

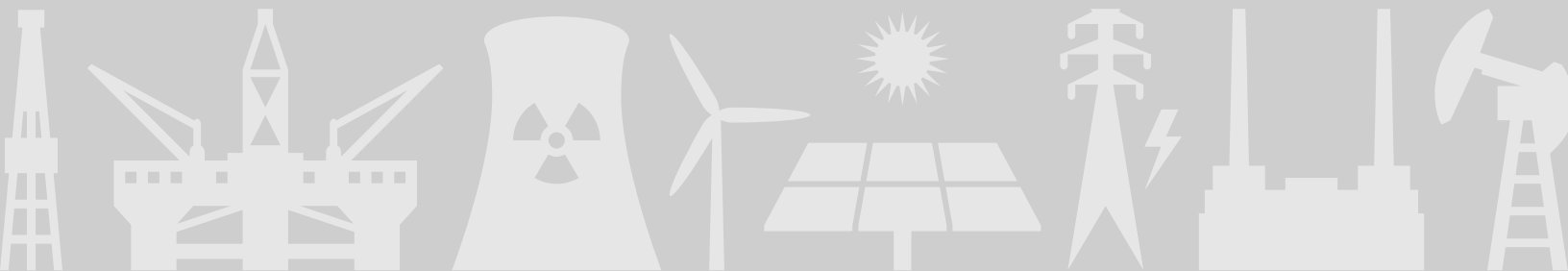


# AMERICAN GAS TO THE RESCUE?

THE IMPACT OF US LNG EXPORTS ON EUROPEAN SECURITY  
AND RUSSIAN FOREIGN POLICY

By Jason Bordoff and Trevor Houser

**SEPTEMBER 2014**



## ABOUT THE CENTER ON GLOBAL ENERGY POLICY

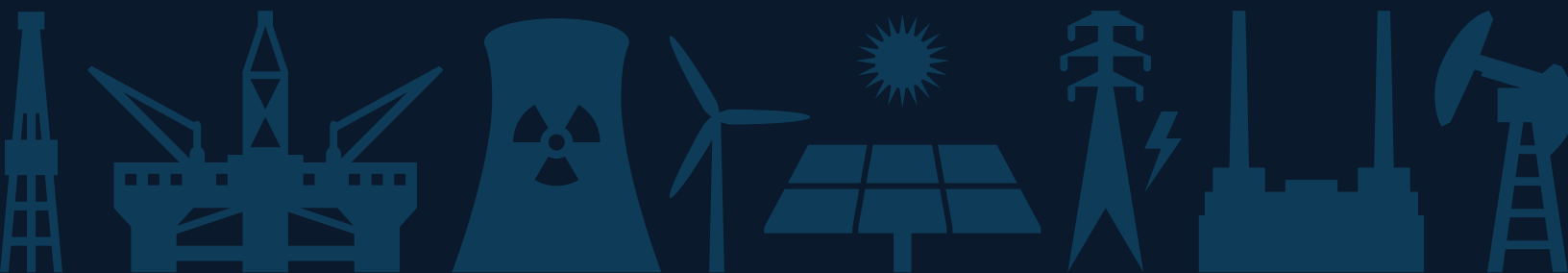
The Center on Global Energy Policy provides independent, balanced, data-driven analysis to help policymakers navigate the complex world of energy. We approach energy as an economic, security, and environmental concern. And we draw on the resources of a world-class institution, faculty with real-world experience, and a location in the world's finance and media capital. Visit us at [energypolicy.columbia.edu](http://energypolicy.columbia.edu)

 [facebook.com/ColumbiaUEnergy](https://facebook.com/ColumbiaUEnergy)

 [twitter.com/ColumbiaUEnergy](https://twitter.com/ColumbiaUEnergy)

## ABOUT THE SCHOOL OF INTERNATIONAL AND PUBLIC AFFAIRS

SIPA's mission is to empower people to serve the global public interest. Our goal is to foster economic growth, sustainable development, social progress, and democratic governance by educating public policy professionals, producing policy-related research, and conveying the results to the world. Based in New York City, with a student body that is 50 percent international and educational partners in cities around the world, SIPA is the most global of public policy schools. For more information, please visit [www.sipa.columbia.edu](http://www.sipa.columbia.edu)





# AMERICAN GAS TO THE RESCUE?

THE IMPACT OF US LNG EXPORTS ON EUROPEAN SECURITY  
AND RUSSIAN FOREIGN POLICY

By Jason Bordoff and Trevor Houser\*

**SEPTEMBER 2014**

\***Jason Bordoff**, a former White House energy adviser to President Barack Obama, is a professor and the founding director of the Center on Global Energy Policy at Columbia University. **Trevor Houser**, partner at the Rhodium Group (RHG) and visiting fellow at the Peterson Institute for International Economics, formerly served as a Senior Advisor at the US State Department.

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK



## ACKNOWLEDGEMENTS

For exceptional research assistance, the authors wish to thank Akos Losz and Shashank Mohan. For very helpful comments on earlier drafts of this paper, the authors thank Edward Morse, Laszlo Varro, Stephen Sestanovich, Timothy Frye, Jonathan Stern, Carlos Pascual, Nick Butler, John Knight, Edward Kott, James Henderson, and Charif Souki. The authors thank Matthew Robinson for excellent editorial work.

## EXECUTIVE SUMMARY

As Western governments have responded to Russia's continued efforts to destabilize Ukraine, the potential for US natural gas exports to inflict economic pain on Moscow and undermine its influence in Europe have made for some eye-catching headlines—try searching the Internet for “hit Putin where it hurts” or “get Putin's attention” for a sampling. To cut through the hyperbole surrounding this issue, the Columbia University Center on Global Energy Policy undertook a study that provides a cool-headed examination of the impact of US LNG exports on European energy security and Russian foreign policy. The key findings include:

- The US shale gas boom has already helped European consumers and hurt Russian producers by expanding global gas supply and freeing up liquefied natural gas (LNG) shipments previously planned for the US market. This has strengthened Europe's bargaining position, forcing contract renegotiations and lowering gas prices. US LNG exports will have a similar effect.
- Over the long term, US exports, along with growth in LNG supply from other countries such as Australia, will create a larger, more liquid and more diverse global gas market. This will increase supply options for Europe and other gas consumers, and give them even more leverage in future negotiations with Russia and other producers. Maximizing the benefits of this opportunity, however, requires changes in European policy and infrastructure that focus on reducing vulnerability to Russian supply disruption, not only dependence on Russian gas overall.
- While there are important longer-term benefits for Europe from US LNG exports, they are not a solution to the current crisis. Those terminals already approved will not be online for sever-

al years. Terminals pending approval, if constructed, will not be available until after 2020.

- Although US LNG exports increase Europe's bargaining position, they will not free Europe from Russian gas. Russia will remain Europe's dominant gas supplier for the foreseeable future, due both to its ability to remain cost-competitive in the region and the fact that US LNG will displace other high-cost sources of natural gas supply. In our modeling we find that 9 billion cubic feet per day (93 billion cubic meters per year) of gross US LNG exports results in only a 1.5 bcf/d (15 bcm) net addition in global natural gas production.
- By forcing state-run Gazprom to reduce prices to remain competitive in the European market, US LNG exports could have a meaningful impact on total Russian gas export revenue. While painful for Russian gas companies, the total economic impact on state coffers is unlikely to be significant enough to prompt a change in Moscow's foreign policy, particularly in the next few years.

---

# TABLE OF CONTENTS

ACKNOWLEDGEMENTS .....	2	<i>US LNG projects will displace higher cost projects elsewhere, limiting supply growth</i>	
EXECUTIVE SUMMARY .....	3	<i>Central and Eastern Europe lack infrastructure to receive LNG volumes</i>	
INTRODUCTION .....	6	<i>Russia's revenues from gas exports are low and provide little leverage for the West</i>	
AMERICA'S NATURAL GAS TURNAROUND .....	8		
US domestic gas boom redirects global LNG supplies			
Rising gas production will make the US a major LNG exporter			
EUROPE'S NATURAL GAS DILEMMA .....	12		
Europe remains heavily dependent on Russian pipeline gas supplies			
Russia-Ukraine disputes over gas prices threaten supply stability			
THE BENEFITS OF THE US SHALE GAS BOOM .....	16	THE EUROPEAN SIDE OF THE LEDGER .....	35
Global supply boost helped Europe renegotiate some gas contracts		Invest in infrastructure for Central and Eastern Europe	
Retroactive compensations costly for Gazprom		Apply EU competition law to promote an integrated European gas market	
European Commission antitrust probe could force major contract changes		Expand Europe's underground gas storage capacity and pooled reserves	
US LNG exports may head to Asia, but consumer benefits are global		Increase European gas development	
Low cost of US brownfield LNG projects allow US terminal operators to offer better contract terms for buyers		Create incentives to boost energy efficiency and cut gas demand	
US LNG contract terms may create flexibility and liquidity in global market			
Europe has significant spare LNG import capacity to take more supply		CONCLUSION .....	42
MODELING THE EFFECT OF FUTURE US LNG SUPPLY .....	25	APPENDIX I .....	43
Europe sees biggest economic gains from US LNG, while Russia the most pain		Model documentation	
Several factors will mute the impact of US LNG on European energy security		APPENDIX II .....	46
<i>Exports of US LNG are years away from start up</i>		Gazprom Gas Deliveries by Country	
		NOTES .....	47
		BIBLIOGRAPHY .....	55
		BOXES	
		Spot versus oil-indexed prices in Europe .....	16
		The Russia-China gas deal .....	19
		Implications of US LNG exports for Asian gas markets .....	20
		Modeling.....	25
		The importance of South Stream .....	37

## FIGURES

Figure 1: US natural gas production and prices.....	8
Figure 2: Net US natural gas imports .....	9
Figure 3: Natural gas prices by region .....	10
Figure 4: The relative role of natural gas .....	12
Figure 5: Share of total US and EU energy consumption met through imported gas .....	13
Figure 6: Share of 2012 EU energy demand met through imported gas, by country .....	13
Figure 7: EU natural gas imports by supplier .....	14
Figure 8: European gas prices, spot vs. Gazprom .....	18
Figure 9: Wholesale gas price formation of traded natural gas volumes .....	20
Figure 10: European LNG import capacity and utilization.....	24
Figure 11: European LNG Import capacity vs. Russian gas imports .....	24
Figure 12: Change in annual natural gas expenditures by value .....	26
Figure 13: Change in annual natural gas expenditures by percent.....	26
Figure 14: Change in annual natural gas export revenue by value.....	27
Figure 15: Change in annual natural gas export revenue by percent.....	27
Figure 16: Impact of US LNG on European gas suppliers ....	29
Figure 17: Impact of 9 bcf/d of US LNG exports on global gas supply .....	30
Figure 18: Impact of 18 bcf/d of US LNG exports on global gas supply .....	30
Figure 19: Marginal cost of natural gas suppliers to Europe .....	31
Figure 20: Russian government revenue from natural gas exports.....	34
Figure 21: Russian long-term contract gas prices to European countries 2010-2013 .....	38
Figure 22: Energy intensity in selected economies in the EU and FSU regions .....	41

## TABLES

Table 1: Proposed US LNG export terminals .....	11
Table 2: Renegotiations of gas supply contracts with Gazprom .....	17
Table 3: US LNG export terminals with firm investment plans .....	28
Table 4: Russia-Europe pipeline capacity .....	32
Table 5: Proposed Central and Eastern European LNG import terminals .....	33
Table 6: The significance of oil and gas exports to the Russian economy .....	34

## MAP

Map 1: Gazprom's natural gas export pipeline system to China .....	19
Map 2: The Ukrainian and the Yamal-Europe gas pipeline system.....	36
Map 3: The Blue Stream and the proposed South Stream pipelines.....	37

## INTRODUCTION

In the last several months, as Western governments have put in place sanctions in response to Russia's takeover of Crimea and continued efforts to destabilize Ukraine, the question of the role energy has played in the crisis has been raised frequently, both in terms of the cause of the crisis but also as a solution. In particular, policymakers and experts have asked if the recent surge in US natural gas production could be used to achieve the twin objectives of inflicting economic pain on Moscow and undermining its influence in Europe by providing the region an alternative source of energy supply to Russian gas. The resulting discussion has suffered from a bit of hyperbole—try searching the Internet for “hit Putin where it hurts” or “get Putin's attention” for a sampling.<sup>1</sup> As Washington considers further actions to respond to Russian aggression, including potential changes to US energy export policy, and Europe looks for ways to weaken Moscow's energy leverage, a cool-headed examination of the potential impact of US liquefied natural gas (LNG) exports is required. This paper aims to provide such an examination.

In short, we find that the US shale gas boom has already helped European and other gas consumers and hurt Russian gas producers by freeing up LNG imports the United States was projected to need before the advent of the shale revolution. Even though European LNG imports have declined in recent years, and Russian exports have reached all-time highs, the additional global gas supply that has resulted from the US shale boom has strengthened Europe's bargaining position with Russian suppliers. US LNG export terminals already approved and under development will continue to improve that negotiating power and provide the region with more supply options. Additional LNG terminals, were they to be approved, financed, and constructed, would have an even greater effect, especially if coupled with much-needed policy and infrastructure changes by Europe.

There are a number of reasons for US policy makers and the public to support US LNG exports. By 2020, the global natural gas market is likely to look quite different than it does today. While LNG supply is relatively tight currently, a significant increase in global supply projected by the end of the decade will create a more liquid, diverse global gas market. The United States, along with Australia, will play a key role in that transformation, particularly given the lack of destination clauses in at least some, if not most, US LNG export contracts. This will allow for more competition in the global market, putting downward pressure on prices and giving gas-importing nations more leverage with traditional suppliers.

While these are important long-term benefits for Europe, US gas will not provide a solution to the current crisis for at least three reasons. First, those US LNG terminals already approved will take years to come online, and the terminals still pending approval would not be available until after 2020.

Second, even in the longer term, while US LNG exports can increase European negotiating leverage, they will not free Europe from Russian gas, as much of the recent rhetoric has suggested. In our modeling, the amount of European gas imports from Russia is little changed by US LNG exports. That is not only because of long-term contract obligations, but also because Russian gas will likely remain the most economically competitive source of gas into European markets. Moreover, Russian supply is still needed as US LNG exports add much less to global gas supply on net than the gross quantity exported. Rising US gas exports will push down world prices and crowd out other higher cost sources of natural gas supply. Thus, in our modeling we find that 9 billion cubic feet per day (93 billion cubic meters per year)<sup>2</sup> of gross US LNG exports results in only a 1.5 bcf/day (15.5 bcm) net addition to global natural gas supply.



## While US LNG exports can increase European negotiating leverage, they will not free Europe from Russian gas, as much of the recent rhetoric has suggested.

Third, while US LNG exports could have a meaningful impact on Russian gas revenue and on state-run Gazprom by lowering prices, gas revenue is a small share of the country's overall export revenue and even smaller share of GDP. As such, the economic pain imposed on Russia by US LNG exports is unlikely to be significant enough to prompt a change in its foreign policy, particularly in the next few years.

While US LNG exports help support European energy security, there are even more important steps Europe can take itself to reduce Russian leverage. These include expanding pipeline and storage capacity, boosting domestic energy production, increasing energy efficiency, and continuing to promote an integrated, liberalized European energy market. Realistically such efforts should be aimed at reducing vulnerability to short-term Russian supply disruptions rather than attempting to eliminate Russian gas imports all together.

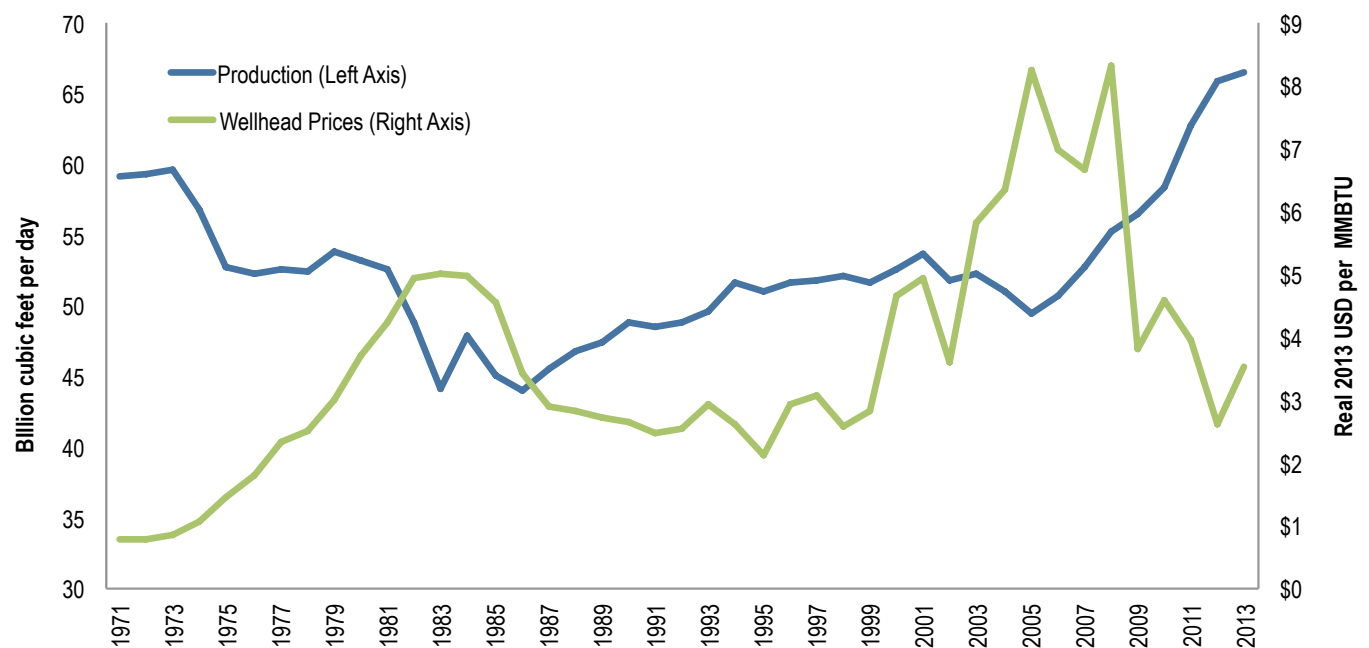
## AMERICA'S NATURAL GAS TURNAROUND

### US DOMESTIC GAS BOOM REDIRECTS GLOBAL LNG SUPPLIES

The combination of three technological innovations revolutionized natural gas production in the United States over the past decade. Hydraulic fracturing allowed companies to extract gas from shale and other low permeability formations previously considered inaccessible. Horizontal drilling increased the amount of shale that can be “fracked” from a single well pad. Improvements in seismic imaging gave companies far better information on where to drill. A surge in natural gas prices in the early 2000s prompted companies to begin applying these three innovations at scale in the Barnett, Haynesville, and Fayetteville shale deposits—and the result was dramatic. Proven natural gas reserves have grown by more than 50% since 2005, and

production has expanded by 17 bcf/d (175 bcm), or 34%, due almost entirely to output from shale plays<sup>3</sup> (Figure 1). This production growth resulted in a sharp decline in natural gas prices, from \$8 per mmBtu on average in 2008 at the wellhead to an average of \$2.7 per mmBtu in 2012—the lowest annual level since 1999—before rebounding to a mid-\$4 per mmBtu range.<sup>4</sup> As US natural gas prices fell and global oil prices remained high, producers began applying the same combination of horizontal drilling, hydraulic fracturing, and seismic imaging to liquids-rich shale formations. Drilling activity in the US gradually shifted from gas-rich to liquids-rich shale plays, such as the Bakken and the Eagle Ford. However, natural gas output has continued to expand thanks to the associated gas extracted alongside oil in these areas, the development of the

**Figure 1: US natural gas production and prices**



Source: Bureau of Economic Analysis, 2014; EIA Natural Gas Gross Withdrawals and Production, 2014.

vast Marcellus shale gas play in the Northeast, and efficiency gains that have lowered production costs.<sup>5</sup>

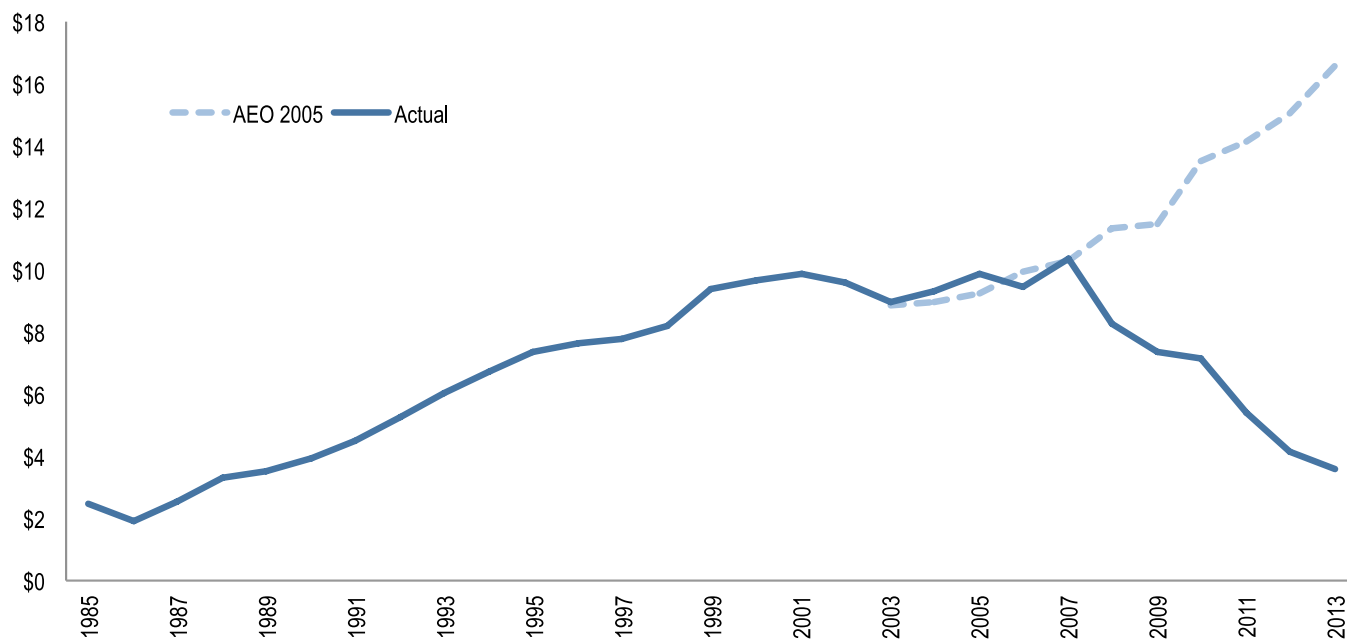
This dramatic growth in production has resulted in a sharp drop in the US energy trade deficit. Not long ago, the United States was the world's largest natural gas importer. At 10 bcf/d in 2005 (103 bcm), net imports accounted for 16% of US natural gas consumption.<sup>6</sup> Most US gas imports were supplied through pipelines from Canada, but the United States was also projected to become one of the largest importers of liquefied natural gas (LNG).<sup>7</sup>

In its 2005 Annual Energy Outlook (AEO), the US Energy Information Administration (EIA) projected net US natural gas imports would grow to almost 17 bcf/d (175 bcm)<sup>8</sup> by 2013 (Figure 2). Expectations were that the vast majority of this import growth would be met with LNG. In the 2005 AEO, US LNG imports were projected to reach 9.7 bcf/d (100 bcm) by 2013—nearly as much as the current 10.3 bcf/d (106 bcm) of LNG exports by Qatar,

the world's top LNG exporter.<sup>9</sup> In anticipation of growing US demand for imported gas, companies constructed 11 LNG importing terminals along the US Gulf Coast and East Coast,<sup>10</sup> and LNG exporters around the world, particularly in Angola and Qatar, invested in new liquefaction capacity to supply the growing US market.

By 2013, however, net US natural gas imports had fallen to 3.7 bcf/d (38 bcm) thanks to the shale boom, the lowest level since 1989,<sup>11</sup> and are now half Japan's levels and less than Germany's or Italy's.<sup>12</sup> Net imports accounted for only 5% of total consumption, compared to the 29% forecast by the EIA in 2005, almost none of which came from LNG.<sup>13</sup> The 9.4 bcf/d (97 bcm) of LNG the US was projected to import by 2013 is now available for other global consumers. This is a significant realignment in the context of a global LNG trade of 31 bcf/d (322 bcm)<sup>14</sup> and came as the Fukushima disaster in 2011 significantly increased Japanese LNG demand as nuclear power plants were taken off line.<sup>15</sup>

**Figure 2: Net US natural gas imports**  
Billion cubic feet per day



Source: EIA Annual Energy Outlook 2005, Monthly Energy Review, 2014.

## RISING GAS PRODUCTION WILL MAKE THE US A MAJOR LNG EXPORTER

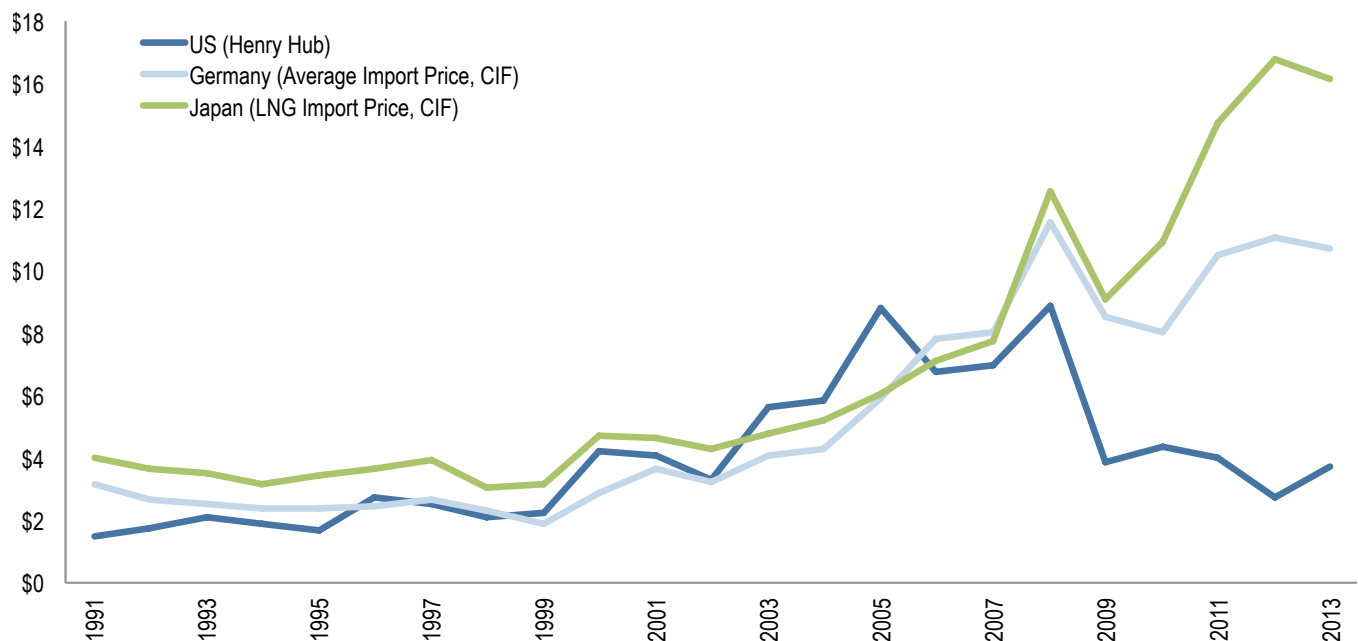
In addition to eliminating the need for LNG imports, the US is now in a position to become one of the world's largest LNG exporters. In 2005, US natural gas prices at Henry Hub were higher than what European or Japanese importers paid for LNG (Figure 3). By 2013, Henry Hub prices were less than one-third of European levels and less than one-quarter of Japanese levels.<sup>16</sup> The average spread between US Henry Hub and Japanese LNG import prices in 2013 was more than \$12 per mmBtu. The International Energy Agency in its World Energy Outlook 2013 estimated liquefaction and transport costs from the US Gulf Coast to Japan at \$5 to \$8 per mmBtu, which would imply a healthy \$4 to \$7 per mmBtu arbitrage opportunity.<sup>17</sup> These potential profits have spurred interest from a number of companies to build LNG export terminals, in many cases by repurposing idle LNG import facilities.

The DOE must find that such importation or exportation is “consistent with the public interest.”<sup>18</sup> For coun-

tries with which the United States has signed a free trade agreement (FTA) exports are automatically “deemed consistent with the public interest.”<sup>19</sup> The Federal Energy Regulatory Commission (FERC) must also approve the LNG terminal itself, and is charged with assessing and mitigating any environmental or public safety concerns posed by terminal construction or operation.

As of July 2014, the DOE received 43 applications for permission to export LNG from a total of 34 proposed terminal projects (Table 1).<sup>20</sup> Almost all of these applications have been approved for FTA countries. Yet of the 18 countries with which the United States has an FTA requiring national treatment for trade in natural gas,<sup>21</sup> only six—South Korea, Singapore, Mexico, Canada, Chile, and the Dominican Republic—currently import LNG, with Korea accounting for more than 79% of the total demand from that group in 2013.<sup>22</sup> Korea's 5.2 bcf/d (54 bcm) LNG import market is relatively large, but not nearly enough to absorb all US gas exports.<sup>23</sup> Therefore, access to non-FTA countries—

**Figure 3: Natural gas prices by region**  
USD per mmBtu



Source: BP Statistical Review of World Energy 2014.

especially those in Asia where demand is rapidly growing—is considered essential to making US LNG projects viable, and most companies also have applied for permission to export to non-FTA countries. As of August 2014, the DOE had conditionally approved seven projects with a combined 10.5 bcf/d (109 bcm) of export capacity for sale to non-FTA countries, and FERC had authorized three, totaling 5.7 bcf/d (59 bcm).<sup>24</sup> DOE recently eliminated conditional approvals from its national interest determination process.<sup>25</sup> DOE will

now consider whether to give final approval to any project that has received final FERC authorization—the intention being to allow commercial considerations to signal to DOE which projects are most viable. If the projects conditionally approved by the DOE were to be built, the US would be vying with Australia to be the world’s second largest LNG exporter after Qatar, depending on the timing and ramp-up of liquefaction plants in Australia.<sup>26</sup> Another 27 bcf/d (279 bcm) of US LNG capacity is still pending approval.

**Table 1: Proposed US LNG export terminals**

Terminal Project	Location	Non-FTA Capacity (Bcf/d)	DOE FTA Application Status	DOE Non-FTA Application Status	FERC Application Status
Sabine Pass LNG Train 1-4	LA	2.2	Approved	Approved	Approved
Freeport LNG	TX	1.8	Approved	Approved	Approved
Cameron LNG	LA	1.7	Approved	Approved	Approved
Lake Charles LNG	LA	2.0	Approved	Approved	Filed
Dominion Cove Point LNG	MD	0.77	Approved	Approved	Filed
Jordan Cove LNG	OR	0.8	Approved	Approved	Filed
Oregon LNG	OR	1.25	Approved	Approved	Filed
Gulf LNG	MS	1.5	Approved	Under Review	Filed
Elba Island LNG	GA	0.35	Approved	Under Review	Filed
Excelerate LNG	TX	1.38	Approved	Under Review	Filed
Golden Pass LNG	TX	2	Approved	Under Review	Filed
Corpus Christi LNG	TX	2.1	Approved	Under Review	Filed
CE FLNG, LLC	LA	1.07	Approved	Under Review	Filed
Magnolia LNG	LA	1.08	Approved	Under Review	Filed
Sabine Pass LNG Train 5-6	LA	1.38	Approved	Under Review	Filed
Louisiana LNG	LA	0.28	Pending Approval	Under Review	Filed
Gulf Coast LNG	TX	2.8	Approved	Under Review	Not Filed
Carib Energy	-	0.06	Approved	Under Review	Not Filed
Main Pass Energy Hub	Gulf of Mexico	3.22	Approved	Under Review	Not Filed
Waller LNG Services	TX	0.19	Approved	Under Review	Not Filed
Pangea LNG	TX	1.09	Approved	Under Review	Not Filed
Gasfin Development	LA	0.2	Approved	Under Review	Not Filed
Venture Global LNG	LA	0.67	Approved	Under Review	Not Filed
Eos LNG	LA	1.6	Approved	Under Review	Not Filed
Barca LNG	LA	1.6	Approved	Under Review	Not Filed
Delfin LNG	Gulf of Mexico	1.8	Approved	Under Review	Not Filed
Texas LNG	TX	0.27	Approved	Under Review	Not Filed
SB Power Solutions	-	0.07	Approved	Not Filed	Not Filed
Advanced Energy Solutions	FL	0.02	Approved	Not Filed	Not Filed
Argent Marine Management	AL	0.003	Approved	Not Filed	Not Filed
Annova LNG	TX	0.94	Approved	Not Filed	Not Filed
Strom Inc.	-	0.02	Pending Approval	Under Review	Not Filed
Venture Global LNG	LA	0.67	Pending Approval	Under Review	Not Filed
Alturas LLC	TX	0.2	Pending Approval	Not Filed	Not Filed
SCT&E LNG	LA	1.6	Pending Approval	Not Filed	Not Filed

Source: DOE and FERC, current as of July 31, 2014.

## EUROPE'S NATURAL GAS DILEMMA

### EUROPE REMAINS HEAVILY DEPENDENT ON RUSSIAN PIPELINE GAS SUPPLIES

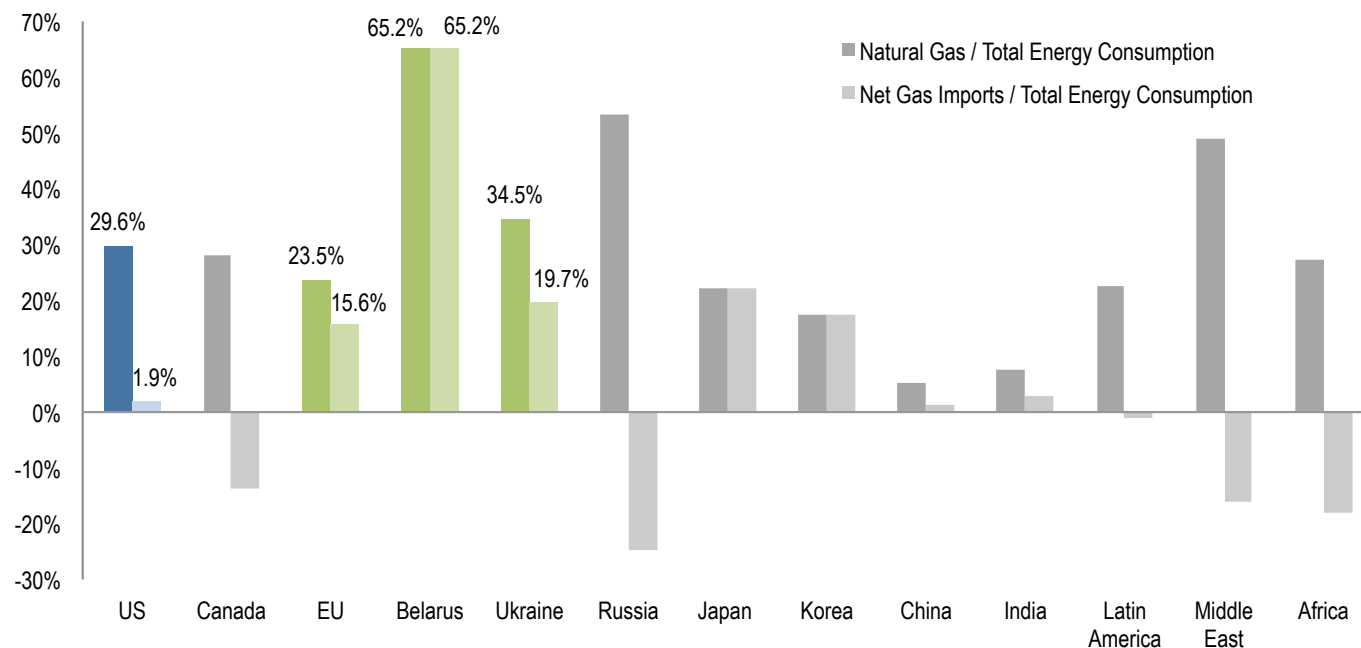
Europe's natural gas position stands in stark contrast to that of the US. The 28 member states of the European Union (EU) are slightly less natural gas dependent on average than the United States, with 24% of total energy consumption supplied through natural gas, compared to 30% in the US (Figure 4). The share of total EU energy demand met through imported gas is considerably higher, however, 15% for the EU compared to 2% for the United States in 2013. And while US dependence on imported gas has fallen from a high of 5% of total energy consumption in 2002, European dependence on gas

imports has grown over the past decade, up from 12% in 2002 (Figure 5).

Within the EU dependence on imported natural gas varies widely by country (Figure 6). Italy meets a third of its energy needs with imported natural gas, while Lithuania is closer to 38%, according to Eurostat data.<sup>27</sup> Germany is slightly above the EU average at 19%, while France is slightly below at just under 15%. Denmark and the Netherlands, on the other hand, are natural gas exporters.

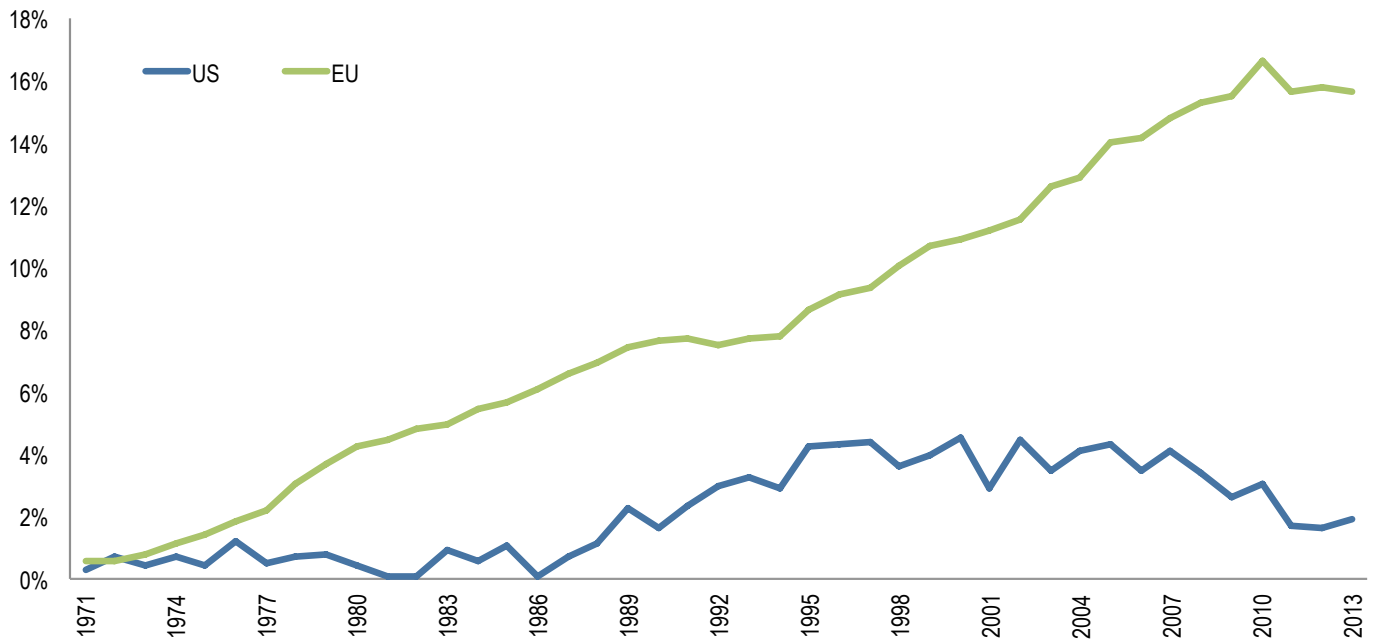
Of the two-thirds of total EU natural gas demand met through net imports in 2013, nearly 90% came by pipeline (Figure 7).<sup>28</sup> Russia is the largest single source of Eu-

**Figure 4: The relative role of natural gas**  
Total gas and imported gas as a share of total energy consumption, 2013



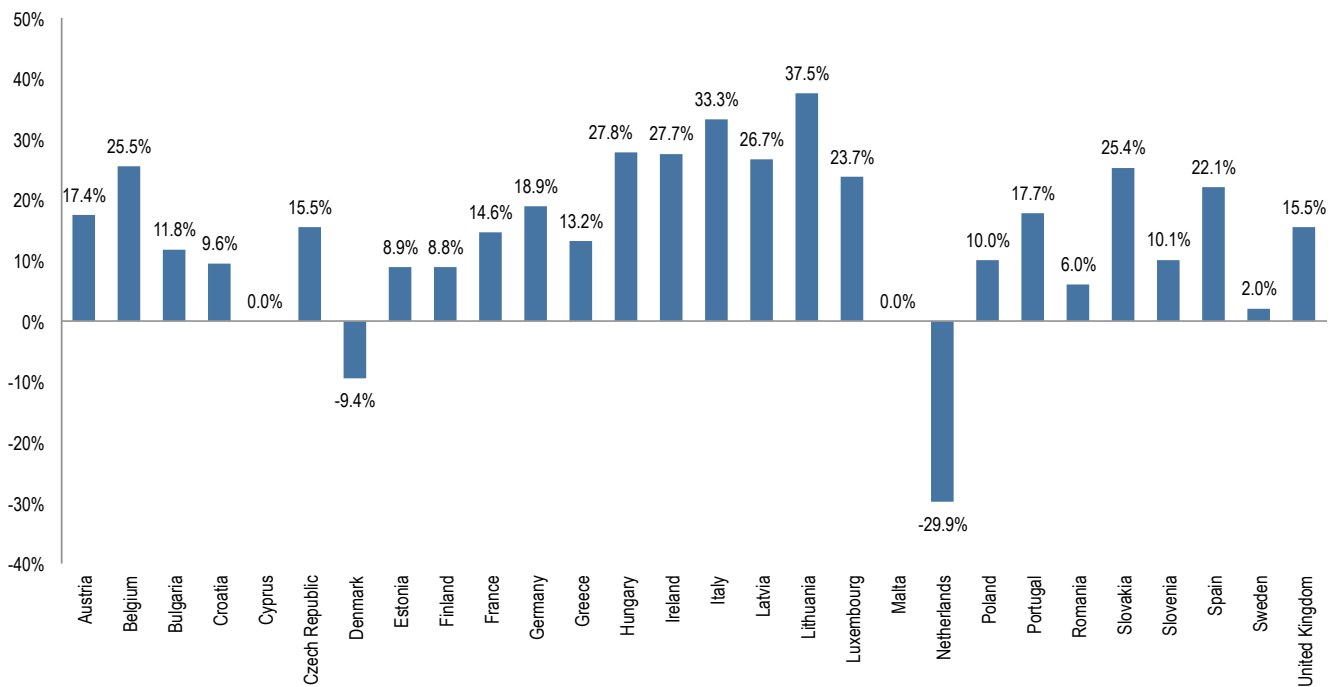
Source: BP Statistical Review of World Energy 2014.

Figure 5: Share of total US and EU energy consumption met through imported gas



Source: BP Statistical Review of World Energy 2014.

Figure 6: Share of 2012 EU energy demand met through imported gas, by country



Source: Eurostat.

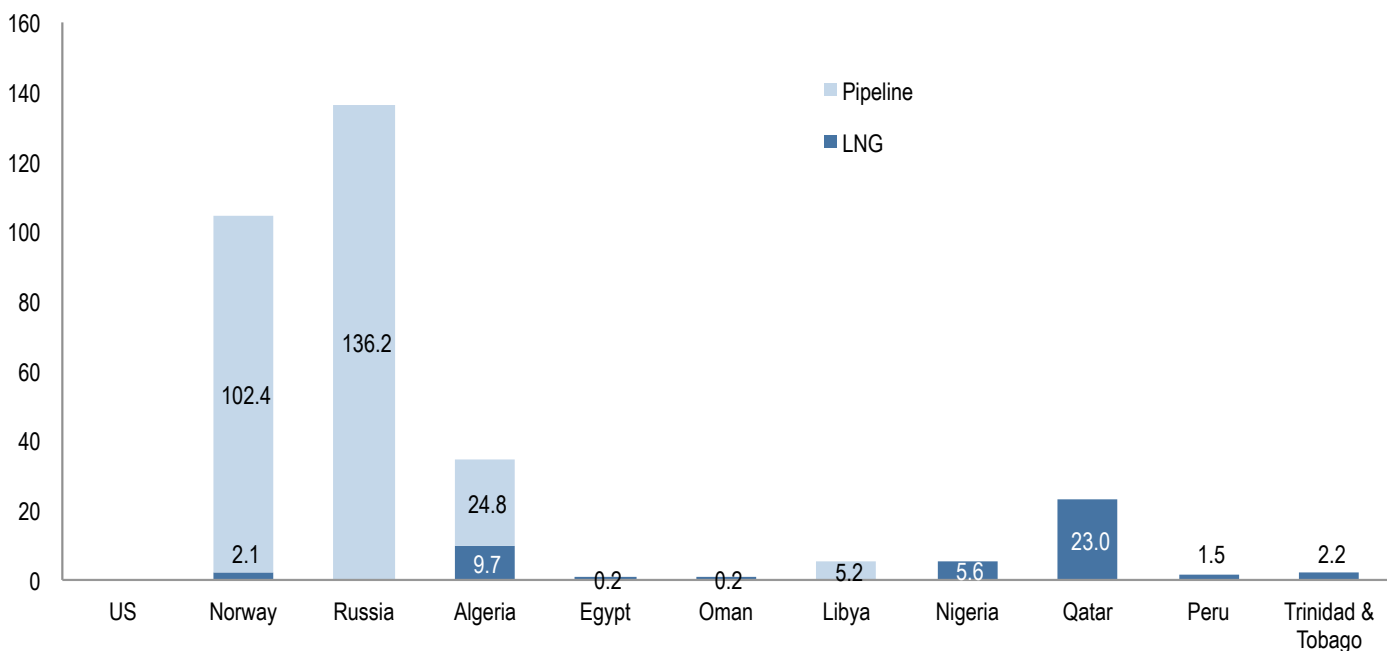
ropean pipeline gas imports and accounted for more than one-third of total EU gas supply in 2013.<sup>29</sup> In addition, Russia is a critical swing supplier for the region, meeting demand during periods of higher consumption. Most Russian gas reaches Europe through Belarus and Ukraine, which rely on Russia far more than most EU members for energy. In Ukraine, 34% of total primary energy demand is met with gas, about 56% of which came from Russian imports in 2013.<sup>30</sup> Belarus is even more reliant on gas, which accounts for 65% of total energy consumption, all of which is purchased from Russia.<sup>31</sup> Russia traditionally sold gas to these transit countries at far lower prices than to consumers within the EU. Moscow still rewards Belarus with discounted gas prices for the country's participation in Russia's Eurasian customs union.<sup>32</sup> The discounted gas price offered to Ukraine in December 2013 was also intended as an incentive to convince Kiev to join the Russia-led trade bloc.<sup>33</sup>

## RUSSIA-UKRAINE DISPUTES OVER GAS PRICES THREATEN SUPPLY STABILITY

Price disputes between Russia and Ukraine resulted in the disruption of Russian supplies to the EU in 2006 and 2009. Russia cut off gas supply to Ukraine again in June 2014 in an escalation of the most recent pricing dispute. Gazprom insists gas shipments will not resume until Ukraine pays off a debt of \$4.5 billion, but Kiev is demanding lower gas prices first.<sup>34</sup> Gazprom has continued to deliver supplies to Europe via Ukraine, but supply risks remain and it is unclear how the standoff will be resolved.

Ukraine has filled roughly half its existing storage and three-quarters of its targeted volume to protect against winter disruptions. Presently, it has adequate storage to meet domestic consumption some way into the winter

**Figure 7: EU natural gas imports by supplier**  
Billion cubic meters, 2013



Source: BP Statistical Review of World Energy 2014.



Presently, Ukraine has adequate storage to meet domestic consumption some way into the winter (perhaps January or February), but increased storage supplies are still needed to both satisfy domestic demand and ensure stable seasonal supplies into Europe. Ukraine may face potentially life-threatening gas shortages, particularly if this winter is unusually cold.

(perhaps January or February), but increased storage supplies are still needed to both satisfy domestic demand and ensure stable seasonal supplies into Europe.<sup>35</sup> Ukraine may face potentially life-threatening gas shortages, particularly if this winter is unusually cold. Reverse pipeline flows into Ukraine from the EU can help replace some of the imports from Russia. Reversed lines from Poland and Hungary, as well as an upgrade of an unused pipeline from Slovakia,<sup>36</sup> could meet up to 1.65 bcf/d (17 bcm)<sup>37</sup> of Ukraine's 4.35 bcf/d (45 bcm) of demand.<sup>38</sup>

Gazprom has threatened to reroute the gas around Ukraine if it suspects Ukraine of stealing any of the transit supplies of gas for its own use, and plans to increase injections into underground storage in the EU to ensure customers there continue to receive adequate supplies. But such measures cannot fully compensate for the Ukrainian loss, as about a third of Russian gas shipments to Europe will have to be transported via Ukraine, even if Gazprom ramps up transport volumes through its Nord Stream pipeline to full capacity.<sup>39</sup>

Given both Ukraine's and the EU's dependence on Russian gas, and the importance of energy exports to the Russian economy, it is logical that policymakers, both in Europe and the US, are exploring the extent to which US LNG exports can help resolve the current crisis by providing Europe with an alternative source of natural gas supply and thus reducing Moscow's leverage over both Ukraine and EU member states, and prompting a

change in its attitude by adversely impacting the Russian economy.

Next we will assess the potential benefits of US LNG exports in achieving these objectives and the role that energy can play in the broader US response to the crisis.

## THE BENEFITS OF THE US SHALE GAS BOOM

### GLOBAL SUPPLY BOOST HELPED EUROPE RENEGOTIATE SOME GAS CONTRACTS

The US natural gas revolution has already undermined the profits of Russian producers and benefitted European consumers. The displacement of 9.4 bcf/d (97 bcm) of LNG supply that resulted from the US shale boom coincided with a period of sharply reduced European gas demand, due to the great recession in 2009 and the subsequent Euro crisis from 2010.<sup>40</sup> Oil prices rebounded quickly following the crisis, but natural gas prices in Europe remained low, due in large part to this additional supply of LNG. This is significant as most long-term gas contracts are indexed to the price of oil, a pricing system that emerged in the 1960s when oil and refined products were the natural competition for gas. The divergence between oil-indexed and spot

natural gas prices in Europe put considerable pressure on Europe's traditional gas suppliers, particularly Russia's Gazprom, to amend their oil-indexed price formulas, or ease volumetric commitments tied to take-or-pay obligations. These take-or-pay contracts require a customer to pay for a certain amount of natural gas, whether they take the gas or not. This is generally a high percent of contracted volumes.

Statoil, one of the major gas suppliers to the European market, was the first to respond, introducing spot gas indexation in most of its European contracts.<sup>41</sup> Gazprom was initially less flexible in re-negotiating contracts, and insisted on maintaining oil-indexed pricing. However, most of Gazprom's large European customers were eventually granted considerable gas price discounts—partly by linking a small percentage of the contracted volumes to hub

### SPOT VERSUS OIL-INDEXED PRICES IN EUROPE

The divergence of oil-indexed and spot natural gas prices in Europe in recent years was initially the result of the 6 to 9 month lag embedded in most oil-indexed pricing formulas, which were originally put in place to protect gas consumers in the event of an oil shock. At the beginning of 2009, oil-indexed gas prices still reflected record-high oil prices seen two quarters earlier, while spot prices were deeply depressed from the recession and the growing glut of LNG previously destined for US shores.<sup>1</sup>

The period of low oil prices proved remarkably short-lived in 2009, and the effect of the temporary oil price collapse remained relatively muted in the 6 to 9 month rolling average levels used in oil-indexed gas price formulas. The Fukushima disaster in Japan diverted some of the flexible LNG volumes away from Europe, and thus contributed to a significant increase in European spot gas prices in 2011.<sup>2</sup> However, spot prices on average were still about 15% lower than oil-indexed gas prices in 2011, when in-

ternational crude oil futures were settling into the current, historically high average range of over \$100 per barrel, a level which continues to bolster oil-indexed gas prices.

Under the so-called take-or-pay obligations included in long-term gas contracts, major European utilities were required to pay for more expensive oil-indexed gas than they actually needed after the recession, while cheaper spot gas was readily available in the global LNG market. The sustained gap between spot and oil indexed gas prices threatened the profitability of the European utility sector, and eventually forced consumers and suppliers to the table to re-negotiate oil-indexed gas contracts across Europe.<sup>3</sup>

The original rationale for linking oil and gas prices in European gas supply contracts—that end-users had a real choice between burning gas and oil products and could thus respond to price changes—is no longer relevant, and the emergence of spot gas markets increasingly allows for gas prices to be based on the supply and demand for gas.<sup>4</sup>

**Table 2: Renegotiations of gas supply contracts with Gazprom**

Company	Primary Market	Year	Renegotiation Details
E.On	Germany	2010	15% spot pricing included in LT contract (for 3 years)
Eni	Italy	2010	15% spot pricing included in LT contract (for 3 years)
GDF Suez	France	2010	15% spot pricing included in LT contract (for 3 years)
Edison	Italy	2011	Agreement reached out of court on price discount and total compensation of \$290 mn for FY 2011
Eni	Italy	2012	Price discount, more flexibility in take-or-pay volumes and retroactive compensation for FY 2011 agreed
Verbundnetz Gas	Germany	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
GDF Suez	France	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
Wingas	Germany	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
SPP	Slovakia	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
Botas	Turkey	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
Econgas	Austria	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
Sinergie Italiane	Italy	2012	Ca. 10% price discount (lower P0) negotiated (for 3 years)
E.On	Germany	2012	Arbitration started, agreement on ca. 7-10% discount and \$1.3 retroactive compensation
PGNiG	Poland	2012	Arbitration started, agreement on ca. 10% discount and \$930 mn retroactive compensation for FY 2011 and 2012
RWE Transgas	Czech Republic	2013	Arbitration court awarded ca. \$1.3 bn compensation
Eni	Italy	2013	Price discount of ca. 7% agreed for FY 2013
Lietuvos Dujos	Lithuania	2014	Negotiated 20% price discount for renewed contract post-2014
Eni	Italy	2014	100% spot indexation in all LT contracts from FY 2014

Source: Center on Global Energy Policy based on industry and press reports.

prices, typically 15%, and partly by introducing discounts within the existing oil-indexed formulas (Table 2). These re-negotiations were not always consensual and often took place in arbitration courts.<sup>42</sup>

The costs for Gazprom were substantial. Starting in 2009, the company agreed to significant concessions on pricing terms in its long-term gas supply contracts with European customers. As a first step in a long series of contract renegotiations, Gazprom allowed three of its largest European customers, namely E.On, GDF Suez, and Eni, to link 15% of their contracted gas volumes to spot gas prices instead of the traditional oil product linkage for a limited period of 3 years.<sup>43</sup> Some of these contracts were later further amended.<sup>44</sup>

Other European utilities soon followed suit and started re-negotiating existing gas contracts with Gazprom. European long-term gas supply contracts typically contain provisions for the periodic revision of contract terms. These price review clauses allow the contracting parties to adjust the base prices (P zero) and indexation formulas every three years if market conditions changed materially during the last review period.<sup>45</sup> Between 2011 and 2014, Gazprom agreed to review pricing formulas and reduce prices with most of its European customers, initially for a period of three years.

These price renegotiations took the form of price discounts through adjustments to the pricing formula and retroactive compensation to Gazprom's main European customers, in-

cluding France's GDF Suez, Italy's Eni, Germany's Wingas, Austria's Enagas, Slovakia's SPP, Turkey's Botas, and Poland's PGNiG, among others.<sup>46</sup> Germany's RWE settled its pricing dispute with Gazprom in arbitration court, while a similar arbitration proceeding with Italy's Edison is still ongoing. Although the renegotiated contract terms are not always made public, various media reports suggest that the amount of these discounts ranged between 7% and 10%.<sup>47</sup> Based on 2013 delivery data, our estimates suggest that the agreed discounts reduce Gazprom's revenues by about \$5 billion each year,<sup>48</sup> although it is not clear whether these discounts will be extended beyond the current 3-year price review period.

### RETROACTIVE COMPENSATIONS COSTLY FOR GAZPROM

Gazprom also agreed to pay an estimated \$4.4 billion in retroactive compensation to various European gas buyers through the end of 2013, according to the company's financial statements.<sup>49</sup> As of the end of 2013, Gazprom already paid out \$3.5 billion in cash refunds for earlier gas deliveries to its European customers.<sup>50</sup> Some of the awards disclosed in company filings and news reports were indeed substantial. The retroactive adjustment paid to Poland's PGNiG, for example, was worth \$930 million,<sup>51</sup> covering the 2011 and 2012 financial years. E.On's compensation agreed in 2012 was nearly \$1.3 billion.<sup>52</sup>

Beyond the initial agreement allowing spot indexation for 15% of contracted volumes with its biggest customers in 2010, Gazprom proved reluctant to introduce more spot indexation in its long-term gas contracts during later renegotiation rounds, using base price adjustments for providing discounts instead. However, in May 2014, Eni and Gazprom announced that they had changed the basis of price indexation in all of their long-term gas supply contracts<sup>53</sup> to “fully align it with the market.”<sup>54</sup> Most market commentators and media outlets interpreted this to mean essentially the complete abandonment of oil-indexation and a conversion of all of Eni’s contracts to spot gas indexation. A Sanford C. Bernstein report suggests that Eni’s renegotiated index formula will be linked to spot gas prices at Italy’s PSV (Punto di Scambio Virtuale) gas hub.<sup>55</sup> The changes will apply retroactively from the beginning of 2014, and are estimated to have a \$760 million positive impact on the operating profit of Eni’s gas and power division this year.<sup>56</sup>

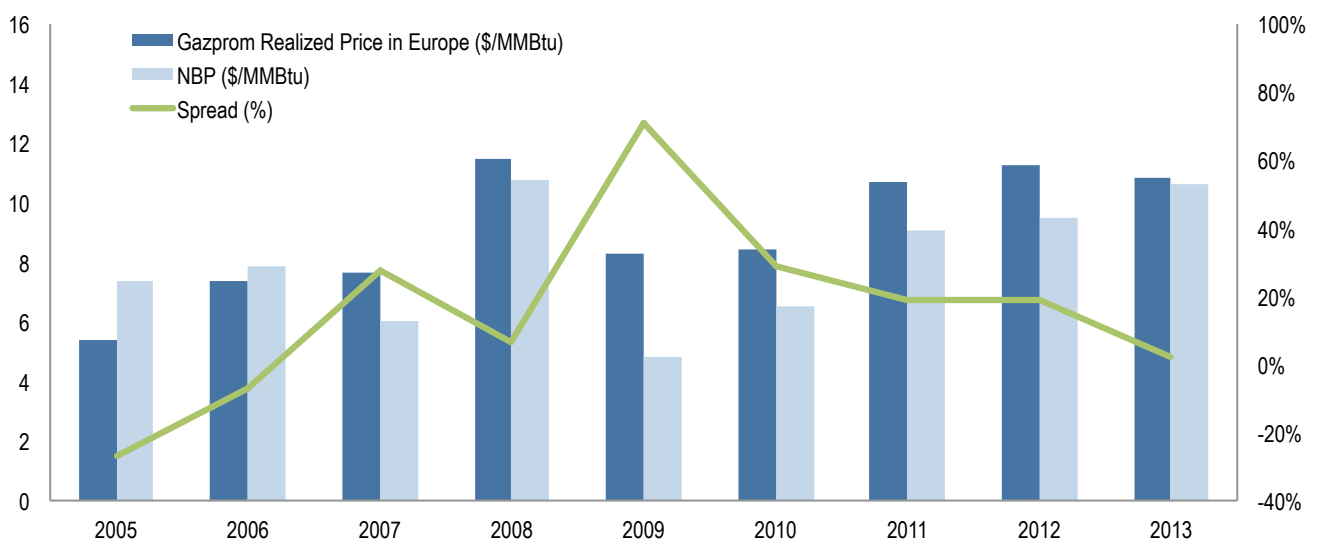
### EUROPEAN COMMISSION ANTITRUST PROBE COULD FORCE MAJOR CONTRACT CHANGES

Potential fines resulting from the European Commission’s antitrust probe against Gazprom, which started in 2012,

can also be attributed to the changing gas supply landscape. The EU Commission initiated the antitrust proceedings to investigate whether Gazprom abused its monopolistic position in Central and Eastern Europe to impose higher pricing, prevent the resale of gas, and hinder the diversification of supply in the region.<sup>57</sup> Gazprom’s pricing practices and the rigidities that the Commission suspects may remain in some of the company’s long-term gas supply contracts in Central and Eastern Europe—especially destination restrictions for Russian gas considered illegal under European competition rules—appeared far more onerous with the increasing supply of lower-priced spot gas to Western European gas hubs. Large Western European utilities were also quicker in winning price concessions and retroactive compensation from Gazprom, which temporarily increased the regional differences in the pricing of Russian gas. In 2012, for example, delivered Russian gas prices decreased in Germany and stayed flat for France and Austria.<sup>58</sup> In the same year, Hungary, Slovakia, and the Czech Republic faced sharply higher prices for Russian gas.<sup>59</sup>

An adverse antitrust ruling may further weaken Gazprom’s market position by requiring the company to eliminate any remaining destination restrictions, or possibly even to replace oil-indexation with hub-based pricing formulas in

**Figure 8: European gas prices, spot vs. Gazprom**



Source: BP Statistical Review of World Energy 2014, Gazprom.

## THE RUSSIA-CHINA GAS DEAL

Gazprom's weakened hand in the European gas market may have pushed Russian negotiators towards a swift conclusion of a gas deal with China, following more than 10 years of unsuccessful talks. In May 2014, Gazprom inked a 30-year supply agreement to sell China National Petroleum Corp. (CNPC) 3.7 bcf/d (38 bcm) of gas starting in 2019.<sup>1</sup> The feed gas for the new Russia-China pipeline will be sourced from new East Siberian developments, notably from Gazprom's Kovykta and Chayanda fields. Gazprom will invest \$55 billion to develop these giant greenfield projects, with China ponying up \$25 billion in advance payments to assist in this effort.<sup>2</sup>

Pricing details have not been disclosed, but industry analysts estimate the implied gas price in the contract at between \$350 and \$390 per thousand cubic meters, or between \$10 and \$11 per mmBtu.<sup>3</sup> This is roughly in line with what Gazprom's European customers pay and considerably lower than current LNG import prices in Asia. Previous negotiations reportedly failed because Gazprom demanded prices closer to Asian LNG levels, while China was unwilling to pay even the much lower European con-

tract prices.<sup>4</sup> The recent agreement suggests Gazprom likely conceded on pricing as a result of both diminished market prospects in Europe and growing tensions with the West, while China achieved a price level close to European spot prices, which it has targeted throughout the negotiations.

It is important to note that China and Europe will not compete for the same Russian gas supplies, and the current Russia-China gas deal will not give Gazprom the option of diverting gas from Europe to China. The Kovykta and Chayanda gas fields, which will feed the new Russia-China gas link, are greenfield development projects located far from the European market, and would not be developed absent a pipeline to China. Another proposed Russia-China pipeline, the so-called "western pipeline route" connecting West Siberian gas fields with China's western border, could later enable Russia to physically divert gas supplies from Europe to China.<sup>5</sup> This project is not covered in the recent gas contract, and negotiations on the western Russia-China route are in a relatively early stage.

**Map 1: Gazprom's natural gas export pipeline system to China**



Source: Gazprom.



all of its long-term supply contracts. The antitrust case may also result in substantial fines of up to 10% of the company's annual revenues in the markets in question. Morgan Stanley estimates that Gazprom's annual revenue from the markets covered by the investigation (Poland, Czech Republic, Slovakia, Hungary, Bulgaria, Estonia, Latvia and Lithuania) is in the region of \$17 billion, which implies a maximum fine of about \$1.7 billion.<sup>60</sup> Even if the EU's

competition authority rules against Gazprom, however, the company may still appeal to the European Court of Justice, which could delay the final ruling by several years.

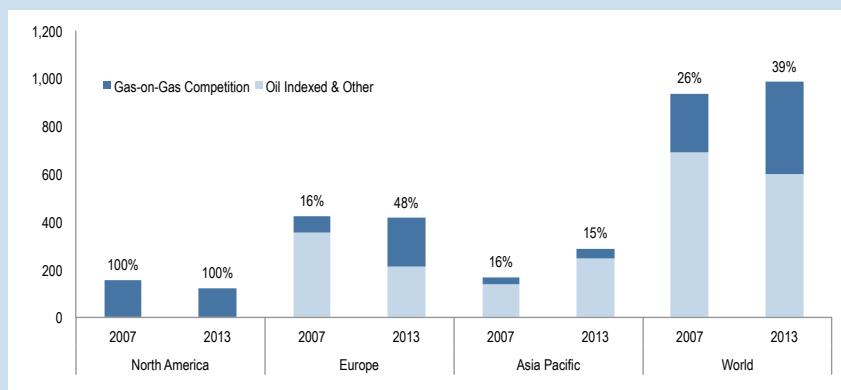
The renegotiation of Russian gas contracts recently caused spot and oil-indexed gas prices in Europe to converge (Figure 8) and Gazprom's pricing premium has been squeezed. In addition, Gazprom's share price continues to perform

## IMPLICATIONS OF US LNG EXPORTS FOR ASIAN GAS MARKETS

The Asia Pacific region is the largest market for imported LNG and will become the largest concentrated gas consuming region by 2035, surpassing North America and Europe, according to the IEA.<sup>1</sup> However, the Asia Pacific region lacks a competitive gas market, and the prospects of developing a sufficiently liquid gas trading hub that could establish a reliable price signal for the region remain limited by institutional barriers and inflexibilities in the long-term take-or-pay contracts. While competitive gas-to-gas pricing of natural gas is gaining ground globally, with the most significant progress towards competitive gas pricing made in Europe, the share of competitively-priced gas in Asia remains stagnant at around 15% since 2007 due to the rigidities of LNG supply and demand in the region (Figure 9).<sup>2</sup> Long-term oil-indexed LNG supply contracts are still the predominant form of pricing gas in Asia, and the majority of short-term and spot LNG contracts are also priced in reference to oil-indexed prices, or negotiated in a highly non-transparent manner on a cargo-by-cargo basis.<sup>3</sup>

US LNG exports will encourage more competition in Asian gas markets by increasing diversity of supply and liquidity. More importantly, these supplies are flexible in their destination. One of the key impediments for the emergence of a competitive market is the prevalence of destination clauses in long-term Asian LNG contracts.

**Figure 9: Wholesale gas price formation of traded natural gas volumes Bcm/year, gas-on-gas competition % of total**



Source: IGU Wholesale Gas Price Survey.

These prevent the resale of natural gas cargoes in other markets, where they might fetch a higher price, thereby hindering the convergence of regional gas prices and stiffening the whole LNG supply chain. New LNG export terminals in the US will offer full destination flexibility for their mainly Asian buyers, thereby introducing a large volume of flexible LNG supplies to the Asia Pacific market.<sup>4</sup> This will allow buyers to demand greater destination flexibility from other suppliers, and will put pressure on sellers to offer LNG on more flexible terms eventually. While this will take time, the IEA estimated in a recent study that almost 50% of the Asian LNG supply contracts that were in place in 2013 will have expired by 2017,<sup>5</sup> creating opportunities for buyers to introduce more flexibility in renewed contracts just as US LNG exports start to ramp up.

well below its pre-recession levels, due to a combination of diminished pricing power in Europe, growing competition in the Russian domestic gas market from Novatek and Rosneft, the liberalization of Russia's LNG market, the relentless pursuit of value-destroying geopolitical projects like the South Stream pipeline, and a substantial over-investment in upstream production capacity.<sup>61</sup>

### **US LNG EXPORTS MAY HEAD TO ASIA, BUT CONSUMER BENEFITS ARE GLOBAL**

As previously mentioned, if the LNG export terminals already approved by the Department of Energy are built and fully utilized, the United States could add another 10.5 bcf/d (109 bcm) to global LNG markets in the coming years beyond the 9.4 bcf/d (97 bcm) already freed up by the drop in US LNG import demand. Export capacity of around 8-9 bcf/d (83-93 bcm) is also consistent with the 5 to 7 US projects many private forecasters expect would be economic to build.<sup>62</sup>

When assessing how this additional supply might shape energy economics and geopolitics in Europe, it is important to note that Asia will be the likely destination for a large share of US LNG exports. Delivered LNG prices are higher in Asia than in Europe (Figure 3) as traditional Asian importing countries like Japan and Korea lack meaningful domestic gas production and have been willing to pay a premium for secure LNG supply. Moreover, Japanese and Korean utilities generally have greater ability to pass on high natural gas prices to consumers than their European peers. Emerging Asian LNG markets, most importantly in China, are also paying a premium for LNG relative to European consumers.<sup>63</sup> Despite the increased time and cost required to move LNG from the US Gulf Coast to Asia, current price spreads make it the most commercially attractive destination for US gas. The expansion of the Panama Canal will also shave about a dollar off the cost of shipping LNG from the Atlantic Basin to Asia.<sup>64</sup> Indeed, more than half of the long-term offtake agreements from prospective US LNG terminals were signed by large Asian import agents or utilities, such as Japan's Osaka Gas and Korea's Kogas.<sup>65</sup>

Some US LNG will reach European shores—Cheniere, for example, has contracts with Centrica in the UK and two Spanish utilities<sup>66</sup>—although on a regular basis the gas is likely to be resold into the Asian market given existing arbitrage opportunities. Still, the absence of destination or

resale restrictions in the contracts provides Europeans with increased optionality, so the gas can be brought to Europe when prices there are higher or to meet seasonal demand.

Even if not a single drop of US LNG finds its way to Europe, however, additional US LNG exports will impact European gas markets. Expanding the amount of LNG available globally will further increase consumer leverage in price negotiations and put downward pressure on global gas prices. And the more US gas Asian customers purchase, the less gas they buy from other LNG suppliers, expanding the set of non-Russian options available in Europe.

### **LOW COST OF US BROWNFIELD LNG PROJECTS ALLOW US TERMINAL OPERATORS TO OFFER BETTER CONTRACT TERMS FOR BUYERS**

Were all the 10.5 bcf/d (109 bcm) of currently approved US LNG capacity added to the market it could replace two-thirds of current European gas imports from Russia, either directly through sales to Europe or indirectly by displacing supply previously destined for the Asian market. However, as discussed in greater detail later, the actual addition of supply to world markets will be limited as higher cost production will not be able to compete. In addition, the actual amount of US LNG will depend on how much capacity the industry finds economic to build. The recent changes to DOE's export policy that remove the requirement that projects seeking to export to non-FTA countries obtain conditional authorizations will allow commercial considerations to better signal to DOE which projects are most viable and able to finance completion of the FERC authorization process.

The economic viability of the proposed US LNG terminal projects and their level of progress vary considerably. Almost all the terminals that have received approval thus far are so-called brownfield projects looking to outfit existing import terminals with liquefaction equipment. The capital investment required to add liquefaction facilities to already operational import terminals is considerably lower than building a new liquefaction terminal from scratch.<sup>67</sup> The primary reason for the lower capital cost is that much of the infrastructure, including pipelines, storage tanks, loading berths and marine loading arms, is already in place. During the previous decade, an estimated \$100 billion was invested in these underutilized US LNG import terminals.<sup>68</sup>

As a result, most of the proposed brownfield export facilities are among the cheapest LNG liquefaction projects globally. These projects have very favorable netback economics, and are highly competitive with new Australian LNG projects for the Asian LNG market, despite the US terminals' greater distance from the region.<sup>69</sup> The operators of American brownfield terminals are well positioned to offer a great degree of volumetric flexibility as well as destination flexibility to prospective LNG importers, which is part of what has attracted Asian utilities and other buyers.<sup>70</sup>

Greenfield projects in the United States face considerably longer permitting procedures, greater execution risk, and have to compete with other major infrastructure projects for scarce engineering and construction services—similar to the difficulties faced by most other LNG export terminal projects around the world. The Jordan Cove and Oregon LNG projects, both located in Oregon, face additional hurdles, although they would have easier access to the most lucrative Asian LNG market. Both West Coast projects are relatively far from the parts of the country where natural gas production is growing, such as the Midwest and the Marcellus play further east, and would source gas from the Rockies and from Western Canada. The long-term production outlook in both areas is also less certain and hundreds of miles of pipelines would need to be constructed to connect them to gas hubs, making their overall economics less favorable.<sup>71</sup> Some of the other proposed greenfield projects are little more than PowerPoint presentations at the moment, as it only costs \$50 to file an export application with DOE.<sup>72</sup>

### **US LNG CONTRACT TERMS MAY CREATE FLEXIBILITY AND LIQUIDITY IN GLOBAL MARKET**

US LNG export terminals will operate under a fundamentally different business model than liquefaction terminals elsewhere in world, which could shape global gas markets beyond the direct impact of additional supplies. Constructing LNG export terminals is an extremely lengthy and capital intensive process. As a result, terminal operators generally require long-term sales purchase agreements and relatively inflexible volumetric commitments from the buyers. As discussed, the price of LNG is usually indexed to another commodity, typically to oil or a combination of petroleum product prices in a destination market, most often on a 6 to 9 month rolling average basis. (There is increasing use of

natural gas spot price indexation for spot or term LNG contracts in Europe, although long-term contracts often continue to use oil indexation.) In this contractual arrangement, the producer takes the investment risk, and shares the price risk with the buyer, while the buyer takes most of the volumetric risk in the form of take-or-pay obligations.

Several US LNG export projects, such as Cheniere's Sabine Pass project set to begin operating in 2015, appear likely to operate under a different "tolling type" contractual structure. This means that the terminal operator charges a fixed capacity fee, around \$3 per mmBtu in Cheniere's case, which has to be paid even if the buyer decides not to use the booked capacity.<sup>73</sup> The buyer may be responsible for sourcing gas from the US market, as well as any fuel required to run the liquefaction plant. The buyer is typically also responsible for arranging shipping. Cheniere's contract structure is slightly different because it also sources the feed gas to convert to LNG, and charges a markup of 115% of the Henry Hub price to cover its procurement and fuel costs.<sup>74</sup>

It is unclear at this point how many other US LNG export projects will use a similar tolling arrangement in their offtake agreements.<sup>75</sup> The deals announced so far suggest that many US LNG exports will be sold under long-term tolling-type contracts, but it is too early to determine whether this model will predominate. Ultimately, the contract structure could have important implications for the volume of LNG that the US exports and thus the impact it has on US gas prices.

Under traditional take-or-pay contracts, even if the US price of gas rose enough to make US natural gas, plus liquefaction and transportation, uncompetitive in foreign markets, the buyer would still be obligated to take the cargo, so the US would continue to export the contracted volumes of gas. Depending on the contract structure, in such a scenario, the buyer might resell the gas into the US market to avoid paying the transportation costs, however.

Without a take-or-pay obligation, if US gas prices rise above a certain level, the arbitrage between Henry Hub gas and alternative LNG supply may not be large enough to make it economic for buyers to take US natural gas. That arbitrage window is not the full \$6 to \$7 per mmBtu cost of liquefaction and transportation, however, because the tolling fee is a sunk cost. That means that there still may be cases when Asian and European buyers opt to receive the gas even if



the US price rose to levels that seemingly closed the arbitrage window because they would need to pay the \$3 tolling cost in any event. Even if Henry Hub prices rise, buyers will continue to take the US LNG, even under a tolling model, until the point at which the arbitrage window narrows to the variable cost of transportation plus liquefaction fuel. That would be true when the buyer is an end-user, such as a utility, although not necessarily if the buyer were a marketer or portfolio player looking to resell cargoes through spot or term tenders. In the latter case, the marketer will be unable to resell the gas if the end-user has lower cost options, so the marketer would pay the tolling fee but the gas volumes would not be exported from the United States.

From the standpoint of the global LNG market, the long-term commitment to pay the capacity fee is still a substantially smaller commitment than traditional oil-indexed take-or-pay contracts. Thus, the advent of US tolling-type contracts may provide the global LNG market with more liquidity and buyers with more flexibility than the historic alternatives, and shift the balance of power from gas producers to consumers. In addition to the adjustments to European gas contracts with Russia, consumers are beginning to flex their muscles for better terms. Asian buyers are pressing Chevron, the developer of the Kitimat LNG project in Canada, for a natural gas-indexed contract.<sup>76</sup>

Buyers are also less willing to make 20-year or 30-year LNG purchase agreements. Less than half of the long-term LNG contracts concluded in 2013 were for 20 years or longer, while all other long-term sales agreements signed last year were for periods shorter than 15 years, due at least in part to the anticipated presence of large volumes of flexible US LNG on the global market.<sup>77</sup>

The share of 20-year or longer contracts among the long-term sales agreements finalized in 2012 was 57%,<sup>78</sup> while in 2009, the corresponding share was 67%.<sup>79</sup> Prospective developers of new greenfield liquefaction projects still need to secure 20-year offtake agreements to be able to obtain financing, and to justify the large up-front capital investment associated with LNG projects.

The absence of destination clauses may also reduce some element of gas price volatility because, even if US LNG terminals run at or near capacity most of the time, their supplies can be diverted to different markets in response to price spikes. On the other hand, more spot trading can

increase short-term price volatility relative to long-term oil-indexed contracts, as the market responds more quickly to supply and demand shocks and threats.

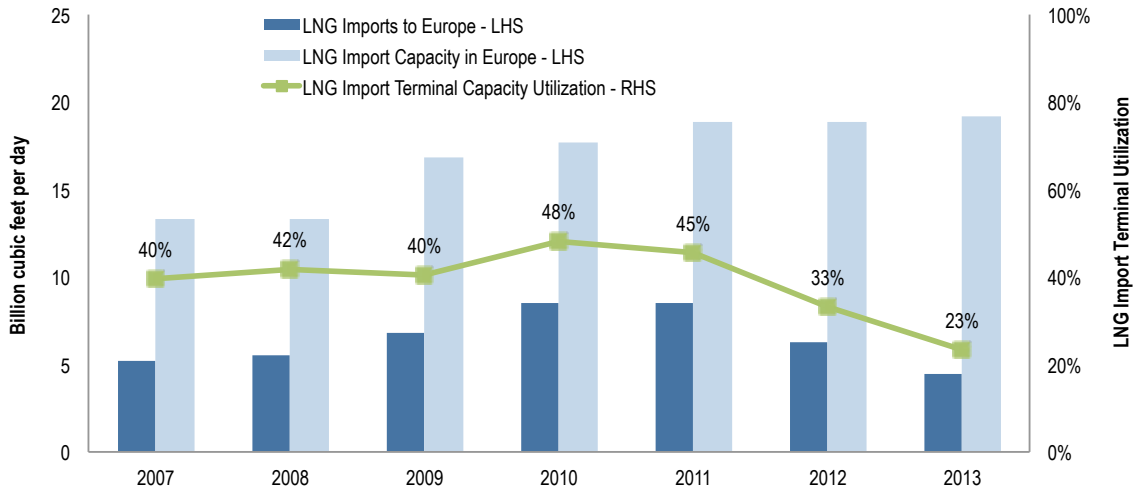
## EUROPE HAS SIGNIFICANT SPARE LNG IMPORT CAPACITY TO TAKE MORE SUPPLY

Europe is well positioned to expand the volume of LNG it imports as more supply becomes available. European countries<sup>80</sup> had an extensive LNG import infrastructure with 22 operational terminals and a total regasification capacity of 19 bcf/d (199 bcm) at the end of 2013.<sup>81</sup> Another three terminals were under construction with a combined capacity of 2 bcf/d (21 bcm) at the end of last year.<sup>82</sup> Utilization rates at these terminals have dropped sharply in recent years, from 48% in 2010 to 23% in 2013, with Europe becoming close to a residual market for LNG shipments (Figure 10).

A number of factors account for the decline in LNG consumption in Europe. European gas demand remains stagnant, as subsidized renewables and cheap coal continue to squeeze natural gas out of power generation. The collapse of European carbon prices has further undermined the competitiveness of natural gas relative to coal in the EU. Asian and Latin American buyers are also willing to pay higher prices for LNG than European ones to meet rising demand, bidding away spot LNG cargoes from Europe. LNG volumes that are landed in European terminals as required under long-term take-or-pay contracts are often re-exported to higher paying markets in Asia and South America.

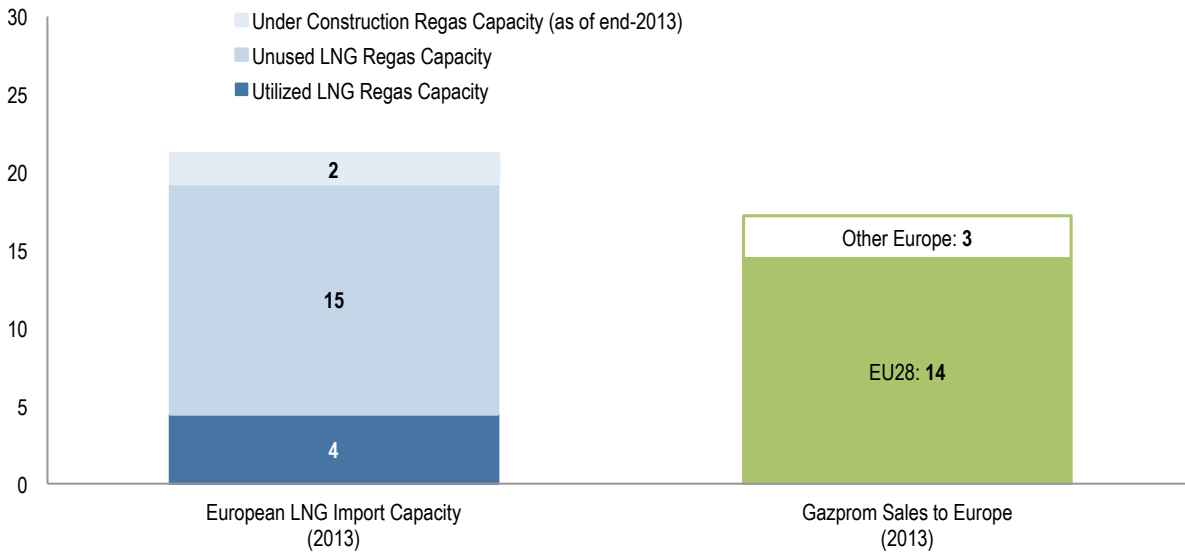
In theory, the European Union already has enough LNG import capacity to almost completely replace Russian gas shipments with imported LNG, were such supply available and affordable. EU member states imported 14.5 bcf/d (150 bcm) of natural gas from Russia in 2013 (Figure 11), while the idle LNG import capacity in the bloc was about 14.1 bcf/d (146 bcm)—although the largest chunk of unused regasification capacity is in Spain, which is not well connected to the rest of the European gas transmission system. The greater European region, including Turkey, Switzerland and the non-EU members on the Balkan Peninsula, imported about 17 bcf/d<sup>83</sup> (179 bcm) of natural gas from Russia last year. Unused LNG regasification capacity in this broader region was at 14.7 bcf/d (152 bcm) in 2013, with another 2 bcf/d (21 bcm) under construction.<sup>84</sup>

**Figure 10: European LNG import capacity and utilization**



Source: International Group of Liquefied Natural Gas Importers.

**Figure 11: European LNG Import capacity vs. Russian gas imports**  
Billion cubic feet per day



Source: GIIGNL, Gazprom Export delivery statistics.

## MODELING THE EFFECT OF FUTURE US LNG SUPPLY

### EUROPE SEES BIGGEST ECONOMIC GAINS FROM US LNG, WHILE RUSSIA THE MOST PAIN

Despite challenges with US LNG exports, it is entirely possible that additional export capacity could get approved and built, and that total US LNG exports could exceed the volumes already approved, or even potentially the 14.5 bcf/d (150 bcm) Russia currently sells to members of the

European Union.<sup>85</sup> Given the uncertainty surrounding both market demand and policy support for future US LNG supply, we assess the impact of both 9 bcf/d (93 bcm) and 18 bcf/d (186 bcm) of US LNG exports on European and global gas markets.

We find that European consumers stand to benefit considerably from US natural gas exports. While more

### MODELING

In conducting our analysis, we employ the World Energy Modeling System Plus (WEPS+) used by the EIA to produce the International Energy Outlook (IEO).<sup>1</sup> WEPS+ integrates with the EIA's National Energy Modeling System (NEMS) that is used to produce the Annual Energy Outlook (AEO), the most commonly used long-term projection of US energy supply and demand, allowing for harmonized US and global energy outlooks.<sup>2</sup>

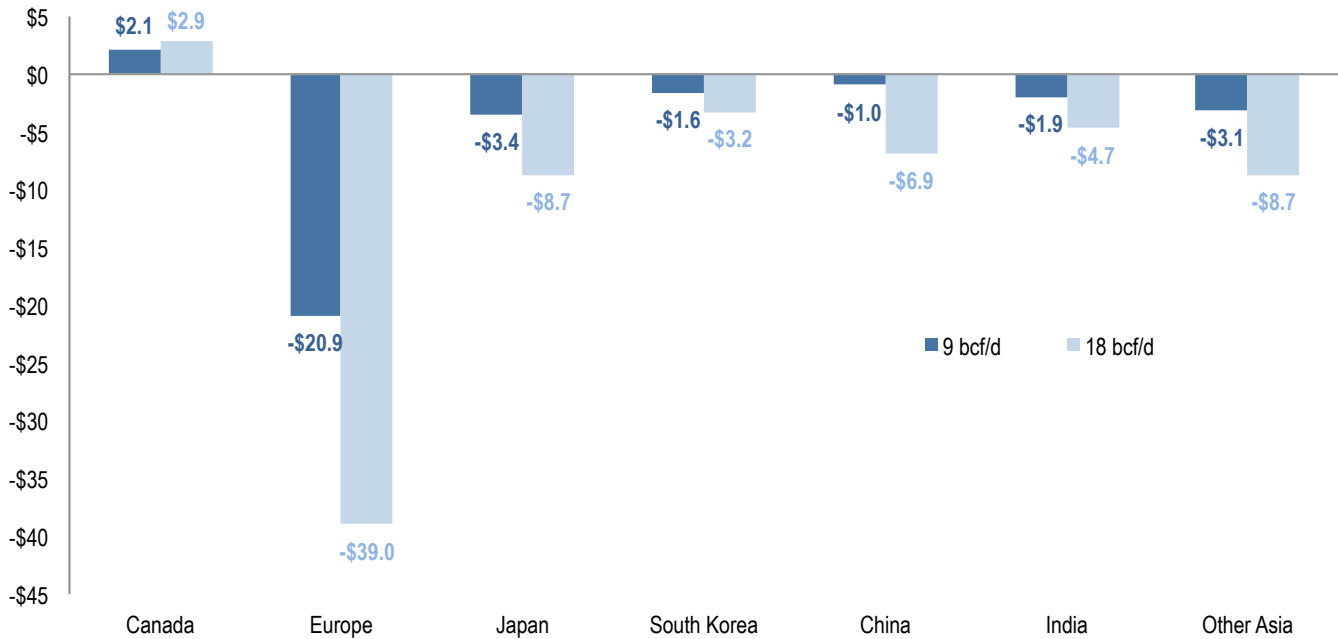
For global natural gas projections in particular, WEPS+ relies on EIA's International Natural Gas Model (INGM), which combines estimates of natural gas reserves, resources and extraction costs, energy demand, and transportation costs and capacity in order to estimate future production, consumption, and prices of natural gas. INGM incorporates regional energy consumption projections by fuel from the WEPS+ model, as well as more detailed US projections from NEMS. An iterative process between INGM and WEPS+ is used to balance world natural gas markets, with INGM providing supply curves to WEPS+ and receiving demand estimates developed by WEPS+.

INGM uses regional natural gas demand estimates from NEMS for the United States rather than those computed as part of the WEPS+ output, so that the final output for

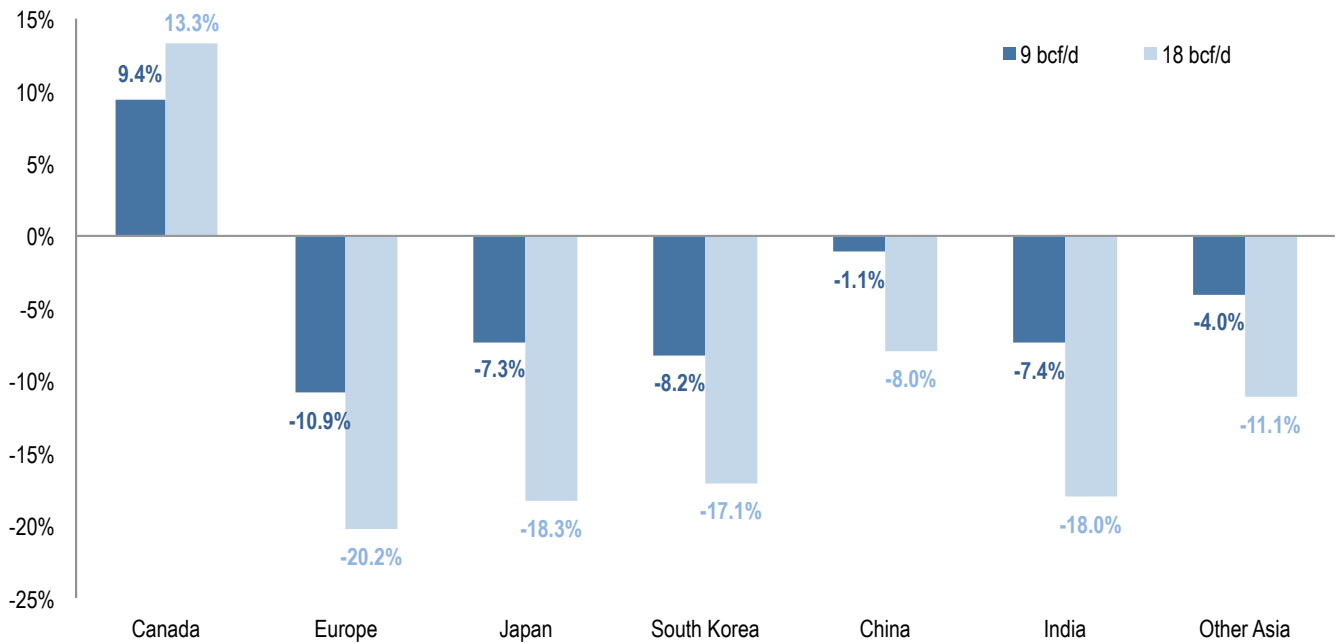
the United States is consistent with AEO projections. The model assumes that while contracts with pricing formulas related to crude oil or fuel oil prices dominate LNG trade and pipeline supply from Russia to Europe, marginal supply and demand decisions will reflect the marginal costs based on supply, demand, and transport fundamentals as reflected in short-term nodal and seasonal market prices. In addition, while LNG contracts may constrain trade in the near term, the model assumes markets are flexible over the long term and LNG will flow to the demand locations that value the LNG the most.

We use as our reference case a scenario in which the US exports no natural gas, to isolate the energy market impact of potential US LNG exports. We then compare this to a 9 bcf/d (93 bcm) and 18 bcf/d (186 bcm) scenario. US natural gas production costs are based on the version of NEMS used to produce the 2013 AEO, which is integrated into the most recent version of WEPS+ at the time of publication. In the 2013 AEO, natural gas prices at Henry Hub are \$4.13 per mmBtu (in real 2011 USD) in 2020, \$4.87 per mmBtu in 2025 and \$5.4 per mmBtu in 2030. Further details on our modeling approach are included in Appendix I.

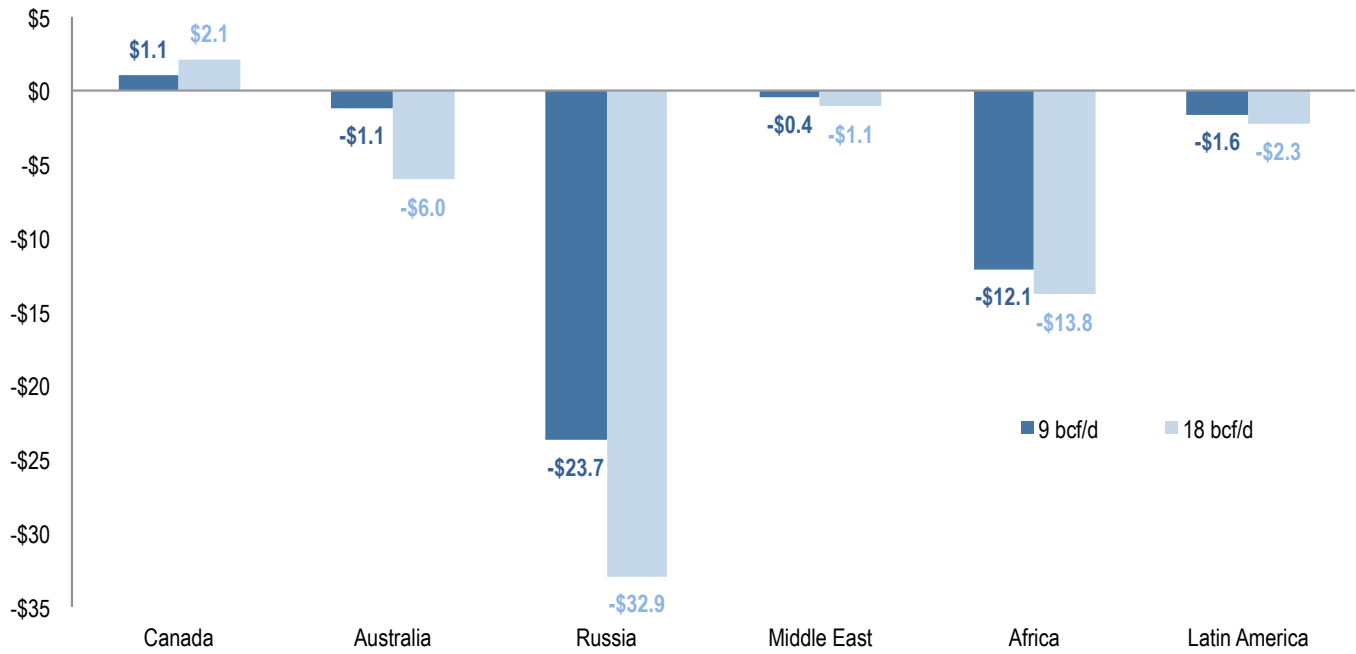
**Figure 12: Change in annual natural gas expenditures by value**  
Billion 2011 USD



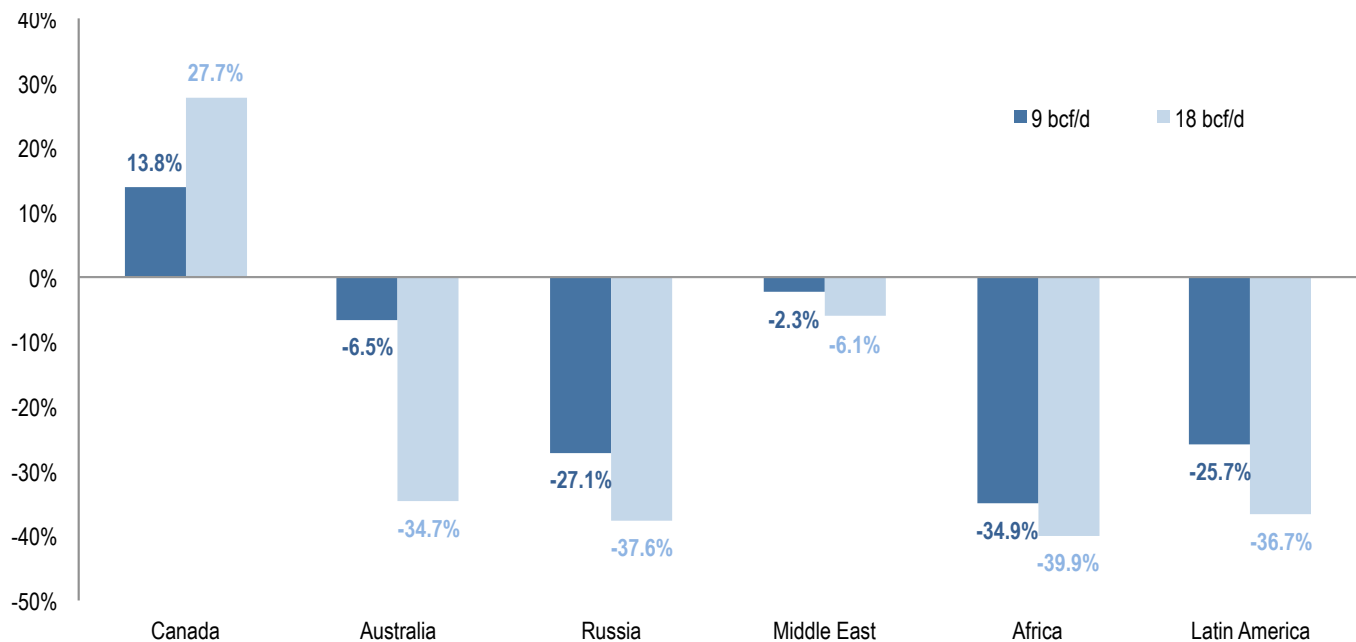
**Figure 13: Change in annual natural gas expenditures by percent**  
Percent



**Figure 14: Change in annual natural gas export revenue by value**  
Billion 2011 USD



**Figure 15: Change in annual natural gas export revenue by percent**  
Percent



volume goes to Japan than to Europe in our modeling, additional supply puts downward pressure on prices globally, and the magnitude of the resulting benefit—in dollar terms—is greater in Europe due to greater overall gas consumption. At 9 bcf/d (93 bcm) of US LNG exports, European consumers, including Ukraine, save \$21 billion on natural gas per year (Figure 12), representing an 11% reduction in total natural gas expenditures (Figure 12). At 18 bcf/d (186 bcm) of US exports, these savings grow to \$39 billion a year, or a 20% decline in gas expenditures.

Just as Europe is the largest economic winner from US LNG exports in our modeling, Russia is one of the largest economic losers. A small decline in sales volume and a large decline in sales price to Europe translates into a \$24 billion (Figure 14), or 27% (Figure 15), reduction in annual export revenue at 9 bcf/d (93 bcm) of US LNG exports relative to a world where US gas is not sold abroad. That grows to \$33 billion at 18 bcf/d (186 bcm), or 38%, and accounts for 1.1% of projected Russian GDP.

It is important to note that these findings are derived both from the production and transportation costs in the model and its assumption that over the long term both pipeline gas and LNG will be priced at the margin. If oil-linked contracts persist between 2020 and 2030, and prices continue to be set above marginal cost, then consumers could see an even larger cost reduction to the extent US LNG exports allow consumers to renegotiate these contracts. On the other hand, if oil-linked contracts above marginal cost are still prevalent between 2020 and 2030 and consumers are not able to renegotiate, the potential cost savings from US LNG exports could be considerably less.

## SEVERAL FACTORS WILL MUTE THE IMPACT OF US LNG ON EUROPEAN ENERGY SECURITY

Although the potential impact of planned US LNG exports on European gas expenditures could be considerable, the impact of US LNG exports on European security and Russian foreign policy is limited by four factors:

- US LNG will take several years to enter the market;
- US LNG exports will result in a much smaller increase in global gas supply than the volume of US exports;
- European LNG infrastructure does not allow imports to replace Russian gas into Eastern and Central Europe; and
- Natural gas revenue is a small share of Russia's energy export revenues.

### Exports of US LNG are years away from start up

US LNG will not hit the market soon enough to play any role in the outcome of the current crisis in Ukraine. Cheniere Energy's Sabine Pass Terminal in Louisiana is the only US lower-48 LNG export terminal currently under construction, and only two additional terminals—Sempra's Cameron LNG project in Louisiana and Freeport LNG Development's Freeport terminal in Texas—have won final FERC approval as of August 2014. At least two other already approved projects have more or less established timelines and are approaching final investment decision. The Sabine Pass terminal is expected to start commercial operations in 2016, while the other projects are only expected to be operational after 2018 (Table 3). As a result, in our modeling we explore

**Table 3: US LNG export terminals with firm investment plans**

Project Type	Status	Project	Region	Start Date	Bcf/d
Brownfield	Under Construction	Sabine Pass (train 1-4)	US Gulf Coast	2016	2.2
Brownfield	Firm Plan	Freeport LNG	US Gulf Coast	2018	1.8
Brownfield	Firm Plan	Cove Point LNG	US East Coast	2018	0.8
Brownfield	Firm Plan	Lake Charles LNG	US Gulf Coast	2019	2.0
Brownfield	Firm Plan	Cameron LNG	US Gulf Coast	2020	1.7

Source: FERC, DOE, Goldman Sachs, press reports.

the impact of both our 9 bcf/d (93 bcm) and 18 bcf/d (186 bcm) scenarios in the 2020-2025 time frame.

### US LNG projects will displace higher cost projects elsewhere, limiting supply growth

While the introduction of US LNG exports in the global gas market will likely put downward pressure on world gas prices, it will have a relatively modest impact on the actual quantity of gas Russia sells to Europe (Figure 16). As a result, even with a high 18 bcf/day (186 bcm) of US LNG exports, Europe is unlikely to have the ability to completely cut itself off from Russian gas, nor could it cope with the sudden disappearance of those supplies. There are three reasons for this:

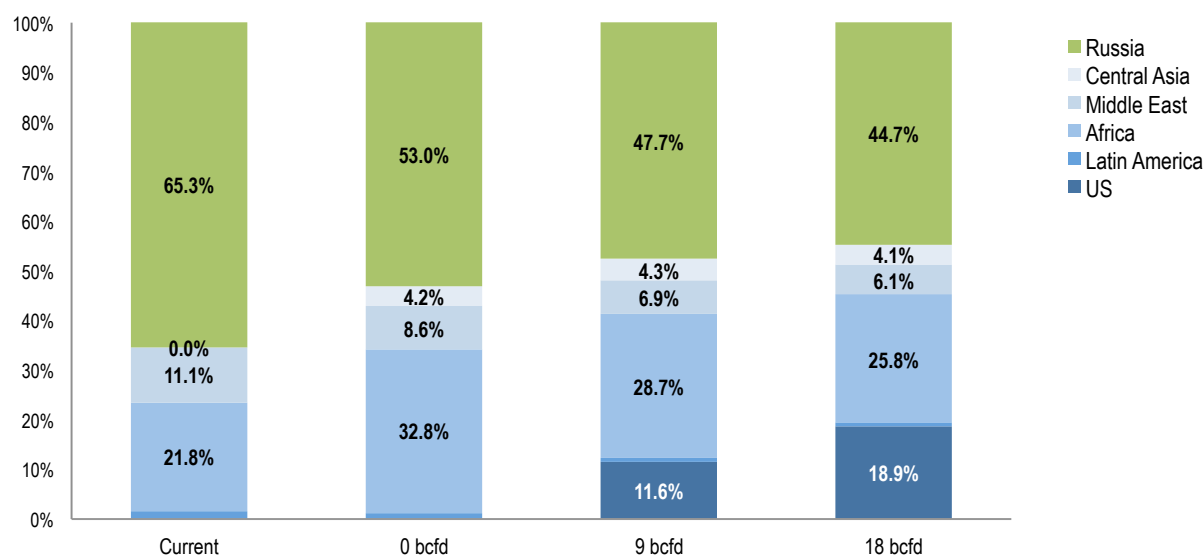
- the loss of other supplies to the global market that result from US LNG exports,
- the economics of Russian gas into Europe, and
- the existing long-term gas contracts between Gazprom and its European customers, most of which will still be in place in 2025.

First, not all the gas that the United States will sell abroad can be considered additional global supply. US LNG terminals are competing with other gas projects and producers

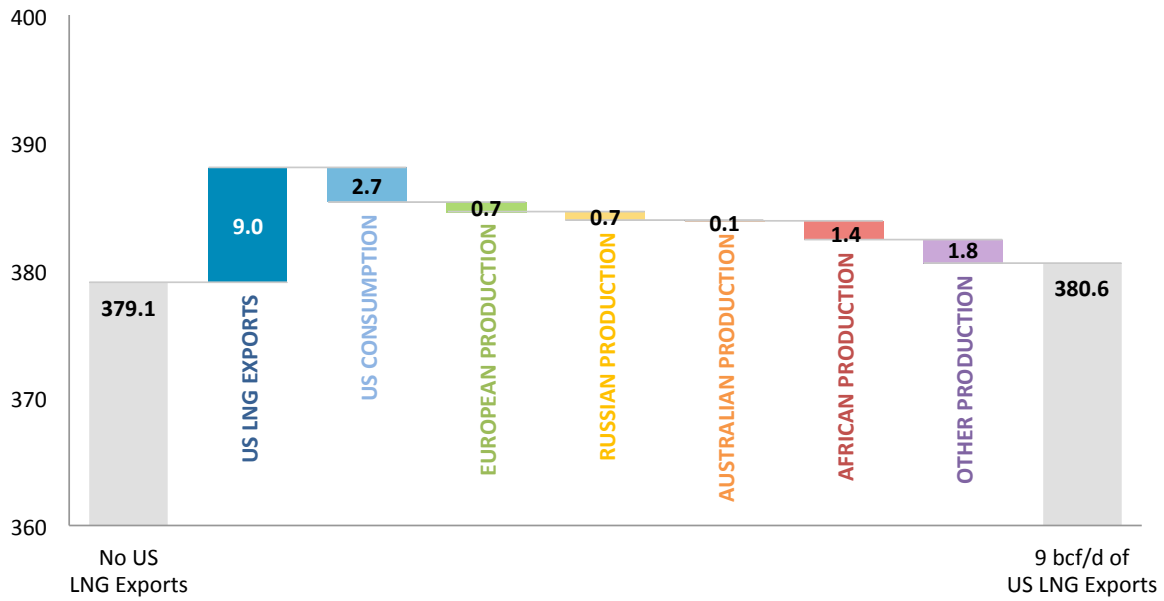
around the world for customers. The reduction in global gas prices as a result of US exports discussed above attracts new consumers, but also crowds out other producers. In economic terms, lower-cost US projects shift the global gas supply curve down and to the right, changing the point at which supply meets demand—the price—making some higher cost sources of supply uncompetitive.

In our modeling, Russian production falls by 0.7 bcf/d (7.2 bcm) in response to 9 bcf/d (93 bcm) of US LNG (Figure 17). European production falls by roughly the same amount, however, as some higher cost North Sea production struggles to compete. The biggest decline is in Africa, where US supply crowds out prospective African LNG projects. Additionally, increased foreign demand for US natural gas leads to a modest increase in domestic prices and reduction in domestic consumption. While the amount of gas the US produces for export rises, there is a small decline in the amount produced for the domestic market. Overall US production increases in response to higher US LNG exports, but not quite as much as the total exported volume. All told, 9 bcf/d (93 bcm) of US exports increases net global supply by 1.5 bcf/d (16 bcm).<sup>86</sup> The same dynamic occurs at 18 bcf/d (186 bcm) (Figure 18).

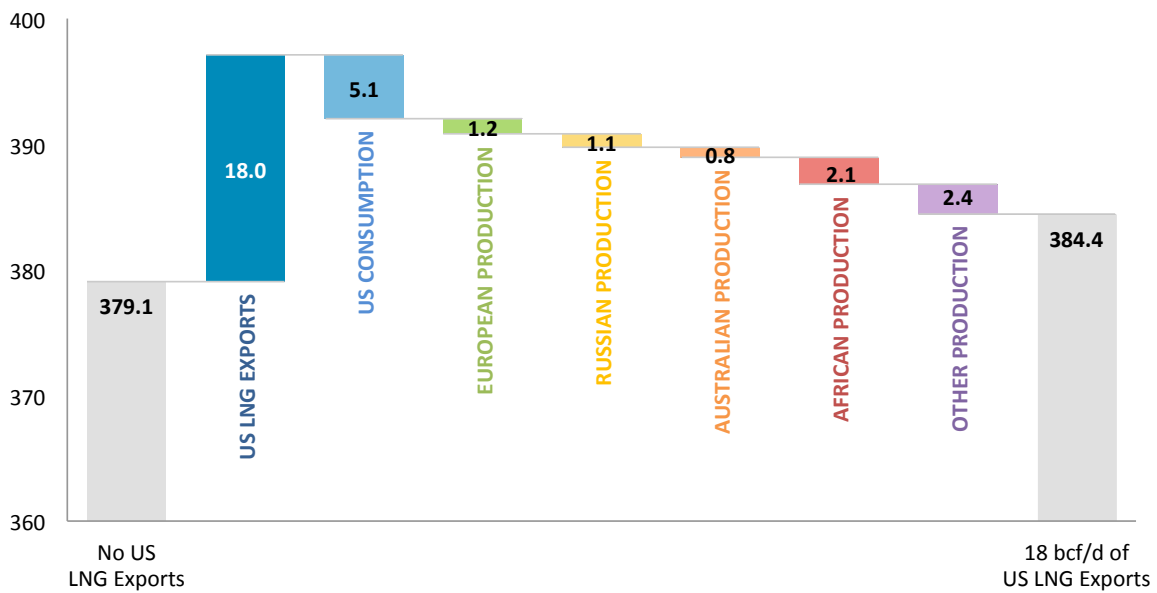
**Figure 16: Impact of US LNG on European gas suppliers**



**Figure 17: Impact of 9 bcf/d of US LNG exports on global gas supply Bcf/d**

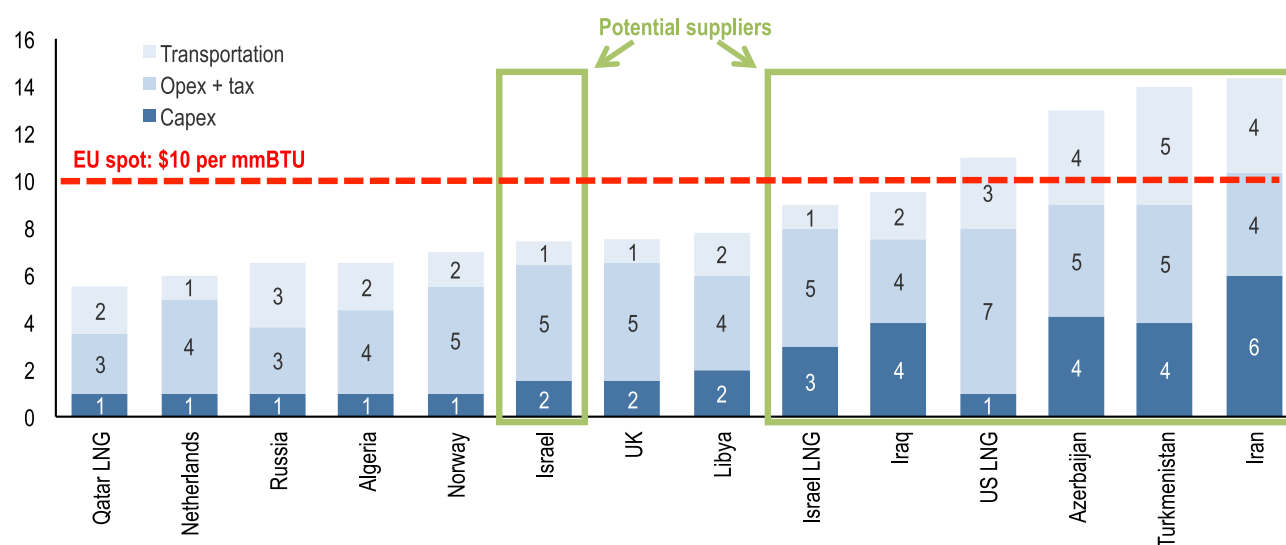


**Figure 18: Impact of 18 bcf/d of US LNG exports on global gas supply Bcf/d**





**Figure 19: Marginal cost of natural gas suppliers to Europe**  
\$ per mmBtu



Source: Morgan Stanley, IHS.

The second factor tying Europe to Russian gas is that it is relatively cheap and will likely remain competitive in the European market for the foreseeable future. Russia is among the lowest cost suppliers of gas in the European market, along with other existing gas exporters like Qatar, Algeria, and Norway (Figure 19). In our modeling, Russia's share of European gas<sup>87</sup> imports declines modestly in response to US LNG exports but still accounts for nearly half of all imports, even in the 18 bcf/d (186 bcm) scenario. While Europe has the physical ability over the long-term to replace all the gas it currently buys from Russia, such a move would require significant political intervention and is highly unlikely to occur only on commercial grounds. Gazprom appears to be sensitive to such political risk, and in its recent cutoff of supplies to Ukraine is walking a fine line between trying to exert its energy leverage without undermining its reputation as a reliable supplier.

Even if it were economic for Europe to replace Russian gas, volume obligations under existing long-term gas contracts would make it immensely difficult to do so. Such obligations will continue to require Gazprom's customers

in OECD Europe to take delivery of at least 10 bcf/d (103 bcm) of Russian gas in 2020, and more than 9 bcf/d (93 bcm) until 2027. These volumes assume a 70% take-or-pay commitment in European gas contracts.<sup>88</sup>

Russia has no real alternative market for much of its current and future natural gas production in the traditional West Siberian gas producing basins, and thus has an incentive to remain price competitive in Europe. Gazprom has long been working to diversify its exports to reduce its reliance on the European natural gas market, primarily via pipeline gas supplies to China. As discussed earlier, Russia recently concluded a long-term gas supply contract with China.<sup>89</sup> However, as noted, the feed gas to the new Russia-China pipeline link will be sourced from new East Siberian developments, which are not linked to European markets and as such the deal is unlikely to result in any diversion of Russian gas currently sold to Europe.

LNG development has also been part of Russia's long-term strategy to diversify its natural gas exports. If all current projects are executed as planned, Russia may have an ad-

ditional 6.8 bcf/d (70 bcm) of LNG liquefaction capacity by around 2020.<sup>90</sup> However, all Far Eastern projects are fed from East Siberian and Sakhalin Island developments, which do not currently supply the European market. Novatek's Yamal LNG development will also be supplied from a dedicated greenfield project in the far north Yamal Peninsula, and thus will not divert legacy gas production volumes away from Europe towards global LNG markets.<sup>91</sup> Gazprom's Baltic LNG project may divert some gas from European pipeline imports, but will likely supply the Spanish LNG market.<sup>92</sup> The vast Shtokman development in the Barents Sea is currently not deemed economically feasible.<sup>93</sup> Overall, even if the Russian LNG projects prove viable in the face of growing competition from US and Australian LNG projects, they will mobilize additional volumes and will not reduce Russia's ties to its main European export market.

### Central and Eastern Europe lack infrastructure to receive LNG volumes

A major barrier to replacing Russian pipeline gas with imported LNG is infrastructure. European LNG regasification capacity is theoretically sufficient to displace all Russian imports with LNG, but all currently operational LNG import terminals are located in Western and Southern Europe. Central and Eastern European countries are only now beginning to develop LNG import terminals in the Baltic Sea region.

The dearth of LNG terminals in Eastern Europe is due in large part to the extensive long-distance pipeline network,

built during the 1970's, that connects the main Russian gas producing areas with European end-users. This pipeline network had a combined carrying capacity of 16 bcf/d (168 bcm) at the end of 2013, and the spare capacity in the system has only grown over the past decade as Russia diverted some of its Western European gas shipments to the newly-built Nord Stream pipeline running under the Baltic Sea<sup>94</sup> (Table 4). The Russian pipeline network crossing Central and Eastern Europe will have even greater excess capacity if Gazprom and its European partners move ahead with the construction of the South Stream pipeline, which would bring Russian gas to the Central European Gas Hub in Austria and to a host of transit countries in Southeastern Europe.

Central and Eastern European gas markets are relatively small and poorly integrated, and many of them are landlocked. Gas demand in Central and Eastern European countries is also relatively low compared to Western European importers. Poland has the biggest population in the region, comparable to that of Spain. However, it only imports about 1.1 bcf/d (11 bcm) of natural gas annually, roughly 40% of Spain's imports in 2013, due to the Polish electricity sector's dependence on cheap domestic coal.<sup>95</sup>

The level of integration among these small Central and Eastern European gas markets is also relatively weak. The Soviet-era gas pipeline system spanning the region is oriented from east to west, while north-south connections were all but missing until the beginning of this decade. The gas trading infrastructure is also relatively immature in the re-

**Table 4: Russia-Europe pipeline capacity**

Pipeline System	Peak Transit Capacity	Est. Utilization
<b>Existing via Central and Eastern Europe</b>		
Ukraine (Soyuz/Brotherhood)	11.6 bcf/d	49%
Belarus (Yamal-Europe)	4.6 bcf/d	100%
<b>Existing via Other Routes</b>		
Nord Stream (Phase 1-2)	5.3 bcf/d	ca. 50%
Blue Stream	1.5 bcf/d	87%
<b>Under construction/planned</b>		
South Stream	6.1 bcf/d	n/a
Nord Stream (Phase 3-4)	2.7+ bcf/d	n/a

Source: Morgan Stanley, Oxford Institute for Energy Studies.

gion, and the only functional gas trading hub with sufficient liquidity serving the Central European region is located in Baumgarten, Austria.

Despite the many difficulties facing LNG infrastructure developments in Eastern Europe, a number of import terminal projects have recently broken ground (Table 5). Poland's 0.5 bcf/d (4.8 bcm) LNG import terminal in Swinoujscie is under construction and expected to start commercial operations by mid- 2015.<sup>96</sup> Lithuania's 0.3 bcf/d (3.0 bcm)<sup>97</sup> floating LNG regasification unit is also largely complete and will begin receiving cargoes in 2015.<sup>98</sup> The prospects of LNG projects in the Adriatic and Black Sea regions are less favorable, however. None of the previously proposed LNG regasification projects in the Southeast European region appear to be making significant progress at the moment.

Political reaction to the Ukraine crisis could potentially accelerate the pace of LNG import terminal construction, especially in the Eastern part of Europe. Financing large-scale infrastructure projects purely out of energy security considerations has proved challenging in the past, as illustrated by the failure of the Nabucco pipeline project, which would have transported gas from the Caspian to Europe as part of efforts to diversify the Continent's gas supply.<sup>99</sup> In the case of the Polish LNG project, howev-

er, EU funds totaling \$180 million—about 15% of total project cost—helped ease financing difficulties.<sup>100</sup> For Lithuania, a substantial loan from the European Investment Bank as well as a price discount, which the country's gas company has secured from Gazprom, has mitigated some of the country's \$600 million investment in a costly supply diversification project.<sup>101</sup> Lithuania paid one of the highest rates for Russian gas among EU member states in 2013 of \$465 per thousand cubic meters, according to Reuters.<sup>102</sup> However, the country's gas utility, Lietuvos Dujos, negotiated aggressively and managed to obtain a substantial price discount from Gazprom in May 2014 by using the option of alternative LNG supplies as a bargaining chip.<sup>103</sup>

### Russia's revenues from gas exports are low and provide little leverage for the West

Oil and gas play a major role in the Russian economy. The country exported \$356 billion of oil and gas in 2013, accounting for more than two-thirds of total Russian export revenues<sup>104</sup> and one-sixth of Russian GDP (Table 6). Most of this, however, was from oil rather than natural gas. Russia's crude oil and refined products exports amounted to \$283 billion in 2013, whereas the total value of Russian natural gas exports was less than \$73 billion, of which an

Table 5: Proposed Central and Eastern European LNG import terminals

Country	Company	Name of Facility	Investment	Probability of Going Forward	Capacity (bcfd)	Last Reported Start Date
Albania	Grupio Falcione	Fiere	New Facility	Low	1.2	2016
Croatia	Plinacro	Krk Island	New Facility	Low	0.6	2016
Croatia	Total/Gazprom/E.ON/OMV	Adria LNG	New Facility	Low	1.5	2017
Estonia	Balti Gas	Paldiski	New Facility	Medium	0.25	2015
Estonia	Vopak, E.ON	Muga	New Facility	Low	0.28	2017
Finland	Gazum	Jeddihe or Tuikkiven	New Facility	Medium	0.2	2019
Finland	Gazum	Porsio Harbour	New Facility (small scale)	Low	0.01	2015
Finland	Outokumpu	Tornio Harbour	New Facility (small scale)	Low	-	2016
Latvia	Latvenerga	Riga	New Facility	Low	0.48	2016
Lithuania	Maipetos Nafta	Maipeda	New Facility	High	up to 0.29	2014
Poland	Gaz-System, Polska LNG	Swinoujscie	New Facility	High	0.48	2014
Poland	Gaz-System, Polska LNG	Swinoujscie	Expansion	Medium	0.72	-
Romania	Gaz-System, Polska LNG	Covidanta	New Facility	Low	0.77	-
Ukraine	NA	Yuzhnyi	New Facility	Low	0.48	2018

Source: Gas Infrastructure Europe Database (July 2013), Bloomberg Businessweek.

**Table 6: The significance of oil and gas exports to the Russian economy**

Export Revenues	\$ billion in 2013	% of GDP	% of Export Revenues
Crude Oil Export	174	8%	33%
Oil Products Export	109	5%	21%
<b>Total Oil Export</b>	<b>283</b>	<b>14%</b>	<b>54%</b>
Natural Gas Pipeline Export	67	3%	13%
LNG Export	6	0%	1%
<b>Total Natural Gas Exports</b>	<b>73</b>	<b>3%</b>	<b>14%</b>
<b>Total Oil &amp; Natural Gas Export</b>	<b>356</b>	<b>17%</b>	<b>68%</b>

Source: BOFIT, Central Bank of Russia, metals & mining export revenues from Goldman Sachs.

**Figure 20: Russian government revenue from natural gas exports**

Source: BOFIT, Central Bank of Russia.

estimated \$54 billion came from European pipeline gas exports (Figure 20). Going forward, it is possible that natural gas's share of Russia's energy export revenue may rise as Moscow implements various tax reforms to encourage greater investment in its oil sector, particularly unconventional production, which could reduce the share of oil rents captured by the state.<sup>105</sup> Expanded sanctions, if they continue to target oil rather than gas production, may have a similar effect.

The relatively small role of gas export revenues in the economic growth formula of the world's second largest gas producer is due in part to the fact that about 60% of Russian gas production is consumed in the large and inefficient domestic gas market and another 7% is used to operate the country's pipeline network.<sup>106</sup> To put the size of Russia's domestic gas market in context, the 28 members of the European Union consumed 42 bcf/d (438 bcm) in 2012 while Russia consumed 40 bcf/d (413 bcm).<sup>107</sup> The European Union has a population 3.5 times the size of Russia and an economy that is eight times larger. Of the Russian gas that is exported, roughly a quarter is shipped to CIS countries, typically at a discount, further reducing natural gas export revenue.<sup>108</sup> This discount applied to Ukraine as well, until Gazprom decided to unilaterally revoke it in April 2014. In contrast, Russia only consumes 31% of the oil it produces at home,<sup>109</sup> with oil exports accounting for 14% of GDP in 2013.<sup>110</sup>

## THE EUROPEAN SIDE OF THE LEDGER

American LNG will not free Europe from Russian gas. Even if planned export terminals were available today, they would not provide Europe with enough gas to replace Russian supply nor inflict enough economic pain to prompt a change in current Russian foreign policy. Expanded US natural gas exports can, however, improve European negotiating leverage, reduce long-term Russian influence in Europe, and significantly reduce European natural gas expenditures through increased competition and supply diversification. Even if US LNG supply does not routinely enter the European market, increased diversity of supply improves Europe's ability to weather temporary supply disruptions. Consistent with the US DOE's recent procedural change to eliminate conditional approvals, the Department should continue implementing its statutory authority to approve LNG export applications in a way that allows commercial considerations rather than regulators to determine the ultimate quantity of LNG export capacity built in the US. Capturing the benefits of US LNG will require European action as well, and expanding LNG imports is only part of an effective energy security strategy. Such a strategy should aim to reduce Europe's vulnerability to a disruption in Russian gas supply rather than simply reduce its dependence on Russian gas. The EU can do so by:

- boosting natural gas infrastructure investment;
- applying EU competition law to promote an integrated European gas market;
- increasing physical gas storage;
- increasing EU gas production; and
- improving energy efficiency.

### INVEST IN INFRASTRUCTURE FOR CENTRAL AND EASTERN EUROPE

Even if parts of Europe are able to import more LNG, other parts will have difficulty accessing volumes. The supply emergencies of 2006 and 2009 put the infrastructure gaps

among Central and Southeastern European countries in a particularly sharp light, and underlined the importance of creating an interconnected and integrated gas market in the region. While LNG import capacity can help—Lithuania is set to have a floating terminal in place by the end of 2014, for example—the natural gas transmission infrastructure in Central and Eastern Europe was developed during the Soviet-era, primarily to supply Western European gas markets, as discussed in the previous section. As a result, the primary orientation of the gas pipelines in Central and Eastern Europe is from east to west. North-south connections were almost entirely missing among Central and Eastern European member states until about a decade ago.

In the aftermath of the 2006 and 2009 gas supply disruptions, building out infrastructure has become a key priority, and the EU Commission has provided considerable co-funding for cross-border gas pipeline projects and other investments aimed at strengthening the European gas transmission grid, but there is much more to do. Since the 2009 gas crisis, new cross-border gas pipeline links have been constructed, notably between Hungary and Romania, Hungary and Croatia, Hungary and Slovakia,<sup>111</sup> and Romania and Bulgaria.<sup>112</sup> Transmission system operators in Central and Eastern Europe have also set out to strengthen the resilience of existing cross-border pipeline links by adding flow reversal capabilities to pipeline connections. For Ukraine specifically, there is some capacity to bring new supplies from neighboring countries. Ukraine and Slovakia, for example, signed a gas deal in July 2014 to supply 1 bcf/d (10 bcm) through the use of a previously inactive pipeline by 2015.

Completing the missing infrastructure links in vulnerable Central and Eastern European countries should remain a key goal. New north-south interconnectors and reverse flow capabilities among the Eastern EU member states cannot entirely replace imported Russian gas with other sources. Indeed, in many cases they will continue to transit Russian gas, just via different routes. Rather, the main ben-



efit of stronger interconnections between these countries is to provide flexibility if one of the main Russian import routes suddenly shuts down—presumably the Ukrainian flow—causing another supply emergency.

The EU Commission’s recently adopted energy security strategy emphasizing the need to complete the internal energy market and build the missing infrastructure links across the EU is a step in the right direction. A continued commitment by the EU Commission to support the construction and later expansion of the so-called Southern Corridor, which will take Caspian gas to the European market via Turkey and the Trans-Adriatic Pipeline (TAP) around 2020, remains essential. At present, particularly with the demise of the Nabucco pipeline project, Russia is expanding its grip on the European gas market—its so-called “bear hug”<sup>113</sup>—through the recently completed Nord Stream—OPAL—Gazelle pipeline system linking Russia with Germany and the Czech Republic, along with its continuing efforts to complete the South Stream pipeline.

## APPLY EU COMPETITION LAW TO PROMOTE AN INTEGRATED EUROPEAN GAS MARKET

Building the missing infrastructure links only provides the backbone of a truly liberalized and competitive gas market in Europe. For the interconnected national gas markets to effectively function as a single market, regulatory and policy action is also required. Recognizing this, the European Commission introduced a set of measures to further liberalize European gas markets shortly after the 2009 gas crisis.<sup>114</sup> This so-called third energy package set the goal of creating a truly integrated European energy market by the end of 2014, a target that is likely to be missed. Europe remains a patchwork of national gas markets, which are liberalizing under their own models, and subjected to increasingly complex regulations, which the Commission will ultimately need to harmonize.<sup>115</sup>

Destination restrictions remain an obstacle to an integrated European market. Although they have been illegal for a decade, to the extent they remain in existing long-term contracts, the EU Commission’s antitrust case against

Map 2: The Ukrainian and the Yamal-Europe gas pipeline system



Source: Oxford Institute for Energy Studies.

## THE IMPORTANCE OF SOUTH STREAM

Gazprom's controversial South Stream project, which would carry gas across the Black Sea to Bulgaria and eventually Austria, would bypass Ukraine for European gas transit, similar to the Yamal pipeline through Belarus to Poland or the Nord Stream pipeline linking Russia to Germany through the Baltic. The \$46 billion project would add 6.1 bcf/d (63 bcm) of gas import capacity in Europe, and open an additional supply route for Central and Southeast European markets. From a purely supply security perspective, the project could enhance energy security in Europe by ensuring that enough transit capacity is available, even if gas flows through the main Ukrainian route are completely stopped. The pipeline would also be advantageous for transit countries, which explains why countries such as Bulgaria, Hungary, and Austria favor the pipeline.

Yet South Stream does nothing to reduce European dependence on Russian gas or vulnerability to a disruption of Russian supply. It should not be mistaken for a purely commercial project or for a genuine effort by Gazprom to improve supply security in Europe. Instead, South Stream is a vastly expensive geopolitical project with questionable commercial rationale. It was conceived primarily as a geopolitical tool to advance Russia's strategic objectives, namely to undermine Ukraine's bargaining power in the two countries' complicated gas relationship, and to further strengthen Gazprom's market position in certain Central and Eastern

European and Southeast European markets. The enormous project cost will at least partially be paid for by European transit countries and consumers, while Ukraine would lose revenue and see its bargaining position severely eroded.

At this time, in the wake of the Ukraine crisis, the Commission is blocking the project. It has refused to provide exemption from third-party access for South Stream, among other necessary approvals, which undermines the feasibility of the project. In 2013, the Commission ruled that Gazprom's intergovernmental agreements with South Stream's European transit countries were in violation of EU gas market rules, and ordered the renegotiation of these agreements. Brussels has also recently ordered Bulgaria to suspend construction work on the Bulgarian section of the South Stream pipeline due to the country's non-compliance with EU rules for awarding public contracts. In June 2014, EU Energy Commissioner Gunter Oettinger said he saw no point in further discussions with the Russian government or with Gazprom about bringing South Stream into conformity with the EU's Third Energy Package.<sup>1</sup> The Commission should continue to ensure that competition issues related to the South Stream project are properly addressed. Ultimately, the resolution of the regulatory issues around South Stream need to be viewed in a broader geopolitical context and be part of an overall settlement of the territorial and gas pricing disputes between Russia and Ukraine.

**Map 3: The Blue Stream and the proposed South Stream pipelines**



Source: Oxford Institute for Energy Studies.

Gazprom needs to eliminate them, notably restrictions on reverse flows and third party access to the main Russian transit pipelines in Europe, such as Yamal Europe.<sup>116</sup>

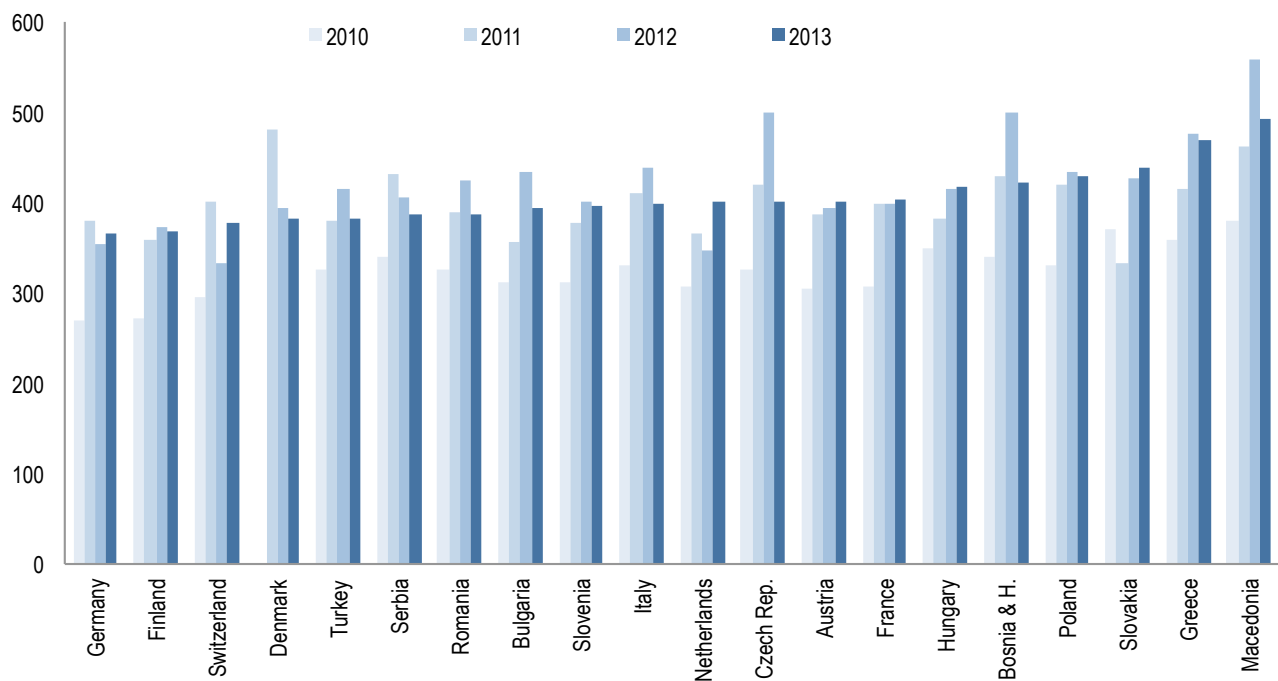
Even if destination clauses are not explicitly in contracts, Gazprom can effectively block reverse flows under its long-term gas transportation contracts. This is particularly problematic in Eastern European transit countries of Russian gas, such as Poland, Romania and Bulgaria, where pre-liberalization transit agreements remain in place, guaranteeing preferential access for Gazprom and its local partners to the transit pipelines and thus restricting third-party access.<sup>117</sup> The transit pipelines represent significant cross-border capacities, which, at present, are effectively owned by Gazprom. Opening these pipelines to third parties could facilitate reverse flows from west to east, and challenge the dominance of Russian gas in the Central and Eastern Europe gas markets.<sup>118</sup> These transit terms are typically enshrined in intergovernmental agreements, which would have to be renegotiated by the respective national governments and Russia. The problem is that transit countries benefit more

from the ship-or-pay revenues received from Gazprom under these legal arrangements than from the timely implementation of the EU's market liberalization rules.

The fact that Germany or Austria can receive gas at a cheaper price from Gazprom than can Hungary, Poland or Slovakia (Figure 21), even though they are farther from Russia, highlights the lack of pipeline interconnections and market integration. But beyond infrastructure problems, it also indicates that some Central and Eastern European countries could do more to further liberalize their gas markets and open both the wholesale and the retail segments to greater competition.

As of mid-2013, the EU Commission had infringement proceedings in progress against all three countries for failure to transpose third-package rules related to gas transit.<sup>119</sup> The European Commission should continue to take an active role in eliminating implicit or explicit destination restrictions from European gas trade by vigorously enforcing the EU anti-competition rules and by participating in the renegotiation of restrictive contract terms.

**Figure 21: Russian long-term contract gas prices to European countries 2010-2013**  
\$ per '000 cubic meters



Source: The Oxford Institute for Energy Studies, *The Russian Gas Matrix: How Markets Are Driving Change*.



## EXPAND EUROPE'S UNDERGROUND GAS STORAGE CAPACITY AND POOLED RESERVES

European countries had a total of 145 underground storage (USG) facilities in mid-2013 and another 54 facilities were under construction, or planned last year, according to Gas Infrastructure Europe.<sup>120</sup> There are some notable gaps on the European underground storage capacity map. EU member states Finland, Estonia, Lithuania and Slovenia as well as non-EU members Macedonia, Bosnia and Moldova, for example, have no underground storage facilities, even though they are heavily dependent on Russian natural gas imports. Ukraine, on the other hand, has one of the largest underground gas storage capacities in Eastern Europe. This can provide the country with a considerable cushion against short-term supply disruptions, even though a large part of the gas in Ukrainian storage serves to ensure the uninterrupted transmission of Russian gas to Europe.<sup>121</sup>

Expansion projects currently under construction and planned would boost European working underground gas storage capacity from 4.5 to 6.0 tcf (128 to 169 bcm).<sup>122</sup> The vast majority of capacity expansion projects are planned in Western Europe—in Germany, Italy, Netherlands and the UK—while the sizeable capacity additions in Eastern Europe are concentrated in Latvia, Poland and Romania.

At best, underground storage provides only limited relief in the event of a major supply shortfall, even in countries that have sufficient working gas storage capacity. Underground storage is not a feasible substitute for imported gas over an extended period of time. Storage facilities are typically designed to allow for seasonal balancing—filled during summer months in order to meet peak demand during the winter months. If they are drawn down to meet a major supply disruption, additional supplies will still be needed to meet winter demand. Moreover, withdrawal capacity generally falls short of daily natural gas requirements in many European countries, especially during the peak winter months. The primary purpose of underground storage facilities in Europe is to balance seasonal demand fluctuations, and not necessarily to serve as a last resort option in the event of a supply disruption. Only a handful of European countries, notably Hungary, Italy, Portugal, Romania and Spain, have mandatory strategic gas storage obligations in place, which require a certain amount of gas to be reserved for genuine supply emergencies.<sup>123</sup> This is similar to the approach taken by consumer nations holding strategic oil stocks.

The European Commission's recent proposal to pool a small part of Europe's existing strategic gas stockpiles in a virtual common capacity reserve, under the auspices of the IEA, for example, deserves further investigation, and the Commission should be prepared to provide public funding to support such supply security initiatives if necessary.<sup>124</sup> As was proposed in the Hampton Court Summit of 2005, there is merit to the idea of setting up a Europe-wide strategic gas storage requirement, along with associated rules for use, storage levels, and sharing of costs—although a careful analysis of costs and benefits is required. In the meantime, the EU regulation passed in 2010 (Regulation 994/2010) on security of gas supply required Member states to ensure that by end-2014 they could withstand a cut off from their single largest supplier. When the Commission checked in May 2013, only 16 of the EU-28 countries had met this standard. Meeting this standard should be a priority for Member countries.

## INCREASE EUROPEAN GAS DEVELOPMENT

Europe has significant shale gas resources, although the estimates still vary greatly. According to the US Energy Information Administration in 2013, Europe has 470 tcf (13.3 tcm) of technically recoverable shale gas reserves, compared to 567 tcf (16 tcm) in the United States.<sup>125</sup> A literature review of 50 sources by the EU Joint Research Centre in 2012 found that high, best, and low estimates of technically recoverable shale gas in the EU were 621 tcf, 561 tcf, and 81 tcf (17.6 tcm, 15.9 tcm, and 2.3 tcm), respectively.<sup>126</sup> Ukraine has the third-largest technically recoverable shale gas resources in Europe, behind Poland and France.<sup>127</sup>

Exploration activity has been minimal, however, and significant legal, regulatory, and technical challenges exist. Compared to the United States, shale resources in Europe are challenged by many factors, including:

**Less favorable geologic conditions:** Typically, resources in Europe are trapped in shale layers that are much deeper than in the United States, raising the cost of extraction.<sup>128</sup> Test drilling operations in Poland, for example, showed geologic conditions there not as favorable as in the United States.

**Greater population density:** The most extensive shale developments are taking place in sparsely populated parts of the United States. The efficient development of so-called sweet spots in shale plays require the drilling of a large num-

ber of wells in relatively tight spacing. This type of development is less feasible in Europe, where population density is more than three times greater than in the United States.

**More restricted access to infrastructure:** In Eastern Europe in particular significant investments in infrastructure are needed to consume and import gas. Moreover, Europe lacks the rules in place in the United States that ensure shared access to pipelines at tariff rates set by regulators, thus preventing the owner of the pipeline from also owning and controlling the commodity flowing through it.

**Weaker public support:** The public debate in Europe has raised far more public concern about shale development than in the United States.<sup>129</sup> Countries like Germany have moved slowly and called for further study. Others like France have banned shale outright. The United Kingdom has been among the most supportive, but even there the pace of potential development is slow due to public opposition.

**Lack of private mineral rights ownership:** The United States is unique in that the landowner often owns the mineral subsurface rights as well. That means that communities see tangible benefits from shale development that they would not in many other places in the world. European policymakers must ensure that communities in which development occurs also benefit from the revenue and royalties collected.

**More concentrated oil and gas industry:** Independent producers, not the large majors, led the US shale revolution. These smaller companies were willing to take on the high risk, high reward potential of the US unconventional resource base, while the larger, more risk averse energy majors were largely on the sidelines, at least in the early stages of the shale boom. The oil and gas industries in European countries are dominated by a few larger integrated players and a number of national champions, and lack the large number of independent exploration and production companies found in the United States, and to a lesser extent, Canada and Australia.

**Less developed service industry:** North America has by far the most developed and vibrant oilfield service sector in the world. In early 2012, it was estimated that over 2,000 rigs were available to the US industry for onshore development versus 72 in Europe.<sup>130</sup> It will take some time for the service sector to ramp up production in Europe, even if all other challenges are eventually overcome.

Through regulations that give producers both the necessary incentives to develop and build public confidence by requiring the highest standards of safety and enforcement, EU countries can begin to create the conditions that will allow shale production to occur. But it is important to be realistic that the scope is likely to be more limited and take much longer than in the United States.

The United States can help in these efforts by providing technical support and expertise to European regulators on how to develop shale safely and economically—something it has been doing already, for example, through a State Department program.<sup>131</sup> US officials can also support countries by working to expand access for American firms with experience and expertise in developing shale resources.

Although beyond the scope of this paper, promoting the development of a wide range of indigenous renewable fuels and nuclear power can also increase diversity of supply and resilience to supply shocks as well as help the EU meet its aggressive climate change goals.

## CREATE INCENTIVES TO BOOST ENERGY EFFICIENCY AND CUT GAS DEMAND

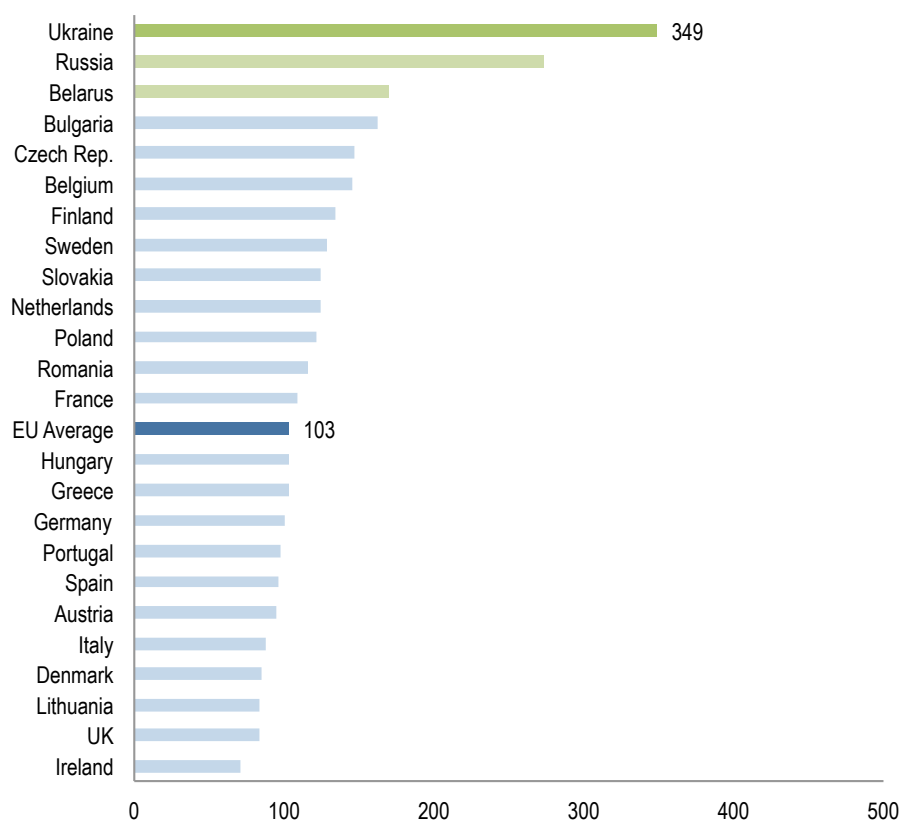
Improving energy efficiency can play a significant role in reducing European natural gas demand and imports in the medium- to long-term. The EU Commission's latest energy efficiency plan, which was released in July 2014, proposes a 30% reduction in primary energy consumption compared to 2007 baseline projections by implementing a set of energy efficiency measures.<sup>132</sup> The accompanying impact assessment suggests that such a reduction would result in 26% lower natural gas imports in the EU in 2030 relative to the baseline, which is equivalent to an 8 bcf/d (82 bcm) decline in net imports relative to the reference scenario.<sup>133</sup> The annual net cost of implementing the 30% target at the energy system level would average about \$27 billion through 2030,<sup>134</sup> as the majority of energy efficiency investments would be offset by fuel cost savings. Energy savings would primarily occur in the residential and commercial sector, as much of the industrial sector in Europe is already highly energy efficient.<sup>135</sup> Note these targets are not mandatory, but indicative of what can be achieved on energy efficiency at modest cost.

Energy efficiency measures would be especially important for Eastern European member states. The share of natural gas in residential and commercial heating is especially high in Hungary, Slovakia, and the Czech Republic, about 52%, 49% and 39%, respectively in 2012, versus 35% for the EU as a whole.<sup>136</sup> In addition, for the reasons previously mentioned, the share of Russian gas in natural gas imports is vastly higher in the Eastern part of the EU than in the older member states. Therefore, cutting energy demand in Eastern member states' residential and commercial sectors, where the greatest potential lies, may be among the most cost-efficient way to reduce Russian gas imports.

The Ukrainian economy is particularly inefficient in its energy use, and has the potential to reduce energy demand considerably. Generating a million dollars of PPP-adjusted GDP requires 3.5 times more energy in Ukraine than the average EU member state, and more than two times as much as in the most energy-intensive Eastern EU member states, Bul-

garia and the Czech Republic (Figure 22). The IEA noted in a 2012 assessment of Ukraine's energy policies that huge energy efficiency potential remains in the country's residential and industrial sectors, that district heating systems are in "dire need of refurbishment", and that the building stock is poorly insulated.<sup>137</sup> Heavily subsidized gas, heat, and electricity prices remain a considerable burden on the economy, accounting for an estimated 7.5% of GDP in 2012, and are a major obstacle to more efficient energy use.<sup>138</sup> The IMF has recently set the gradual reduction of natural gas subsidies in Ukraine as one of the main conditions for a \$17 billion loan package for the country.<sup>139</sup> Similar incentives should be provided to further financial assistance programs targeting Ukraine. The removal of subsidies and reduction of energy intensity in Ukraine could yield triple dividends, resulting in fuel cost savings, cutting dependence on imported Russian gas, and making the country's energy companies, particularly state-owned Naftogaz, economically viable entities over time.

**Figure 22: Energy Intensity in Selected Economies in the EU and FSU Regions**  
Toe per million \$ of GDP (PPP)



Source: IMF, BP Statistical Review of World Energy 2014.

## CONCLUSION

The shale gas revolution has transformed the North American energy landscape and upended the outlook for the global natural gas market. Already, the US shale gas boom has displaced a large volume of imports previously expected to meet US demand, freeing up those supplies and improving the bargaining position of consuming regions like Europe. By the end of the decade, US exports will help further loosen the LNG market to the benefit of European consumers and the detriment of Russian producers.

Despite the recent rhetoric, US LNG exports are not a solution to the current crisis in Ukraine and will not free Europe from Russian gas. Europe will remain dependent on Russia for the majority of its gas supplies with or without US LNG. Over time, however, US LNG can help Europe minimize the amount of leverage Russia gains from selling gas to Europe, as part of a broader European energy security policy agenda.

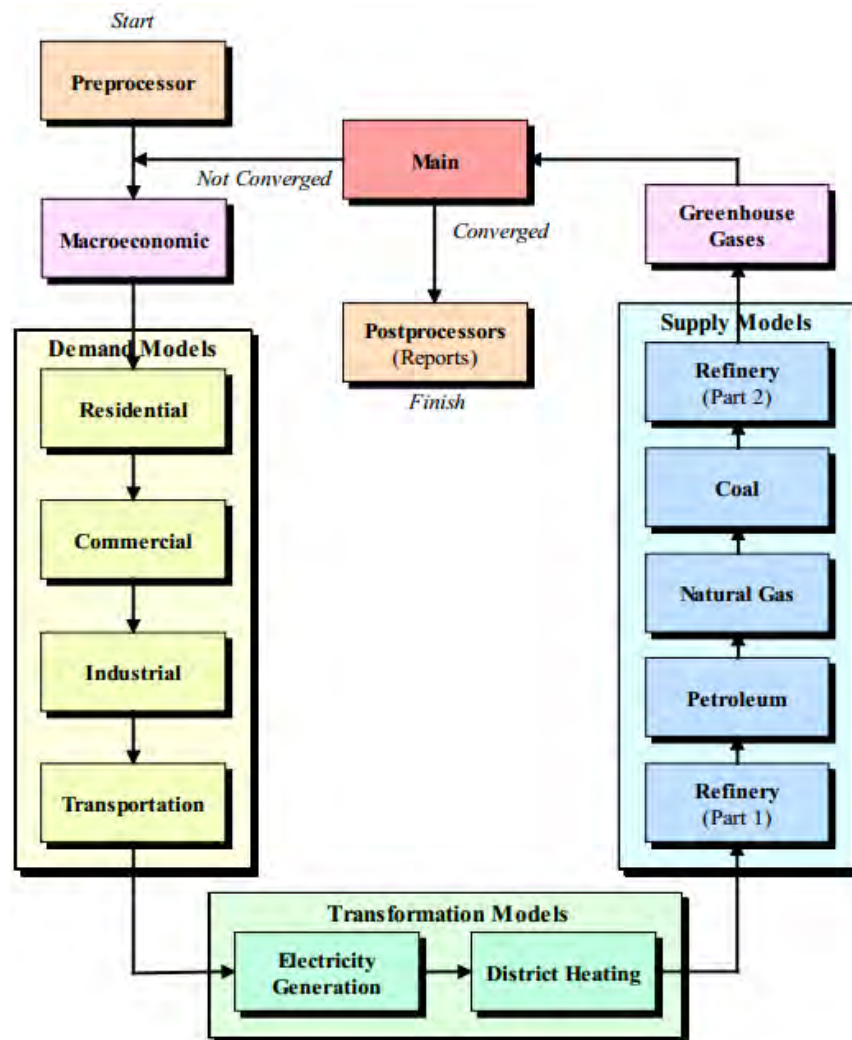
## APPENDIX I

### MODEL DOCUMENTATION

To assess the impact of LNG exports from the United States on international natural gas markets, this study leverages a set of interconnected energy-economic models developed and updated by the US Energy Information Administration (EIA).<sup>140</sup> Rhodium Group (RHG) maintains an in-house version of each of these models and results presented

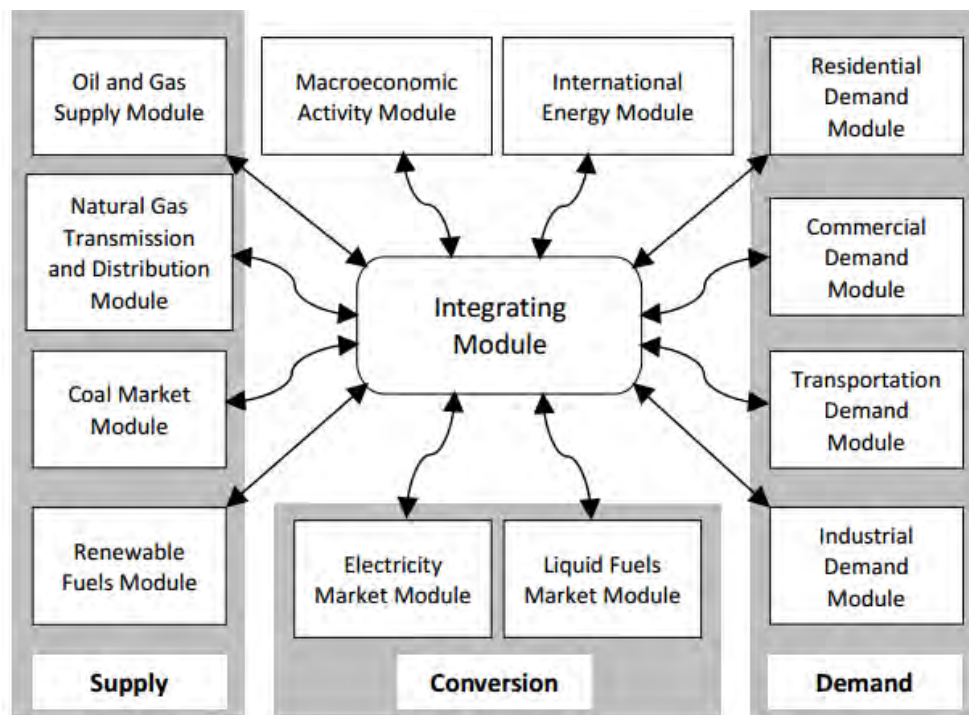
in this report are from the simulation runs conducted by RHG.<sup>141</sup> We chose these models because they are publicly available and fully documented, and because they are used to produce the Annual Energy Outlook (AEO) and International Energy Outlook (IEO), the most frequently referenced projections of US and global energy supply and demand respectively.

**Figure 1: Structure of the World Energy Projections System Plus (WEPS+)**



Source: EIA.



**Figure 2: Structure of the National Energy Modeling System (NEMS)**

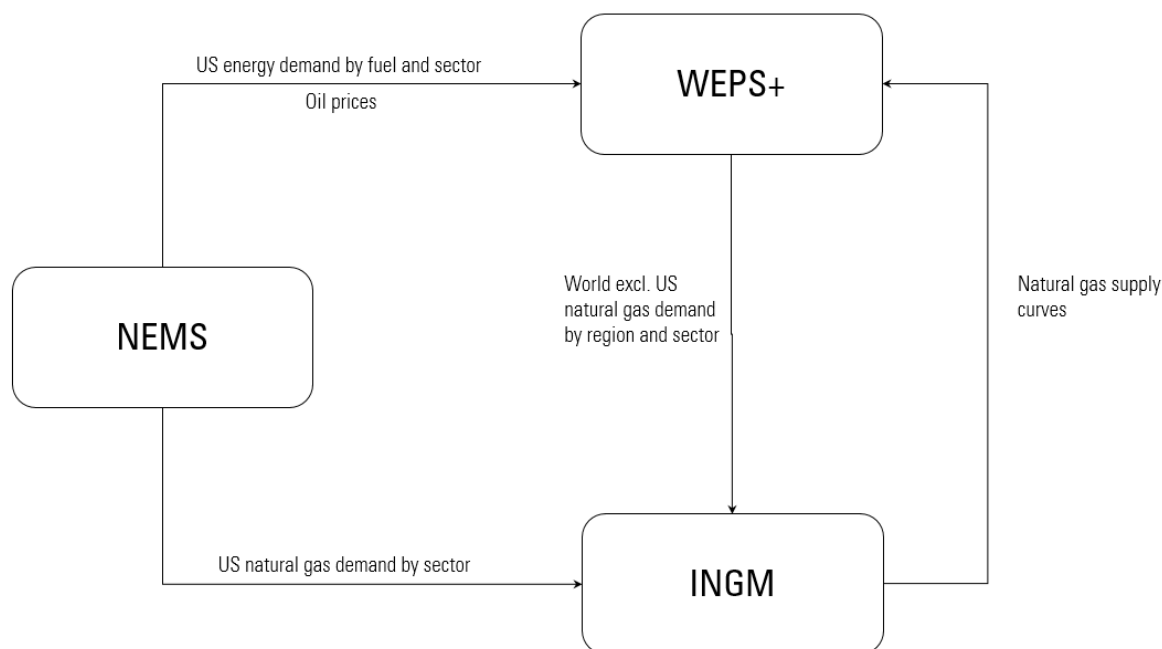
Source: EIA.

To produce the IEO, the EIA relies primarily on the World Energy Projection System Plus (WEPS+). WEPS+ is modular in design and incorporates a number of separate energy models, integrated through the overall system model (Figure 1). These models project energy system variables for sixteen WEPS+ regions. Although the details of each of these models differ,<sup>142</sup> they all equilibrate demand and supply in a specific energy sub-system. The demand models forecast energy consumption and supply models forecast energy production, given price, GDP, policy and technology input assumptions. The Main model iterates through each of these models until energy demand equals energy supply at an equilibrium price for all sectors and fuels. The macroeconomic assumptions for WEPS+ come from IHS Global Insight's world macroeconomic model.

To project world energy supply and demand, WEPS+ integrates two other models—the National Energy Modeling System (NEMS) and International Natural Gas Model (INGM). NEMS, the model used by EIA to produce the AEO, is an energy-economic model that combines a de-

tailed representation of the US energy sector with a macroeconomic model provided by IHS Global Insight. The version of RHG-NEMS used for this analysis is keyed to the 2013 version of the AEO.<sup>143</sup> Like WEPS+, NEMS is designed as a modular system with a module for each major source of energy supply, conversion, activity and demand sector, as well as the international energy market and the US economy (Figure 2). US energy supply and demand projections in WEPS+ are taken from NEMS.

INGM provides the natural gas supply curve used in the WEPS+ Natural Gas Supply Model. INGM is a stand-alone<sup>144</sup> global gas market forecasting model. It provides a detailed outlook for gas production, consumption, price and trade flows for 61 regions around the world. The model contains region-specific resource availability and production cost estimates for conventional onshore gas, conventional offshore gas, tight gas, shale gas and coalbed methane and transportation and processing cost estimates both for LNG and pipeline gas. Regional and sectoral demand estimates are provided by WEPS+.<sup>145</sup>

**Figure 3: Integrating WEPS+, NEMS and INGM**

The basic assumption behind the model is that gas producers, consumers and transportation providers will behave competitively and hence gas supply and demand in each region will be determined by market equilibrium, subject to policy and market constraints. While recognizing that oil-linked long-term contracts dominate current LNG and pipeline gas trade, the model assumes that marginal supply and demand decisions reflect marginal cost, based on underlying supply, demand and transportation fundamentals. The model employs a linear program (LP) to simulate competitive natural gas markets. The LP combines multiple activities at different regions and optimizes them to determine the market equilibrium for each year of the simulation.

For this study, we modeled three US LNG export scenarios. The first is a reference scenario in which the US does not export any LNG. We then compare this to two export scenarios, one in which the US exports 9 bcf/d of LNG in the 2020-2025 timeframe and another in which exports reach 18 bcf/d during that period.

For each scenario, we start by running NEMS to access the impact of 0, 9 and 18 bcf/d of LNG exports on natural gas supply and demand within the US. The AEO 2014 version of NEMS endogenously models the LNG exports but also allows exports to be exogenously specified, which we do for this study. The US natural gas demand projections from each of these scenarios are then passed to WEPS+. We then modify the amount of US LNG export capacity available in INGM under each scenario and update the natural gas supply curves in each of the sixteen WEPS+ regions.<sup>146</sup> We then run WEPS+ for each scenario to find the new supply and demand equilibrium and resulting change in production, consumption, price, and trade patterns.



## APPENDIX II

### GAZPROM GAS DELIVERIES BY COUNTRY

Country	Exported Volumes in 2013 (Bcm/year)
Austria	5.2
Belgium	-
Bulgaria	2.9
Croatia	0.2
Czech Republic	7.9
Denmark	0.3
Estonia	0.7
Finland	3.5
France	8.6
Germany	41.0
Greece	2.6
Hungary	6.0
Ireland	0.5
Italy	25.3
Latvia	1.1
Lithuania	2.7
Netherlands	2.9
Poland	12.9
Romania	1.4
Slovakia	5.5
Slovenia	0.5
UK	16.6
Other EU28	1.2
<b>Total EU28</b>	<b>149.5</b>
Turkey	26.7
Switzerland	0.4
Serbia	2.0
Bosnia and Herzegovina	0.2
Macedonia	-
<b>Total Other Europe</b>	<b>29.3</b>
<b>Total Greater Europe</b>	<b>178.8</b>

Source: Gazprom in Figures 2009-2013.

## NOTES

- 1 For example, *“The ability to turn the tables and put the Russian leader in check lies right beneath our feet, in the form of vast supplies of natural energy.”* US House of Representatives Speaker John Boehner, from his op ed “Counter Putin by Liberating U.S. Natural Gas,” *Wall Street Journal*, March 6, 2014, <http://online.wsj.com/news/articles/SB10001424052702303824204579421024172546260>;
- “It’s time for America to hit Russia where it hurts; namely, in its wallet.”* Ohio Rep Bill Johnson, from his op ed Boosting natural-gas exports can hit Russia where it hurts,” *Washington Times*, March 5, 2014, <http://www.washingtontimes.com/news/2014/mar/5/johnson-boosting-natural-gas-exports-can-hit-russia/>;
- “American natural gas exports would help Ukraine free itself from Russian energy and Putin’s political manipulation.”* US Sen John Barrasso, from a statement on his website, [http://www.barrasso.senate.gov/public/index.cfm?FuseAction=PressOffice.PressReleases&ContentRecord\\_id=9572cd71-aeb6-6e59-520a-6bf78582eafe&IsPrint=true](http://www.barrasso.senate.gov/public/index.cfm?FuseAction=PressOffice.PressReleases&ContentRecord_id=9572cd71-aeb6-6e59-520a-6bf78582eafe&IsPrint=true);
- “[LNG exports] would reassure our allies and send a message to Putin.”* US Rep Ed Royce, from “Rep. Royce, headed to Ukraine, says US underestimates Putin,” by Cathy Taylor, *Orange County Register*, April 16, 2014;
- “Today, the US has the leverage to liberate our allies from Russia’s stranglehold on the European natural-gas market.”* US Sens John McCain and John Hoeven, from their op ed “Putting America’s Energy Leverage to Use,” *Wall Street Journal*, July 28, 2014, <http://online.wsj.com/articles/john-hoeven-and-john-mccain-putting-americas-energy-leverage-to-use-1406590261>.
- 2 For the purposes of this paper, billion cubic feet per day figures are converted into billion cubic meters per year throughout, assuming 1 billion cubic meters = 35.3 billion cubic feet of natural gas. Billion cubic meter per year figures are shown in parentheses after the bcf/d figure in text.
- 3 Energy Information Administration, “Natural Gas Gross Withdrawals and Production,” [http://www.eia.gov/dnav/ng/ng\\_prod\\_sum\\_dcu\\_nus\\_m.htm](http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_nus_m.htm).
- 4 US Energy Information Administration, “US natural gas prices,” [http://www.eia.gov/dnav/ng/ng\\_pri\\_sum\\_dcu\\_nus\\_a.htm](http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm).
- 5 International Energy Agency, Medium-Term Gas Market Report 2013, p73-74.
- 6 EIA Short-Term Energy Outlook, <http://www.eia.gov/forecasts/steo/report/natgas.cfm>.
- 7 US Energy Information Administration, “US natural gas imports by country,” [http://www.eia.gov/dnav/ng/ng\\_move\\_imp\\_s1\\_m.htm](http://www.eia.gov/dnav/ng/ng_move_imp_s1_m.htm).
- 8 US Energy Information Administration, “EIA Annual Energy Outlook 2005 to 2025,” <http://www.eia.gov/forecasts/archive/aeo05/>.
- 9 BP Statistical Review of World Energy 2014, “Middle East in 2013,” <http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2014/BP-Statistical-Review-of-World-Energy-2014-Middle-East-insights.pdf>.
- 10 Federal Energy Regulatory Commission, “North American LNG Import/Export Terminals as of August 15, 2014,” <http://ferc.gov/industries/gas/indus-act/lng/lng-existing.pdf>.
- 11 US Energy Information Administration, “US net natural gas imports (annual),” <http://www.eia.gov/dnav/ng/hist/n9180us1A.htm>.
- 12 BP Statistical Review 2014, p29.
- 13 For more details on the EIA’s 2005 forecast for natural gas imports, see EIA Annual Energy Outlook 2005, [http://www.eia.gov/forecasts/archive/aeo05/pdf/0383\(2005\).pdf](http://www.eia.gov/forecasts/archive/aeo05/pdf/0383(2005).pdf).
- 14 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2013,” [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_fv.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_fv.pdf).
- 15 US Energy Information Administration, Japan country brief, <http://www.eia.gov/countries/cab.cfm?fips=ja>.
- 16 BP Statistical Review 2014, p27.
- 17 For further details on the IEA’s estimated costs to ship US LNG to Japan, see Table 3.7 of the IEA World Energy Outlook 2013, p133.

- 18 US Office of Fossil Energy, “Natural Gas Regulation,” <http://energy.gov/fe/services/natural-gas-regulation>.
- 19 US Office of Fossil Energy, “How to Obtain Authorization to Import and/or Export Natural Gas and LNG,” <http://energy.gov/fe/services/natural-gas-regulation/how-obtain-authorization-import-and-or-export-natural-gas-and-lng>.
- 20 US Office of Fossil Energy, “Summary of LNG Export Applications of the Lower 48 States before the Department of Energy (as of July 31, 2014),” <http://energy.gov/sites/prod/files/2014/08/f18/Summary%20of%20LNG%20Export%20Applications.pdf>.
- 21 Not all countries that have an FTA with the United States require national treatment for trade in natural gas, (i.e. Costa Rica and Israel). See Office of Fossil Energy, “How to Obtain Authorization to Import and/or Export Natural Gas and LNG,” <http://energy.gov/fe/services/natural-gas-regulation/how-obtain-authorization-import-and-or-export-natural-gas-and-lng>.
- 22 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2013,” p8-9, [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_fv.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_fv.pdf).
- 23 BP Statistical Review, p28.
- 24 US Department of Energy, “Long Term Applications Received by DOE/FE to Export, Domestically Produced LNG from the Lower-48 States (as of July 31, 2014),” <http://www.energy.gov/sites/prod/files/2014/08/f18/Summary%20of%20LNG%20Export%20Applications.pdf>.
- Federal Energy Regulatory Commission, “North American LNG Import /Export Terminals Approved,” <http://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf>.
- 25 US Department of Energy, “Procedures for Liquefied Natural Gas Export Decisions,” *Federal Register*, August 15, 2014, <https://www.federalregister.gov/articles/2014/08/15/2014-19364/procedures-for-liquefied-natural-gas-export-decisions>.
- 26 According to the IEA Medium-Term Gas Market Report 2014 (p151-154), Australia had seven LNG terminals under construction with a combined capacity of 8 bcf/d (83 bcm) as of May 2014.
- 27 Eurostat, Natural gas consumption statistics, [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/Natural\\_gas\\_consumption\\_statistics](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Natural_gas_consumption_statistics).
- 28 Natural gas’s role in Europe’s energy mix has declined slightly over the past few years from 26% in 2010 to 24% in 2013, thanks to policy-incentives for renewables and low carbon prices in the EU emission trading scheme that have allowed coal to regain some market share. But that decline may be over. The International Energy Agency projects gas will either maintain or increase its market share in the EU, even under an aggressive emission reduction scenario (IEA World Energy Outlook, p593). In its 2014 European Energy Security Strategy report, the European Commission projects current EU natural gas import levels will continue through 2020 and then grow between 2020 and 2030 (European Commission, European Energy Security Strategy, 2014).
- 29 Gazprom, “Gazprom in Figures 2009-2013,” <http://www.gazprom.com/f/posts/55/477129/gazprom-in-figures-2009-2013-en.pdf>.
- EU consumption data from BP Statistical Review 2014, p23.
- 30 BP Statistical Review 2014 p28, 41.
- 31 Ibid.
- 32 Vladimir Soldatkin and Denis Pinchuk, “Russia woos Belarus with gas price cut, \$10 bln loan,” Reuters, Nov 21, 2011, <http://www.reuters.com/article/2011/11/25/russia-belarus-idUSL5E7MP1JW20111125>.
- 33 Irina Reznik and Henry Meyer, “Russia Offers Ukraine Cheaper Gas to Join Moscow-Led Group,” Bloomberg News, December 2, 2013, <http://www.bloomberg.com/news/2013-12-01/russia-lures-ukraine-with-cheaper-gas-to-join-moscow-led-pact.html>.
- 34 “Russia cuts Ukraine’s gas supply over nearly \$4.5B debt,” The Associated Press, June 16, 2014, accessed through Canada MSN News, <http://news.ca.msn.com/money/cbc-news/russia-cuts-ukraines-gas-supply-over-nearly-dollar45b-debt-1>.
- 35 Isis Almeida, Anna Shiryayevskaya and Volodymyr Verbyany, “European Gas Reverses Biggest Drop Since 2009 on Ukraine,” Bloomberg News, August 20, 2014, <http://www.businessweek.com/news/2014-08-19/european-gas-reverses-biggest-drop-since-2009-on-ukraine>.
- 36 Jan Lopatka, “Slovakia Reaches Reverse Gas Flow Deal With Ukraine,” Reuters, April 26, 2014, <http://www.reuters.com/article/2014/04/26/ukraine-crisis-slovakia-gas-idUSL6N0NI0HU20140426>.
- 37 Reverse flow capacity is 0.5 bcf/d (5.5 bcm) between Hungary and Ukraine, 0.15 bcf/d (1.5 bcm) between Poland and

- Ukraine and about 1 bcf/d (10 bcm) between Slovakia and Ukraine, although the reversed Slovakia-Ukraine pipeline will only start operations in the fall of 2014.
- 38 BP Statistical Review 2014, p23.
- 39 Neil MacFarquhar, "Gazprom Cuts Russia's Natural Gas Supply to Ukraine," *The New York Times*, June 16, 2014, [http://www.nytimes.com/2014/06/17/world/europe/russia-gazprom-increases-pressure-on-ukraine-in-gas-dispute.html?\\_r=0](http://www.nytimes.com/2014/06/17/world/europe/russia-gazprom-increases-pressure-on-ukraine-in-gas-dispute.html?_r=0).
- 40 IEA Medium-Term Gas Market Report 2012, p31.
- 41 Henning Gloynstein and Nerijus Adomaitis, "Analysis: Statoil to gain in Europe's shift to spot gas pricing," Reuters, August 14, 2013, <http://www.reuters.com/article/2013/08/14/us-energy-gas-oil-analysis-idUSBRE97D0GR20130814>.
- Ajay Makan, "Statoil breaks oil-linked gas pricing," *Financial Times*, November 19, 2013, <http://www.ft.com/intl/cms/s/0/aad942d6-4e25-11e3-b15d-00144feabdc0.html#axzz34WxMI7Cq>.
- William Powell, "Statoil ditches the theory, beating Gazprom in practice," Platts, February 18, 2013, <http://www.platts.com/news-feature/2013/naturalgas/eu-gas/index>.
- 42 Tino Andresen, "RWE Sees End Of Europe's 40-Year-Old Gas Pricing for Gazprom," Bloomberg News, July 9, 2013, <http://www.bloomberg.com/news/2013-07-08/rwe-expects-to-rid-gazprom-deals-of-oil-price-after-arbitration.html>.
- 43 Catherine Belton and Ed Crooks, "Gazprom in Contract Shake-up," *Financial Times*, February 25, 2010, <http://www.ft.com/intl/cms/s/0/53068c2c-2254-11df-9a72-00144feab49a.html?siteedition=intl#axzz3AzzAGJRm>.
- 44 Anna Shiryayevskaya, "Eni Seeks Third Revision To Gazprom Natural Gas Supply Contract," Bloomberg News, February 20, 2013, <http://www.bloomberg.com/news/2013-02-20/eni-seeks-third-revision-to-gazprom-natural-gas-supply-contract.html>.
- E.ON statement from website, <http://www.eon.com/en/media/news/press-releases/2012/7/3/eon-reaches-settlement-and-raises-group-outlook-for-2010.html>.
- 45 Jonathan Stern and Howard Rogers, "The Transition to Hub Based Gas Pricing in Continental Europe," Oxford Institute for Energy Studies, March 2011, p5, <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/03/NG49.pdf>.
- 46 Guy Chazan, "Gazprom bows to demand with gas price cut," *Financial Times*, February 16, 2012, <http://www.ft.com/intl/cms/s/0/2e57f4c4-58ad-11e1-9f28-00144feabdc0.html#axzz3Bp9flaYi>
- 47 Simon Pirani, "Consumers as Players in the Russian Gas Sector," The Oxford Institute for Energy Studies, 2013, p4, <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/01/Consumers-as-players-in-the-Russian-gas-sector.pdf>.
- Elizabeth Stoner, "Gazprom Expects European Gas Export Rise In 2013, Medvedev," ICIS, June 4, 2013, <http://www.icis.com/resources/news/2013/06/04/9675324/gazprom-expects-european-gas-export-rise-in-2013-medvedev/>.
- 48 Gazprom delivered 17 bcf/d (179 bcm) of natural gas to customers in the wider European region. Assuming an average price reduction from \$410 to \$380 per thousand cubic meters, or a 7% average discount, as reported in the Morgan Stanley research note "EU gas supply: A few options, but no easy alternatives" from April 23, 2014, the calculated revenue loss for Gazprom adds up to \$5.36 billion annually.
- 49 Gazprom, "OAO Gazprom Financial Report 2013," <http://www.gazprom.com/f/posts/07/271326/gazprom-financial-report-2013-en.pdf>.
- 50 Ibid.
- 51 Maciej Martewicz, "PGNiG to Gain \$930 Million on Gazprom Deal; Shares Rally," Bloomberg News, November 6, 2012, <http://www.bloomberg.com/news/2012-11-06/pgnig-sees-ebitda-rising-by-up-to-932-million-on-gazprom-deal.html>.
- 52 Jan Hromadko, "E.ON Settles Gazprom Dispute," *The Wall Street Journal*, July 3, 2012, <http://online.wsj.com/news/articles/SB10001424052702304211804577504762186727888>.
- 53 Isis Almeida and Anna Shiryayevskaya, "Eni Gets Gaprom Gas Price Cut as Oil Link Challenged," Bloomberg News, May 23, 2014, <http://www.bloomberg.com/news/2014-05-23/eni-gets-gazprom-gas-price-cut-as-oil-link-challenged.html>.
- 54 Relatively few details of the revised contracts are publicly available from the contracting parties. Some experts contend that the revised Eni-Gazprom contracts are still technically oil-indexed, but they contain price floors and ceilings determined by hub prices. If that were the case, the contracts would effectively be hub-indexed, even if the contracting parties decided to retain the façade of oil indexation in their revised gas supply contracts.
- 55 Bernstein Research, "ENI: New CEO Accelerates Gas and Power Turnaround," May 23, 2014.

56 Ibid.

57 Aoife White, "Gazprom Faces EU Antitrust Probe on Eastern Europe Gas Sales," Bloomberg News, September 5, 2012, <http://www.businessweek.com/news/2012-09-04/gazprom-faces-eu-antitrust-probe-on-eastern-european-gas-sales>.

58 Jonathan Stern, "Russian Responses to Commercial Changes in European Gas Markets," in *The Russian Gas Matrix: How Markets Are Driving Change*, edited by James Henderson and Simon Pirani, p61, Oxford University Press, 2014.

59 Ibid.

60 Morgan Stanley report, "EU gas supply: A few options, but no easy alternatives," April 23, 2014.

61 Jonathan Stern and James Henderson, "Gazprom's West-Facing Supply Strategy to 2020," in *The Russian Gas Matrix: How Markets Are Driving Change*, edited by James Henderson and Simon Pirani, p258-264, Oxford University Press, 2014.

62 Goldman Sachs includes five LNG terminals in its baseline forecast through 2020 with a combined capacity of 8.5 bcf/day, or 88 bcm in its research note "Global LNG: The next 10 years: Looking softer on the back end," (March 31, 2014); Barclays assumes that five to seven US LNG terminals can be built through 2020, the company's baseline capacity forecast is for 8 bcf/day, or 83 bcm, in "US LNG export approvals: Burden shifts to FERC," (June 13, 2014); Credit Suisse has six US terminals in its baseline forecast with a combined capacity of 8.5 bcf/day, or 88 bcm, as presented in its "Oil and Natural Gas Outlook for 2014," (January 2014).

63 IEA Medium-Term Gas Market Report, p192-198.

64 Bill White, "Expanded Panama Canal could reroute LNG industry," Office of the Federal Coordinator for Alaska Natural Gas Transportation Projects, November 28, 2012, <http://www.arcticgas.gov/expanded-panama-canal-could-reroute-lng-industry>.

65 Barclays report, "US LNG export approvals: Burden shifts to FERC," June 13, 2014.

66 See press statements on Cheniere's website for further details, <http://phx.corporate-ir.net/phoenix.zhtml?c=101667&p=irol-news&nyo=0>.

67 Scott Weeden, "Wood Mackenzie: Biggest, Most Liquid Market Makes U.S. LNG Exports Attractive," *E&P Magazine*, April 2, 2012, <http://www.epmag.com/Product>

[Field-Development/Wood-McKenzie-Biggest-Liquid-Market-US-LNG-Exports-Attractive\\_98526](http://www.epmag.com/Product-Field-Development/Wood-McKenzie-Biggest-Liquid-Market-US-LNG-Exports-Attractive_98526).

68 "A liquid market," *The Economist*, July 14, 2012, <http://www.economist.com/node/21558456>.

69 Ibid.

70 IEA Medium-Term Gas Market Report, p157.

71 The Jordan Cove terminal project envisions a 232-mile pipeline connection to an existing gas terminal in Malin, Oregon, while the Oregon LNG terminal requires a 85-mile pipeline connection to the Williams Northwest Pipeline system in Washington State. Both projects will source feed gas from the Rockies and Western Canada. For more details on Jordan Cove, see: <http://www.jordancoveenergy.com/> and <http://www.vereseninc.com/our-business/business-development/jordan-cove-lng-project/>. For more details on Oregon LNG see <http://www.oregonlng.com/project-overview/>.

72 US Office of Fossil Fuel, "How to Obtain Authorization to Import and/or Export Natural Gas and LNG," <http://energy.gov/fe/services/natural-gas-regulation/how-obtain-authorization-import-and-or-export-natural-gas-and-lng>.

73 Goldman Sachs, "Initiate on Cheniere; LNG and CQH at Buy; CQP at Neutral," p4, January 7, 2014.

74 See Cheniere Energy's 8-K filing from August 11, 2014, <http://biz.yahoo.com/e/140811/lng8-k.html>.

75 Operators of the Cove Point, Cameron LNG, and Freeport LNG terminals have announced tolling-type arrangements, according to company statements.

In the case of Cove Point, Dominion specifies in a press statement that: "The customers will procure their own natural gas and deliver it to the Cove Point pipeline. Dominion will liquefy the gas, store it and load it into ships brought to the facility on the Chesapeake Bay. Dominion will provide a tolling service, and will not take possession of either the natural gas or the LNG." For further details see:

<http://dom.mediaroom.com/2013-04-01-Dominion-Cove-Point-Liquefaction-Project-Moving-Forward-Cements-Front-Runner-Status>.

For Cameron LNG, Sempra announced in a deal with Mitsubishi and Mitsui that: "The commercial development agreements bind the parties to fund all development expenses, including design, permitting and engineering, as well as to negotiate 20-year tolling agreements, based on agreed-upon terms outlined



in the commercial development agreements. Each tolling agreement would be for 4 million tonnes per annum (Mtpa).” See: <http://www.prnewswire.com/news-releases/sempra-energy-unit-signs-commercial-development-agreements-with-mitsubishi-corporation-mitsui-co-ltd-to-develop-louisiana-liquefaction-facility-147718105.html>.

In the case of Freeport LNG, in February 2013 it announced it signed: “a binding 20-year Liquefaction Tolling Agreement (LTA) with BP for 4.4 million tons per annum (mtpa), equivalent to the production capacity of the second train of Freeport LNG’s proposed natural gas liquefaction and LNG loading facility on Quintana Island near Freeport, Texas. In July 2012, Freeport LNG executed LTAs with Osaka Gas Co., Ltd. and Chubu Electric Power Co. for a total of 4.4 mtpa.” For further details: <http://www.bloomberg.com/article/2013-02-11/an5WR4UvCZeQ.html>.

76 Ruth Liao, “Chevron Struggles to Meet Buyer Price Ideas on Canadian Kitimat LNG,” ICIS, March 13, 2014, <http://www.icis.com/resources/news/2014/03/13/9762677/chevron-struggles-to-meet-buyer-price-ideas-on-canadian-kitimat-lng/>.

77 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2013,” p6, [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_fv.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_fv.pdf).

78 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2012,” p6, [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2012.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2012.pdf).

79 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2009,” p4, [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2009.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2009.pdf).

80 EU member states plus Turkey.

81 International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2013,” p31, [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_fv.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_fv.pdf).

82 IEA Medium-Term Gas Market Report 2014, p178, <http://www.iea.org/Textbase/npsum/MTGMR2014SUM.pdf>.

83 Gazprom, “Gazprom in Figures 2009-2013,” <http://www.gazprom.com/f/posts/55/477129/gazprom-in-figures-2009-2013-en.pdf>.

84 IEA Medium-Term Gas Market Report 2014, p206.

85 Gazprom, “Gazprom in Figures 2009-2013,” <http://www.gazprom.com/f/posts/55/477129/gazprom-in-figures-2009-2013-en.pdf>.

86 Information about the global natural gas supply and demand curves, and underlying project cost and demand-elasticity estimates, included in the INGM, NEMS and WEPS+ models used for this analysis can be found in Appendix I.

87 Includes Norway, Ukraine, Belarus and Turkey.

88 Jonathan Stern, “Russian Responses to Commercial Changes in European Gas Markets,” in *The Russian Gas Matrix: How Markets Are Driving Change*, edited by James Henderson and Simon Pirani, p53, Oxford University Press, 2014.

89 Jane Perlez, “China and Russia Reach 30-Year Gas Deal,” *The New York Times*, May 21, 2014, [http://www.nytimes.com/2014/05/22/world/asia/china-russia-gas-deal.html?\\_r=0](http://www.nytimes.com/2014/05/22/world/asia/china-russia-gas-deal.html?_r=0).

90 International Energy Agency, IEA Medium-Term Gas Market Report 2014, p154-156.

91 Ibid. p98.

92 “Gazprom and Enagas Discuss Baltic LNG Transport to Europe and Latin America,” PennEnergy, December 13, 2013, <http://www.pennenergy.com/articles/pennenergy/2013/12/gazprom-and-enagas-discuss-baltic-lng-transport-to-europe-and-latin-america.html>.

93 Guy Chazan, “Gazprom Puts Shtokman Project on Ice,” *Financial Times*, August 31, 2012, <http://www.ft.com/intl/cms/s/0/604b9b38-f359-11e1-9ca6-00144feabdc0.html>.

94 Elena Mazneva and Ryan Chilcote, “Russia May Disrupt European Gas In Repeat of 2009, Naftogaz Says,” Bloomberg News, August 12, 2014, <http://www.bloomberg.com/news/2014-08-12/russia-may-disrupt-european-gas-in-repeat-of-2009-naftogaz-says.html>.

95 BP Statistical Review 2014, p28.

96 Maciej Martewicz and Piotr Bujnicki, “Poland To Get Baltic LNG Terminal On Time As Costs Increase,” Bloomberg Businessweek, August 5, 2014, <http://www.businessweek.com/news/2014-08-05/poland-to-get-lng-terminal-on-time-as-costs-discussed-pbg-says>.

97 IEA Medium-Term Gas Market Report 2014, p178.

- 98 Nerijus Adomaitis, “Lithuania Nears LNG Deal With Statoil,” Reuters, May 26, 2014, <http://www.reuters.com/article/2014/05/26/lithuania-statoil-Ing-idUSL6N0OC2WH20140526>.
- 99 Art Patnaude and Jan Hromadko, “European Pipeline Loses Bid To Ship Gas,” *The Wall Street Journal*, June 26, 2013, <http://online.wsj.com/news/articles/SB10001424127887323419604578569450535628198>.
- 100 Natural Gas Europe, “Extra EU Grant For The First Polish LNG Terminal,” January 8, 2013, <http://www.naturalgaseurope.com/extra-eu-grant-for-the-first-polish-lng-terminal>.
- 101 European Union website, “State aid: Commission Authorizes €48 Million Aid for Construction of Lithuanian LNG Terminal,” [http://europa.eu/rapid/press-release\\_IP-13-1124\\_en.htm](http://europa.eu/rapid/press-release_IP-13-1124_en.htm).
- 102 Nerijus Adomaitis and Andrius Sytas, “Lithuania Wins Cheaper Russian Gas After LNG Sabre Rattling,” Reuters, May 8, 2014, <http://uk.reuters.com/article/2014/05/08/lithuania-gazprom-idUKL6N0NU4CM20140508>.
- 103 Ibid.
- 104 Export of goods only, excludes export of services and capital transfers.
- 105 For a summary of recent tax reforms, see IEA Medium Term Oil Market Report 2014, p93.
- 106 Morgan Stanley, “Ukraine crisis magnifies risks, but investment case not broken. Buy into weakness,” April 23, 2014.
- 107 BP Statistical Review 2013, p23.
- 108 Ibid.
- 109 BP Statistical Review 2014, p8-9.
- 110 GDP data from World Bank, Oil and oil product export statistics from Central Bank of Russia, “Russian Federation: Crude Oil Exports, 2000-14,” [http://www.cbr.ru/eng/statistics/print.aspx?file=credit\\_statistics/crude\\_oil\\_e.htm&pid=svs&sid=vt1](http://www.cbr.ru/eng/statistics/print.aspx?file=credit_statistics/crude_oil_e.htm&pid=svs&sid=vt1).
- 111 The Hungary-Slovakia interconnector pipeline is currently undergoing pressure testing, with commercial operations expected to start in January 2015.
- 112 The Giurgiu-Ruse pipeline connecting the Romanian and Bulgarian gas transmission networks was expected to be operational by the end of 2013, but unforeseen technical challenges have delayed the project. Construction was still ongoing as of March 2014, according to Bulgarian government sources. The commissioning of the pipeline is expected in late 2014.
- Ministry of Economy and Energy of the Republic of Bulgaria, <http://www.mi.government.bg/en/themes/gas-interconnection-greece-bulgaria-igb-910-347.html>.
- 113 Dieter Helm, “A Credible European Security Plan,” 2014, <http://www.dieterhelm.co.uk/sites/default/files/European%20Security%20Plan.pdf>.
- 114 The third energy package was not a direct result of the 2009 gas crisis, preparations for the regulatory package had begun before the second-Russia-Ukraine gas crisis.
- 115 Pierre Noel, “EU Gas Supply Security: Unfinished Business (Working Paper),” University of Cambridge, 2013, <http://www.econ.cam.ac.uk/dae/repec/cam/pdf/CWPE1312.pdf>.
- 116 Ibid.
- 117 Agency for the Cooperation of Energy Regulators, “Transit Contracts in EU Member States—ACER Inquiry,” p15-35, April 9, 2013, [http://www.acer.europa.eu/Official\\_documents/Acts\\_of\\_the\\_Agency/Publication/ACER\\_Report\\_Inquiry\\_on\\_Transit\\_Contracts\\_9\\_April\\_2013.pdf](http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Report_Inquiry_on_Transit_Contracts_9_April_2013.pdf).
- 118 Pierre Noel, “EU Gas Supply Security: Unfinished Business (Working Paper),” p13, University of Cambridge, 2013, <http://www.econ.cam.ac.uk/dae/repec/cam/pdf/CWPE1312.pdf>.
- 119 Agency for the Cooperation of Energy Regulators, “Transit Contracts in EU Member States—ACER Inquiry,” April 9, 2013, [http://www.acer.europa.eu/Official\\_documents/Acts\\_of\\_the\\_Agency/Publication/ACER\\_Report\\_Inquiry\\_on\\_Transit\\_Contracts\\_9\\_April\\_2013.pdf](http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Report_Inquiry_on_Transit_Contracts_9_April_2013.pdf).
- 120 Gas Infrastructure Europe, “Storage Map,” <http://www.gie.eu.com/index.php/maps-data/gse-storage-map>.
- 121 The Energy Charter Secretariat, “The Role of Underground Gas Storage for Security of Supply and Gas Markets, p106,” [http://www.encharter.org/fileadmin/user\\_upload/Publications/Gas\\_Storage\\_ENG.pdf](http://www.encharter.org/fileadmin/user_upload/Publications/Gas_Storage_ENG.pdf).
- 122 Gas Infrastructure Europe, GSE Storage Map dataset, July 2014, [http://www.gie.eu/download/maps/2014/GSE\\_STOR\\_MAP\\_DATA\\_July2014.xls](http://www.gie.eu/download/maps/2014/GSE_STOR_MAP_DATA_July2014.xls).



- 123 United Nations Economic Council for Europe, International Gas Union, “Study on Study on Underground Gas Storage in Europe and Central Asia,” 2013, p46-48. Study results based on a survey of 14 UNECE member countries, [http://www.unece.org/fileadmin/DAM/energy/se/pdfs/wpgas/pub/Report\\_UGS\\_Study\\_www.pdf](http://www.unece.org/fileadmin/DAM/energy/se/pdfs/wpgas/pub/Report_UGS_Study_www.pdf).
- 124 Communication from the Commission to the European Parliament and the Council, “European Energy Security,” European Commission, May 2014, [http://ec.europa.eu/energy/doc/20140528\\_energy\\_security\\_communication.pdf](http://ec.europa.eu/energy/doc/20140528_energy_security_communication.pdf).
- 125 US Energy Information Administration, “Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States,” June 2013, <http://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf>.
- 126 David Buchan, “Can Shale Gas Transform Europe’s Energy Landscape,” p3, Centre for European Reform, July 2013, [http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief\\_buchan\\_shale\\_10july13-7645.pdf](http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief_buchan_shale_10july13-7645.pdf).
- 127 US Energy Information Administration, “Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States,” p6, June 2013, <http://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf>.
- 128 David Buchan, “Can Shale Gas Transform Europe’s Energy Landscape,” p6, Centre for European Reform, July 2013, [http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief\\_buchan\\_shale\\_10july13-7645.pdf](http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief_buchan_shale_10july13-7645.pdf).
- 129 Steven Erlanger, “As Drilling Practice Takes Off in U.S., Europe Proves Hesitant,” *The New York Times*, October 9, 2013, <http://www.nytimes.com/2013/10/10/world/europe/as-drilling-practice-takes-off-in-us-europe-proves-hesitant.html?page-wanted=all>.
- 130 KPMG International, “Central and Eastern European Shale Gas Outlook,” 2012, <https://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/shale-gas/Documents/cee-shale-gas-2.pdf>.
- 131 The U.S. Department of State launched the Unconventional Gas Technical Engagement Program in April 2010, “to help countries seeking to utilize their unconventional natural gas resources—shale gas, tight gas and coal bed methane—to identify and develop them safely and economically.” For further details see: <http://www.state.gov/s/ciea/ugtep/>.
- 132 European Commission, “Energy Efficiency and its Contribution to Energy Security and the 2030 Framework for Climate and Energy Policy,” July 2014, p15, [http://ec.europa.eu/energy/efficiency/events/doc/2014\\_eec\\_communication\\_adopted.pdf](http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_communication_adopted.pdf).
- 133 Ibid. p9.
- 134 Ibid. p17.
- 135 European Commission, “Energy Efficiency and its Contribution to Energy Security and the Framework for Climate and Energy Policy (Working Document),” July 2014, [http://ec.europa.eu/energy/efficiency/events/doc/2014\\_eec\\_ia\\_adopted\\_part1.pdf](http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_ia_adopted_part1.pdf).
- 136 Eurostat database.
- 137 International Energy Agency, “Ukraine 2012,” OECD/IEA, p9-10, [http://www.iea.org/publications/freepublications/publication/Ukraine2012\\_free.pdf](http://www.iea.org/publications/freepublications/publication/Ukraine2012_free.pdf).
- 138 International Monetary Fund, “Ukraine Unveils Reform Program with IMF Support,” April 30, 2014, <https://www.imf.org/external/pubs/ft/survey/so/2014/new043014a.htm>.
- 139 Ibid.
- 140 EIA is the statistical and analytical agency within the U.S. Department of Energy. For further information on EIA and its work, visit <http://www.eia.gov/>.
- 141 For other examples of RHG analysis performed using this suite of models, visit <http://rhg.com/topics/energy-and-natural-resources>.
- 142 For documentation on each of these models, see <http://www.eia.gov/reports/index.cfm?t=Model%20Documentation>.
- 143 For full documentation on NEMS, see <http://www.eia.gov/reports/index.cfm?t=Model%20Documentation>.
- 144 Though INGM can be run separately, it is almost exclusively used in conjunction with WEPS+.
- 145 For detailed documentation of the model, see [http://www.eia.gov/forecasts/aeo/nems/documentation/ingm/pdf/ingm\(2011\).pdf](http://www.eia.gov/forecasts/aeo/nems/documentation/ingm/pdf/ingm(2011).pdf).
- 146 INGM—WEPS+ interface uses historical relationship to aggregate the data from 61 INGM regions to 16 WEPS+ regions.

**SPOT VERSUS OIL-INDEXED PRICES IN EUROPE**

- 1 IEA Medium-Term Gas Market Report 2010, p195-199.
- 2 Guy Chazan, “Higher bills likely as LNG heads to Asia,” *Financial Times*, May 6, 2012, <http://www.ft.com/intl/cms/s/0/6ada8a28-960c-11e1-a6a0-00144feab49a.html#axzz3CqdZBh9C>
- 3 “Careful What You Wish For,” *The Economist*, July 14, 2012, <http://www.economist.com/node/21558433>.
- 4 Jonathan Stern, “Is There a Rationale for the Continuing Link to Oil Product Prices in Continental European Long-Term Gas Contracts?” Oxford Institute for Energy Studies, April 2007, <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG19-IsThereARationaleFortheContinuingLinkToOilProductPricesinContinentalEuropeanLongTermGasContracts-JonathanStern-2007.pdf>.

**THE RUSSIA-CHINA GAS DEAL**

- 1 “Gazprom: Russia’s Wounded Giant,” *The Economist*, March 23, 2013, <http://www.economist.com/news/business/21573975-worlds-biggest-gas-producer-ailing-it-should-be-broken-up-russias-wounded-giant>, and Anders Aslund, “Gazprom’s Demise Could Topple Putin,” Bloomberg View, June 9, 2013, <http://www.bloombergview.com/articles/2013-06-09/gazprom-s-demise-could-topple-putin>.
- 2 Tim Treadgold, “Merrill Lynch Says Russia’s Gas Deal With China Was A Political Win But A Business Loss,” *Forbes*, May 28, 2014, <http://www.forbes.com/sites/timtreadgold/2014/05/28/merrill-lynch-says-russias-gas-deal-with-china-was-a-political-win-but-a-business-loss/>.
- 3 Lucy Hornby, Jamil Anderlini and Guy Chazan, “China and Russia sign \$400bn gas deal,” *Financial Times*, May 21, 2014, <http://www.ft.com/intl/cms/s/0/d9a8b800-e09a-11e3-9534-00144feabdc0.html#axzz3C1jMbtBT>.
- 4 “A Liquid Market,” *The Economist*, July 14, 2012, <http://www.economist.com/node/21558456>.
- 5 Katya Golubkova, “Putin says Russia may speed up alternative gas route to China,” Reuters, May 24, 2014, <http://www.reuters.com/article/2014/05/24/us-russia-forum-putin-idUSBREA4N07720140524>.

**IMPLICATIONS OF US LNG EXPORTS FOR ASIAN GAS MARKETS**

- 1 IEA World Energy Outlook 2013, p103, <http://www.worldenergyoutlook.org/publications/weo-2013/>.
- 2 International Gas Union, Wholesale Gas Price Survey, 2014, [http://www.igu.org/sites/default/files/node-page-field\\_file/IGU%20Wholesale%20Gas%20Price%20Survey%20Report%20-%202014%20Edition.pdf](http://www.igu.org/sites/default/files/node-page-field_file/IGU%20Wholesale%20Gas%20Price%20Survey%20Report%20-%202014%20Edition.pdf).
- 3 Werner ten Kate, Laszlo Varro, Anne-Sophie Corbeau, “Developing a Natural Gas Trading Hub in Asia,” International Energy Agency, 2013, [http://www.iea.org/media/freepublications/AsianGasHub\\_WEB.pdf](http://www.iea.org/media/freepublications/AsianGasHub_WEB.pdf).
- 4 IEA Medium-Term Gas Market Report, p15.
- 5 Werner ten Kate, Laszlo Varro, Anne-Sophie Corbeau, “Developing a Natural Gas Trading Hub in Asia,” International Energy Agency, 2013, [http://www.iea.org/media/freepublications/AsianGasHub\\_WEB.pdf](http://www.iea.org/media/freepublications/AsianGasHub_WEB.pdf).

**MODELING**

- 1 US Energy Information Administration, “Models used to generate the IEO2013 projections,” <http://www.eia.gov/forecasts/ieo/models.cfm>.
- 2 US Energy Information Administration, “Annual Energy Outlook,” <http://www.eia.gov/forecasts/aeo/>.

**THE IMPORTANCE OF SOUTH STREAM**

- 1 R. Teichmann, “Gas Pipeline Wars: The EU Threatens to Obstruct Gazprom’s South Stream Project,” Global Research, June 10, 2014, <http://www.globalresearch.ca/gas-pipeline-wars-the-eu-threatens-to-obstruct-gazproms-south-stream-project/5386475>.

## BIBLIOGRAPHY

- Abdelal, Rawi, “The Profits of Power: Commerce and Realpolitik in Eurasia.” *Review of International Political Economy*, Vol. 20, No. 3, 2013, Boston, p421-456.
- Agency for the Cooperation of Energy Regulators, “Transit Contracts in EU Member States.” Ljubljana, April 2013, [http://www.acer.europa.eu/Official\\_documents/Acts\\_of\\_the\\_Agency/Publication/ACER\\_Report\\_Inquiry\\_on\\_Transit\\_Contracts\\_9\\_April\\_2013.pdf](http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Report_Inquiry_on_Transit_Contracts_9_April_2013.pdf).
- BP, “Statistical Review of World Energy 2014.” London, 2014.
- BP, “Statistical Review of World Energy 2013.” London, 2013.
- Buchan, David, “Can Shale Gas Transform Europe’s Energy Landscape?” London: Centre for European Reform, July 2013, [http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief\\_buchan\\_shale\\_10july13-7645.pdf](http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief_buchan_shale_10july13-7645.pdf).
- Bureau of Economic Analysis, “National Income and Product Accounts.” Washington, D.C.: US Department of Commerce, 2014, <http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1>.
- European Commission, “European Energy Security Strategy.” Brussels, May 2014, [http://ec.europa.eu/energy/doc/20140528\\_energy\\_security\\_communication.pdf](http://ec.europa.eu/energy/doc/20140528_energy_security_communication.pdf).
- European Commission, “Energy Efficiency and its Contribution to Energy Security and the Framework for Climate and Energy Policy (Working Document).” Brussels, July 2014, [http://ec.europa.eu/energy/efficiency/events/doc/2014\\_eec\\_ia\\_adopted\\_part1.pdf](http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_ia_adopted_part1.pdf).
- International Energy Agency, “IEA Medium-Term Gas Market Report 2014.” Paris, OECD/IEA, 2014.
- International Energy Agency, “IEA Medium-Term Gas Market Report 2012.” Paris, OECD/IEA, 2012.
- International Energy Agency, “Ukraine 2012.” Paris: OECD/IEA, 2012. [http://www.iea.org/publications/freepublications/publication/Ukraine2012\\_free.pdf](http://www.iea.org/publications/freepublications/publication/Ukraine2012_free.pdf).
- International Energy Agency, “World Energy Outlook 2013.” Paris: OECD/IEA, 2013.
- International Gas Union, “Wholesale Gas Price Formation—A global review of drivers and regional trends.” Oslo, 2011, [http://www.igu.org/sites/default/files/node-page-field\\_file/IGU%20Whole%20Sale%20Gas%20Price%20Report%2C%20June%202011.pdf](http://www.igu.org/sites/default/files/node-page-field_file/IGU%20Whole%20Sale%20Gas%20Price%20Report%2C%20June%202011.pdf).
- International Gas Union, “Wholesale Gas Price Survey - 2014 Edition - A global review of price formation mechanisms 2005-2013.” Oslo, 2014, [http://www.igu.org/sites/default/files/node-page-field\\_file/IGU%20Wholesale%20Gas%20Price%20Survey%20Report%20-%202014%20Edition.pdf](http://www.igu.org/sites/default/files/node-page-field_file/IGU%20Wholesale%20Gas%20Price%20Survey%20Report%20-%202014%20Edition.pdf).
- International Gas Union, “World LNG Report.” Oslo, 2012.
- International Group of Liquefied Natural Gas Importers (GIIGNL), “The LNG Industry in 2013.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_fv.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_fv.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2012.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2012.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2012.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2011.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2011.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2011.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2010.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2010.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2010.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2009.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2009.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2009.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2008.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2008.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2008.pdf).
- International Group of Liquefied Natural Gas Importers, “The LNG Industry in 2007.” Paris. [http://www.giignl.org/sites/default/files/PUBLIC\\_AREA/Publications/giignl\\_the\\_lng\\_industry\\_2007.pdf](http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_the_lng_industry_2007.pdf).
- Gazprom, “Gazprom in Figures 2009-2013 Factbook.” Moscow, 2014. <http://www.gazprom.com/f/posts/55/477129/gazprom-in-figures-2009-2013-en.pdf>.
- Noel, Pierre, “EU Gas Supply Security: Unfinished Business (Working Paper),” Cambridge: University of Cambridge, 2013, <http://www.econ.cam.ac.uk/dae/repec/cam/pdf/CWPE1312.pdf>.

Pirani, Simon, James Henderson, Anouk Honore, Howard Rogers, Katja Yafimava, "What the Ukraine crisis means for gas markets," Oxford: The Oxford Institute for Energy Studies, 2014. <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/03/What-the-Ukraine-crisis-means-for-gas-markets-GPC-3.pdf>.

Pirani, Simon, "Consumers as Players in the Russian Gas Sector." Oxford: The Oxford Institute for Energy Studies, 2013. <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/01/Consumers-as-players-in-the-Russian-gas-sector.pdf>.

Stern, Jonathan, "Gazprom's West-Facing Supply Strategy to 2020", in Henderson, James and Pirani, Simon (ed.) *The Russian Gas Matrix: How Markets Are Driving Change*. Oxford: Oxford University Press, 2014, p258-285.

Stern, Jonathan, "The Impact of European Regulation and Policy on Russian Gas Exports and Pipelines," in Henderson, James and Pirani, Simon (ed.) *The Russian Gas Matrix: How Markets Are Driving Change*, Oxford: Oxford University Press, 2014.

Stern, Jonathan, "Is There a Rationale for the Continuing Link to Oil Product Prices in Continental European Long-Term Gas Contracts?" Oxford: Oxford Institute for Energy Studies, April 2007. <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG19-IsThereARationaleFortheContinuingLinkToOilProductPricesinContinentalEuropeanLongTermGasContracts-JonathanStern-2007.pdf>.

Stern, Jonathan, "Russian Responses to Commercial Change in European Gas Markets", in Henderson, James and Pirani, Simon (ed.) *The Russian Gas Matrix: How Markets Are Driving Change*, Oxford: Oxford University Press, 2014, p50-81.

Ten Kate, Werner, Lazlo Varro, Anne-Sophie Corbeau, "Developing a Natural Gas Trading Hub in Asia," Paris: International Energy Agency, 2013. [http://www.iea.org/media/freepublications/AsianGasHub\\_WEB.pdf](http://www.iea.org/media/freepublications/AsianGasHub_WEB.pdf).

United Nations Economic Council for Europe, International Gas Union, "Study on Study on Underground Gas Storage in Europe and Central Asia." Geneva, 2013. [http://www.unece.org/fileadmin/DAM/energy/se/pdfs/wpgas/pub/Report\\_UGS\\_Study\\_www.pdf](http://www.unece.org/fileadmin/DAM/energy/se/pdfs/wpgas/pub/Report_UGS_Study_www.pdf).

US Energy Information Administration, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States." Washington, DC: US Department of Energy, June 2013, <http://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf>.

US Energy Information Administration, "Annual Energy Outlook 2014." Washington, DC: US Department of Energy, <http://www.eia.gov/forecasts/aeo/>.

US Energy Information Administration, "Annual Energy Outlook 2005." Washington, DC: US Department of Energy. [http://www.eia.gov/forecasts/archive/aeo05/pdf/0383\(2005\).pdf](http://www.eia.gov/forecasts/archive/aeo05/pdf/0383(2005).pdf).

US Energy Information Administration, "International Energy Statistics." Washington, DC: U.S. Department of Energy, 2013, <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm>.

US Energy Information Administration, "Monthly Energy Review." Washington, DC: US Department of Energy, 2014, <http://www.eia.gov/totalenergy/data/monthly/>.

US Energy Information Administration, "Natural Gas Gross Withdrawals and Production," Washington, DC: US Department of Energy, 2014. [http://www.eia.gov/dnav/ng/ng\\_prod\\_sum\\_dcu\\_NUS\\_m.htm](http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_m.htm).

### Investment bank reports and research notes

Bank of America Merrill Lynch, "A new anchor for global gas," May 23, 2014.

Barclays, "US LNG export approvals: Burden shifts to FERC," June 13, 2014.

Bernstein Research, "ENI: New CEO accelerates gas and power turnaround," May 23, 2014.

Bloomberg New Energy Finance, "Cajun Roulette: US LNG exports in a global context," April 22, 2013.

Goldman Sachs, "Initiate on Cheniere; LNG and CQH at Buy; CQP at Neutral," January 7, 2014.

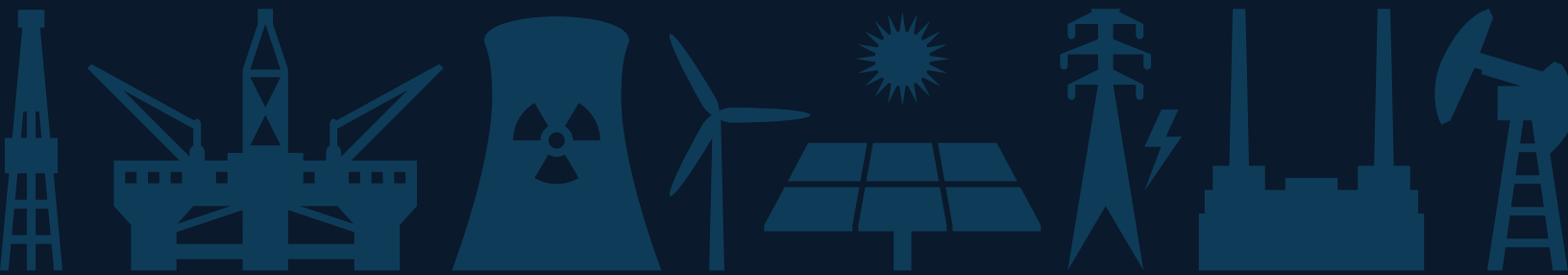
Goldman Sachs, "Global LNG: The next 10 years: Looking softer on the back end," March 31, 2014.

Goldman Sachs, "What if all US LNG exports turn out to be optional?" June 28, 2014.

Morgan Stanley, "EU gas supply: A few options, but no easy alternatives," April 23, 2014.

Morgan Stanley, "Ukraine crisis magnifies risks, but investment case not broken. Buy into weakness," April 23, 2014.

Societe Generale, "Putting a price on gas or Putin's gas price?" March 19, 2014.





COLUMBIA | SIPA

Center on Global Energy Policy

