Towards the Global Sustainable Development through the Arctic Science Partnership

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Hyo-Sun Kim, Ph.D.
Head of Policy Division
Korea Polar Research Institute
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EARTH FEVER: +1.6 F/0.9 C since 1900

Natural CO2 peak: 290 ppm

CO2 now: 400±/-ppm

Sources:
National Geographic Society
U.S. Department of Energy
NASA Goddard Institute for Space Studies
Oak Ridge National Laboratory
Scripps Institution of Oceanography
### Why the Arctic Is So Hot?

<table>
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<tr>
<th>country</th>
<th>Energy risk index</th>
<th>rank</th>
<th>country</th>
<th>Energy risk index</th>
<th>rank</th>
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<td>10</td>
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<td>23</td>
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<td>1,616</td>
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<td>12</td>
<td>Ukraine</td>
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</table>

Rethinking New Nexus of Climate and Energy Security

Environmental
Economic
Social

Green Growth

GDP Growth Rate (real, %, Left)
Gini coefficient (Right)

-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00
0.240 0.250 0.260 0.270 0.280 0.290 0.300 0.310 0.320
Global Economy: Slower but Shaky

- Economy is still expanding, but growth is weak and uneven due to uncertainties and negative feedback loop
- Emerging-market currencies from China to Russia dropped against the U.S. dollar, reflecting renewed fears that an economic slowdown and weak oil price
## Evolving New Mechanisms: Non-Market Approaches

### Article 6 of Paris Agreement

| 1. | Parties recognize that some Parties choose to pursue **voluntary cooperation** in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to **promote sustainable development and environmental integrity** |
| 2. | Parties shall, where engaging on a voluntary basis in **cooperative approaches** that involve the use of **international transferred mitigation outcomes** towards nationally determined contributions, **promote sustainable development and ensure environmental integrity and transparency**, including in governance, |

| 8. | Parties recognize the **importance of integrated, holistic and balanced non-market approaches** being available to Parties to assist in the implementation of their nationally determined contributions, in the context of sustainable development and poverty eradication, in a coordinated and effective manner, **including through, inter alia, mitigation, adaptation, finance, technology transfer and capacity-building**, as appropriate. These approaches shall aim to: |
| | (a) **Promote mitigation and adaptation ambition** |
| | (b) **Enhance public and private sector participation** in the implementation of nationally determined contributions; and |
Sustainability Indices of Arctic Community (US=1.00)

- Compared to US, Russia spends more on military expenditure and less on health care.
- Canada and Norway outperform US, in terms of mitigation policy and economic growth, respectively.
- However, depressed commodity prices may hurt economy in the Arctic region.

Source: WDI (2015)
The Nordic countries have pioneered energy and carbon taxes, which provide incentives for energy-saving and fuel switching to lower carbon energy.

Iceland has a high portion of renewables in total energy supply.

And carbon sequestration such as LULUCF results in a decrease of net carbon emissions, by 25% lower than in 1990.

Source: WDI (2015)

* Renewable Energy as % of Total Energy Supply (2012) and Net Removals (MT CO₂) from LULUCF (2011)
Different Kuznets Patterns of CO2 Elasticity of Income: Arctic vs. Arctic

- CANADA
- SWEDEN
- U.S.

- CANADA
- SWEDEN
- U.S.

- GERMANY
- U.K.
- FRANCE (right)

- FINLAND
- ICELAND
- NORWAY
- DENMARK

- CHINA
- INDIA
- KOREA
- MEXICO
Arctic Changes: Complexity vs. Challenges
Sea-Ice Loss in the Arctic
Sea-level Rise in Tuvalu
Climate Change: Cause and Consequences
Winners
Losers
Fact sheets: Arctic Biodiversity

- Negative effects on non-migratory Arctic species
- Decreased reproductive success in Arctic seabirds
- Range shift of some Arctic marine species
- Ocean acidification
- Changing relationships among species
- Increase in marine primary productivity
  - increase by 20% from 1998 to 2009, driven by a 45-day increase in the open-ice period and a reduction in summer ice cover of 27% - not spatially homogeneous
Conceptual Framework

- Hanemann (1984) suggested dichotomous choice question
  - Yes/No: incentive-compatible
  - Using pre-test
  - Less starting point bias
  - Less incentive for strategic behavior
- Face-to-face interview
- WTP, not WTA
- Trade-off between WTP and other expenditure

\[
\ln L = \sum_{i=1}^{N} \{ I_i^m \ln [1 - G_c(A_i)] + I_i^w \ln G_c(A_i) \}\]
Sample distribution

- Climate change: 51%
- Biodiversity: 17%
- Future energy: 20%
- Politics: 4%
- Arctic route: 4%
- Fishery: 4%

Sample characteristics
## Results

<table>
<thead>
<tr>
<th>1st WTP ($X)</th>
<th>2nd WTP (2X)</th>
<th>PEOPLE</th>
<th>WTP ($)</th>
<th>Willing to Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>'YES' ($2X)</td>
<td>'NO' ($1/2X)</td>
<td># of Sample</td>
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<td>Yes 45(36.0%)</td>
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<tr>
<td>$1</td>
<td>$2</td>
<td>125</td>
<td>$1</td>
<td>No 80(64.0%)</td>
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<tr>
<td>$2</td>
<td>$4</td>
<td>125</td>
<td>$2</td>
<td>Yes 67(53.6%)</td>
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<tr>
<td>$3</td>
<td>$6</td>
<td>125</td>
<td>$3</td>
<td>No 53(42.4%)</td>
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<tr>
<td>$4</td>
<td>$8</td>
<td>125</td>
<td>$4</td>
<td>Yes 47(37.6%)</td>
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<tr>
<td>$5</td>
<td>$10</td>
<td>125</td>
<td>$5</td>
<td>No 33(26.4%)</td>
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<tr>
<td>$7</td>
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<tr>
<td>$10</td>
<td>$20</td>
<td>125</td>
<td>$10</td>
<td>No 24(19.2%)</td>
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<tr>
<td>$15</td>
<td>$30</td>
<td>125</td>
<td>$15</td>
<td>Yes 16(12.8%)</td>
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</tbody>
</table>

Total 353(35.3%) No 647(64.7%)
What is WTP by Korean Citizen for the Environmental Integrity of the Arctic?

• Total willingness to pay from Korean citizen ranges from 0.319 billion dollars per year to 0.716 billion dollars per year: 5 billion dollars for 100 years
  • Alvarez et al.(2015) and Whiteman and Wadham(2013) predict the social costs of climate change in the Arctic reach 6 trillion dollars
• As Perrings(2010) pointed out, climate change is a cause and at the same time, effects of biodiversity
“We have picked a squad that is flexible and will be able to adapt!”
KOPRI’s Plan-A: Vision & Strategy

### Vision
Global Leading Polar Research Institute

### Core Values
- Excellency
- Engagement
- Enthusiasm

### Goal
- To promote climate change research in response to new paradigm
- To create added-values to the nation through polar research
- To expand the channel of international partnership & collaboration

### Strategy

#### Research Themes
- **Clarifying Antarctic’s Roles in Global Climate Change**
  - Climate observing platform and restoration technology
  - Prediction of marine ecosystem in Antarctica
  - Melting Iceberg in the Antarctica and its influence on global sea level rise

- **Enhancing Arctic Research to lead the Cold Rush Era**
  - DB on the Arctic Environmental & Resource information
  - Satellite Remote Sensing System to analyze Arctic Sea Ice
  - Rapid Climate Changes in the Arctic and its impacts

- **KOPRI, We Build Future for you!**

#### Exploration
- Exploring unseen, unknown, and unexplored
  - Exploring unexplored area of the Arctic & Antarctica
  - Utilizing organisms from the Arctic & Antarctica
  - K-Route Project: land based research in the Antarctica

### Core Values
- Excellency
- Engagement
- Enthusiasm
**Theme 1: DB on the Arctic Information**

**Korea-Arctic Ocean Observing System (K-AOOS)**
Understand the physical processes of ocean-sea ice interaction affecting on the sea-ice changes and identify sensitivity of climate change prediction.

**Investigation of submarine resource environment and seabed methane release in the Arctic**
Through Araon Arctic expeditions with the Arctic countries,
- Acquiring basic data and information on geological environment for Arctic submarine resources
- Investigating a global issue, subsea CH₄ release in the Arctic causing abrupt global warming

**Circum Arctic Permafrost Environment Change Monitoring, Future Prediction and development Techniques of useful biomaterials (CAPEC)**
Diagnostic circum-Arctic permafrost environmental change, development of future prediction model and useful substance application technology based on permafrost observation nodes.

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1. **Purpose**

2. **Korea-Arctic Ocean Observing System (K-AOOS)**
   - Understand the physical processes of ocean-sea ice interaction affecting on the sea-ice changes and identify sensitivity of climate change prediction.

3. **Investigation of submarine resource environment and seabed methane release in the Arctic**
   - Through Araon Arctic expeditions with the Arctic countries,
   - Acquiring basic data and information on geological environment for Arctic submarine resources
   - Investigating a global issue, subsea CH₄ release in the Arctic causing abrupt global warming

4. **Circum Arctic Permafrost Environment Change Monitoring, Future Prediction and development Techniques of useful biomaterials (CAPEC)**
   - Diagnostic circum-Arctic permafrost environmental change, development of future prediction model and useful substance application technology based on permafrost observation nodes.
Theme 2: Satellite Remote Sensing for Arctic Sea Ice Observation

Purpose

- Development of satellite observation and analysis for Arctic sea ice
- Development of prototype satellite data archive/manage system for Arctic sea ice monitoring
- Development of sea-ice remote sensing data processing and analysis technique
- Development of international satellite observing network for Arctic

Images:
- 2015 Arctic (Arirang 5)
- 2016 Antarctic (Arirang 5)
Theme 3: Rapid Changes in Arctic and its impacts

Rapid Climate Changes in Arctic and its impact on Korea Peninsula

Purpose

Achieve prediction capabilities of Arctic-mid latitude climate change and weather disasters by developing state-of-art modelling tools and research skills, which are essential for the prediction of the strength and direction of Arctic polar vortex known to cause the global weather disasters (cold surges, heat waves)
Ongoing Project : Mindmap for Arctic Research Roadmap
Concluding Remarks: Balancing in SD Strategy

- Potential in future is huge, but infra and financing are key elements
  - KOPRI proposed the 2nd Korean icebreaker to fulfill growing research demand
- Diverse approaches and channels should be developed for Win-Win Strategy between the Arctic members and neighboring countries: capacity building and technology transfer
- **Balance is a virtue!**
Thanks You!