RAPID RELIEF OF HUMANITARIAN STRESS FROM ENERGY SANCTIONS: BUILDING ENERGY EFFICIENCY AND SOLAR PV MEASURES FOR RAPID INSTALLATION IN PYONGYANG

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I. INTRODUCTION

In this essay, the authors outline a program that could insulate about 10 percent of the household dwellings in Pyongyang and a solar-cell powered micro-grid that would demonstrate the way to rehabilitate the DPRK's power grid, both achievable cheaply and within six months of start, as part of a post-summit deal to denuclearize the Korean Peninsula.

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Banner image: Nautilus photo, Pyongyang Building Energy Efficiency Project—Before and After, from here

II. NAPSNET SPECIAL REPORT BY DAVID VON HIPPEL AND PETER HAYES

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If the Kim-Trump summit is successful, then one of the first steps along the pathway to denuclearization will likely be to provide energy assistance. How to do this while maintaining stringent sanctions is an apparent paradox, especially given the imperative to move quickly.

There is a way, however, to square this circle. If the energy assistance is provided and targeted to

rapidly relieve humanitarian distress caused by the sanctions, then it is consistent with sanctions while serving as a tangible down payment on a deal that indicates good faith intention on the part of the United States and its allies.

Such energy aid must meet some challenging conditions. It must be deliverable very quickly—say in six months from start to delivery of energy services. It must be significant and measurable, both to demonstrate outcomes to all parties, but also to ensure non-diversion of assistance to military and related uses by monitoring and verification of delivery of the assistance. It must be affordable. It must be deliverable by the ROK as it is the only party likely to shoulder this burden in the short term. And, it must not impose on-going costs on the targeted recipients in the DPRK that could not be supported if the deal falls apart. Otherwise, humanitarian assistance would be a cruel irony that would fuel further distrust in the hearts of ordinary North Koreans.

Finally, the assistance should be deeply symbolic, and embody the spirit of goodwill and cooperation while being meaningful and practical in delivery of energy services.

A program consisting of building energy efficiency measures, basically insulation, windows, and weather-stripping, and a demonstration micro-grid based on renewables, could meet these requirements and support a denuclearization deal.

1. INSULATE RESIDENTIAL APARTMENTS

Building energy efficiency measures, including solid core foam insulation and double-paned windows, plus weather-stripping and other low-cost measures, may be installed to increase the heating efficiency in **50,000 Pyongyang apartments**. This is about 6 percent of the residential dwellings in the capital city, so it would take about five years to insulate every household's dwelling over five years.

This program would:

- Cost about **$73 million** (much of it spent on materials that could be sourced from the ROK);
- All told, create about **1250 direct DPRK installer jobs** under the program, with other direct DPRK and ROK jobs for administration, and indirect jobs serving the program workers.
- **Reduce pollution** by saving more than a million tonnes of coal and avoid more than two million tonnes of greenhouse gases (carbon dioxide equivalent—CO_2e) over the lifetime of the measures.
- Serve as the **pilot program for a five-year effort** to upgrade the energy efficiency of all candidate apartments in Pyongyang and, ultimately, starting the same process elsewhere in the DPRK, saving the equivalent of hundreds of megawatts of coal-fired power and tens of millions of dollars' worth of coal consumption annually.
- The broader building energy efficiency effort would **cut greenhouse gas emissions** with no fuel or electric power input ("negawatts") at total costs on the order of 0.5 to 1.0 billion dollars over five years (factoring in economies of scale and local manufacturing), while providing a key humanitarian benefit (and jobs) to ordinary DPRK citizens affected by sanctions without potential for military diversion.

2. DEMONSTRATION MICRO-GRID

The installation of **solar photovoltaic (PV) systems to demonstrate microgrids** that will be the key to refurbishing the entire DPRK power grid, bottom-up. Installations would include PV panels, inverters, and batteries for potentially grid-independent operation, on the rooftops or other premises

of schools and other human service facilities, such as health clinics or hospitals, in Pyongyang. These systems would provide clean, reliable power to the equivalent of about **170 Pyongyang schools** (for example), which would serve about 16 percent of students in the capital. As such, the program would provide significant humanitarian benefits. This program would:

1. Involve an estimated investment of about **$27 million** (much of it spent on materials that could be sourced from the ROK), to install 14 MW of PV systems;
2. All told, create on the order of **160 direct DPRK installer jobs** under the program, with other direct DPRK and ROK jobs for administration
3. **Reduce pollution** by displacing about 0.4 million tonnes of coal over the lifetime of the systems, and reduce greenhouse gas emissions from the DPRK power sector by about 0.8 million tonnes of CO_2 Looked at another way, however, if the heating services provided by the measures in the program were instead provided by electricity from individual diesel generators, which have been adopted widely in the DPRK due to unreliable grid electricity, the cost to DPRK residents at recent DPRK market diesel prices would be over $200 million annually.

3. OTHER SOCIAL AND ECONOMIC BENEFITS

Both of these programs would provide significant additional benefits, in that they would:

- Offer the potential for **many follow-on jobs** created by the example of the program through, for instance, ROK/DPRK joint-venture **building materials factories** (including, for example, to produce magnesium oxide wallboard) in the DPRK, small "weatherization" entrepreneurs installing insulation, windows, and other measures as a new industry in the DPRK, solar PV installation crews, and other professions as the building and energy supply/demand infrastructure in the DPRK is retrofitted and rebuilt.
- **Require close coordination** on program design between ROK and DPRK officials and experts, both from a distance and on-site, offering many opportunities for inter-Korean engagement on a personal level.
- **Include visible images of cooperation**, such as convoys of cargo ships (perhaps **four ships per month**, depending on the size of the vessels) traveling from Incheon to Nampo to deliver building energy efficiency materials, convoys of trucks loaded with materials on the Nampo-Pyongyang highway *en route* to the capital, trains carrying PV systems moving through the DPRK, on-site consultations between ROK and DPRK experts in apartments and on the roofs of schools—with **hundreds of buildings all over Pyongyang being sites of highly visible cooperation activities**—and training of DPRK installers by ROK trainers.
- Offer the opportunity, if framed appropriately, for the ROK and/or ROK businesses to **obtain carbon credits for the ROK's investment in efficiency and renewable energy in the DPRK.** For example, at the recent (January 2018) ROK Emissions Trading System carbon allowance price of $20 per tonne CO_2e, the lifetime emissions avoided by the two sets of quick-deployment measures above would together be worth on the order of $65 million, potentially underwriting part of the program cost. We would stress, however, that the potential and process of claiming credits for these investments will require careful study and, likely, special arrangements.

APPENDIX 1: CALCULATING THE COSTS AND BENEFITS OF THIS PROGRAM

The table below summarizes the major costs and benefits of these proposed programs. Note that both programs are extremely scalable to different levels of effort and cost, and can be adapted to meet other negotiation goals as needed. In addition, please note that the estimates prepared below

are indicative, and will need to be revised through consultation with experts in the DPRK and the ROK before program deployment.

Key Inputs/Summary Costs and Impact Results, Building Energy Efficiency Program

Parameter	Value	Notes/References
Number of Apartments Covered	50,000	Initial Assumption
Fraction of Pyongyang Apartments Covered	5.92%	Calculated
Program Materials Costs	$ 64,074,167	Calculated
Program Labor Costs	$ 2,000,000	Installer costs only, does not include administration
Program Administrative Costs	$ 6,407,417	Calculated
Shipping Costs	$ 280,000	Calculated
Total Program Costs	**$ 72,761,583**	Calculated
Number of Shipments for Material	14	Calculated: 500 TEU Container Ships, Incheon to Nampo
Direct Jobs Created by Program	1250	Calculated: Over program lifetime only, and installation labor only; does not include administration tasks
Lifetime million tonnes of Coal saved by program	1.17	Calculated
Lifetime million tonnes CO2e saved by program	2.43	Calculated

Key Inputs/Summary Costs and Impact Results, Humanitarian Solar PV Program

Parameter	Value	Notes/References
Number of Schools (or Health Clinics) Covered	170	Initial Assumption
Equivalent Fraction of Pyongyang Schools Covered	15.8%	Calculated
Capacity of Solar PV Systems Installed (MW)	13.77	Calculated
Program Materials Costs	$ 24,097,500	Calculated
Program Labor Costs	$ 247,860	Installer costs only, does not include administration
Program Administrative Costs	$ 2,434,536	Calculated
Shipping Costs	$ 48,548	Calculated
Total Program Costs	**$ 26,828,444**	Calculated
Number of Train Cars for Material	97	Calculated
Direct Jobs Created by Program	155	Calculated: Over program lifetime only, and installation labor only; does not include administration tasks
Lifetime million tonnes of Coal saved by program	0.38	Calculated

Lifetime million tonnes CO_2e saved by program	0.78	Calculated
Total Cost of Building Energy Efficiency and Solar PV Programs	**$ 99,590,027**	Calculated based on Above

III. NAUTILUS INVITES YOUR RESPONSE

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