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ISSUEBRIEF

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The Impact of US Liquefied Natural Gas Exports on Central and Eastern Europe's Energy Security

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The unfolding political crisis between Ukraine and Russia poses an immediate gas supply security risk for Europe, but especially for Central Eastern Europe (CEE), the Baltic States, and South East Europe (SEE).[1]

A supply cut of Russian gas to the European Union might be due to either unintended developments or to intended actions. An unintended supply cut ("failure") might be caused, for example, by lost control over infrastructure management during an unfolding military conflict between Russia and Ukraine. An intentional supply cut might be caused by a Russian response to Western economic sanctions ("counter-sanction"), or be part of a Western embargo on Russian energy deliveries ("embargo").

The principal difference between the unintended and the intended supply security incidents is that in the case of an unintentional action, we assume that Russia will want to compensate, and that the European Union will be willing to accept compensation for lost gas supplies through Ukraine by increased supplies through alternative routes (Yamal and Nord Stream). In the case of an intentional action, such as an embargo or counter-sanction, we do not expect this to happen.

In this paper we set out a framework for analyzing the potential impacts that non-FTA-approved US liquefied natural gas (LNG) could have on CEE gas supply security in the short term (one year), mid-term (up to 2020), and in the longer term.[2] First, we develop a set of failure- and embargo-type supply security scenarios for CEE, each defined in terms of reduced Russian gas supplies to Europe compared to a 2013 reference case. Next, we quantify the impacts of short- and mid-term scenarios on wholesale gas prices and potential lost load in CEE using the European Gas Market Model (EGMM), developed by the Regional Centre for Energy Policy Research (REKK).[3] Our brief and preliminary analysis of modeling results seeks to determine the supply-disruption scenarios that will influence wholesale natural gas price developments in the European Union and CEE enough to attract US LNG shipments to the European Union on a commercial basis. In the short-term scenarios, US LNG is represented by Kenai LNG in Alaska. In the mid-term scenarios, new US LNG enters the 2014 gas infrastructure overnight. Note that in each scenario, US LNG will compete with alternative non-Russian

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1 In this paper CEE consists of Austria, the Czech Republic, Croatia, Hungary, Poland, and Slovakia. The Baltic States are Estonia, Finland, Lithuania, and Latvia. The SEE consists of Bulgaria, Moldova, Romania, Serbia, and Bosnia Herzegovina.

2 Free trade agreement

3 For a detailed description of the regional EGMM, see: Development and Application of a Methodology to Identify Projects of Energy Community Interest, chapter 5.2 (http://www.energy-community.org/pls/portal/docs/2558181.PDF).

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Table 1: Typology of Supply Security Scenarios for CEE

			Scenario Type			
			Failure			Embargo
			Cut of supplies through Ukraine only	Cut of supplies through Ukraine and Belarus	Cut of supplies through all pipelines to EU	Reduction of supplies through all pipelines to EU
Seriousness			100%	100%	100%	30%
Duration	**Short Term**	1 month (April 2014)*	•	•	•	
		1 month (January 2015)	•	•	•	
		3 months (April to June 2014)				•
		6 months (April to September 2014)				•
		12 months (April 2014 to April 2015)				•
	Mid Term	US LNG entering overnight (April to March)	•	•	•	•
*	Scenario without SK-HU and PL LNG					
	US LNG starts delivering to Europe					

supplies to replace missing Russian gas, thus mitigating the supply shock.

Finally, we propose a preliminary game-theoretic framework to further analyze the longer-term significance of US LNG for CEE gas supply security.

Short- and Mid-term Gas Supply Security Scenarios for CEE

All supply security scenario simulation outcomes are compared to a reference case of EU industry at the end of 2013, represented by supply and demand characteristics and contractual constraints, as well as infrastructure topology and capacity limitations. This infrastructure is expanded with the new Slovakia-Hungary interconnector and Polish LNG receiving terminal in those reference scenarios, with events taking place after June 2014. In the short-term reference case, US LNG is represented by the Kenai terminal.

The supply security scenarios developed for the present analysis are explained in Table 1.

Scenarios differ by type. An unintended supply cut or failure compares closely to the 2006 and 2009 gas crises in CEE, when deliveries through Belarus and Ukraine were reduced by 30 percent and 100 percent, respectively.[4] In case of a failure, we assume that Russia will compensate for lost supplies by shipments on alternatives pipelines up to available capacities. We investigate two alternative short-term failures: a full

4 For a detailed discussion regarding the lessons of the 2009 January gas crisis for CEE, see "The Lessons of the January 2009 Gas Crisis in Central and Eastern Europe," in Jean-Arnold Vinois (ed.), *EU Energy Law, Volume VI, The Security of Energy Supply in the European Union*, Deventer, The Netherlands: Claeys and Casteels (2012), pp. 193–219.

Table 2: Wholesale Price Effect/Loss of Load by a 100 Percent Russian Supply Cut on Different Pipeline Routes in CEE, April 2014 (monthly values)

	CEE regional average price		Price change relative to reference	Loss of load	% of demand served
	(EUR/MWh)	(USD/MMBtu)		mcm	
Reference	28.4	11.48			
Ukrainian pipelines cut	30.5	12.33	7.4%	684	83.0%
Ukrainian and Belarus pipelines cut	32.3	13.06	13.7%	1145	71.1%
All routes from Russia to Europe cut	32.5	13.14	14.4%	1202	69.6%

Table 3: Wholesale Price Effect/Loss of Load and Additional Spot LNG to the EU Prompted by a 100 Percent Russian Supply Cut on Different Pipeline Routes in CEE, January 2015 (monthly values)

		CEE Regional average price		Price change relative to reference	Loss of load	Demand served	Spot LNG shipments to EU	
		EUR/ MWh	USD/ MMBtu	%	mcm	%	TWh/ year	bcf/ year
Without SK-HU and PL LNG	Reference	32.2	13.02				24	81.6
	Ukrainian pipelines cut	36.2	14.64	12.4%	762	89.2%	28	95.2
	Ukrainian and Belarus pipelines cut	44	17.79	36.65%	1373	79.23%	41	139.4
	Everything from Russia to Europe cut	44.4	17.95	37.89%	1511	77.08%	49	166.6
		EUR/ MWh	USD/ MMBtu	%	mcm	%	TWh/ year	bcf/ year
With SK-HU and PL LNG	Reference	32.2	13.02				24	81.6
	Ukrainian pipelines cut	35.3	14.27	9.6%	629	91.2%	31	105.4
	Ukrainian and Belarus pipelines cut	40.4	16.33	25.5%	1189	82.6%	48	163.2
	Everything from Russia to Europe cut	40.8	16.50	26.7%	1382	79.7%	60	204.0

cut in April 2014, and cuts to different pipeline combinations in January 2015.

In the case of a Western embargo, the objective of the action is to reduce dependence on Russian gas supplies. We simulate the impact of a 30 percent decrease in shipments on all Russia-EU pipelines for three, six, and twelve months.

Finally, we develop a mid-term scenario by assuming that the US LNG infrastructure forecasted to come online by 2020 is implemented overnight, *ceteris paribus*.

Analysis of Short- and Mid-term Supply Security Scenarios

First, we model the outcomes of short-term failure situations.

An Unintended Supply Cut in April 2014

In the following we simulate the consequences of a supply cut on all pipelines through Ukraine; on all pipelines from Ukraine and Belarus; and on all pipelines from Ukraine, Belarus, to the Baltic States, and the Nord Stream. First, we assume that 100 percent of the deliveries in April are stopped. The consequences are quantified as a wholesale gas price increase above the reference scenario, which is the normal situation without any supply security problem.

In the April scenario European demand is much lower than in the winter period, but storages are not yet filled.[5]

Compared to the reference, a 100 percent supply cut from Russia in April would result in a 7 to 14 percent price increase in Central Eastern Europe, assuming prices are allowed to rise in order to encourage demand-side adjustment to the supply shock. If, on the other hand, we assume that the reference price (11.5 USD/MMBtu regional average) is unchanged, this would result in a 0.6 to 1.2 bcm non-served demand in CEE (see the last two columns in Table 2). This means that in the worst case, about one-third of the demand would not be served.

On a commercial basis US LNG would not land in Europe. Our model simulates an increase in April spot LNG cargo to 3 TWh from 0 TWh in the reference case, due to a Norwegian delivery to Greece.

5 In April 2014, the 2013 infrastructure is in place; the only addition is that reverse flow on Yamal (German-Polish border) is allowed. It started operation on April 1, 2014.

Table 4: Wholesale Price Effect/Loss of Load in CEE by a 30 Percent Embargo on Russian Natural Gas Exports to the EU for Different Time Periods (2014–15)

	Length of embargo	Reference price	CEE Regional average price in an embargo situation		Price change relative to reference	Loss of load	Demand served
		EUR/MWh	EUR/MWh	USD/MMBtu	%	mcm	%
Without SK-HU and PL LNG	3 months	27	28.1	11.4	4.1%	1093	88.5%
	6 months	26.8	29.2	11.8	9.0%	2744	84.1%
	12 months	28.9	38	15.4	31.5%	25337	49.9%
			EUR/MWh	USD/MMBtu	%	mcm	%
With SK-HU and PL LNG	3 months	26.9	27.9	11.3	3.7%	1070	88.8%
	6 months	26.6	28.8	11.6	8.3%	2667	84.6%
	12 months	28.8	32.1	13	11.5%	23913	54.9%

An Unintended Supply Cut in January 2015

In the January 2015 scenario, demand is peaking in Europe. Injection into storage has been completed in the summer and fall, anticipating normal winter conditions to come. We do not assume that extra strategic storage injections occur; traders decide how much storage they use on a commercial basis, expecting no supply security problems. The infrastructure in January 2015 is extended by the Slovakia-Hungary interconnector and the Polish LNG terminal in Świnoujście. To allow for comparison with the previous table, we also present the results without these new pieces of infrastructure.

Supply cuts in January 2015 would result in sharper wholesale gas price increases (12–38 percent) on an already higher reference monthly price ($13/MMBtu) when compared to the April 2014 cases. At the same time, the amount of lost load does not increase significantly (0.6–1.5 bcm).

It is of little surprise that the Slovakia-Hungary interconnector and the Polish LNG terminal help in mitigating the damages to the region. The Polish LNG terminal delivers only to Poland, and only when the Yamal pipeline is not delivering gas from Russia. Using the LNG terminal at maximum capacity, the price effect on Poland can be reduced from a 92 percent increase to a 58 percent increase. The Slovakia-Hungary interconnector has a more widespread, regional effect. Connecting the cheaper Western Europe with the more expensive Eastern and Southeastern Europe, the average price in Western Europe under the Ukraine cut scenario[6] rises from 4 percent to 6 percent, but in exchange there is significant reduction in Hungary (from 34 percent down to a 19 percent increase), Romania (42 percent to 27 percent), Bulgaria (38 percent to 25 percent), Croatia (22 percent to 7 percent), and Serbia (34 percent to 25 percent).

Not even in the worst-case scenario (all deliveries from Russia stopped for January) would the Alaska LNG from the United States deliver to Europe on a commercial basis, although the yearly LNG flow to Europe (to Poland, Italy, UK, Greece, Spain, and Portugal) would triple from other LNG suppliers. Poland receives only 5 TWh from the 60 TWh total (see Table 3).

A Western Embargo

An intended supply cut means that either Russia is not willing to serve European consumers, or Europe is not willing to accept natural gas deliveries from Russia. With reference to the intention of the European Council to define a policy package to reduce the European Union's dependence on Russian gas supply,[7] we assume an embargo scenario when the European Union reduces its natural gas purchases from Russia by 30 percent on different time horizons. This means that only 70 percent of the Russian contracted quantity will be delivered to Europe. The modeled length of the embargo is three, six, and twelve months.

The results are presented with and without the new Polish LNG terminal and the Slovakia-Hungary interconnector.

The longer an embargo situation lasts, the higher the costs that CEE customers are forced to pay. Average

6 The same price increase remains even under the more-serious supply-cut scenarios. The CEE region's position does not worsen with more-serious failures and consequent supply cuts.

7 During their meeting of March 20–21, 2014, the leaders of EU member states concluded that "The European Council is concerned about Europe's high energy dependency rates, especially on gas, and calls for intensifying efforts to reduce them, especially in the most dependent member states."

Table 5: Spot LNG Flows to Europe in Different Embargo Scenarios

	Length of embargo	Spot LNG flow in reference	Spot LNG flow	Increase in spot LNG flow	Country of origin	Destination
		TWh	TWh	%		
Without SK-HU and PL LNG	3 months	4	5	25%	NO	ES, GR, PT
	6 months	6	9	50%	NO	ES, GR, PT
	12 months	24	69	188%	NG, NO, EG	ES, GR, IT, PT, UK
		TWh	TWh	%		
With SK-HU and PL LNG	3 months	4	7	75%	NO	PL, PT, GR, ES
	6 months	6	11	83%	NO	PL, PT, GR, ES
	12 months	24	82	242%	NG, NO, EG	ES, GR, IT, PT, UK

yearly prices of the region might be up to 29–38 EUR/MWh (12–15.5 USD/MMBtu), which is a 4 to 31.5 percent relative price increase. The new Slovakia-Hungary interconnector would have the same effect that it has in the January 2015 scenario: Connecting CEE to the Western European market redistributes the costs of the embargo more evenly among the European states; however, it is still far from equal. A one-year embargo would even affect Spain (3 percent price increase), which remains untouched in the less-serious scenarios due to its relative isolation and good LNG connectivity. Most Western European member states would suffer close to a 9 to 10 percent price increase. Even in this extreme case, no LNG would arrive from Alaska on a commercial basis.

Table 5 indicates the growth of spot LNG deliveries in the different embargo scenarios. The Polish LNG is served in all cases only by Norwegian spot LNG (above its long-term contract from Qatar). In the three-month embargo scenario, a third of the total EU spot LNG is shipped from Norway to Poland. As the embargo persists and gas prices in Western Europe grow higher, LNG from larger distances becomes competitive—first from Egypt (EG) to Greece (GR), and then from Nigeria (NG).

Note that improved interconnectivity (Slovakia-Hungary interconnector) eliminates extreme price differences among EU regions, allowing additional LNG shipments to more easily reach CEE markets.

The Mid-term: Western Embargo under Increased US LNG Export Potential

In order to get a better understanding of the likely longer-term impacts of increased US LNG export potentials on CEE gas supply security, we model a scenario in which we assume the anticipated US investments for 2020 come online *overnight*. We essentially ask: To what extent could US LNG mitigate the supply shock caused by a failure or an embargo in 2014–15 if those expanded capacities were already in operation?

As of March 2014, the US Department of Energy has approved LNG export terminals of over 8 bcf/day capacities, with those close to 40 bcf/day still seeking approval. However, most reports estimate that the United States will settle at a level of 5 to 7 bcf/day by the end of the decade.[8] A majority of the early US LNG is contracted to utilities in India, Japan, and Korea, which will be competitive in the growing Asian LNG spot market, and exert pressure on oil indexed contracts in Asia as long as Henry Hub prices remain low.[9] We assume in our modeling, therefore, that by the end of the decade, Japanese LNG prices will decrease by 3 to 4€/MWh. We also assume that about 30 percent of the US LNG capacity will be available for spot trade.

Our simulation results suggest that no LNG from the expanded capacities would arrive from the United States to the European Union on a commercial basis under normal supply and demand conditions, or in the case of a supply cut of all deliveries only through Ukraine.

However, deliveries would start to land in Europe in the event of a twelve-month, 100 percent cut of both Ukrainian routes and Yamal. Under this scenario, 38 TWh US LNG would arrive to the UK, and 0.7 TWh to Poland.

In the 30 percent, twelve-month embargo scenario, only 3 TWh US LNG would arrive to the UK (Figure 1, on the right).

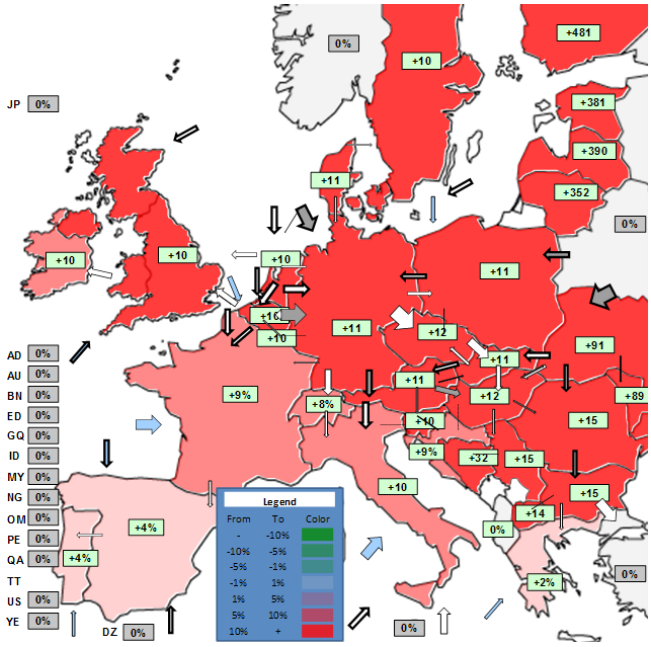
Apparently, the present EU gas infrastructure would not allow for shipping alternative gas supplies to the

8 See reports: ICF International, EIA AEO 2014, CSIS, Peterson Institute for International Economics, Michael Levi (CFR).

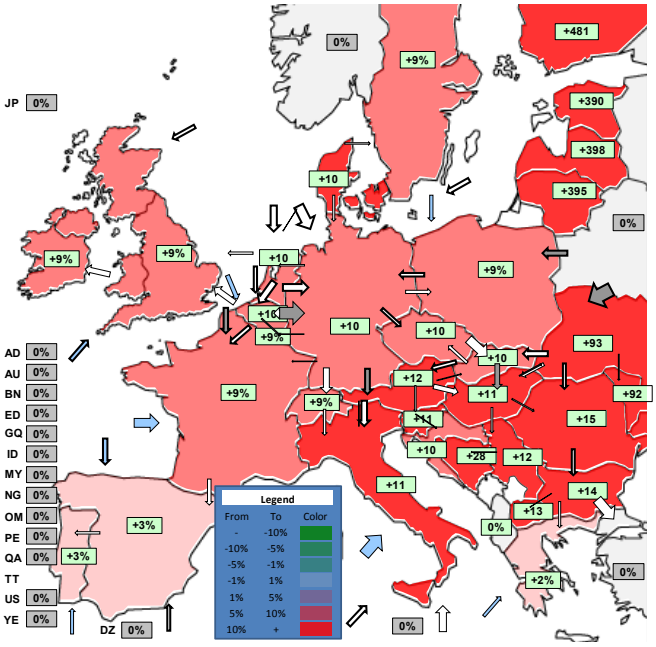
9 Sabine Pass, Dominion Cove Point, and Cameron LNG.

Figure 1: EU Price Increase in a 30 Percent, Twelve-month Embargo Situation (compared to a 2013 reference)

With 2014 infrastructure:



With 2014 infrastructure plus new 7 bcf/day US LNG export capacity and Panama Canal:



Baltic States and Finland, essentially leaving these countries without gas. Otherwise, increased US LNG shipments could significantly reduce the cost of a Western embargo for the European Union.

However, the measurable improvement in Europe's position has to be interpreted cautiously. In this simulation, new US LNG is coming online simultaneously with the Panama Canal expansion, which changes the calculation of other global LNG suppliers. At the end of the decade, the Trans Adriatic Pipeline (TAP) is also scheduled to start deliveries from Azeri sources. In the end, all of these supply sources will compete with US LNG deliveries to Europe.

Understanding the long-term impacts of US LNG exports to the European Union

In the unfolding crisis between Russia and the Western allies, the question of who controls the supply of natural gas to the European Union might become a source of conflict. This is because, as we saw above, both Russia and the European Union potentially could impose a huge cost on each other by strategically manipulating gas supply quantities and prices.

Let us assume that both Russia and the European Union consider a strategic cut in gas supplies between one another. From the Russian side, the reason might be to destabilize Ukraine or respond to Western sanctions against Russia. From the European Union's side, the purpose of the cut is to impose a high cost on Russia[10] for its behavior in the Crimea. Both parties are rational, and will make their decision based on the expected net benefit of their actions.

The costs and benefits of a counter-sanction

The costs of a counter-sanction for Russia are the immediate loss of revenue from lost gas sales, and the loss of a future EU gas market share due to increased efforts on the EU side to diversify away from Russian gas. The benefit of a counter-sanction for Russia is the expected damage this might cause to the affected countries in the form of lost load and related GDP loss, and an increased gas bill for CEE/EU.[11] Costs and benefits of a counter-sanction will be realized with a certain probability, with the value between 0 and 1. We might assume this probability to be increasing, with a growing benefit/cost ratio from the Russian point of view.

The costs and benefits of an embargo

The costs and benefits of the embargo case are very similar to the counter-sanction case, but with opposite signs. The benefit of an embargo to the European Union is the damage or cost Russia will incur. This damage consists of the immediate loss of revenue from lost gas

10 Since mid-March 2014 President Barack Obama has frequently warned that Russia will pay the cost of any military maneuvers it launches in Ukraine.

11 In this analysis we disregard other costs and benefits.

sales, and the loss of a future EU gas market share due to increased efforts on the EU side to diversify away from Russian gas. The cost of an embargo for the European Union is the expected damage this might cause to the EU countries in the form of lost load and related GDP loss, and an increased gas bill for CEE/EUW. Costs and benefits of an embargo will be realized with a certain probability, with the value between 0 and 1. We might assume this probability to be increasing, with a growing benefit/cost ratio from an EU perspective.

For future research we propose to apply the above game-theoretic approach, and to investigate the role that US LNG exports to the European Union can play in changing the expected payoffs for Russia and the European Union under different strategies. US LNG exports might increase CEE supply security by either physically replacing missing Russian gas, and/or by directly or indirectly moderating gas prices in the European Union. This will decrease the expected benefit of a counter-sanction for Russia, thus reducing the probability of such an action. The latter result can already be achieved by the credible threat that LNG can—and will—reach Europe in the case of a counter-sanction. It can also reduce the cost of an EU embargo, thus increasing the European Union's willingness to take part in one.

For illustrative purposes, we estimate that the increased gas cost for the European Union in the case of a twelve-month, 30 percent embargo with existing US LNG export capacity will be around €10.8 Bn (see the scenario in Figure 1). In addition, the Baltic States and Finland would essentially lose their entire gas supply. At the same time, lost revenue from gas sales would be as high as €18.7 Bn for Russia. Additional costs would come from an accelerating loss of its remaining market share in the European Union.

Conclusions

In this paper we simulate the likely impacts of different gas supply security scenarios on CEE by the European Gas Market Model of REKK. We found that monthly CEE wholesale gas prices would increase by 7 to 14 percent in the case of a monthlong unintended supply cut in April 2014, depending on the pipelines affected. If the same event took place in January 2015, the likely monthly average price increase would be 12 to 38 percent for CEE.

Once the European Union decides to carry out an embargo on Russian gas in the form of a 30 percent reduction in purchases for three, six, or twelve months, the consequent price increase becomes more dramatic, and ranges from 4 to 32 percent, depending on the length of the embargo.

As the embargo lasts longer and the gas price in Western Europe grows higher, LNG from Norway, Egypt, and Nigeria becomes competitive. We find that on a commercial basis, US LNG exports have no chance to respond to the current Ukrainian crisis, either directly, via LNG shipments to Europe, or indirectly, in the form of improved global liquidity.

Nonetheless, a policy decision of allowing US LNG exports to the European Union might have far-reaching positive impacts on CEE gas supply security in the mid- and long term. The potential mechanisms through which a positive impact might materialize are the following:

- In case of the risk of physical gas shortage, US shipments could be contracted (perhaps above market price) for delivery to West European terminals (e.g., Rotterdam) and transported to the CEE region.
- US export liberalization policy could decrease the credibility of the threat that a counter-sanction by Russia would seriously hurt CEE. This might in and of itself reduce the probability of such an action on the Russian side.
- In case of an unfolding "gas battle" between the European Union and Russia, the resulting price spikes will attract US LNG deliveries on a commercial basis to the EU market, given that the Panama Canal expansion is completed.
- In addition, US LNG exports to Asia might decrease Asian LNG prices, thus making the European Union more attractive for spot LNG. This will put more immediate price pressure on Russia, and help CEE pricewise.

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