Final Report on 2000-2004 Research

Promoting a Northeast Asian Energy Community

Prepared by the

Northeast Asia Economic Forum, Honolulu, USA

March 2005

Northeast Asia Economic Forum
1601 East-West Road
Honolulu, Hawaii 96848, USA
Tel. 808-944-7443
Fax 808-944-7446
www.neaef.org

Contents

LIST OF FIGURES

LIST OF TABLES

Acknowledgments and Contributors

This report was prepared by the Northeast Asia Economic Forum (NEAEF), in cooperation with government bodies, research institutes from the Northeast Asian region and North America, international organizations and leading experts in energy, economics, international relations, regional cooperation, finance and investment. We thank our contributors and research participants:

Kent Calder, Director, Reischauer Center for East Asian Studies, School of Advanced International Studies, Johns Hopkins University

Steve Cowper, former Governor of Alaska and Chairman, NEAEF North American Committee

Richard Corbett, Member of the European Parliament

Rebecca Gaghen, Special Adviser to the Executive Director, OECD-IEA

Norio Ehara, Head, Non-Member Countries Division, Asia/Pacific & Latin America, OECD-IEA

Karla Fallon, Project Coordinator NEAEF and Seminar Specialist, East-West Center

Mohammad Farhandi, former Lead Energy Specialist, East Asia and Pacific Region, World Bank

Fereidun Fesharaki, Senior Fellow, East-West Center, and President, FACTS, Inc.

Vladimir Ivanov, Director of Research, Economic Research Institute for Northeast Asia (ERINA)

Robert J. Priddle, Executive Director of the International Energy Agency, 1994-2002

Longhai Shen, Senior Adviser, Development and Reform Commission, PRC

John Tichotsky, Professor, Alaska Pacific University, and Fellow, Institute of the North

Kyung-Hwan Toh, Director for Gas Industry, Ministry of Commerce and Industry and Energy, Korea

Xiaojie Xu, Chief Researcher and Consultant Beijing Osion Oil Development Consulting Co., Beijing

With special thanks to:

The Honorable Taro Nakayama, Member of the House of Representatives, Japan

Kengo Asakura, President, Ecology and Energy Co., Ltd.

Ganbold Basaanjav, former State Secretary of the Ministry of Foreign Affairs, Mongolia

Kennon Breazeale, Projects Coordinator, NEAEF

Lee-Jay Cho, Chairman, NEAEF

The Honorable Glyn Ford, Member of the European Parliament

Kazuaki Hiraishi**,** Asian Pipeline Research Society of Japan

Masaru Hirata, Secretary General, Northeast Asia Gas and Pipeline Forum

Kazuyuki Katayama, former Director, Energy Resources Division, Ministry of Foreign Affairs

Ki Joong Kim, Research Fellow, KEEI

Young-Doo Kim, General Manager, Office of Technology & Project Planning, Korea Gas Corporation (KOGAS)

Dong-In Lee**,** Managing Director, LG Caltex

Rimtaig Lee, Vice Chairman, Northeast Asia Energy Forum

Alexandre Mansourov, Associate Professor, Asia Pacific Center for Security Studies

Kohei Miwa, Energy Resources Division, Economic Affairs Bureau, Ministry of Foreign Affairs of Japan

Chang Won Park, Research Fellow, KEEI

Yasuo Sawai, Executive Vice President, National Institute for Research Advancement

Takafusa Shioya, President, NIRA

Toufiq Siddiqi, President, Global Environment and Energy in the 21st Century, Hawaii

Keizo Takewaka, Director, Economic Security Division, Ministry of Foreign Affairs of Japan

Yasuo Tanabe**,** Vice President, Research Institute of Economy, Trade and Industry, Japan

Akihiro Tonai, Economic Security Division, Economic Affairs Bureau, Ministry of Foreign Affairs of Japan

Arlon Tussing, Fellow, Institute of the North

Takashi Yamamoto, Research Fellow, NEAEF

Seung-Jick Yoo, Director, Center for Energy Research Northeast Asia, KEEI

Meng-Hyun Yoon, Senior Vice President and Overseas KEDO Project Division, KEPCO

Susumu Yoshida, Director General, ERINA

Executive Summary

In the year 2000 the Northeast Asia Economic Forum (NEAEF) initiated a study on a "Northeast Asian Energy Community." The NEAEF assembled a team of leading experts to assess the broad benefits of this Energy Community and the challenges in its creation or promotion.

The rationale for both the Northeast Asian Energy Community and for this study is based on the following:

- Northeast Asia (NEA) is considered an important *economic growth center.* The region's importance to world energy markets—as well as its share in CO_2 emissions—will continue to grow.
- Several economies must import large amounts of energy. These energy-short economies are heavily *dependent* on the Middle East for oil and are attempting to lower this dependency.
- The lack of indigenous energy supplies, the unstable political environment surrounding energy supplies from the Middle East, chokepoints and long maritime supply routes, and increased vulnerability to supply disruptions, make energy a perceived *national security* issue in the region.
- Existing patterns of energy consumption, especially widespread use of coal, and projected increases in fossil fuel use in general, create *environmental problems* within the region and globally. Most of NEA's incremental energy demand and emissions will come from China.
- Areas of Siberia and the Russian Far East have potentially commercial natural gas and oil. Additional use of oil and low-polluting natural gas promises neighboring economies of NEA an opportunity to improve security of energy supply, industrial efficiency and quality of life by diversification of fuel sources, lower electricity-generation costs, and reduction in air pollution.
- Russia also stands to benefit from the potential of development of natural gas and oil for export to foster economic recovery and growth.
- Natural gas, in particular, can play an important *geopolitical role*: The long-term political and economic relationships required for maintaining gas trade could help stabilize the NEA region.
- Because of projected increases in energy demand and diversification needs, regional cooperation and *not* competition will be the key to ensuring access to energy supplies.

The ultimate goal of the NEAEF project is to make clear the common principles and mutual benefits of regional cooperation in energy trade, namely, economic stability underpinned by secure energy supply.

NORTHEAST ASIA IN THE GLOBAL CONTEXT

NEA accounts for more than one-fifth of the world's population. The economies of NEA already account for nearly one-fifth of the world's total GNP and energy

consumption. It is expected that this region will account for one-third of the world's total energy demand in the coming three decades. NEA's thirst for energy goes far beyond petroleum. As its economy grows, the region consumes larger amounts of coal and natural gas also. Energy is the Achilles Heel of Northeast Asia. Over the medium and long term, concerns about energy security in this region are likely to push regional energy cooperative projects forward.

REGIONAL ISSUES NEED A REGIONAL APPROACH

The concept and promotion of a Northeast Asian Energy Community responds to the lack of energy cooperation in NEA compared with other initiatives around the world: among them are the North American Working Group, the EU-Russia Energy Partnership, the Euro-Mediterranean Partnership, Energy Cooperation in APEC and ASEAN+3 Energy Cooperation.

At this early stage, a Northeast Asian Energy Community is envisaged not as formal institutionalized arrangements—as this may indeed require different political relations among the countries of the region than those that presently exist—but rather as an international energy dialogue or energy partnership that can help define the essential role of government and private entities in energy policy, enhance transparency, and that, for the time being, may flourish better on a less formal basis.

REGION-SPECIFIC CHALLENGES

Dependence on Middle East energy sources. Japan and Korea both get between 70 and 80 percent of their oil from the Middle East, and China roughly 50 percent. There is a need to diversify, to shift from oil to alternate energy resources such as natural gas and renewable resources, and to look for alternate sources of energy other than the Middle East.

Vulnerability. For its energy supply delivery, Northeast Asia relies on key chokepoints and long sea lanes with increasing vulnerability to supply disruptions (piracy and terrorism).

Diversification and Russian energy sources. Diversification toward Russian oil and gas and toward a Northeast Asian electric-power grid that supplies secondary Russian energy to the region, have been widely proposed as appropriate lines of diversification. Concerns have arisen recently over what is seen as an effort to centralize control over the Russian energy sector. To the extent that energy policy is a tool of national geopolitical purpose in producer nations, consumers need to consider ways of offsetting the leverage that tight markets and concentrated state dominance in energy contract determination give to those producers.

Lack of energy infrastructure. Significant infrastructure costs at both ends of the supply and demand chain will have to be addressed to maximize the potential economic benefits of full regional energy integration.

Huge energy investment needs. According to the IEA, NEA will account for about 26% ($4,303 billion) of world total energy investment ($16 trillion) during 2001-2030 (Russia $1,050 billion, China $2,253 billion, and OECD Pacific, including Japan and Korea, $1,000 billion).

For Eastern Siberia and the Russian Far East, including funds for geological exploration and development, the projected estimated investment need is $200 billion.

Estimates for the next 10 years put China's energy investment needs at US$700–US$725 billion, about three-fourths of which would be for the power sector. Investment in the gas sub-sector is expected to be US$25–US$30 billion for the period, and the balance is equally divided between oil and coal.

The total investment needs of Korea's energy sector over the next ten years is about US$75 billion, over 85% of which will be in the power sector. Its infrastructure investment needs (energy, roads and telecommunication) is estimated to be US$155 billion for the period.

Realizing this investment will call for more rigorous sector reforms (more cost-reflective pricing and improved collection), more stable and predictable investment regimes, development of domestic financial markets (especially for electricity investment), greater transparency in energy markets and policies, more reliable statistics, and stronger incentives for private and foreign investors.

Promoting cooperation and managing competition. Concerns over competition between China and Japan over Russian resources arose during negotiations on the Pacific Pipeline route. Promoting cooperation and managing this competition, as well as competition that may arise among other parties such as China and the US, is a potential challenge.

The wisdom and importance of an oil stockpiling system for NEA is certainly recognized. However, this is being addressed effectively in the ASEAN+3 forum, with experts meeting again to discuss stockpiling issues in Hanoi in March 2005.

WHY GAS SHOULD BE A PRIORITY

Asia's economic miracle has largely been fueled by coal and petroleum. Although the Asia-Pacific region dominates the world liquefied natural gas (LNG) market, gas has been underutilized in the region relative to its potential. We argue, however, that natural gas should have a key role in Asia's future for *geopolitical, environmental, and economic reasons*.

Geopolitical Benefits

Expanding gas use will reduce oil dependency on the Middle East, and it will alleviate the pollution and carbon dioxide emissions. Furthermore, the long-term political and economic relationships required for maintaining gas trade could help to stabilize the region. Gas trade requires and creates long-term bonds between sellers and buyers. Only natural gas has this important characteristic. Once the buyers and sellers are bound into long-term relationships (15- to 20-year agreements), with involvement from a consortium of international banks, it is imperative that they avoid dangerous confrontations.

The main obstacle to increasing the use of natural gas today is the lack of sufficient terminal and pipeline systems for its transport. The development of infrastructure necessary for gas expansion will require support from the public and private sector.

Environmental Benefits

Natural gas is *the most environmentally friendly fossil fuel* in terms of pollutants and carbon dioxide emissions. Compared with other fossil fuels, natural gas produces essentially no sulfur emissions and lower levels of NOx and particulate emissions. Gas also produces 25-33 percent less CO_2 than oil, and 40-45 percent less than coal, per unit of energy produced. A switch from coal to natural gas would allow the same amount of energy consumption, but would lower emissions of CO_2.

Economic Gains

Gas is significantly more efficient than other fossil fuels (gas generates more power and does more work per unit of fuel used). Gas trade enlarges the market as a whole, resulting in economies of scale and improved efficiency. Inclusion of China is particularly important for achieving a large-scale regional market in NEA. Under the right policy conditions—such as improved pricing structure, adequate legal and regulatory frameworks, and a competitive market—the availability of a market in the consuming countries of Japan, Korea, and China will be improved.

CHALLENGES FOR PRODUCERS AND CONSUMERS

Until pipeline gas reaches South Korea and Japan in the future, LNG will continue to be the only significant and viable source of gas consumption. However, new LNG markets are emerging and China's imports will have an effect on already tightening LNG markets.

South Korea

South Korea is the second-largest LNG importer in the world. It relies on imported LNG to meet all of its natural gas requirements, and this trend will continue. Because of a larger growth rate in gas consumption, Korea has more flexibility than Japan does in deciding what route to take in filling the projected gap between demand and the guaranteed LNG imports from current contracts. Depending on the number of additional LNG contracts that are carried out in the future, the gas pipeline option, such as Irkutsk, may be economically justified between 2010 and 2020. However, if more low-cost LNG supplies become available, the need for pipelines may be further delayed.

Japan

Japan is the world's largest LNG consumer. Gas demand has weakened in recent years; therefore, the future of the Japanese economy and gas outlook are met with caution. Japan has a very limited gas transmission system and thus lacks the requisite gas infrastructure network to facilitate the growth of gas demand in other sectors. Some Japanese experts propose that natural gas imports must be further promoted through a pipeline not only for fuel diversification and to reduce oil dependence, but also for competitive pricing. The development of such a transmission network could potentially reach small gas users and have a profound impact on domestic gas consumption.

China

At the present time, natural gas has a minor share in total primary energy production and consumption in China. Coal dominates both energy production and consumption. Oil is the second largest source of primary energy consumption. China's growing dependence on imported oil since 1993 is a concern to the government. This has become an important impetus for developing, producing, and consuming more natural gas in order to diversify sources of energy supply. Since the late 1990s, the Chinese government has been making efforts to improve the country's infrastructure, and LNG imports and long-distance gas pipelines are planned.

Prospects for Natural Gas Cooperation in Northeast Asia

While the underdevelopment of natural gas and the lack of infrastructure are reasons for the underutilization of natural gas in NEA and the Asia-Pacific region at large, the same factors are also expected to contribute to future growth of natural gas consumption. In the area of both LNG and international pipelines, there are important potentials for NEA economies to have closer cooperation.

Cooperation in Natural Gas Pipelines

There is no international gas pipeline in the Northeast Asian region. The pipelines that are being planned for Northeast Asia start in Russia. The first involves a proposal for a pipeline to bring Sakhalin-1 gas to Japan. While Sakhalin-1 will be ready to export gas in the next five years, Japan may not have the necessary demand to justify the proposed pipeline until sometime after 2010. The other options out of Russia are both from Siberia: Yakutsk or Irkutsk. The Irkutsk 4,100 km pipeline is possible sometime after 2010. The Yakutsk pipeline may be feasible by 2015.

In addition to Japan, China has long been interested in Sakhalin natural gas. In fact, China believes that there is a good chance for Sakhalin gas to be imported to China before the Irkutsk gas arrives.

Many uncertainties exist for the pipelines that are not yet built. The availability of financing is an issue in getting a pipeline off the ground. Legal frameworks that can facilitate financing of such large infrastructure projects are not yet in place. Cross-border fees, which increase with the number of countries a pipeline passes through, further increase the prices paid by local consumers. Lastly, contractor fees for process engineering, field maintenance, etc. create uncertainties about the final cost of the gas.

LNG Cooperation

Despite the fact that Northeast Asia is the world's largest importer of LNG, there is no trade between the NEA economies themselves. A future development may be Russian LNG to Japan from Sakhalin-2. In the distant future, more possibilities may arise for further cooperation in the area of LNG. Russia's exports of LNG to Japan can expand further, and the LNG can also be exported to Korea and China.

In Asia, gas prices are entirely based on crude oil (not fuel oil) for LNG and partially on fuel oil for shorter-distance pipelines. In a high oil price scenario, competition will decide the preference between pipelines versus LNG. In a low oil price scenario, only existing LNG projects can continue. However, in a high oil price scenario, from $20 per barrel or more, LNG and long distance pipelines may be profitable. Indeed, the level of oil prices may be the most important factor in the development of gas trade in

Asia. The recent very high prices (in the range of $35-50 per barrer), and questions over whether these levels will persist, add another element of uncertainty.

THE INSTITUTIONAL AND POLICY ENVIRONMENT, AND THE ROLE OF GOVERNMENT

Political Context

The lack of strong political commitments by the governments of the countries involved is probably the most important contributing factor to slow progress in energy trade in NEA. This in part stems from the concern that the oil or gas supply could be used for political leverage by either supplier or consumer countries. This is indeed possible, although it is becoming increasingly impractical for countries to exercise this type of political leverage.

Trade Barriers

Large-scale energy trade is hampered by political constraints linked to governments' regional and national objectives and priorities, including the perception that greater integration is a threat to strategically important national energy entities. The differing pace of energy sector reform across countries impedes trade, and the institutional and regulatory frameworks—needed to develop and operate cross-border gas transmission networks efficiently—are not in place. There are potential conflicts between private sector interests, which are more likely to have a narrow project-by-project approach, and the broader public sector interest of optimizing energy utilization as a whole.

Institutional Context

Another impending factor is the inadequate institutional context for moving this initiative forward. Japan, China, and South Korea all have obvious interests in seeking arrangements to increase the supply of oil and gas. Russia has an incentive to gain from the sale of its large reserves in eastern Russia and in promoting economic development in the Russian Far East. Thus, potential exists for mutually advantageous energy trade. But progress has been slow because NEA has relatively underdeveloped mechanisms for inter-governmental coordination and cooperation at the regional level. Economic relations are conducted almost exclusively on a bilateral basis. This may be sufficient for general trade and investment, but not for promoting industries bound to a regional infrastructure, such as the energy trade.

Institutionalizing a Northeast Asian Energy Community

Observers of NEA commonly remark on the great diversity between the countries of the region. However, diversity of energy circumstances is no barrier to energy integration. Several such international energy communities have already been constituted. The diversity of the energy circumstances of the countries of NEA is not necessarily an obstacle to some form of association. Everything depends on the objective. Countries with very diverse backgrounds can come together if they perceive a *clear mutual interest*. Therefore, there is no reason, in principle, why the countries of Northeast Asia, despite their very different energy situations, should not form an energy community, if there are clear common principles to which they subscribe and if they perceive that clear mutual benefit can be derived from association.

Why should governments and industry bother with such efforts, and what about community and consumers? Promoting the necessary frameworks for expansion of energy trade and gas use in the Asia-Pacific community is a win-win undertaking.

Individual energy end-users win because gas is more efficient—which can mean it is cheaper—and cleaner. Business wins because it sees energy and gas in particular as a good investment: both energy exporters and importers can benefit from the increased market activity. Finally, governments can also benefit when its citizens and industries benefit. Some governments will win, owing to increased energy security (rising from reduced reliance on oil, diversified sources, and stronger functioning gas markets) and improved geopolitical relationships.

PROJECT AND RESEARCH PROPOSALS

The NEAEF proposes the following steps designed to bring the region closer to its goal of energy security, environmental sustainability, and political stability:

- Supporting a Network and Dialogue of Parliamentarians
- Analysis of Energy Strategies and Policies in Northeast Asia
- Analysis of Projects and Assessment of their Regional Context and Benefit
  In addition to the oil and gas project discussed earlier, we may also consider proposals for North Korea.
- Policy Framework Integration
- Institutional Arrangements and Policy Recommendations

COMMITMENT TO INDEPENDENT AND IMPARTIAL RESEARCH AND ACTIVITIES

The NEAEF is committed to providing independent and neutral research and policy recommendations. The NEAEF does not act on behalf of any specific country or private interest. It aims to identify projects and proposals that serve the Northeast Asian region as a whole and that help advance economic cooperation and inter-dependence among the various countries involved.

Introduction

In the year 2000 the Northeast Asia Economic Forum (NEAEF) initiated a study aimed at analyzing, refining, and promoting the concept of a "Northeast Asian Energy Community." The NEAEF assembled a team of leading energy, economy, environment, finance, governance, and international relations experts to assess the broad benefits of this Energy Community and the challenges in its creation or promotion.

The rationale for both the Northeast Asian Energy Community and for this study is based on the following:

1. Northeast Asia is considered an important *economic growth center*.
2. Several economies of the region have *limited energy resources* and must import large amounts of energy. These energy-short economies are heavily *dependent* on the Middle East for oil and gas and are attempting to lower this dependency.
3. The lack of indigenous energy supplies, the volatile political environment surrounding energy supplies from the Middle East, and the long maritime supply routes, make energy a perceived *national security* issue in the region.
4. Economic growth in Northeast is highly energy intensive in China and is becoming highly electricity-intensive in Japan and South Korea.
5. Existing patterns of energy consumption, especially widespread use of coal, and projected increases in fossil fuel use in general, create *environmental problems* within the region and globally.
6. Areas of the Russian Far East and Siberia have resources of potentially commercial natural gas and oil. Additional use of low-polluting natural gas promises neighboring economies of Northeast Asia an opportunity to improve security of energy supply, industrial efficiency and quality of life by diversification of fuel sources, lower electricity-generation costs, and reduction in air pollution.
7. These benefits have a counterpart in the potential of development of natural gas and oil for export to foster economic recovery and growth in economically depressed regions of eastern Russia.
8. Natural gas, in particular, can play an important *geopolitical role*: Gas trade creates long-term bonds between sellers and buyers. The long-term political and economic relationships required for maintaining gas trade could help stabilize the Northeast Asian region.
9. Projected increases in energy demand and diversification needs may become the catalyst for competition over resources or, alternatively, cooperation.
10. The ultimate goal is to "lift the strategic sights" of governments and the public above strictly national policies by clarifying the benefits of regional cooperation in energy.

At this early stage, a Northeast Asian Energy Community is envisaged not as formal institutionalized arrangements—which may indeed require different political relations among the countries of the region than those that presently exist—but rather as an international energy dialogue or energy partnership that can help define the essential role of government and private entities in energy policy and that, for the time being, may flourish better on a less formal basis.

From 2000 to 2005, research was conducted on five target areas: (1) analysis of changing global energy markets and implications for Northeast Asia, (2) analysis of energy markets (oil and natural gas) in Northeast Asia, with an initial focus on Russian energy strategies and policy, (3) analysis of challenges to producers and consumers in production and distribution of natural gas, (4) analysis of the investment environment in Northeast Asia and (5) analysis of the institutional and policy environment. Herein we provide a summary of research results for this period.

In addition, an important element of this project has been an open dialogue with policymakers from Northeast Asia, North America, and Europe. This is so because the NEAEF recognizes the critical role policymakers and government play in ensuring that political complications do not overwhelm the shared interest that the nations involved have in the viability of specific energy projects and in an Energy Community.

This emphasis on policymaker dialogue is evident in the final section of this report which outlines proposals and steps designed to bring the region closer to its goal of energy security, environmental sustainability, and political stability.

Chapter 1

Changing Global Energy Markets and Implications for Northeast Asia

Supplying energy to Northeast Asia is a high-stakes issue—both for this dynamic region and for the broader world. Japan, Korea, and China all have, in varying ways, a radical dependence on imported energy that becomes ever more painful as their growth proceeds and prices rise. For the global political economy, the energy demand of these three countries is a crucial driver, both for energy prices and ultimately for world economic growth as well. Indeed, China alone accounted for a full 40 percent of the increase in world demand for oil during 2003, contributing to the sharp rises in oil prices of the past year.

Energy, as is often remarked, is the Achilles Heel of Northeast Asia. Japan, Korea, and Taiwan—which together produce over a sixth of global GDP—have not a single major oil or gas field among them. Mainland China has oil and hydro-electric capacity, but it is located largely in the North and the West of the country, while energy demand is largely in the South and East. And energy infrastructure—power-transmission lines, railways, pipelines, and electric-power generation equipment—remains inadequate and under-developed, in that growing nation.

As Northeast Asia grows, its demand for oil, in particular, soars much faster, fueled by the consumer revolution sweeping the region. Over a million cars annually are sold now in the nations of ASEAN, and roughly that number in China—over double the levels of just five years ago. Consumer appliances, including air conditioners, further contribute to rising demand. Petrochemical industries, and the related use of plastics and fertilizers, are also surging region-wide, spawning further demand for oil.

Northeast Asia's thirst for energy goes far beyond petroleum. As its economy grows, the region consumes ever larger amounts of coal and natural gas also. The result could lead to a deepening energy crisis in a region representing a fifth of the global economy, and a larger share of its energy demand.

From the global perspective, Northeast Asia is also looming increasingly large. Its share of global primary energy demand, which was less than 17 percent in 2000, is expected to rise over 21 percent by 2030. Its growth in oil demand over the past twenty years has been more than four times the global average, while its natural gas demand growth has been more than five times as fast. In some areas, such as liquefied natural gas (LNG), Northeast Asia's market has become overwhelmingly important, with a full two-thirds of global LNG supply currently flowing to the region. However, Asia's dominance in LNG markets is declining, raising new challenges for the region.

The distinctive Middle East–Northeast Asian linkages also make Northeast Asia's energy picture globally important from a geopolitical perspective. Japan and Korea both get between 70 and 80 percent of their oil from the Middle East, and China roughly 50 percent. The United States, by contrast, gets only 23 percent of its oil from that volatile region, and Europe even less. Conversely, the Middle East ships half of

all its energy exports to Northeast Asia, and this share is likely to rise in coming decades. There is a deepening "Middle East–Northeast Asia axis" in global energy markets that has profound, but as yet unappreciated, importance for global affairs of the twenty-first century.

Two transcendent realities need to be considered in thinking systematically about Northeast Asia's energy future. Most importantly, that economically and geopolitically crucial region is a part of a larger global system, albeit an increasingly substantial part of that whole. Secondly, Northeast Asian energy problems have some highly distinctive aspects, justifying region-specific analysis and policy solutions.

That Northeast Asia is just a component in a global integrated political-economic system is a commonplace view. Yet it is nevertheless an important point easily lost in regionalist dialogues. The logic of intra-regional energy dialogue, for example, must come to terms with the reality that two-thirds of global proven oil reserves are in the Middle East, with marginal production costs far lower than in Northeast Asia. Middle Eastern shares of global gas reserves are lower, but still substantial.

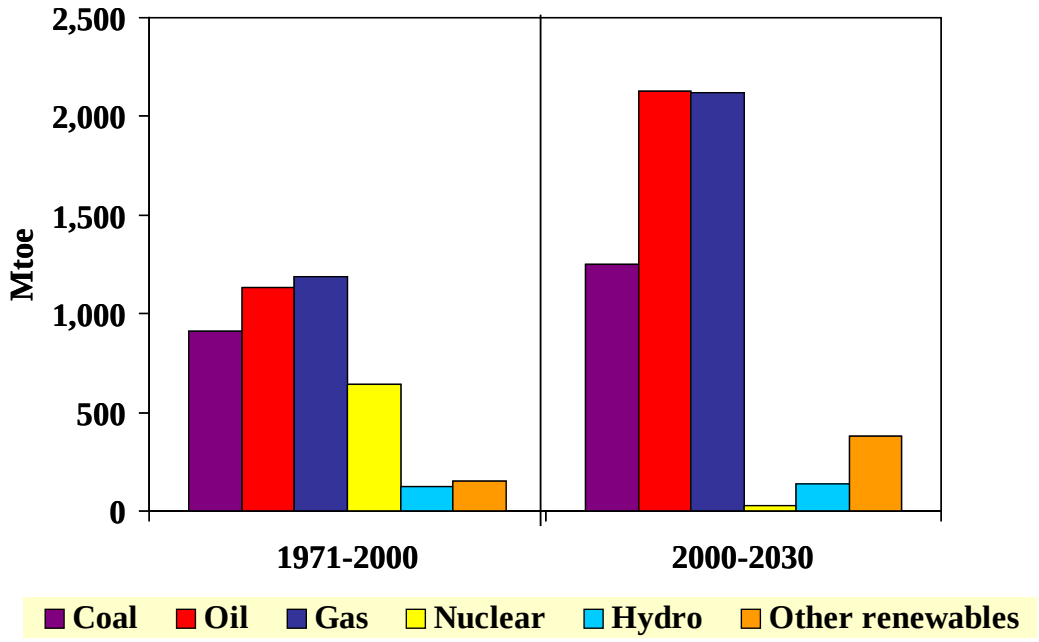


Figure 1. Increase in world primary energy demand by fuel, 1971-2030
Source: IEA

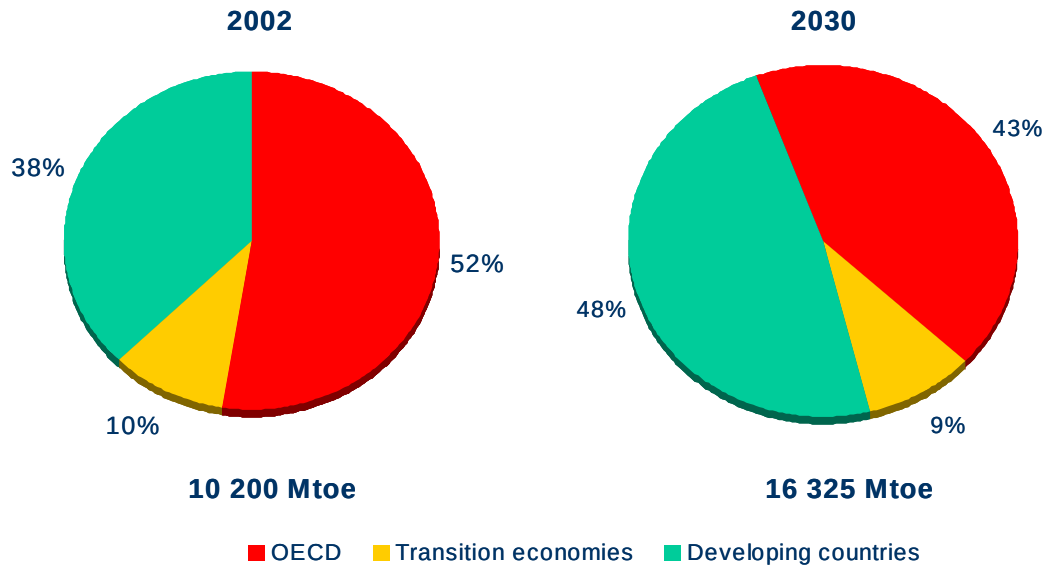


Figure 2. Regional shares in world energy demand, 2002 and 2030
Source: IEA

These realities certainly do not obviate the potential need for intra-regional projects within Northeast Asia. Ongoing political uncertainties in the Middle East, increasing reliance on key chokepoints and the dangers of piracy and terrorism across the long sea-lanes from the Persian Gulf, of course greatly enhance the logic of Northeast Asian energy projects. Yet the globally competitive cost position of the Middle East, and the prospect of a stable resolution to its political troubles (as well as the possibility of increased volatility), need to be factored into debate on the ultimate feasibility of Northeast Asian regional projects also.

Energy security and geopolitics also need to be realistically factored into the regional equation. What configuration of supply provides optimal assurance to consumers that they will receive energy at reasonable prices, in environmentally acceptable forms, as far as possible into the future? Undue reliance on single suppliers, or a small number of suppliers, in rigid, institutionalized form, can clearly have undesirable aspects, especially in the event that suppliers decide to use energy supply, and terms of supply, as a strategic weapon. This happened during the 1970s in oil, of course, when tight markets provided market power to the OPEC cartel. The possibility that it could happen in natural gas, if consumers were tied too rigidly to individual suppliers, deserves further consideration. And the potential dangers are substantial for East Asia, given its heavy overall dependence on imported energy.

Japan, Korea, and to a lesser degree China are all heavily dependent on Middle Eastern oil. Market forces have driven this dependence, and must be considered in reducing it. Yet there clearly is a powerful energy-security argument for *diversification*.

Table 1. Increasing dependence on the Middle East for oil (share of imports in %)

Import Origin	Korea	Japan	China	W. Europe	NAFTA
Middle East	69.9	73.3	34.9	16.1	18.6
Africa	5.0	3.2	15.6	15.6	13.2
Asia-Pacific	21.6	13.3	25.9	0.2	2.2
Others	3.5	10.2	23.5	68.9	65.9

China factor: Rapidly growing demand for energy.
Contributes to recent hikes in oil prices.
Heavy dependence on coal (62%) has serious environmental impact.

Source: KEEI

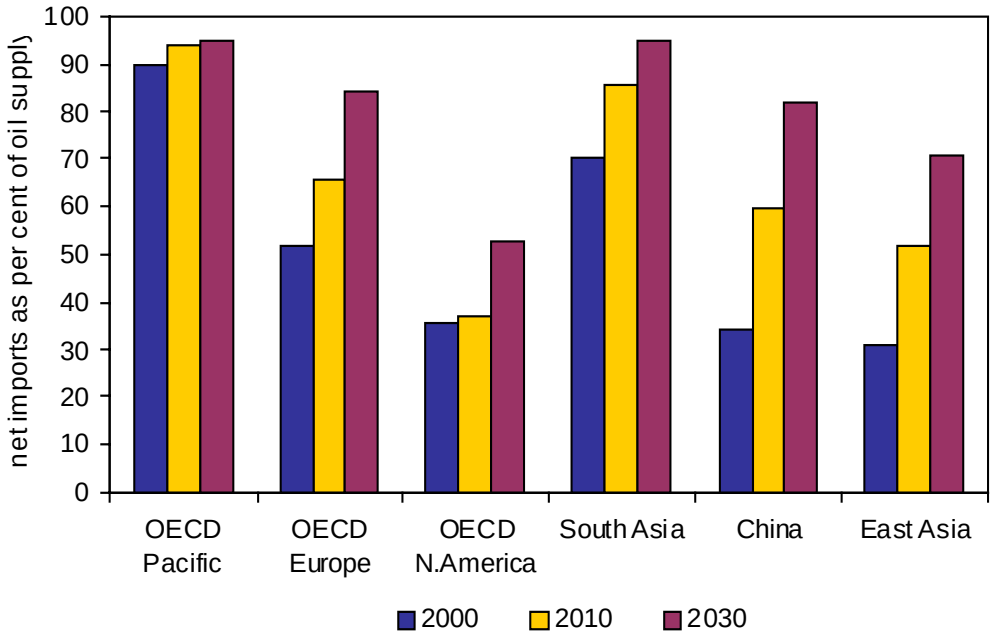
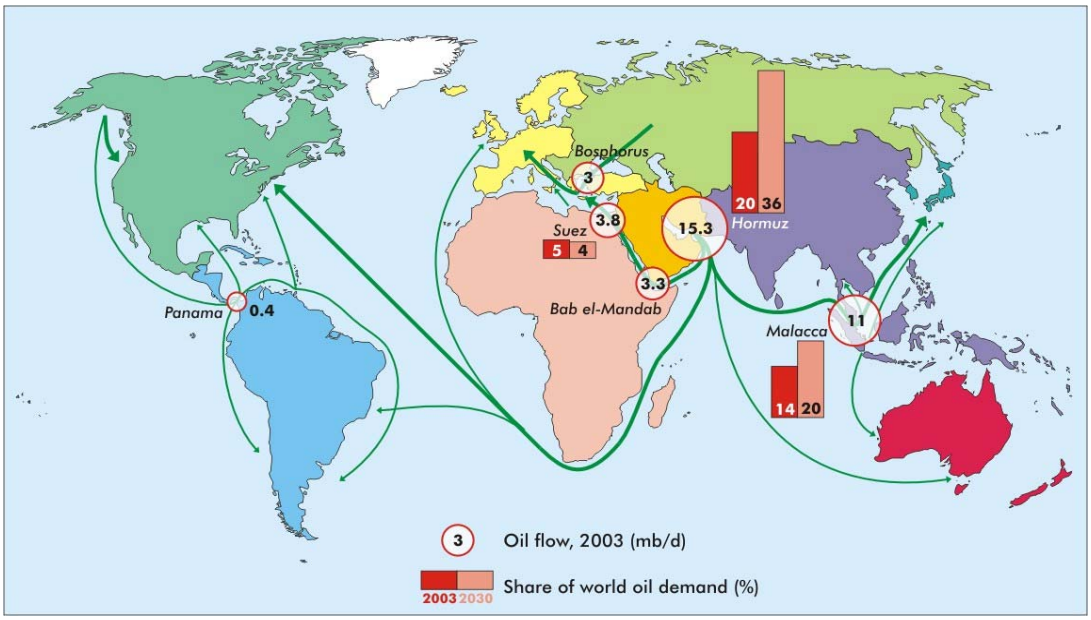
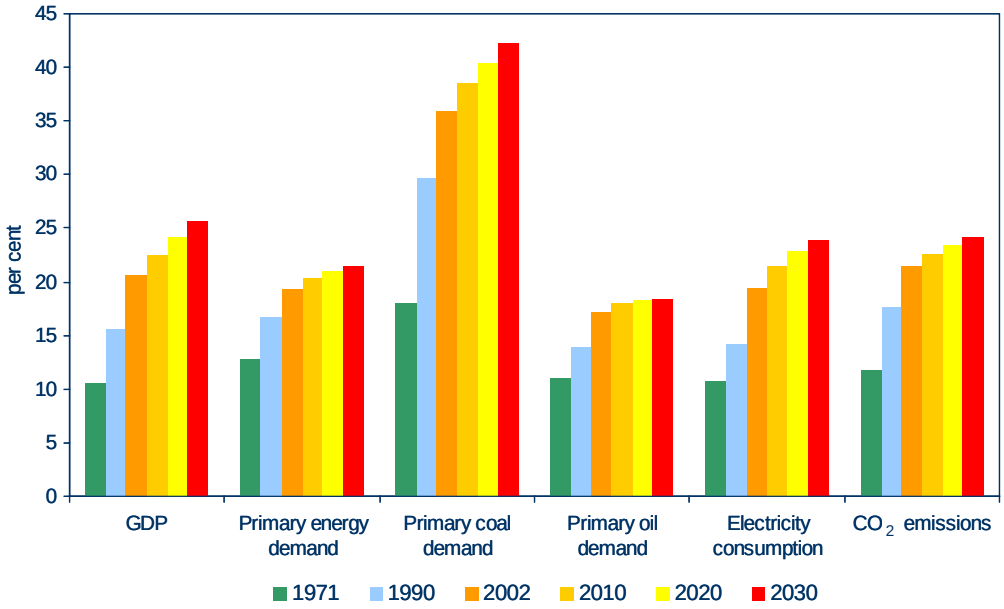


Figure 3. Oil import dependence by region, 2000-2030
Source: IEA



The risk of supply disruption will grow as trade and flows through key maritime and pipeline chokepoints expand

Figure 4. Longer transport routes increase vulnerability
Source: IEA



The importance on Asian consumers on world energy markets will continue to grow

Figure 5. Shares of China, Japan, and Korea in the global economy and energy markets, 1971-2030
Source: IEA

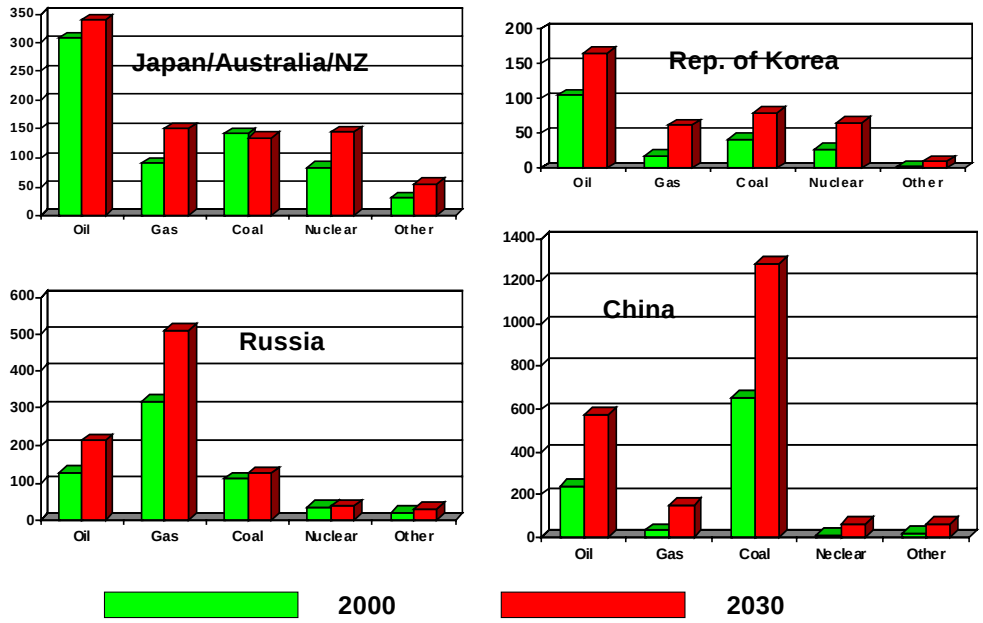
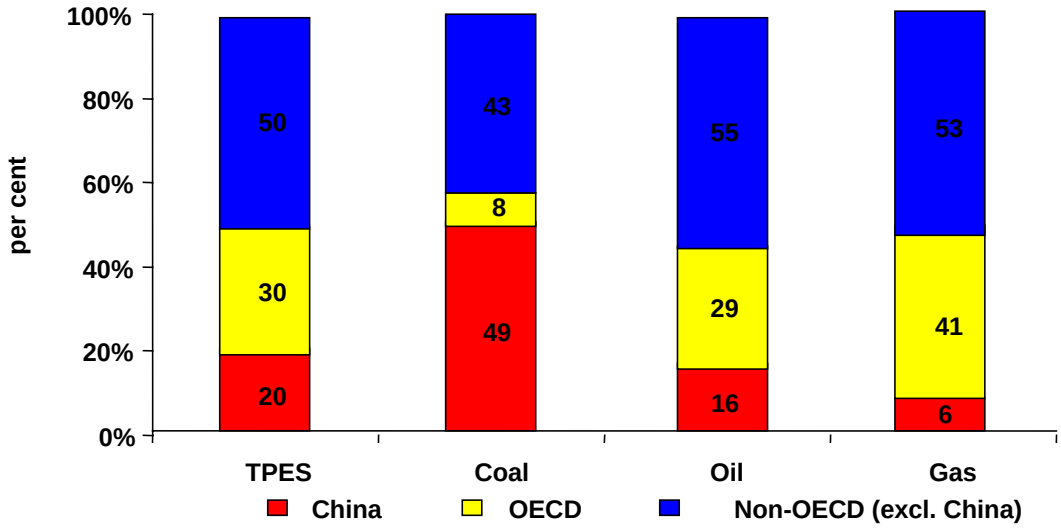


Figure 6. Total primary energy supply in Northeast Asia, 2000 and 2030 (Mtoe)
Source: IEA



China is second largest energy consumer
China will account for 20% of world incremental energy demand
and for half of increase in coal use over the next three decades

Figure 7. Shares of China, OECD, and rest-of-the-world in incremental energy demand (total primary energy supply, coal, oil and gas), 2000-2030
Source: IEA

Two appropriate lines of diversification have been widely proposed: toward Russian gas, and toward a Northeast Asian electric-power grid that supplies secondary Russian energy to the region. Recent agreements to supply Russian energy to the Pacific,

including Japan, China, and the U.S. West Coast, also seem far-sighted and stabilizing from a geopolitical perspective. Russian government and industry are placing greater emphasis on Northeast Asia and the Asia-Pacific region since the articulation of the Energy Strategy of the Russian Federation in 2001 and 2003. Deeper mutual interdependence between Russian and its Pacific neighbors is certainly to be applauded, as long as it emerges within the context of broad, diversified sources of supply for the consumers involved.

Diversified supply sources seem more important today geopolitically than five years ago, for two fundamental reasons. First, markets are tighter than they have been, giving rise to questions about whether or not high intra-regional growth in Northeast Asia can be sustained. Secondly, there appear to have been changes in government-business relations and in the relationship of energy to national strategy within Russia. To the extent that energy policy is a tool of national geopolitical purpose in producer nations, consumers logically need to consider ways of offsetting the leverage that tight markets and concentrated state dominance in energy contract determination give to those producers.

The concrete implication of tight markets and more centralized Russian energy policy making is not to depreciate the importance of Russia-related oil, gas, and electricity projects. Their logic remains strong. It is, however, increasingly important to appreciate the value of broad multinational projects–of which those now under way in Sakhalin are an example–involving major Japanese, United States, and European firms. Their involvement broadens potential product markets, and increases leverage for all consumers in Northeast Asia and elsewhere. Energy and, more generally, development plans may well be easier to realize, and substantially more congruent with the real interests of consumers in the region, if they take a sophisticated view of the political-economic equations outside Northeast Asia, as well as within it.

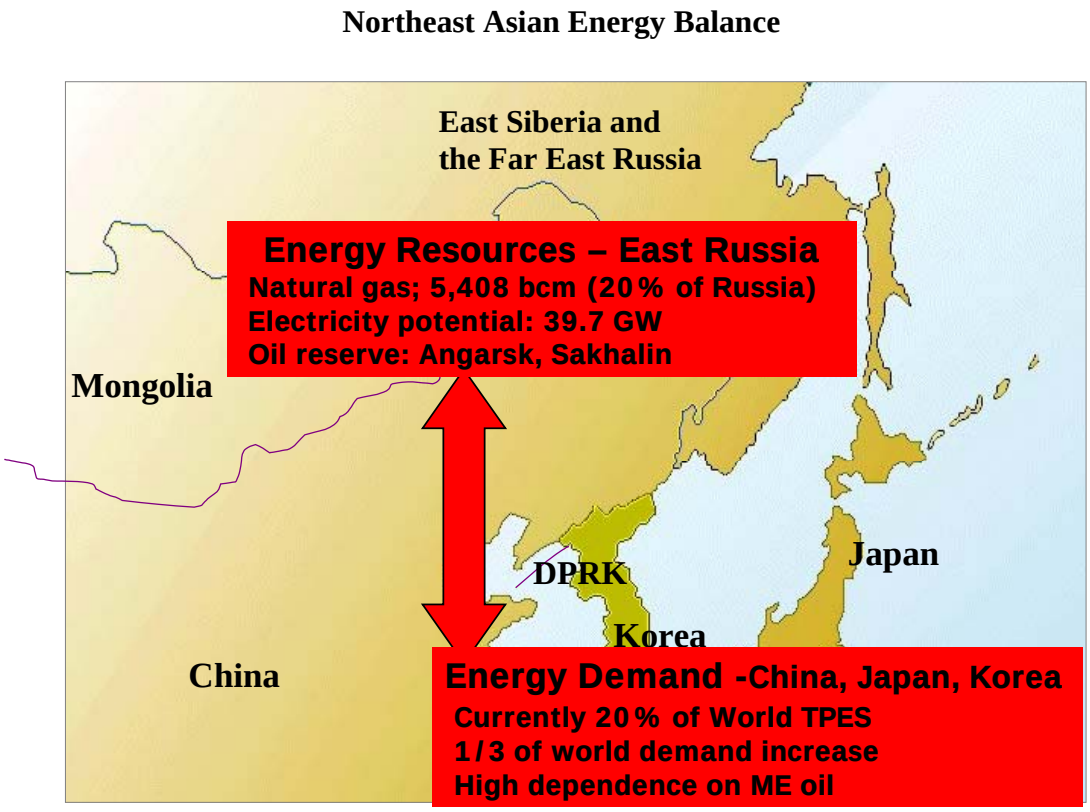


Figure 8. Northeast Asian energy balance
Source: IEA

Chapter 2

Russian Energy Strategy and Policy, and Implications for Northeast Asian Energy Cooperation

In Russia, the oil and natural gas projects in Eastern Siberia and the Russian Far East projects are widely seen as instruments for developing the eastern provinces of the country and integrating Russia with the economies of Northeast Asia. In 2004 attention centered on the Taishet-Nakhodka oil pipeline project (the Pacific Pipeline) in the context of dialogue with Japan and plans for energy cooperation between Russia and China, including oil-by-rail shipments, as well as the ongoing energy dialogues with Europe and the United States.

On January 14, 2005, Victor Khristenko, Russia's Minister of Industry and Energy, met with Nobutaki Machimura, Japan's Minister for Foreign Affairs, to discuss prospects for energy cooperation, including the Pacific Pipeline project and the participation of Japanese companies in the exploration and development of oil fields in Eastern Siberia. During the meeting, the Japanese foreign minister reconfirmed Japan's interest in participating. Khristenko, however, emphasized that the pipeline should be purely commercial project, and thus should be funded without tied loans or state guarantees.

During his visit to China in late August 2004, Khristenko formally revealed that a pipeline to the Pacific coast is the priority for Russia. He also mentioned that Russia intends to discuss the financing options with the governments of Japan and China and did not rule out the involvement of the Russian government in the implementation of this mega-project. When construction begins, Russia wishes to clarify China's position on a branch pipeline to Daqing, as well as the prospects for its participation in the project as a whole.[1]

In addition, during the 2004 September Russia-ROK Summit in Moscow, the two sides agreed to cooperate in oil and natural gas resource development in Eastern Russia and work out an agreement on long-term natural gas cooperation, similar to the concept adopted by Russia and Germany. Then there were discussions with KOGAS with regard to purchasing a stake of about 20% in Sakhalin Energy, providing at the same time a market for LNG. And in January 2005, Alexei Miller, the head of Gazprom, quietly visited North Korea. A company statement indicated that cooperation in the oil and gas sectors was discussed with Premier Pak Pong-ju.

EU-Russia energy dialogue is also evolving along the following lines: (1) long-term gas contracts and no numerical import restrictions, (2) contract confirmation with regard to nuclear fuel for new EU members, (3) electricity market integration, (4) a joint study of strategic oil stockpiling, (5) investment promotion and long-term financing mechanisms, and (6) infrastructure development and technology cooperation.

1. If a branch pipeline to Daqing is approved, the border crossing will be moved much farther eastward (Skovorodino), compared with the route proposed by Yukos and CNPC.

The oil and natural gas business with Europe is complex because of Russia's almost complete dependence on the European markets. In the 1990s, Russia lost a considerable share of the European oil and gas market and now wants to get this share back. Russia is ready to compete with OPEC for a greater share, as well as for new investment.

It is also interesting to note that, within its dialogue with the EU, Russia is discussing the prospects for a strategic oil stockpiling mechanism that would help stabilize oil prices when they are excessively high; when the market is saturated, oil could be stockpiled. In other words, stability may be more important to Russian oil producers than high oil prices.

On the other hand, the export dependence on Europe affects the export price of Russian oil. One option for reducing this dependence is the northern pipeline, which could be built to the Baring Sea coast, thereby helping Russia to gain access to the American market as well. The expectation is that this could also somehow influence the price of Russian oil on the European market, which is currently the sole direction of exports.

INVESTMENT PLANS

Recent events in Russia demonstrate that the state wants greater control and a larger share in the energy business. Despite the Yukos affair and the auction of Yuganskneftegaz, there are indications that Russia is willing to cooperate and that Western oil and gas companies are still interested. Several Western oil and gas firms have recently signed new deals in Russia or plan to expand existing ones.

For instance, the French company Total intends to obtain a 25% share in Russian gas producer Novotech, which currently produces about 20 billion cubic meters of natural gas annually and is the largest independent natural gas producer in Russia. The total reserves of Novotech are significant: about 1.5 trillion cubic meters of natural gas.

BP paid nearly $7 billion for half of the TNK oil and gas production venture. BP-TNK is now the largest, and BP's corporate revenue rose by 20% in the first quarter of 2004, while its global oil production increased by 18%. Some believe that this is a direct result of the TNK-BP merger.[2]

ConocoPhillips invested $2 billion for the state's 7.59% stake in LUKoil (a sale sanctioned by President Putin). Based on reserves, LUKoil is the world's second largest oil firm. The two companies have also agreed to set up an estimated $1.5 billion joint venture in Russia's northern oil region of Timan-Pechora, in which ConocoPhillips will take up a 30% stake.

An important political issue associated with the ConocoPhillips-LUKoil alliance is related to LUKoil's significant share in the West Qurna oil field in Iraq. Questions were raised about this, but now, with the participation of ConocoPhillips, it looks like

2. Under the TNK-BP agreement, TNK came up with 96% of its equity capital, while Onaco provided 99%, Sidanco 82%, and Slavneft 50%.

LUKoil will be able to expand its business. After the BP-TNK tie-up last year, the ConocoPhillips deal was the largest single foreign investment project in Russia.

In addition, the ChevronTexaco CEO has proposed that the company invest $5-10 billion in new projects in Russia.

Not all Western companies have met with success. In 1993 ExxonMobil won the rights to develop Sakhalin-3 oil fields. However in 2004 the Russian government revoked the tender and has indicated it plans to auction the rights again. If the auction does proceed, ExxonMobil believes Russia will be sending a negative signal to foreign investors. This would be in addition to concerns regarding Russia's recent investment cap (only firms with at least 51% Russian ownership will be permitted to bid on energy projects).

In the domestic arena, Gazprom-Rosneft will likely become a powerful player in the oil business as well. By 2010, the company is expected to produce about 30-40 Mt of oil and gas condensate annually in the Caspian project (in partnership with LUKoil) and the Prirazlomnoye field (with Rosneft).

Gazprom will be a very significant player in almost all the Sakhalin energy projects, not only in Sakhalin I, given that it is due to inherit Rosneft's share. Moreover, Gazprom could also be the operator of the Sakhalin V project in partnership with TNK-BP, as well as Sakhalin IV. The natural gas reserves of these three projects are well in excess of 1 trillion cubic meters.

Gazprom is also committed to gas projects in Eastern Siberia (Kovykta) and the Far Eastern region (Chayanda). According to Russian sources, the consumption of natural gas this year jumped to the level projected for 2020, owing mainly to its relatively low price. Consequently, Gazprom wants higher prices and faster growth in domestic gas tariffs, in order to ensure more investment in new projects.

Gazprom does not like the idea of allowing other companies to enter the pipeline business in Russia. On the other hand, it wants to expand its business through LNG. Consequently, Gazprom has been consulting PetroCanada about constructing a liquefaction plant somewhere near St. Petersburg, spending approximately $1.5 billion and exporting LNG to North America via PetroCanada channels. It has also been involved in close consultations with ChevronTexaco and Statoil.

ChevronTexaco appears interested in forming a strategic alliance with Gazprom. The two companies have signed a memorandum of understanding announcing a six-month feasibility study concerning joint oil and natural gas projects in Russia and the United States. ChevronTexaco has also said that the development of a global integrated natural gas business is the cornerstone of its growth strategy, and Gazprom could be a useful partner in promoting this strategy. As far as Gazprom is concerned, access to the American gas market is strategically important, and Gazprom wants to bring advanced LNG production and transportation technologies to Russia.

The long-term plan is to export 10-15 billion cubic meters of LNG to the United States. In Asia, through the potential acquisition of some assets, as proposed by Royal Dutch Shell, Gazprom could gain a share in the Sakhalin II project and become an

actor in Asian LNG markets. As for Sakhalin I, a possible partnership with ExxonMobil could lead, at some stage, to a pipeline to China—or Japan.

BP-TNK controls 62% of Rusia Petroleum, the license-holder for the Kovykta gas and condensate field. Here, things are developing with the involvement of Gazprom, but many elements of the discussions remain obscure. Gazprom not only wants a share in the Kovyktinskoye gas field, but is also prepared to be the operator and the designer of the infrastructure. In short, Gazprom wants almost exclusive control over this field; this is not welcome news to BP-TNK.

On a more positive note, ExxonMobil plans to invest almost $2 billion in the Sakhalin I project and has recently discussed with Gazprom the prospects for integrating Sakhalin gas reserves with the nationwide natural gas pipeline system to be extended to Eastern Russia (including Khabarovskiy and Primorskiy territories). In addition, the prospects for exporting natural gas to regional markets in Northeast Asia were discussed. Some believe that China was the focus of discussions because Northeast China is an alternative market to Japan for the natural gas output of Sakhalin I, with a pipeline going through Khabarovsk, Vladivostok and then on to Harbin.

Russia's investment climate may improve when the law on subsoil use is adopted in 2005. The law covers three main areas: (1) single-stage bidding for exploration *and* production rights, (2) distribution of all licenses on the basis of open auctions, and (3) shifting dispute-settlement procedures from the current mix of courts and government officials to courts only.

The government itself wants at least four critical results from the new law on sub-soil use: (1) expanded investment in exploration (without exploration, Russia's plans to be the major exporter of natural gas and oil will be called into question), (2) rational resource utilization, probably providing considerable tax benefits to companies working with reserves that are difficult to extract, so that all companies are on a more-or-less even footing, (3) greater control over licenses (currently, in the eyes of the government, too many licenses are issued to users), and (4) increased revenue. The government wants to increase its revenue, but ultimately one of the main purposes of this new law is to strengthen federal control over Russia's regions.

THE PACIFIC PIPELINE

Following a Transneft proposal, the Pacific Pipeline project was revised and its target capacity was raised to 80 Mt from the 50 Mt proposed in the *2020 Energy Strategy*. The project's total cost also increased to US$15 billion.[3] As of early 2005, pipeline plans see it start at Taishet and terminate at Perevoznaya Bay. The new terminus in Perevoznaya Bay rather than Vostochny, a main industrial port next to Nakhodka, has given rise to opposition due to environmental concerns. See Addendum on Russian Government Directive No. 1737-p for further project details and plans.

3. The length of the Taishet-Kazachinskoe-Skovorodino-Perevoznaya Bay pipeline is 4,130 km; pipes with a diameter of 1,220 mm will be used. The pipeline route will cross seven administrative entities: Irkutskaya, Chitinskaya and Amurskaya oblasts, the Republic of Buriatiya, the Evreiskaya Autonomous Oblast, and Khabarovskiy and Primorskiy krais.

Until early 2004, there was little clarity on whether the oil reserves already discovered in Eastern Siberia would be able to supply sufficient crude oil to fill the system. This uncertainty caused speculation and intense debate centered on the alleged competition between the Pacific route and a route to China. A more detailed picture regarding reserves began to emerge in February 2004.

According to Transneft, Tomskaya Oblast and the Khanty-Mansiyskiy Autonomous District in Western Siberia, as well as the oil provinces of Eastern Siberia, have been designated as the resource base for the new oil pipeline system. The largest hydrocarbon provinces are Leno-Tungusskaya and Khatango-Viliuyskaya. Ninety-two oil fields have been developed in Tomskaya Oblast, with a further 19 awaiting development. In Khanty-Mansiyskiy district there are 26 explored fields. The majority of explored resources are located in Irkutskaya Oblast and Evenkiya in Krasnoyarskiy Krai and in Yakutia. The supply of crude oil for the Pacific Pipeline may reach 56 Mt a year, excluding domestic consumption. The remaining 24 Mt will be made available from fields in Western Siberia.

The increased estimated cost of the project compared with initial calculations is due to (1) the increased international price for steel and pipes, (2) the longer route, part of which will cross permafrost areas, as well as other harsh and earthquake-prone terrain, (3) the capacity of the pipeline, which is now planned at 80 million tons, and (4) environmental construction standards and safety measures.

RUSSIAN FINANCING OF THE PACIFIC PIPELINE PROJECT

An "investment tariff" or additional duty levied on all other export-oriented oil shipments by Transneft may be an option. According to Sergei Grigoriev, Deputy CEO of Transneft, the company used such schemes back in 2000, when it started building the Baltic Pipeline System.[4] This may be an unpopular measure among the oil majors. However, in 2004, oil companies had to pay a little more than $100 per ton of crude oil exported and this duty is expected to be lowered to $80 per ton this year. Even if the additional charge of $1 per barrel (about $7 per ton) for exported oil were imposed as an investment tariff, Transneft could generate revenue close to $2 billion a year, provided that oil exports grow further.

According to Transneft, the current tariffs for oil shipments via its pipeline system are the lowest pipeline tariffs in the world. In 2002, the average export tariff was $0.37 per ton per 100 km, while the domestic rate for oil refineries was only $0.13 per ton per 100 km. These disparities were corrected, albeit not to fully. In December 2004, Transneft applied to the Federal Tariff Service (FTS) for permission to raise its tariffs by 11% in 2005.

The average rate per ton per 100 km ($0.34) compares favorably with rates charged in Kazakhstan ($1.00-$1.40), Ukraine ($0.40-$0.90) and Europe ($1.53 in Hungary and $1.67 in Croatia). In the 1996-2003 period, the share of transport costs in the price of Russian oil for export was between 5% and 9%, depending on the world oil price. In the United States and Canada this share is close to 25%, while the world average is

4. In 2004, Transneft decided to delay a 12 billion ruble ($410 million) bond issue. Now that Moody's has upgraded its credit rating to Sovereign level, the company says that it could make more sense to draw loans than to place bonds.

about 10%. As of April 2004, the share of transport costs in the price of oil delivered via pipeline from Samara to Novorossiysk was 4.7%, while in the case of oil-by-rail shipments the share was 12.8%. In the case of oil delivery from Western Siberia to Novorossiysk or Primorsk via BTS (Baltic Trunk Pipeline System), the transportation charge would be close to $17 per ton.

Furthermore, the Pacific Pipeline project will begin with the construction of an oil terminal on the Pacific coast and proceed in phases, with oil shipments conducted by both pipeline and rail beginning in 2007. As construction progresses, the distances covered by rail shipments will become shorter. Furthermore, the idea of moving oil to China by rail in large volumes was approved by President Putin, after Gennadiy Fadeev, the former railway minister and now president of the newly formed RZD, proposed the use of idle railway capacity. This proposal was discussed in February 2004 at a meeting in Khabarovsk, focused on infrastructure development in Eastern Russia.[5]

Political support for the oil-by-rail project is important because RZD needs to modernize and expand infrastructure at the border with China in order to transship large volumes of oil. For example, modernization and electrification work on the 365 kilometer-long stretch of railway from Karymskaya station to Zabaikalsk station requires $500 million in capital investment. Improved utilization of capacity on the BAM would allow the $160 million a year maintenance costs of this railway to be met. The entire investment program of RZD related to China is estimated at $1.3 billion.

CONCLUSIONS

Just as energy importers would like to diversify oil supplies, oil-by-rail shipments to China demonstrate that Russia is trying to access new markets in its neighborhood. However, diversification and access to new markets in the Asia-Pacific region, and Northeast Asia in particular, are not the sole goals, but rather a development tool for Russia's eastern areas and a stepping-stone to mutually beneficial economic links with its neighbors.

To translate all these plans into reality, huge investment will be needed, currently estimated at about $200 billion for Eastern Siberia and the Russian Far East, including funds for geological exploration and development. The Upper House of the Russian parliament recently debated Russia's energy strategy toward 2020 and some proposals were made concerning the fact that this strategy must somehow be upgraded for a number of reasons, including low exploration rates and inadequate investment in exploration and geological studies.

The Russian government may be pursuing two different strategies: one for already explored territories, established companies and old partners (Europe), and another for the development of new areas by new companies and with access to new markets (Northeast Asia). Obviously, the government wants greater control over Eastern

5. In 2003, Russian oil companies exported 23 Mt of crude oil solely by rail, equivalent to 11% of total oil exports.

Siberia and the Russian Far East, and it wants projects in those areas to bring about sustainable development and prosperity.

Two announcements made in Moscow in the closing days of 2004 demonstrate that both Japan and China are strategically important counterparts in Russia's national energy strategy. On the last day of 2004, an announcement was made on Russia's intention to launch the Pacific oil pipeline project. In an earlier announcement, Viktor Khristenko noted that Yuganskneftegaz would not be part of the Gazprom and Rosneft merger. The assets of this former Yukos subsidiary would be transferred to a new company wholly owned by the state. However, Khristenko said that up to 20% of the stock of this newly formed company could be offered to CNPC in exchange for assets controlled by CNPC, both in China and in third countries. The minister specified that this possibility was envisaged in earlier agreements signed with CNPC.

If policymakers of the region intend to enhance national energy security through multilateral partnerships, they must ensure that each party involved shares the burden. On the other hand, they should act to make the "energy pie" bigger, rather than approach energy security issues from the standpoint of competing interests. Regarding the Pacific Pipeline, it was likely not China or Japan, but Russia that wanted to bring its oil and gas to the markets of Northeast Asia in very large volumes using a route that contributes to regional development and promotes the discovery of and access to new reserves, as well as facilitating access to multiple markets in Northeast Asia. Despite an emerging atmosphere of competition surrounding the pipeline, it was not that Japan and China were competing for a pipeline route; rather, diverse interests inside Russia were the true contenders.

Furthermore, an energy security regime in the broader sense would require policy coordination in the field of energy conservation. Given the potential for new business in the environmental industry, it may be wise to promote environmental interdependence as a "substructure" of overall energy cooperation. Here, technology transfer as a means of raising energy efficiency could be the most important element. In other words, in order to promote energy security throughout Northeast Asia, experts and policymakers can think not in terms of competition among countries, but of competition among fuels and technologies, as well as sources of oil supply.

The benefits can be multiple and significant, or narrow and limited, depending on the willingness of the parties to develop strong, long-term bonds in the energy sector. In order to adopt and implement such policies effectively, political leadership and longer-term outlooks are needed.

Chapter 3

Why Gas Should Be a Priority: Geopolitical, Economic, and Environmental Arguments

Asia's economic miracle has largely been fueled by coal and petroleum. Although the Asia-Pacific region[6] dominates the world liquefied natural gas (LNG) market, gas has been underutilized in the region relative to its tremendous potential. The approach of Asia-Pacific countries to natural gas has changed in the past few years. However, historical patterns and the recent economic crisis have not led to the bold initiatives needed to expand natural gas use dramatically.

We argue, however, that natural gas should have a key role in Asia's future for geopolitical, environmental and economic reasons.

GEOPOLITICAL BENEFITS

Asia's rising oil dependency is causing growing governmental concern over the security of energy supply and access. In 1998, some 57 percent of oil consumed in the Asia-Pacific region was imported, with over 90 percent of oil imports coming from the Middle East, and the degree of energy dependency will likely continue to increase. While the Asia-Pacific region's oil reserves are limited, its potential gas reserves are, in contrast, encouraging. While the region may not become fully self-sufficient in gas supplies, substantially more gas resources can be developed.

Expanding gas use will reduce troublesome oil dependency on the Persian Gulf, and it will alleviate the pollution currently produced by coal burning and carbon dioxide emissions. Furthermore, the long-term political and economic relationships required for maintaining gas trade could help to stabilize the region. Gas trade requires and creates long-term bonds between sellers and buyers. Only natural gas has this important characteristic—no other fuel requires the same kind of durable relationship. Once the buyers and sellers are bound via long-term relationships (15- to 20-year agreements), with involvement from a consortium of international banks, it is imperative that they avoid dangerous confrontations.

Certainly Northeast Asian countries, particularly Japan, believe that large-scale natural gas imports from Siberia and the Russian Far East can help reduce tensions between the two countries. This view is also shared by Korea and China, both of which have plans to operate long-term, long-distance gas pipelines with Russia. In the distant future, pan-Asian natural gas pipeline networks are a possibility, first linking Northeast Asian nations, and then Southeast Asian and South Asian countries. If this scenario realized it could well promote international dialogue and ease tensions across countries, not to mention benefiting the region economically. The Russia-Europe

6. In this section the Asia-Pacific region refers to the following group of economies: Australia, Bangladesh, Bhutan, Brunei, China, India, Indonesia, Japan, Malaysia, Mongolia, Myanmar, Nepal, North Korea, New Zealand, the Pacific islands, Pakistan, Papua New Guinea, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam. Russia and the Central Asian economies are not included.

pipelines are a model here, having brought enduring stability to Euro-Russian relations.

Therefore, the main obstacle to increasing the use of natural gas today is the lack of sufficient terminal and pipeline systems for its transport. The development of the distributional infrastructure necessary for dramatic gas expansion will require support from both the private sector and, most importantly, Asian governments.

ENVIRONMENTAL BENEFITS

Natural gas is *the most environmentally friendly fossil fuel* in terms of pollutants and carbon dioxide emissions. Compared with other fossil fuels, natural gas produces essentially no sulfur emissions and significantly lower levels of NOx and particulate emissions. Gas also produces 25-33 percent less CO_2 than oil, and 40-45 percent less than coal, per unit of energy produced. In 1998, natural gas accounted for about 11 percent of the total fossil energy consumption in Asia, but contributed only 8 percent of the regional CO_2 emissions. In comparison, coal accounted for 42 percent of Asia's total fossil energy consumption and 54 percent of the CO_2 emissions. Because of the higher rate of CO_2 emission, the share of coal in total CO_2 emissions has been consistently higher than its share in total primary fossil energy consumption, while the opposite is true for natural gas A switch from coal to natural gas would allow the same amount of energy consumption, but would lower the emission of CO_2 in the Asia-Pacific region and throughout the world.

While it can be argued that global impacts may have limited support in some of the countries involved, the deteriorating quality of urban air in major Asian cities has become a critical issue. For example, although China, has taken some positive steps, urban air pollution continues to be an extremely serious problem in its major cities, and this trend is expected to continue over the next 20 to 30 years unless comprehensive changes are made in the type, manner, and specifications of fuels used.

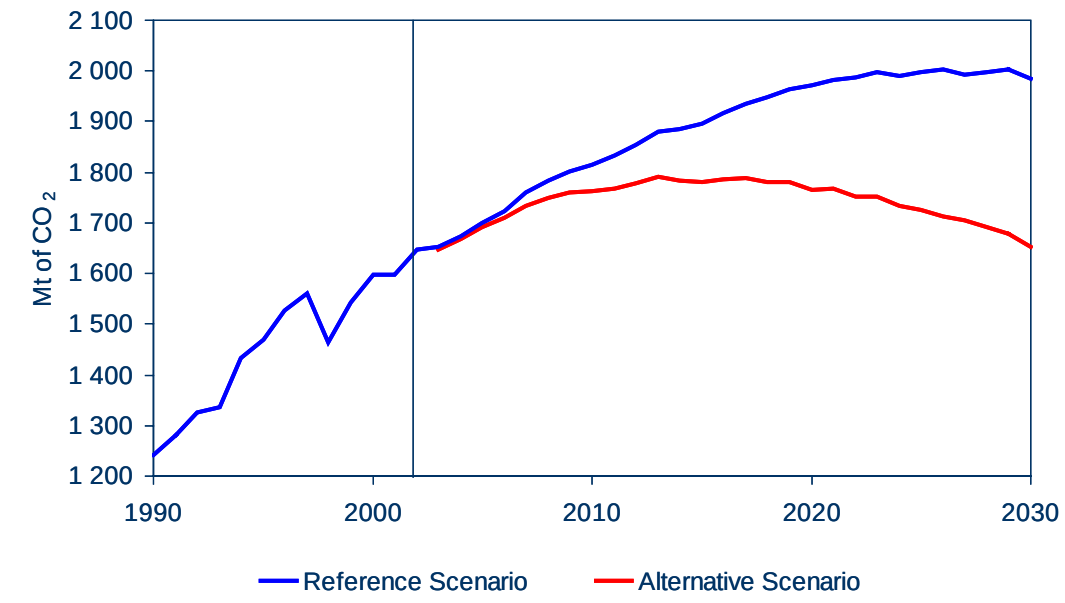


Figure 9: CO_2 emissions in Japan and Korea in the reference and alternative scenarios
Source: IEA

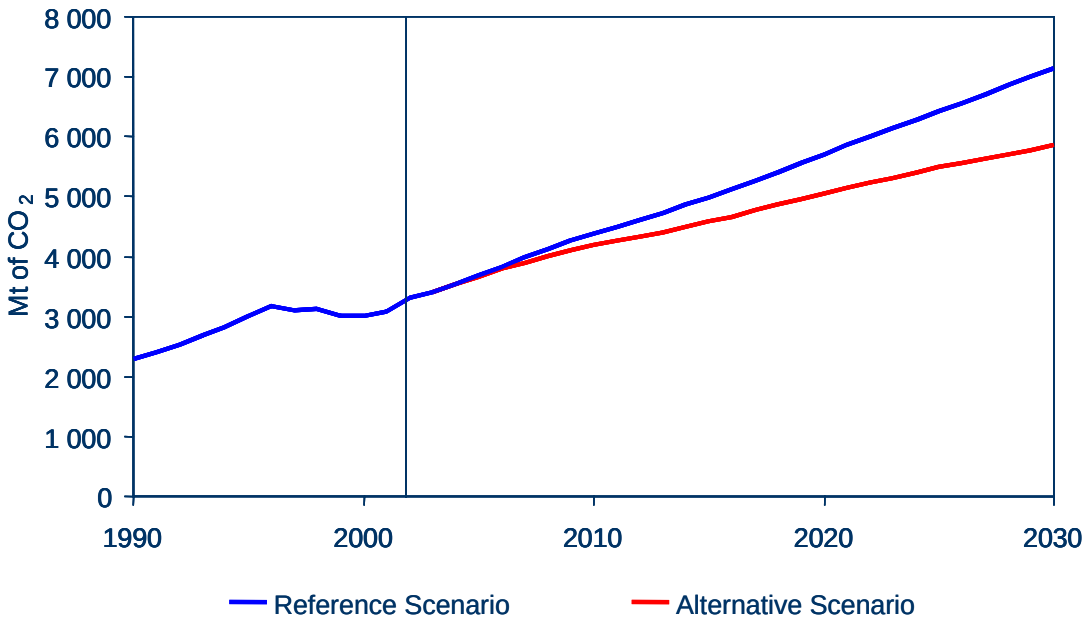


Figure 10. CO_2 emissions in China in the reference and alternative scenarios
Source: IEA

ECONOMIC GAINS

Gas is significantly more efficient than other fossil fuels (i.e., gas generates more power and does more work per unit of fuel used). Combined-cycle gas technology results in better utilization of gas, with higher electricity output, lower costs, and less pollution. The thermal efficiency of the combined-cycle gas-turbine power generation process (frequently chosen by users of natural gas) is as much as 50 percent higher than conventional steam technologies using oil or coal, and the gap is growing. Although coal and oil can also be gasified for use in combined-cycle gas-turbine systems, this generally yields lower net thermal efficiencies.

The benefits of regional gas trade in general cannot be overemphasized. One major positive economic impact of such trade is that it enlarges the market as a whole, resulting in economies of scale, improved efficiency, and greater competitiveness of regional producers. Growing regional activity can also stimulate increased demand for inputs from non-regional sources.

Inclusion of China is particularly important for achieving a large-scale regional market. China's development into a growing economic force in the region presents significant opportunities for its neighbors. China's imports from ASEAN countries alone have grown about fourfold over the past 10 years. A recent analysis of the impact of China's joining the WTO indicates that it will benefit East Asian exporters more than any other region in the world.

It could be argued that regional trade benefits might be gained more quickly through other types of general trade with less heavy front-end commitments. Gas and liquefied natural gas (LNG) projects typically require major initial investments and long-term commitments (in the form of take-or-pay contracts for 15 to 20 years), and have long lead construction times. While all forms of trade expansion should, of course, be pursued, gas trade projects have particular benefits that must be taken into account.

NATURAL GAS MARKETS IN NORTHEAST ASIA: THE GLOBAL CONTEXT

Globally, energy users depend on oil for 40 percent of their total primary commercial energy consumption. Oil is the most important component of global energy use, and coal is a distant second at 26 percent, with natural gas in the third position at 24 percent of the total. Nuclear power and hydroelectricity are relatively minor sources. In Asia, however, coal is the leader, accounting for some 44 percent of total energy used. Oil in percentage terms equals its global share but natural gas consumption is only 10 percent in Asia. Indeed, Asia has the lowest dependency on natural gas of any geographical region in the world. India's and China's heavy use of coal overshadows the overall Asia-Pacific pattern. But even if they are excluded from our calculations, the share of natural gas in the commercial energy consumption in the region increases to only 16 percent, still less than the global share. If we eliminate India and China, the share of oil also expands to 52 percent (greater than the world share) and coal shrinks to 20 percent.

World gas consumption grew at a moderate average rate of 2.2% during the two decades from 1980 to 1999. The growth rate, however, was more than double that of oil consumption. In 1999, the world consumed 222 billion cubic feet per day (bcf/d) of natural gas compared with 147 bcf/d in 1980 and 191 bcf/d in 1990. In comparison,

the gas consumption growth in the Asia-Pacific region was much faster: 6.9% per year on average from 1980 to 1999. In 1999, the region consumed 26 bcf/d of natural gas, up from 7 bcf/d in 1980 and 15 bcf/d in 1990.

Table 2. Primary commercial energy consumption by fuel, 1998 (%)

	Oil	**Gas**	Coal	Nuclear	Hydro
World	40	**24**	26	7	3
Asia-Pacific region	39	**10**	44	5	2
Asia-Pacific region (excluding China and India)	52	**16**	20	10	2

Source: BP Amoco (1999)

Despite the increasing consumption in the region, natural gas is still underutilized. The reason behind the low gas demand is explained by four factors.

First, Asia lacks a pre-existing gas-user culture of the kind that existed in North America and Europe, where an infrastructure for distributing gas was developed long ago. Asia, on the other hand, developed much of its centralized energy infrastructure later, when electricity distribution systems were used to meet most energy needs, so it has lacked a gas-distribution system upon which modern gas use could build.

Second, developing gas use generally requires much larger investments than do oil or coal projects because gas is more difficult to transport. This has deterred lower-income countries seeking rapid economic growth (in Latin America as well as Asia), which have preferred easier, smaller-investment projects using oil. International corporations exploring for oil and gas in Asia have also preferred developing oil for the same reason—it brings quicker returns on investment and is easier to market. This helps explain why international gas markets are underdeveloped.

Third, Asian gas resources are located far from the biggest, wealthiest centers of demand. This has contributed to the slow development of a regional market. Without large and integrated gas markets and easy means of transportation, consumption is constrained.

The fourth factor is a lack of transparent and competitive gas pricing mechanisms, even though Asia dominates the growing world LNG trade. Unlike oil, there is no international gas market to which Asian countries can link their domestic natural gas prices. In some countries, local gas prices are loosely linked with the prices of fuel oil. In others, including China and India, natural gas prices are determined and regulated by the governments, often set at low levels to benefit industrial sectors or to subsidize the residential sector in areas adjacent to natural gas fields.

Excessive government intervention in natural gas pricing has discouraged exploration, development, and production of natural gas in many Asian countries, leading to less natural gas consumption as well. Moreover, promoting gas consumption did not become a priority for national governments until the economic boom of the 1980s generated the skyrocketing energy needs of the 1990s.

Despite these factors, the Asia-Pacific region represents one of the fastest growing areas in the global natural gas industry. However, gas trade in the region is predominantly in the form of LNG. In comparison, the gas trade via pipeline is quite limited. About 75% of global LNG trade is in Asia, more specifically Northeast Asia, which is one of three main regional gas markets. The other two are North America and Europe, including the former Soviet Union.

In making projections for energy demand, we need to remember that the growth potential of Asian developing countries is still enormous, as their primary energy demand per capita is still very low. Therefore the rebound in economic growth, after the economic crisis in the East Asian countries, has continued and will continue to translate into renewed and healthy energy demand growth rates for the region.

Under the right policy conditions—such as a rationalized pricing structure, adequate legal and regulatory frameworks, and a competitive market—the availability of a market in the consuming countries of Japan, Korea, and China also will not be an issue. Even under a "low growth" scenario, the potential market for natural gas in these countries is large by any standard, and is expected to grow substantially over the next two decades.

Table 3. Estimated demand for natural gas in Northeast Asia: low-growth scenario, 2000 and 2020

Economy	2000 (trillion cubic feet)	2020 (trillion cubic feet)	Annual Growth (%)
China	1.00	4.7	8.0
Japan	2.65	3.6	1.5
Korea	0.65	2.1	6.0
Total	4.30	10.4	4.5

Note: Under a base-case GDP-growth scenario, annual gas consumption growth in China, Japan, and Korea would be 10%, 2%, and 6.7%, respectively; under a high-growth scenario it would be 11.5%, 2.5%, and 7.5%.

Source: World Bank

Under a low-growth scenario, natural gas consumption in Japan is expected to grow at 1.5 percent a year between now and 2020; in Korea at 6 percent, and in China at 8 percent. These correspond to an increase in consumption from 2.6 tcf in 2000 to 3.6 tcf in 2020 in Japan, from 0.65 tcf to 2.1 tcf in Korea, and from 1 tcf to 4.7 tcf in China. Japan and Korea will have to rely on additional imports (either LNG or piped gas) to meet their entire additional needs between now and 2020. China's proven gas reserves of about 50 tcf will not last more than 10 to 12 years, based on a medium-growth scenario. Therefore, a more than ample market for gas in Korea, China and (to a lesser extent) Japan, is not an issue under liberalized market conditions.

As countries advance economically, the ability to afford the initial capital investments for infrastructure increases. This is also the case in the utilization of natural gas, where major utilization constraints are usually caused by a lack of infrastructure. It can then be assumed that natural gas's role in the primary energy mix in Asian developing countries will increase as infrastructure develops. This is especially true in countries where utilization is non-existent or very low.

Chapter 4

Challenges for Producers and Consumers in Production and Distribution of Natural Gas

Japan, South Korea, and Taiwan remain the most significant LNG importers for now. They are all part of Northeast Asia, and their role in the Asian and global LNG business is unique. Until pipeline gas reaches South Korea and Japan in the future, LNG will continue to be the only viable source of gas, except for limited domestic gas production in Taiwan and, to a lesser extent, in Japan. However, new and potential LNG markets are emerging in India, China, the Philippines, west coast of North America, etc. China's imports will have a significant effect on what are already tightening LNG markets in Asia and emerging LNG markets in the Middle East.

In Korea and Taiwan imports are handled by state-controlled monopolies. Both economies are in the process of deregulating LNG imports and privatizing these state monopolies. Nevertheless, the state-owned monopoly KOGAS in Korea was able to use its powerful position to invest heavily in a national gas transmission system, which facilitated the growth of natural gas demand, especially in the industrial and residential sectors. In Japan, a number of gas and electric utility companies dominate LNG imports. Historically, importers were responsive to policies promoted by the Japanese government. This is slowly becoming a thing of the past, with deregulation and an increasing emphasis on market-oriented business operations. The combined effects of multiple importers, exorbitant land costs, and legal right-of-way issues mean that Japan, which is the seventh biggest gas consumer in the world, has only a very limited gas transmission system. Thus, any plans for imports via pipeline will have to go directly to Tokyo or some other large demand center.

SOUTH KOREA

South Korea is the second-largest LNG importer in the world and has the fastest growing LNG market in the Asia-Pacific region. Since 1987, gas consumption has increased at the high annual rate of 18.7 percent owing to economic growth, increased energy requirements in city gas and power generation, government efforts to promote alternatives to oil and coal, and more stringent environmental regulations to reduce the emission of pollutants from fossil fuels. When placed within a regional context, LNG demand growth in the country during 1991–99 was 5.8 and 1.4 times higher than the demand growth in the respective Japanese and Taiwanese markets. Although South Korea is not bound by the Kyoto Protocol to reduce emissions of greenhouse gases by an average of 5.2 percent from the 1990 level during 2008–2012, the government has volunteered to reduce greenhouse gas emissions starting in 2018. The adoption of more stringent environmental regulations in recent years has worked in favor of cleaner fuels, such as natural gas and nuclear power.

South Korea relies on imported LNG to meet all of its natural gas requirements. This trend will continue in the future. Because of the anticipated high growth rate in gas consumption, Korea has more flexibility than Japan does, in deciding what route to take in filling the projected gap between guaranteed LNG imports from current contracts and demand. Depending on the number of additional LNG contracts that are

carried out in the future, the gas pipeline option, such as Irkutsk, will be economically justified by 2010 under the base and high cases and by 2020 under the low case. Moreover, given the projected substantial deficit in existing supplies, there will be room for a bigger gas pipeline by 2015–2020. The piped gas would be necessary, assuming lower-cost LNG sources have been used up in the region. If more low-cost LNG supplies become available, the need for pipelines may be further delayed.

JAPAN

Japan has grown to become the world's largest LNG consumer with a total import volume of 51.3 mmt/y in 1999. Gas demand weakened in the 1990s compared with previous years, owing to economic recession. Although signs of recovery are becoming apparent, the future of the Japanese economy and gas outlook are met with caution and concern. The growth rate of gas demand is expected to reach 0.4 percent during the 1999–2010 period, the lowest among the current LNG importing countries in Asia and below the projected regional LNG demand average of 3.4 percent.

Although Japan is the seventh biggest gas consumer in the world, it has a very limited gas transmission system and thus severely lacks the requisite gas infrastructure network to facilitate the growth of natural gas demand in other sectors. The underdeveloped condition of the country's gas distribution system is a major factor in explaining why energy retail prices paid by Japanese consumers are several times higher than their American or European counterparts. Bulk consumers in Japan pay about one-third more for LNG compared with gas delivered through a pipeline from Russia to the German border, while households and commercial users pay about three to five times U.S. prices for gas. The high price of natural gas limits its attractiveness.

Although the mountainous inland terrain and legal right-of-way issues are obstacles to developing a pipeline transmission network, a more important factor may be the lack of motivation and market distortions. Regional electric power producers have acquired significant influence in determining the future of the power industry and gas infrastructure and have generally been unsupportive of a pipeline transmission network.

Some Japanese experts propose that natural gas imports must be further promoted through a pipeline not only for fuel diversification, but also for competitive pricing. The development of such a transmission network could potentially reach many small gas users and have a profound impact on domestic gas consumption. Others emphasize that natural gas penetration in the transportation, residential, and commercial sectors promises a reduction of oil dependence. Also, some experts argue that, if Japan follows the pattern of other advanced economies, maintaining the share of nuclear power in electricity generation at the current level, the role of natural gas in electricity generation should rise from the current level of 24% to 30% or more to fill the gap. If the nuclear power program is scaled down with natural gas filling a shortfall, the annual demand could rise by 13-16 million tons of LNG or 16-20 billion cubic meters of pipeline gas. At the same time, the official projection for 2008 with regard to the share of natural gas in power generation is 22.4%.

A combination of factors, such as the slow recovery of the domestic economy, the partial deregulation of the gas and electricity markets, and the inadequate provisions of the gas infrastructure, contributes to uncertainty over the future of Japan's gas

demand. Japan will continue to rely heavily on imported natural gas primarily in the form of LNG to meet its domestic gas demand. In the base case, sufficient supply from guaranteed LNG sources from existing contracts and probable LNG supplies from Malaysia and Australia are expected through 2015. By 2020, however, a deficit of 3.8 mmt/y is anticipated. Some experts believe that owing to the small volume, the construction of a pipeline may not be justified. Therefore, the supply gap is likely to be filled by LNG, possibly through additional volumes from existing contracts or Shell's proposed Sakhalin-2 facility in Russia. Under the high-case scenario, additional LNG supplies will have to be tapped earlier, compared with the base case, in order to fill the anticipated lack of an estimated 5.1 mmt/y in 2015.

CHINA

Within Northeast Asia, China is the only country, other than Russia, that has large potential in natural gas resources. China currently consumes all of the natural gas it produces. At the present time, natural gas has a minor share in total primary energy production and consumption in China. Coal dominates both energy production and consumption, and China is the world's largest coal producer and consumer. Oil is the second largest source of primary energy consumption in China, and it is very important to the economy. China's growing dependence on imported oil since the early 1990s is a concern to the Chinese government. This has become an important impetus for developing, producing, and consuming more natural gas in order to diversify the sources of energy supply. Nuclear power is a late starter in China's energy development, but its expansion has accelerated since the early 1990s. Hydropower has traditionally been given priority status, and construction of hydropower plants has proceeded in a relatively fast fashion over the past several decades.

Since the late 1990s, the Chinese government has been making efforts to improve the country's infrastructure, and LNG imports and long-distance gas pipelines have been planned. In Guangdong Province, BP was picked as the foreign partner for the 3 mmt/y LNG terminal, with a 30% equity share in the project. The expectation is that the terminal will become operational by 2007. Initial shipments will come from Australia's North West shelf expansion. According to the Energy Information Agency, a second terminal will be built at Fujian. This terminal will receive LNG from the BP Tangguh project in Indonesia, the projected starting date is 2007. Reportedly, in 2004 China also struck an agreement to buy more than 110 million tons of LNG from Iran over 25 years, with deliveries starting in 2008. China National Petroleum Corporation (CNPC) has also completed its 4,167-kilometer west-to-east natural gas pipeline to transport natural gas from the Tarim basin in the west and the Ordos basin in the northwest to the Lower Yangtze region, particularly Shanghai.

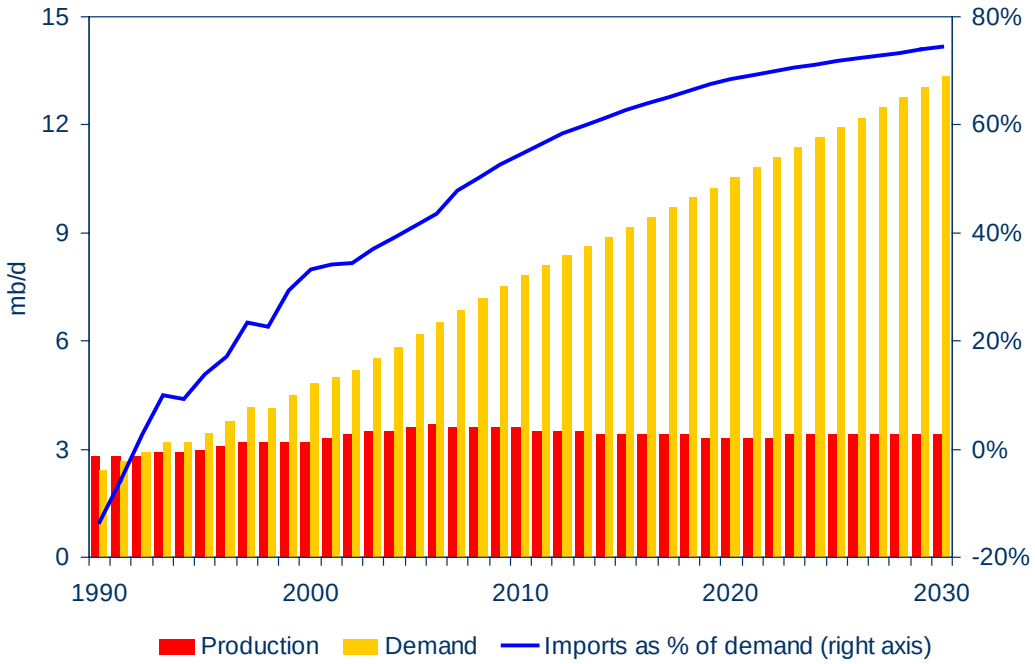


Figure 11. China's oil supply balance, 1990-2030
Source: IEA

Compared with other fossil fuels, natural gas shows promise of a bright future in China. The importance of natural gas in China lies in its future growth, which is more promising than oil's or coal's, and in the likelihood of increasingly widespread natural gas use in China.

Forecasts of China's gas consumption over the next 20 years are robust. The optimistic forecasts are based on several macro observations. First, China has potential natural gas resources. Second, China is facing serious environmental problems because of its heavy reliance on coal. Third, natural gas investment has drawn attention not only in China but also around Asia and elsewhere in the world. Fourth, natural gas has a variety of uses in different sectors of the economy. Finally, the rapid economic growth in China, especially in the coastal areas and south China, has provided a solid foundation for the country to switch to or use more clean energy such as natural gas.

Under the base-case scenario, China is expected to start importing LNG by 2006 or 2007, followed by partial imports of Sakhalin gas to Northeast China beginning in 2010 and Russian Irkutsk imports by 2015. As a result, China's natural gas consumption is forecast to increase from 2.4 bcf/d in 2000 to 4.5 bcf/d in 2005, 7.6 bcf/d in 2010, and 13.3 bcf/d in 2015. Alternatively projections show that the 2015 gas consumption in China could range from 9.0 bcf/d under the low-case scenario to 16.3 bcf/d under the high-case scenario. The high-case scenario assumes higher domestic production, a full start of pipeline gas imports from Sakhalin in 2010, and

higher LNG imports beginning in 2010. The low-case scenario originally foresaw lower domestic production, with LNG imports not arriving until after 2005, and the first imports via pipeline not arriving until 2015.

PROSPECTS FOR NATURAL GAS COOPERATION IN NORTHEAST ASIA

While the underdevelopment of natural gas and the lack of international pipelines and domestic infrastructure are reasons for the underutilization of natural gas in Northeast Asia and the Asia-Pacific region at large, the same factors are also expected to contribute to future growth of natural gas consumption in the region. In the area of both LNG and international pipelines, there are huge potentials for Northeast Asian economies to have closer cooperation.

Cooperation in Natural Gas Pipelines

There is no international gas pipeline in the Northeast Asia region. In the wider Asia-Pacific region, the only cross-border natural-gas pipelines currently in existence are in Southeast Asia. In the short term, Southeast Asia is the only area where we will see more natural gas pipelines constructed. Piped gas imports should reach India toward the end of the decade, and Russian gas may enter Northeast Asia sometime in the next decade.

The pipelines that are being planned for Northeast Asia start in Russia (Table 4). The first involves a proposal for a pipeline to bring Sakhalin-1 gas to Japan. While Sakhalin-1 will be ready to export gas in the next 5 years, Japan may not have the necessary demand to justify the proposed pipeline until sometime after 2010. ExxonMobil began a feasibility study on the project in June 1999 and estimated that the pipeline would have an output equivalent to 10 mmt/y of LNG at a cost of US$1–1.5 billion. The Sakhalin-2 project will likely supply Japan with LNG before piped gas reaches the island nation.

The other options out of Russia are both from Siberia. One is from Yakutsk and the other from Irkutsk. The Irkutsk 4,100 km pipeline is possible sometime after 2010. The Yakutsk pipeline may be feasible by 2015. Only one Irkutsk route will be selected and of the two, the one through "Manchuria" is the most probable. Under the "Manchurian route," China and South Korea would each import 1.3 bcf/d of gas (currently such a pipeline is viable only with such large volumes, but no one has such demand at the moment).

In addition to Japan, China has long been interested in Sakhalin natural gas. In fact, China believes that there is a good chance for Sakhalin gas to be imported to China before the Irkutsk gas arrives. From China's viewpoint, the most desirable routes are the Irkutsk and Sakhalin lines. If the Sakhalin gas does not come, China privately prefers the eastern line from Irkutsk to Beijing, which does not pass through Mongolia but goes through China's northeast instead. China hopes to import natural gas to its heavily polluted northeast as well as the fast growing north. The environmental reasons cited by China may be convincing enough for Japan to give the green light for China to import Sakhalin-1 gas (Japan has a 37.5% equity share), provided that there will be enough to meet the needs of Japan, too. Meeting Japan's needs does not appear to be a problem. Even so, it is still unclear when a pipeline project could start.

Table 4. Potential future international gas pipelines in Northeast Asia

From	To	Field	Length (km)	Capacity (bcf/d)	When (year)
Russia	Japan	Sakhalin-1	800	n.a.	post-2010
Russia	China (Beijing)	Sakhalin-1	n.a.	1.5	2010 or later
Russia	China (Shanghai)	West Siberia	6,500	3.2	post-2020
Russia	China (Shanghai)	West Siberia	6,800	2.5	post-2020
Russia	China	Irkutsk (East)	3,300	1.3	2010-2015
	South Korea	Irkutsk (East)	800	1.3	2010-2015
	Total	Irkutsk (East)	4,100	0.0	2010-2015
Russia	China (Beijing)	Irkutsk (West)	3,365	2.5	2015
Russia	China/Japan	Yakutsk	4,800	2.0	2015-2020
Turkmenistan	Japan via China		7,500	1.9	2020
Turkmenistan	Shanghai, China		6,100	2.9	2020

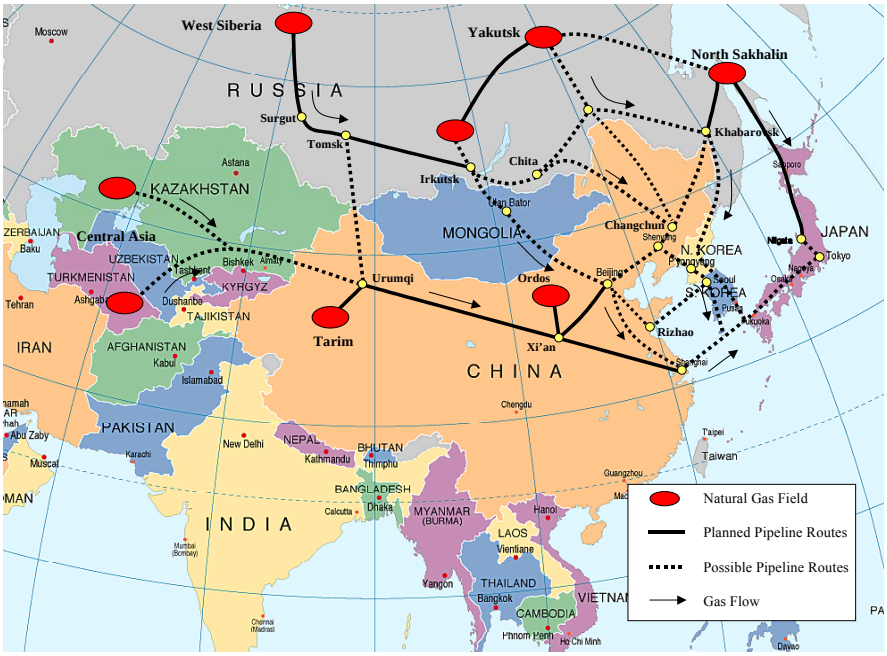


Figure 12. Map of proposed natural gas pipelines in Northeast Asia
Source: Northeast Asian Gas and Pipeline Forum and NIRA

West Siberia has been well developed by Russia and contains vast natural gas resources. Gazprom has long used it as the base for supplying natural gas to Europe. Transporting natural gas from West Siberia is also a possibility in the future. At present, one of Gazprom's proposals calls for the construction of a gas pipeline 6,500 km long with a design capacity of 2.5 bcf/d. One of the advantages of the West Siberia–Shanghai line is that it can use the proposed west–east natural gas line across China, from Xinjiang to Shanghai. However, proposals for Central Asian pipelines from Turkmenistan and Kazakhstan to China are considering this same option.

Many uncertainties exist for the pipelines that are not yet built. The availability of financing, whether concessional or not, is an issue in getting a pipeline off the ground. Cross-border fees, which increase with the number of countries a pipeline passes

through, further increase the prices paid by local consumers. Lastly, contractor fees for process engineering, field maintenance, etc. create uncertainties about the final cost of the gas.

LNG Cooperation

Despite the fact that Northeast Asia is the world's largest importer of LNG, there is no trade between the Northeast Asian economies themselves. The likely future development is Russian LNG to Japan from Sakhalin-2.

In the distant future, more possibilities may arise for further cooperation in the area of LNG. Russia's exports of LNG to Japan can expand further, and the LNG can also be exported to Korea and China.

LNG Versus Long-Distance Pipelines

The long-distance pipelines from the Russian Far East and Central Asia are political priorities for Japan, Korea, and China. These pipelines are seen not simply as carriers of gas, but projects that will cement long-term political and economic relations between Asia and Russia, resulting in enhanced energy security. With the rising prominence of the private sector and the deregulation/privatization process, the government-to-government deals of the past are not enough. What is needed is economic impetus and competitiveness. The governments can help, but cannot force construction of pipelines until the private sector end-users are convinced of the economic viability of these projects.

In Asia, gas prices are entirely based on crude oil (not fuel oil) for LNG and partially on fuel oil for shorter distances pipelines. In a high oil price scenario, competition will decide the preference between pipelines versus LNG. In a low oil price scenario, only existing projects can continue, unless there are provisions for oil price floors which affect the gas prices. Asian LNG prices will remain linked to oil in Asia, until perhaps the 2007-2010 period. Within that time period, many of the existing LNG contracts will come up for renewal. As they get renewed, the buyers are likely to opt for renewing only a portion of their contracts, leaving the rest for spot purchases (however, the spot market creation will be a slow process in Asia)

The level of crude oil prices has a very significant impact on gas trade. Oil prices at $10-$12 per barrel can deliver a blow to any LNG deal. Similarly, long distance pipelines cannot be viable at these prices (though shorter pipelines can still be economic). However, in a "high" oil price scenario, from $20 per barrel or more, LNG and long distance pipelines can be highly profitable. Indeed, the level of oil prices may be the single most important factor in the development of gas trade in Asia. The recent very high prices (in the range of $35-50 per barrer), along with the question of whether these levels will persist, add another element of uncertainty.

There are some 40-50 million tons of competitive LNG projects waiting for customers, making it difficult for long-distance pipelines to compete with these LNG projects. However, once these projects find customers, the next group of LNG projects is likely to be quite costly. That is when long-distance pipelines will have a real chance. That would approximate a period around 2010-2015. Long-distance pipeline projects take many years to complete, probably 7 to 10 years. To ensure success of these projects, end-users must be convinced of the economic feasibility of

such projects. In Japan, many of the electric power companies remain skeptical. In Korea, private end-users are similarly skeptical, while the gas companies and government-owned companies are quite eager to participate in these projects. The gap between the two sides needs to be narrowed.

SPECIFIC CHALLENGES IN PIPED GAS TRADE

Gas Market Development

The most important criterion is the commercial viability of the pipeline project: it must yield a reasonable rate of return for investors, and it must adequately compensate for the risks taken. The most important prerequisite for building the Northeast Asian Gas Pipeline is sufficient demand. The key to the development of gas reserves in East Siberia and the Russian Far East is to develop gas consumption markets.

Governments in Northeast Asia should facilitate downstream gas market development: encouraging gas consumption by providing tax incentives, reducing burdens in project approval procedures, backing the long-term gas purchase commitments of state-owned off-takers based on realistic future demand evaluations, by reducing the burden in downstream gas project approval procedures, and so on.

Pricing

Major distortions of pricing structures in the receiving countries, either at the absolute (i.e., subsidy) or relative levels, will inevitably impact the economics of the project, even if a firm and viable gas purchase and sale contract exists. Consequently, pricing structures for natural gas, both use and delivery (i.e., transit fees), and the pricing structure of petroleum products, electricity, and the other possible energy products for which gas can substitute, need to be developed.

Sectoral Reform

On the sectoral front, while Japan has made progress toward liberalizing the sector, Korea and China are in midstream. Japan's revision of its Gas Utility Law in 1999 further opened the gas market, strengthened the competitiveness of utilities, and minimized government involvement in the sector. However, in China, although much progress has been achieved in restructuring the oil and gas sector, the administered market approach has now reached its limits. If a regional gas trade initiative is to be implemented, there is a need to move forward to remove the major obstacles that still exist.

Legislative Framework

The legislative framework must be adequate to support a relatively free and competitive market in the utilization of natural gas and its future expansion. This includes laws and regulations related to open access provisions, transit fees, and security of supply. This framework would also need to include provisions for an enabling environment to promote increased private sector participation, which is key to meeting the huge investment needs associated with this type of project.

Regulatory and Competition Policy

Efficient regional gas trade requires each country involved to remove all impediments to the operation of a free energy market and the enhancement of competition. Such a market operation would include open-access pipeline systems, unbundled gas

services, market-oriented pricing, and independent regulators. Governments will need to introduce specific regulations relating to the gas transportation sector. Regulations will also be required to control the conduct of enterprises, such as requiring pipeline operators to provide third party access to their pipelines, dispute resolution, and royalty, tariff, and transit fee setting.

Issues become even more complex once cross-border interconnections are in place. Hence, there is a need for a framework that would help remove uncertainties about the rights and obligations of selling, buying, and transit countries in the region and encourage greater investment by both the private and public sectors. For effective private sector participation, an internationally accepted legal framework is required that clarifies governing laws, regulations for licenses/permits, accounting standards, and resolution of commercial disputes. The regulatory risks are reduced, for instance, if the technical and health-safety and environment regulatory framework and procedures are predictable and reasonably efficient in all countries involved. This should also cover private sector corporate laws, foreign investment protection, and bankruptcy law.

Chapter 5

The Investment Environment

WORLD INVESTMENT OUTLOOK

World energy demand is expected to increase by two-thirds of the current demand by 2030. Among fuels, oil will continue to be the largest primary energy source, although its share will fall slightly. Natural gas will overtake coal just before 2010, and gas will be the second largest energy source thereafter, while the shares of coal, nuclear fuel, and hydropower will fall slightly. In response to the increase in the world energy demand, there must be a corresponding growth in energy production. According to IEA projections, more than 90% of the increase in the world's primary energy production in the coming three decades will occur in developing countries and transitioning economies that are outside the OECD region. This increase is up from 60% in the last 30 years. Annual growth of electricity is the fastest among all forms of energy, and it is followed by oil, gas, and renewables.

If we integrate all types of energy into our outlook, more than 16 trillion dollars will be needed for energy supply infrastructure from now until the year 2030. The electricity sector will take around 60% of this investment. Around 19% of the total investment will be made in the oil sector. A similar amount of capital is needed for investment in the natural gas sector. Coal accounts for only a minor share.

NORTHEAST ASIA GROWTH PROSPECTS AND INVESTMENT NEEDS

Given East Asia's performance prior to the 1997 financial crisis, its rapid recovery afterward, China's sustained economic growth, and dynamics resulting from intra-regional trade—and barring any unforeseen major disruption—it can be assumed that the robust economic growth of the region will continue in the medium term. However, because of the region's heavy reliance on external markets (about two-thirds of the region's exports go to the countries outside the region), and its trend toward global integration, its economies cannot be isolated from vulnerabilities of the global economy. For the purposes of this section, it is assumed that the growth in 2005 will be slightly below 6%, and that the average annual growth for 2006-2015 will be about 5.5%.

With regard to the Northeast Asian region, this section focuses on the growth prospects and energy investment needs of China, Japan, South Korea (ROK)—and to a lesser extent the DPRK, given the absence of reliable and current data. This section does not review Russia, whose energy policies and investment needs are discussed in a previous section.

China

China's economic performance up to now has been stellar. Although there could be some slowdown (partly by design), robust growth is expected to continue for the medium term. It is estimated that China's 2005 growth will be about 7%, and it is assumed that growth will continue at an average rate of 6% per year for 2006-2015. This slower growth is in line with country's strategy to eliminate overheating and to avoid a so-called "hard landing."

China's future investment needs should be assessed in the context of three elements, which underlie the Chinese economy: urbanization, globalization, and modernization. In the energy sector, even under a conservative growth scenario, the investment requirement will be large, both for increasing domestic energy supply and to provide infrastructure for imported energy. China's need for a significant share of the world oil and gas supply will allow it to control important signals to the market as a strategic buyer. Already we may point to the energy demand increase in China as a cause of higher oil prices (i.e., some US$5-US$10 a barrel).

It is estimated that China will need an investment of US$700–US$725 billion over the next 10 years for its energy sector alone, about three-fourth of which will be for the electric power sector (generation, transmission, and distribution).[7] The investment in the gas sub-sector is expected to be US$25–US$30 billion for the period, and the balance is equally divided between oil and coal.

With regard to the source of financing, there will still be a continuing need, albeit at reduced level, for concessional external financing (particularly if we also consider China's massive infrastructure investment needs, especially for roads and telecommunications). The role of the private investors will continue to be hampered by unclear legal framework and the reluctance of private investors to accept provincial government guarantees. Therefore, the financing of infrastructure in China for the medium term is expected to be dominated by the public sector (directly or indirectly), although it will increasingly shift to the private sector over the next 20 years. In the energy sector, because of the private investors' preference for quick payback, nuclear, hydro, and clean coal technology are not expected to attract major private funding.

Japan

Japan's economy appears to have finally reversed its decline and to be on the path of sustained growth. Whether Japan's recovery is sustainable over the medium term is an ongoing debate among economists. Nonetheless, it is expected that some government initiatives, such as cleansing banks of bad loans and the so-called "reform without sanctuary" strategy, will bear fruit and provide the impetus for sustained growth. In the medium term, it is assumed that Japan will grow at 1.5%-2% per year.

For the purpose of this section, it was not deemed necessary to evaluate Japan's investment needs for the energy/infrastructure sector, particularly since Japan meets virtually all its future investment needs from internal sources. For example, many of the utilities use internal cash or corporate-based borrowing to finance investment.

South Korea

South Korea had relatively weak growth in 2003 (about 3%), mainly due to weakness in domestic demand. Although the economy picked up in 2004 and, as the result of strong growth in exports, the growth is expected to be about 5%, the weakness in domestic demand continues. More alarmingly, corporate expenditure has slowed substantially. However, in the medium term, exports are expected to remain strong,

7. The IEA estimates that China's electricity generation sector alone will require about US$800 billion over the next three decades. See International Energy Agency, *World Energy Outlook 2003* and International Energy Agency, *World Energy Investment Outlook 2003*.

and Korea's economic outlook is considered stable. It is estimated that the economy will grow at an annual average of 4% over the next ten years.

Regarding investment needs of its energy sector, clearly the level of 8%-9% annual growth in primary energy demand, which prevailed over the past three decades, will no longer be the case. Assuming that Korea will liberalize all its energy prices by 2007, and adopt aggressive energy efficiency implementation programs—particularly in heavy industries such as steel, cement, chemicals, and petrochemicals—its primary energy demand will grow at about 3%-3.5% per year over the next ten years, with natural gas at 6%-7% (representing the highest growth rate), followed by coal, nuclear power, and oil. Electricity is expected to grow at about 3% per year.

The total investment needs of Korea's energy sector over the next ten years is about US$75 billion, over 85% of which will be in the power sector. Its overall infrastructure investment needs (energy, roads, and telecommunication) is estimated at US$155 billion for the period.

Financing of energy projects in Korea has shifted significantly over the past ten years, from government and government-based borrowing to corporate-based commercial borrowing, and is shifting gradually to the domestic market. This trend is expected to continue.

Democratic People's Republic of Korea (DPRK)

The lack of reliable information about the DPRK precludes definitive statements about various aspects of its economy. Experts universally agree, however, that the country suffers from two acute shortages: food and energy. Its indigenous energy resources are limited to coal and hydropower. Even coal and hydropower reserves are inadequate, relative to consumption needs. While details are sketchy, outside experts believe that, after accounting for suppressed demand, the DPRK meets only half of its energy needs.

To rehabilitate the energy sector, so that it can meet the country's energy needs in a reliable and efficient manner, a large investment (large relative to the size of the economy) will be required, perhaps some $30 billion over the next ten years. Clearly, resources of this magnitude will not be available to the DPRK in the near future. Even if they were, meeting the DPRK's investment needs presents complex issues in the optimization of the investment program. For example, if new electric power generation capacity could be needed, it may first be necessary to rehabilitate an existing plant, since it will take 4-5 years for the new generation to come on stream. Or, while a fertilizer plant may need to be rehabilitated (and refineries revamped), it may be essential initially to import fertilizer and diesel oil. For infrastructure more generally, rough estimates indicate that the DPRK will need about US$75 billion over the next ten years for new investments and maintenance of its energy, roads, and telecommunications infrastructure.

The DPRK has the highest benefits to gain by meeting its infrastructure investment and maintenance needs through sub-regional integration. Such a plan in the short term (4-5 years) would include four overlapping phases: stocktaking, imports, capacity building, and "light" rehabilitation. The longer-term objectives (5-20 years), would also have four overlapping phases: conducting deeper analytical works for its

infrastructure investment needs and strategy, "heavy" rehabilitation, regional integration, and new construction.[8] In particular, the potential for the DPRK's energy system to be integrated into the energy network of some of the neighboring countries (China, Russia, and the ROK) deserves serious consideration. The integration could be through energy trade (import/export), or the DPRK facilitating a transit route.

TOTAL SIZE OF INVESTMENT NEEDS

Based on the above, the total energy investment needs of China, the ROK, the DPRK, and Mongolia (which we add here) over the next ten years is estimated at US$800-US$830 billion. The indicative estimate for meeting the infrastructure needs (energy, as well as roads and telecommunications) of these countries is estimated to be US$1,400-US$1,700 billion over the next ten years.

These are clearly "ball park" estimates, a function of many variables such as domestic and international prices, structure of the sector, the legal, regulatory and policy framework, the performance of global and regional economies, technology and innovations, and political environments. Nonetheless, the thrust of the discussion does not change, in that the demand for energy and infrastructure in Northeast Asia will continue to increase substantially, the corresponding investment needs will be large, and the financing required to meet most of these investments would have to come from the private sector, regionally and internationally.

Although the size of the above investment is large, it is still small in relation to the size of Northeast Asia's GDP. Resources available in the global capital market could meet a good portion of the investment requirements. The challenge, however, is to develop an investment climate that will be attractive to private investors.

THE INVESTMENT ENVIRONMENT AND INTEGRATION

It is only recently that we have begun to analyze and quantify the cost of doing business in different countries. Some of the result are revealing, in that the negative impacts of an adverse business climate on investment growth is far more significant than originally perceived. A good investment climate is conducive to higher productivity. The investment climate includes the country's institutional, legal, and regulatory frameworks, as well as the environment under which everyday business is conducted—from frequency of power outages to the number of days required to clear export/import items through customs, or to get a telephone line connection.

While the negative impacts of these elements are different on different economies, their common feature is that that they all act as trade barriers and cause slower growth. For example, a recent survey shows that the investors' highest concerns in developing Asia are corruption, inflation, and policy stability.[9] In countries where these concerns may not be at issue, a high tax, for example, can act as a barrier. Although appropriate tax policies are effective instruments to promote domestic and foreign investments, the most effective instruments are the ones that remove obstacles to growth such as heavy regulations, lack of infrastructure, and inadequate

8. Mohammad Farhandi, "DPRK's Energy Sector Issues and Options," 2003.

9. World Bank, *Removing Obstacles to Growth: An Overview*, 2004.

institutions. The cost of heavy regulations on the investment environment is high by any measure.[10]

The average difference between poorer and wealthier countries on "doing business" cost indicators is threefold.[11] Another survey shows that companies in countries with positive conditions in areas such as corruption, policy unpredictability, high taxes, and poor domestic financial market, experience on average a sales growth that is 11% more than those operating in countries where these factors are negative.[12] Further, there are indirect costs associated with doing business in a negative investment climate, for example, the tendency of firms to underreport revenues where there are weak policy and institutional conditions.

The evidence is thus overwhelming that investment climate has a significant impact on investment growth, including the size of investment and sources of private sector financing—and private sector sources will have to provide the lion's share of Northeast Asia's investment needs.

An essential element of a sound investment climate is meaningful integration. China is far higher on the list of countries in which it is easy to do business, for example, than are Brazil and Argentina. It takes 5-6 days to clear imports through Shanghai customs, but it takes up to 15 days in Rio de Janeiro. It takes up to five months to obtain a telephone connection in Dhaka but only seven days in Tianjin. Losses due to power outages in Karachi are 6% of total sales, but in Shanghai they amount to only 1.5%.[13] While individual countries' trade policies play important roles in the growth of investment, high productivity is partly related to the greater integration that comes with a sound investment climate: there is a strong correlation between investment climate and integration. Chinese success over the past two decades can, for the most part, be attributed to providing an easier business environment and striving for greater integration.

10. It must be noted that regulations also exist in those countries in which the cost of doing business is among the lowest (i.e., New Zealand), but regulations are less costly and burdensome. See World Bank, *Removing Obstacles to Growth: An Overview*, 2004.

11. World Bank, *Removing Obstacles to Growth: An Overview*, 2004. For example, a survey has shown that it takes 153 days to start a business in Maputo, but only two days in Toronto; it takes 21 procedures to register commercial properties in Nigeria, but three procedures in Helsinki; it costs about US$2,000 to enforce a contract in Indonesia, while it costs US$1,300 in Korea; and, in India, a creditor gets 13 cents on the dollar in case of a debtor's bankruptcy, in Japan, 90 cents on the dollar

12. Batra, D. Kaufman and A.H. W. Stone, *Investment Climate Around the World; Voices of the Firms from the World Business Environment Survey*, 2003. Also, if hypothetical improvements can be made on all aspects of the "doing business" indicators in a country to reach the top quartile of countries, annual economic growth can be raised by an estimated 1.4-2.2 percentage points.

13. D. Dollar, M. Hallward-Driemeier and T. Mengistae, *Investment Climate and International Integration*, 2004.

CHALLENGES IN THE NORTHEAST ASIAN INVESTMENT ENVIRONMENT

We have addressed the amount of capital investment that is required to meet the demand for energy in the world. Whether all this required investment is achieved or not will depend on how favorable an investment climate is provided and how efficiently each government overcomes the challenges and obstacles. In order to realize the expected investment in this region, what is needed are:

- more rigorous sector reforms, notably more cost-reflecting pricing and improved collection
- more stable and predictable investment regimes
- better corporate governance
- development of domestic financial markets
- stronger incentives for private and foreign investors.

Chapter 6

The Institutional and Policy Environment, and the Role of Government

POLITICAL CONTEXT

The lack of strong political commitments by the governments of the countries involved is probably the most important, single, contributing factor to slow progress in energy trade in Northeast Asia. This in part stems from the concern that the oil or gas supply could be used for political leverage, in one form or another, by either supplier or consumer countries. Although this is possible, it is becoming increasingly impractical for countries to exercise this type of political leverage. Economic interdependence across the globe has created a "web" of vast networks through which numerous options for transactions and trades are available, thus making it highly unlikely that an action of a single country alone could cause a disruption of supply.

TRADE BARRIERS

Large-scale energy trade is hampered by political constraints linked to governments' regional and national objectives and priorities, including the perception that greater integration is a threat to strategically important national energy entities. The differing pace of hydrocarbon sector reform across countries also impedes trade, and the institutional and regulatory frameworks needed to develop and operate cross-border gas transmission networks efficiently are not in place. There are potential conflicts between private sector interests, which are more likely to have a narrow project-by-project approach, and the broader public sector interest of optimizing energy utilization as a whole.

INSTITUTIONAL CONTEXT

Another impeding factor is the inadequate institutional context for moving this initiative forward. Japan, China, and South Korea all have obvious interests in seeking arrangements to increase the supply of oil and gas. Russia has an incentive to gain from the sale of its large reserves in eastern Russia and in promoting economic development in a region with high potential but significant under-investment. Thus, potential exists for a mutually advantageous energy trade for all these countries. But progress has been slow because, despite having large economies, the countries of Northeast Asia have relatively underdeveloped mechanisms for inter-governmental coordination and cooperation at the regional level. Northeast Asia has not yet reached the level of cooperation and coordination of ASEAN or the European Union. Economic relations are conducted almost exclusively on a bilateral basis. This may be sufficient for general trade and investment, but not for promoting industries bound to a regional infrastructure, such as the energy trade.

THE ROLE OF GOVERNMENT

The role of the governments in the receiving countries in cross-border energy trade will raise many new policy issues for governments in the region, and the interaction between government and the marketplace will have a significant bearing on trade development. For instance, governments need to decide on the role of existing

national energy companies and whether these companies will become more commercial or remain full or quasi-monopolies. Whether strong domestic capital markets develop will have a significant bearing on the possible privatization of these entities.

Furthermore, many regional governments see a close linkage between economic and social development and energy policy, and hence engage in substantial intervention in gas markets. In particular, gas prices are often subsidized in one or more sectors of the economy, or gas resources are allocated to specific market sectors on the basis of the expected broader macroeconomic benefits of developing these sectors. Such measures to address social or industrial policy objectives tend to undermine efforts to conserve energy and make it more difficult to optimize the economic use of gas and obtain necessary investment in infrastructure. This leads to less than optimal use of national economic resources as scarce government funds are diverted to building additional supply capacity to meet artificially stimulated demand.

One of the major areas where natural gas competes with other fuels is electric power generation. While natural gas, especially gas imported via pipelines or as LNG, has higher fuel costs, the capital investment for gas-fired plants is generally lower than for building similar plants that will burn coal or fuel oil. Overall, natural gas can compete with coal and fuel oil if higher environmental standards are set—for example, requiring plants that burn fuel oil and coal to be equipped with flue-gas desulfurization (FGD) units. Ultimately, the choice of fuels to be used, and at what plant-construction costs, will vary between different locations in different countries, and with the environmental regulations that are adopted.

THE ROLE OF THE PRIVATE SECTOR AND GOVERNMENT

If desirable policies are pursued, infrastructural issues can be addressed partially through private sector investments, especially in commercially viable projects such as some oil development and distribution networks and LNG terminals. However, for bigger projects with longer commitments, such as long-distance pipelines, *a precondition for attracting private sector investment will be strong government support.*

Since the mid-1990s, a wave of privatization and deregulation has been spreading across Asia. In almost every case, decision-making processes are being delegated to the end-users who, with the help of banks, are increasingly making the key investment choices. Under these circumstances, project financing avoids mega-projects that require long-term commitments predicated on expectations of enduring, robust economic performance. This problem is more complex for pipeline gas than perhaps for oil and certainly for LNG. Pipeline project costs are enormous, running anywhere from $10 to $30 billion. Moreover, the pipelines are long—2,000-7,000 kilometers (1,200-4,500 miles)—and usually involve broad cross-border issues. No private company can provide enough guarantees to convince international banks to finance such large projects over such long periods of time.

Therefore, governments, although they may wish to rely on private sector investment, have an important role to play in promoting risk management, a competitive investment environment, and access to funds through trade, legal, fiscal, and policy frameworks.

Chapter 7

Institutionalizing a Northeast Asian Community

REGIONAL COMMUNITY BUILDING: LESSONS FROM THE EU EXPERIENCE

There have always been two driving forces behind the process of European integration. One has been a political or ideological motivation, and the other a pragmatic, and to a large degree, economic preoccupation. The idealistic one was very prominent following World War II; the idea was that Europeans had to restructure and reorganize their continent. The argument was that if Europeans simply reverted to the old system of totally sovereign nation states in shifting alliances, then one day that would lead to war again. The challenge was to build a structure that would develop common interests, make the countries interdependent, make war impossible or at least unthinkable, and at the same time provide a set of institutions so that differences could be resolved around the table rather than on the battlefield. The second driving force is more pragmatic. Europe is a group of small and medium-size countries that are highly interdependent economically, ecologically, and in many other ways. Europeans have to find common solutions to common problems. These institutions not only enable Europeans to do that but also enable Europe to compete in the global arena in a way that the individual countries would be unable to compete.

But if there is a market at a European level, then at least in some areas of policy, common rules for that common market are needed. These include common rules on consumer protection, aspects of labor law, common rules relating to the environment, etc. These rules are needed to avoid distortions of competition where the country with the laxest standards may attempt to attract investment for that reason. Competition policy is another example of common rules.

Regarding energy, Europe established the European Coal and Steel Community (ECSC) and ELRATOM for transnational cooperation in the fields of coal, steel, and nuclear energy. This was the first recognition that the evolution of industrial society had outgrown the limits of the nation state; that the future lay with those who worked together in partnership and cooperation; and that those who integrated would outcompete those who did not. The ECSC and ELRATOM were transformed step by step into a new entity that few of their founders could have imagined. The European Union also cooperates in foreign policy matters. Where it can agree to speak with one voice, it amplifies the European position. This does not mean that the member states are integrating everything; they are not creating a centralized system. Most areas of policy remain national.

It bears repeating, that the European Union, even when it was described as the European Economic Community, was always about more than just free trade. European integration was in many respects a reaction to war, and although currently a "European identity" and "common heritage" are stressed among proponents of the European Union, this was not always the case. The road to integration and overcoming differences has been long and challenging and has required vision and political will. It has always been a political project beyond mere trade. Trade was just the starting point, from which the European Union has evolved.

DIVERSITY AND A NORTHEAST ASIAN COMMUNITY

Observers of Northeast Asia commonly remark on the great diversity between the countries of the region. For the purposes of this report, we may also remark on their diversity in terms of indigenous energy resources, energy requirements, and policy priorities. However, *diversity of energy circumstances is no barrier to energy integration*. Indeed, the very essence of an international market in any commodity is the ability to match supply and demand across national frontiers. But when asked to reflect on an Asian Energy Community, we mean something more than this sort of bilateral (or even multilateral) mutual exchange, project by project.

When political, economic or social communities are formed, they are inspired by the expectation that collective activity will bring benefit to the members, beyond that which they could hope to achieve individually or through project-based collaboration. Several such international energy communities have already been constituted. The diversity of the energy circumstances of the countries of Northeast Asia is not necessarily an obstacle to some form of association. Everything depends on the objective. Countries with very diverse backgrounds can come together if they perceive a *clear mutual interest*. There is much diversity among OPEC members, and the International Energy Agency (IEA) membership is highly diverse. But members of the IEA have a clear mutual interest in economic stability, underpinned by a secure energy supply. That commitment to mutual support in an oil crisis was the motivating force for those who created the IEA and those who have since joined. *But their mutual commitment now extends well beyond that single issue*.

Therefore, there is no reason, in principle, why the countries of Northeast Asia, despite their very different energy situations, should not form an energy community, if there are clear common principles to which they subscribe and if they perceive that clear mutual benefit can be derived from association. One must ask, of course, whether there is some unique quality that might bring together the countries of this region. One thing for which there is always room is dialogue between different interest groups. We have seen pragmatic examples of such dialogue in Northeast Asia in various conferences and fora, without institutionalization. It might be formalized by some form of intergovernmental commitment. But that step should be taken only if there are clear benefits in view. Governments need to be involved in a successful process like this, only when their commitment can be expected to eliminate obstacles to a clear, common objective.

So why should governments and industry bother with such efforts? And what about community and citizen end-users? Promoting the necessary frameworks for expansion of energy trade and gas use in the Asia-Pacific community is a win-win undertaking. Individual energy end-users win because gas is more efficient—which can mean it is cheaper—and cleaner. Business wins because it sees energy and gas in particular as a good investment—both energy exporters and importers can benefit from the increased market activity. Finally, governments can also benefit when its citizens and industries benefit. Some governments will win, owing to increased energy security (rising from reduced reliance on oil, diversified sources, and stronger functioning gas markets) and improved geopolitical relationships.

CONCLUSION

PROJECT AND RESEARCH PROPOSALS

In the first five years of the Northeast Asia Economic Forum (NEAEF) project on a Northeast Asian Energy Community, significant steps were taken in analyzing changes in global energy markets, natural gas markets, production and distribution alternatives, the investment environment of the region, and the institutional and policy environment. Emphasis was placed on integrating these analyses as well as various projects proposed to bring Russian energy resources to Northeast Asia into a framework or "Grand Design" that would facilitate regional cooperation and ultimately energy security.

Furthermore, the first five years of the NEAEF initiative succeeded in establishing a network of parliamentarians and experts willing to participate and further policy-level dialogue on a Northeast Asian Energy Community. Given the lack of regional institutions and the expected high capital costs of financing the huge energy infrastructure development needs of the region, this is an important achievement. After all, it is up to politicians to muster the will and to advance politically sustainable arguments that would cause the body politic to consider the costs of *not* achieving: diversification of energy sources, greater energy efficiency, and financing energy infrastructure development. Our discussions of energy requirements and dimensions of sustainability will be to no avail unless they are presented in such a way as to enhance the enlightened self-interest of a politically motivated public.

Having formulated a general framework for a Northeast Asian Energy Community, the NEAEF proposes the following steps designed to bring the region closer to its goal of energy security, environmental sustainability, and political stability:

Supporting a Network and Dialogue of Parliamentarians

Following the recommendations of parliamentarians from Northeast Asia and the European Union that met at the European Parliament in Brussels in November 2003, the NEAEF will continue to facilitate a series of meetings of parliamentarians concerned with energy and security. During these meetings or working groups, parliamentarians will be able to share, informally, experience and approaches in energy-security policy-making and regional integration. In addition, parliamentarians will have an opportunity to review the concrete energy project proposals and technologies developed thus far and to question experts on these proposals. The network and dialogue aims to raise consciousness and expertise of parliamentarians on these issues and to elicit government-level commitment to eliminating obstacles to the clear common objective and benefits of Northeast Asian energy trade.

Analysis of Energy Strategies and Policies in Northeast Asia

We have begun with an analysis of Russian energy strategy and policy in the context of the Pacific Pipeline project. The NEAEF intends to broaden the scope of this analysis to include the energy strategies of Japan, China, and Korea, as well as the U.S. This analysis is particularly important, given the need to improve transparency in energy markets as well as policy and statistics. It also allows for monitoring of regulatory reforms.

Analysis of Projects and Assessment of their Regional Context and Benefit
The NEAEF has already identified a number of energy projects being proposed or considered at various levels of government. These include, but are not limited to, gas and oil pipelines from Eastern Siberia and the Russian Far East to Japan, China, and South Korea, and trade in electricity. They also include the gas-based projects proposed as strategies for resolving North Korea's energy crisis and the political-security issues of the Korean peninsula. Our analyses suggest that, as the next step, these various projects need to be reviewed and weighed against each other to compare their progress as well as their economic and political costs and benefits, economic, technical, and political feasibility, and their potential time frames and practical realization.

This should be a priority area for research, review and policy coordination given three important recent developments: (1) an increased sense of urgency in Japan, China, and South Korea over the need to diversify energy supplies and lower their dependence on the Middle East, (2) the impasse in KEDO, (3) the willingness of the U.S. and Northeast Asian countries to enter into multilateral dialogue over the North Korea nuclear proliferation issue, and (4) tentative indications from the U.S. side that it is not opposed to a gas-based strategy for resolving security issues in the Korean peninsula.

Policy Framework Integration
Despite the importance of the "market" and the private sector, government plays an indispensable role in solving the difficulties faced in organizing and financing a trans-continental pipeline system to move oil and gas and any of the other projects aimed a enhancing energy security. Government is involved in resolving framework issues regarding destination markets, routing, pipeline design, and in negotiating mutually acceptable sharing of procurement, construction, and costs. These crucial decisions are not made by one single-minded profit-maximizing entity in a market uncorrupted by special-interest political pressures. Government must ensure that political complications over these framework issues do not overwhelm the shared interest that the nations involved have in the total cost and economic viability of the energy transport system.

The NEAEF therefore recommends an initiative in policy framework integration that will clarify the role of government and will *prioritize* projects according to the *regional* economic and political benefits they can yield, and the *financial requirements* they demand. The NEAEF proposes that this last-named "financial dimension" requires specific attention and further study, as it is a critical determinant of project success. Research may include consideration of regional funding mechanisms such as a Northeast Asian Development Bank.

Institutional Arrangements and Policy Recommendations
It should be noted that the above three proposed areas of research and dialogue have been presented separately for purposes of analytical clarity. They are, however, inter-related and will be considered in reference to each other to yield institutional arrangements and policy recommendations.

COMMITMENT TO INDEPENDENT AND IMPARTIAL RESEARCH AND ACTIVITIES

The NEAEF is committed to providing independent and neutral research and policy recommendations. The NEAEF does not act on behalf of any specific country and aims to identify projects and proposals that serve the Northeast Asian region as a whole and that help advance economic cooperation and interdependence among the various countries involved.

The NEAEF does not act on behalf of any private company or special interest. It brings objectivity to research and proposals that will serve development of and cooperation within the region as a whole, rather than the more narrow interests of a particular business or sector. However, the NEAEF understands that the private sector is a critical stakeholder, and the NEAEF is therefore committed to clarifying the needs, interests, and roles of the private sector vis-à-vis a Northeast Asian Energy Community.

The NEAEF counts among its researchers and advisers not only experts with in-depth knowledge of the energy sector and economics, but also political figures with deep experience in balancing economic and political considerations as well as business and public needs.

The NEAEF's staff and network of experts and practitioners include individuals with expertise in international and energy economics, banking and finance, political science and governance, sociology, engineering, environmental science, and education, ensuring that research and activities are inter-disciplinary. The NEAEF's staff and network of experts and practitioners come from the Northeast Asian region itself and from North America and Europe, ensuring that research and activities are informed by national, regional, and global perspectives.

Appendix I

PACIFIC PIPELINE GOVERNMENT DIRECTIVE NO. 1737-P

On December 31, 2004, the official government website announced that, earlier in the day, the Russian Government had issued Directive № 1737-p concerning the project. The ten-point document includes the following instructions:

- Approve the proposal to construct the Taishet-Skovorodino-Perevoznaya Bay integrated oil pipeline system with an annual capacity of 80 Mt
- Authorize the Transneft Company to serve as chief contractor for the project's design and construction work
- Develop a program for geological exploration and licensing of hydrocarbon resources in Eastern Siberia and the Far Eastern region (Ministry of Natural Resources, in coordination with the Ministry of Industry and Energy, and the Ministry of Economic Development and Trade)
- Define by May 1, 2005, the construction schedule and the construction phases of the pipeline in coordination with opportunities for accessing hydrocarbon resources (Ministry of Industry and Energy and Ministry of Natural Resources, jointly with Transneft)
- Define the shipping routes and schedules in Perevoznaya Bay, near oil terminal facilities (Ministry of Transport, Ministry of Defense)
- Design the railway logistics for shipping (a) construction materials and equipment for the ESP oil pipeline; and (b) crude oil by railway in coordination with the construction schedule and implementation phases of the pipeline (Ministry of Transport, with the participation of RZD Russian Railways)
- Advise regional authorities (provinces) to provide support for the project
- Ensure that oil transportation tariffs support the reconstruction and operation of the existing pipeline system to Taishet and facilitate project financing (Federal Tariff Service)
- Define by May 1, 2005, possible measures that will enhance the economic feasibility of pipeline construction (Ministry of Industry and Energy, with the Ministry of Economic Development and Trade, and the Ministry of Finance)
- Coordinate and monitor work on implementing the project and report to the Government twice a year (Ministry of Industry and Energy)

PACIFIC PIPELINE DETAILS

Most of the pipeline will be laid underground, but it will also run through some 435 kilometers of marshland and more than a thousand kilometers of rocky terrain, mudflows, and steep hillsides. The pipeline will cross 50 rivers, both large and small, as well as dozens of motorways and railways. The underground sections of the pipeline will be covered by three layers of an anti-corrosion coating, while the overland pipeline will be protected by an epoxy coating and other special materials.

Motorway and railway crossings will be underground, including those in permafrost areas, which will have thermo-insulation. River crossings will be carried out using both the traditional trench and the trench-less technique.

Pipeline maintenance will be conducted by teams at linear stations located along the pipeline; these will be about 80–100 kilometers apart in mountainous areas, increasing to 200–250 km in flat sections. Remote pumping stations and linear valves in locations without roads will be equipped with helipads. Some 32 pumping stations have been designed, including 13 with tank farms with a total capacity of 2.67 billion cubic meters.

The list of installations to be built includes cargo terminals capable of accepting tankers of 300,000 tons deadweight, piers, and auxiliary facilities. The entire pipeline system will be fully automated to deal with emergencies.

Appendix II

SUMMARY OF ENERGY PROPOSALS FOR THE KOREAN PENINSULA

This appendix briefly introduces four specific projects that have been proposed to provide energy to North Korea. It has been suggested that these projects need to be reviewed and weighed against each other to compare their economic and political costs and benefits, economic, technical, and political feasibility, and their potential time frames and practical realization.

Joint construction of a coal-fired power plant in North Korea
The benefits of this proposed project included the low land and labor costs of construction in North Korea, the potential for exporting electricity to the South during peak periods, and low generation costs from using coal. Thus far, a test calculation of the cost and benefit under simplified assumptions shows a substantial net surplus. Several drawbacks to this project have been pointed out, among these the environmental and health impacts of a highly polluting energy source.

Cross-border transmission line linking the Russian Far East with North Korea
This project envisions the interconnection of the power grids of the southern part of the Russian Far East and North Korea by means of construction and joint usage of an AC transmission line in the territory of the two countries, thereby allowing electric power export from Russia to North Korea. The export of this electricity is dependent on the development of the Russian Far East's hydroelectric potential, in particular the commissioning of the Bureya hydropower generation facilities. Therefore, an important question is whether or not Russia is able to supply the necessary quantity of power to the DPRK.

Cross-border pipeline connecting Eastern Siberia/Russian Far East with South Korea by way of North Korea
The KoRus Gas Company was organized to build, own, and operate a natural gas pipeline from Sakhalin to the Korean peninsula. KoRus is a private consortium of Russian, South Korean and American companies. The proposed route of the pipeline runs from Lazarev to Khabarovsk to Vladivostok in Russia and from Vladivostok onshore through North Korea to a destination in South Korea. KoRus claims to have gained political support from North and South Korea, Russia, and the United States, and to have the endorsement of the United Nations and the IEA. In addition to the many route, design, engineering, financing and construction issues that all the projects face, there is the question of how quickly this project could offer delivery of energy to North Korea, with some experts claiming that it might not see results in less than 10-12 years from the time that it is agreed upon.

Construction of gas-fired electrical plant in North Korea and south-north pipeline
This new proposal suggests constructing a gas-fired combined-cycle electric power plant near Pyongyang (with others to follow) and constructing a natural gas pipeline north of the Incheon marine LNG terminals to this new gas-fired power station in North Korea. This project sees a commitment by KOGAS to import sufficient incremental LNG at Incheon to supply natural gas for the new power plant in the North. The second phase of this project would see a northward expansion of the natural gas pipeline from Pyongyang to its ultimate connection—gas sources in

Russia. Eventually the flow of gas will be reversed and the pipeline will serve as a conduit for Russian gas to North Korea, South Korea, and possibly Japan. This project claims to provide a speedier solution to energy supply and ultimately the nuclear proliferation issue.

All four projects outlined above should assume that North Korea must commit itself to irreversible termination of nuclear-weapons development and international transactions in weapons-related materials (and perhaps termination of nuclear power generation) as a condition of these investments, and must verifiably complete this termination prior to any deliveries of energy. However, these conditions are not explicit in all the proposed projects.

It should be noted that a further proposal has been made for building a trunk pipeline from Russia to South Korea under the Sea of Japan outside the territorial limits of North Korea, with one or more laterals from that trunkline into North Korea. This proposal, too, warrants review.

Appendix III

ECONOMIC ASSESSMENT OF NATURAL GAS PIPELINE PROJECTS FOR NORTHEAST ASIA

(under review)

Prospective PNG Projects

Irkutsk: Three routes
- Russia-Mongolia-China-South Korea
- Russia-Mongolia- China-North Korea-South Korea
- Russia- China-North Korea- South Korea

Yakutsk: Two routes
- Russia-China-North Korea
- Russia-North Korea-South Korea

Sakhalin: 2 routes
- Russia-China-North Korea-South Korea
- Russia-North Korea-South Korea

Economic Factors in PNG Project

Cost of field development
- Nature of natural gas reservoirs; size of gas-gathering facilities
- Kovtkya: $1.5-2 billion. Vilui: $1.2-2.4 billion. Sakhalin: $1.3-1.6 billion.

Length of transmission line
- Cost of project depends on the environmental conditions
  - Sakhalin/Japan option: (42-56") $0.95-1.4billion.
  - Irkutsk/Korea: (30-56") $6-14.5 billion.
  - Vilyui/Korea: (30-56") $6-15 billion.

Pressure and carrying capacity
- High pressure can reduce up to 30% of transportation cost
- Strong economies of scale in pipeline diameter

The size and sophistication of market
- The market should be large enough to recover the costs

Table 1. Assumptions for pipeline natural gas projects in Northeast Asian countries

Projects	S1	S2	Y1	Y2	I1	I2	I3
Russia							
Supply (mcm)	5,000	11,000	5,000	11,000	10,000	10,000	10,000
C. Distance (km)	1,155	1,905	2,045	3,415	727	727	1,610
Mongolia							
Supply (mcm)					500	500	
C. Distance (km)					1,439	1,439	
China							
Supply (mcm)	6,000		6,000		10,000	10,000	10,000
C. Distance (km)	2,005		2,895		3,450	3,491	3,390
North Korea							
Supply (mcm)	500	500	500	500		498	500
C. Distance (km)	2,522	2,405	3,412	3,915		108	3,907
South Korea							
Supply (mcm)	10,000	10,000	10,000	10,000	10,000	10,000	10,000
C. Distance (km)	2,776	2,649	3,656	4,159	4,115	4,252	4,151
Total Supply (mcm)	*21,500*	*21,500*	*21,500*	*21,500*	*30,500*	*31,000*	*30,500*

Source: KEEI.
Note: S1 & S2: Sakhalin 1 & 2; Y1 & Y2: Yakutsk 1 & 2; I1, I2 & I3: Irkutsk 1, 2 &3.

Table 2. Pipeline investment cost estimates (US$ million)

Projects	S1	S2	Y1	Y2	I1	I2	I3
Russia							
Pipeline	1,443	2,327	2,460	4,143	1,695	1,695	2,782
Compressor Station	489	789	834	1,404	574	572	943
Mongolia							
Pipeline					1,529	1,529	
Compressor Station					303	311	
China							
Pipeline	1,127		1,172		2,031	2,100	2,347
Compressor Station	227		236		521	424	474
North Korea							
Pipeline	398	641	398	641		498	498
Compressor Station	87	140	87	140		108	108
South Korea							
Pipeline	70	70	70	70	677	88	88
Compressor Station	98	98	98	98	145	123	123
Total Supply (mcm)	3,941	4,066	5,357	6,496	7,477	7,448	7,362

Source: KEEI.
Note: Constant unit cost of pipeline construction assumed for all projects; S1 & S2: Sakhalin 1 & 2; Y1 & Y2: Yakutsk 1 & 2; I1, I2 & I3: Irkutsk 1, 2 &3.

Table 3a. Transportation cost from Irkutsk: Route 1
(US$ per million Btu)

Route 1 (I1)			
Country	City	By Sector	By Country
Russia	Algalsk	0.216	0.541
	Briaji	0.349	
	Border	0.541	
Mongolia	Ulaanbaatar	0.525	0.525
China	Sunwha	0.263	0.872
	Beijing	0.384	
	Tianjin	0.456	
	Pakhong	0.595	
	Iljoe	0.732	
	Border	0.872	
S. Korea	Seoul	1.216	1.216
Trans. Cost to Seoul		3.153	
Joint Construction		2.639	

Source: KEEI.

Table 3b. Transportation cost from Irkutsk: Route 2
(US$ per million Btu)

Route 2 (I2)			
Country	City	By Sector	By Country
Russia	Algalsk	0.212	0.531
	Briaji	0.342	
	Border	0.531	
Mongolia	Ulaanbaatar	0.514	0.514
China	Sunwha	0.251	0.878
	Beijing	0.366	
	Shenyang	0.719	
	Border	0.878	
N. Korea	Pyongyang	0.3410	0.341
S. Korea	Seoul	0.860	0.860
Trans. Cost to Seoul		3.124	
Joint Construction		2.629	

Source: KEEI.

Table 3c. Transportation cost from Irkutsk: Route 3 (US$ per million Btu)

Route 3 (I3)			
Country	City	By Sector	By Country
Russia	Irkutsk	0.212	0.900
	Ulan-Ude	0.511	
	Chita	0.783	
	Border	0.900	
China	Changchun	0.701	0.929
	Shenyang	0.776	
	Border	0.929	
N. Korea	Pyongyang	0.341	0.341
S. Korea	Seoul	0.860	0.860
Trans. Cost to Seoul			302.7
Joint Construction			2.478

Source: KEEI.

Note: In route 2 and 3 transit cost of N. Korea is US$0.341 per million Btu. Route 3 is the most cost effective option; transit fee passing North Korea is cheaper than through Mongolia.

Table 4a. Transportation cost from Yakutsk: Route 1 (US$ per million Btu)

Route 1 (Y1)			
Country	City	By Sector	By Country
Russia	Yakutsk	0.228	1.049
	Tynda	0.752	
	Blagoveshchensk	1.049	
	Border	1.049	
China	Changchun	0.378	0.621
	Shenyang	0.459	
	Border	0.621	
N. Korea	Pyongyang	0.276	0.276
S. Korea	Seoul	0.850	0.850
Trans. Cost to Seoul		2.795	
Joint Construction		2.405	

Source: KEEI.
Note: No passage through China in Route 2 (Y2); need demand in Russian cities in route, transit in North Korea through both routes.

Table 4b. Transportation cost from Yakutsk: Route 2 (US$ per million Btu)

Route 2 (Y2)			
Country	City	By Sector	By Country
Russia	Yakutsk	0.223	1.803
	Tynda	0.767	
	Blagoveshchensk	1.070	
	Khabarovsk	1.411	
	Vladivostok	1.788	
	Border	1.803	
N. Korea	Pyongyang	0.430	0.430
S. Korea	Seoul	0.850	0.850
Trans. Cost to Seoul		3.083	
Joint Construction		2.706	

Source: KEEI.
Note: No passage through China in Route 2 (Y2); need demand in Russian cities in route, transit in North Korea through both routes.

Table 5a. Transportation cost from Sakhalin: Route 1 (US$ per million Btu)

Route 1 (Y1)			
Country	City	By Sector	By Country
Russia	Ohka	0.156	0.622
	Komsomolsk	0.456	
	Khabarovsk	0.599	
	Border	0.622	
China	Changchun	0.388	0.653
	Shenyang	0.477	
	Border	0.653	
N. Korea	Pyongyang	0.276	0.276
S. Korea	Seoul	0.850	0.850
Trans. Cost to Seoul		2.401	
Joint Construction		2.057	

Source: KEEI.
Note: No passage through China in Route 2 (Y2); need demand in Russian cities in route, transit in N. Korea through both routes.

Table 5b. Transportation cost from Sakhalin: Route 2 (US$ per million Btu)

Route 2 (Y2)			
Country	City	By Sector	By Country
Russia	Ohka	0.168	1.083
	Komsomolsk	0.498	
	Khabarovsk	0.647	
	Vladivostok	1.067	
	Border	1.083	
N. Korea	Pyongyang	0.430	0.430
S. Korea	Seoul	0.850	0.850
Trans. Cost to Seoul		2.364	
Joint Construction		2.043	

Source: KEEI.
Note: No passage through China in Route 2 (Y2); need demand in Russian cities in route, transit in N. Korea through both routes.

Table 6. Estimated import cost to South Korea (US$ per million Btu)

	SI	S2	Y1	Y2	I1	I2	I3
Transport cost	2.40	2.36	2.80	3.08	3.15	3.21	3.03
Import cost	3.10-3.40	2.86-3.36	3.30-3.80	3.58-4.08	3.65-4.15	3.71-4.21	3.53-4.03

Source: KEEI.
Note: Assuming $0.5~1.0 per Mbtu for gas field cost; most projects are competitive with LNG; Sakhalin projects appear most competitive; with interconnection between Sakhalin and Yakutsk, transport cost to Seoul is about $2.317/Mbtu; with interconnection between Irtkusk and Yakutsk, transport cost to Seoul is about $2.358/Mbtu.

Table 7. Sensitivity analysis: transportation cost from Sakhalin (US$ per million Btu)

	Reference	30% increase in investment cost (A)	Inc. up 30bcm (B)	A+B
Route 1	2.40	2.77	1.80	2.08
Route 2	2.36	2.81	1.63	1.94

Source: KEEI.
Note: With 30% increase investment cost, transportation cost increases 15% (route 1) and 19% (route 2). With volume increase (up to 30bcm), Transportation cost decreases 25% (route 1) and 30% (route 2); combining (A) and (B), transportation cost decreases 13% (route 1) and 17% (route 2)

Table 8a. Sensitivity analysis: transportation cost from Sakhalin: Route 1 (US$ per million Btu with 30 bcm)

Route 1 (Y1)			
Country	City	By Sector	By Country
Russia	Ohka	0.112	0.447
	Komsomolsk	0.328	
	Khabarovsk	0.431	
	Border	0.447	
China	Changchun	0.289	0.487
	Shenyang	0.356	
	Border	0.487	
N. Korea	Pyongyang	0.214	0.214
S. Korea	Seoul	0.654	0.654
Trans. Cost to Seoul		1.802	
Joint Construction		1.511	

Source: KEEI.
Note: Route 1. Russia and China increase to 20bcm; Route 2. Russia and Korea consume 15bcm/a rep.

Table 8b. Sensitivity analysis: transportation cost from Sakhalin: Route 2 (US$ per million Btu with 30 bcm)

Route 2 (Y2)			
Country	City	By Sector	By Country
Russia	Ohka	0.120	0.773
	Komsomolsk	0.352	
	Khabarovsk	0.462	
	Vladivostok	0.761	
	Border	0.773	
N. Korea	Pyongyang	0.290	0.290
S. Korea	Seoul	0.567	0.567
Trans. Cost to Seoul		1.630	
Joint Construction		1.443	

Source: KEEI.
Note: Route 1. Russia and China increase to 20bcm; Route 2. Russia and Korea consume 15bcm/a rep.

Table 9a. Sensitivity analysis: transportation cost from Sakhalin: Route 1 (with 30% increase in investment cost)

Route 1 (Y1)			
Country	City	By Sector	By Country
Russia	Ohka	0.195	0.782
	Komsomolsk	0.573	
	Khabarovsk	0.752	
	Border	0.782	
China	Changchun	0.451	0.760
	Shenyang	0.554	
	Border	0.760	
N. Korea	Pyongyang	0.353	0.353
S. Korea	Seoul	0.877	0.877
Trans. Cost to Seoul		2.772	
Joint Construction		2.418	

Source: KEEI.

Table 9b. Sensitivity analysis: transportation cost from Sakhalin: Route 2 (with 30% increase in investment cost)

Route 2 (Y2)			
Country	City	By Sector	By Country
Russia	Ohka	0.214	0.773
	Komsomolsk	0.627	
	Khabarovsk	0.823	
	Vladivostok	1.358	
	Border	1.378	
N. Korea	Pyongyang	0.554	0.554
S. Korea	Seoul	0.878	0.878
Trans. Cost to Seoul		2.811	
Joint Construction		2.473	

Source: KEEI.

Table 10a. Sensitivity analysis: transportation cost from Sakhalin: Route 1 (30bcm-30% increase in investment cost)

Route 1 (Y1)			
Country	City	By Sector	By Country
Russia	Ohka	0.141	0.562
	Komsomolsk	0.412	
	Khabarovsk	0.541	
	Border	0.562	
China	Changchun	0.337	0.567
	Shenyang	0.414	
	Border	0.567	
N. Korea	Pyongyang	0.274	0.274
S. Korea	Seoul	0.675	0.675
Trans. Cost to Seoul		2.078	
Joint Construction		1.776	

Source: KEEI.

Table 10b. Sensitivity analysis: transportation cost from Sakhalin: Route 2 (30bcm-30% increase in investment cost)

Route 2 (Y2)			
Country	City	By Sector	By Country
Russia	Ohka		0.983
	Komsomolsk		
	Khabarovsk		
	Vladivostok		
	Border		
N. Korea	Pyongyang	0.374	0.374
S. Korea	Seoul	0.586	0.586
Trans. Cost to Seoul		1.943	
Joint Construction		1.747	

Source: KEEI.

Table 11. Issues in PNG projects in Northeast Asia (bcm)

Gas Field	A+B+C1	C2
Irkutsk		
Verkhne-Chonskoye	11.7	83.8
Kovytinskoye	296.7	1100.7
Sakha Rep.		
Talakanskoye	35.5	18.6
Chanyandinskoye	164.8	44.7
Srednebotuobinskoye	152.3	18.6
Srednevilyuiskoye	160.0	
Sredbetyungskoye	156.2	9.2
Sakhalin		
Piltun-Askokhskoye	58.9	19.3
Lunskoye	324.5	59.6
Arkutun-Daginskoye	22.0	46.2
Chaivo	113.9	26.6
Odoptu-More	58.1	26.2

Source: KEEI.
Note: Reserve 1) Project will be viable only if gas reserve is large enough to recover the costs incurred in pipeline construction and bringing the gas to market; 2) If gas pipeline project crosses several countries, development costs are higher.

Table 12. Risk management: corruption ranking

Country	Rank	Score	Country	Rank	Score
New Zealand	1	9.43	Indonesia	45	2.65
Japan	17	7.05	India	46	2.63
South Korea	27	5.02	Russia	47	2.58
Taiwan	29	4.98	China	49	2.43

Source: Asian Wall Street Journal

Table 13. Risk management: country risk

0-20%	20-40%	40-60%	60-80%	80-100%
Hong Kong	Thailand	Philippines		Iraq
Taiwan	Malaysia	India		Russia
Singapore	South Korea	Indonesia		
	China (94/8)	China (94/12)		

Source: The Economist

Table 14. Risk hedge: political risks

Risk	Hedging Tools	Who Provides Hedge
Availability of licenses and permits	Good working relationship with government	Sponsors
Country risk	Investment	Insurance Company
Sovereign risk	Structure project to include government	Sponsors

Table 15. Risk hedge: rate risks

Risk	Hedging Tools	Who Provides Hedge
Exchange rate risk	Options, futures, swaps,	Financial institution
Inflation rate risk	Long-term supply contract with price schedules	Suppliers and purchasers
Interest rate risk	Fixed rate loans, interest ceiling clauses, interest rate derivatives	Financial institutions, lenders

Source: KEEI.

Table 16. Risk hedge: construction risks

Risk	Hedging Tools	Who Provides Hedge
Supply, raw material and availability of building material	Supply-or-pay contract	Supplier
Contractor performance	Feasibility study	Sponsors
Force majeure	Insurance	Insurance agency
Cost over runs	Completion guarantee Stand-by credit	Contractor Lender
Delays	Completion guarantee	Contractor

Source: KEEI.

Table 17. Risk hedge: operation risks

Risk	Hedging Tools	Who Provides Hedge
Energy supply	Long-term supply contract	Energy supplier
NG demand	Take-or-pay contract	Purchaser
Transportation of product to market	Long-term transportation contract	Transportation com.
Conflicts of interest among sponsors	Inter-sponsor contracts	Sponsors
Force majeure	Insurance	Insurance agency

Source: KEEI.