

**GEOPOLITICS OF NATURAL GAS:**  
**An Analysis of Prospective Developments in the**  
**Natural Gas Trade and Geopolitical Implications**

*A Joint Study Convened by the*  
*Stanford Program on Energy and Sustainable Development and the*  
*James A. Baker III Institute for Public Policy of Rice University*

Slowly and quietly, natural gas is drawing abreast of oil in geopolitical importance. A series of technological changes have made gas the fuel of choice for heating, as a feedstock for industrial uses, and as the fuel for the vast majority of new electric power plants the world around. Even coal-rich nations such as China and India are turning to gas—seeking the high efficiency and low environment impacts offered by gas-burning technologies. As a result, world gas demand is projected to grow by more than three-fourths over the next two decades, and the share of gas in world primary energy demand is to increase from one-fifth today to over one-quarter by 2020.<sup>1</sup>

While most experts agree that global gas supplies are sufficient to meet burgeoning demand for some time to come, the key challenge to meeting rising gas demand is transportation. As with oil, the world's richest gas resources are generally far removed from where they are needed. Western Europe, North America, South Asia and China—the areas where gas demand is projected to grow most rapidly—have relatively limited supplies, while over two-thirds of the world's proven gas reserves are located in Russia and the Middle East.<sup>2</sup> Southeast Asia has significant offshore deposits, but delivering this gas to market requires the construction of an extensive pipeline network. Delivering gas from concentrated supply sources to distant demand centers will require a major expansion of natural gas transportation infrastructures—pipelines to move compressed gas as well as ships to carry gas that is super-cooled to liquid form.

The growing importance of natural gas to modern economies will force new thinking about energy security. The U.S., for example, is in the midst of a rapid expansion of its capacity to import liquefied natural gas (LNG), which will expose U.S. gas markets to events overseas. A controversial project to pipe gas from Bolivia across Chile to LNG tankers and then to California helped trigger the recent downfall of the Bolivian government. Other exporters are also vying for the California market—such as Sakhalin on Russia's Pacific coast and from Indonesia. Yet Sakhalin's gas will not be immune from the periodic waves of nationalization that rock the Russian energy industry. Indonesia has also proved to be an unstable partner—its gas projects are located in areas beset by civil war.

While these concerns are just arriving on the agendas of policy makers in the U.S., other countries have a longer experience with gas imports. West European nations have imported gas by pipeline from Siberia and North Africa for more than two decades and today the continent depends on these regions for nearly half of its gas supplies. On the other side of the world, the isolated energy markets of Japan and South Korea dominate

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<sup>1</sup> World Energy Outlook, IEA 2000.

<sup>2</sup> BP Statistical Review of World Energy 2003.

the world LNG market, taking nearly 70% of all LNG imports. Yet the rapidly changing world gas trade combined with the forces of market liberalization are shaking up the bilateral trades and fixed prices that have dominated these markets to date.

Several research efforts to date have focused on the institutional mechanisms that play a crucial role in the development of international gas transport infrastructure. The recently completed World Bank (ESMAP) study *Cross-Border Oil and Gas Pipelines: Problems and Prospects* briefly examines twelve cases of cross-border energy infrastructures to identify common challenges and the best practices for mitigating these challenges.<sup>3</sup> The International Energy Agency (IEA) has convened a series of workshops on cross-border gas trade, including policy makers, industry experts and academics and continues to examine issues of gas import security.<sup>4</sup>

There is a voluminous literature on hypothetical gas transport projects—lines drawn with crayon on maps that represent the hundreds of authors' proposed gas lines. Some studies such as the *Shell Global Scenarios*, have considered gas infrastructure expansion in the broadest social and geopolitical contexts.<sup>5</sup> Still other efforts have focused on the specific economics of hypothetical natural gas pipeline options in specific regions. In 2000 the Asia Pacific Energy Research Center published two reports—one focused on the economics of gas pipeline options in Northeast Asia and a second on gas pipeline options for Southeast Asia.<sup>6</sup> Similarly, the Baker Institute at Rice University has analyzed the pipeline and LNG options for importing gas from the Russian Far East to Japan<sup>7</sup>. The International Institute for Applied Systems Analysis has also conducted a large-scale economic modeling effort to study the routing of Central Asian natural gas to European and Asian markets.<sup>8</sup> Every major enterprise that produces, transports or sells gas across borders enlists models to explore the economics of different projects and scenarios.

Much less attention has been focused on the interplay of the political and economic forces that affect (and often determine) which specific cross-border gas trade projects are constructed. Filling that niche is the aim of the Geopolitics of Natural Gas study. We are working on two tracks—one looks to the past, at actual built projects of gas infrastructures. The other track looks forward, with economic models of future gas trade and explores scenarios that have been informed by the historical case study research.

### *Historical Case Studies*

Not only are the world's major gas reserves far removed from where they are needed, but tapping those reserves implies pouring hundreds of billions of dollars into countries that

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<sup>3</sup> The World Bank study is available at: <http://www.worldbank.org/ogmc/crossborderoilandgaspipelines.pdf>

<sup>4</sup> For further information on the IEA efforts refer to: <http://www.iea.org/about/gas.htm>

<sup>5</sup> Shell International, *Shell Global Scenarios to 2020: People and Connections*, Public Summary, 2002.

<sup>6</sup> These studies are available on the APERC website at: <http://www.ieej.or.jp/aperc/>

<sup>7</sup> The Baker Institute study is available at: <http://www.rice.edu/projects/baker/Pubs/workingpapers/naturalgas/index.html>

<sup>8</sup> G. Klaasen, A. McDonald and J. Zhao, "The Future of Gas Infrastructures in Eurasia." *Energy Policy* (2000) vol. 29: 399-413

are often viewed as poor investment risks. These projects, especially pipelines, require dedicating capital resources to projects that are fixed to the ground—immobile, yet requiring often decades of operation to recover the initial investment. Six case studies focus on the special challenges of investing in such large-scale, long-distance gas transportation infrastructures. Those studies concentrate on countries that do not have the long histories of cooperation and/or the stable legal and political environments that are often seen as essential to attracting private investors—these are the “hard” cases to understand. The expansion of gas as a global fuel depends in large part on success in attracting investment within those political, institutional and economic environments. The studies examine the factors that explain why these projects were built and why alternative viable projects stalled (see Table 1).

**Table 1. Historical Case Studies of Cross-Border Gas Trade Infrastructure**

Case Study	Author(s)
1. Arun LNG	Steven W. Lewis and Fred von der Mehden, Rice University
2. Transmed	Mark Hayes, Stanford University
3. Yamal I	David Victor and Nadejda Victor, Stanford University
4. Southern Cone pipelines	David Mares, University of California San Diego
5. Turkmenistan-Iran	Martha Olcott, Carnegie Endowment for International Peace
6. Qatar LNG	Kohei Hashimoto, Institute for New International Political Systems

The project has developed a research protocol to guide the case study teams. Although each case study examines a complex story in its own right, the protocol ensures comparability across cases on key issues, notably:

1. **Transit country risks.** Three of the case studies involve transit countries and thus will facilitate analysis of transit risk and the strategies adopted to mitigate this risk in a range of market contexts.
2. **Changing market rules.** The time and geographic span of the six case studies will facilitate insights on the impacts of liberalization and increased role of the private sector in cross-border gas projects.
3. **Long-term contracts.** Investors and gas suppliers raise concerns over the shift away from long-term take-or-pay contracts. Other evidence suggests that these contracts were never as inviolable as perceived, and were mainly used as “smoke” for the banks. Each case study is examining the provisions of the contract structure.

4. **Security of supply issues.** Should importing countries be concerned about suppliers withholding supplies for economic or political gain? What does past experience tell us about this problem and how it is ameliorated? Insights from all cases.
5. **LNG vs. pipeline.** Case studies will provide insights into the non-cost factors affecting the choice of gas transport technologies.
6. **Delay/Lead times for new project development.** Preliminary evidence from the case studies suggests that many projects—especially first connections between countries may take over a decade to develop due to institutional barriers.

Early first drafts of all six of these case studies are on hand, and final drafts are expected in late February, ready for peer review.

### *Modeling the Future*

Simultaneous to the analyses of historical case studies, work is underway on the development of an economic model of world gas markets. The **World Gas Trade Model (WGTM)** is being developed by a team of scholars at Rice University and integrates the most up-to-date and detailed estimates of natural gas supplies with cutting-edge modeling architecture. This is just a starting point however, as many world energy models exist and make frequent predictions of future gas trade and growth.

The economic modeling will seek to integrate insights from our case study research and growing evidence of structural changes in the world gas trade—especially the shift toward more flexible trade in LNG and the development of regional trading hubs for gas.<sup>9</sup> The model will be structured to allow for analysis of key insights from the case studies, such as on the rigidity of long-term contracts and the (long) lead times often required for new project development. A model rooted in the political and institutional realities and possibilities of the gas trade would be distinct from the optimization models that are typically deployed in forward-looking studies of gas infrastructures.

The base runs from the model are expected in January 2004. At that point, the modeling team and members of the case study teams will work together on three applications of the model:

- Politics and Economics: the 1990s. We will calibrate the model to 1990 conditions and then run it for the period 1990 to 2003 using just technoeconomic variables, such as capital and operating costs of projects, gas reserves, and transportation distance. We will then compare the results for the “optimal” run with the real outcomes—the projects actually built in the 1990s. The modeling and case study teams, working together, will aim to explain the differences between the optimal and real outcomes. We will focus on ways to incorporate political, institutional and legal variables into the model so that an embellished

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<sup>9</sup> Previous research by Peter R. Hartley and Dagobert L. Brito at Rice University analyzed the shift from bilateral to multi-lateral trading in gas. See Hartley and Brito, “Using Sakhalin Gas in Japan”, James A. Baker III Institute for Public Policy, Rice University, Working Paper, November 2001.

- model better reflects this wider range of factors at work. We may prepare special runs in which we “layer” these additional variables—for example, adding indicators of political and investor risk to existing cost structures—to explore the sensitivity of outcomes to these factors.
- Making a market: the case of China. The first drafts of the case studies have revealed that some countries have “made” a market for gas with key projects—pipelines, LNG projects, or special price and regulatory arrangements. Examples include Japan in the aftermath of the Arab oil embargo and the Soviet Union with the creation of a twenty-year gas policy in the 1950s. The World Bank and national governments have also attempted to create markets for gas in several key South American countries. From these historical examples we are learning about the rates of change and the roles of key projects in “making a market;” these factors tend not to be reflected in economic models because they are explicit policy interventions, often pursued as “grand projects” with a governmental hand that does not follow a narrow economic path. China is already attempting to create such a market with the West-East pipeline project and a few LNG projects, but creation of a much larger market requires politically more challenging tasks—bringing gas from Russia (across or around Mongolia), allowing vast imports of LNG from politically unstable countries (e.g., Indonesia), displacing coal (and jobs), etc. Many of the challenges for Chinese policy arise not just from the higher short-term cost of gas (compared with coal) but also Chinese notions of energy security, which are often used to block energy import projects. We plan to use these insights to develop 2-3 storylines for possible creation of a gas market in China and to explore the consequences for regional and world gas markets with the WGTM.
  - Internal Reform: the role of state-owned enterprises. Nearly all the major gas exporting countries have built gas sectors that are dominated by state-owned enterprises (SOEs). This poses possible challenges for technoeconomic models. On the one hand, SOEs are integrated monopolies that can adopt a long-term perspective that is consistent with the long-run optimization framework that is often used in large scale energy models. On the other hand, SOEs are often highly dysfunctional entities—inefficient in their operations and often seized by the state to perform special functions, such as building large (often uneconomic) trophy projects. Often the state seizes large amounts of the SOE’s revenues for general budgetary purposes, which leaves the SOE unable to spend on long-term capital projects. (Similar patterns are evident in the electric sector, where Stanford’s PESD has devoted much research attention in recent years.) To date, the implications of this internal organization of the gas sector has not been examined in models. We will develop 2-3 storylines that will explore the implications using one key SOE as the example: Gazprom. We will examine the implications for Western European regional gas markets of alternative pathways in Gazprom reform. Among the issues will be the possibilities for high quantities of low cost gas if Gazprom reform leads to low transit fees for Turkmenistan and Kazakhstan (and a lesser degree Uzbekistan); similarly, creation of an open access pipeline regime could provide large quantities of associated gas from oil

operations (most of which is presently not transported from oil fields), available to sale inside the former Soviet Union or in the west.

Finally, the case studies and the modeling efforts will help to frame a discussion of the contours of the world gas market over the next three decades and its implications for political relations between nations—especially nations that will be required to build and operate costly shared gas infrastructures. We also will examine whether key gas suppliers could form a cartel—a “gas OPEC.” More broadly, attention will be given an investigation of whether market power will flow to port-accessible buyers or to major producers with spare capacities.

### *Implications*

Our goal is not only to explain the past with greater precision but also to look at possible futures in the shift to gas. We aim to develop visions for a future gas economy that are more firmly rooted in a realistic assessment of the political and institutional factors that have a large impact on investment in infrastructures and thus on the pace and character of the unfolding gas revolution. Although we focus on the political and institutional factors that will shape this gas transition, we also aim to speculate on the political *consequences* of a shift to gas. We expect that the shift to gas will bind nations together more tightly as more countries will be forced to build and operate shared infrastructures.

The study will conclude with two major products.

First, the study team will prepare an edited book volume that will integrate the results and present, in one place, all the major findings. (A draft outline for the book is attached.) To prepare the ground we are planning to host an event in February in Moscow with the Carnegie Endowment for International Peace focused on preliminary findings related to Russian and Turkmenistan gas exports to Europe and Turkey and the future shape of the liberalizing European gas market.

Second, the team will host a major conference that will bring together policy analysts, industry, and government representatives. We will present results from the study and focus a dialogue on the long-term implications of a gas-intensive world. This capstone conference will be held at Rice University in Houston, Texas in May 2004.

Further information on the Geopolitics of Natural Gas study, including meeting notes and presentations, is available at: <http://pesd.stanford.edu/research/natgas.html>.

*DRAFT BOOK OUTLINE:*

**GEOPOLITICS AND THE EMERGENCE OF A GLOBAL NATURAL GAS MARKET**  
(page numbers are estimated pages, final printed form)

Preface by James A. Baker III, former U.S. Secretary of State (3 pages)

A. Introduction and Context (35 pgs total)

1. Introduction: Vision for this Study and the Development of International Trade in Natural Gas (35 pgs)— Amy Jaffe and David Victor

B. Historical Case Studies (170 pgs total)

2. Case Study Methods and Key Questions—David Victor and Mark Hayes (15 pgs)
3. Liquefied Natural Gas from Indonesia: The Arun project—Steve Lewis and Fred Von der Mehden (20 pgs)
4. The Transmed and Maghreb projects: Gas for Europe from North Africa—Mark Hayes (25 pgs)
5. Russian gas exports to Europe: the Yamal project through Belarus and Poland—David Victor and Nadejda Victor (25 pgs)
6. Gas Trade in the Southern Cone—David Mares (30 pgs)
7. International Gas in Central Asia: Turkmenistan, Iran, Russia and Afghanistan—Martha Olcott (20 pgs)
8. Liquefied Natural Gas from Qatar: The Qatargas project—Kohei Hashimoto (20 pgs)
9. Implications: Comparative analysis of the Case Studies (15 pgs)—David Victor, Mark Hayes

C. International Gas Trade Economics (60 pgs total)

10. Basic model structure/Economic drivers—Kenneth Medlock, Peter Hartley and Jill Nesbitt
11. Analysis of Scenarios—Kenneth Medlock, Peter Hartley, Jill Nesbitt, Amy Jaffe and selected members of the case study teams
12. Gas export cartels and the evolving state of the LNG Market—Amy Jaffe and Ron Soligo

D. Implications

13. Gas Geopolitics in 2030 (20 pgs)—Amy Jaffe and David Victor

E. Bibliography

F. Appendices:

Appendix 1: Glossary of Key Terms, including all acronyms

Appendix 2: Case Study Research Design Additional Detail

Appendix 3: Gas Trade Model Description and Input Data