



NAUTILUS INSTITUTE

# Linking CTR to Energy Sustainability and Prosperity in the DPRK

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**Presentation for APLN Series of Workshops on “Co-operative Solutions for North Korean Denuclearization”**

**Workshop 2: CTR+ and Energy Security in the DPRK**

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# OUTLINE OF PRESENTATION

- Introduction
- “Third-Party” CTR+ DPRK Energy Sector Engagement/Assistance Project
  - Tasks
  - Organizations and Budget
- The DPRK as a Participant in Regional Energy Infrastructure
- Identifying and Matching DPRK Energy Needs with Consortium Assistance Criteria
- Possible Consortium Priority Projects
- Conclusions

# Introduction

- In any resumption of diplomacy, it must be recognized that the DPRK's *energy insecurity* is a key (though hardly only) driver of its choice to pursue nuclear, as well as chemical and biological weapons...but
- Energy sanctions resolutions passed to date are very unlikely to have the desired effects
- As such, cooperative threat reduction “plus” (CTR+) activities addressing the DPRK energy sector, focusing particularly on those that seek to involve the DPRK in international energy projects, can play important roles in engagement

# Working with North Koreans: Nautilus/KANPC DPRK Humanitarian Wind Power Project





# Working with North Koreans: Nautilus DPRK Building Energy Efficiency Training (BEET) Project



September  
2021



APLN Workshop

# Working with North Koreans: Nautilus Regional Energy Security Project (2019)



September  
2021



APLN Workshop

# **“Third-Party” CTR+ DPRK Energy Sector Engagement/Assistance Project**

- Overview: 6 - 12 Month Pilot Energy-efficiency Renewable Energy (EE/RE) Engagement Program
  - Building envelope/system efficiency (including in PY, for visibility), residential lighting improvements, industrial and irrigation motors
  - Small hydro, wind, solar power, microgrids, agricultural equipment efficiency
  - Humanitarian measures in homes/schools/clinics
  - Job creation in DPRK during project (and after)
  - CO<sub>2</sub> emissions reductions (credits for ROK?)
  - Not likely to violate spirit of sanctions
  - Cargo ships headed north with insulation = image of cooperation
  - First step to rebuilding T&D grid from bottom up
  - Pilot program for ongoing 5-year effort

# Key Tasks for Project Planning and Delivery

- **Negotiate Funding and Permissions:** Identify funding sources, obtain permissions (or waivers) as needed
- **Survey of DPRK Energy Use** and infrastructure in candidate buildings for EE measures, survey of potential sites/locations for mini-grids/RE...
- **Modeling of Building Energy Performance and Design of EE Measures:** use data on buildings/energy use to select a suite of EE measures, model efficacy in application to DPRK buildings
- **Training of DPRK Counterparts in Building Energy Surveys, Building Energy Modeling** (USG permissions required?)



# Key Tasks for Project Planning and Delivery

- **Finalize EE Measure Selection, Mini-grid/RE Site and Measure Selection:** Selecting and costing EE and RE measures/related equipment, seeking donations of materials, iterative to fit budgets
- **Prepare Plans to Install Measures, and Train Installers:** Choose limited set of apartment types, RE/mini-grid sites, train DPRK/international technicians
- **Order and Ship Project Materials and Equipment:**
  - Insulation, weatherstripping, heat controls, windows/doors, datalogging equipment, mini-grid equipment (switches, wiring, electricity storage, inverters...), RE equipment (wind and solar), grid intertie equipment, equipment to install/test all of the above
  - Possible that some materials/equipment can be obtained free or at concessional prices by, e.g., ROK firms willing to contribute

# Key Tasks for Project Planning and Delivery

- **Install EE and RE Measures** on project sites
- **Quality Control/Quality Assurance for Installations, Monitoring, and Training of Users:** QA/QC on installations of RE/EE equipment
  - Monitor some subset of installations (work out sharing of data with counterparts), train residents, users/maintenance people of mini-grids and RE systems to use and maintain systems
- **Communicate Results of Project to Stakeholders, Plan Next Steps:** Results from monitoring, digest of participant interviews (both NKs and international) to identify challenges, benefits to different parties, make plans to build on project
- **Overall Project Management**

# Types of Organizations and Individuals Needed for Project (by Task, Indicative)

- **Obtaining Funding and Permissions**
  - Group/groups experienced in working with DPRK-related agencies in the US and the ROK, possibly Europe
- **Survey of DPRK Energy Use**
  - Individuals or firm experienced in building energy, energy use audits to international standards: US or European NGOs focusing on EE, private contractors/academics in US, Europe, ROK and/or China
- **Modeling of Building Energy Performance and Design of EE Measures**
  - Individuals or groups with building energy modeling expertise, e.g. U.S. national lab staff/former staff, NGO
- **Training of DPRK Counterparts in Building Energy Surveys and Modeling**
  - Possibly more academic of groups in two categories above

# Types of Organizations and Individuals Needed for Project (by Task, Indicative)

- **Finalize Selection of EE Measures, Mini-grid/RE Site and Measure Selection**
  - Both via consultations with NKs, but require different skills. Person/group experienced in working in DPRK, plus EE/RE experts, from NGOs, national labs/institutes, academia
- **Prepare Plans to Install Measures, and Train Installers**
  - Involvement of groups working in measure/site selection, managed by firm adept in implementing big projects rapidly
- **Order and Ship Project Materials and Equipment**
  - Probably lead firm as above, with advisors from previous tasks for continuity



# **Types of Organizations and Individuals Needed for Project (by Task, Indicative)**

## **■ Install Measures**

- **Teams of NKs and a few internationals, the latter carefully chosen professionals, plus translators, working on individual apartments under international foremen coordinating with DPRK counterparts**
- **Teams may specialize: insulation, wallboard, paint...**
- **Under ultimate direction of lead firm as above**

## **■ Quality Control/Quality Assurance for Installations, Monitoring, and Training of Users**

- **Separate firm experienced in QA/QC for these types of projects, possibly one with experience working for multilaterals, utilities, or governments**

# Types of Organizations and Individuals Needed for Project (by Task, Indicative)

- **Synthesize, Communicate Results of Project to Policyholders, Plan Next Steps**
  - **Group(s) with experience communicating with policyholders on DPRK issues**
- **Project Management**
  - **Probably same lead firm as above, but with coordination/oversight from a governing board of individuals with DPRK experience**

# Illustrative Budget and Project Timing

- **Target**—project that can be completed in 12 months, at a cost of about \$100M
  - Cost is purely illustrative—can be scaled as needed (but **BEFORE** offering to DPRK)
- **Costs**
  - Building energy efficiency/renewable energy hardware
  - Installation labor costs (DPRK and international)
  - Administration costs
  - Shipping costs
  - Project/program preparation

# Activities Leading to Cooperation with DPRK on Energy and Related Issues

- Important to design projects that can be built upon with future engagement activities, also as models for peaceful redevelopment activities by the DPRK itself
  - Good projects should start relatively small
  - Be scalable based on needs and funds available
  - Designed to build/take advantage of growing technical/organizational capacity of DPRK partners
  - Meet the needs of several different DPRK constituents (and of participants/supporters in ROK, elsewhere—**especially NEA region**)
  - Constructed so as to contribute toward peaceful, sustainable improvements in DPRK economy

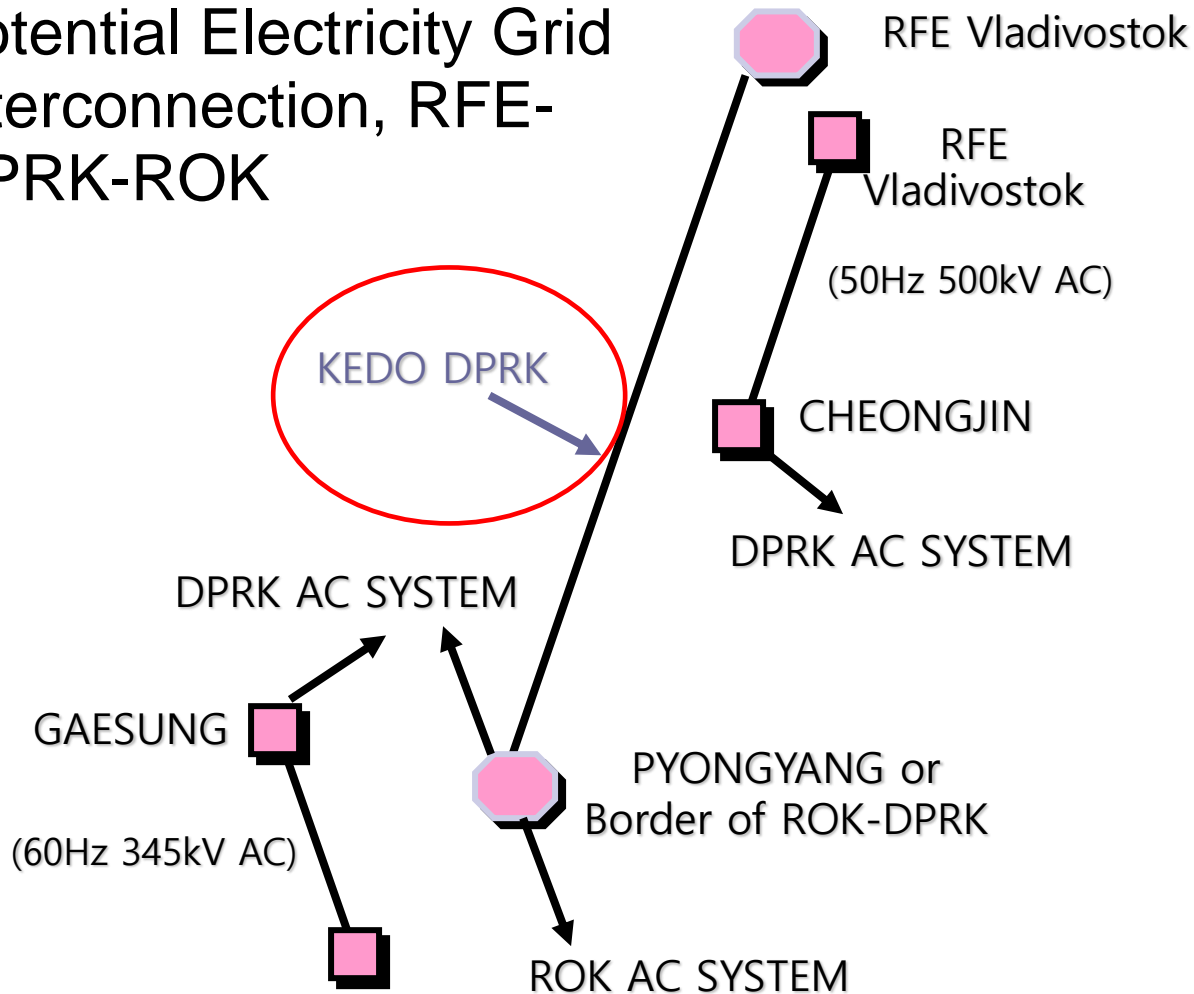


# The DPRK as a Participant in Regional Energy Infrastructure

- Potential DPRK Participation in Regional Resource Sharing Efforts: Options
  - Regional oil pipelines
  - Regional natural gas pipelines
  - Electricity grid interconnections
    - Could ultimately involve nuclear reactors in the distant future, and/or connections to large renewable generation, such as in Mongolia, via schemes **such as “The Asian Super-Grid” and “Gobitec”**)
  - Co-development/deployment of renewable energy and energy efficiency technologies
  - Sharing of excess oil refining capacity
  - Cooperation on transportation infrastructure
  - LNG import capacity co-development, DPRK+ROK
  - Cooperation on regional emergency fuel storage

# The DPRK as a Participant in Regional Energy Infrastructure

- Potential Electricity Grid Interconnection, RFE-DPRK-ROK



# The DPRK as a Participant in Regional Energy Infrastructure

- Potential Benefits of DPRK's Involvement:
    - The DPRK could gain access to energy resources that would be difficult to develop on its own
    - The DPRK obtains “rents”, monetary payments or energy supplies, in exchange for transit
    - DPRK could obtain better access to conventional energy, energy efficiency, renewable technologies
- AND**
- The DPRK would be obliged to work with the countries of the region to negotiate access rights and fees, tariffs, other parameters of cooperative projects
  - The DPRK would need to undertake, make public assessments of its energy resources, infrastructure

# The DPRK as a Participant in Regional Energy Infrastructure

- Potential Benefits of DPRK's Involvement (2):
  - Through cooperative projects, DPRK will learn (rather, continue to learn) economic cost-benefit analysis, other economic and financial concepts
  - Cooperative projects provide substantial opportunities/requirements for capacity-building for DPRK officials and technicians
  - Cooperative projects will allow foreigners better access to the DPRK, allowing them to learn more about the DPRK's needs and situation
  - Correspondingly, through cooperative projects DPRK residents will have expanded contact with people, ideas from other nations
- Very different approach, likely outcomes from negotiations associated with Agreed Framework, 6-party talks (which focused on value received by DPRK)



# Identifying and Matching DPRK Energy Needs with Consortium Assistance Criteria

- Energy-focused third-party CTR+ engagement activities must consider DPRK energy needs and wants (not necessarily the same thing)
- ...While at the same time being acceptable to the international community and...
- Seeking to integrate the DPRK in regional initiatives around, for example, sharing of energy and other resources, energy efficiency improvement, greenhouse gas emissions mitigation...
  - Introduce/reinforce **market-based** approaches
  - Stress need for **transparency** in transactions, and in regional organizations needed to support initiatives

# DPRK Energy Sector Overview

- As of 1990, DPRK per-capita energy use ~ 3X China's, 50% of Japan's (with 10-20X GDP/cap)
- Post USSR, decline in supply of imported crude oil in early 1990s
  - More or less stable since 2000 (imports from China)
- Related continuing degradation of electricity generation, Transmission and Distribution (T&D) infrastructure
  - Unreliable, spotty supplies; modest local rehabilitation of power plants, and T&D systems, hydro additions
  - Consumers generating own power—solar PV, diesels
- Continuing degradation of industrial facilities
  - Some light industry additions, especially for export

# DPRK Energy Sector Overview

- Net result, ~60% reduction in energy use/capita
  - Severe restriction in the energy services available—heated homes, lighting, kilometers traveled, and industrial products manufactured
- Biomass (including wood) energy has replaced commercial energy (electricity, oil, and coal)
  - But partially and at low efficiency, and with resulting deforestation and soil degradation
- Coal remains dominant form of energy use
  - Billions of tonnes of reserves (anthracite and lignite), but often used inefficiently

# DPRK Energy Sector Overview

- DPRK grid nominally capacity of 8 – 10 GW, but..
  - Total usable capacity limited by poor state of repair of generation/T&D equipment, seasonal hydro flows...
  - Available generation on the order of 2 – 3 GW
  - Annual 2020 electricity use similar to Washington DC
- DPRK military used estimated 31% of oil, 25% percent of electricity in 2019
- Investment will be required on a massive scale to repair/refurbish/replace energy system elements
  - Tens of billions for electricity grid alone
  - Without international assistance, slow and marginal improvements possible at best; continued inefficiency



# DPRK Energy Sector—Energy Balance 2019

<b>UNITS: PETAJOULES (PJ)</b>	<b>COAL &amp; COKE</b>	<b>CRUDE OIL</b>	<b>REF. PROD</b>	<b>HYDRO/NUCL.</b>	<b>WOOD/BIOMASS</b>	<b>CHAR-COAL</b>	<b>HEAT</b>	<b>ELEC.</b>	<b>TOTAL</b>
<b>ENERGY SUPPLY</b>	457	31	14	38	165	-	-	(1)	704
Domestic Production	619	0	-	38	161	-	-	-	819
Imports	0	30	14	-	4	-	-	0	49
Exports	163	-	0	-	-	-	-	1	164
Stock Changes	-	-	-	-	-	-	-	-	-
<b>ENERGY TRANSF.</b>	(112)	(31)	16	(38)	(7)	2	3	35	(131)
Electricity Generation	(73)	-	(13)	(38)	-	-	3	57	(64)
Petroleum Refining	-	(31)	31	-	-	-	-	(0)	(0)
Coal Prod./Prep.	(30)	-	-	-	-	-	-	(4)	(34)
Charcoal Production	-	-	-	-	(7)	2	-	-	(5)
District Heat Production	(2)	-	(0)	-	-	-	1	-	(5)
Own Use	-	-	(2)	-	-	-	-	(3)	(5)
Losses	(8)	-	-	-	-	-	(1)	(14)	(23)
<b>FUELS FOR FINAL CONS.</b>	345	-	30	-	157	2	3	35	572
<b>ENERGY DEMAND</b>	345	-	30	-	157	2	3	35	572
INDUSTRIAL	155	-	4	-	1	-	-	13	173
TRANSPORT	-	-	10	-	1	-	-	4	14
RESIDENTIAL	139	-	3	-	119	2	2	4	269
AGRICULTURAL	4	-	1	-	19	-	-	1	24
FISHERIES	0	-	1	-	-	-	-	0	1
MILITARY	21	-	9	-	7	-	-	9	46
PUBLIC/COMML	25	-	1	-	5	-	1	4	37
NON-SPECIFIED	-	-	-	-	-	-	-	-	-
NON-ENERGY	1	-	1	-	6	-	-	-	8
<b>Elect. Gen. (Gr. TWhe)</b>	4.34	-	0.74	10.66	-	-	-	-	15.74

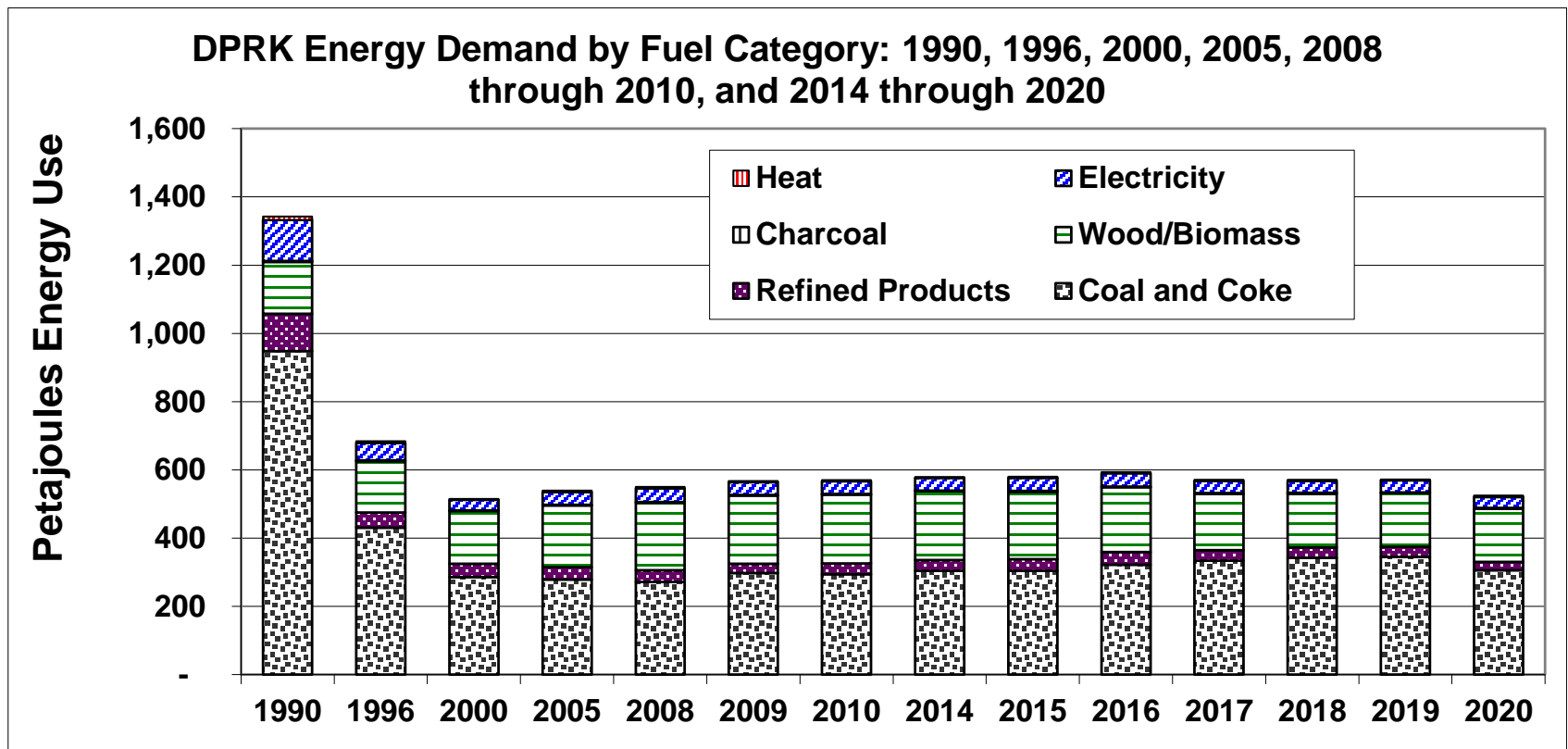
\*Note: Gross terawatt-hours for coal-fired plants includes output for plants co-fired with coal and heavy fuel oil.

# DPRK Energy Sector—Energy Balance 2020

<b>UNITS: PETAJOULES (PJ)</b>	<b>COAL &amp; COKE</b>	<b>CRUDE OIL</b>	<b>REF. PROD</b>	<b>HYDRO/ NUCL.</b>	<b>WOOD/ BIOMASS</b>	<b>CHAR- COAL</b>	<b>HEAT</b>	<b>ELEC.</b>	<b>TOTAL</b>
<b>ENERGY SUPPLY</b>	379	32	7	39	164	-	-	(1)	619
Domestic Production	461	0	-	39	162	-	-	-	662
Imports	0	32	7	-	2	-	-	0	41
Exports	82	-	-	-	-	-	-	1	83
Stock Changes	-	-	-	-	-	-	-	-	-
<b>ENERGY TRANSF.</b>	(73)	(32)	18	(39)	(7)	2	5	33	(94)
Electricity Generation	(43)	-	(13)	(39)	-	-	5	51	(40)
Petroleum Refining	-	(32)	32	-	-	-	-	(0)	(0)
Coal Prod./Prep.	(22)	-	-	-	-	-	-	(3)	(25)
Charcoal Production	-	-	-	-	(7)	2	-	-	(5)
District Heat Production	(2)	-	(0)	-	-	-	1	-	(4)
Own Use	-	-	(2)	-	-	-	-	(2)	(4)
Losses	(6)	-	-	-	-	-	(1)	(13)	(20)
<b>FUELS FOR FINAL CONS.</b>	306	-	24	-	156	2	5	32	525
<b>ENERGY DEMAND</b>	306	-	24	-	156	2	4	32	525
INDUSTRIAL	125	-	4	-	1	-	-	10	140
TRANSPORT	-	-	7	-	1	-	-	4	11
RESIDENTIAL	141	-	3	-	121	2	4	6	278
AGRICULTURAL	4	-	1	-	18	-	-	1	23
FISHERIES	0	-	1	-	-	-	-	0	1
MILITARY	17	-	6	-	7	-	-	8	37
PUBLIC/COMML	18	-	1	-	4	-	1	3	26
NON-SPECIFIED	-	-	-	-	-	-	-	-	-
NON-ENERGY	1	-	1	-	6	-	-	-	7
<b>Elect. Gen. (Gr. TWhe)</b>	2.58	-	0.72	10.74	-	-	-	-	14.04

# DPRK Energy Demand by Fuel

- Refined products use has probably grew between 2010 and 2017/2018, but likely declined again in 2019/2020 due to supply, income restrictions of sanctions, COVID



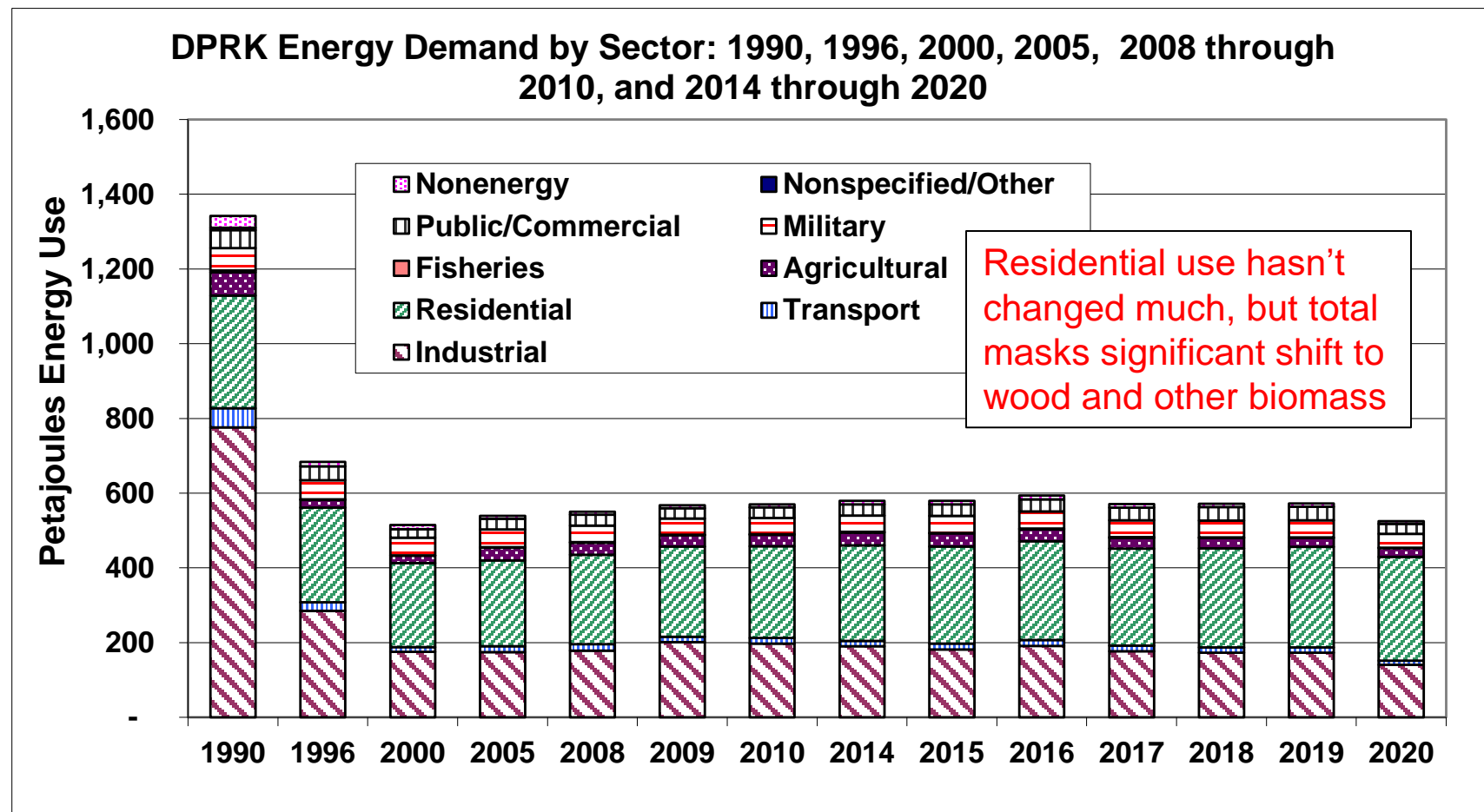
# DPRK Energy Demand by Sector

- Fuel substitution in the transport sector (biomass-fueled truck); simultaneous multi-use transport (goods, soldiers, civilians); dark (but opulent) Pyongyang subway station, solar PVs sprouting from apartment balconies



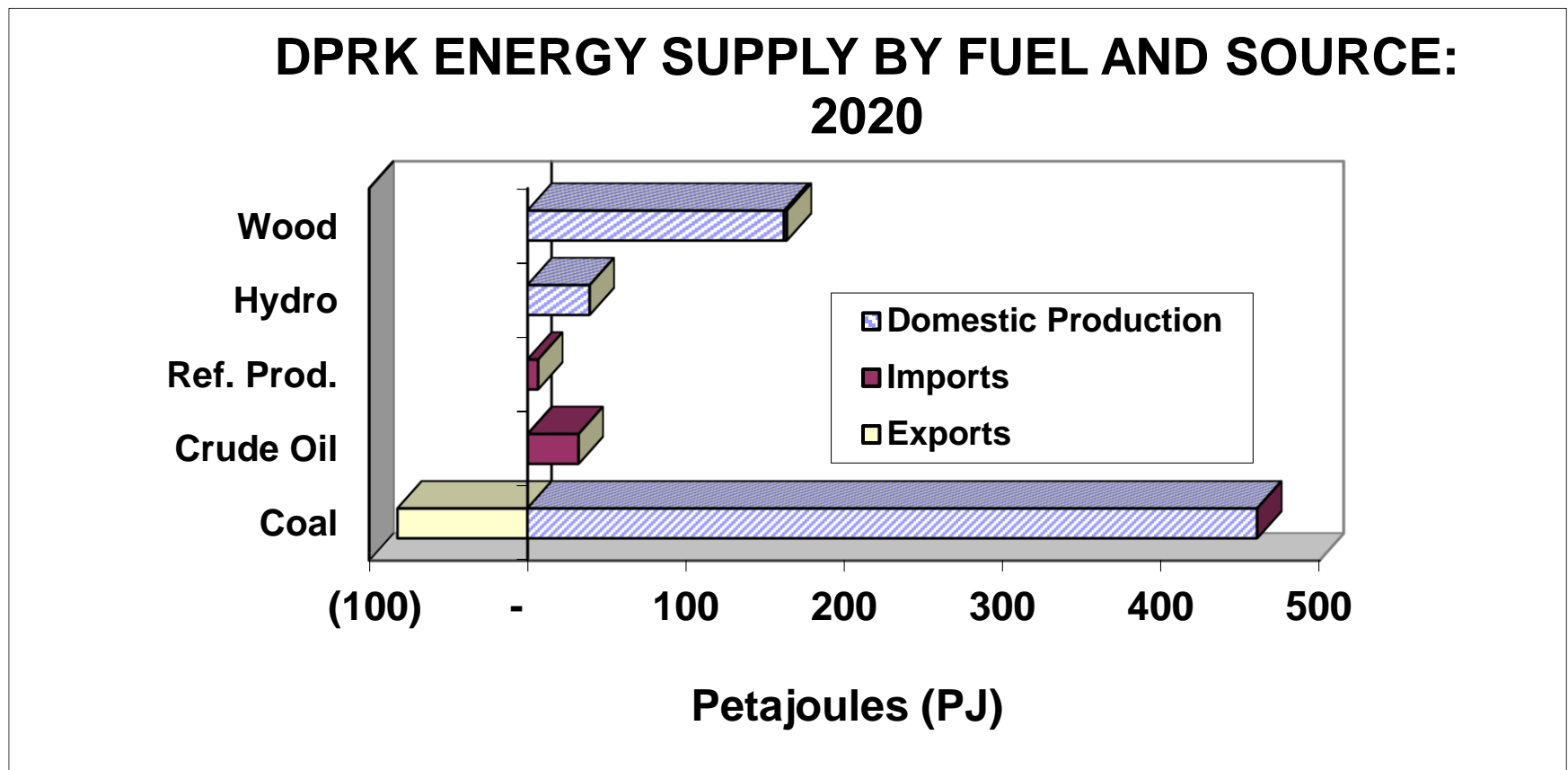
# DPRK Energy Demand by Sector

- Transport, commercial had **grown since 2010**



# DPRK Energy Demand by Fuel

- Most fuel supplies domestic with the significant exception of crude oil and petroleum products



# “Third-Party” DPRK Energy Sector Engagement/Assistance Project

## ■ Key Project Elements

- **Energy Needs Assessment:** Obtain improved understanding of DPRK energy sector status and needs to inform project design and delivery
- **Building Energy Efficiency Measures:** insulation, weatherstripping, heating system controls, windows, lighting improvements/controls, apartments, some other buildings (schools/hospitals/clinics)
- **Mini-grid/Renewable Energy Measures:** Probably mostly solar PVs, some wind, possibly storage also possible, with mini-grid system(s) for village/town and/or humanitarian application
  - For both of above, specify, source, purchase, and deliver, material, tools, then organize installation, commission



# “Third-Party” DPRK Energy Sector Engagement/Assistance Project

## ■ Key Project Elements (continued)

- **Capacity Building:** Training in energy assessment, building energy analysis, measure installation and maintenance/troubleshooting, ongoing data collection
- **Follow-up:** Surveys of apartment dwellers, technicians, others as to experience with measures, data collection/analysis from selected installations (and arranging for same), planning for expanded program with DPRK counterparts
- **Linkages to Future Economic Development:** identify opportunities (and processes) for in-country production of selected materials (e.g. MgO board), energy-efficient design, new local businesses

# Conclusions

- Sustainable solutions to DPRK's long-term energy problems are a necessary, but not sufficient, condition for enduring success in nuclear weapons negotiations
  - Failing to address DPRK's underlying needs for energy services renders solution to nuclear issue unachievable and unsustainable
- Sanctions make life more difficult for ordinary North Koreans, leaving more energy services unmet
  - But not much impact on missile/N-weapons programs
- Energy Cooperation options
  - Domestic-DPRK and regional energy and other networks
  - Engagement options that involve energy efficiency and renewable energy initiatives generally “robust” for application in DPRK, fulfilling many different considerations, few “downsides”
  - Start with smaller, local projects w/ extensive capacity-building
  - Consider regional energy import/export needs and goals
  - KEDO reactors unlikely to be built, but serve as a precedent that DPRK will remember in negotiations

# Conclusions

- Solving linked DPRK nuclear weapons and energy insecurity issues requires phased, coordinated, stepwise, multi-faceted approach on local, national, regional levels
  - Consider a 6-12-month ROK-DPRK collaboration pilot program to start, as above, focusing on coordinated renewables, energy efficiency, humanitarian energy aid, economic development
- Build toward integrating DPRK w/ NEA nations in cooperative energy projects supporting goals of cooperative threat reduction
  - Economic integration/market development, transparency of economic and technical negotiations, regional institution-building, collaboration on technical and environmental standards...



# THANK YOU!

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# **ADDITIONAL SLIDES FOR REFERENCE**



# Recent Nautilus Publications, DPRK Energy Sector and Engagement Options

- David von Hippel, Peter Hayes, "US-DPRK CTR+: PROVISION OF HUMANITARIAN ENERGY EFFICIENCY, RENEWABLE ENERGY, AND MICRO-GRID MEASURES TO THE DEMOCRATIC PEOPLES' REPUBLIC OF KOREA (DPRK) FOR COOPERATIVE THREAT REDUCTION", NAPSNet Special Reports, May 10, 2021, <https://nautilus.org/napsnet/napsnet-special-reports/us-dprk-ctr-provision-of-humanitarian-energy-efficiency/>
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- David von Hippel and Peter Hayes, "DPRK IMPORTS OF GENERATORS IN RECENT YEARS: AN INDICATION OF GROWING CONSUMER CHOICE AND INFLUENCE ON ENERGY SUPPLY DECISIONS?", NAPSNet Special Reports, November 02, 2018, <https://nautilus.org/napsnet/napsnet-special-reports/dprk-imports-of-generators-in-recent-years-an-indication-of-growing-consumer-choice-and-influence-on-energy-supply-decisions/>
- David von Hippel and Peter Hayes, "DPRK RAILROAD AND SHIPPING SECTOR IMPORTS AND EXPORTS FROM AND TO CHINA AND OTHER NATIONS, 2000-2017: IMPLICATIONS FOR THE STATUS OF THE RAIL AND SHIPPING SUB-SECTORS IN THE DPRK ENERGY ECONOMY", NAPSNet Special Reports, September 05, 2018, <https://nautilus.org/napsnet/napsnet-special-reports/dprk-railroad-and-shipping-sector-imports-and-exports-from-and-to-china-and-other-nations-2000-2017-implications-for-the-status-of-the-rail-and-shipping-sub-sectors-in-the-dprk-energ/>
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# COVID-19 Impact on DPRK Energy Sector

- Little or no direct data, but COVID-19 has undoubtedly affected DPRK oil product supply and demand, as well as demand for other fuels
- Estimate net impact of pandemic in 2020 (and beyond) on energy by analysis considering:
  - National COVID-19 “lockdown”, including military lockdowns at times, school closures, and quarantines, have continued to restrict fuel products demand/availability in many sectors through 2020 (and likely continuing in 2021)
  - Restrictions on fuel imports, both on- and off-books, by limited and slowed cross-border commercial traffic by land and sea, particularly with China, as well as with other trading partners, combined with crackdown on smuggling

# COVID-19 Impact on DPRK Energy Sector

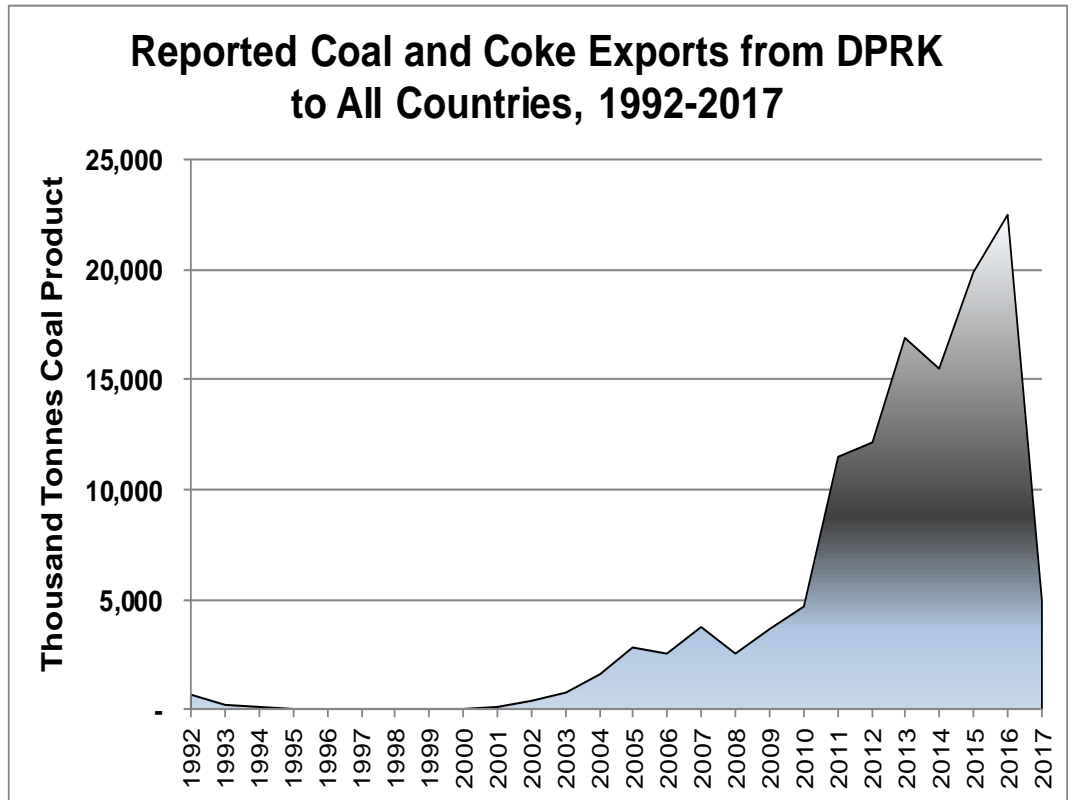
- Estimate net impact of pandemic in 2020 (and beyond) on energy by analysis considering:
  - Economic losses reported by DPRK state media, anecdotal increases (though not consistent) changes in fuel prices
  - Issues with industrial output due to lack of inputs and spare parts from China, affecting the mining sector as well
  - Demonstrable idling of the DPRK's maritime fleet, including many of the ships that have been implicated in unofficial trade in coal and oil products, starting with a recall of ships on January 22 (2020)
- Results: Estimated lower (15-20%) demand/supply for oil, coal, electricity
  - 25% reduction in coal output due in part to (further) export restrictions
  - Biomass fuel use not much changed on net basis

# Nautilus DPRK Energy Sector Analysis: Overall Approach

- Obtain as much **information** as possible about the DPRK economy and energy sector from media sources, visitors to the DPRK, and other sources
  - Any and all types of information—the few official DPRK stats and announcements, trade statistics, reports/analysis by others, commissioned research, papers prepared at Nautilus workshops (including by DPRK delegations), anecdotal...
- Use available information, comparative analysis, and judgment to **assemble a coherent and consistent picture** of the DPRK energy sector (**energy balance**)
- Think about **possible future paths** for DPRK energy sector/economy, changes (national, regional, global) that might bring those paths about, what changes might mean at end-use, infrastructure levels

# DPRK Coal Supplies

- Huge increases in exports to China ~2010 – 2016 probably doubled total domestic output by 2016 relative to 2010 estimates
- Large fall in reported exports in 2017 due to sanctions
- Probably some “off-books” exports, but volume unlikely to make up for imported drop.
- Many of mines geared for export may have reduced production, rather than shifting sales to domestic market.

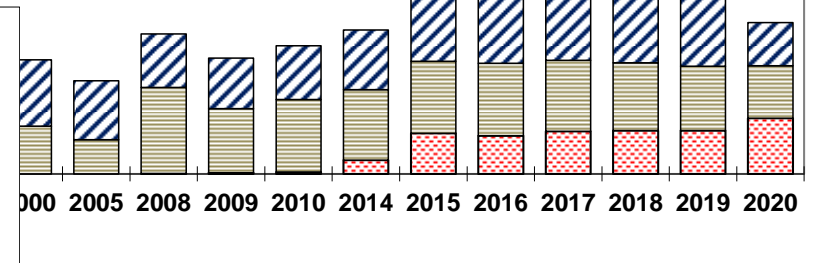
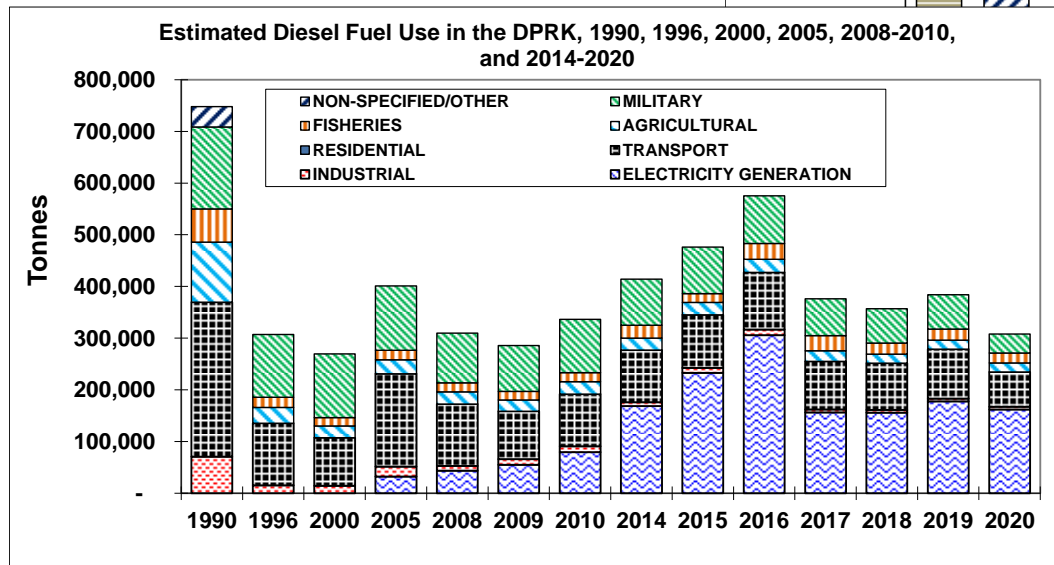
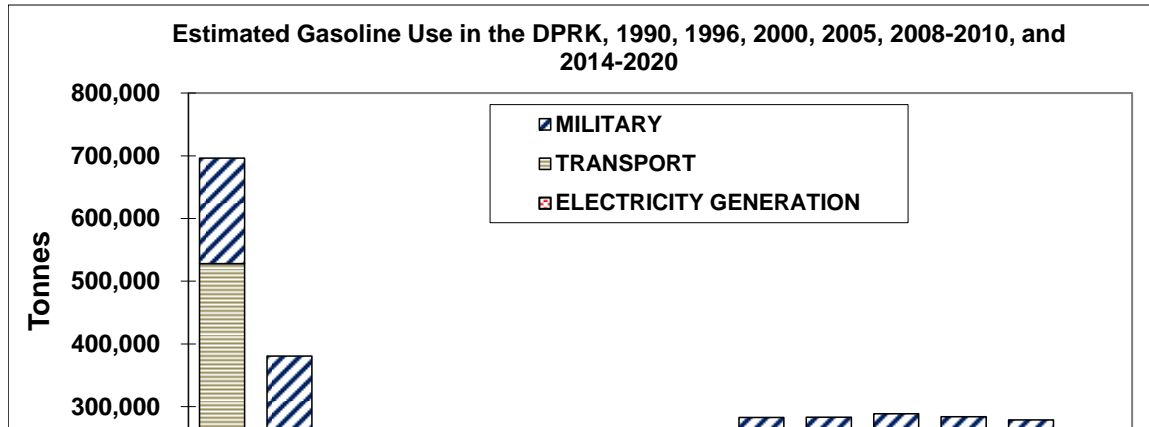


# DPRK Oil Supply and Demand

- Caveats: There is little solid information about energy demand in the DPRK; our estimates are consistent with available information, but true figures may be different
- For 2014 - 2020 we have assumed additional oil products imported “off-books”, because
  - A) some off-books imports have inevitably gone undetected, and
  - B) it seems improbable that DPRK oil products demand could decrease enough to account for the decrease in reported total fuels imports without severe/visible economic dislocation, which visitors have not reported.
- It is possible that off-books imports were either greater than estimated, meaning higher oil products use (particularly in 2017-2019), and/or that some demand was served by drawing down stocks of oil products
- 2019-on UN “Panel of Expert” reports suggest that DPRK oil product imports via ship-to-ship transfers in (for example) 2018 as high as 500,000 tonnes (assuming ships were nearly full, which we do not); we assume “off-books” trade of 160,000 tonnes in 2018

# DPRK Oil Demand

- Estimates of Diesel and Gasoline use by sector (and for electricity generation)





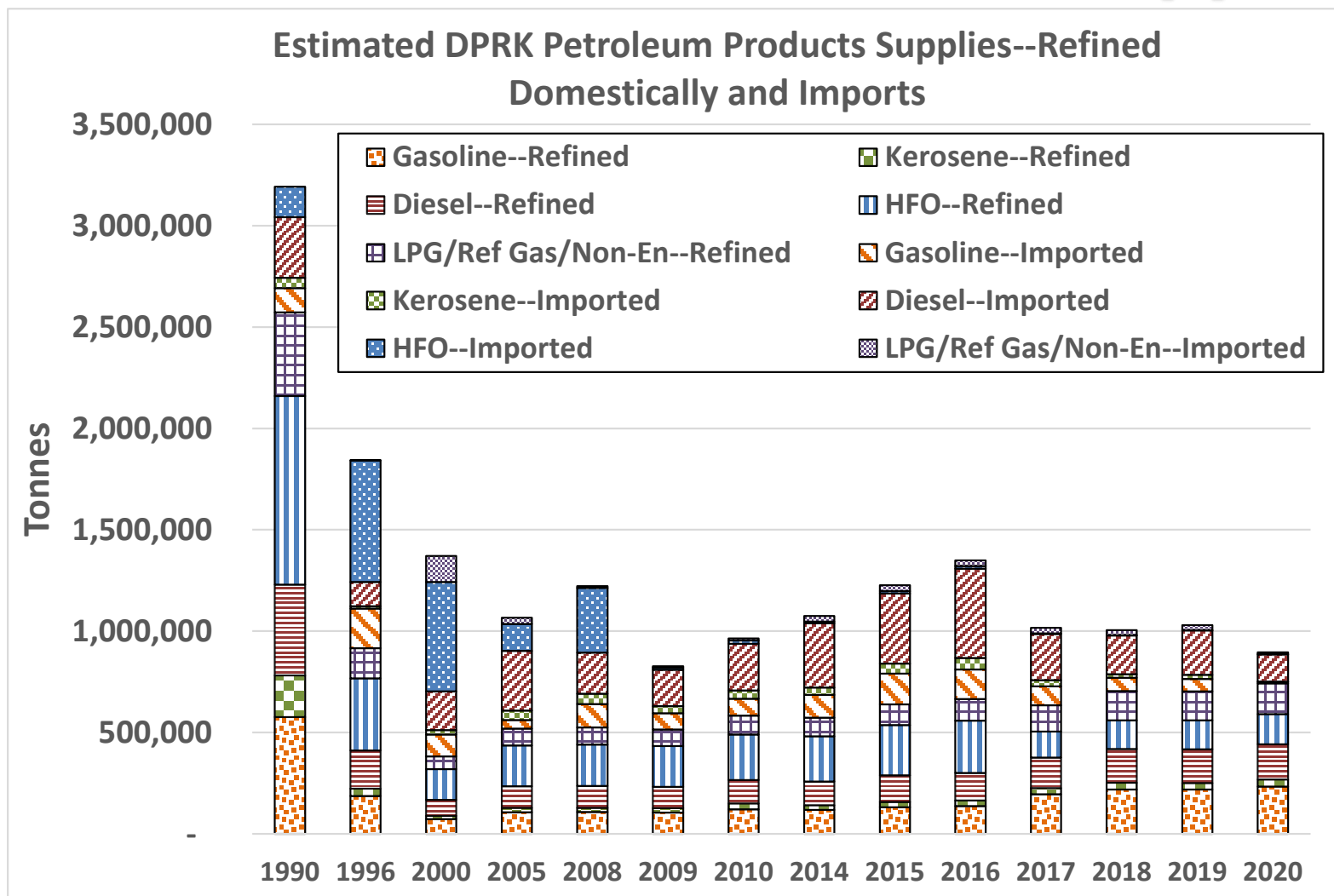
# DPRK Oil Storage

- Example—New and expanded oil storage at Nampo: total estimated at ~200,000 cubic meters (DPRK total ~1.5 M cu m)
  - New footings for tanks not yet built at upper left (for ~+20-30k cu m)
  - At least 5 tanks, maybe 50-70,000 cubic meters, built in 2020





# DPRK Petroleum Products Supplies



# DPRK Oil Refining Industry

## ■ Two major refineries

- Northwest (Ponghwa Oil Refinery): receives crude oil from China via pipeline, runs at part capacity
  - 2016 addition of “cracker” unit, potentially significant for chemical precursor production
- Northeast (at Sonbong): has received oil from Russia, Middle East, has not run much since 1990s
- Both older, small by international standards
- Sonbong refinery expansion is a possible cooperation project

## ■ A third, simple refinery, reportedly near Nampo, may produce fuels for the military

- Source of crude oil for refinery unclear, could come from domestic production, or “unofficial” imports

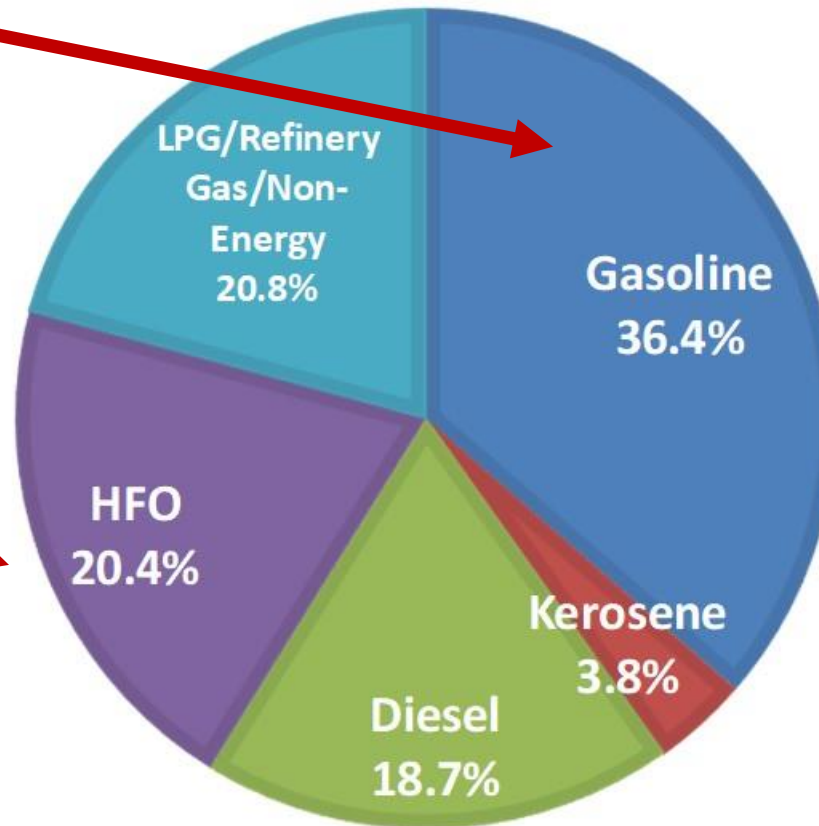
# DPRK Oil Refining Industry

**Sungri Chemical Plant Oil Refinery at Sonbong (Soviet-built refinery near Russian border, currently inactive)**



# DPRK Oil Refining Industry

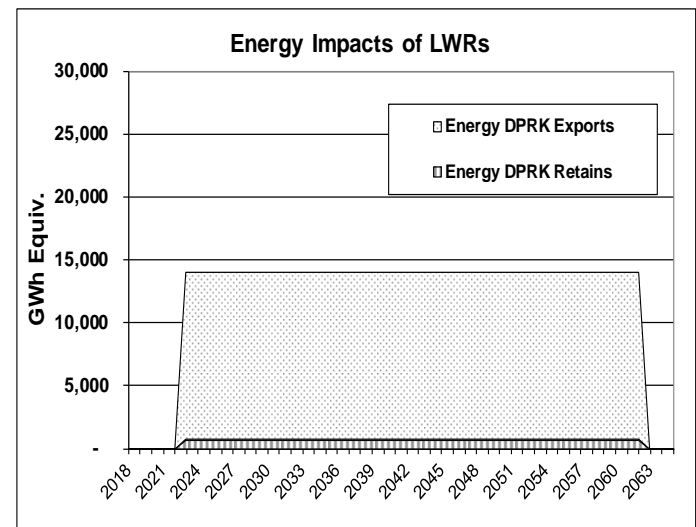
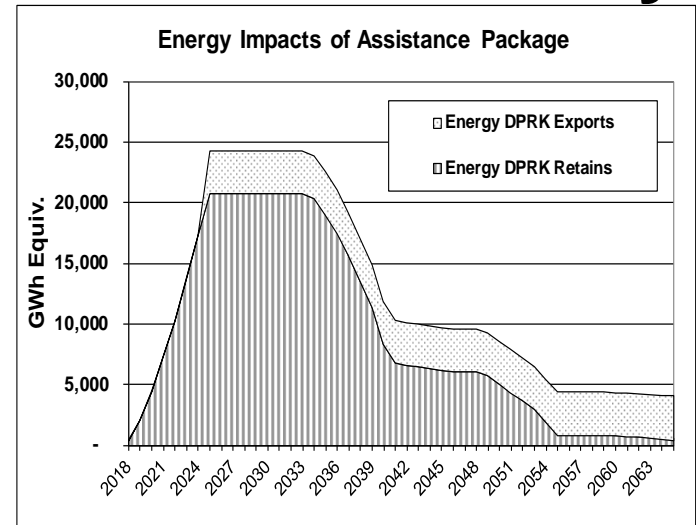
ESTIMATED DPRK REFRINERY OUITPUT BY FUEL,  
2017



Significant  
estimated  
difference  
from 2016 due  
to addition of  
catalytic  
cracking unit  
at Ponghwa

# DPRK Energy Sector Engagement Options for the International Community

- Illustrative “2 GWe LWR-equivalent” overall energy assistance package phased in as DPRK meets agreement obligations



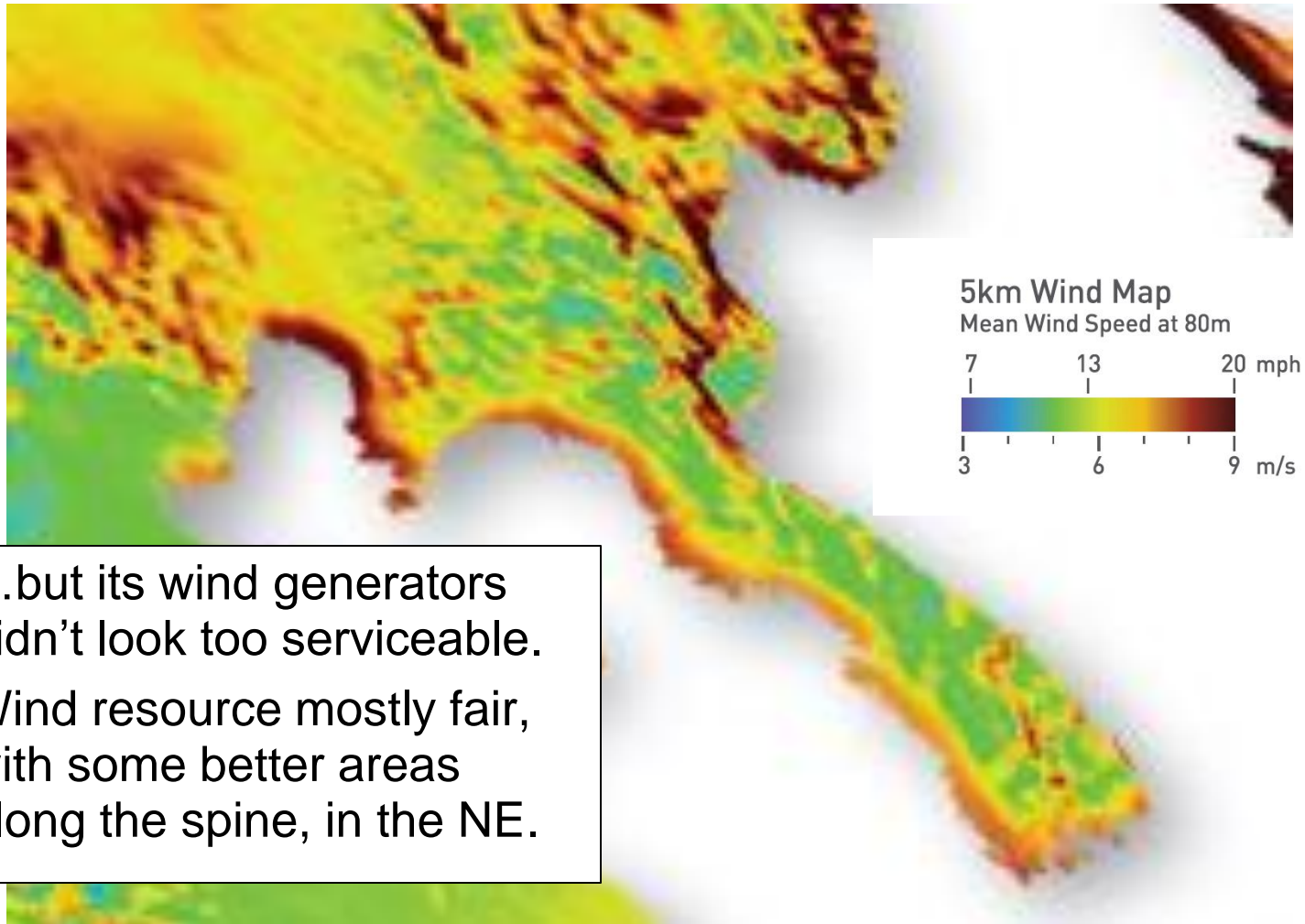


# The DPRK Electricity Grid: DPRK-made Mini-Hydroelectric Turbine-Generator



- As of 1998, DPRK was producing workable-looking micro-hydro equipment....

# DPRK Renewable Energy: Wind Resources



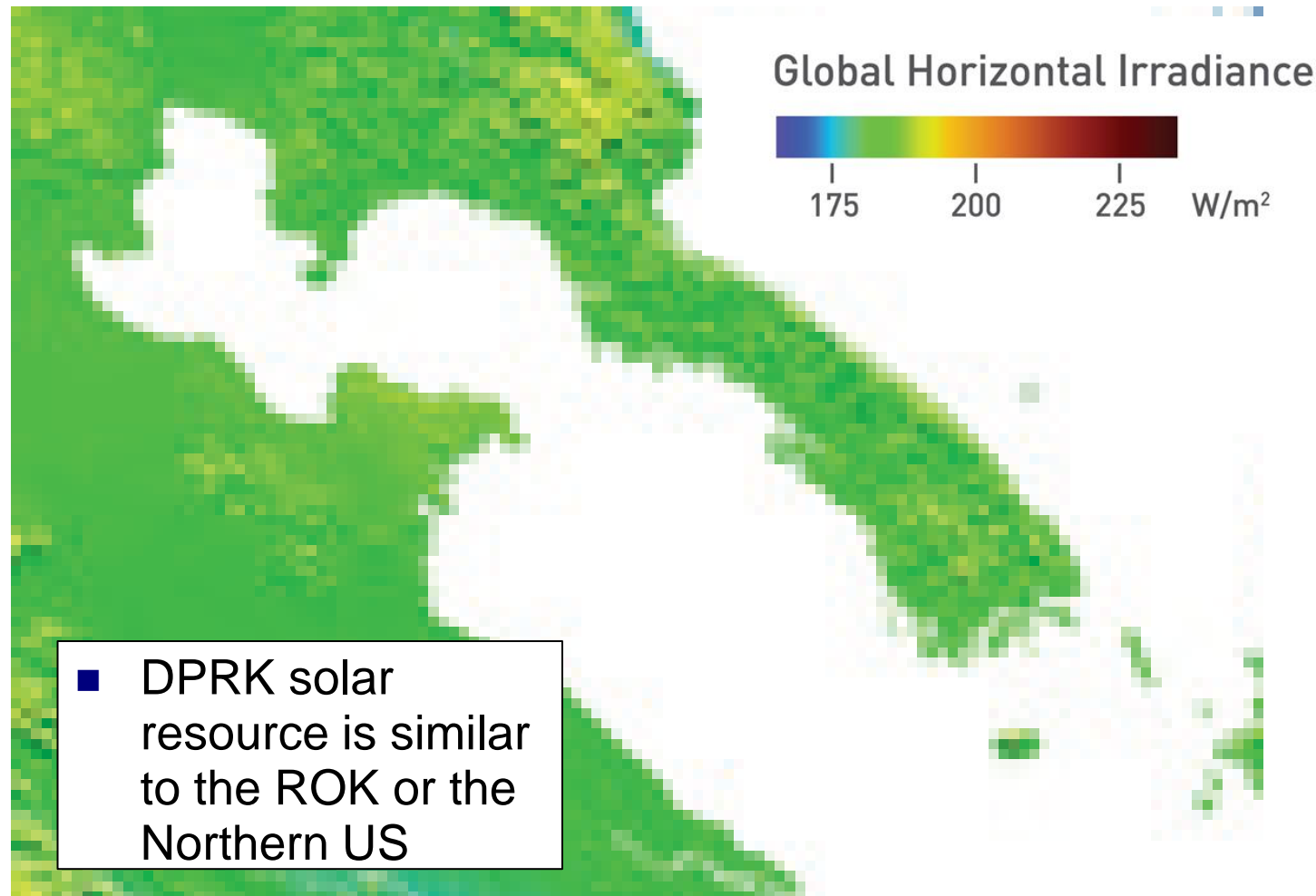
- ...but its wind generators didn't look too serviceable.
- Wind resource mostly fair, with some better areas along the spine, in the NE.



# **DPRK Renewable Energy: Nautilus/KANPC DPRK Humanitarian Wind Power Project**



# DPRK Renewable Energy: Solar Resources



# What Do North Koreans Say that They Want for the Energy Sector?

- **Light Water (nuclear) Reactor—point of national pride, benchmark of previous negotiations**
- **Upgrading of large thermal, hydro plants**
- **Cooperation and training in energy efficiency in many areas**
  - **Improving building energy efficiency, including solar passive design, efficient residential and office buildings, and application of building energy design software**
  - **Application of energy efficiency technologies and methods generally throughout the economy**

# What Do North Koreans Say that They Want for the Energy Sector?

- **Small- and medium-scale renewable energy technologies (solar, wind, hydro, production of methane gas from wastes)**
- **Cooperation and training related to mining technologies (coal/minerals)**
- **Building human and institutional capacity in many areas**
  - **Acquisition of technical materials, receiving instruction in basic energy concepts and in the use of design and analysis tools and software...**