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by

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Abstract

North Korea is an extremely isolated and impoverished nation. While its political elites are able to enjoy some degree of luxury in spite of UN sanctions, the lower classes suffer from shortages of food, electricity, healthcare, and other basic needs. Many of the lower class and fringe populations reside in rural areas with limited infrastructure, and rely on black markets to survive. Their situation could be dramatically improved if electricity could be provided to their communities to power heating, health clinics, manufacturing facilities, fertilizer plants, and water pumps for agricultural irrigation.

Given the unpredictability of the North Korean regime and its known hostility toward the US, any action to benefit the marginal populations there must be done in such a way that the regime can get no benefit. By erecting small wind power arrays connected only to local microgrids, rural residents will benefit without the regime being able to divert the resources. Homes can be warmed in the harsh winters, farmland can be returned to productivity, economic output can be boosted, and health services can be dramatically improved. Resultant environmental benefits will include slowing deforestation and river siltation, which exacerbates floods, will be reduced.

This proposal outlines the needs of the North Korean people, the justifications for helping them, and the specific steps that should be taken by both the public and private sectors to reduce the scale of the ongoing humanitarian crisis.

Policy Recommendation: US Government Should Fund the Development of Wind-Powered Microgrids Within North Korea Through a Joint Diplomatic Effort with the Republic of Korea, Other Foreign Governments and International NGOs

1. Overview

The Democratic People's Republic of Korea (DPRK) suffers from a severe lack of energy generating capacity to support its residential and industrial demand. The shortfall affects even the capital, Pyongyang, though the problem is much worse in the North Korean hinterlands. Even if generating capacity is increased, the distribution grid is antiquated and shoddy. The lack of electricity means that people cannot heat or even light their homes in the harsh winters, and factories can only operate sporadically, making them an unreliable source of money and food for employees. Many of the factories that are unable to operate are sources of fertilizer and farming equipment, so the inability to produce affects agriculture as well. The human security outlook of North Korea is deficient in every way, but it could be improved hugely with the development of wind-powered microgrids in communities that are suffering.

Erecting wind turbine arrays near remote towns with the appropriate climatic conditions and connecting them to a microgrid that only supports the local area would solve multiple challenges at once. First, by ensuring that the microgrid is not connected to the national electricity distribution grid ensures that the new capacity could not be diverted to activities or persons that the US and South Korea do not want to support. Second, providing improved electrical capacity has the potential to slow the rate of migration by people attempting to defect from the DPRK, as well as ensuring that adequate infrastructure is already in place if the DPRK collapses or is reunified with South Korea. Third, increased electricity would slow the level of environmental degradation, as less timber would be cut for fires and agricultural land could become more productive, meaning fewer hillsides and other suboptimal locations would be converted to farmlands, as is the current practice. Finally, the international image of the US would benefit from gifting the turbines to the DPRK as a humanitarian gesture and, critically, improve the perception of the US by locals within the DPRK.

2. Security – Definitions and Implications

The United Nations Development Program, in 1994, defined human security as, “safety from such chronic threats as hunger, disease and repression [and] protection from sudden and hurtful disruptions in the patterns of daily life.”¹ The report continued, stating that all threats to human security can be classified under seven broader categories: economic security, food security, health security, environmental security, personal security, community security, and political security.² Developing the energy infrastructure of North Korea would have positive ramifications in alleviating the vast array of threats to human security that currently persist there, including elements of each of the seven categories just mentioned.

Concerning economic security, an increased availability of electricity to power industry would enable the North Korean economy to restart, providing jobs, income and access to food and goods to North Korean citizens. Concerning food security, substantial energy is required to power water pumps for irrigation, both for dry soil crops and for paddy crops such as rice.³ Not only does the current shortage of electricity limit the amount of water that can be pumped, but it also prevents the industrial production of fertilizer to assist in crop production. Concerning health security, a reliable and steady supply of electricity is required to operate clinics and hospitals. Though data is limited, the extremely unreliable supply of electricity across North Korea has likely cost many people their lives, as hospitals cannot rely on modern medical equipment available in other parts of the world. Concerning environmental security, an increased supply of electricity would mitigate high levels of environmental degradation currently occurring in North Korea, as the need for timber as a fuel source would drop, thus reducing the rate of illegal harvesting that exists at present. Concerning personal security, there is a known correlation between illuminating public streets at night and reducing rates of crime. With the exception of Pyongyang, no part of North Korea is substantially well lit at night. Data is again limited, but what crime does exist in the country would likely be reduced. Furthermore, insofar as personal security refers to threats from the state, the

¹ UNDP, “Human Development Report 1994: New Dimensions of Human Security,” P. 23.

² *Ibid.*, PP. 24-25.

³ Williams, von Hippel and Hayes. “DPRK Briefing Book: Fuel and Famine: Rural Energy Crisis in the DPRK,” Nautilus Institute, 2000.

North Korean regime punishes even petty crime very harshly. With improved resources and living conditions, the incidence of petty crime is also likely to decrease, meaning that fewer people would have their personal security threatened by the regime. Concerning community security, North Korea does not have ethnic minorities that are under threat, but it does have a highly stratified class structure with limited mobility. Members of the lowest classes often resort to smuggling or other black market activities due to a lack of available resources.⁴ These classes, mostly pushed to the rural areas of the country, would benefit hugely from improving the supply of electricity, owing to increased availability of jobs, food, health care facilities, heating and cooking resources, and a decreased need to resort to crime. Concerning political security, though the North Korean regime is not thought to be at great risk of domestic upheaval because of the tight controls on society, the world might find a more cooperative partner in the Kim regime if the domestic energy picture is secure and humanitarian assistance is provided to the country willingly.

It is well known that the life of the average North Korean citizen is poor by international standards. However, the above illustrates that improvements to just one aspect of North Korea's infrastructure can have a dramatic impact on every aspect of the life of its citizens. The following will elaborate on the shortcomings of the present situation and expand upon the implications of several of these aspects of human security that will see the most immediate improvement for North Korean citizens.

3. Detail of DPRK Needs

3.1 DPRK Energy Picture

Satellite pictures of Northeast Asia taken at night show the severity of North Korea's energy shortage, with the only dot of light in the entire country emanating from Pyongyang (see Appendix I). Even the capital city has frequent blackouts. Foreigners visiting Pyongyang have spoken of sections of the grid being turned on as they arrive and turned off again as they leave, in a poor effort to create the illusion of widespread availability of electricity. It is well known that only the elite of North Korean society live in

⁴ Fisher. "The Other Side of North Korea': a Defected Smuggler's Extraordinary Story," *Washington Post*, December 5, 2013.

Pyongyang and the majority of the resources are diverted there, leaving the rest of the country with very little. Only 26% of North Korea's 24 million people have access to electricity, and even those 26% get it only sporadically.⁵ Both China and South Korea, the two countries that border North Korea, have near 100% access.

North Korea's energy output comes mostly from coal fired thermal plants and from hydroelectric dams, at 36% and 61% respectively.⁶ The DPRK is attempting to bring its Yongbyon nuclear reactor back online, in violation of UN sanctions, though it remains unclear if these efforts will be successful.⁷ The main function of that reactor is thought to be the production of fuel for nuclear weapons, but it may provide some local electricity as well. In 2002, construction began on two light-water reactors that had been promised to the North Korean government by President Clinton in 1994 under the terms of the Agreed Framework, though construction was suspended in 2003 and formally abandoned in 2006.⁸ The abandonment of those plans occurred due to noncompliance with IAEA regulations concerning North Korea's other nuclear facilities, including reprocessing and enrichment facilities thought to be producing weapons material.

Due to the unreliability of the North Korean regime to hold to its commitments, it is recommended that future energy pacts, such as will be outlined below, be made through NGOs, aid organizations and other non-official channels to avoid willful noncompliance by the regime as it seeks to gain face with its citizens.

3.2 Current Electricity Infrastructure

Many reports describe the condition of the electrical grid within North Korea as being decrepit and substandard. Regional grids were merged into a national one in 1958 and some of the infrastructure from that period remains in place.⁹ The grid was serviced by the Soviet Union until its collapse in 1991, and since then almost no maintenance has been performed and spare parts to replace worn or broken

⁵ World Bank, "Access to electricity."

⁶ Trading Economics, "North Korea."

⁷ Dahl, "Steam, Water May Show North Korea Trying to Restart Reactor: IAEA," Reuters, November 28, 2013.

⁸ Arms Control Association, "Chronology of US-North Korea Nuclear and Missile Diplomacy."

⁹ Calder, Kent. "Korea's Energy Insecurities: Comparative and Regional Perspectives," Korea Economic Institute, Special Studies Vol. 3, 2005. P. 30.

components of the grid have effectively run out.¹⁰ Thus, even if terms could be agreed under which the US government felt it prudent to restart construction of the light-water reactors, the distribution of the power from those plants would be hindered.

Furthermore, by hooking into a large national grid, the government of North Korea could control the flow of that electricity to regions or projects that it deems deserving, which may not coincide with the regions that the US government feels should be electrified.

3.3 Optimal Strategies for Rapid Improvements

If electricity generating infrastructure is built in North Korea, it should be targeted at providing electricity to under-electrified residential areas, to factories that provide a critical function in sustaining the domestic agriculture sector, to factories whose output would help restart North Korea's stalled economy, and to other energy-related facilities such as coal mines that are currently too short on electrical power to carry out their basic function.¹¹ To accomplish these goals, the best strategy is to facilitate the construction of small-scale power generation near its intended end-users. This eliminates the risk of power being diverted to unintended recipients, as well as increases the efficiency of delivery by reducing the distance the electricity must travel from source to user. Wind turbines are an ideal component of this microgrid scheme in that they can be rapidly deployed, are relatively low-cost, require minimal real estate, and the weather conditions in the mostly mountainous terrain of North Korea are a good match for wind power. Furthermore, there are a number of wind turbine start-up manufacturers in South Korea who need test-beds for their turbines in order to build a reputation.¹² Turbines could potentially be purchased from these firms cheaply with the guarantee that their turbines will get the field-testing that they require and the opportunity for their brand to be highlighted as contributing to the project.

¹⁰ *Ibid.*, P. 35.

¹¹ von Hippel and Hayes, "Foundations of Energy Security for the DPRK," Nautilus Institute, 2012.

¹² Williamson, "South Korea's Drive for Renewable Energy," BBC, December 1, 2011.

3.3 Terrain Viability for Wind Energy

Approximately 80% of North Korean territory is mountainous.¹³ Many of the mountains are of such an altitude that tree cover is minimal.¹⁴ A detailed study of the precise average wind speeds across the country has not yet been conducted. That said, expert estimates have stated that wind turbine viability in the country is high, particularly in the mountains and along the coasts. Based on the estimates of scholars from the Nautilus Institute who have conducted wind energy projects in the DPRK, and considering data provided by the government of North Korea at an energy conference, the total wind energy potential of the mountains and coasts is in the range of hundreds of megawatts, and at least 18% of North Korean territory has average wind speeds of adequate velocity for conventional wind turbine design.¹⁵

A new American firm, SheerWind, recently published its design for a new form of wind-powered electrical generator which claims to produce 600% more electricity per turbine than conventional designs, and can function on much lower wind speeds.¹⁶ The costs of SheerWind's design also appear to be very competitive. If the data holds up to scrutiny and the technology is viable, the new turbine design could be deployed in areas with much lower average wind speeds and still produce substantial amounts of electricity to benefit the local community.

In order for wind power to be deployed on a large scale, a comprehensive viability study should be conducted. Numerous avenues exist for funding such a study, to be enumerated below. Some of those funding sources will provide money for in-depth studies if the initial indicators suggest a high level of probability that wind power will succeed in that area. The above information indicates that North Korea is a strong candidate for wind power to succeed, so seeking funds for a detailed study should be relatively straightforward.

¹³ Anderson, "Biogeography," in "North Korea: a Geographical Analysis," United States Military Academy, West Point, NY, 2002. P. 31.

¹⁴ *Ibid.*, P. 32.

¹⁵ von Hippel and Hayes. "Fueling DPRK Energy Futures and Energy Security," Nautilus Institute, DRAFT, June, 2007. P. 154.

¹⁶ SheerWind, "How it Works."

3.4 Population Impacts

Operating under the assumption that the new SheerWind design is not yet ready for large-scale deployment, the traditional wind turbine design and its climatic needs must be the baseline for determining the usefulness of wind array and microgrid development in North Korea. Because the mountainous regions have been described as the part of the country with the greatest potential viability for wind energy, the residents of the mountainous provinces are the likeliest to see benefit from wind power. Furthermore, because of the need to connect the energy supply to microgrids to control its downstream usage, it should only be deployed in either rural areas or localities with only non-military industry. Some of those sites will have to be identified on a case-by-case basis. Initially, however, census data from the North Korean 2008 Census, which was conducted with UN assistance and oversight, can be useful in determining which provinces and localities potentially stand to benefit most from pilot programs.

Table 1 indicates the total population of each of North Korea's provinces and divides them into rural and urban populations. Though the Census data does not indicate what level of population density or size serves as the cutoff between urban and rural, the high levels of rural populations in provinces with significantly mountainous terrain nonetheless indicates a strong likelihood of beneficial impact from deploying wind-powered microgrids in those provinces.

Table 1. Urban and Rural Populations of North Korea, by Province¹⁷

Province	Urban Population	Rural Population	Total Population
Rygangang*	464,690	254,579	719,269
North Hamgyong*	1,645,886	681,476	2,327,362
South Hamgyong*	1,811,074	1,254,939	3,066,013
Kangwon*	724,611	751,971	1,477,582
Chagang*	828,253	471,577	1,299,830
North Pyongan**	1,431,936	1,296,726	2,728,662
South Pyongan**	2,629,943	1,421,753	4,051,696
North Hwanghae	972,632	1,141,040	2,113,672
South Hwanghae	821,954	1,488,531	2,310,485
Pyongyang City	2,823,414	431,874	3,255,288
Total	14,154,393	9,194,466	23,349,859

* Predominantly mountainous terrain (see Appendix I for DPRK topography)

**Partially mountainous terrain

¹⁷ Central Bureau of Statistics, "DPR Korea 2008 Population Census National Report," Pyongyang, 2009. P. 18-22.

Based on these figures, the rural population is approximately 40% of the total. The Census divides the entire country into 3,339 population localities.¹⁸ The number of localities with populations above 20,000 people is 109, leaving 3,230 total localities with smaller populations. By far the largest cohort of population localities is the 2,000-2,999 residents range, with 969 localities of that size. The next largest are the 1,000-1,999 size and the 3,000-3,999 ranges, with 636 and 605 localities of those size respectively. The population of localities with fewer than 4,000 people is 5,568,397, and that figure rises to 7,235,430 if expanded to included localities with populations under 5,000. Depending on the electrical output of each wind array and the levels of electricity supply in each area that would serve to significantly increase all aspects of human security as discussed above, an ideal population range for pilot development locations must be determined.

Preliminary estimates by the author anticipate that providing electricity to localities with populations of 4,000 people or fewer is a viable target for pilot deployments. However, larger populations could be served if the wind power viability is high enough and the region is remote enough that the government would not relocate elements of its military supply industry there to take advantage of the new power supply. Areas with smaller populations have only a small available workforce, so while economic activity becomes possible again with new energy supplies, the extremely energy-intensive industries such as arms production remain unviable.

4. Causes for Global Concern and Attention

4.1 Food Security

According to a report, “UN irrigation experts estimate that the electricity requirement of pumping th[e] amount of water [necessary for agriculture] averages 1,200 kWh per hectare per year, corresponding to an annual national requirement of 1.2 billion kWh.”¹⁹ This was, at the time of the report in 2000, approximately one third of North Korea’s total energy capacity. That should not be interpreted, however, as North Korea having more than adequate capacity to power all of its water pumps. As

¹⁸ “DPR Korea 2008 Population Census National Report,” all figures below from P. 23.

¹⁹ Williams, von Hippel and Hayes. “DPRK Briefing Book: Fuel and Famine.”

discussed above, the national grid infrastructure is in poor repair, and much of the agricultural electricity demand may be located in regions that are poorly, or not at all, connected to the electricity supply. Local energy generating infrastructure is the easiest way to solve this problem and ensure that adequate supply exists everywhere it is needed.

Pumping water is not the only agricultural power consumer, however. Fertilizer production and the operation of farm equipment are also substantial users of power and fuel. Unfortunately, providing all electrical farm equipment to be run on batteries charged by wind turbines is a nice idea, but that is beyond the scope of this policy recommendation. Should this recommendation be accepted and pursued, that is an avenue that could be explored in the future, but in the meantime, fuel shortages represent a lingering logistical challenge for the North Korean agricultural sector. Regarding fertilizer production, the power consumption rates of the production methods used in North Korea were not readily available at the time of writing this report, but the wide need for improved access to various fertilizers is well documented by the Food and Agriculture Organization of the UN and the World Food Programme. Very few farmers have access to the levels of fertilizer that would dramatically increase crop yields due to shortages in production domestically. Those that do manage to find adequate and balanced supplies of fertilizer far outpace the national average in terms of crop yields.²⁰ Increased electricity supply in agricultural areas of North Korea would facilitate greater production of fertilizers, thus improving crop yields and ensuring greater access to food supplies for citizens. At present, crops are substantially below the level necessary to guarantee an adequate and healthy supply, with state ration levels averaging only 200 grams of cereals per person per day in 2011.²¹

4.2 Community Security and Population Migration

It is well documented that many North Koreans attempt to escape from the country every year, seeking refuge in South Korea, Japan and other nations. More

²⁰ Food and Agriculture Organization of the UN and the World Food Programme, "FAO/WFP Crop and Food Security Assessment Mission to the Democratic People's Republic of Korea," 2011. P. 5.

²¹ *Ibid.*, P. 24.

North Koreans would be successful in this if China did not repatriate any escapees that it captures. Testimonies given by the escapees describe the difficult living conditions in the DPRK, with limited access to heat, electricity, and food. Because the government of North Korea is unable to adequately provide for its citizens, more and more of them are risking their lives by attempting to escape. In the event of a regime collapse or an escalation of conflict on the peninsula, the number of North Koreans attempting to seek better living conditions in China, South Korea or elsewhere would increase drastically. Prior to such an event, if the living conditions within North Korea could be improved, particularly for the lower classes, the rate of migration could be reduced and a major refugee crisis can be averted. Given the potential magnitude of refugee numbers that might begin flowing north into China and south across the DMZ, the economic impacts to the Chinese and South Korean economies in such a scenario would be dramatic and potentially have global ramifications. Steps taken now to contribute to infrastructure modernization within North Korea will reduce the potential scale of migration in the event of regime collapse or Korean reunification, as well as generally improving the quality of life for the particularly disadvantaged rural and lower classes.

4.3 Environmental Security

Satellite imagery has corroborated North Korean defector testimony as to the state of environmental degradation in North Korea. With power to fertilizer factories sporadic at best, agricultural output has gone down. As a result, North Korean farmers have begun farming on hillsides to increase their crop.²² Though the harvest from such suboptimal planting locations is small, it augments the otherwise minimal amount of food each family has to sustain them through the winter. To create these plots, farmers are denuding the hills of trees and groundcover. The erosion that this has enabled has led to increased problems with flooding, as well as siltation of dams, thus reducing the dams' hydropower output capacity.²³ This problem is self-reinforcing, as the erosion of hillsides and reduced capacity of waterways to handle excess water due to siltation has

²² McKenna. "Inside North Korea's Environmental Collapse," NOVA Next, March 6, 2013.

²³ von Hippel and Hayes, "Foundations of Energy Security for the DPRK," Nautilus Institute, 2012.

increased the DPRK's susceptibility to flooding even further, and crops are regularly lost to floods.

Energy shortages also cause families to seek alternative fuels to warm their homes in winter. Harvesting trees for wood fuel is a major driver of North Korean deforestation, though the practice is illegal. Fuel shortages are so extreme that there are reports and photos of some military vehicles being converted to run on wood instead of diesel by constructing furnaces in the back of the truck, enabling the vehicle to stop by the side of the road and harvest new fuel as needed. North Korea's forested area shrunk by more than 18% between 2001 and 2011.²⁴ Given the pace of deforestation currently occurring, an environmental crisis is already well underway in North Korea. This will continue to exacerbate the annual flooding that afflicts the country, as well as increasing the number of environmental migrants that will try to escape and seek better living conditions in neighboring countries.

The ramifications of these destructive practices are not limited to North Korea, as deforestation eliminates a valuable carbon sink for global CO₂ emissions. Extensive burning of coal and wood in households in North Korea's harsh winters is also an avoidable contributor to CO₂ emissions. Of the 5,887,471 residences catalogued by the 2008 Census there, 5,430,104 homes were fully reliant on coal or wood burning for heating.²⁵ An even larger number of those homes used coal or wood for cooking, at 5,483,912, with the figures for both heating and cooking almost evenly split between wood and coal.²⁶ For context, in the winter of 2010/11, "frost penetrated more than 1.2 metres into the soil, and in many areas there was a continuous period of sub-zero temperatures for 40 days," illustrating just how harsh the North Korean winter is and the importance of adequate energy supply to keep people healthy.²⁷ Electric heaters and cook-stoves are not currently widely deployed due to the unreliability of the electricity supply. If the electricity supply is increased and stabilized, a transition to electric utilities could occur, thus slowing or stopping deforestation and significantly cutting down on CO₂ emissions.

²⁴ World Bank, "Forest area."

²⁵ "DPR Korea 2008 Population Census National Report," P. 256.

²⁶ *Ibid.*, P. 262.

²⁷ "FAO/WFP Crop and Food Security Assessment Mission to the DPRK," P. 10.

4.4 Economic Incentives

The DPRK has approximately US\$6.4 trillion worth of rare-earth minerals.²⁸ Some efforts are being made to extract these minerals currently, though without adequate power supply and infrastructure, progress is necessarily slower than it could be. With the development of a reliable power supply near to the resources, extraction could be conducted much more easily. Companies from China, Japan, South Korea, and others are all involved in recovering these resources. By providing infrastructure development, the DPRK might be willing to grant US firms access to these valuable resources. Even if that is overly optimistic, an influx of rare-earths onto the global market will bring down prices for the many US companies that are involved with electronics manufacturing that could take advantage of these resources.

5. Precedents for Success

5.1 Domestic Policy Precedents

Between the Department of State, the Department of Energy and the Agency for International Development, the United States is no stranger to investing in energy infrastructure overseas. Through these government agencies, numerous energy research and development projects have been funded and cooperatively undertaken. Alternative energy deployment programs are also not new as targets for US funding and support. For instance, the Obama administration co-founded the US-Asia Pacific Comprehensive Energy Partnership with the Sultan of Brunei and the president of Indonesia.²⁹ Through this partnership, the State Department is working with the US Trade and Development Agency to support the development or deployment of a number of alternative and renewable energy programs across Asia. Programs that have particular relevance to the idea of deploying wind power in North Korea are a program in Vietnam that is funding research into best practices for integrating wind power into the local grid, and another program in Indonesia sponsored by the Department of

²⁸ Yonhap News Agency, "N. Korea Possesses 6,986 tln Won Worth of Mineral Resources," September 19, 2013.

²⁹ Department of State, "State Dept. on US-Asia Pacific Comprehensive Energy Partnership," October 10, 2013.

Energy to develop sustainable technologies to power isolated and remote power grids.³⁰ The lessons learned from both of those projects will serve as a solid knowledge bank for the development of wind-powered microgrids in rural North Korea.

The motivation for the government to be involved in such programs comes from the notion of energy diplomacy, the basic foundational concepts of which were recently enumerated by the State Department. To explain its interest in energy issues, the statement reads:

“Energy is at the nexus of national security, economic prosperity and the environment. The Department of State’s work in national security, bilateral and multilateral diplomacy, commercial advocacy and development are widely affected by energy concerns. The Bureau of Energy Resources integrates energy security interests into foreign policy decision making, putting energy diplomacy at the forefront of U.S. foreign policy along three pillars.”³¹

The fact sheet goes on to describe the means to achieving its goals:

“To counter poverty and development issues due to lack of access to energy, poor resource management or both, we: Encourage responsible resource management by promoting global transparency standards, developing countries’ technical capacity and supporting accountable legal and regulatory regimes and sound financial management in line with international standards. Expand energy access through economic statecraft and partnerships with development agencies to help encourage creation of commercially viable models backed by private investment.”³²

Furthermore, the Department of Energy is a participant in the East Asian Summit Renewable and Alternative Power Workstream, which is “a multi-year effort to increase private sector investments in renewable energy technologies in the region.”³³ In light of these various policies and agendas, pursuing an energy development strategy in North Korea would be a perfect fit with current US government objectives.

Of domestic actors and their precedent of involvement in Asian energy development, a critical resource and potential partner in development is the Nautilus Institute, based in San Francisco. In the late 1990s, a team from Nautilus erected a

³⁰ *Ibid.*

³¹ Department of State, “State Dept. Facts on Energy Diplomacy in 21st Century,” October 30, 2013.

³² *Ibid.*

³³ “State Dept. on US-Asia Pacific Comprehensive Energy Partnership.”

number of wind turbines in a small North Korean village whose energy infrastructure had been damaged by a tidal wave. Their project involved the building of small wind turbines to generate power for local consumption, mainly providing capacity for lighting in the village and energy for a refrigerator in the municipal clinic.³⁴ The village had a population of about 2,300 people, putting it in the same range as the estimated target population size for this recommendation. Using the Nautilus Institute as an intermediary or as consulting advisors with experience in navigating the challenges of working with the DPRK government would be highly valuable in streamlining any efforts and improving the chances of success.

5.2 International Efforts and Institutions

Certain European governments also have policies of assisting in energy development abroad. The government of Denmark, according to one report, funded the construction of a wind array off the western coast of North Korea in 1986,³⁵ though no information could be found as to what became of that installation, its size and capacity, or anything to indicate how long it was in use. The governments of Germany and Denmark, in particular, have funded a number of projects in Asia, Africa, the Middle East and Latin America. Danish funding, in conjunction with the UN Development Program, helped establish a new wind power facility in South Africa.³⁶ A German government program called Technical Expertise for ReNewable Energy Application (TERNA) funds projects to help teach the information necessary to develop wind energy projects, such as determining optimal locations for arrays to be built and the technical knowledge necessary to maintain them.³⁷ TERNA has funded projects across Africa, Asia and Latin America, with the nearest in proximity to North Korea being the People's Republic of China. Though TERNA does not fund the actual installation of wind turbines, it could be a good source of funding to carry out the viability survey that would

³⁴ Williams, von Hippel and Hayes, "DPRK Briefing Book: Fuel and Famine."

³⁵ Yonhap News Agency, "North Korea Focusing on Developing Wind Energy," November 23, 2006.

³⁶ "Power from the wind in South Africa," Liane Greeff, in *Africa Renewal*, April 2012, P. 26.

³⁷ Abramowski and Posorski, "Wind Energy for Developing Countries," DEWI GmbH - Deutsches Windenergie Institut, DEWI Magazin No. 16, February 2000, P. 46.

be necessary before beginning any construction, and may be a good source of expertise in training local technicians to maintain the equipment.

Training local technicians will be another important element of any project. As evidenced by the Nautilus project, getting equipment and people into North Korea is not impossible. Getting access to remote locations on a regular maintenance schedule is another matter, and likely to be an insurmountable challenge until a point of greater liberalization by the DPRK government. For instance, the DPRK recently hired British seismologists to help determine if the sole volcano in the country, Mount Baekdu, on the border with China, was nearing an eruption.³⁸ Though the scientists were allowed to visit the site, heavy restrictions were placed on the type of monitoring equipment they could bring into the country, or back out of it, and electronic communications of data to the outside world were restricted to a sporadic basis. The cooperation with international scientists should be taken as an encouraging sign that development projects could be feasible with less resistance than might be assumed, but training local technicians and maintenance teams will ensure the longevity of any infrastructure investments.

In terms of the DPRK itself, there is growing interest in alternative energy technologies to meet its energy needs, suggesting that the foreign provision of such would likely be welcomed. Before his death in December 2011, Kim Jong-il inspected a solar water heater in Pyongyang and was reported to be impressed and encouraged by the technology, stating, "We must aggressively develop and utilize renewable energy sources, such as solar heat."³⁹ Also in 2011, the North Korean government took legal steps to increase support for alternative energy sources, and allegedly began erecting some wind turbines of their own in the western part of the country.⁴⁰ Whether or not these new policies stick remains to be seen, however. Interest in wind energy also spiked in 2006 when the DPRK delegation to an Asian energy conference announced that Pyongyang was implementing a three-stage plan to develop wind farms by 2020.⁴¹ That plan stated that by 2015, three large wind farms would be in place. It is possible

³⁸ The Economist, "Another Rumbler: North Korea Allows British Scientists onto Its Most Sacred Peak," October 26, 2013.

³⁹ Nakano, "North Korea Also Turning to Renewable Energy Sources," *Asahi Shimbun*, November 29, 2011.

⁴⁰ *Ibid.*

⁴¹ Yonhap News Agency, "North Korea Focusing on Developing Wind Energy."

that this has occurred and no public reports have been made, but the assumption is that while the government is strongly interested in wind power, it has not yet succeeded in erecting an array. This fact may mean that any offers to construct turbines in the country will be well received.

Other than the Nautilus Institute's project from 1998, which is still operational according to the Institute, there is one other verifiable wind array in North Korea, located in the Rason Special Economic Zone on the northeast coast, near the borders with China and Russia. Because of the unique investment terms of the SEZ, the array is wholly foreign owned and operated, but alleges to provide utility-grade levels of electricity.⁴² This project has not been widely documented, but has been photographed and described by American residents in the SEZ (see Appendix I). While the SEZ has different rules than the rest of the country, North Korean officials are still able to witness firsthand the success of the wind array there, and thus their openness to wind power projects being jointly developed with foreign entities elsewhere is anticipated to be strengthened. This is compounded by the fact that the current energy infrastructure in the DPRK is of such low capacity that energy-generating capabilities themselves lack the power to operate. There is not enough power for coal mining, meaning that the power plants lack fuel, thus creating a feedback loop of energy shortages.⁴³ Any ways that the national demand can be reduced are likely to be encouraged and welcomed.

6. Recommendations

6.1 Addressing North Korean Belligerence Towards the US

That the DPRK government responds belligerently to the US is no secret. Deals, once struck, are often reneged upon and terms are frequently abrogated. This happens because the DPRK feels as though unreasonable or one-sided demands are being made of it, or that its sovereignty is at risk, or because it feels it can gain face with its citizens by appearing to stand up to an imperialist oppressor. These are all legitimate challenges for any future project that seeks engagement with the DPRK. If the US government is not overtly involved with the project, however, many of these issues are

⁴² Krahun North Korea Tourism and Trade Company, "Fossil Fuel and Wind Power Plants in Rason," Facebook photo album, June 23, 2013.

⁴³ Nakano. "North Korea also turning to renewable energy sources."

likely to disappear. Other foreign governments have normalized ties with Pyongyang that could serve as intermediaries. Private organizations and NGOs have had successful interactions with the regime. Even private American citizens have had some success in dealing with the Kim family – Dennis Rodman made three trips to North Korea in 2013, as he took the reins of the national basketball team.⁴⁴ The State Department’s efforts at energy diplomacy make it an ideal sponsor for developing rural wind-powered microgrids in North Korea, but to ensure the success of the projects, it should work through other organizations that will foster cooperation from the regime. As described above, those organizations could be the governments of Denmark or Germany, an institution like Nautilus, or an energy-focused non-profit or NGO. By acting through intermediaries, the Department of State or the Department of Energy could obtain regular reports to monitor implementation and ensure that the project is not co-opted by the DPRK to be diverted to non-approved uses, while also removing the barrier of distrust that currently exists between the US and the DPRK.

6.2 Policy Recommendations

1. The Department of State or the Department of Energy should, through the cooperation of a NGO or energy non-profit, fund a wind energy viability study of North Korea to determine optimal locations for construction. The German government’s TERNA program may be an ideal partner in this action.
2. Upon completion of the viability study, areas of high capacity should be cross-referenced with areas of rural impoverishment and under-electrification, ensuring that the targeted areas for installation do not contain facilities for arms production or other sanctioned industries.
3. Once locations are determined, the Department of State or the Department of Energy should fund, through a third-party organization, the construction of wind power arrays to be connected to microgrids that serve only the targeted locality.

⁴⁴ Subramanian, Courtney. “Dennis Rodman Returns to N. Korea to Train Basketball Team,” *Time*, December 14, 2013.

4. The implementing organization should acquire the necessary turbines from South Korean start-up manufacturers in need of test-bed deployment or, if proven viable and as efficient as is claimed, from the SheerWind corporation to utilize their high efficiency/low cost turbine model.

5. The efforts should not be tied to North Korean denuclearization or other preconditions, but should instead be presented as a humanitarian effort. This mitigates the possibility of the project falling apart as a result of DPRK non-cooperation.

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Appendix I - Images

North Korea at Night

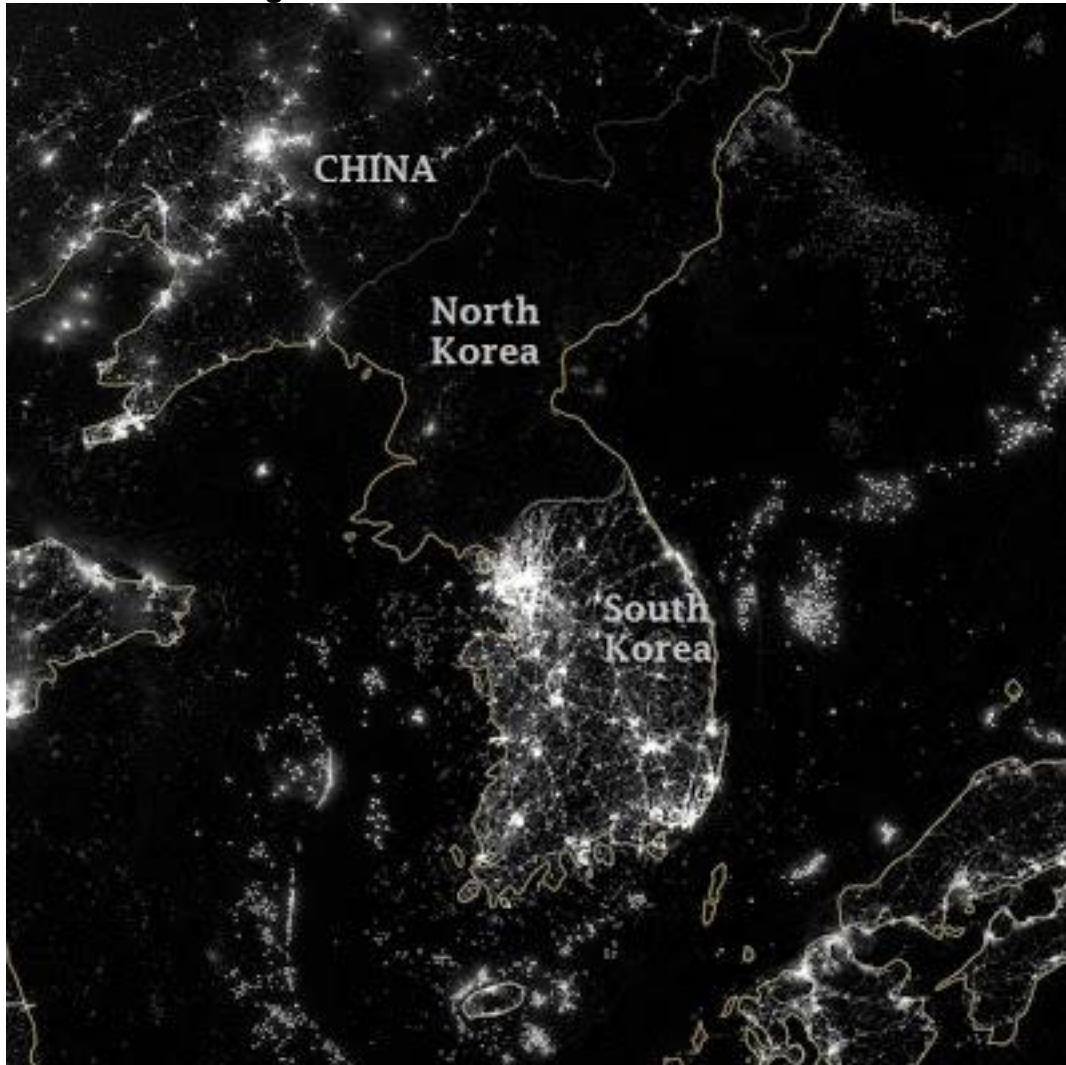


Image from NASA,
<http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=79796>

Topography of North Korea with Provincial Borders

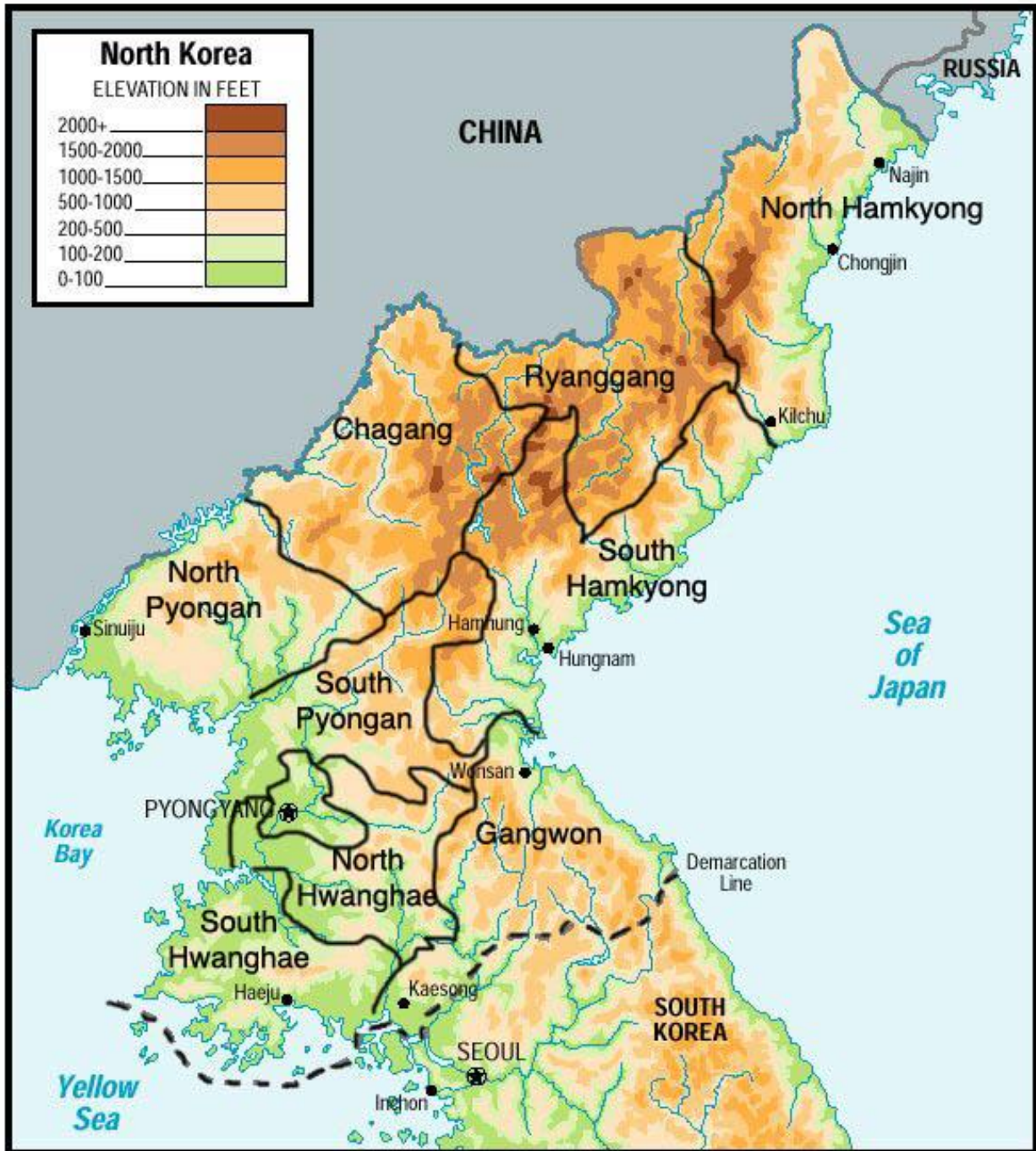


Image from GlobalSecurity.org, adapted by author to include approximate provincial borders. <http://www.globalsecurity.org/military/world/dprk/images/dprk-map-topo.jpg>

Utility-grade Wind Array in Rason SEZ, DPRK



Image from Krahun North Korea Tourism and Trade Company,
<https://www.facebook.com/photo.php?fbid=676611965687736&set=a.676610882354511.1073741835.575530259129241&type=3&theater>