DPRK COAL EXPORTS TO CHINA UNDER NEW UN SANCTIONS: POTENTIAL IMPACTS AND “WORK-AROUNDS”



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David von Hippel and Peter Hayes

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I. INTRODUCTION

This essay by David von Hippel, Nautilus Institute Senior Associate and Peter Hayes, Nautilus

Institute Executive Director, analyzes the potential impacts of UNSC sanctions on North Korean coal exports to China, and how China may apply these sanctions in 2017. They argue that "China arguably has leeway over about 8 million tonnes of North Korean exports that it can allow, or to variable extents, not allow, in 2017, thereby signaling to Washington that it will (or will not) cooperate on the DPRK nuclear weapons issue. Its cooperation will depend on where it perceives that the Trump Administration is heading with regard to the overall US-China relationship. At the same time, China will factor into its decision as to what level of exports to allow the degree to which it feels that the DPRK should be rewarded or punished for trouble-making or compliance with China's demands that it not cause trouble in the Peninsula or beyond."

A version of Section 3 of this article has been published by *NK News* as "How Chinese traders could work around coal sanctions", by David von Hippel and Peter Hayes, dated February 15, 2017, and available here.

The views expressed in this report do not necessarily reflect the official policy or position of the Nautilus Institute. Readers should note that Nautilus seeks a diversity of views and opinions on significant topics in order to identify common ground.

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II. NAPSNET SPECIAL REPORT

DPRK COAL EXPORTS TO CHINA UNDER NEW UN SANCTIONS: POTENTIAL IMPACTS AND "WORK-AROUNDS"

By David von Hippel and Peter Hayes

1. Background of DPRK Energy Supply and Demand Situation

Though the Democratic Peoples' Republic of Korea (the DPRK, or "North Korea") has been chronically short of many commercial forms of energy since the breakup of the Soviet Union in 1990, one resource that it does have in abundance is coal. Electricity supply problems, due to a combination of aging infrastructure, lack of access to/funds for technological updates, and, often, fuel supply constraints, have rendered electricity supplies unreliable or worse in most parts of the nation. Similarly, the lack of indigenous oil and gas production (though apparently some resources do exist, including offshore) have made North Koreans dependent on imports of crude oil and oil products, mostly from China and Russia.

Per capita, by our estimates (the DPRK does not publish regular energy statistics), North Korea consumed about one thirtieth (1/30) as much electricity as South Korea, and a tenth as much as China, in 2014, along with a tenth as much overall energy supply per capita as South Korea (despite heavy use of biomass, which burns with low efficiency) and less than a third as much as China.[1]

The DPRK does, however, have billions of tonnes of coal resources. Since 2000, and particularly since 2010, North Korea has been increasingly exporting anthracite coal, primarily to China. Coal has thus been a major source of export earnings for the DPRK, and as a consequence constitutes a large target for the increased economic sanctions recently imposed on the DPRK by the United

Nations Security Council (UNSC) in response to the DPRK's most recent nuclear weapons test. The effect of these most recent sanctions on the DPRK's economy, and relatedly (but not necessarily directly) their effectiveness in positively influencing DPRK behavior, depends in large part on the rigor with which this particular set of sanctions will be implemented by China.

DPRK's Recent Coal Exports to China in Context of Overall Coal Production

The DPRK's coal exports to China, as reported in China's customs statistics, were less than a million tonnes (Mt, all tonnes herein are metric tonnes) annually until 2004, when exports began to rise markedly, averaging about 3 Mt per year from 2005 through 2009. By 2013, DPRK coal exports to China were nearly 17 Mt, and reached their peak at 19 Mt in 2015. Full-year statistics for 2016 are not yet available as of this writing, but will be similar to 2015, even with sanctions beginning in the last month of 2016.[2] Placed in the context, the level of China's imports of coal from the DPRK in 2015/2016 amounted to over half of our estimate of the DPRK's total coal production even in 2014, when China's imports from the DPRK were over 15 million tonnes. This means that a large portion, possibly even a majority, of the DPRK's coal output has been routed to China in the last three years.[3]

Coal Exports in the Context of the DPRK's Export Earnings and Trade Balance

The value of the DPRK's official trade for 2015, as indicated in the UN Comtrade reporting system, was somewhat less than USD 3.1 billion, of which China accounted for 82 percent, or $2.5 billion. (India was a very distant second, at about $100 million.). Of this total, just under $1.1 billion, or 42 percent, were from China's imports of coal from the DPRK. Almost as large were China's imports of items of clothing from the DPRK, which totaled over $800 million, although it is our guess, based on customs statistics that show the DPRK importing on the order of $600 million worth of goods from China in categories related to textile production (such as "Manmade Filaments, Including Yarns And Woven Fabrics Thereof"), that these clothing imports represent mainly goods made in the DPRK for China using North Korean labor and Chinese materials. Beyond coal and clothing, most of the remainder of the value of DPRK's exports to China fell into the categories of iron and steel, non-metallic mineral products, metal ores, and "fish and crustaceans, molluscs and other aquatic invertebrates".[4] China's exports to the DPRK for 2015 sum to a value of just under $3 billion, meaning a trade imbalance between the two nations of about $500 million.

Recent UN Resolution and Sanctions Focusing on DPRK Coal Exports

United Nations Security Council (UNSC) Resolution 2321, dated November 30, 2016, imposes additional sanctions on the DPRK stating "The Security Council strengthened its sanctions regime against the Democratic People's Republic of Korea today, condemning that country's 9 September nuclear test in the strongest terms".[5] The main impact of the sanctions with regard to the DPRK's coal exports, is that it is designed to reduce the DPRK's annual coal exports by "about 60 percent with an annual sales cap of $400.9 million, or 7.5 million metric tonnes, whichever is lower", starting in 2017.[6] In addition, for immediate effect, the Resolution limits December, 2016's exports of coal from the DPRK to about 1 million tonnes, or a value of $53.5 million, whichever is lower. The coal "cap" is in the context of an overall statement that the DPRK "should not supply, sell or transfer coal, iron and iron ore (surprisingly, steel is not specifically listed), and that all States should

prohibit the procurement of those materials from that country, with the exception of total coal exports to all Member States" as above. Also exempted are "transactions in iron and iron ore intended exclusively for livelihood purposes". Additional elements included in the Resolution were summarized as follows:

"By other terms of the resolution, the Council prohibited Pyongyang from exporting copper, nickel, silver and zinc, new helicopters and vessels, as well as statues. It decided further that all Member States shall take steps to limit the number of bank accounts held by diplomatic missions and consular posts, as well as diplomats of the Democratic People's Republic of Korea within their respective territories. Member States should further close existing representative offices, subsidiaries or bank accounts in the Democratic People's Republic of Korea within 90 days, unless required for the delivery of humanitarian assistance.

"The Council decided further that all Member States shall suspend scientific and technical cooperation with persons or groups officially sponsored by, or representing, the Democratic People's Republic of Korea except for medical exchanges. It added 11 individuals to the list of those subject to a travel ban and asset freeze, as well as 10 entities to the list of entities subject to an asset freeze. The Council also added 11 items to the list of nuclear- and/or missile-usable items and three to the list of chemical/biological weapons-usable items[7] of which Member States should prevent the supply, sale or transfer to the Democratic People's Republic of Korea.

"Concerned that the country's nationals were working in other States to earn hard currency for use in its nuclear and ballistic missile programmes, the Council called upon States to exercise vigilance over that practice."

2. Estimated Impact of New Sanctions on DPRK Coal Exports, IF Sanctions Operate as Intended

Estimated Impact on Coal Exports and Revenues

Assuming that DPRK coal exports for the first 10 months of 2016 were, as reported, 18.6 million tonnes, and that the final two months of the year would in the absence of sanctions have produced the same average monthly level of exports as the first 10 months—albeit probably at higher prices, due to various changes in the coal market in China—limiting the DPRK's exports over the final month of 2016 to 1 million tonnes would have reduced DPRK coal exports by about 900 thousand tonnes, worth on the order of $90 million. In 2017 (and, presumably, beyond), assuming an average price for coal over the next year in the range of prices prevailing in the latter half of 2016 (about $80-$100 per tonne), reducing the DPRK's coal exports to 7.5 million tonnes annually would reduce exports by on the order of 9 to 10 million tonnes, and revenues by on the order of $700 million to $1 billion.[8]

Loss of Revenue Relative to DPRK Income from Trade

Losing up to a billion dollars in annual coal revenue would decrease the DPRK's overall income from reported exports to all countries by on the order of 23 to 33 percent, and income from exports to China by about 28 to 40 percent. If not compensated for by other changes in imports or exports, this loss of trade income would increase the DPRK's trade deficit by on the order of 150 to 230 percent—that is, would double or triple its trade deficit—with similar impacts on the DPRK's trade deficit with China (which accounts for over 95 percent of the DPRK's overall trade deficit).

Relative Importance of Loss of Coal Revenue to DPRK Economy

The closed nature of the DPRK's economy, and the difficulty of valuing goods and services in an official economy that is not market based, coupled with an unofficial economy that is (probably largely) market-based but keeps no records, makes estimation of overall GDP in the DPRK a difficult task. Indeed, 2015 estimates of the DPRK's GDP by the ROK's Bank of Korea and Hyundai Institute appear to differ by about 50 percent, and do not even agree on whether the DPRK's economy expanded or contracted in 2015.[9] Based on estimates of the overall size of the DPRK economy, the loss of coal revenue due to sanctions would amount to on the order of 3 to 7 percent of overall GDP, depending on whose estimate of North Korean GDP (and which estimate of future coal price) one uses.

This is certainly a significant impact, but understates the overall effect of the coal export cap on the DPRK economy because the loss in export revenue represents a loss of hard currency[10] that cannot easily be compensated for by domestic economic activity. That is, the loss of export income means that the DPRK cannot buy international goods at the same level, and there are many international goods for which domestic substitutes are difficult to obtain in the DPRK. This, of course, is the whole point behind sanctions—that the DPRK will be denied the hard currency needed to be able to purchase desired international goods, including those related to its nuclear weapons program. It is unlikely, however, that the reduction in the DPRK's hard currency earnings would be felt uniformly across all of the types of goods it imports. Given the DPRK's emphasis on the military, one would expect that to the extent that the coal export cap affects the imports of commodities, those related to the military—and in particular the nuclear—sector would be the last to be affected by the need to economize. Moreover, as noted below, there may be a number of "work-arounds" that the DPRK and its trade partners (mostly China) might use to blunt the actual impact of the new UNSC sanctions on the DPRK's economy.

Potential Impact of Resolution on Coal Use in the DPRK

The DPRK's own coal use in 2010, by our estimates, amounted to about 17 Mt, of which about 3 Mt was for power generation and district heat, 7 Mt for the industrial sector, 5 Mt for the residential and commercial/institutional sector, and 1 MT for the military.[11] In practice, admittedly, separating military and industrial coal demand is not straightforward, since much of the industrial sector is operated by or for the military (or both). In a more "normal" economy one might think that if DPRK coal exports are dramatically reduced, as they would under full compliance with the November UNSC resolution, prices of coal for local consumption might fall, and availability of coal for district heating, home heating, and power generation might rise. This may well come to pass, to some degree, depending on the extent to which coal markets are price-controlled, and conversely, the amount of coal that is sold in official or unofficial markets. But it is also possible that the mines that have been producing probably higher-than-average-quality coal for export to China,[12] especially those run by Chinese companies, would simply shut down in response to the export cap, thereby reducing overall DPRK output, and negating all or a portion of any domestic supply benefit that might accrue to DPRK consumers as a result of the resolution. Almost certainly, there is substantial suppressed demand for coal and substitutes in the DPRK due to the non-market allocation and distribution system to households and enterprises. Some portion—perhaps 20 percent—of coal not exported to China might end up used domestically even if the domestic coal price were to increase to recover the full cost of switching the supply from export to China to local users. This switch represents the upper limit on the "humanitarian dividend" that might follow from limiting exports via sanctions.

This dividend would be offset, however, by lost household and enterprise income due to the shutdown of mines closed due to the reduction in coal exports due to sanctions. As a rough estimate of this lost income, we assume (as described above) that the overall annual reduction in DPRK coal exports due to sanctions is 10 Mt, and that the domestic economy absorbs 2 Mt of this reduction. This means that overall annual DPRK coal output is reduced by about 8 Mt. Further assuming that coal miners working in these for-export mines earn a wage of $100 per month,[13] work 25 days per month, and produce about 4 tonnes of coal per day,[14] a reduction of 8 Mt means a reduction of $8 million in annual income for miners' households (only). Add in reductions for other mine workers, for businesses servicing the mine, and for indirect economic activity around the mine, and a multiplier of 10 seems plausible, arguably resulting in an annual reduction in humanitarian welfare on the order of $80 million. This amount, though obviously a very rough estimate, is still a small portion of the overall reduction in the DPRK's income from coal exports, as most of the coal income reduction would fall on the DPRK state, Chinese mine operators, and DPRK elites, in some probably un-knowable combination.

3. Potential "Work Arounds" for DPRK, China, and Chinese Traders to Soften the Impact of New Sanctions

The sanctions placed on the DPRK by the United Nations Security Council (UNSC) in response to the DPRK's most recent nuclear weapons test include restrictions on the exports of coal from the DPRK to other nations. These sanctions will affect the DPRK's coal trade with China almost exclusively, since China is virtually the sole importer of DPRK coal. Although the new sanctions, under UNSC Resolution 2321, dated November 30, 2016, could reduce the DPRK's hard-currency income by on the order of a billion dollars annually, and coal exports by 9 to 10 million tonnes (Mt) per year, there are a number of "work-arounds" that could be employed by the DPRK and China to soften the blow on the DPRK's coffers. These "work-arounds" could include "off-books" coal trade between the partners, lack of enforcement of restrictions on export and transport of coal by local Chinese customs and other officials, the designation of China's exports (for example, of food, fuel, and clothing) to the DPRK as "humanitarian", and/or China allowing DPRK to import goods from China on a concessional (or deferred payment) basis. In addition, it is possible, given recent trends in China's coal market, that the restrictions under UNSC Resolution 2321 are in line with what China would have done anyway with respect to DPRK coal imports, and thus do not represent much of a change in plans for China overall. Each of these possibilities is discussed briefly below.

"Off-books" Coal Trade by the DPRK

China—or more specifically, Chinese businesses—could import coal from the DPRK on an "off-books" basis, that is, without recording the trades in China Customs Statistics. These imports, though of course difficult to find evidence for without specific testimony from traders on one or both sides of the border (which is unlikely to be forthcoming), could occur with the tacit acceptance of Chinese officials or without their knowledge, including shipments crossing the border (by land or sea) through routes where customs officials are not present. Such "off-books" trades of coal by the DPRK could boost the DPRK's hard currency earnings without counting towards the sanctions total. Alternatively, coal could be bartered for Chinese goods, therefore avoiding the exchange of hard currency but displacing the need for hard currency by the DPRK.

Potential Lack of Enforcement of Restrictions by Local Chinese Customs Officials

Even for trade in coal that does come under the purview of customs, it is possible that the actions of local Chinese customs officials may not be fully consistent with China's national commitment to the new UNSC resolution. Under the resolution, customs officials would presumably be obliged to turn back coal shipments once annual quotas were reached. Officials could fail to do so either by not being adequately informed about the quotas (and/or how closely the quotas were being approached), or by knowing about the quotas but allowing non-compliant trades through anyway, including in exchange for payments of some kind from traders.

Additionally, although China has pledged to enforce the resolution "reasonably", as it has always enforced UN resolutions, a statement by an spokesman for the Chinese Foreign Ministry, Geng Shuang goes on to say:

"Resolution 2321 formulates new measures, showing the resolve of the Security Council, and also points out they must avoid creating adverse consequences for North Korean civilian and humanitarian needs, and are not intended to create negative effects on normal trade".[15]

It is unclear how Chinese officials at the national and local levels would interpret "negative effects on normal trade" with regard to Resolution 2321, since it most certainly is designed to reduce normal trade in coal between the DPRK and China, or at least reduce trade from levels that have been arguably "normal" in the past several years.

Transportation Considerations under the Resolution

The Resolution also includes a clause on transportation of goods, including the de-listing of ships owned, operated, and/or crewed by the DPRK, allowing inspection of North Korean "cargoes" of other forms (including in the personal luggage of DPRK officials—important for other reasons but unlikely to be of consequence for coal exports). For coal trade in particular, since it is almost exclusively between the DPRK and China, interdiction and inspection of cargoes that may violate the terms of the agreement will depend almost entirely on Chinese enforcement activities, since once outside the DPRK the shipments will likely almost exclusively transit Chinese land territory or territorial waters. Chinese interdiction and inspection thus becomes central to the coal export provisions of the Resolution having an effect on the DPRK economy.

Designation of China's Exports to the DPRK as Humanitarian

Since much of the DPRK's earnings from exports, and thus much of the DPRK's hard currency available to support its nuclear weapons program, comes from sales of coal and other goods to China, China could designate some portion of its exports of essential goods (food, clothing, medicines, fuel) to the DPRK as "humanitarian" (which some arguably may well be), and thus either treat coal imports to China, including exports beyond the UNSC Resolution targets, as essential for paying for China's exports of such goods to the DPRK, or…

China Could Allow the DPRK's Trade Deficit to Increase

The DPRK's trade deficit with China in 2015 was already nearly half a billion dollars. Even if the DPRK's hard currency income decreases as a result of the new cap on coal exports, China could conceivably continue its exports of food, fuel, and other goods to the DPRK at the current (2015/2016) level and simply let its trade deficit with the DPRK expand. What accounting mechanisms might be used to allow the expansion of the trade deficit to happen are unclear, but one

could imagine that means such as implicit or explicit loans to the DPRK government from the Chinese government, subsidies for Chinese traders to supply goods to the DPRK, outright gifts of goods (for example, on humanitarian grounds), subsidized prices for some commodities,[16] and/or some other mechanisms might be used to allow the trade deficit to expand without hurting individual Chinese businesses that trade with the DPRK.

China Could Designate Some of the DPRK's Exports of Coal as "Humanitarian"

China could designate some of the DPRK's coal exports to China—and/or exports of other commodities, such as ores and metals, also on the UNSC list—as being required on humanitarian grounds to enable the DPRK to pay for food, medicine, clothing, fuel for non-military sectors, and the like, as well as to provide welfare to the considerable number of working households engaged by the coal mining sector in the DPRK. It has been suggested that China has used this argument in response to previous UNSC resolutions calling for reductions in imports from the DPRK.[17] China could calibrate the degree to which it designates DPRK coal exports as humanitarian to seek what it perceives as a balance between showing compliance with/support for the UNSC resolution (possibly factoring in its response to unrelated geopolitical issues, such as friction over new US policies) with reducing imports from the DPRK sufficiently to send a message of displeasure to the latter, but not enough to cause significant stress on the DPRK civilian economy.

Impact of DPRK's Coal Exports on the Chinese Coal Market

China produced over 3.7 billion tonnes of coal in 2015, and consumed about five percent more than it produced.[18] As such, its net imports were on the order of 100 million tonnes. Therefore even at annual exports of close to 20 million tonnes, the DPRK provides a tiny fraction of China's coal, and far from a majority of China's coal imports, though the importance of DPRK coal in regions of China near the DPRK border may be somewhat higher. Moreover, China's coal consumption and production have both actually fallen slightly in the last three years, as China works to move toward the use of cleaner fuels and using energy more efficiently. Thus China is reducing its coal imports anyway, and is reducing its own domestic coal supply capacity (which is more than adequate to meet its needs) to increase efficiency.[19] As a consequence, China does not need to import coal from the DPRK as much as the DPRK needs to export coal, and the impact of the UNSC cap on DPRK exports of coal will have little impact on China's overall coal supply, though it can be expected, of course, to affect the volume of business done by particular traders, and possibly increase costs somewhat to some Chinese consumers of DPRK coal.[20]

What Might China's Overall Approach be to the New Sanctions?

Following the logic outlined at the end of section 2 above, if China cut DPRK exports by 2 Mt of coal to demonstrate that it is complying with the UNSC resolution on coal exports—which it incidentally might have done anyway due to the state of Chinese coal demand and trends in global coal supply—then 7-8 Mt of coal remains designated by the UNSC resolution as sanctionable by China. The extent to which China designates this amount as either to be reduced as a part of sanctions or to be included in a humanitarian (and/or "normal trade") exemption, in some combination, based on their estimate of what the DPRK could not consume domestically if exports stopped, is a political choice for the Chinese government.

Thus, China arguably has leeway over about 8 million tonnes of North Korean exports that it can allow, or to variable extents, not allow, in 2017, thereby signaling to Washington that it will (or will not) cooperate on the DPRK nuclear weapons issue. Its cooperation will depend on where it perceives that the Trump Administration is heading with regard to the overall US-China relationship. At the same time, China will factor into its decision as to what level of exports to allow the degree to which it feels that the DPRK should be rewarded or punished for trouble-making or compliance with China's demands that it not cause trouble in the Peninsula or beyond.

Indeed, one might posit that Trump's reassurance to President Xi on February 10 2017 that the United States will adhere to "our One China" policy[21] gained the United States, for example, 1Mt of coal exports denied to the DPRK, and that the DPRK's missile test on February 12 2017—undertaken against China's wishes[22]—earned the DPRK, for example, a second 1Mt of exports denied as punishment, leaving 6 Mt of coal for China to allow or deny as the year progresses. If so, it would have been an expensive week for Pyongyang—roughly $80-100 million punishment for provoking the United States with nuclear armament, and another $80-100 million punishment for the missile test.

Of course, we do not know the Chinese calculus exactly for reward and punishment of the DPRK, or how much China is willing to punish the DPRK to reward the United States on bigger strategic issues (these being different payoffs, and not necessarily related). Nor do we know who exactly makes these choices in China with regard to the different parties. The same uncertainty applies to the unknowns about the Trump administration's willingness to link consideration of China's adherence to the DPRK coal export cap sanctions to other geopolitical issues. These coal export reduction numbers are merely indicative. One can be sure, however, that someone in China is keeping count of coal exports from the point of view of the broader politics, and the trade statistics will tell at least a part of this story as it unfolds.

No-one seriously believes that the sanctions can actually impede the North Korean missile and nuclear weapons program at this stage, although they might slow those programs down marginally in some ways, and accelerate them in others (for example, by making the North Koreans even more skillful at smuggling hardware and knowledge, and further accelerating their indigenous R&D of missile technologies[23]). Given the spectacular anti-China statements and actions made by new American President Donald Trump and his appointees in the lead up to and after the 2016 U.S. elections, it is hard to believe that China will pursue a hard line that risks destabilizing the DPRK politically or economically in order to accommodate American concerns about North Korea's nuclear program at this time. With South Korea's government effectively paralyzed by Park Geun Hye's impeachment process, China is most likely to adopt a minimalist imposition of coal export sanctions against the DPRK in order to maximize social and political stability in the DPRK itself, while sending the strongest possible message to the United States and others that cooperation on strategic objectives shared by great powers is a mutual affair, not a one-way street.

5. Conclusions and Comments

The coal import cap included as part of the sanctions described in UNSC Resolution 2321 has the potential to decrease the DPRK's coal export earnings by on the order of one billion dollars, which would be about a third of their overall reported exports and thus hard-currency earnings. Such a reduction would reduce the DPRK's ability to purchase all types of goods on the international market, though its effect on support for the DPRK's nuclear weapons program would depend on how the DPRK government chooses to allocate the drop in revenue. In practice, however, the effectiveness of the sanctions depends considerably, as noted above, on to how China ultimately interprets the sanctions, and how stringently China chooses and/or is able to enforce the letter and

spirit of the resolution. In addition, as Stephan Haggard notes, the DPRK is "deft" at avoiding and working around sanctions,[24] and actions such as off-the-books trades in coal may cut into the actual reduction in the DPRK's revenues that the sanctions provide.

Thus far, predictably, the DPRK's response to sanctions the sanctions has been to reject them as "an abuse of power" on the part of the UNSC. DPRK officials "warned of tough countermeasures" (though unspecified), and said that the sanctions "will inevitably escalate tensions".[25] Although such rhetoric is far from unprecedented on the part of the DPRK, it suggests that the additional sanctions may, at best, have both positive and negative effects on the DPRK's behavior toward the international community.

Although its trade is by far the most affected by the coal cap in the new UNSC resolution, China loses little from reducing coal imports from DPRK, given that it was reducing its coal imports anyway to stabilize its own coal supply situation. This means that China's own energy sector interests, beyond those of its traders actively engaged in buying and selling DPRK coal, will not be significantly affected by the new resolution, and its compliance in enforcing the resolution will depend almost entirely on how it balances its perceived need to keep the DPRK economy stable enough to avoid further friction on its border with the need to assure the international community that it is doing its part to help to curb the DPRK's nuclear weapons program.

As noted above, there may be a number of ways that the DPRK and China could "work around" the DPRK coal import cap. Some of these—"off-book" coal exports, for example—will not be easy to detect without direct information from those involved in the trade and/or detailed review of remote data. Other work-arounds, such as an expanding trade deficit, could (at least in part) be detected if customs data shows a decrease in the volume and value of China's imports of coal (and/or other commodities) from the DPRK without a corresponding decrease in China's exports of goods to the DPRK. It will also be interesting to track whether other key, presumably unsanctioned exports of goods from the DPRK to China, such as finished apparel, expand to take up the slack as coal exports decline. An eye on the details of customs data may help to track the potential impact of the sanctions on the DPRK economy, but is unlikely to tell the entire story.

Although we have noted above some of the reasons why the latest round of UNSC sanctions may not be as effective as hoped in curbing the DPRK's spending on its nuclear weapons program, it is clear that sanctions are one of the few peaceful means that the international community has to express its dismay at DPRK behavior, and to try and influence that behavior. That said, other (non-military) options for addressing the DPRK nuclear weapons program must proceed concurrently with sanctions. Engagement with the DPRK, starting small with training projects on, for example, renewable energy and energy efficiency, and building to pilot projects in the DPRK, are a way of opening channels of communication that can be built upon over time. The key to addressing the DPRK nuclear sector remains finding a way for representatives of the international community, especially the United States and the Republic of Korea,[26] to sit down for substantive discussions on the nuclear issue with the DPRK. The initial price for doing so may well be providing some confidence-building engagement activities of interest to the DPRK and acceptable to others.[27]

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[2] Michelle Nichols (2016), "U.N. slaps new sanctions on North Korea to slash cash from exports", Reuters, dated December 1, 2016, and available as http://www.reuters.com/article/us-northkorea-nuclear-un-idUSKBN13P1TF.

[3] In United Nations (UN) Comtrade statistics for 2015, only one other nation is listed as importing coal (commodity code HS 2701) from the DPRK, and it is listed as "Other Asia, nes" (nes = "not elsewhere specified"), with imports of about 280 thousand tonnes, less than 2 percent of total reported DPRK coal exports. The DPRK did also import about 1 Mt of coal from China and Russia in 2015, almost all from the latter.

[4] The total value of goods in these categories, plus clothing and coal, represented about 91 percent of the total value of the DPRK's exports to China in 2015.

[5] United Nations Security Council (2016), SECURITY COUNCIL *7821ST MEETING (AM), Security Council Strengthens Sanctions on Democratic Republic of Korea, Unanimously Adopting Resolution 2321 (2016)*, available as http://www.un.org/press/en/2016/sc12603.doc.htm.

[6] Ben Blanchard (2016), "China says new North Korea sanctions not meant to harm 'normal' trade", Reuters, dated December 1, 2016, available as http://www.reuters.com/article/us-northkorea-nuclear-un-china-idUSKBN13Q3TQ.

[7] These items are a combination of specific chemicals (such as ammonium nitrate) and pieces of equipment, such as 10 to 20 liter fermenters.

[8] See, for example, DailyNK (2016), "Coal export prices to China falling in Ryanggang Province despite increasing trade", *DailyNK*, dated 11/4/2016, and available as http://www.dailynk.com/english/read.php?num=14168&cataId=nk00100, and Alastair Gale (2016), "North Korean Coal Windfall Boosts Nuclear Advance: New mineral riches complicate Washington-Beijing talks over how to curb Pyongyang's nuclear program", *The Wall Street Journal,* updated Oct. 25, 2016, and available as http://www.wsj.com/articles/north-korean-coal-windfall-boosts-nuclear-advance-1477387708. The latter article notes that the DPRK export coal prices increased by more than 50 percent in September and October of 2016, due largely to restrictions in domestic coal production in China and in coal production in Australia, a major exporter to China. Over 2012 through 2015, the average annual price paid by China for DPRK coal has ranged $53 (in 2015) to over $100 (in 2012) per tonne, thus is it difficult to pick a particular value with which to calculate the DPRK's lost revenue due to coal export-related sanctions.

[9] See, for example, Benjamin Katzeff Silberstein (2016), "North Korean GDP per capita over $1,000 for the first time ever last year, says Hyundai", *North Korean Economy Watch*, dated October 4th, 2016, and available as http://www.nkeconwatch.com/category/statistics/gdp-statistics/.

[10] Lumping the Chinese RMB in with other traditional "hard" currencies, at least for the DPRK's purposes.

[11] Individual estimates of coal use do not quite add to the total use estimate due to rounding.

[12] Coal imported by China is reportedly high-grade anthracite, imported for use in ceramics and metallurgical industries and also blended with other coal for use in power plants in China. See, for example, Clyde Russell (2016), "China buys record North Korean coal as sanctions ignored: Russell", *Reuters*, dated September 26, 2016, and available as

http://www.reuters.com/article/us-column-russell-coal-china-idUSKCN11W0CO.

[13] As suggested, for example, by Andrei Lankov (2016), "Average North Koreans will be hit hardest by sanctions:

Miners, engineers and truck drivers will be the victims of the latest round of North Korea sanctions", *Al-Jazeera*, dated April 14, 2016, and available as http://www.aljazeera.com/indepth/opinion/2016/04/average-north-koreans-hit-hardest-sanctions-160413060120033.html.

[14] This rate of productivity would be low for a typical fully-mechanized underground coal mine, but seems not unreasonable for probable mining conditions in the DPRK, even in mines that have benefited from recent Chinese infrastructure investment.

[15] Ben Blanchard (2016), "China says new North Korea sanctions not meant to harm 'normal' trade", Reuters, dated December 1, 2016, available as http://www.reuters.com/article/us-northkorea-nuclear-un-china-idUSKBN13Q3TQ.

[16] Subsidized prices, however, might be a departure from past practice in China/DPRK trade. In past research Nautilus has found that the reported (customs statistics) prices of key Chinese exports to the DPRK, including fuel, were if anything somewhat higher than the prices charged by China to other, albeit mostly larger-volume, trade partners.

[17] See, for example, Clyde Russell (2016), "China buys record North Korean coal as sanctions ignored: Russell", *Reuters*, dated September 26, 2016, and available as http://www.reuters.com/article/us-column-russell-coal-china-idUSKCN11W0CO.

[18] British Petroleum (BP, 2016), *Statistical Review of World Energy -- data workbook*, Excel workbook downloaded from http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html.

[19] WU Lixin, QIN Rongjun and REN Shihua (2016), "China to phase out coal imports", dated 2 December 2016, and available as https://reneweconomy.com.au/china-to-phase-out-coal-imports-78992/.

[20] Based on a review of Chinese coal imports in 2013 through 2015 from UN trade statistics (https://comtrade.un.org/data/), China has paid a somewhat higher average price—about 14 to 24 percent higher—for coal from nations other than the DPRK than it has paid for DPRK coal. Since these costs are on a per-tonne basis, parts of the cost difference could be explained by a lower average heat content for DPRK coal, relative to coal from other exporters (chief among them Russia, Indonesia, Canada, and especially Australia) and/or could reflect the lower costs of transporting coal from the nearby DPRK.

[21] J. Perlez (2017), "Trump, Changing Course on Taiwan, Gives China an Upper Hand," *New York Times*, February 10, 2017, at **https://www.nytimes.com/2017/02/10/world/asia/trump-one-china-taiwan.html?_r=0**.

[22] Ju-min Park (2-17), "New nuclear-capable missile test a success, North Korea says," *Reuters*,

February 13, 2017, at:
http://www.reuters.com/article/us-northkorea-missiles-nk-idUSKBN15R10O.

[23] See T. Postol, M. Schiller (2016), "The North Korean Ballistic Missile Program," *Korea Observer,* 47:4, 2016, pp.751-805, available at: http://www.iks.or.kr/board/index.html?id=vol47no4.

[24] Stephan Haggard (2016) "UN Security Council Resolution 2321: A Deeper Dive", dated December 5, 2016, and available as https://piie.com/blogs/north-korea-witness-transformation-un-security-council-resolution-2321-deeper-dive.

[25] See, for example, Associated Press (2016), "North Korea rejects UN sanctions, briefs envoys in Pyongyang", dated December 2, 2016, and available as https://www.washingtonpost.com/world/asia_pacific/north-korea-rejects-un-sanctions-briefs-envoys-in-pyongyang/2016/12/02/b640e1fa-b854-11e6--39c-91749443c5e5_story.html?utm_term=.7a756193e3f4.

[26] Although ongoing and upcoming (respectively) transitions in both the US and ROK do, admittedly, make the likelihood of an attempt at engagement in the near future virtually un-knowable.

[27] Options for such activities, and for larger energy-sector projects with the DPRK, have been the topics of a number of publications by the authors, including, for example, David von Hippel and Peter Hayes (2015), *Energy sector cooperation with the DPRK in support of a regional Nuclear Weapons Free Zone*, NAPSnet Special Report, available as https://nautilus.org/napsnet/napsnet-special-reports/energy-sector-cooperation-with-the-dprk-in-support-of-a-regional-nu-lear-weapons-free-zone/, and the short article by David Von Hippel (2016), "Bright idea? Engaging North Korea through energy: Offering to assist the DPRK with energy infrastructure could bring it to the negotiating table", *NK News.org*, dated October 11th, 2016, and available as https://www.nknews.org/2016/10/bright-idea-engaging-north-korea-through-energy-incentives/.

IV. NAUTILUS INVITES YOUR RESPONSE

The Nautilus Asia Peace and Security Network invites your responses to this report. Please send responses to: nautilus@nautilus.org. Responses will be considered for redistribution to the network only if they include the author's name, affiliation, and explicit consent.

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