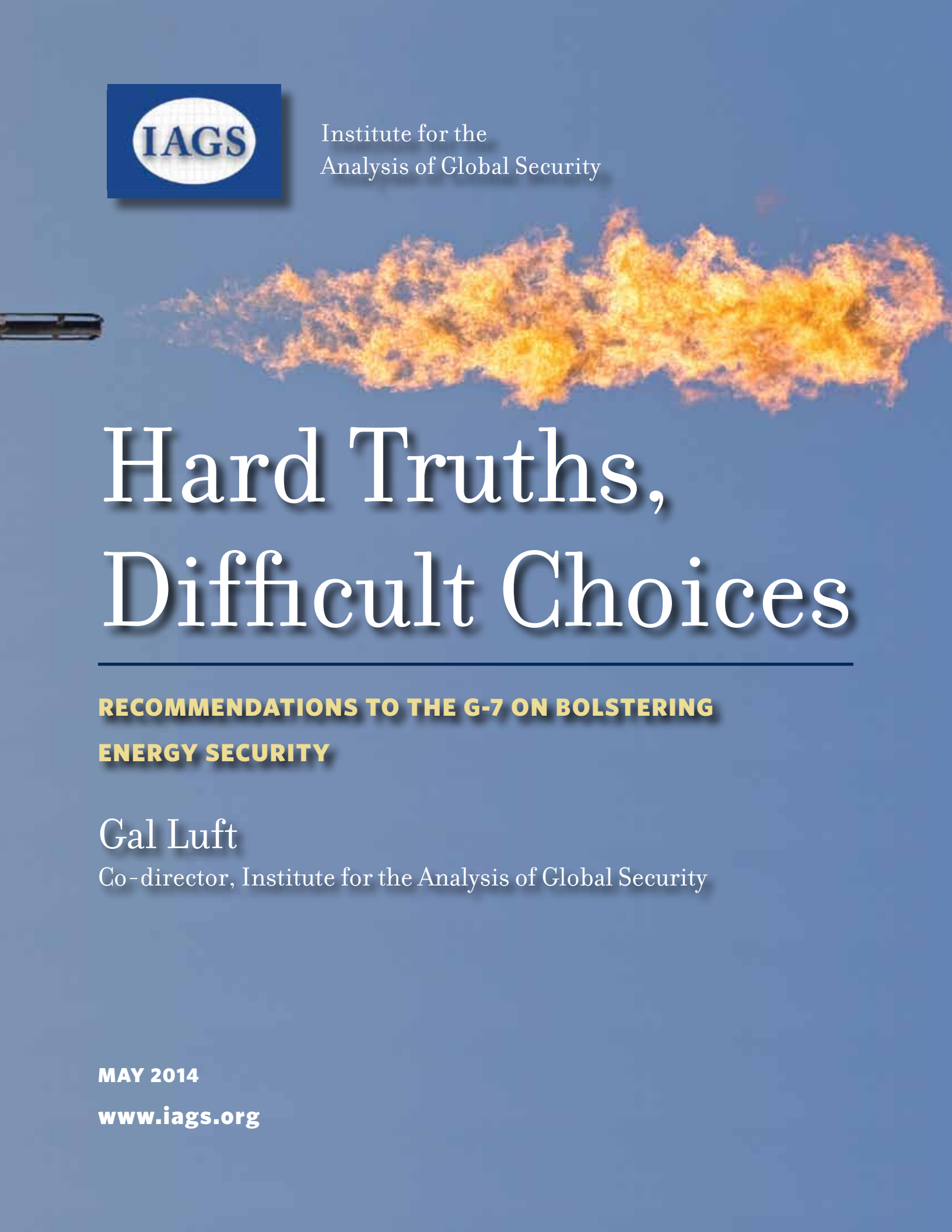

Institute for the
Analysis of Global Security

Hard Truths, Difficult Choices

RECOMMENDATIONS TO THE G-7 ON BOLSTERING ENERGY SECURITY

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Executive Summary

The crisis in Ukraine has awoken a new sense of energy insecurity in Europe, triggering calls for a better coordinated multinational approach to energy security. This report provides a series of recommendations aimed at bolstering energy security for G-7 countries and their allies. It does not aim to replace or augment national energy policies. Instead, it focuses on ways G-7 governments through their collective powers can draw the contour lines of a new energy landscape and create the mechanisms needed to bolster global energy security. The report recommends the following:

- **Prioritize diversification of gas transit routes.** While diversifying the European electricity sector away from Russian natural gas through alternative supplies from North America, Africa, the Middle East and the Caspian is a worthy goal, diversification of transit routes, especially lessening the dependence on Ukraine, which has proven to be an unreliable transit country, should be of higher priority. It is therefore in the interest of Europe to support – rather than oppose – new corridors for Russian gas such as the South Stream pipeline, which would transport Russian gas through the Black Sea and to Bulgaria, Serbia, Hungary, Slovenia, Austria, Italy and beyond.

- **Promote a grand bargain with Turkey.** The G-7 countries should develop and promote a grand bargain with Turkey, one which on the one hand supports Turkey's aspirations to become a land bridge for Caspian and East Mediterranean energy while on the other persuades Turkey to facilitate the transit of LNG tankers through its straits.

- **Strike a better balance between environmental and energy security strategies.** The traditional definition of energy security is "availability of sufficient energy supply at affordable prices." The shift away from coal thus far has compromised both the availability and the affordability of energy in Europe. Its pace should therefore be reassessed. More broadly, Europe should strike a better balance between its environmental and energy security strategies, adopting a more positive sentiment toward currently rejected sources of base load electricity like coal, nuclear power and unconventional gas.

- **Stockpile turbine fuels.** To hedge the risk of supply disruptions or fuel price spikes European electric utilities should be encouraged to build emergency stockpiles for turbine fuels. The natural gas-derived alcohol fuel methanol offers a simple and economic way to store natural gas in liquid form. The International Energy Agency is the most equipped body to coordinate and manage the stockpile and it should be encouraged to develop turbine fuel emergency response policies and stock release mechanisms.

- **Monetize flared gas.** Stranded gas, which is currently flared in very large quantities throughout the world, should be brought to market by advancing the commercialization of gas capture and liquefaction technologies, including the development of small and easily deployable systems that can reach wellheads in remote areas where natural gas pipeline infrastructure is missing.

- **Open vehicles to fuel competition.** Oil's virtual monopoly over the global transportation fuel sector should be broken by opening vehicles to fuel competition. Cars sold around the world should be capable of running on another fuel in addition to or instead of gasoline or diesel, whether alcohol fuel, electricity, gaseous fuel like compressed natural gas or some combination thereof.

- **In Asia's gas market, advance the shift from oil indexation to gas-to-gas competition and promote the establishment of at least one regional trading hub.**

- **Create a robust icebreaking capability** – including investment in nuclear icebreakers – as a way to enable future commercial and military activities in Arctic oil and gas sector.

- **Prepare energy systems for cyber-attacks** through multinational cooperation.

Introduction

The crisis in the Ukraine has awoken a new sense of energy insecurity in Europe, triggering calls for a better coordinated multinational approach to energy security with focus on the integration of North American energy exports into the European energy landscape. The March 24, 2014 Hague Declaration by the G-7 in support of Ukrainian sovereignty called upon the group's energy ministers to seek ways to strengthen Europe's energy security. And indeed in their May 6 meeting in Rome, G-7 energy ministers issued a joint statement in which they committed to "a systematic and enduring step change to improve energy security at national regional and global levels."

The search for energy solidarity has been proposed several times under various multinational platforms. In the aftermath of the 2006 Russian cutoff of gas to Ukraine, Poland proposed that politically motivated energy supply cuts be treated like terrorism and thus be grounds for invoking Article 5 of the NATO Treaty against the perpetrator. This idea was quickly scuttled by the principal NATO members. Another attempt to create a multinational framework for energy security has been promoted by Ukraine and Turkmenistan under the banner of the Organization for Security and Cooperation in Europe (OSCE). This initiative morphed into a draft United Nations General Assembly resolution calling for "international cooperation for promoting reliable transportation of energy to international markets" which gained the support of 55 members including 34 European members as well as Russia and China. More recently, Polish Prime Minister Donald Tusk called for the establishment of an energy union in which European countries will negotiate with energy suppliers as a single block.

This report provides a series of recommendations aimed at bolstering energy security in the G-7 framework and beyond. It does not aim to replace or augment national energy policies. Instead, it focuses on ways G-7 governments through their collective powers and influence can draw the contour lines of a new energy landscape and create the mechanisms needed for lasting energy security for the entire world.

While much emphasis has been placed on achieving coordination between governments and international organizations, effective and lasting energy security cannot be achieved exclusively through a business-as-usual approach and soft power mechanisms. Strengthening European energy security will require Europe to embark simultaneously on three diversification strategies:

- **Diversification of the electricity sector away from Russian natural gas** through alternative supplies from North America, Africa, the Middle East and the Caspian.

- **Diversification of transit routes and transit countries**, lessening the dependence on Ukraine which has proven to be an unreliable transit country.
- **Diversification of energy commodities in the electricity and the transportation fuel sectors**, striking a better balance between climate and energy security strategies and adopting a more positive sentiment toward currently rejected sources of base load electricity like coal, nuclear power and unconventional gas.

The Russian attack on Ukrainian sovereignty has evoked strong sentiments on both sides of the Atlantic and indeed Russia's unilateralism and anti-competitive behavior should be abhorred by all G-7 members. That said, one should not ignore the chronic failure of Ukraine to serve as a reliable transit country and its responsibility for Europe's current predicament. Therefore, of the three aforementioned diversification efforts, the shift away from Ukraine as a conduit of gas to Europe – for example through the construction of the South Stream pipeline – is the one that can be implemented most expeditiously and should therefore be supported even if the source of the gas is Russia.

The rhetoric of "getting off Russian gas" can backfire on both Europe and the United States as it would encourage Russia to intensify its efforts to shift it energy supply to the Asia-Pacific

The United States, for its part, should not sink into complacency due to its plentiful domestic oil and gas supply enabled by the shale boom. It should use the crisis in Europe as a teaching moment. The United States will continue to be part of the global energy market and energy will continue to influence its foreign relations even if it should no longer require imports of foreign energy. Washington should use the momentum in its domestic energy production to define a new role in the world's energy landscape and to convince its allies of its genuine commitment to become an active and reliable exporter of energy commodities as well as the technologies used for their safe extraction.

The world energy system is becoming increasingly integrated. More and more natural gas is traded in the form of liquefied natural gas (LNG); transnational pipelines and power grids create new mutual dependencies; and in the era of cyber threats critical energy systems can be attacked from anywhere in the world. This globalization of energy entails changes and regulatory reforms in G-7 countries' trade policy as well as in their domestic electricity and transportation systems. In many cases the architecture that governs countries' energy trade policies and its attendant rules and regulations are outdated and often rooted in the energy crises of the 1970s.

Much has happened over the past four decades. The United States is producing more energy than ever before, and energy sources, technologies and threats that did not exist in the 1970s are omnipresent today. And while the mantra of an "all of the above" energy policy has been reiterated by many governments there are still too many "buts" and exclusions to what on its face purports to be an all-encompassing approach.

The recommendations presented in this report should not be seen as punitive measures against Russia, nor should they be construed as a call for the G-7 powers to follow Russia's footsteps in using energy as a geopolitical tool. Energy should be seen as an enabler of peace and prosperity, not an instrument of foreign policy. Further, while diversification away from Russia may be desired, such an effort should be measured and will take a long time to achieve. Both American and European leaders should therefore recognize that the rhetoric of "getting off Russian gas" can backfire on both Europe and the United States as it would encourage Russia to intensify its efforts to shift it energy supply to the Asia-Pacific energy market through game-changing pipeline projects in China, North and South Korea, India and possibly Japan. Russia's shift to the east could undermine the competitiveness of U.S. LNG in Asia while cutting the availability of gas and infrastructure investment in the European market.

If the crisis in the Ukraine is to be a catalyst for new thinking on long-term energy security, G-7 members will have to depart from some long held positions, to confront inconvenient truths, to adjust priorities, to update the law to reflect 21st century conditions and to strengthen existing energy security mechanisms like the International Energy Agency, instead of creating new ones. Most important, national leaders must candidly articulate to their people the tradeoffs among security, environment, health and economic prosperity associated with each element of the energy mix in order to reflect the dramatic technological, geopolitical and economic changes that have occurred over the past few years and reach the most balanced and economically sustainable energy strategies.

Diversify gas sources but, more importantly, transit routes

The kneejerk reaction to Russia's intervention in Crimea has centered on the call for the United States to expedite exports of its surplus natural gas to help allies overseas. According to this line of thinking, American gas exports would not only be a boon to the U.S. economy but also a potent geopolitical tool to be wielded against the Kremlin. However, presently this option remains purely theoretical. The United States does not have a single operational LNG export terminal, and the countries that are most likely to be affected by Russian energy coercion, Ukraine included, do not have even a single terminal for receiving LNG. This is likely to change in the coming years as the United States and Europe, respectively, are in the process of constructing liquefaction and regasification terminals. The U.S. Department of Energy has already approved permits for seven LNG projects for exports to countries with which the United States has no free trade agreements: three of the projects are in Louisiana, two in Texas, one in Maryland and one in Oregon. There are 30 additional applications under consideration. How many of those export applications will be

While it would be advisable for Europe to reduce its overall dependence on Russia's gas its first priority should be to reduce its dependence on Ukraine as a transit country.

approved and built, and, as a result, how much of America's gas will eventually flow overseas depends on a myriad of economic and political considerations and is premature to determine. But it is likely that, if built, the seven approved terminals will have a combined export capacity of 9.2 billion cubic feet per day (Bcf/d) of natural gas – about the same amount of gas Germany currently imports. Such an addition to the global market is not trivial. Today total global gas trade movements amount to roughly 100 Bcf/d of which LNG trade makes 30 percent. This means that U.S. exports would increase global gas trade by 10 percent and global LNG trade by as much as 30 percent. This figure could go even higher should the North American shale boom prove to be sustainable.

But it is important to keep the North American shale option in proportion. While the United States could potentially supply a good amount of gas to Europe, such an option is far from being a panacea. Not only would it take years to ripen, but much of America's already approved gas

WHICH COUNTRY WOULD BE RELIABLE AS A TRANSIT COUNTRY?

Country	Corruption Rank (Out of 177 countries; 1 is least corrupt)
Ukraine	144
Bulgaria	77
Serbia	72
Hungary	47
Slovenia	43
Austria	26
Italy	69
Turkey	53

Source: Transparency International, Corruption Perceptions Index 2013

exports are committed to long-term contracts with Asian customers and are not likely to reach Europe, where LNG prices are lower. Europe should therefore focus on other potential gas suppliers in its immediate neighborhood such as Africa, the Middle East and the Caspian. More importantly, while it would be advisable for Europe to reduce its overall dependence on Russia's gas its first priority should be to reduce its dependence on Ukraine as a transit country through which 16 percent of Europe's gas flows. Ukraine's chronic political instability, its deep corruption (In 2013 Transparency International called Ukraine the most corrupt nation in Europe), its complex relations with Moscow and its poor payment history make it an unreliable transit country. Future European energy security therefore entails the development of alternative conduits for Russian gas, ones that do not rely on Ukraine.

RECOMMENDATIONS:

1 Replace Ukraine as Europe's main energy transit country

Europe's energy security challenge may have less to do with Russia than with Ukraine. The Nord Stream pipeline from Russia to Germany transported 23.7 billion cubic meters (bcm) of natural gas in 2013 without interruption. It is therefore in the interest of Europe to welcome – rather than oppose – other energy corridors from Russia such as the South Stream pipeline which would transport annually, if built, over 60 billion cubic meters of natural gas from Russia through the Black Sea and to Bulgaria, Serbia, Hungary, Slovenia, Austria, Italy and beyond. South Stream may not get Europe off of Russian gas, but it will diversify the transit path away from the Ukraine into countries that are more politically stable, more transparent and less corrupt.

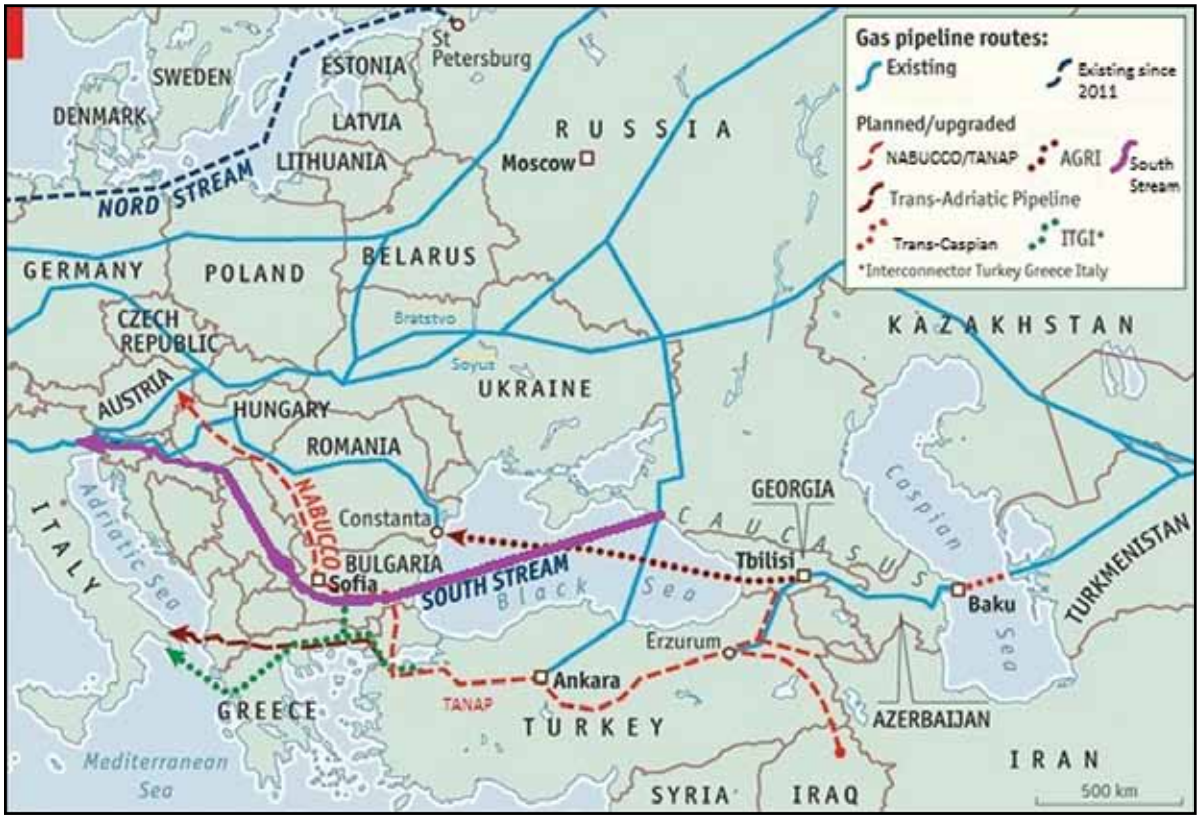
2 Reaffirm commitment to the Southern Corridor

Since the end of the Cold War, the United States has been a strong supporter of developing energy corridors from the Caspian to Europe via the Caucuses and Turkey in order to help Europe diversify its energy resources away from Russia while supporting the economic and political development of the former Soviet republics in Central Asia. Hence, the Clinton Administration set as a policy priority the construction of the Baku-Tbilisi-Ceyhan oil pipeline, and the George W. Bush

Administration saw high priority in opening a southern natural gas corridor from the Caspian to the heart of Europe. In 2008, the Bush administration even appointed a dedicated envoy for Eurasian energy tasked with coordinating policy in the Caspian region and facilitating progress on the Southern Corridor. But in recent years America's activism in the pursuit of a Southern Corridor has somewhat subsided, and the position of envoy for Eurasian energy has not been filled since the departure of Ambassador Richard Morningstar to become U.S. Ambassador to Azerbaijan in 2012.

Some of the proposed projects that are expected to make Europe more independent of Russia's gas supplies include Nabucco-West (Turkey-Austria Pipeline), the Trans-Adriatic Pipeline (TAP, connecting Greece, Albania and Italy), and the Trans-Anatolian Pipeline (TANAP, connecting Georgia and Greece through Turkey). Additionally, the Trans-Caspian Gas Pipeline, which is opposed by Russia, could connect Turkmenistan to the European gas system through Azerbaijan and Georgia. However, with the exception of TANAP, construction has not yet begun on any of the pipelines. TANAP is not likely to be commissioned before 2018 and TAP is expected to become operational by 2019. To meet the strategic goal of diminishing Gazprom's presence in Europe, the United States should reaffirm its commitment to the Southern Corridor and articulate a clear vision as to its preferred export route, in the hope that both the United States and the EU could actively and jointly support the same Southern Corridor architecture.

EUROPE'S NATURAL GAS PIPELINE SYSTEM



3 Develop a grand bargain with Turkey

No matter which route is chosen for a Southern Corridor, Turkey will be a key transit country for European energy security. The importance of its security and stability is therefore paramount. Turkey can also be an important conduit for the natural gas discovered in the Eastern Mediterranean. The Israeli government has already approved the export of up to 500 billion cubic meters of gas from the Tamar and Leviathan fields off of its shores and much of this gas could be directed to the European market via a pipeline between Israel and Turkey. At the same time, Turkey's opposition to LNG tanker traffic through the Bosporus due to safety concerns undermines the energy security of the Black Sea countries, especially Ukraine and Bulgaria.

The G-7 countries should develop and promote a grand bargain with Turkey, one which on the one hand supports Turkey's aspirations to become a land bridge for European energy while on the other persuades Turkey to facilitate the transit of LNG tankers through its straits. The G-7 countries should also continue the efforts to expedite the normalization in the relations between Turkey and Israel to increase the viability of a Turkey-Israel pipeline. They should also continue to advance a mutually accepted agreement on economic waters among Israel, Lebanon and Cyprus to ensure that East Mediterranean energy is developed in a peaceful and uninterrupted manner. It is also recommended that the United States and countries like Japan and Belgium where LNG traffic passes near residential areas share their experience and best practices with Turkey to reduce the risk of accidents and malicious attacks against LNG traffic in the Bosporus.

4 Strengthen cooperation on unconventional gas, not only shale

Shale gas is already transforming the energy scene in North America. With some regulatory changes and investments it can do the same in Europe. The landmass stretching between the United Kingdom and the Ukraine is believed to contain upward of 470 trillion cubic feet of shale gas. But the road to shale gas recovery is bumpy, mainly due to environmental opposition, and recovery costs are likely to be substantial. The United States seeks to help Europe exploit its shale resources in an environmentally responsible manner. To this end the U.S. State Department launched the Unconventional Gas Technical Engagement Program and the Energy Governance and Capacity Initiative – two programs that bring together technical expertise from across the government to help other countries build up their own oil and gas industries. Additionally, the U.S. Department of Energy and the Chinese government launched in 2009 the U.S.-China Shale Gas Resource Initiative – a joint effort to enhance investment and technical cooperation aimed at accelerating shale gas development in China. A similar program can be initiated for Europe focusing on the development of new fracking techniques, new fracking fluids, safety standards and environmental best practices.

Additionally G-7 countries should enhance their cooperation on methane hydrates development. Since the deposits of hydrates are enormous – according to US Geological Survey estimates

there is more energy in the world's methane hydrates than in all the world's oil, coal and gas put together – unlocking the secret to their safe and environmentally responsible extraction could be a game changer in the global energy landscape, far more substantial than the shale revolution. Of the G-7 members the United States, Japan and Canada have invested the most in the development of methane hydrate extraction technologies, and in March 2013 Japan became the first country to get gas to successfully flow from hydrates off its shore. It has set a target to commercialize methane hydrates by the early 2020s.

While the barriers to methane hydrate commercialization seem formidable so did those for shale gas a decade ago. The United States, Japan and Canada should establish a joint mechanism to advance cooperation on methane hydrates. Joint actions should include standard development, pilot projects and demonstrations, technical roadmaps, infrastructure development, environmental studies, as well as public awareness and engagement.

Build turbine fuel "blood banks"

The concern about a Russian cutoff of gas supply to Europe elevates the need for emergency stocks for the commodity. Natural gas is stored today throughout Europe and North America in depleted gas wells, water aquifers and salt caverns, but such storage is done for commercial purposes as a way to address seasonal variations in demand – not for strategic reasons as is the case for oil. Furthermore, each country or utility manages its own stockpile with no crossover or mechanism to coordinate gas shipments in times of emergency.

Stockpiling natural gas is a very different process from storing crude oil. Oil is a fungible commodity that can be easily shipped from country to country at short notice. It can be stored at relatively low cost and once stored it does not evaporate; it does not require a perpetual investment of energy to maintain a stockpile. Natural gas is another story. While it can be moved around in the form of LNG this can only be done if both the sender and receiver have the appropriate terminals for liquefaction and regasification. While most G-7 countries have such terminals, the countries which are most vulnerable to supply cutoffs don't. And even were this not the case, stockpiling natural gas in the form of LNG is a losing proposition since the amount of energy needed to refrigerate the gas in order to keep it in liquid form could easily exceed over a short period of time the amount of energy contained in the gas itself.

One way to avoid these problems is to stockpile the alcohol fuel methanol. Easily made from natural gas, methanol is a liquid stable at room temperature; it is not easily flammable and can be safely transported like other liquid chemicals. Methanol is widely used today for industrial purposes and in China several provinces use it as transportation fuel. But methanol can also be an excellent fuel for electricity turbines for when gas supply is disrupted. Most power turbines can be retrofitted to run on methanol in addition to natural gas. On many levels methanol is superior to natural gas and distillate as fuel for heavy duty gas turbines. Methanol can achieve an improved heat rate, higher power output due to the higher mass flow, and lower NOx emissions due to the lower flame temperature. Since methanol contains no sulfur, there are no SOx emissions.

RECOMMENDATIONS:

1. European governments should encourage public and private utilities to voluntarily retrofit their electricity turbines to enable multi-fuel optionality and to voluntarily build on-site storage capacity for emergency turbine fuels as a way to hedge their risk against supply disruptions or fuel price spikes.

2. The mandate and budget of the International Energy Agency (IEA) should be bolstered in order for the Agency to be able to serve as the international mechanism to administer and coordinate the strategic turbine fuel reserves. Since its establishment 40 years ago the IEA has skilfully managed the world oil blood bank through an emergency stockpiling system encompassing roughly four billion barrels of oil. The few times that an OECD country was in distress – such as the United States during Hurricane Katrina – the IEA was there to deliver the crude. The same should be done with turbine fuel. The IEA should be encouraged to develop turbine fuel emergency response policies and stock release mechanisms. An IEA managed emergency methanol stockpile could be deployed throughout Europe, Asia and North America to ensure power reliability in any affected country in the event of an embargo, natural disaster or terror attack.

Counter Russia's moves in Asia

Post-Crimea, Russia's energy leverage over Europe may have reached its apex. To sustain its economy and to maintain its position as an energy superpower Moscow must extend its energy tentacles into Asia, where the thirst for oil and gas is insatiable. To this end, on May 21 2014, Russia signed a $400 billion gas deal with China. According to the agreement Russia will supply China annually 38 bcm through a pipeline from Siberia to North-Eastern China. Recently, Russia also wrote off 90 percent of North Korea's debt, a gesture estimated at $10 billion, in exchange for Pyongyang's agreement to build a pipeline that would run from Sakhalin through North Korea to South Korea, the world's second largest gas importer, with the goal of supplying South Korea with 10 bcm of gas annually. In doing so, Russia will not only assign to North Korea the same role it assigned Ukraine – a vulnerable-to-pressure energy transit country which holds the key to an economy much larger than itself – but also potentially raise South Korea's dependence on Russian gas from 6 to 30 percent, thus acquiring a means to exert influence over the third largest economy

The pipelines to China, India and the Koreas — should they be built — would make one third of humanity beholden to Russia's energy resources and provide Russia inordinate power on the world stage.

The relations with China are critical to another piece of Russia's pipeline strategy - selling energy to India, which has just displaced Japan to become the world's third biggest economy in terms of purchasing power parity. Russia and India are negotiating the construction of a $30 billion oil pipeline – the most expensive ever – to connect Russia's Altai mountain region to Xinjiang province in China's north-west and from there to northern India.

The above three pipelines to China, India and the Koreas – should they be built – would make one third of humanity beholden to Russia's energy resources and provide Russia inordinate power on the world stage. Against this cunning strategy and in light of the Obama administration's "Pivot to Asia" policy, the United States and its allies should articulate an alternative vision for

Asia's energy security based on the principles of open markets, free trade and competition rather than Russian mercantilism.

RUSSIA'S PROPOSED PIPELINES IN ASIA

RECOMMENDATIONS:

1. As guarantor of South Korean security, the United States should take a strong public position against the Russia-Korea pipeline and express it to Seoul. This pipeline will not only embolden and enrich North Korean leader Kim Jong-un but it will also inject Russia into the already challenging security landscape of the Korean Peninsula.

2. The United States should convince its Asian allies that it is committed to become an energy exporting country and a major player in the global energy trade system. This means expediting the permitting process for export terminals for coal, eliminating destination requirements for LNG exports and removing the anachronistic four-decade ban on crude oil exports.

3. The price of natural gas in the Asia-Pacific is mostly indexed to oil or oil products, and this is one reason why Asian gas prices are so high. In order to facilitate competition and lower prices, natural gas should be indexed to spot prices that are tied more closely with supply and demand fundamentals in the region (gas-to-gas competition). However, despite the fact that the Asia-Pacific is the second largest gas market in the world, it lacks a single natural gas trading hub to facilitate the transparent exchange of the commodity and provide more competitive prices. The amount of gas currently traded via pipelines is very limited and the market relies increasingly on

LNG which is more conducive to gas-to-gas competition. If Russia succeeds in carrying out its pipeline strategy this will undermine the prospects of an Asian trading hub as piped gas is more likely to be tied to oil. This will result in perpetuation of the oil indexation to the detriment of the region's economies. Unsurprisingly, both the Organization of OPEC and the Gas Exporters Country Forum (of which Russia is a member) endorsed oil indexation as the preferred pricing scheme to trade natural gas.

The governments of Asia-Pacific, with the support of the G-7, should work jointly to gradually shift the gas market toward gas-to-gas competition and toward the establishment of at least one regional trading hub. This will not happen overnight but the intention and vision should be articulated in order to steer investments in natural gas infrastructure and to facilitate the emergence of an Asian gas trading hub.

4 The G-7 countries should promote the accession of China and India to the International Energy Agency, even though those two countries are not members of the OECD, and impress upon those two countries the benefits of membership in the organization. Being part of a multinational energy security mechanism would strengthen China and India's connection to the club of rich industrialized democracies countries rather than to Russia, whose application for OECD membership has been suspended in light of its recent behavior.

Focus on oil, not only gas

The G-7 countries are dissimilar with regards to their dependence on foreign energy sources for electricity generation. While Japan and the European members are dependent on imported coal and natural gas, the United States and Canada are essentially self-sufficient. The transportation sector is another story. G-7 countries share a common predicament – their transportation sectors are almost totally dominated by oil, a commodity whose inordinate strategic

Contrary to popular belief, Russia is much more of an oil exporter than a gas exporter.

importance has profound geopolitical implications. Further, for the G-7 countries (with the exception of Canada) foreign oil dependency imposes a considerable burden on national economies. Even though U.S. oil import dependency has recently dropped to its lowest level in decades, the North American oil boom seems to have had no impact on the global price of crude and hence on the price of fuel consumers pay at the pump. OPEC, the oil cartel which holds some three quarters of conventional oil reserves, has not increased its contribution to the oil market perceptibly since 1973 and only produces a third of global oil supply. Due to post-Arab Spring social spending increases by Persian Gulf regimes intent on maintaining stability, the price of oil key OPEC members need in order to balance their national budgets (the fiscal breakeven price of oil) is well over $100 a barrel. The same is true for Russia whose fiscal breakeven price for oil is approximately $117 a barrel.

Country	Fiscal breakeven price/barrel 2013
Russia	$117
Saudia Arabia	$95
Venezuela	$105
Iran	$130
Iraq	$109
Algeria	$110
Nigeria	$110

Source: APICORP and IAGS

Contrary to popular belief, Russia is much more of an oil exporter than a gas exporter. In 2012, Russia produced 10.6 million barrels per day (mbd) of oil while consuming only 3.1 mbd: 70 percent of its crude production was exported. In contrast most of Russia's natural gas production

remains at home. In 2009, Russia consumed 416 bcm of the 592 bcm of natural gas that it produced, leaving only 30 percent of total production for exports. From a financial standpoint Russia's oil revenues are almost seven times larger than its gas revenues. According to Russia's President Vladimir Putin, in 2013 revenues from crude oil were $191-$194 billion while revenues from natural gas were only around $28 billion. This means that Russia's economy is much more vulnerable to changes in oil prices than in gas prices.

High oil prices enrich and embolden Russia and OPEC countries while draining enormous amounts of wealth from oil importing economies. In developing economies high oil prices reverse human development and contribute to poverty. In more extreme cases, as is the situation in some African nations, high oil prices can lead to food shortages, political violence and refugee migration to the shores of Europe, topping off an existing immigration challenge.

Together, G-7 countries consume more than one third of the world's petroleum. It is therefore in their interest to take collective measures to reduce the strategic importance of oil and hence lower its price.

The root of the G-7 economic vulnerability with regards to oil is the fact that today vehicles rolling onto our roads can essentially run on nothing but oil-based fuels and consumers are thus thwarted from making an on-the-fly choice among different fuels when the price of oil is high. As long as this is the case, G-7 economies and the rest of the world will remain susceptible to oil price hikes emanating from OPEC and Russia to the detriment of the world economy and security. What is needed is a competitive transportation fuel market in which fuels made from a variety of energy commodities – coal, gas, biomass etc - can vie with petroleum-based fuels for market share. In other words, cars should be capable of running on another fuel in addition to or instead of gasoline or diesel, whether alcohol fuel, electricity, gaseous fuel like compressed natural gas or some combination thereof. A proliferation of fuel competitive cars like flexible fuel vehicles, natural gas vehicles and plug in vehicles would drive significant increases in production capacity for cleaner non-petroleum fuels, and eventually oil based fuels will face competition over fuel market share.

Fuel Options	Fuel Choice Enabling Technologies
Ethanol	Flex Fuel Vehicle
Methanol	Flex Fuel Vehicle
Gasoline	Flex Fuel Vehicle
Biodiesel	Optimized diesel engine
Natural Gas	CNG Vehicle/Dual Fuel/Bi Fuel
Electricity	Electric Vehicle/ Plug in Hybrid Electric Vehicle
Liquefied Petroleum Gas	Retrofitted conventional vehicle
Hydrogen	Fuel Cell Vehicle

Collectively G-7 countries are home to 45 percent of the world's vehicles, and together they hold 40 percent of the world's automobile manufacturing capacity. Thus, if fuel choice becomes a standard feature in vehicles sold in these seven markets, due to economies of scale and other factors there is likely to be a spillover effect to the rest of the world. By pursuing a free market-oriented policy that has as its primary objective a competitive market in which fuels made from various energy commodities can be arbitraged against petroleum fuels, the G-7 countries can lead the world in placing the best price damper on oil - competition.

RECOMMENDATION:

Open vehicles to fuel competition

Automakers should be given the option of meeting a significant part of their existing fuel economy obligations in the United States, Europe and Japan by making most of the new vehicles they manufacture in a given model year fuel competitive vehicles.

Monetize flared gas

About a third of the world's emissions of methane – a greenhouse gas 30 times more potent than carbon dioxide – occur in oil and natural gas wells, where billions of cubic feet of stranded natural gas are currently being flared by the energy industry. According to the World Bank sponsored

Flaring is one of the world's most wasteful practices; a valuable resource going up in flames due to an inability to bring it to market.

Global Gas Flaring Reduction Partnership, approximately 14.3 Bcf/d of gas are flared worldwide. To put this in perspective this is just a little under the 15.5 Bcf/d the EU imports from Russia. Flaring is a global problem. Iraq flares more than half the gas it produces. Gas flaring from Nigerian wells and refineries alone emits more greenhouse gases than any other single source in Africa south of the Sahara. Iran and Russia also flare a great deal of gas. With North Dakota becoming America's fourth largest oil and gas producing state, the United States has recently joined the notorious list of the world's top ten gas flaring nations.

Flaring is one of the world's most wasteful practices; a valuable resource is going up in flames due to an inability to bring it to market. By capturing and monetizing flared methane the world can gain a vast new supply source of gas. Methanol enables oil and gas producers to do so. In Equatorial Guinea, for example, gas that had been previously flared is being turned into 300 million gallons of methanol per year. There is opportunity for that to happen elsewhere. Using about 10 percent of the world's flared natural gas would produce 50 billion gallons of methanol - enough to fuel the entire vehicle fleet of Germany.

RECOMMENDATION:

The Global Gas Flaring Reduction Partnership effort should be augmented by a joint research and development program to advance the commercialization of technologies to capture and convert stranded gas to liquid fuel and other usable products, including the development of small and easily deployable systems that can reach wellheads in remote areas where natural gas pipeline infrastructure is missing.

Adopt a more balanced approach toward coal

Though it is cheaper than gas, nuclear and renewables, coal has been for some time the unwanted child of Europe's energy system due to its health and environmental deficiencies. Coal aversion has also gained ground in the United States. The Obama Administration recently adopted several policies aimed at shrinking the share of coal in the global energy pie, including a ban on financial support for coal projects overseas from multilateral development banks, such as the World Bank, to which the United States is a major donor, as well as onerous regulations which essentially block the permitting for proposed coal fired power plants. In addition, the approval of three new West Coast coal terminals, proposed for Oregon and Washington, has been delayed because of environmental concerns.

Much attention has been placed on America's potential contribution to global energy security with respect to natural gas exports but little on its ability to export coal.

While the environmental problems associated with coal mining and burning cannot be ignored, they should be balanced against the energy security implications associated with an overly aggressive shift away from coal. As Poland's Prime Minister Donald Tusk recently stated: "We need to fight for a cleaner planet but we must have access to energy resources and jobs to finance it."[1] This means that national energy policies guided primarily by the desire to reduce greenhouse gas emissions often come at the expense of energy security and economic prosperity. In Europe's case the shift away from coal has raised electricity prices and deepened countries' dependence on imported natural gas. The traditional definition of energy security is "availability of sufficient energy supply at affordable prices." The shift from coal thus far has compromised both the availability and the affordability of energy. Its pace and pathway should therefore be reassessed.

Furthermore, G-7 countries should be more aware of the impact measures taken to restrict the use of coal have on energy poverty in the developing world. In India alone roughly 400 million

1 Donald Tusk, "A United Europe can end Russia's Energy Stranglehold," *Financial Times*, April 21, 2014

people – more than the entire population of the United States – lack basic electricity. In Southeast Asia there are another 130 million in the same position. In Sub Saharan Africa, only ten percent of the rural population has access to electricity. Such extreme energy poverty leads people to make poor and highly consequential choices like the indoor burning of wood, farm residue and animal waste. The human cost of such choices is staggering. A recent report by the World Health Organization reveals that the world's single biggest killer after cardiovascular diseases is household air pollution – exposure to poisonous fumes emitted by cooking stoves and heaters due to lack of electricity. Globally, 4.3 million people died in 2012 from health conditions related to household air pollution – more than from HIV, road fatalities, suicide and homicide combined. [2]

For the foreseeable future coal will continue to be the cheapest and most widely used source of base load electric power. According to the International Energy Agency, the combined 600 million person economy of the ten Association of Southeast Asian Nations (ASEAN) countries is projected to triple by 2035 and the region's energy demand is projected to increase 80 percent, a rise equivalent to Japan's current energy demand. Three quarters of the thermal capacity now under construction in this region alone is coal fired, and the Asian Development Bank (ADB) estimates that coal will account for approximately 83 percent of electricity production in the Asia-Pacific by 2035. Like it or not, coal will be consumed around the world regardless of the barriers imposed by rich countries. The only question is whether the coal will be produced in North America, where environmental standards are high, or elsewhere.

Much attention has been placed on America's potential contribution to global energy security with respect to natural gas exports but little on its ability to export coal. As American electric utilities are shifting rapidly from coal-fired power generation to natural gas-powered turbines the United States is left with gigantic reserves of coal which can be utilized by European and Asian consumers. The United States is by far the world's largest reserve holder of coal, home to 27 percent of the globe's total. However, U.S. coal exports are far lower than its reserve base permits. The United States currently produces 13 percent of the world's coal supply. With exports of roughly 120 million metric tons of coal a year it accounts for only 11 percent of world's coal trade. This level can - and should - be ramped up.

2 Burden of Disease from Household Air Pollution for 2012, World Health Organization, www.who.int/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf

RECOMMENDATIONS:

1. European governments should revise their coal policies, striking a more reasonable balance between energy security (cost and availability) and environmental policies.

2. President Obama's National Export Initiative, aiming to double U.S. exports, should place greater emphasis on the role of coal exports.

3. The United States should streamline the permitting process of new coal export terminals.

4. Governments should focus on improvements in the way coal is produced, transported and used rather than the unrealistic goal of crowding it out altogether. The goal should be to introduce more efficient power plants such as supercritical (high temperature), ultra-supercritical steam power plants, and circulating fluidized bed plants, all of which have higher efficiency than the sub-critical plants dominant in most countries. Additionally, the coal strategy should focus on providing more economic output per unit of coal. This can be done through gasification and polygeneration technologies, which remove impurities before combustion and allow the production of electricity as well as gas, chemicals, and methanol fuel.

Rethink nuclear power

The U.S., Japan and Europe have been the undisputed leaders of nuclear technology in the world since the emergence of the civilian nuclear industry. But this leadership is eroding by the day. Following the Fukushima nuclear disaster, Japan shut down all of its nuclear reactors and with the exception of two has kept them all shut. Germany immediately shut down eight of its 17 nuclear plants, with the retirement of all remaining reactors scheduled by 2022. Italy has

What is at stake is who will dominate nuclear technology in the 21st Century: G-7 and their fellow democracies or non-democratic and non-transparent regimes.

maintained a non-nuclear policy. Switzerland and Spain have banned the construction of new reactors. Belgium is considering phasing out its nuclear plants, perhaps as early as 2015. Although France is frequently heralded as a nuclear commercial model for the world, it is considering cutting nuclear power's electricity contribution by more than a third by 2025. In the United States nuclear power plants are facing a competitive issue in power markets due to low natural gas prices and government policies that favor renewables, and in the past year and a half five reactors have been shut down.

The G-7 countries have today 250 nuclear power plants in operation. But many of those plants are aging and new plants are not on the horizon. Of the 72 reactors currently under construction worldwide only nine are in the G-7 countries. And of the 173 reactors currently planned only 21 are in the G-7 countries. On the other hand Russia and China are moving at full throttle in their nuclear expansion. Russia has ten reactors under construction and 31 planned and China has 29 reactors under construction and 57 planned.

WORLD NUCLEAR POWER REACTORS

	G-7	China	Russia	World Total
Operating reactors	250	20	33	434
Under construction	9	29	10	72
Reactors planned	21	57	31	173

Source: World Nuclear Association

Throughout the G-7 economies the nuclear power industry is being squeezed out of the energy marketplace while hegemony over nuclear technology is gradually shifting to the east. Without continuous development of know-how and technical infrastructure by the transatlantic community it will be China and Russia that will become the world's hubs on all nuclear matters and it will be in those two countries, not the G-7, where the best practices and safety standards of the new generation of nuclear reactors will be determined. What is at stake is who will dominate nuclear technology in the 21st century: G-7 and their fellow democracies or non-democratic and non-transparent regimes.

RECOMMENDATION:

As the world's largest producer of nuclear power, accounting for more than 30 percent of worldwide nuclear generation of electricity, the United States should collaborate with Europe and Japan in the development of a new generation of reactors that are potentially safer, lower-cost, and produce less nuclear waste, including those using high-temperature gas coolant technology, as well as molten salt reactors that could use thorium fuel. Such cooperation on research and development combined with a strengthening of nuclear safety governance would pave the way for significant growth in nuclear capacity while restoring the democratic world's dominance in the nuclear space.

Get serious about the Arctic: Close the icebreaking gap

The melting of the Arctic ice sheet is increasingly framing the Arctic region as a new frontier in superpower competition over access to natural resources and maritime shipping lanes. About 15 percent of the world's undiscovered oil and 30 percent of undiscovered gas are believed to be in the Arctic. Four-fifths of these reserves are located offshore. Arctic oil and gas could be an important part of the global energy landscape in the second half of the 21st Century. Yet the future of the Arctic is uncertain. This is mostly because members of the Arctic Council – Canada, U.S., Russia and the Nordic countries Norway and Denmark - have not finalized their strategic concepts regarding the region. The UN Law of the Sea Convention (UNCLOS) to which all countries involved but the United States are parties determines that countries can lay claim to their Exclusive Economic Zone (EEZ) of 200 miles from their continental shelf. But Russia's continental shelf is still not delineated as it is not yet clear how far its landmass reaches. Russia has made moves to claim or to reinforce pre-existing claims to the waters or seabed of the Arctic and as the Arctic region becomes less forbidding the United States and the Nordic countries will likely find themselves in an increasingly assertive race against Russia to exploit its energy bonanza. Therefore G-7 governments, particularly the United States and Canada, should develop a coherent Arctic strategy and allocate the resources needed to strengthen their position in the region. Any effective Arctic strategy must focus on providing the hardware necessary for militaries and commercial actors to operate freely and safely in the region. Unfortunately, despite the significant geopolitical and geo-economic interests, the non-Russia Arctic powers have treated the region with insufficient resources and even less policy attention while Russia is pursuing a path of aggressiveness and unilateralism.

Just like space exploration requires spacecraft, exploring and navigating the Arctic requires the use of icebreakers, preferably nuclear ones.

Today, neither the G-7 countries nor the other Arctic neighbors – Denmark, Norway, Sweden, Iceland and Finland – have the capacity to operate commercially and militarily in the Arctic. Just like space exploration requires spacecraft, exploring and navigating the Arctic requires the use of icebreakers, preferably nuclear ones. Nuclear ice breakers are much more powerful than their diesel-powered counterparts but more importantly they do not require refueling and

THE ICEBREAKING GAP

	G-7	Russia
Conventional icebreakers	13	32
Nuclear icebreakers	0	6
Planned	3	9
Total icebreakers	16	47

Source: US Congressional Research Service

hence offer a much longer range. Russia is the only country in the world that holds the capability to operate in the Arctic on a sustained basis. Russia's icebreaker fleet is three times larger than the G-7's fleets combined. Furthermore, Russia currently operates five nuclear icebreakers, and in 2013 it started building the world's largest. The G-7 countries – and other Arctic nations for that matter – do not have one nuclear icebreaker nor do they have any plan to build any. The 2014 Quadrennial Defense Review stated that the U.S. naval fleet is "capable of operating in every region and across the full spectrum of conflict" and the U.S. Coast Guard's strategy document for the Arctic region, released on May 21, 2013, stated that "The United States must have adequate icebreaking capability to support research that advances fundamental understanding of the region and its evolution," and that "The Nation must also make a strategic investment in icebreaking capability to enable access to the high latitudes over the long-term." [3] Yet the United States has only one conventional icebreaker in planning.

RECOMMENDATIONS:

1 Revise the U.S. Department of Defense's Arctic Strategy to address the shortcoming in military preparedness in Arctic operations.

1 Allocate resources for bolstering naval capabilities in the Arctic region as part of the U.S. Department of Defense Quadrennial Defense Review process, including for the procurement of at least one nuclear icebreaker.

3 United States Coast Guard Arctic Strategy, May 2013, http://www.uscg.mil/seniorleadership/DOCS/CG_Arctic_Strategy.pdf

Cooperate on cyber-energy security

Cyber-attacks pose a new and severe challenge to national economies, and the energy sector is a prime casualty of such attacks. In the United States 40 percent of all cyber-attacks in 2012 were directed against the energy sector. Recent virus attacks against major oil and gas facilities in Saudi Arabia and Qatar have demonstrated the vulnerability of the energy sector to cyber threats. Utilities across the world are also being hacked on a daily basis. Such attacks impose a mounting cost on energy companies, the insurance industry and national budgets, making energy less affordable and less reliable. A recent report by Willis warned that the energy industry may be sitting on an "uninsured cyber-attack time bomb" and that the future cost of such attacks will reach $1.8 billion a year by 2018.[4] But under certain scenarios the cost could be substantially higher. For example, hacking into Dynamic Positioning Systems of offshore oil and gas rigs could cause spills and environmental disasters akin to the Deepwater Horizon accident in 2010 which has cost British Petroleum over $42 billion. Hacking into industrial control systems of hydroelectric dams can flood vast areas and destroy local communities. And an orchestrated and severe attack on a national grid can cause catastrophic damage to the economy. Europe has already faced a cyber-attack on national infrastructure in Estonia in 2007, an attack that is believed to be linked to Russian perpetrators.

Cyber vulnerabilities evolve quicker than ever with the rapid development of smart grid technologies and greater reliance on wireless and public internet. Governments and private industry are anything but unaware of the challenge and have been working together for some years to protect critical infrastructure. This is also true on the multinational level. In 2008 NATO accredited its Cooperative Cyber Defense Center of Excellence in Talin, Estonia, to conduct research and training on cyber security. EU-U.S. Cooperation on cyber security dates back to the 2010 EU-U.S. summit, where leaders committed to the creation of a Working Group on Cyber Security and Cybercrime. This initiative has led to many meetings and collaborations. At the March 2014 Brussels Summit the EU and the United States decided to strengthen and upgrade their cooperation on cyber issues. However, thus far this collaboration has focused mainly on general cyber security doctrine and general data protection, less so on the specific nexus between energy and cyber security.

4 *Energy Market Review 2014*, Willis, http://www.willis.com/documents/publications/Industries/Energy/20140404_Willis_Energy_Market_Review_2014.pdf

RECOMMENDATIONS:

1. To limit the effects of cyber-attacks governments should encourage more businesses and critical facilities to better insulate themselves from system failure by adopting micro-grid elements like standby generators, uninterruptible power source (UPS) devices, backup storage batteries, fuel cells and other business continuity and recovery solutions.

2. Establish an energy cyber security learning center within the transatlantic community. Such a center will assess threats and monitor the development and enforcement of cyber security standards (like replacement of weak passwords with stronger authentication measures), it will recommend compliance requirements and their adoption on the multinational level and will also develop matrices for assessing and grading national energy systems according to their level of cyber resilience.

3. Conduct joint multinational exercises to simulate the scenario of a major attack on a country or countries, the recovery efforts and the response of allies to such an attack.

The Institute for the Analysis of Global Security (IAGS) is a non-profit public educational organization dedicated to research and public debate on issues related to energy security. IAGS seeks to promote public awareness to the strong impact energy has on the world economy and security and to the myriad of technological and policy solutions that could help nations strengthen their energy security.

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