REKK Regional Centre for Energy Policy Research

DANUBE REGION strategy Energy

Natural Gas Security of Supply in the Danube Region

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

SZÉCHENYI 2020

Hungarian Government

European Union
Cohesion Fund

INVESTING IN YOUR FUTURE

Research question and methodology

Energy Union is proposing to strengthen natural gas security of supply by enforcing existing measures and more concentrated financial support on infrastructure. How can the following measures help to increase SOS in the DR?

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

Methodology: European Gas Market Modelling

- 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

Modelling today's natural gas wholesale market in Europe

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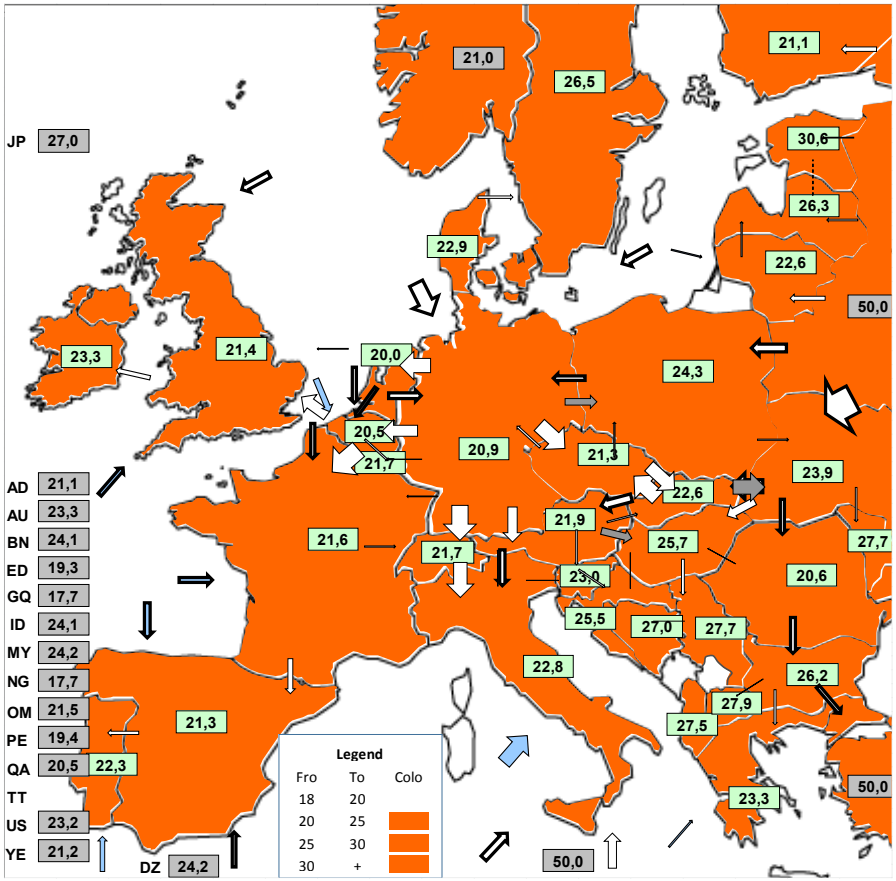
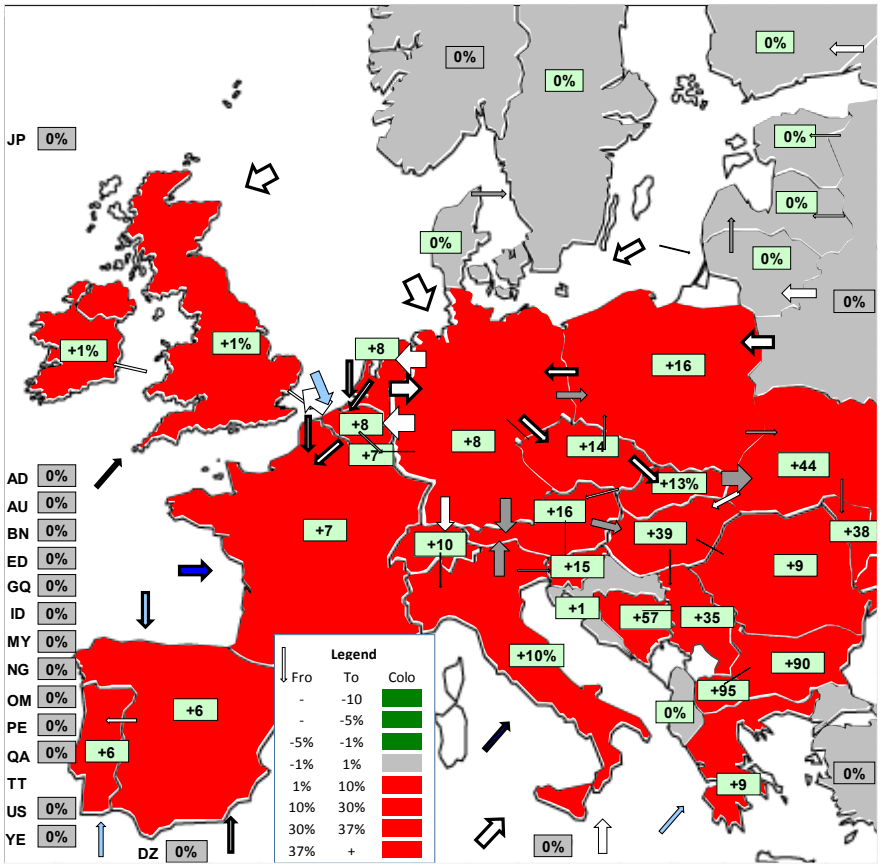
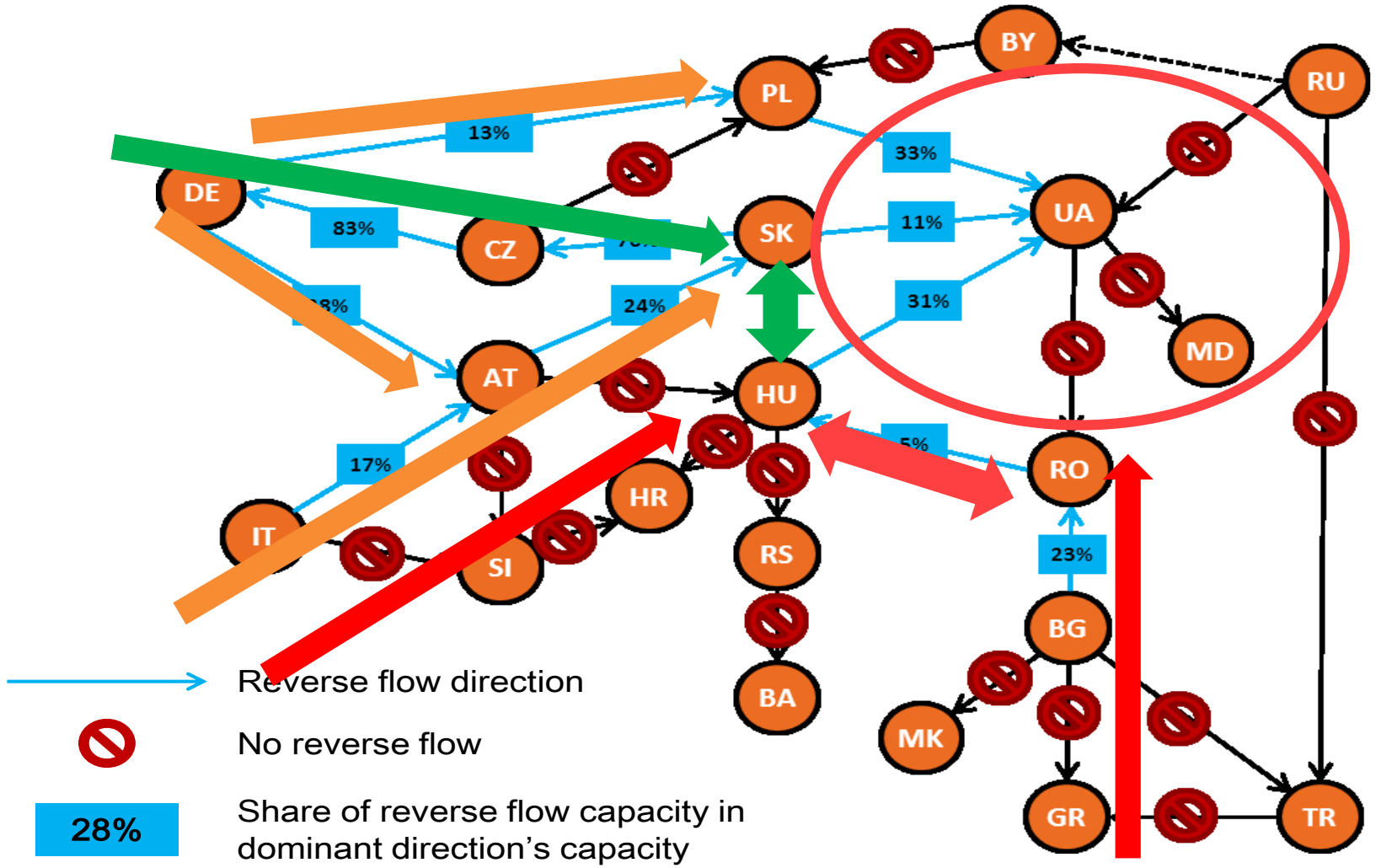
Reference 2015 Prices (€/MWh)



January crisis in reference Price increase (%)



1. Physical reverse flow and new interconnector projects are key



1. Price increase in Europe due to a 100% supply cut in January on all Ukrainian pipelines

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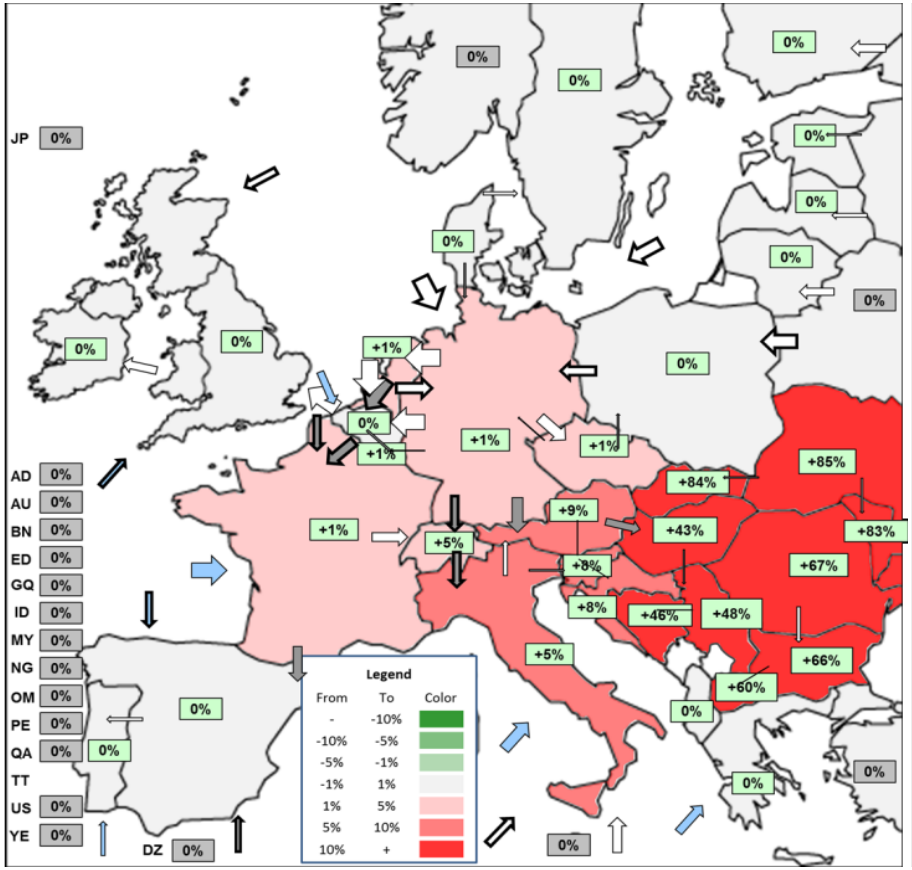
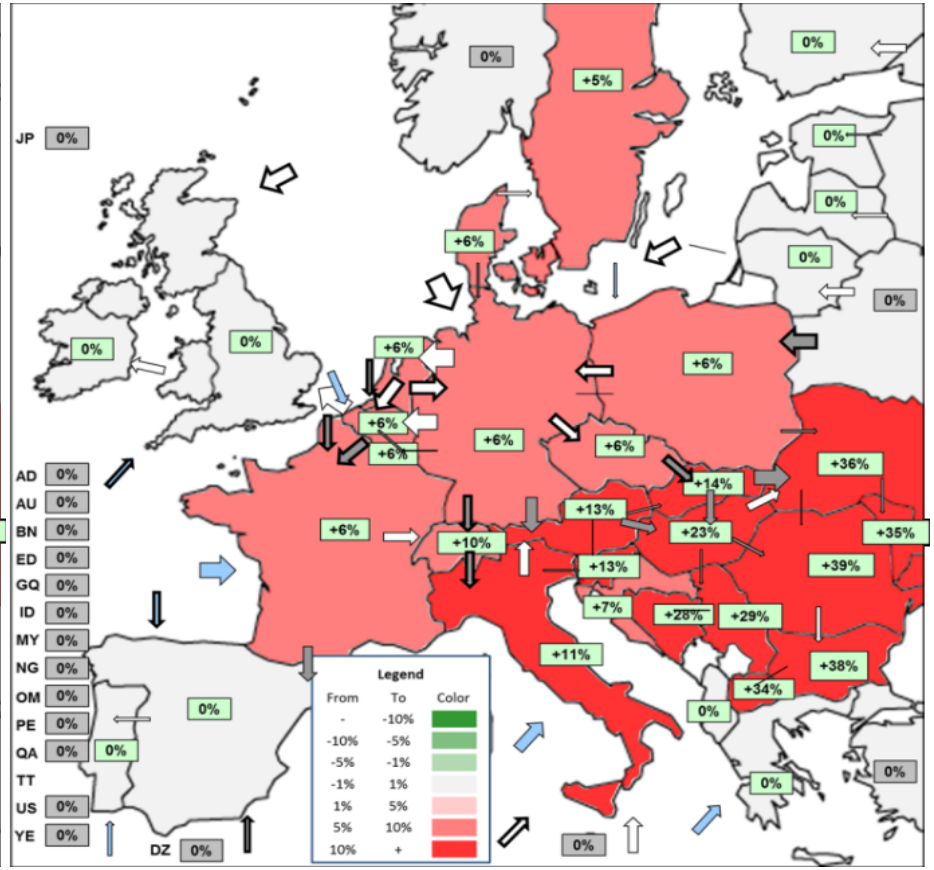
2009 scenario



2015 scenario



1. Price increase in Europe due to a 100% supply cut in January on all Ukrainian pipelines

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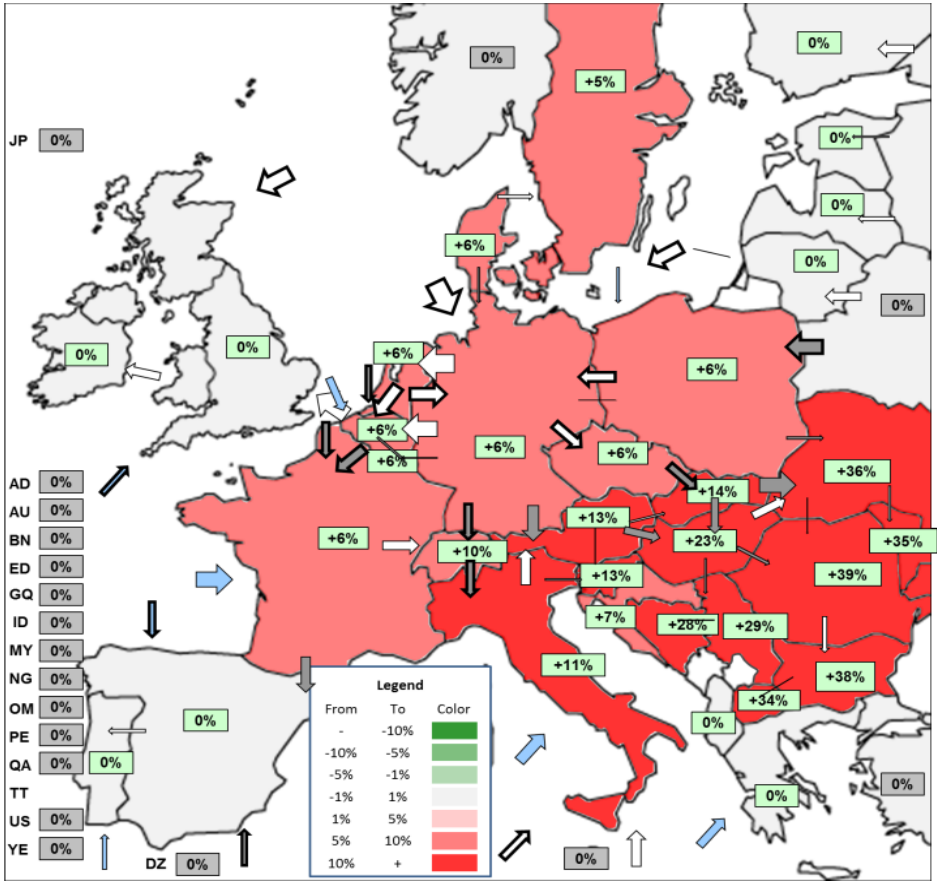
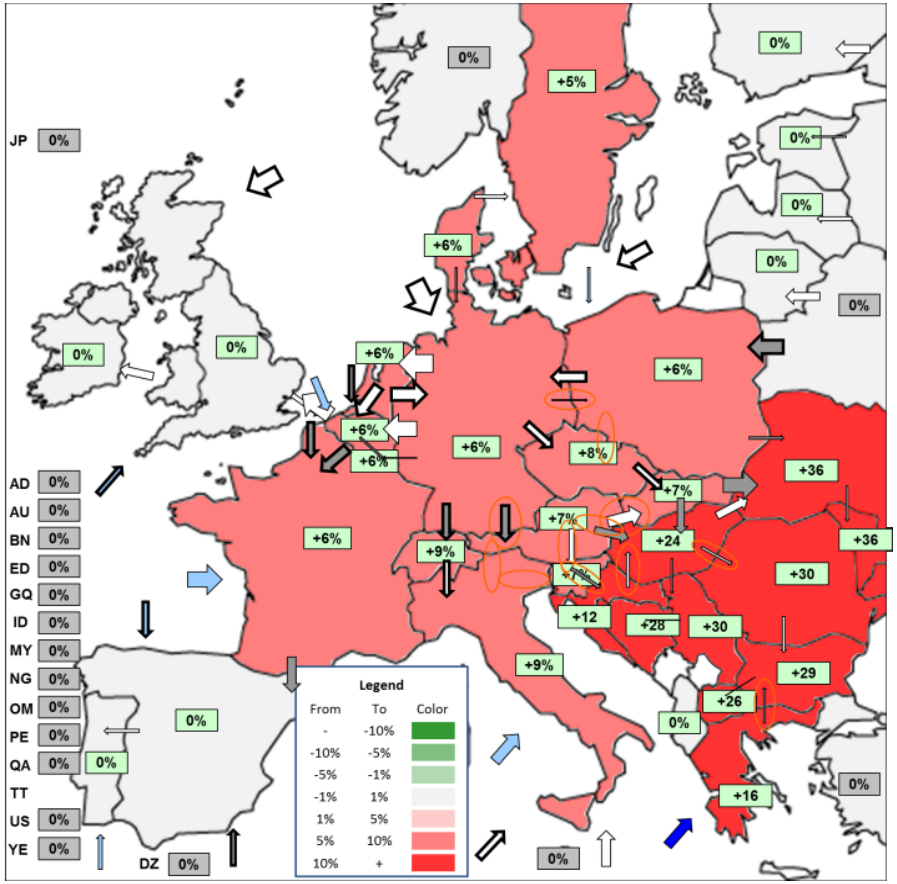
2015 scenario



2015 infrastructure with 100% reverse flow



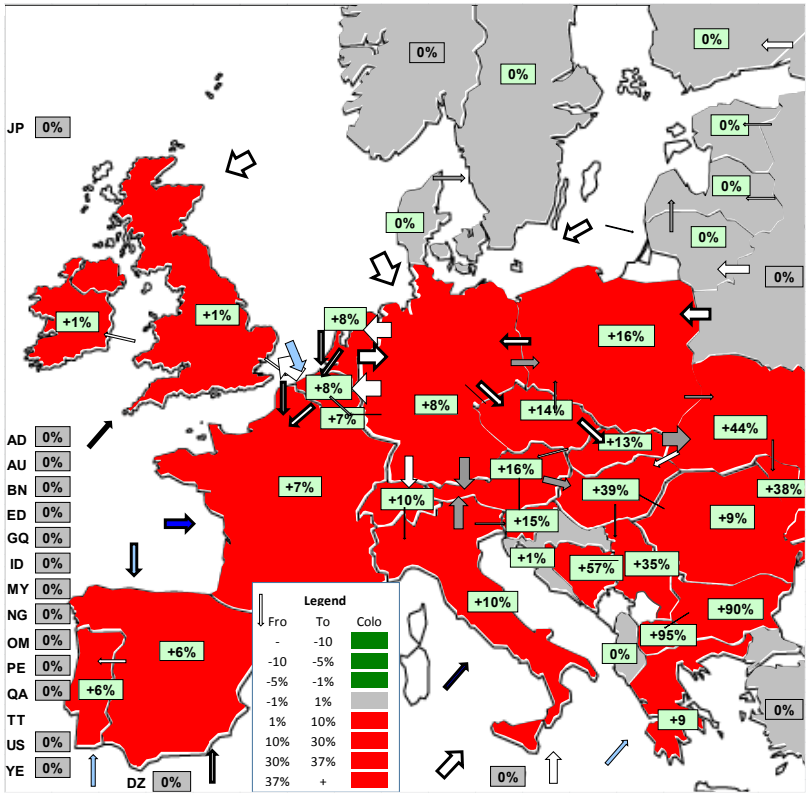
1. Usefulness of additional reverse flows (modelling result)

	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			

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. In the SOS runs, above these two most important projects, three more projects experience flows during the crisis: GR-BG, RO-HU and HR-HU. The rest of the projects' exemption from the reverse flow obligation might be justified.

Source: REKK EGMM® modelling result

2. Modelling a 100% supply cut on all Ukrainian pipelines in January



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 effected 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.

2. Short-term gas PCI projects

A	Short-term projects	(2014 – 2016)		
#	Name 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

2. Short-term PCI projects significantly decrease the damages

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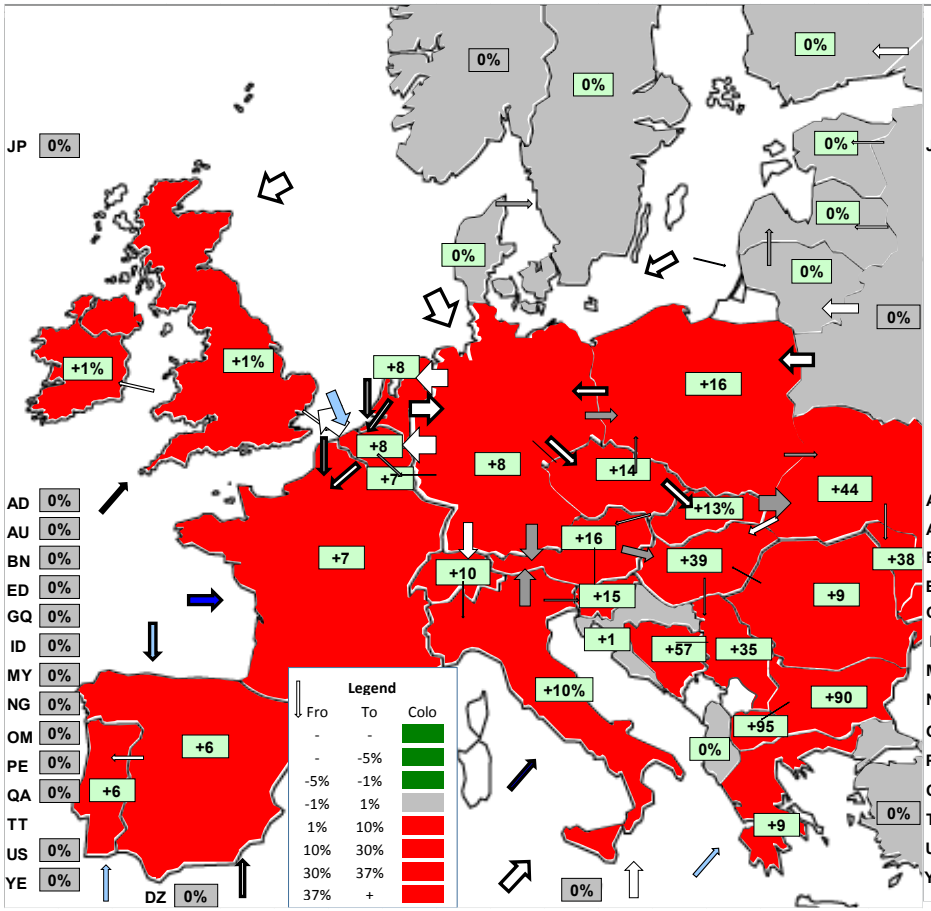
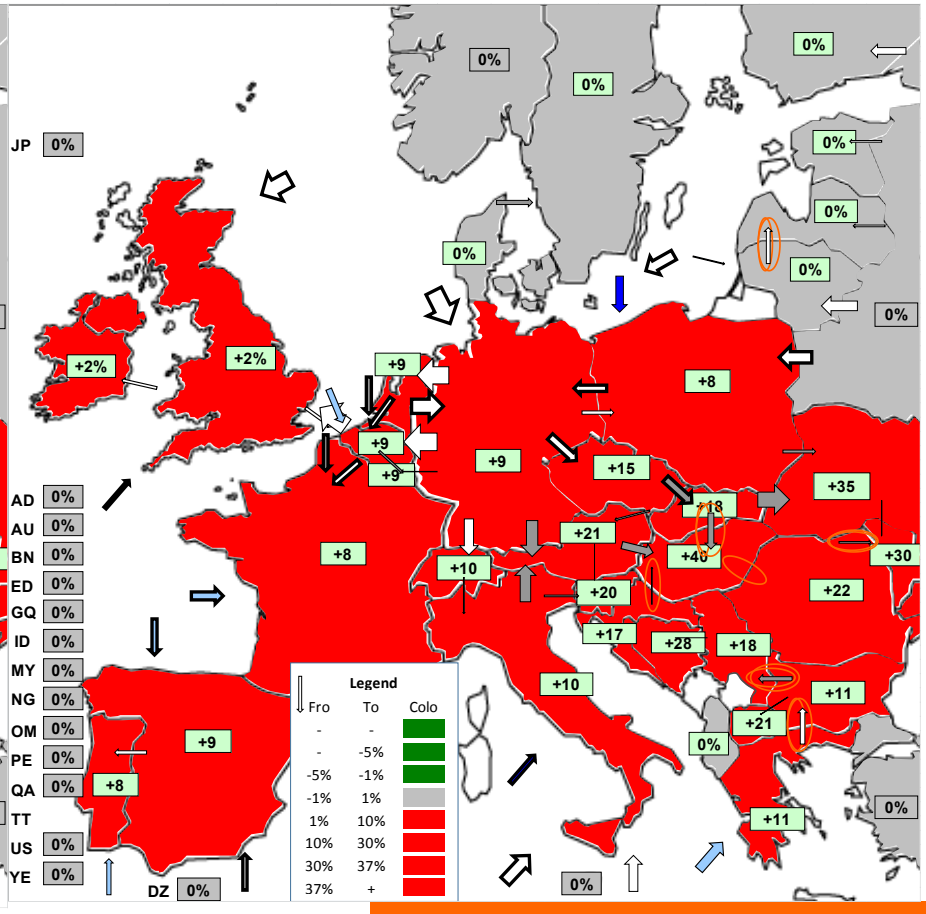
Reference SOS January price increase (%) compared to reference normal scenario



Short term PCI projects January SOS price increase (%)



2. Release of strategic storage stocks in Hungary brings regional benefits

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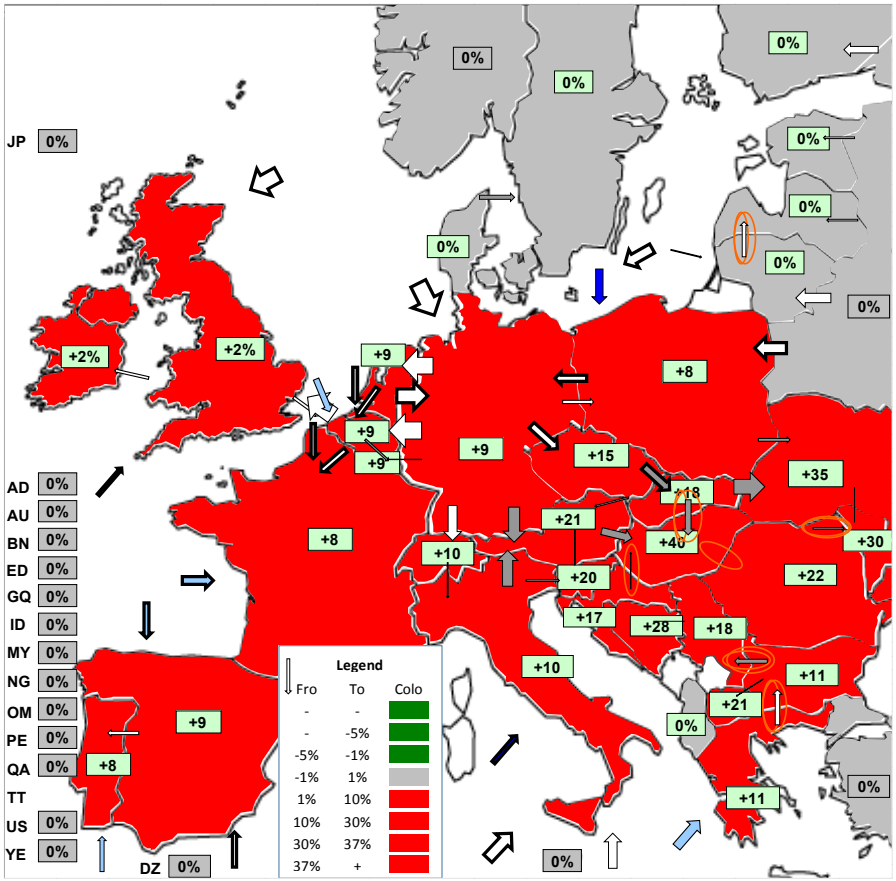
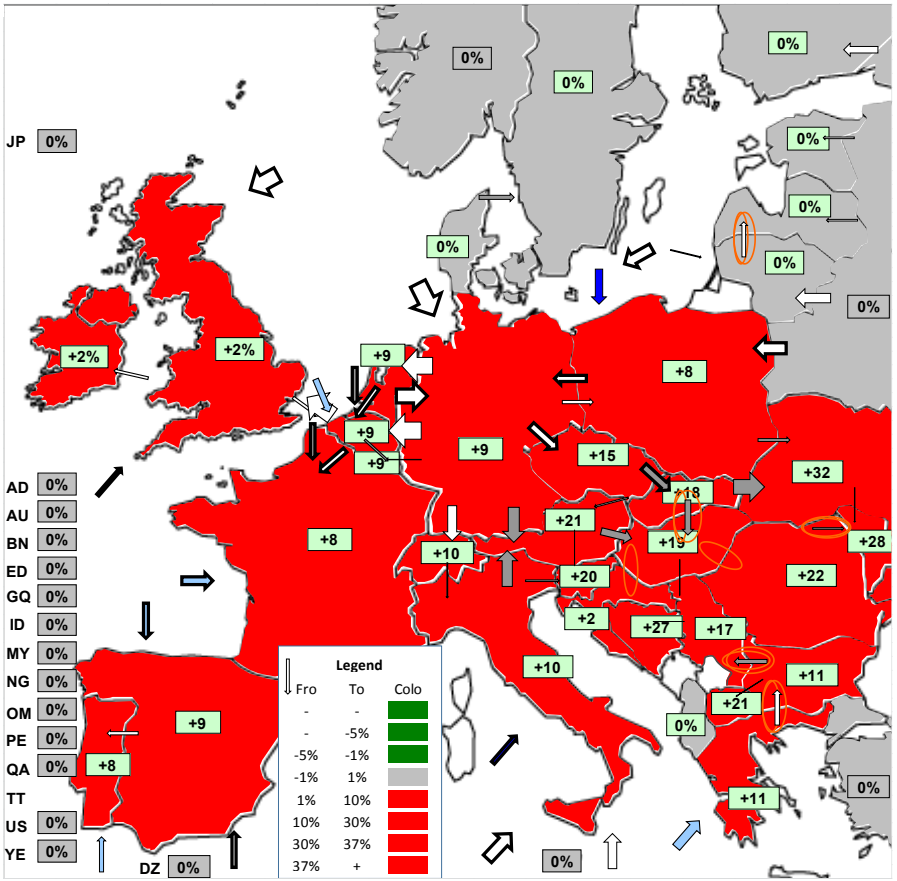
Short term PCI SOS January price increase WITHOUT strategic storage released



Short term PCI SOS January price increase WITH strategic storage released in Hungary



2. Mid-term gas PCI projects

B	Medium-term projects	(2017 – 2020)		
#	Name 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: permitting	526,01 GWh/day (20 bcm/year)	2019
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]

2. Effect of mid-term PCIs

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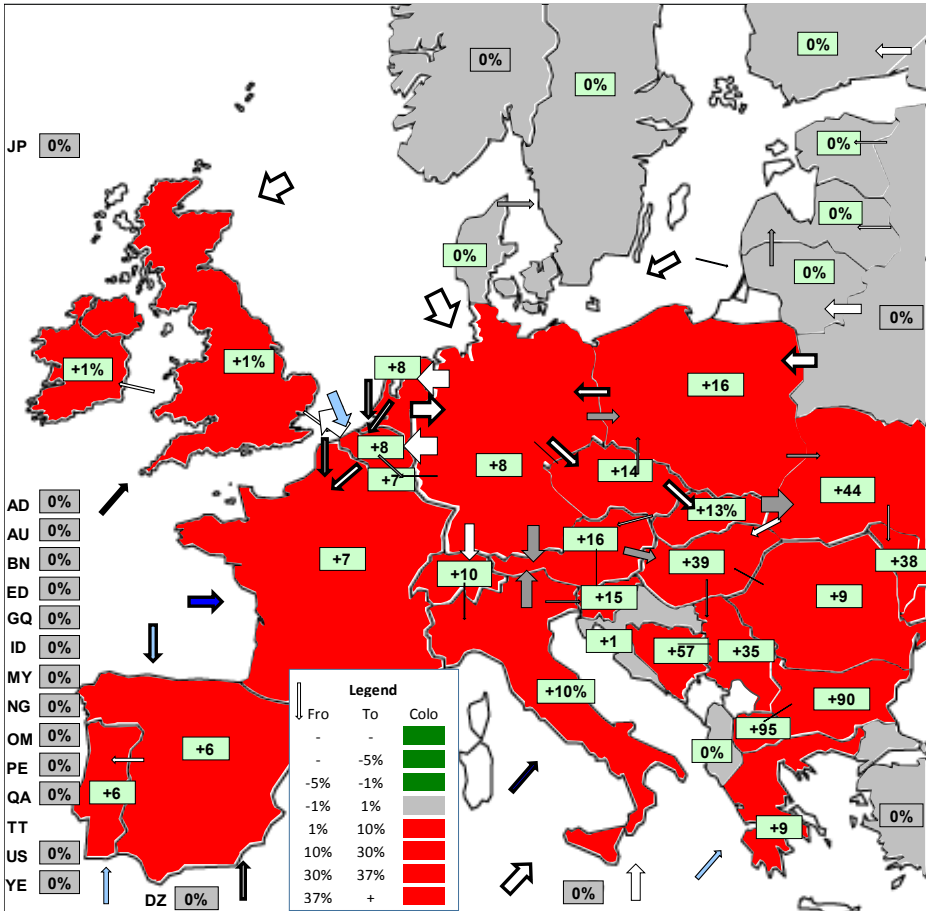
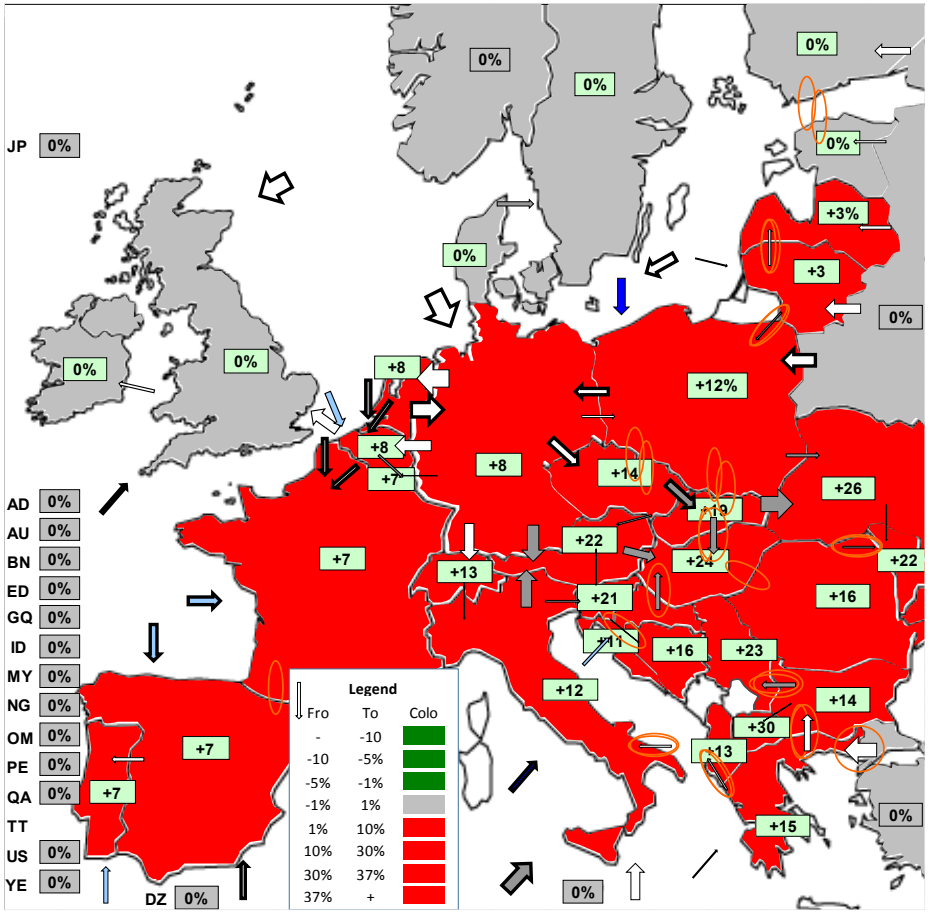
Reference SOS



With mid term PCI projects implemented



2. Summary of PCI projects SOS effect

Price increase compared to normal reference (%)		SOS	SOS reference	Short term_SOS		Mid term_SOS	
Market	Jan (€/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 security of supply shock in winter . (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.)

3. More LNG to Europe

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

- 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
- 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 in use.

Key messages

- Newly built infrastructure in Europe since 2009 has significantly improved gas supply security for Danube Region: 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.

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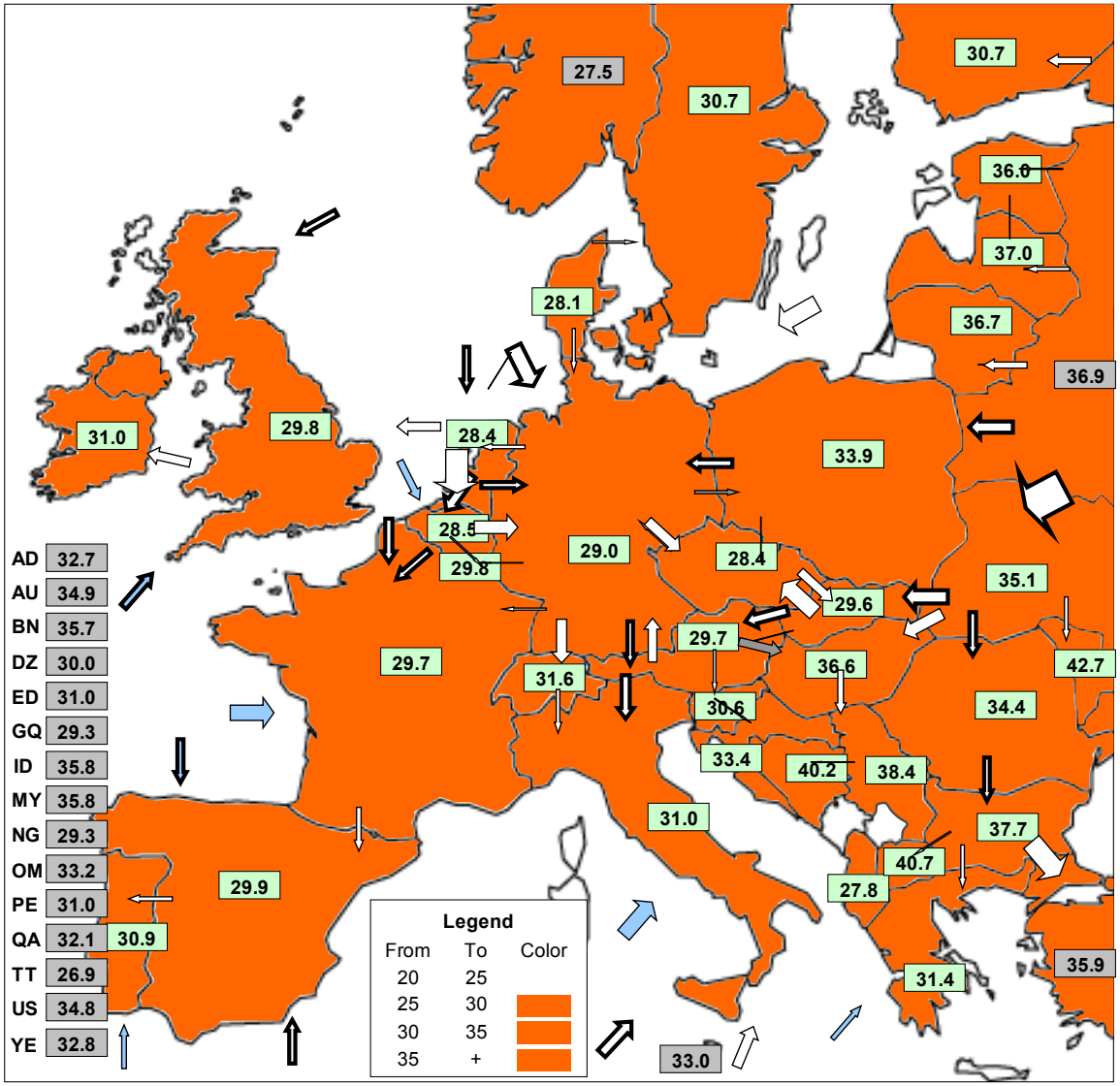
ANNEX:
European Gas Market Model

European Gas Market Model – major characteristics

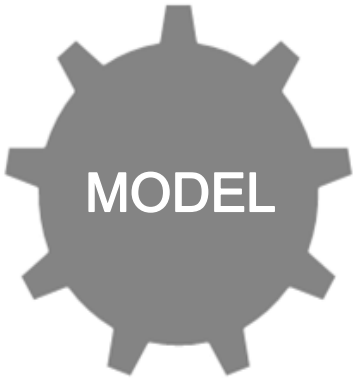


- Whole Europe (35 countries) is modelled
- Competitive prices by countries; 12 months
- Trade is based on long term contracts and spot trade within the EU and with exogenous countries (NO, RU, TR, LNG)
- Natural gas flows and congestions on interconnectors
- Physical constraints are interconnection capacities (transmission tariffs are also included)
- Trade constraints: TOP obligations
- Domestic production and storage facilities are included
- Arrows: modelled gas flows
- LNG market representation is linked to Asian LNG prices

One gas year – 12 months

INPUT

- Demand by countries (annual quantity, monthly distribution)
- Domestic production (annual quantity, minimum and maximum production)
- TOP contract (ACQ/DCQ), flexibility
- Infrastructure: Interconnectors, storage, LNG, tariffs
- External price: for LTC, LNG, NO, TR, RU



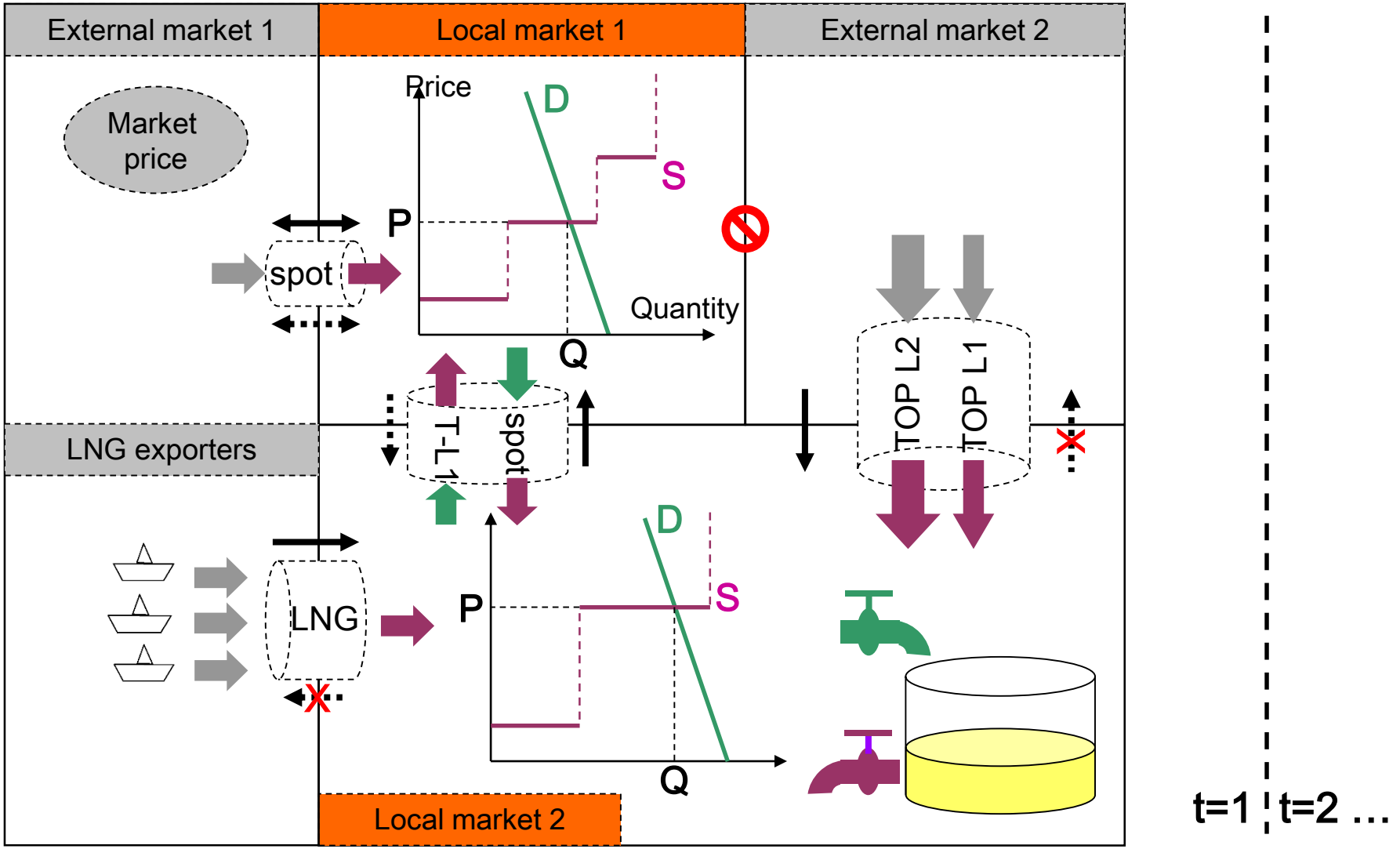
OUTPUT

- Wholesale gas price by country
- Consumption by countries
- Gas flows on interconnectors
- Storage stock change
- Import through long term contracts and spot trade

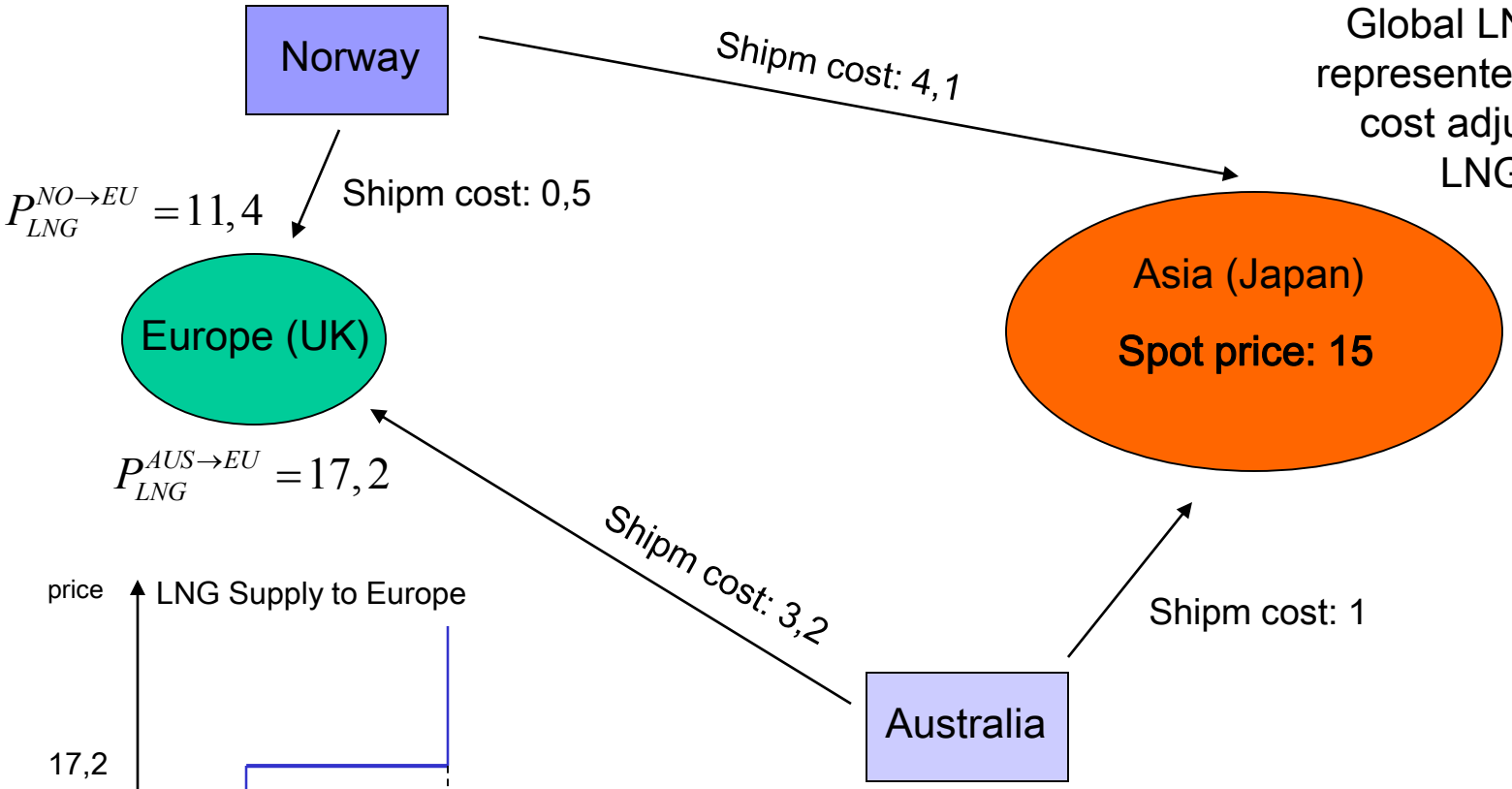
Social welfare:

- Consumer surplus
- Producer surplus
- Storage operation profit
- Storage arbitrage profit
- Net profit from long-term contracts
- TSO auction revenue
- TSO operation profit

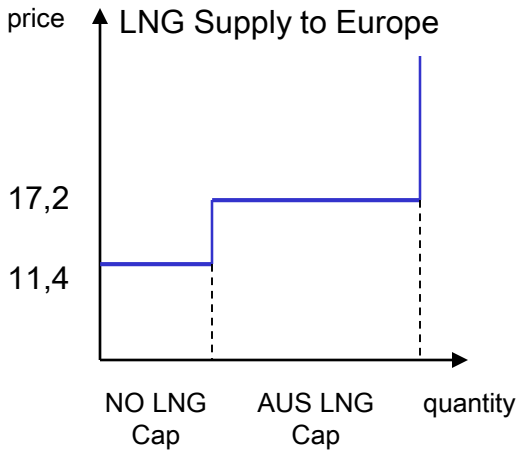
Model scheme



A simple model of spot LNG pricing for Europe (in $/MMBtu)



Global LNG market is represented by shipment cost adjusted Japan LNG prices



$$P_{LNG}^{AUS \to EU} = P_{SPOT}^{ASIA} - C_{SHIPM}^{AUS \to ASIA} + C_{SHIPM}^{AUS \to EU}$$

EGMM references

- Analysis of the CSEE gas storage market; the impact of system use charges on the demand for gas storage capacity (E.ON, 2012) and (MoFA, 2013)
- CBA of PECI projects for the Energy Community (2013)
- Latest significant upgrade supported by FGSZ (Hungarian TSO)(2013)
- The impact of gas infrastructure corridors on the regional gas market (MoFA RoBoGo, March 2014), FGSZ South Stream (April 2014)
- Supply Security analyses related to the Ukrainian crisis (2014, Atlantic Council, EFET, IDDRI)
- Towards2030 - Dialogue
- CBA of PCI projects for the Hungarian Energy and Public Utility Regulatory Authority (2014-2015)
- Measures To Increase The Flexibility And Resilience Of The European Natural Gas Market (2014, IEA)

Key modelling assumptions

- Infrastructure setup in the reference scenario:
  - Existing infrastructure
- Long term contracts
  - Price of LTCs is based on press information and on Quarterly report data
  - Flexibility of LTCs is uniform (30%), except for energy island countries
- New infrastructure is modelled with a uniform 2 €/MWh tariff
- Outside market prices are set exogenously
  - Japanese LNG Price is 27 €/MWh on average (seasonal fluctuation is assumed) LNG suppliers use Japanese price for their netback price
  - Turkish and Russian markets trade only through long term contracts the 50€/MWh price on the border is the spot trade price (we assume that there is no spot trade)
  - Norwegian spot price is 21 €/MWh on average (seasonal fluctuation is also assumed)