
**Pacific Northwest
National Laboratory**

Operated by Battelle for the
U.S. Department of Energy

Case Study: Northeast Asian Energy Cooperation Council (NAECC) - Facilitation of a Regional Energy Project

SJ Kreyling

November 2006



Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights**. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY

operated by

BATTELLE

for the

UNITED STATES DEPARTMENT OF ENERGY

under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
ph: (800) 553-6847
fax: (703) 605-6900
email: orders@ntis.fedworld.gov
online ordering: <http://www.ntis.gov/ordering.htm>



This document was printed on recycled paper.

(9/2003)

NAECC

Case Study: Northeast Asian Energy Cooperation Council (NAECC) - *facilitation of a regional energy project.*

Given the region's energy needs, the complexity of cooperative energy projects and the ongoing political issues, a regional forum to discuss project risks and advantages, and to facilitate decision-making on issues ranging from the technical to the financial, may be required. To this end, the purpose of the NAECC is to provide a neutral (non-political) third party venue: (1) to identify specific energy projects for cooperation; (2) to establish technical feasibility and related costs for these projects through a multilateral process involving national energy experts; and (3) to have the Executive Committee of the Council (made up of senior former diplomats, academics, energy specialists and professional leaders from member countries of the Council) refine the results of the technical specialists into projects that are most likely to be accepted by the governments of the countries involved.

*The following is an example of what the NAECC process might look like based on future scenarios of the power industry in Northeast Asia. **NOTE:** Highlighted boxes provide additional information to help the reader better understand the structure of the Council as the scenario develops.*

The Process Begins

The Secretariat Staff's memo on potential future projects is sitting on the NAECC Director's desk when he comes in to work. This is fortunate, because he has been thinking about the latest regional energy projections and forecasts, along with the work undertaken by the staff since the last semiannual meeting – and knows it is time to get the NAECC project review process started again. Scanning the memo, he notes that the projects fall into one of

three categories: crude oil pipelines, natural gas pipelines, and electrical grid infrastructure projects. The Director knows that it will be important to examine the viability of any regional energy project from a

The NAECC Council Secretariat and Staff might include:

- **A Director**
- **A Deputy Director**
- **1-Person public information program**
 - **manage political opposition**
 - **gather public support for projects**
- **1-2 Experienced bankers**
 - **with expertise to prepare projects with banks**
- **2 Secretarial Staff**

broad perspective – taking into account not only the technical, financial, and economic aspects of the project, but political, security, environmental, and institutional considerations – in order to find where these aspects converge and create “win-win” cooperative scenarios for the countries involved.

The Director is also keenly aware that Northeast Asia's electrical power demands have increased and the areas affected by power shortages are projected to be larger than in previous years.

Additionally, the generation capacity of many countries is not rising fast enough to meet the increase in demand. This has provoked discussion in

The Staff of the Secretariat:

- **supports the Director and Deputy Director**
- **coordinates the activities of the technical experts**
- **organizes and facilitates regional workshops**
- **convenes and facilitates meetings with the Executive Committee**
- **liaises with multinational banks and other financial institutions**

national energy policy circles that unless urgent measures and precautions are taken, it is highly likely the region will face serious electricity shortages by 2010 and economically debilitating shortages after 2020. Moreover, meeting these demands by increasing imports will create competition among states in the region for scarce and expensive resources.

To address these issues, the Staff has maintained contact over the past few months with technical experts from the countries participating in the Council, coordinated their efforts, and drafted a memo that outlines several projects on the interconnection of Northeast Asian countries' grid systems. Projects that have been identified by the Secretariat Staff as worthy of further consideration are: a "Russia-Japan" link with power transmission from the Uchursk hydroelectric power plants; a "Russia-China-South Korea" connection

from the Primorsk nuclear power plant; and a "Russia-Mongolia-China" link from the Bratsk hydroelectric plants.

Additionally, the Council staff confirms from their individual research that Northeast Asian net electricity consumption is expected to grow annually 2.6 - 4.7 % per year from 2005-2030.¹ They believe that fueling this increase in demand is the rate of growth expected in both population and GDP, with the economies of developing Asia growing faster than any other region in each category (Figures 2 & 3).

Reading further, the Director notes the Staff's financial estimate, which states that the international trade in energy is expected to grow – increasing the disparity of income between where energy is produced and where it is consumed. To cope with this mismatch, regional investment in energy infrastructure will be required. Currently, while a significant amount of investment is flowing into developing Asia (Figure 4), only 9% of total world investment flows into Russia.² Considering that Northeast Asia contains several of the world's most energy and resource-rich nations and regions (notably the Russian Far East, Mongolia, Northeast China), regional energy cooperation could facilitate the needed investment in energy infrastructure to bring resources from these areas to those in the region that need it.³

¹ Energy Information Administration, World Net Electricity Consumption by Region, Reference Case, 1990-2030, Appendix A, table A9, http://www.eia.doe.gov/oiaf/ieo/pdf/ieoreftab_9.pdf, cited November 5, 2007. The first number represents Non-OECD Russian consumption and the second represents Non-OECD Asia (China, et al.).

² IEA, *World Energy Outlook 2006*, pp. 71-77.

³ According to Na Guangcheng and Zhang Zhonghua, in a paper by Shoichi Itoh, "Sino-Russian Energy Relations: The Dilemma of Strategic Partnership and Mutual Distrust", *Russia's Shift Towards Asia*, Chapter 4, 2007 – while Russia accounted for only as much as 5% of China's total overseas investment, it accounted for a mere 0.08% of total foreign investment into China as of early 2005.'

The Director of the NAECC, having been appointed to lead this regional effort on energy cooperation, knows that his ability to remain impartial and to be regarded as objective by the countries represented on the Council, will be important to the credibility and legitimacy of both the organization and the projects the NAECC reviews. To do this, he must facilitate the review process in a transparent manner, manage the staff effectively, and advocate financially sound and economically effective regional energy projects, while proceeding with the utmost of care.

Based on these factors, the staff's analysis and his own experience, the Director gives approval to begin work on determining the viability of these projects and the Council Secretariat Staff begins to develop the project directions approved by the Director in greater detail and set up a regional workshop.

The Staff of the Council Secretariat convenes a Regional Workshop

Building on the Staff's efforts, the Director convenes a workshop that brings together the Secretariat Staff with energy policy researchers, regional studies experts, energy-efficiency experts, and power system experts to identify which of these projects, if any, warrant further review, and according to what priority. The workshop focuses on identifying the technical, economic, financial and environmental risks and benefits associated with the projects. The projects are evaluated based on the pre-existing feasibility studies and the information and analysis now available from the experts. During this process, energy and energy-efficiency experts note that, according to the

World Energy Outlook's 2006 reference scenario, over 70% of the increase in world primary energy demand between 2005 and 2030 will come from developing economies (Figure 1). Demand for coal follows a similar trend of rapid growth in the region; and while nuclear power's share of world primary energy drops during this period, the biggest increases in nuclear energy production are predicted to occur in Russia, Japan, and Korea.⁴ These observations highlight the urgency of addressing the regional electricity consumption and matching supplier countries with consumer countries.

Workshop experts also identify that the combined potential generation capacity of hydroelectric, tidal power and natural gas power generation in East Siberia and the Far East amount to 21.1 GW in 2020 – which exceeds the area's own electricity demand of 14.9 GW. At the same time, China has been facing a shortage of electricity in the past years and is expected to experience the world's most dramatic increase in power demand. In order to meet the rapid growth of electricity demand, meet mandated carbon reduction goals, and to replace plants that are to be retired, China would have to build 800 GW of new capacity by 2030. Korea, which has around 54 GW of power generation capacity as of 2000, is expected to begin to import about 10% of its minimum expected power load by 2015.⁵

Following the workshop, the Staff continues to coordinate the efforts of the workshop participants who develop detailed analyses on the projects back in their home countries.

As the analyses are brought together and synthesized by the Secretariat Staff, the

⁴ International Energy Agency (IEA), *World Energy Outlook 2006* (OECD, Paris, 2006) pp. 68-70.

⁵ International Energy Agency (IEA), *Energy Challenges in Northeast Asia and Project Proposals in 2004*, http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=992, cited 6 November 2007

financial experts on the Secretariat Staff contact potential financiers to discuss possible funding mechanisms based on discussions from the workshop.

The final project(s) documents address the economic advantages of the project to the relevant countries, as well as the technical and possible financial specifications.

From there, the energy experts from the countries participating in the NAECC process concluded that the major effects of regional interconnected grid projects would be as follows:⁶

- A regional decrease in required installed capacity of power plants due to the fact that the combined annual load maximum of consumers in an interconnected power system is less than the sum of electric power systems annual maxima at their separate operation. This difference is especially large when annual load maxima in interconnected power systems take place in different seasons of the year.⁷
- An overall decrease in fuel costs due to joint optimization of operating conditions with regionally interconnected electric power systems;
- An improvement of the interconnected grid's reliability – or a decrease in required capacity reserves with the same level of reliability.
- Positive environmental outcomes can be realized when Northeast Asian countries use large, more “environmentally clean” power plants (hydro, nuclear or tidal),

⁶ Sergi Podkovalnikov, Russian Academy of Sciences, “Power Grid Interconnection in Northeast Asia: View From East Russia”, Workshop on Power Grid Interconnection in Northeast Asia, May 2001, <http://www.nautilus.org/archives/energy/grid/abstracts/podkovalnikov.pdf>, cited 6 November 2007

⁷ In Russia, North provinces of China, Korea People Democratic Republic (KPDR) and Mongolia, the annual load maximum is in winter in the evening hours and in Japan, Republic of Korea (ROK) and South provinces of China it is in summer in daytime. Interconnecting electric power systems of these countries will bring about sufficient effect of power plants capacity saving.

which otherwise would not have been constructed (or will be constructed, but only in the very remote future).

Based on technical and economic considerations, the electric grid interconnection between Russia, China and Korea is selected by the Director as the best project for further NAECC review during the upcoming semiannual Executive Committee meeting. The main purpose of the selected grid interconnection project is the sale of power from Russia to China, with future potential to build-out and connect to both North and South Korea. A final feasibility study of the project was completed and its main conclusions were: 1) it will be beneficial to both China and Russia if, in the years 2010-2020, China purchases 2000-3000 MW from Russia; 2) ± 600 kV DC lines are recommended for interconnections, and the terminals of the proposed interconnection at both sides are respectively in Tangshan city and Irkutsk city (2500 km); 3) the investment will be around 1.1 billion USD; 4) in order to be financially feasible, the electricity price is determined to be 4.5-5 US cents/kWh.⁸

The Executive Committee Convenes to Review the Project

The NAECC Director now has the viable cooperative project he has been looking for and is ready for the final stage of the NAECC review process – using the Executive Committee’s expertise to provide a final check on the recommended energy project. To this end, the Director brings together selected technical experts, the Council Secretariat

⁸ Felix F. Wu, “Perspectives On Power Grid Interconnection In Northeast Asia”, http://www.nautilus.org/archives/energy/grid/abstracts/wu_general.pdf, cited 5 November 2007

and the Executive Committee at one time for a briefing on the Russia-China-Korea electrical grid interconnection project.

In preparation of the upcoming semiannual meeting of the NAECC, the members of the Executive Committee have been surveying the political landscape. From their vantage point, Northeast Asia has undertaken political and economic change over the past two decades, including the opening of economies once completely closed to foreign

The Executive Committee would include approximately ten politically influential representatives taken from each of the five countries represented on the Council; each would provide one to two political or civic leaders, ideally an ex-foreign minister or other such knowledgeable person.

investment. Regionally, governments have been generally receptive to creating closer economic ties as well as conducting bilateral and even multilateral cooperation in energy related issues. Despite these positive trends, the Executive Committee members have noted that the region remains characterized by insufficient mechanisms for energy cooperation as well as those to facilitate trade, technology transfers and investment.⁹ Given this environment, the Executive Committee is eager to see an energy project that the NAECC feels has the potential to act as a catalyst for peacefully furthering the region's economic and energy security relationships.

The NAECC Director opens the meeting, with participants from the Secretariat Staff and selected economic, financial, and technical experts from the countries participating in the Council, some of whom also participated in the earlier workshop. The project is outlined

⁹ Mark J. Valencia and James P. Dorian, MULTILATERAL COOPERATION IN NORTHEAST ASIA'S ENERGY SECTOR: POSSIBILITIES AND PROBLEMS, An IGCC Study Commissioned for the Northeast Asia Cooperation, Dialogue V, Energy Workshop Seoul, Korea, 11-12 September 1996

and all considerations developed by the NAECC, including possible financing, are presented and discussed. The Executive Committee listens to the briefing on the Russia-China-Korea electrical infrastructure project and asks a variety of questions to the Staff and gathered experts. During the meeting, the Committee offers their observations and thoughts on the project, based on their specific area of expertise and knowledge of the region, with the intent of ensuring that all aspects of the project have been fully considered.

The Next Step

The Director now has all the information required in order to offer an informed recommendation to the Council. Final adjustments are made following the meeting with the Executive Committee and the Director is satisfied with the outcome of the process. From here, it is now up to the Director and his Staff to forward the approved project to the member governments of the NAECC for their consideration.

Outcome

The final result of the NAECC review process is ultimately the Council's guarantee that any regional energy project sent from the NAECC to participating governments meets the strict criteria set forth in the NAECC charter.

Figure 1: World Primary Energy Demand by Region (World Energy Outlook 2006)

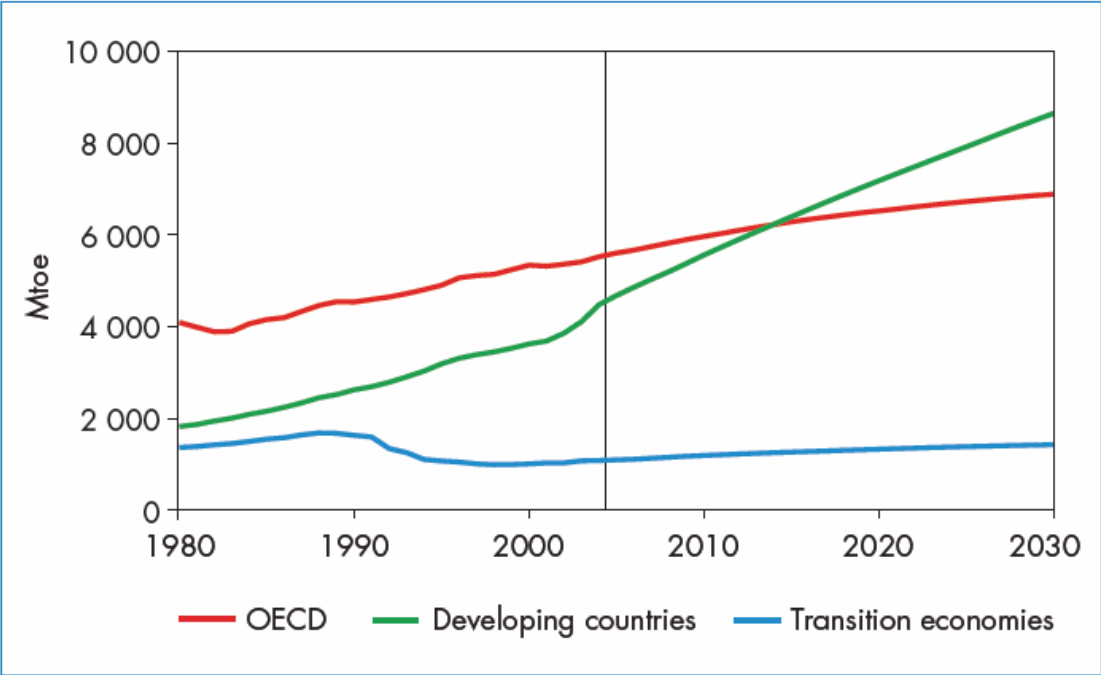


Figure 2: World population by Region (World Energy Outlook 2006)

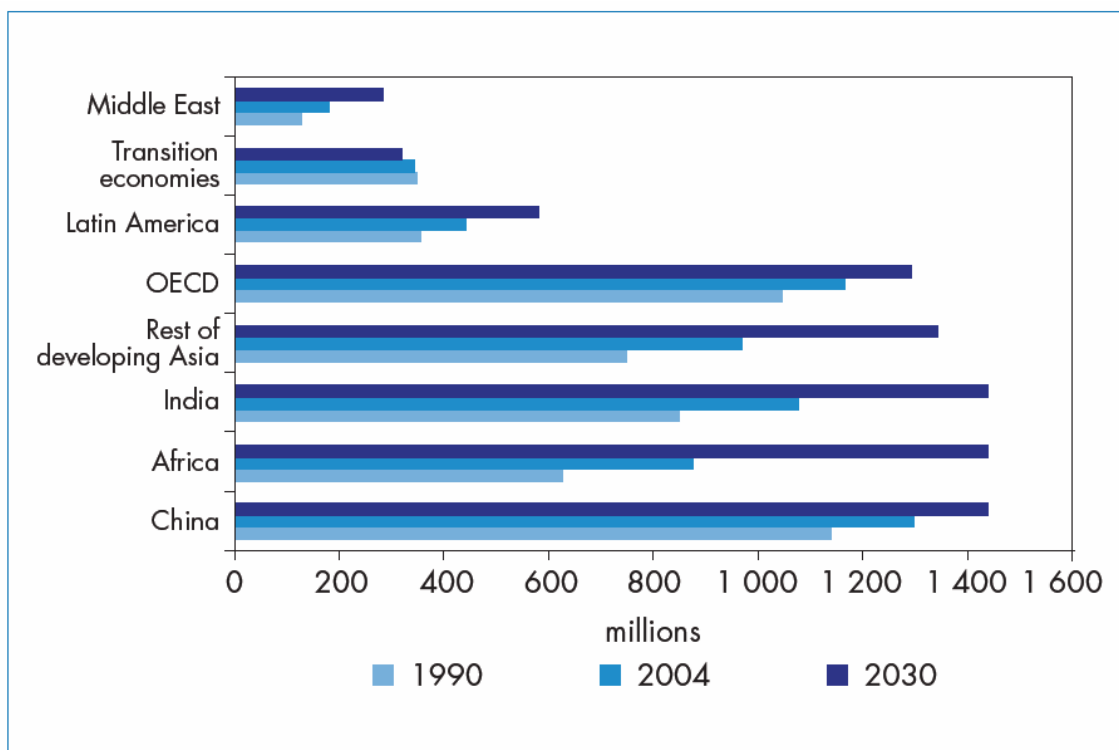


Figure 3: Growth in Real GDP Per Capita by Region (World Energy Outlook 2006)

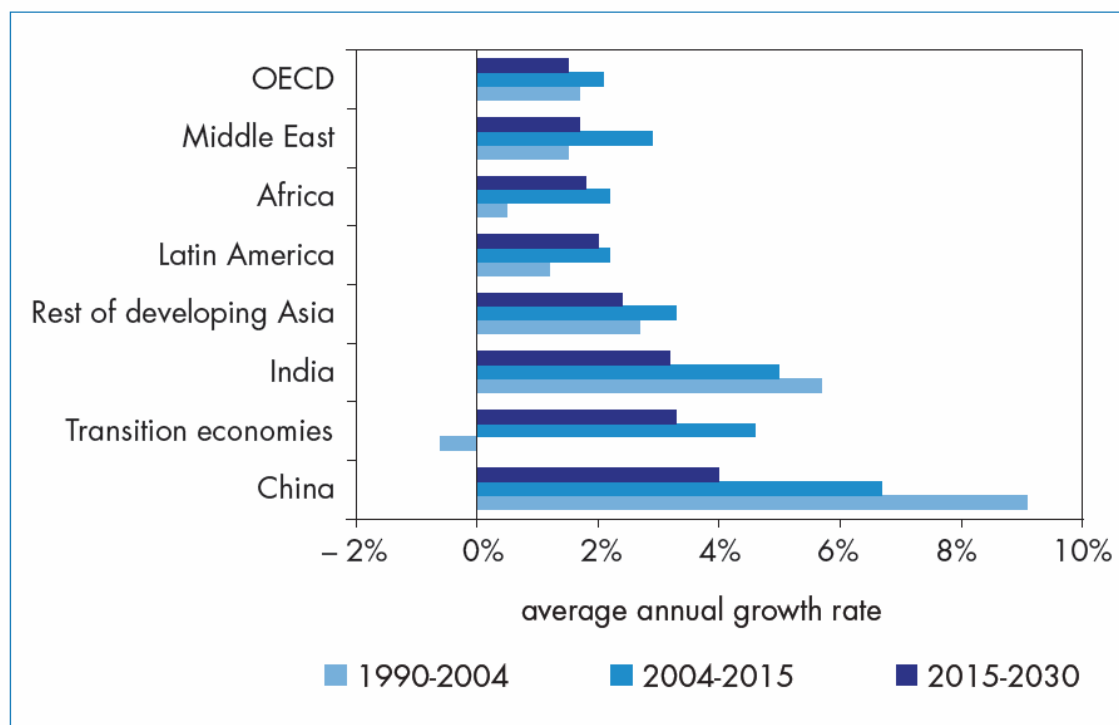


Figure 4: Cumulative Investment in Energy-Supply Infrastructure, 2005-2030 (\$ billion in year 2005 dollars)

	Coal	Oil	Gas	Power	Total
OECD	156	1 149	1 744	4 240	7 289
North America	80	856	1 189	1 979	4 104
Europe	34	246	417	1 680	2 376
Pacific	42	47	139	582	809
Transition economies	33	639	589	590	1 850
Russia	15	478	440	263	1 195
Developing countries	330	2 223	1 516	6 446	10 515
Developing Asia	298	662	457	4 847	6 264
<i>China</i>	<i>238</i>	<i>351</i>	<i>124</i>	<i>3 007</i>	<i>3 720</i>
<i>India</i>	<i>38</i>	<i>48</i>	<i>55</i>	<i>967</i>	<i>1 108</i>
<i>Indonesia</i>	<i>13</i>	<i>49</i>	<i>86</i>	<i>187</i>	<i>335</i>
Middle East	1	698	381	396	1 476
Africa	20	485	413	484	1 402
Latin America	12	378	265	719	1 374
<i>Brazil</i>	<i>1</i>	<i>138</i>	<i>48</i>	<i>252</i>	<i>439</i>
Inter-regional transport	45	256	76	–	376
World	563	4 266	3 925	11 276	20 192

Note: World total includes \$161 billion of investment in biofuels.