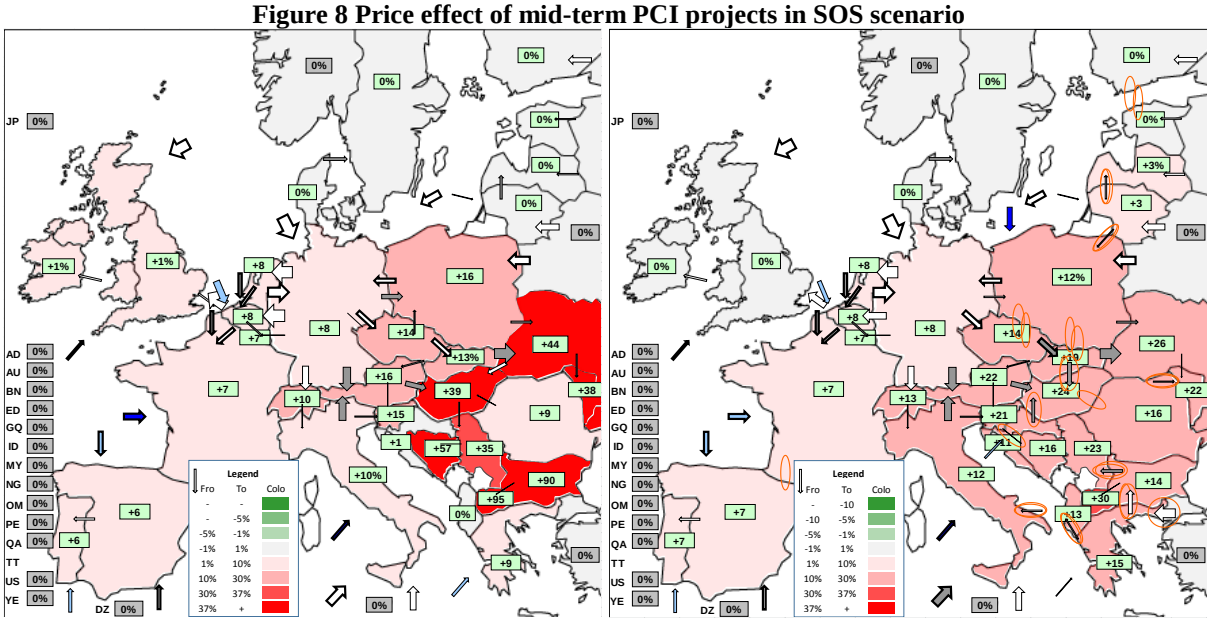


Figure 8 Price effect of mid-term PCI projects in SOS scenario



The new interconnectors and LNG terminals help in mitigating the damages. In the case of a 100% supply cut in January the price increase relative to the reference scenario decrease significantly in DR countries: from 33% to 21% due to the short-term projects and to 19% due to short- and medium-term projects.

Table 3 Summary of PCI projects' effect in an SOS situation

Price increase compared to normal reference (%)		SOS	SOS reference	Short term_SOS		Mid term_SOS	
Market	Jan normal (€/MWh)	Jan (€/MWh)	%	Jan (€/MWh)	%	Jan (€/MWh)	%
AT	23,7	27,5	16%	28,6	21%	28,6	22%
BA	27,5	43,1	57% (45%)*	35,1	28% (27%)*	26,8	16%
BG	26,5	50,4	90%	28,9	11%	25,2	14%
CZ	22,3	25,4	14%	25,5	15%	25,1	14%
DE	23,0	24,7	8%	24,9	9%	24,4	8%
HR	26,5	26,7	1%	31,1	17% (2%)*	24,8	11%
HU	27,4	38,2	39% (27%)*	35,3	40% (19%)*	31,1	24% (20%)*
MK	27,4	53,4	95%	32,0	21%	28,2	30%
MV	28,2	38,9	38%	36,3	30%	34,0	22%
RO	23,2	25,4	9%	31,7	22%	30,0	16%
SB	30,3	41,1	35% (25%)*	33,1	18% (17%)*	29,8	23%
SI	25,0	28,8	15%	29,9	20%	29,9	21%
SK	23,5	26,6	13%	27,7	18%	27,7	19%
UA	24,3	35,0	44% (37%)*	32,5	35% (32%)*	30,1	26%

DR average	25,4	34,3	**33% (30%)***	30,5	**21% (18%)***	27,8	**19% (18%)***
Whole Europe	26,3	29,5	**17%**	27,9	**12%**	26,2	**12%**

* Figures change when the Hungarian strategic stock is released in the region (1,2 bcm)

The Hungarian strategic storage is very important regionally, until the necessary cross border capacity is achieved. With the mid-term projects implemented only Hungary will need that stock.

With the mid-term projects in place almost the same level of security is achieved in the DR region as in the EU. Most importantly no DR country would experience an extreme (above 30%) price increase due to a one month in winter security of supply shock. (Romanian price increase is not driven by the crisis but it is the consequence of eliminating the isolation of a relatively cheap country and allowing trade.)

From this table we learn how much can be achieved by the implementation of the short term PCI projects on a Danube region level (from the 33% January price increase without any projects we experience a 21% increase when Short term PCI's are implemented and a 19% increase when mid-term PCI's are also implemented. It is important to note however that the PCI projects bring benefits also under the „normal" business circumstances, so the 19% increase in the mid-term scenario is in absolute terms only a 2,4 €/MWh increase in a security of supply shock compared to the starting normal price in 2015.

More LNG to Europe

Table 4: LNG flows to Europe in different infrastructure scenarios

TWh	Normal scenario			SOS scenario		
	Reference	Assuming short-term PCIs	Assuming mid-term PCIs	Reference	Assuming short-term PCIs	Assuming mid-term PCIs
Total LNG flow to Europe	781	787	775	786	792	784
LNG flow to Croatia	-	-	13,8	-	-	18,8
Congested terminals	-	-	-	FR, IT	IT,PL	IT,PL

We find no congested LNG terminal in Europe in a normal situation. In case of SOS situation France and Italy gets congested. When new LNG in PL comes online (Short term) the congestion from France moves to PL due to the lack of physical reverse flow from France to Germany and further into the Region. When Croatian terminal is implemented, it will receive LNG flows on a spot basis even under „normal" circumstances In SOS situation it is even more used.

Key messages

- Newly built infrastructure in Europe since 2009 has significantly improved gas supply security for the Danube Region. This is reflected in the fact that the range of the price increase in the case of a supply shock significantly decreased in DR countries. From the additional reverse flows AT-SK, DE-AT expansion, GR-BG and HR-HU are proved to be the most important.
- Realization of selected PCI projects would significantly decrease the damages in Danube Region in the case of a supply shock. With the short- and mid-term projects in place almost the same level of security is achieved in the DR region as in the EU. No DR country would experience an extreme (above 30%) price increase due to a one month in winter security of supply shock. Hungarian strategic storage is also very important regionally.
- Croatian LNG brings significant benefits to the Danube Region both under normal and SOS circumstances.

ANNEX I. Short-term selected gas PCI projects

A	Short-term projects (2014 – 2016)			
#	Name of project	Details	Capacity	Finished by
Baltic gas market				
1	LT: LNG vessel	Vessel (not a PCI). Status: operational since Oct 2014	50 GWh/day	End 2014
2	Klaipėda-Kiemėna pipeline upgrade together with LT-TV upgrade	Capacity enhancement of the connection from Klaipėda to the LT-LV interconnector. Status: EIA and engineering design	57,4 GWh/day	2020
Gas optionality in Central and South-East Europe				
1	PL: LNG terminal	Terminal in Swinoujscie and connecting pipeline (not a PCI due to maturity). Status: under construction	150 GWh/day	End 2014
2	EL-BG interconnector	New interconnector to support diversification and deliver Shah Deniz gas in Bulgaria. Status: permitting, EIA (2 years delay)	134 GWh/day	2016
4	BG: storage upgrade	Increase storage capacity in Chiren; Status: pre-feasibility	up to 5,78 TWh/year mobil gas capacity	2017
5	HU-HR reverse flow	Reverse flow enabling gas flows from Croatia to Hungary. Status: feasibility studies.	76 GWh/day	2015
6	HU-RO reverse flow	Project to enable gas flows from Romania to Hungary. Status: feasibility studies	127 GWh/day	2016
7	BG-RS interconnector	New interconnector supporting SoS in Bulgaria and Serbia. Status: EIA, routing, financing (issued with Srbijagas unbundling to access finance)	80 GWh/day	2016
8	SK–HU interconnecter	New bi-directional pipeline. Status: construction	SK-HU: 126,8 HU-SK: 50,75 GWh/day	2015
9	RO-MV interconnector	Under construction (in delay)	30 GWh/day	2016

ANNEX II. Mid-term selected gas PCI projects

B	Medium-term projects	(2017 – 2020)		
#	Name of project	Details		Finished by
Baltic gas market				
1	PL-LT interconnector	New bi-directional pipeline (GIPL) ending isolation of the Baltic States. Status: feasibility/FEED	PL-LT: 73,4 GWh/day LT-PL:30,6 GWh/day	2019
2	FI-EE interconnector	New bi-directional offshore pipeline ("Balticconnector"). Status: pre-feasibility/permitting	80 GWh/day	2019
3	Baltic LNG terminal	New LNG terminal with location to be decided (EE/FI). Status: pre-feasibility, permitting	FI: 133 GWh/day	2017
Enabling gas from Spain to flow north				
1	ES-FR "Midcat" interconnector	New interconnection (including compressor) to enable bi-directional flows[1] between France and Spain. Status: feasibility study	ES-FR: 230 GWh/day	tbd
Cluster Gas optionality in Central and South-East Europe				
1	PL-CZ interconnector	New bi-directional pipeline between Czech Republic and Poland. Status: Feasibility/FEED, permitting (CZ)	153,2 GWh/day	2019
2	PL-SK interconnector[2]	New bi-directional pipeline between Slovakia and Poland. Status: final investment decision in 2014	PL-SK: 143,9 GWh/day, SK-PL: 174,5 GWh/day	2019
4	TANAP (TR-EL)	Trans-Anatolian Natural Gas Pipe bringing Caspian gas to the EU via Turkey and opening the Southern Gas Corridor. Status: feasibility/final investment decision	TR-GR: 348 GWh/day	2019
5	TAP (EL-AL-IT)	Intra-EU section of the Southern Gas Corridor. Direct connection to TANAP. Status:	526,01 GWh/day (20 bcm/year)	2019

		permitting		
6	IAP (AL-ME-HR)	New interconnector part of the Balkan Gas Ring and connected to TAP. Status: feasibility/FEED	HR-AL:30, HR-BiH: 30, HR-ME:15 GWh/day	2020
7	HR – LNG terminal	New LNG terminal in Krk supporting SoS and diversification in the Region. Status: feasibility/FEED (financing issues)	170 GWh/day (6,5 bcm/year)	2019
11	EL: Alexandroupolis LNG terminal	New LNG terminal in Northern Greece. Status: permitting	455 GWh/day	2016[3]
12	EL: Aegean LNG terminal	New LNG floating terminal at Bay of Kavala. Status: feasibility/FEED, permitting	155 GWh/day	2016[4]