



**Final Grant Report**  
to U.S. Department of Energy  
Oakland Operations Office

**Final Narrative and Technical Report**  
**Asian Energy Security**  
**DOE Grant DE-FG03-03SF22718**

**December 1, 2003**

**This document provides our Fourth Quarter and Final Report for DOE Grant DE-FG03-03SF22718, "Asian Energy Security." The original grant period was January 31, 2003 through January 30, 2004.**

## **1. The Vancouver Energy Security Workshop**

The "Fourth East Asia Energy Futures (EAEF) Project Energy Paths Analysis/Method Training Workshop" was held in Vancouver from 4 to 7 November, 2003. This workshop was organized by the Nautilus Institute for Security and Sustainability of Berkeley, California in collaboration with the Liu Institute for Global Issues at the University of British Columbia (UBC). The full agenda of the workshop and list of participants is attached. For the first time, Mongolia participated along with Canadian energy experts. In the month just before the workshop, the DPRK delegation cancelled their trip due to the death of their head of delegation, and the inability of Canada to review and issue a visa application for a replacement.

The workshop provided one and a half days of presentations of current national and regional energy sector development and their implications for energy security, including the continuation of collaborative project activities from previous workshops. The remaining two and a half days provided "hands-on" work and training as a group with the LEAP energy/environmental analysis software tool, including training in both the basic and recently-added features of the software, and collaborative work on country data sets. This work built upon work in previous EAEF workshops held in Beijing (co-hosted by the Energy and Environmental Technology Center at Tsinghua University) and in Berkeley. Training was provided in applying the latest version of the LEAP software, as well as an opportunity to discuss important regional energy issues. Finally, a thorough discussion of follow-on workplan was conducted and is reported on below.

## **2. Summary of presentations**

### **Session I: Country Energy Sector Updates**

Dr. David von Hippel, Chair

Presentations in this session were delivered by a representative from each country attending, and were designed to update the Workshop on country specific energy sector activities. Summaries included:

- Recent changes in the energy sector.
- The latest (official or unofficial) energy outlook (brief).
- National concerns regarding energy and environmental security, and presentation of national plans (in general) to address those concerns.
- National interest in or participation in regional initiatives for sharing energy resources.
- Special topics of concern to the nation in the area of the energy sector, the environment (as it relates to energy), and energy security.

#### China

*Prof ZHANG Aling and Prof. WANG Yanjia*

*"Update on Energy Sector Activities and Plans in China"*

Dr. Wang stressed the rapid growth in Chinese energy consumption fueling growing national concerns over oil security and environmental protection. A focus on bilateral cooperation and energy information sharing must be emphasized in regional cooperation, according to Wang.

#### Japan

*Ms. Kae TAKASE*

*"Energy Update in Japan"*

Ms. Takase discussed major policy issues in Japan including energy policy law, deregulation, international pipeline and climate change. Energy policy law is leading Japan to a more nuclear-friendly country, according to Takase. If the nuclear cycle continues, 5 tons of plutonium /year will be produced in Rokkasho – the whole cycle will cost upwards of \$200 billion. Ms. Takase also noted the implications of Asian-pacific oil pipeline and northeast Asian natural gas pipeline and the difficulty in compliance with Kyoto protocol in the first phase.

#### Russian Far East

*Dr. Victor KALASHNIKOV and Dr. Alexander OGNEV*

*"Update on Energy Sector Activities and Plans in the Russian Far East"*

The Russian Far East is and will remain a large energy exporter. Production in RFE will increase rapidly in next 10 years, and as the territory contains 36% share of Russian land, but only 5% population and 4.4% GDP, consumption will increase much less rapidly. Kalashnikov reviewed RFE's recovery from the 1992 – 1998 energy crisis as well as development plans for Sakhalin 1&2 for oil and gas extraction and the construction of a 2GW Hydropower plant. Energy security objectives for RFE include: reliable and diverse supply, energy independence, acceptable prices, and mitigation of local environmental impact.

#### Republic of Korea

*Dr. KANG Jungmin, Prof. Shin Eui-soon, and Dr. CHUNG Woo-jin*

*"Update on Energy Sector Activities and Plans in the Republic of Korea"*

Kang presented a new energy vision for ROK in 2010 that showed a new energy policy emerging to include globalization and privatization, regional cooperation, sustainable development market competition. Because energy consumption is growing at a more rapid rate than economic

growth, ROK is increasingly more dependent on overseas imports, according to Kang. Kang outlined the following crucial aspects to increased energy security: diversification, stockpiling fuels, market force vs. government control and regional cooperation. Energy concerns include problems for new nuclear power entities and nuclear waste disposal.

Mongolia

*Mr. Shagdar BATRYENCHIN and Ms. Chogdon OUYNCHIMEG*

*"Energy Sector in Mongolia"*

Batryenchin stressed the importance of external assistance and regional collaboration for Mongolia and stated that the "energy sector should be developed within a regional energy context while taking advantage of new technologies, improving energy security and sources of energy that might further promote economic efficiency and environmental sustainability." Batryenchin emphasized the increasing role of renewable resources in Mongolia, including Hydropower, which has significant potential. Mongolia has approved both the "Mongolia Integrated Power System" and "Mongolia Sustainable Energy Sector Development Strategy" to implement diversity and improve energy security.

DPRK

*Dr. David Von Hippel*

*"The DPRK Energy Sector: Current status and options for the future"*

Von Hippel emphasized the degradation of electricity generation, transmission and distribution and industrial facilities in the DPRK as well as the decline in supply of crude oil from China – reducing DPRK's refinery output. Energy efficiency options were evaluated and three illustrative energy paths – recovery, continued decline, and sustainable development – were discussed. Von Hippel summarized that "providing timely assistance [with a focus on many smaller incremental projects] in a coordinated manner will enhance security in Northeast Asia and accelerate the process of DPRK rapprochement"

## **Session 2: Presentations on Special Topics Related to Regional Energy Use**

Prof. Yanjia Wang, Chair

*Mr. Kevin (Jian Jun) TU*

*"Modeling China's Energy Future with Application of CIMS"*

Tu presented his current work using Canadian Integration Modeling Systems as an example of an alternative energy modeling software application.

*Dr. Michael MARGOLICK (Vice President, Nai Kun Wind Development Inc.)*

*"Wind Energy Technology: Trends and Applications in East Asia"*

Margolick presented an overview of current wind energy technology and discussed the potential of Wind Energy in East Asia.

*Dr. Peter HAYES*

*"Recent Events on the Korean Peninsula, and Implications for Regional Energy Collaboration"*

Hayes argued that global problems exist for three primary reasons: an increase in global insecurity; a rising tide of global dislocation; and increasing global environmental change. To address these global problems from an energy security perspective, Hayes proposed that the

convened group revisit country energy paths, propose alternative pathways and collaborate regionally with an emphasis on grid, fuel sharing and nuclear waste. The value of this regional collaboration, according to Hayes is the stock of common knowledge among the conveners along with a mutual commitment to be grounded and look at policy options that are more realistic than government policy.

### **Session 3: Presentation of Existing LEAP Data Sets and Analyses**

Prof. Shin Eui-soon, Chair

Presentations by a representative from each country that has already developed a LEAP data set included the following subjects:

- A summary of the status of the LEAP modeling efforts including: current status of the data collection, collection methodology, key data sources and key data gaps, problems encountered in gathering data, concerns of the country team regarding data availability and quality, and other topics.
- Business as Usual (BAU) energy paths presentations:
- BAU path design and assumptions -- What were the central sources used? What are the overall assumptions about demographics and economics in the country in the future? Do any of the assumptions have regional implications?
- Reasonableness of BAU paths—are the assumptions made reasonable given recent trends in the country?
- “National” alternative paths and scenarios (descriptions of initial/proposed approaches, and of results as available)
- Data sources and key data gaps

#### **Republic of Korea**

*Dr. KIM Hoseok*

*"The Application of the LEAP Software Tool to Energy Sector Analysis in the Republic of Korea"*

Currently the ROK LEAP model is well equipped with key data, parameters, and BAU energy pathway modeling; alternative pathways are in the first stages of development. Energy policy challenges driving the model include: maintaining supply with economic growth, encouraging competition, reduction of oil dependence, diversification, sustainable development and pollution control. Kim will continue to use a bottom up, energy-economy model to explore pathways that include the introduction and expansion of Natural Gas Vehicles, LFG generation, fuel cell technology, expansion of household compact vehicles, structural change in the electricity sector and regional cooperation.

#### **China**

*Dr. GU Alun*

*"China Energy Future: LEAP Tool Application in China"*

China's LEAP dataset currently includes models and analysis for a BAU energy pathway and two alternative pathways: a High Priority-External pathway that introduces more natural gas, less coal and no further efforts to promote nuclear and renewable resources; and a High Priority – Internal pathway that shows biomass as increasingly important in the residential sector, nuclear as widely used in electricity generation, and the introduction of new energy techniques. The Chinese team's LEAP work is based on the focus issues of diversification, clean energy and regional cooperation. Preliminary conclusions show that, by 2040, all alternative energy

pathways modeled in LEAP lead to more diversified and cleaner energy system relative to the base year.

Russian Far East

*Dr. Victor KALASHNIKOV, Dr. Alexander OGNEV, and Mr. Ruslan GOULIDOV*

*"The Application of the LEAP Software Tool to Energy Sector Analysis in the Russian Far East: Progress Report"*

Kalashnikov reported that LEAP modeling is important to RFE because very limited long-term energy planning exists and, although energy security is an interest, it remains a strictly abstract/qualitative idea. According to Kalashnikov, quantitative analysis is important for the federal government in negotiating North East Asia regional energy cooperation. The Russian team presented BAU and an alternative pathway based on increased diversification and energy efficiency, global environmental obligations. Kalishnikov stated that problems with data collection include the lack of availability of final energy consumption statistics since 1990 with great changes having taken place in the past 10 years.

#### ***Other LEAP related presentations***

(this work presented an example of completed energy pathways work)

*Ms. Lea PRINCE*

*"Questioning Inevitability of Energy Pathways: Alternative Energy Scenario for California"*

Prince presented the completed LEAP modeling work and results of Rebecca Ghanadan – Nautilus Institute Associate as an example of the usefulness of LEAP applications. The structure and modeling results of a Business-As-Usual pathway and three alternative pathways were presented.

*Dr. David VON HIPPEL*

*"Application of LEAP in Japan: The "Power Switch" Energy Path"*

Von Hippel presented a completed study undertaken for WWF Japan as an example of LEAP application. LEAP was used to study potential reductions in emissions from a Power Switch pathway that includes a shift toward energy efficiency and low/no carbon fuels using an aggressive, but conceivable set of measures on Japan's greenhouse gas emissions. The work also evaluates quantitatively and qualitatively relative costs and benefits of a Power Switch Path. The Power Switch Study builds on results of earlier EAEF work by Japan EAEF team, as well as work done for the PARES study.

*Dr. David VON HIPPEL*

*"Regional Energy Cooperation Options: Costs and Benefits"*

Overview presentation that briefly introduces on the relative benefits and costs of regional grid connections, gas pipelines, investments in improved LNG import facilities, end use efficiency increases in gas/electricity end-uses, and other regional initiatives

*Dr. Peter HAYES*

*"Scenarios vs. Paths: What's the Difference and Why Do Them Next Time We Meet?"*

Hayes defined the difference between Energy Pathways and Scenarios in terms of Nautilus Institute research, collaboration, and workshops. The idea of using Scenarios to explore East

Asia Security and regional collaboration with the convened group and other key stakeholders in East Asia was presented for consideration at the next convening.

These papers are being distributed by listserv and will be posted on the project website as they are sent out to the network.

### **3. Follow-on Workplan**

A detailed outline of the follow-on workplan that will lead to the 2004 workshop is provided in Attachment 3.

In summary, At the Vancouver workshop, participants agreed to simulate and compare the relative desirability of regional energy cooperation strategies including: regional power grid interconnections, regional gas and/or oil pipelines, cooperation on nuclear energy and nuclear waste handling issues, and cooperation on development, financing and implementation of energy-efficiency and renewable energy technologies. Nautilus project staff will prepare initial proposals for regional cooperation themes, as well as an initial proposal for how the themes might be quantitatively modeled by the AES collaborating groups. The results of national study teams will be aggregated by Nautilus Institute and presented at the next Asian Energy Security (AES) workshop, which will most likely be held in Beijing in early 2004.

## **2. REPORT ON PROJECT DELIVERABLES**

The report on each deliverable in section 6 of the grant document is *provided in italics*.

### **6.1 Commission, edit, and distribute the following research products from national expert teams**

- ?? Baseline dataset—complete dataset for inclusion in regional dataset, to be distributed by CD-Rom at completion of the project.

*This task was completed at the 2003 EAEF Vancouver workshop; the CD-ROM was updated and re-distributed at the end of the workshop to include the latest presentations and materials brought to the workshop. A copy is provided for DOE HQ and Oakland office.*

- ?? Alternative dataset—complete first dataset for inclusion in regional dataset, to be distributed by CD-Rom at completion of the project.

*This task was completed at the 2003 EAEF Vancouver workshop for those national teams that had already collated an alternative dataset (being DPRK, PRC, Japan, California). Other national study teams will complete their tasks funded out of the next grant. This task will be completed in 2004.*

- ?? Summary national team reports on progress and issues arising from the two datasets.

*This task was completed at the 2003 EAEF Vancouver workshop.*

- ?? Synthesis report on the national and regional energy scenarios developed to frame additional policy measures to strengthen national and regional energy security strategies as a variant on the Alternative energy path.

*This task was completed at the 2003 EAEF Vancouver workshop. The presentation framed the regional cooperation strategies listed above in the narrative section for the on-going workplan.*

- 6.2 Maintain a project website, announcements of reports and activities, and publication of commissioned research papers.

*This task has been completed and the project website may be found at:*

*[http://www.nautilus.org/energy/eaef/Fourth\\_EAEF/index.html](http://www.nautilus.org/energy/eaef/Fourth_EAEF/index.html)*

*The national teams all requested that we increase the public dissemination of these results which was a major step forward from the past, national teams—especially China—were very cautious about releasing detailed energy supply and demand data contained in their datasets.*

- 6.3 Publish excerpted datasets on regional issues of common concern, likely on the power sector.

*This was discussed at the 2003 EAEF Vancouver workshop but before obtaining national study team approval, we could not publish such excerpts. We have obtained consensus that the datasets should be published in Excel. Nautilus staff will extract the datasets and will publish them between now and the next workshop in 2004.*

- 6.4 Conduct briefings in Washington and participate in briefings at DOE HQ, as to the policy options and implications of regional energy security analysis.

*Briefings were conducted in June, August and November 2003 to Department of Energy officials on the regional energy security results. There was also an additional briefing held onsite at the Nautilus Institute for DOE on August 28, 2003.*

- 6.5 Produce quarterly and annual reports to DOE on implementation of the project

*These reports were produced and accepted by DOE.*

Please contact the Nautilus Institute if you have any questions or require any further information.

**Attachment 1:**                      WORKSHOP PROGRAM:  
East Asia Energy Futures (EAEF) Project Energy Paths  
Analysis/Method Training Workshop  
4 to 7 November, 2003  
Vancouver, British Columbia, Canada  
(WORKING DRAFT: 09/30/03)

**4 November**

**Opening Remarks and Presentation of Meeting Goals and Schedule**

**Country Energy Sector Update**

**Presentations of Progress on LEAP (Long-range Energy Alternatives Planning) Data Sets**

**8:30-9:30**            *Welcome tea and breakfast (Registration)*

Opening Remarks and Presentation of Workshop Goals and Schedule

9:30-10:00        Opening Remarks by Canadian Workshop Hosts

10:00-10:10      Presentation of Workshop Goals and Schedule

**Country Energy Sector Updates**

10:10-14:30    Presentations by a representative from each country can include the following subjects:

1. Summary of recent changes in the energy sector of each country.
2. The latest (official or unofficial) energy outlook of each country (brief).
3. Summary of national concerns regarding energy and environmental security, and presentation of national plans (in general) to address those concerns.
4. Summary of national interest in or participation in regional initiatives for sharing energy resources.
5. Special topics of concern to country presenting.

*Japan*

China

Russia (Russian Far East)

**12:15-13:00 LUNCH**

Republic of Korea

*Mongolia (Tentative)*

Democratic Peoples' Republic of Korea

Canada

**14:30-14:45 BREAK**

Presentation of Existing LEAP Data Sets

14:45-16:30 Presentations by a representative from each country that has already developed a LEAP data set can include the following subjects:

1. Summary of the status of the LEAP modeling efforts including: current status of the data collection, collection methodology, key data sources and key data gaps, problems encountered in gathering data, concerns of the country team regarding data availability and quality, and other topics.
2. Business as Usual (BAU) energy paths presentations:  
BAU path design and assumptions -- What were the central sources used? What are the overall assumptions about demographics and economics in the country in the future? Do any of the assumptions have regional implications?  
Reasonableness of BAU paths—are the assumptions made reasonable given recent trends in the country?
3. “National” alternative paths (descriptions of initial/proposed approaches)

Energy Paths Discussion (Part 1):

16:30-17:30 Preliminary Discussion of Energy Paths Approaches and Options, and Integration of National Paths into Regional Framework for Evaluation of Regional Benefits and Costs of Resource Sharing

**17:30 END OF FIRST DAY**

**5 February**

Regional Energy Sharing Alternatives

Energy Paths Discussion (Part 2)

Begin LEAP Training

9:30-11:00 Overview presentation that focus on the relative benefits of regional grid connections, gas pipelines, investments in improved LNG import facilities, and end use efficiency increases in gas/electricity end-uses.

**11:00-11:15 Break**

11:15-12:45: Discussion of Energy Paths Approaches and Options, and Integration of National Paths into Regional Framework for Evaluation of Regional Benefits and Costs of Resource Sharing; Discussion of Collaborative Approach to Continuing Project

**12:45-13:30 LUNCH**

**Afternoon:** Begin Training in LEAP2003 Energy/Environment/Economic Planning and Policy Analysis Software: Lectures and Hands-on Training through Exercises

**17:30 END OF SECOND DAY**

## **Possible Evening Entertainment in Vancouver**

### **6 February**

#### **Continue LEAP Training and Applications**

**Begin 9:30 AM**

*Morning and Afternoon:* Continue training with LEAP2003 Software. Some participants will continue with Exercises, some will begin/continue work on their own data sets. Individualized assistance will be provided for all participants.

*Lunch and Breaks Scheduled as Appropriate*

**17:30            *END OF THIRD DAY***

### **7 February**

#### **Continue LEAP Training and Applications**

**Begin 9:30 AM**

*Morning: Possible Visit to Local Researchers and/or Special Software Demonstration or to Local Energy Facility*

*Continue LEAP Training and Applications*

*Lunch and Breaks Scheduled as Appropriate*

**Late Afternoon: Discussion of Next Steps in Regional Collaborative Research**

**17:00            *CLOSING AND PRESENTATION OF TRAINING CERTIFICATES***

**17:30            *END OF WORKSHOP***

## **Attachment 2: Participants**

### **China**

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### **Japan**

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### **DPRK (The DPRK delegation deeply regrets that they will not be able to attend the workshop)**

*The DPRK delegation sent their regrets that they were not able to attend the workshop.  
The individuals who were to have been included in the DPRK delegation were as follows:*

**JIN Chol,**  
Director,  
State Planning Committee of DPRK Cabinet

**Mr. KIM Song,**  
Secretary General,  
Pyongyang International Information Centre on New Technology and Economy  
(PIINTEC)

**RI Hwa Gun,**  
Senior Staff,  
DPRK Ministry of Foreign Affairs

**PAK Won Guk,**  
Head Official,  
Korean Natural Gas Research Society

**KIM Hye Song,**  
Senior Researcher,  
Non-Conventional Energy Development Centre, DPRK

### **Mongolia**

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**Attachment 3:      **Workplan for 2003-2004 Activities**  
                          **Relating to U.S. Department of Energy**  
                          **Asian Energy Security Grant**  
                          **Grant Number DE-FG52-03NA99539****

*Nautilus Institute for Security and Sustainability*

***Introduction and Background***

In the Asian Energy Security (AES) Project, Nautilus Institute works together with a network of collaborating groups from the countries of Northeast Asia to evaluate the energy security implications of different national and regional energy "paths". The goal of the Asia Energy Security project is to illuminate energy paths—and the energy policy choices that might help to bring them about—that result in a higher degree of energy security for the region and for the world as a whole, that is, to identify energy paths that are "robust" in meeting many different energy security and development objectives, while also offering flexibility in the face of uncertainty. In work to date, Nautilus has carefully assembled a network of colleagues from the countries of the region, trained them together as a group in the use of a common, flexible, and transparent energy and environmental analysis planning software tool (LEAP, the Long-range Energy Alternatives Planning system), and worked with them to prepare base-year energy sector models for each country. To date, complete data sets and models for "Business as Usual" (BAU) energy paths have been compiled for China, Japan, the Republic of Korea, and the Democratic Peoples' Republic of Korea. A partial data set and BAU path has been compiled for the Russian Far East, and a data set is being started in Mongolia, where a team of researchers has just joined the AES project. In several countries, "Alternative" energy paths have been developed as well, or partially elaborated. National energy sector developments, progress on national LEAP modeling, additional LEAP training, and planning for the next phase of the AES project were the topics of a recent (early November) workshop held in Vancouver, British Columbia. With funding from the Department of Energy, Nautilus is poised to build upon the successes of the project to date with a coordinated international effort to research the energy security ramifications of regional coordination on energy issues in Northeast Asia. The paragraphs below summarize Nautilus' plans for the AES project in the coming months.

***Continued Work on LEAP Data Sets***

Work on refining and/or elaborating LEAP data sets will continue, building upon the work already done to produce updated and complete BAU and Alternative-path models for each of the countries in the project. Funds from the project are being allocated to help to support the work of collaborating groups (of two to four individuals) in each country (except the DPRK, where the collaborating group is not expected to receive project funds except for travel to workshops). Nautilus project staff will communicate closely and regularly with collaborating groups, providing advice, suggesting data sources for inputs, reviewing data sets and analytical approaches, and reviewing and editing documents prepared by the collaborating groups.

***Development of Regional Cooperation Themes and Parameters for Modeling***

At the Vancouver workshop, several possible general themes for regional energy cooperation were offered (based in large part on previous work in the AES project and in other Nautilus projects) as possibilities for study under the next phase of the AES project. These included regional power grid interconnections, regional gas and/or oil pipelines, cooperation on nuclear energy and nuclear waste handling issues, and cooperation on development, financing and implementation of energy-efficiency and renewable energy technologies. Nautilus project staff will prepare initial proposals for regional cooperation themes, as well as initial proposal for how the themes might be quantitatively modeled by the AES collaborating groups.

***Work with Collaborating Groups on Analysis of Regional Cooperation Options***

Electronic mail and other means of communication will be used to exchange ideas and opinions (with the collaborating groups and with other key researchers) about draft cooperation proposals, and to refine those proposals into a set of parameters describes a regional Alternative path that is consistent across all of the countries of Northeast Asia. Each country collaborating group will then implement the agreed-upon parameters, using their country LEAP model to prepare a "Regional Alternative" path, the results of which will be prepared to their BAU and National Alternative paths to evaluate the impact of regional cooperation approaches on their nation's energy security. Nautilus will review and comment on the results of the results provided by the collaborating groups, and will aggregate the results on a region-wide basis for reporting to the group as a whole.

### ***Workshop Organization and Implementation***

Nautilus project staff will work with a regional co-host to organize and implement the next AES Workshop. The goal of the next workshop will be to present, discuss, and refine the draft results of the investigation into regional energy cooperation options described above. The workshop will likely be held in China (probably in Beijing or Shanghai), although holding the workshop in Korea or in Mongolia remains a possibility as of this writing. The target date for the workshop is mid-April, subject to the availability of a suitable venue, and the agreement of our co-host and collaborating groups. Each country team will be asked to prepare one or more presentations describing their updated BAU and National and Regional Alternative energy paths, and Nautilus project staff will present regionally aggregated draft results. The workshop will also offer considerable time for discussion of results, time for "hand-on" work as a group in reviewing and refining data sets and results from the LEAP analyses (as well as in the application of other energy security analysis methodologies), and time for settling on plans for dissemination of workshop results to the public and to key policymakers in each participating country. As a part of the latter discussion, Nautilus will suggest an outline for a comprehensive Final Report on the Regional Energy Paths Analysis process, as well as suggestions for other means of project results dissemination.

### ***Results Synthesis***

Following the workshop described above, it is likely that some or all of the country groups will refine their Regional Alternative and other LEAP energy paths somewhat to take into account what has been learned and decided during the workshop. The final national analyses will then be sent to Nautilus, and while working with the country groups, Nautilus project staff will evaluate the final regional results of the analysis. The regional results will be quantitatively evaluated, providing analysis on the relative impact of regional cooperation proposal on physical energy flows and consumption, on the capacity of regional and national energy infrastructure, on costs (internal and external) and on environmental emissions. Techniques such as diversification indices will be used to summarize quantitative data, and narrative analytical approaches an multi-attribute analysis will be used to evaluate the results of regional cooperation options on those facets of energy security that cannot be reasonably assessed in a purely quantitative manner.

### ***Project Reporting and Dissemination***

Nautilus project staff will prepare a draft "Regional Energy Cooperation for Energy Security in Northeast Asia" Report based on a revised version of the outline discussed in the April 2004 Workshop. It is expected that country groups will contribute substantively to the main volume and annexes of the Report by providing text, tables, graphs, and data sets to share with readers. Nautilus staff will work with a "subcommittee" of senior AES collaborators to define, prepare, and refine key summary documents, web pages, and presentations for dissemination to the general public and to policymakers in Northeast Asia and in other nations with an interest in the energy systems of the region. Nautilus staff and possibly others involved in the project may, as appropriate, present the project's findings at events in Washington DC and in the capitols of the nations of the region, as well as to other members of the national policy community and to multilateral institutions. The Report, and other documents from the project, will be submitted to the Department of Energy, and will be made available on the Nautilus Institute web site.