



A University-Business Learning Partnership

Shell Interdisciplinary Scholars Program 1997-1998

BEST PRACTICES IN ENERGY SECTOR REFORM

With Participation by the Colleges of Business, Social Sciences and NSM

Led by the CBA Energy Institute

PROPOSAL ABSTRACT

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Strong trends are emerging around the world toward market-based solutions for energy. How national governments approach energy sector reform is a matter of intense debate. We propose to join this debate in a significant way by addressing two research questions.

- *What are the critical variables that lead to success or failure of energy sector reforms?*
- *Is it possible to assemble a comprehensive database that leads to rigorous assessment and longitudinal, comparative study?*

Our unique approach and contribution to the debate will be the application of analytical tools typically used to evaluate the competitive positions of firms to that of countries, based on our premise that in implementing energy sector reform strategies, countries seek competitive positions with respect to worldwide capital investment. To our knowledge, this approach has not been attempted, at least in a way that provides access to results in the public domain. For this research effort we propose to assemble a team of faculty and students with broad experience in the oil and gas industries; to focus our research on oil and gas exploration and production and pipeline transportation; to investigate as our first sample of countries pairings that bracket general perceptions of success/failure with reform and importance with respect to oil and gas resource positions (U.S./Canada as the baseline, Mexico/Venezuela and Russia/Kazakhstan); to achieve as a specific outcome a National Science Foundation-competitive proposal for ongoing research; to provide specific and rich opportunities for student enhancement; and to provide, through the Energy Institute, specific and rich opportunities for linkages between UH faculty, staff and students and industry and government expertise in this arena.

BEST PRACTICES IN ENERGY SECTOR REFORM
Energy Institute
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INTRODUCTION
A World Trend?

Our lifetimes may well be marked by a sustained shift toward market-based solutions across a wide range of human activities. This trend is driven by many needs – to assemble capital for development, to facilitate self-determination and ultimately to improve quality of life. Historically, energy sectors have been characterized by the often heavy hand of government intervention. The extent of government involvement in energy varies across nations, but is strongest in countries that have been characterized by centralized planning. The strength and endurance of the trend toward market-based solutions for energy is a subject of intense debate around the world. How the debate is resolved – how this trend unfolds – will have a fundamental impact on individuals and businesses and on our energy futures. We believe that university-based research has an important role to play in this debate.

Our Central Questions and General Approach

Given the research statement above, we propose two central, related questions.

- *What are the critical variables that lead to success or failure of energy sector reforms?*
- *Is it possible to assemble a comprehensive database that leads to rigorous assessment and longitudinal, comparative study?*

The notion that countries, like businesses, can track their performance individually relative to their peers is compelling. Lester Thurow¹ popularized the concept of benchmarking as follows.

“A country that wants to win starts by closely studying the competition...Find those in the world that are the best at each aspect of economic performance. Measure your performance against theirs. Understand why they are better. Set yourself the target of first equaling, and then surpassing, their performance (p. 260).”

However, the term “benchmarking” has become somewhat controversial. The obvious problems are, What constitutes the standards of quality against which nations should benchmark themselves? And who should set those standards? With regard to the latter question, the direction of international capital flows is an indicator of which nations are passing the test, although many governments oppose being subjected to the vagaries of international capital markets. The more difficult question is the former. *We argue that quality standards can be revealed through case study assessments combined with comprehensive, objective data collection and analysis.*

In effect, we propose to apply a “best practices” form of analysis, typically used by individual companies, to the problem of government performance in the realm of energy sector organization, policy and regulation. This study will be conducted by an interdisciplinary team that combines knowledge of economic fundamentals for energy markets, geotechnical expertise for oil and gas development and the essential business analysis tools upon

¹ Lester Thurow. 1992. *Head to Head*. William Morrow & Company, Inc.: New York

which the study will be based. We will focus on oil and gas development, specifically on exploration and production (E&P) and transportation, the first two segments in the oil and gas value chain. We will restrict our study to national strategies across three pairs of countries: U.S./Canada (for a baseline), Mexico/Venezuela and Russia/Kazakhstan. These encompass three of the most important world energy regions with the last representing the generally accepted “new frontier” for major oil and gas discoveries and worldwide reserve additions.

Team Strategy

Because of the complexity of the research topic we have targeted, our strategy is to apply support from the Shell Interdisciplinary Scholars Program (Shell Program) toward development of a competitive National Science Foundation (NSF) proposal while producing specific outputs from the Shell funding. In our view, this is the highest and best use of funds that the Shell Oil Foundation has provided to UH.

We have a long-term commitment to our proposed area of research through the Energy Institute based in the College of Business Administration. A specific goal for the Institute is to foster comparative research at UH on issues associated with commercial energy development around the world. We envision ultimately a multi-year study leading to a permanent database and archive housed at the Institute that can support integrated, cross-disciplinary research on a host of related questions and topics. We would conduct periodic reviews and assessments from this database of how countries and regions are performing, an effort that would lead to recommendations and perhaps influence new and better strategies for governments and both state-owned and private companies.

The energy-related experience of our research team reflects areas of study for which UH is well-known and that have great bearing on our topic: the development of oil and gas law in Russia, energy sector reform in Mexico and North American energy integration. In addition, our team includes recognized expertise on worldwide oil and gas development, in particular for the Former Soviet Union (FSU), and the application of scenario building, productivity analysis and other business decision science tools to specific problems. Our study will build on this experience while incorporating basic business, economics and geotechnical analysis to our central questions.

Student Enhancement

A specific goal for the Shell Interdisciplinary Scholars Program is to provide benefits to students at the University, and specifically to engage students in projects that lead to concrete team-building experiences. We feel that our proposed study will make a strong contribution to that goal in the following ways.

1. *Overall team-building and cross-fertilization.* Students from the geotechnical sciences will have an important opportunity to study the business side of energy development, while students from the economics and business disciplines will gain valuable insights on the technical and technological requirements associated with oil and gas development.
2. *Overall research experience.* This study is information and data intensive. Students will gain enormous experience in identifying complex variables, reliable sources and collecting information and data to support this research effort.
3. *Student teams to assist in methodology development.* Dr. Everette Gardner on our research team teaches a course in quality management each semester. This course has a strong focus on the analysis of best practices or benchmarking. Students are required to complete a six-week business project in this area as part of the course. During the spring semester, 1998, we intend to have at least one and possibly two teams of six persons to review and adapt the theory of benchmarking for our study. Dr. Michot Foss teaches an

MBA course on the energy industries, policy and strategy. During the spring semester we will build a class project around the theoretical and implementation aspects of country energy sector reform to support this research. *All of this work will be performed at no additional cost to the project by students with experience and familiarity in the oil and gas industries.*

4. *Student intern team to support database development.* Related to (2), we will form a student intern team for the project that will carry the responsibility of researching variables and preparing briefing papers on those variables that require in-depth understanding in order to establish how they interact with other data. We anticipate that several of these briefing papers will stand on their own as related research products, publishable in trade and, potentially, peer-review journals.
5. *Thesis/dissertation topics and support.* Both the research on individual variables as well as the broader scope of research will support the development of thesis and dissertation topics through to the completion of research requirements. We expect that funding extended to students through this project, in addition to supplemental funding, as well as success in securing an NSF grant, will support in part or in full graduate student research related to this study.
6. *Student internships at energy companies.* The intensity, depth, visibility and importance of our proposed study, and the interactions that our team of faculty and students will have with international oil and gas companies and consulting and research organizations, are such that we fully expect to place students as interns within these organizations, Shell Oil and Royal/Dutch Shell included. Our proposed study will also attract attention from the international development banks and financial community. For students seeking those opportunities, we believe that participation in this study will enhance the prospects for securing internships.
7. *Curriculum enhancement.* The Energy Institute is exploring the creation of an energy concentration for the MBA programs at UH and as a free-standing certificate program for degreed professionals across a variety of disciplines. The knowledge and experience gained from this research and the interactions among the many diverse groups and organizations that will be involved will add tremendously to the depth and richness of courses developed for the concentration/certificate.

Energy Institute Resources

We presented our proposed study to Energy Institute Corporate Sponsors, Advisory Board members and Senior Associates at the Institute's annual meeting on **December 11, 1997**. *Importantly, Corporate Sponsors of the Institute have expressed great interest in this project and the desire to make additional resources available to the Institute and University on behalf of our effort.* Through the Institute, we have several prospects for expanded support.

- Additional funding from Corporate Sponsors and assistance in securing funding from other sources.
- Experienced energy professionals from our Institute networks to provide research support.
- Interactions with key international organizations engaged in worldwide energy sector reform, such as the World Bank, regional development banks (InterAmerican, Asian, and the European Bank for Reconstruction and Development or EBRD).
- Interactions with key national agencies engaged in worldwide energy sector reform, such as the U.S. Agency for International Development (AID), Canada International Development Agency (CIDA), the European Commission directorates (in particular TACIS, which supports developments in central and eastern Europe and the FSU).
- Interactions with national energy agencies, ministries and commissions.
- Finally, we expect this study to benefit from interactions with private sector investment banks and financial institutions who are closely monitoring energy sector reforms. The link between energy sector management and energy project financing is a critical one, and it is the need for stable investment climates in order to develop financing that is driving many reform strategies.

Our proposed study has linkages to other elements of the Energy Institute portfolio.

- The Institute coordinates University participation in the U.S. AID/Hagler Bailly Consulting consortium for oil and gas development in the Central Asia Republics and the Republic of Georgia, as part of U.S. AID's overall efforts on behalf of the New Independent States (NIS) of the FSU. Our participation in this program provides opportunity for data collection, observation, key interactions with critical organizations and companies and some financial support for the most demanding aspect of our proposed research, the Russia/Kazakhstan component. On **December 17**, the Institute and University are hosting a delegation from Central Asia, including officials from Kazakhstan, as part of a U.S. study tour on oil and gas operations and regulatory management sponsored by U.S. AID. We will use that opportunity to begin building bridges for the purposes of this research effort. The UH portion of the study tour includes discussions at the Composites Engineering and Applications Center (CEAC) hosted by the College of Engineering; the Allied Geophysical Lab (AGL) and Geographic Information Systems (GIS) lab hosted by the College of Natural Sciences and Mathematics; and a roundtable on regulatory frameworks for energy hosted by the Institute.
- The Institute maintains an ongoing research/outreach effort on North American energy developments which includes Mexico and for which we are well known. We are strengthening our linkages to Canada, and have initiatives already in place such as our North American Energy Roundtables (with the next upcoming in April 1998) and our Shell Program-funded research on *North American Energy Integration* that can support both the U.S./Canada baseline and Mexico/Venezuela component. Several findings from *North American Energy Integration* have bearing for this proposed study. Importantly, however, *North American Energy Integration* is a conceptual analysis of policy and regulatory barriers to North American natural gas and electricity integration and trade that **did not** include quantitative database development. Our inclusion of the U.S./Canada baseline in this study is a natural extension of North American Energy Integration and represents a new effort.
- The Institute is engaged in a complex array of initiatives in Latin America, which includes efforts to expand our networks in Venezuela. This proposed study both will benefit from and enhance our Latin American program.
- The Institute is exploring development of a complimentary long-term research effort on national energy company best practices. These two research efforts will be strongly linked.

Interactions with Other University Initiatives

Energy sector management and reform are complex processes that affect and involve many aspects of society. Although the budget we have proposed for this study does not allow us to expand beyond the scope of research as described below, we intend to build a multi-dimensional context for this effort that will enrich the study and allow us to draw many additional implications.

- *Issues of Law.* The UH Law Center engaged in a prominent effort during 1991-1992, the Russian Petroleum Legislation Project. Faculty from the Law Center who were engaged in that effort will be included as advisors for this project. Their expertise, of course, extends well beyond the FSU. We will seek their input in a number of areas, including oil and gas, environmental, tax and other aspects of law that impact on, and are essential to, energy sector management. We anticipate that as additional funding sources for our research effort are developed, Law faculty and students will become engaged in our effort in a substantive way.
- *Socioeconomic, political, historical and cultural issues.* At UH we have a rich milieu of knowledge about societies that can shed light on energy sector management and reform. Some of this knowledge is specific to energy (for example, through studies at the Center for Public History CHECK ON). Some is specific to our

understanding of key world energy regions (for example, Center for the Americas and ongoing public opinion and related research on political developments in Russia). We will attempt to draw some of this expertise into our study.

RATIONALE FOR THIS PROJECT

We have identified several justifications for our research topic that have significant implications for outcomes.

- The research we are proposing here represents a new effort that is compatible with and will build upon previous research at the University. Much of what we are proposing is experimental, and has not been previously attempted in either the academic or private business realms. The notion that a rigorous best practices approach can be applied to what governments do is, in itself, a relatively untested concept.
- Many organizations are attempting to assess the success or failure of energy reform programs. For the most part, these efforts are inconsistent, often biased, and not comprehensive though they may provide valuable first looks at how reform strategies are unfolding. Researchers generally rely on case studies that, while useful, do not lead to the collection of data on common variables. In addition, much research on energy sector reform is proprietary.
- We recognize a need for independent, university-based research in an arena that is often politically charged.
- Our research will add value to the ongoing debate with distinct policy and business implications. The strategies that governments deploy today will have far-reaching consequences. Our belief is that academic institutions, and especially a university-business partnership such as the Energy Institute, can play an effective role in providing research that can inform and impact debate and policy making.

PROJECT DESCRIPTION

Background Concepts

The research we propose here embraces four concepts: marketization, oil and gas value chain development, world energy regions and worldwide energy industry organization. These concepts are integral to the design of the proposed study and our expected outputs, and are described in **Attachment 1**.

Work Statement

For our proposed study, we are concerned with the universality of methodology to examine energy development in immature or transition economies. When it comes to countries, assumptions about the context for energy sector reform will certainly vary, just as they may if one is benchmarking companies. The solution is to employ benchmarking techniques that isolate differences in context and point out methods of compensating for differences. The business literature is rich in tools and methods for quantifying subjective information, which is the problem at hand, and evaluating strengths and weaknesses among competitors, which is what countries vying for investment are. In our first Institute-led study for the Shell Program, *North American Energy Integration*, we learned the importance of context and dealt entirely with subjective information, but that study was designed only to yield a conceptual understanding. *The important and unique contribution of the study proposed here is the application of methodologies typically used to solve business problems to decisions made by governments in a business realm.* To our knowledge, this has not been previously attempted, although it is a logical solution to the dilemmas encountered in cross-national studies using traditional economic approaches.

Our team proposes the following.

1. We will conduct a feasibility study to assess a methodology for evaluating energy sector reform. Our long-term goal is to address the oil and gas value chains, upstream to downstream including end use (for example, gas-fired electricity). For this study, we will focus on the upstream (exploration and production of oil and gas) and transportation segments. *An important parameter in energy sector reform is the extent to which policies inhibit or promote value capture along each chain.*
2. Research of the type we are proposing lends itself to two basic options: development of a broad index across countries or case studies. We will blend these options by using a case study approach to establish a baseline – to identify variables that could be collected commonly across sample countries. Initially, two pairs will be considered, Russia/Kazakhstan and Mexico/Venezuela, bracketing general perceptions of success/failure in energy sector reform strategies and strong intra-regional competition for energy industry investment capital. The U.S./Canada pairing provides a baseline because of the availability of data and information, the strength of and parallels between our marketization processes and the understanding of context developed through *North American Energy Integration*.
3. The preliminary set of variables for our analysis are listed in the following table. Final selection of variables will hinge on our own preliminary scoping, literature searches, and, most importantly, interactions with industry and government expertise available through the Institute’s networks. Importantly, the integration of geotechnical factors with environmental considerations will be included.

VARIABLES	EXAMPLE CONSIDERATIONS
Resource ownership	State ownership constrains maximization of value from resource extraction and use
Energy sector management structure	Organization of government agencies impacts efficiencies
Financing for development	Centralized planning and financing impacts value maximization
Legal environment	Stability and transparency for property, contract and administrative law essential for private investment
Foreign participation	Restrictions on foreign participation impacts value maximization
Energy export market development	Tariff and nontariff barriers impact value maximization
Energy pricing	Subsidies impact efficient resource utilization and value maximization
Transportation infrastructure ownership and control	State monopoly impacts private and foreign investment and value maximization
Transportation policy (regulatory framework)	Clear regulatory rules promote stable investment climate
Proximity and size of nearby markets	Generally, the more difficult it is for a country to develop markets for its resources, the more inclined a government might be to energy sector reform
Equipment and technology	Access through private markets enhances value maximization
Environmental policies	Policy design impacts value maximization as well as environmental quality
Resource conservation practices	Policy design impacts efficient utilization and value maximization
Management skills	Familiarity with industry, international and market dynamics enhances investment climate and value maximization
*Technical training for scientists and skilled professionals in both geotechnical and business and related disciplines	Impacts technology development and transfer and creation or enhancement of indigenous work forces
Information handling systems for technical data	Lack of reliable systems impacts resource utilization and value maximization

VARIABLES	EXAMPLE CONSIDERATIONS
Oil and gas reserves and exploration potential	Generally, the less well-positioned a country is with respect to reserves and exploration potential, the more inclined a government might be to energy sector reform
Oil and gas production profile	Resource availability and past and present patterns of development impact resource utilization and market development
Environmental profile	Past and present environmental management practices impact investment climate and value maximization

* *Note that the technical training variable may have interesting long-term consequences for UH and the Institute. Should we find, in foreign markets, that energy companies must provide training in-house or build in-country training programs, we may identify value added opportunities to expand our own training role.*

- Our data collection and overall methodology will be driven by considerations of the analytical techniques we plan to use. For example, a useful analytical tool for the analysis of country reform strategies might be quality function deployment (QFD). We could adapt a QFD-style matrix to relate investor concerns with attributes of a country's energy sector from the previous variable list. In the initial stages of our study, we will focus on the specific analytical tools and the advantages or disadvantages of each relative to our unit of study – national government reform policies. Our overall methodology will be influenced by long-term goals for our research effort, such as reproducibility across other countries and regions, the extent to which our research should lead to specific policy recommendations and the impact on the research community that our contribution will make by offering a new approach. For our proposed Shell Program research we will employ the “process model” developed at the Institute.

GENERIC MODEL	ADAPTATION TO PROPOSED RESEARCH	1998 TIMEFRAME
Preliminary research to define problem area.	Preliminary scoping with Shell faculty/student team.	January-February
With interaction from Corporate Sponsors, Advisory Board and Senior Associates to expand problem area within framework of business-public policy issues associated with commercial energy development.	Use communication channels with Institute networks to solicit broad input for research design and potential outputs.	February-May
Use outreach mechanisms (roundtables and networks) to explore dimensions of problem area. Build roundtables around interdisciplinary expertise from core networks and outside expertise.	The Institute hosted an informal International Colloquium on Energy Sector Reform on June 18, 1997. We will use this annual workshop to further define the parameters of our analysis.	June
Identify specific research products to address problem area and support ongoing forum.	In addition to our final report for the Shell Program, we will identify key research and grantsmanship outputs, including a possible annual assessment of reform strategies.	June-August
Assemble interdisciplinary teams from core networks with links to additional expertise to carry out research initiatives.	Expand core Shell team with participation of key individuals from Institute networks.	June-August
Where possible, determine specific targets and timelines for accomplishments.	Timeframe for data collection and initial analysis.	April-August
Establish feedback loop from research products to ongoing forum.	Create linkages for review and evaluation feedback from data collection and analysis to draft and final reports.	June-December

GENERIC MODEL	ADAPTATION TO PROPOSED RESEARCH	1998 TIMEFRAME
Establish feedback loop from research products to training and other outreach elements to support problem solving.	Create linkages between this research and Institute-led initiatives on MBA curricula and training.	June-ongoing
Monitor results and set parameters for future achievements.	<ul style="list-style-type: none"> • Prepare and distribute Shell program draft report. • Distribute Shell Program final report • Evaluate study and prepare NSF grant proposals (see below) • Finalize and distribute ancillary research papers and products including graduate student research. • Evaluate and design annual assessment of reform strategies for long-term research and ongoing distribution. 	<ul style="list-style-type: none"> • October-November • January 1999 • November-August 1999 • August-ongoing • June-ongoing

Anticipated Results and Outcomes

From the table above, the end result of our study will be the best practices analysis for the sample countries. The most important outcome will be a go/no go decision on whether our research topic and ultimate methodology can successfully compete for NSF funding. We have identified at least two prospective NSF programs that we believe are compatible with our research. One is the recently established Grant Opportunities for Academic Liaisons with Industry (GOALI). The appeal of this program is its compatibility with the structure of the Energy Institute, a university-business partnership with an extensive network of industry and government advisors. GOALI proposals are accepted in February of each year. The second NSF outlet is the Decision, Risk and Management Science Program within the Social, Behavioral and Economic Sciences division at NSF. Proposals in research areas similar to ours have been funded through this program. Proposals to this program are due in January and August of each year.

While our expectation is that our study will yield positive results and a competitive NSF proposal, negative results will still yield useful, publishable information that adds to the body of knowledge. Funding sources outside of NSF will be identified in order to expand sponsored research opportunities. Our approach of using Institute networks and teams to their fullest extent will enhance funding prospects for a long-term effort.

We anticipate several specific research outputs from this study.

- *We expect to demonstrate that methods used to analyze the strengths and weaknesses of firms can also be used to analyze countries, and specifically to evaluate the effectiveness of energy sector reform strategies.*
- Based on these results, we expect to generate a positive result with regard to the next level of funding and effort for this research.
- We expect to reveal discernible differences across our sample of countries that can be linked to the status of their energy reform initiatives.
- We expect student research participation to generate tangible products in terms of supporting research papers and solutions from student teams for adapting business benchmarking methodologies to our study.
- We expect to produce observations that shed light on what governments must do in order to ensure successful reform strategies and on particular issues and constraints that act as barriers.

Evaluation Procedures

The ultimate final evaluation of our study will be the end products and publishable results. However, we anticipate that our effort will draw heavily upon industry and government expertise through the Energy Institute network. As a result, during the course of the study, we will constantly evaluate the choice of methodologies, identification of variables and analytical techniques with a broad array of advisors in order to ensure success. Our strategy for review and evaluation feedback are shown in the table above.

Long-Term Research Benefits and Spinoffs

In this proposal, we have identified several important, potential long-term research benefits and spinoffs that we will attempt to generate.

- Our goal is to create a long-term study effort through a combination of sponsored research and Corporate Sponsor participation.
- *Our long-term research will move quickly to best practices in downstream natural gas value chain management, including natural gas distribution and gas-fired electric power generation.* The natural gas value chain will continue to increase in importance as environmental imperatives grow. Already countries are moving to target natural gas resource development and utilization. The Institute and UH have been heavily engaged in this arena through initiatives in North America and elsewhere.
- The study we have proposed here is targets national government policies, but in many countries (notably the U.S., Canada, Australia, Russia) state, provincial or territorial governments have considerable control. Consequently, a potential spinoff from this research is to more precisely identify the effect of multijurisdictional policies on energy sector management.
- An annual “**scorecard**” assessment published through the Institute of country energy sector reform strategies.
- Graduate student research products, including thesis and dissertation outputs, and internships and curricula and training enrichment.

RESEARCH TEAM QUALIFICATIONS

Our team members and qualifications are as follows.

- **Dr. Michelle Michot Foss**, Director, Energy Institute and Assistant Research Professor, Decision and Information Sciences (DISC), co-PI and Project Manager – extensive research and publications on commercial energy developments in North America, Mexico and other world regions. The Institute is actively engaged in projects and programs in North American and worldwide.
- **Dr. John Casey**, Professor of Geosciences, NSM, co-PI – extensive field work in the earth sciences and broad expertise in petroleum assessment and environmental considerations.
- **Dr. Paul Gregory**, Cullen Professor of Economics – expert on Russian and East European economics and coordinator for the Russian petroleum law project at the UH Law Center, 1991-92.
- **Dr. Everette Gardner**, DISC, CBA – extensive research and publications in scenario analysis, forecasting and productivity analysis and Director of the Global Manufacturing Institute within the CBA.
- **Dr. Gürcan Gülen**, Research Associate, Energy Institute – expertise in world energy markets with a specialty in Turkey, the Middle East and surrounding regions.
- **Students** – A number of highly qualified graduate students, including those with energy industry experience, are available for involvement in this project. At least two students targeted for inclusion already are working in research areas pertinent to this study. As noted earlier, student participation will be crucial because of the extent of data collection and database management and modeling that will be required.



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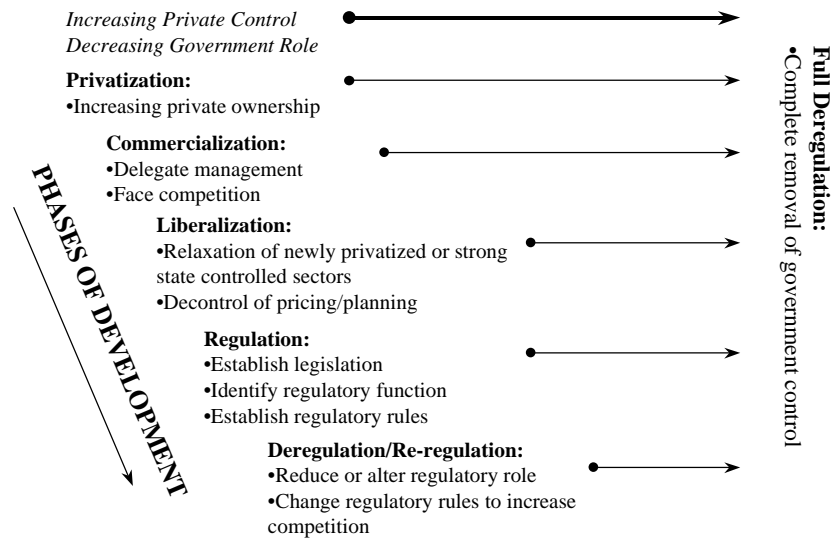
**ATTACHMENT
BACKGROUND CONCEPTS**

Marketization

The essence of our study is the process of “marketization,” the creation of rules and norms that lead to a properly functioning marketplace for energy. The economic tradition has a strict interpretation of what constitutes a market (many buyers and sellers engaged in free exchange of homogeneous products, unfettered resource mobility and price discovery) that is generally relaxed to include other key variables (such as property rights, a legal/institutional framework for contracting and enforcement of contract rights, and political stability and commitment). In specialized sectors like energy, a host of other variables come into play like workforce skills, quality of infrastructure and R&D capacity and technology transfer. Many types of institutional arrangements exist. One example is a totally free market for energy. Another might be a regulated market for energy (typical of the U.S. utility sectors). A third might be centralized government control.

At the Institute, we have developed a way of thinking about the process of marketization, as follows.

The Process of Marketization



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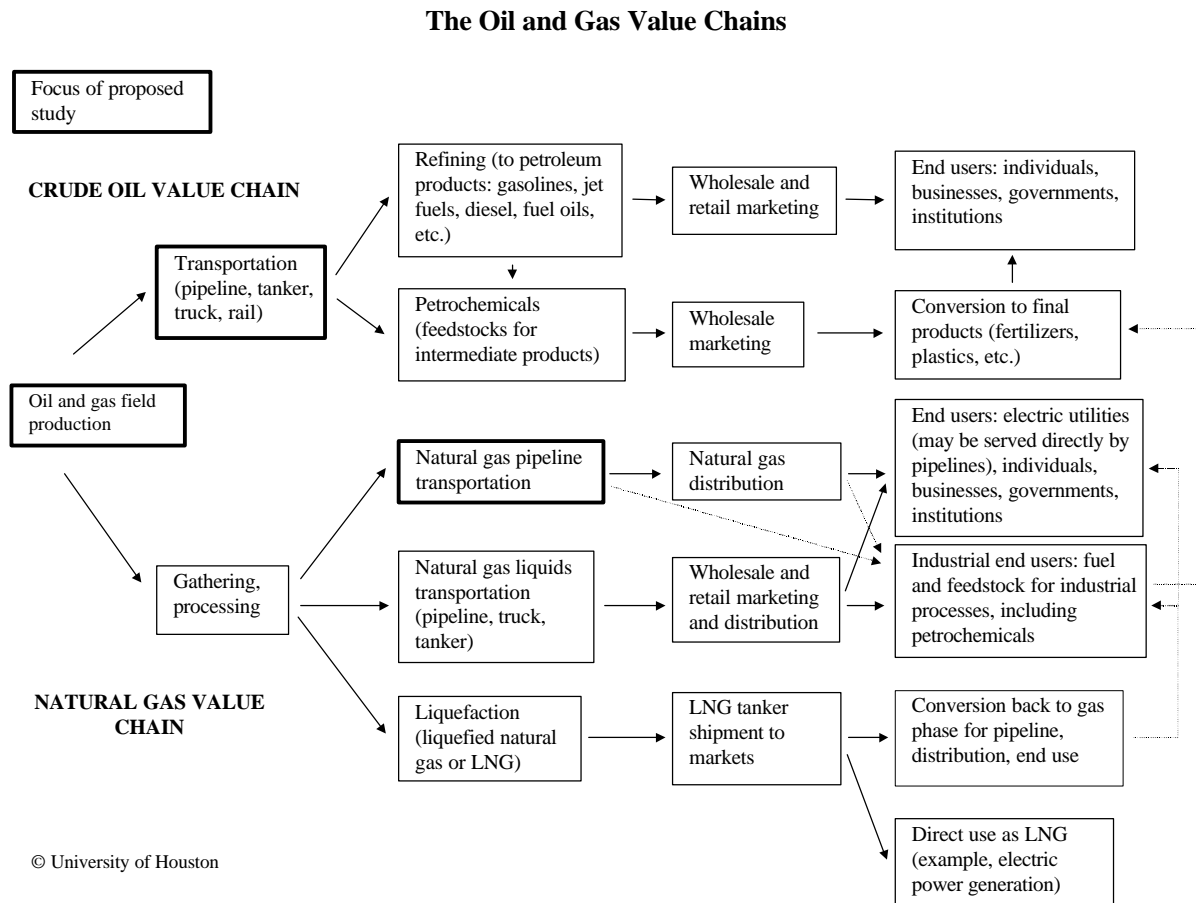
Source: Developed by Dr. Michot Foss for *Asian Oil and Gas: Megatrends, Balance and Geopolitics, a Closer Look at China* (Energy Institute).

Where a country is positioned with respect to the process of marketization is a function of overall economic development and maturity of the institutions that are fundamental to market operations. These institutions may be legal (the courts, body of law), economic (banking, stock exchanges), political (institutions of government, political parties, decision rules for law making), educational (sophistication and accessibility of educational

institutions) or scientific and technical (sources of technology development and processes for transfer and commercialization). In general, the more mature a nation is with respect to its economic development, the further along it is in the process of marketization, i.e., the closer it is to a minimal role for government in energy sector management.

Oil and Gas Value Chain Development

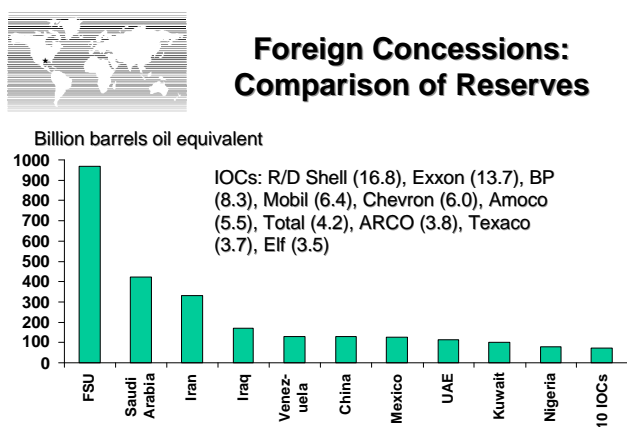
When it comes to oil and gas, the various segments of these industries are highly linked. From the discovery and production of oil and gas at the wellhead, through ultimate end use, value is created and added to the primary commodity, as shown in the simple schematic below.



In these complex industries, policies directed at one segment have implications throughout the value chain. Our proposed study focuses on the upstream (E&P) segments of the oil and gas and the interface with pipeline transportation. (Generally, natural gas gathering and processing follow closely the established regime for E&P. That is, if E&P is conducted by private firms, then the next stage is as well, and vice versa). We have two reasons for setting our initial focus on these segments. First, how governments structure policies for oil and gas E&P are essential to value chain creation in the first place. Second, transportation by pipeline is generally the preferred alternative from producing field to the next stage of development. For crude oil, pipeline transport may be to coastal terminals for crude oil exports or to domestic refining and petrochemicals plants. For gas, it may be to the distribution system, large industrial users or electric utilities. Because of monopoly attributes of pipelines, how governments establish policy and regulatory frameworks can have a significant impact on the remainder of the value chain.

World Energy Regions

Since 1989 and the collapse of the Soviet Union, much more has been learned about oil and gas reserve potential in that region. Current thinking is that the Caspian Sea alone may contain upwards of 180 billion barrels of oil equivalent (oil and natural gas), and may rival the Persian Gulf. The FSU is thought to hold most of the world's known natural gas reserves. Thus, when these data are compiled, the distribution of oil and gas resources among the leading countries, dominated by state owned or controlled enterprises, compared to the international oil companies (IOCs), appears as shown below.



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Excluding Venezuela, China and Mexico, all of the other top producing countries can be grouped into a region we call the "Petroleum Heartland," essentially the swath of countries from northern Africa up through the Middle East and into the FSU. When we assemble the leading world energy regions in this fashion, and complement the Petroleum Heartland with two major energy demand regions (the Inner Demand Crescent and the Outer Demand Crescent) the implications for world oil and gas movements become clear, as shown in the following table. Most shipments of oil are from the Petroleum Heartland to the demand regions, a pattern we expect to remain in place for the foreseeable future. The relationship between the Petroleum Heartland and largest consuming regions and countries (Western Europe, China, India, Japan, South Korea) will dictate much of the geopolitics surrounding crude oil markets in the coming years, and already is. Unlike the other key demand regions, the U.S. currently has the most diverse oil supply. Indeed, most of our crude oil comes from Venezuela, Mexico and other Latin American exporters.

Inter-Area Movements of Oil in 1996 (mb/d)

FROM:	TO:								ROW	Total	
	Inner Demand Crescent			Outer Demand Crescent				ROW			Total
	Europe	Asia/ Pacific	Total	U.S.	Japan	Other	Total				
Petroleum Heartland	8.6	6.6	15.1	3.2	4.3	2.9	10.3	0.6	26.0		
ROW	1.4	1.4	2.8	6.2	1.4	1.9	9.5	0.3	12.5		
Total Imports	9.9	7.9	17.9	9.4	5.7	4.7	19.8	0.9	38.6		

Source: Asian Oil and Gas: Megatrends, Balance and Geopolitics, a Closer Look at China (Energy Institute)

Note: ROW=Rest of world. Asia/Pacific includes China and India. South Korea is included in “Other” within the Outer Demand Crescent. **Data source:** BP Statistical Review of World Energy, 1997.

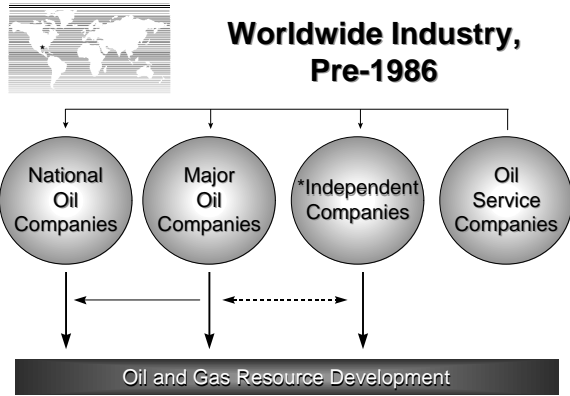
A similar arrangement for natural gas is much more difficult to produce because natural gas tends to be a local or regional fuel, since it must be shipped by pipeline and generally pipeline economics do not sustain extremely long distances. However, the FSU is expected to become a major supplier of natural gas to Europe and, potentially, China, the Koreas and Japan. The deciding factor will be financing that can withstand the risk of the huge distances pipelines must traverse to reach those markets, particularly from the Caspian Sea region (Central Asia).

The implications of world energy region dynamics for our study are the following.

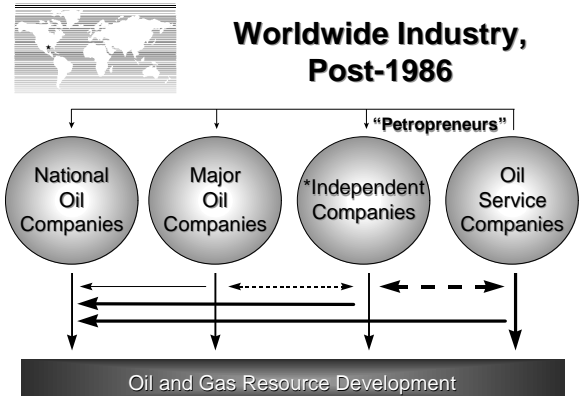
- Energy sector reform tends to be much more difficult to achieve in resource rich countries as compared to resource poor ones, and among countries that do not have recent historical experience with decentralized markets as compared to those that do. This generalization applies to all of the countries included in the Petroleum Heartland, creating considerable tension in world oil and gas markets.
- Energy sector reform is just as critical for consuming countries as for producers.
- Given the pressures on oil in particular as a result of environmental imperatives, and the prospect of policy developments worldwide that may reduce demand for oil, producing countries face the challenge of accelerating value maximization from their resources while the oil “window” remains open.
- The shift to gas will place enormous demands on infrastructure development. Outside of the U.S., Canada and Western Europe, natural gas pipeline grids are typically small or nonexistent, in poor condition and poorly managed.

Worldwide Industry Organization

The conditions in world energy markets represent both imperatives and constraints to energy sector reform. A great deal of change has occurred in the worldwide upstream oil and gas industry organization, as shown below. Prior to 1986, national oil companies (NOCs) and the international majors were the primary developers of oil and gas resources outside of the U.S. and Canada, with the majors providing services – principally financing, technology and management – in various concession arrangements to the NOCs. Within the U.S. and Canada, majors and independents (mid-sized to small companies) have always joint ventured to explore and develop oil and gas fields. The oil service companies provided an array of products and services necessary for E&P, but did not participate in production. Following the collapse in world oil prices in 1981 but especially in 1986, restructuring in the worldwide industry led to a fundamental reorganization among the principle players.



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Source: McKinsey & Company

The shifts in the post-1986 global oil and gas industries have created a new set of dynamics.

- Independent companies have become much more active in the international arena, providing the same types of services to NOCs that majors typically have.
- Oil service companies, looking to protect themselves against the vagaries of world oil and gas market cycles, have begun to participate in the production of oil and gas, packaging their participation with the provision of services and technology. In mature provinces, like the U.S. and Canada, an increasing number of oil service participation arrangements are with independents. Internationally, oil service companies are entering into these arrangements directly with NOCs.
- The majors are no longer the sole, or primary, providers of technology or financing. Increasingly, the independents and oil service companies are vehicles for the introduction of technology improvements and innovations to oil and gas markets. With respect to financing, global capital markets for oil and gas development are becoming increasingly decentralized. In countries with healthy stock markets, new forms of equity offerings centered on technology “plays” are being developed that provide investors with mechanisms to reduce the geologic risk component. Bridge loans and syndicates are being used to launch riskier projects, especially in the international arena. Royalties and trusts are back in vogue but with better due diligence and stronger performance requirements to protect investors.
- A new class of energy company has emerged, the “petropreneur.” McKinsey & Company defines this type of organization as one that can identify and operate in new niches in the upstream businesses, packaging technology, operations and financing in innovative ways, in particular to manage risk in all phases of oil and gas resource development.

The result of these shifts is that oil and gas producing and exporting countries have both incentives and disincentives to engage in energy reform strategies. The incentives come when countries desire to take advantage particularly of global equity markets to their fullest extent, and so engage in public offerings of stock in their NOCs in order to jump-start the reform process. The disincentives stem from the much easier access to technology and financing, reducing pressure to privatize NOCs as long as they are able to demonstrate improved performance.

The Role of Government

Energy is essential for economic development. As a consequence, nation states and their societies have often taken a direct hand in the development of and access to energy products and services. At this time in human history, however, there is considerable debate about the proper role for governments in their energy sectors, just as there is debate about government intervention in national economies overall. A wide array of models for energy sector organization currently are in existence around the world, but there is also a marked trend toward reducing government intervention and increasing “market-based solutions” for energy development, transportation and distribution. By market-based solutions we mean the reliance on the objective interactions between buyers and sellers, with price discovery and transparency and minimal interference, to exchange energy goods and services.

The extent to which energy is perceived to be a strategic material as opposed to a commodity is often the major factor dictating the extent of government involvement in a nation’s energy sector. The idea that energy fuels are commodities like any other (non-fuel metals or agricultural products, for example) is relatively new and emerged out of the disruptions in world energy markets during the 1970s and 1980s. Extreme fluctuations in the prices of energy fuels and changing world market conditions for energy, with growing fuel competition as well as the shift toward market-based economic reforms overall, led to the increased perception that energy fuels could be managed like commodities. The emergence of spot and futures markets for energy fuels provided both energy customers and suppliers with instruments for the management of both price and supply risk. As suppliers and

customers become more comfortable with the notion of energy fuels as commodities, there is less of a need for government intervention as method of managing these risks. Finally, the extent of government involvement tends to be directly linked to how national economies are organized. These simple relationships can be generalized as shown in the table that follows.

Economic and Government Organization of Energy Sectors: Possible Solutions

	Energy is a strategic material.	Energy is a commodity.	
Tendency toward centrally-planned economies.	A High	B Moderate to Low	Government-based solutions for energy.
Tendency toward market-based economies.	C Moderate to Low	D High	Market-based solutions for energy.

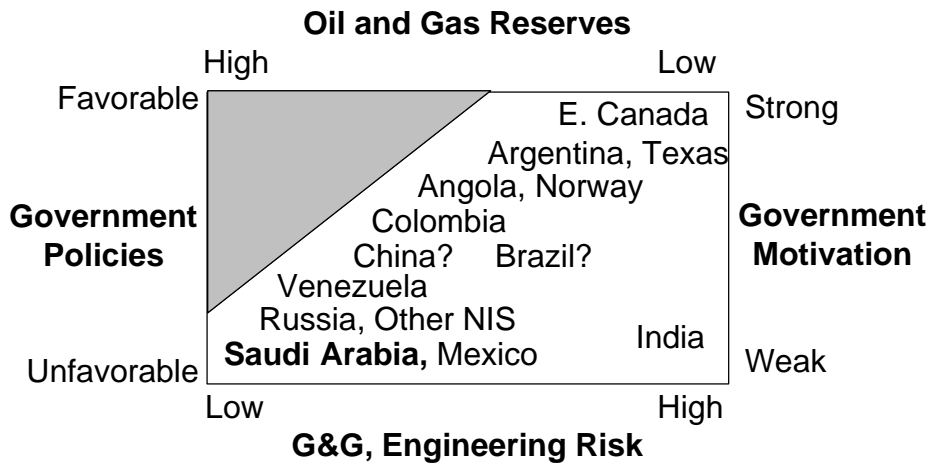
Source: Developed by Dr. Michot Foss, ã University of Houston

The table above suggests that in countries that tend toward centrally-planned economies and where energy is considered to be a strategic material, government-based solutions for energy are more frequently observed (solution A). Good examples are Mexico and Venezuela. In countries that tend toward market-based economies and where energy is generally regarded to be a commodity like any other, market-based solutions are more frequently observed (solution D). Examples of this situation at this time are the U.S. (strong) and Canada (less strong), which have been moving in this direction for some time.

The interesting exceptions are solutions B and C. No good examples of solution B exist for a nation as a whole, because the perception of energy fuels as commodities are most compatible with existence of market-based economies. However, the hypothetical solution B does provide an interesting explanation for some aspects of energy sector management in countries like the U.S. and Canada. Both retain strong government intervention when it comes to energy fuels for military defense purposes in spite of the treatment of energy fuels as commodities and the shift toward market-based solutions for energy when it comes to private transactions. Solution C is the most dynamic situation and is in evidence in many parts of the world. The U.S. and, to some extent, Canada displayed many characteristics that might be associated with solution C during the latter half of this century. In countries that are moving toward market-based economies, market-based solutions for energy are more prevalent. These countries are moving toward solution C from solution A. Parts of Western Europe and India are good illustrations of this trend. As the idea grows that energy fuels are commodities for which security and price risk can be managed, these countries will be able to move more strongly toward market-based solutions for energy (toward solution D from solution C).

Clearly, from the very simple relationships shown in the table, governments may have many different goals when it comes to energy depending upon the mix of macroeconomic organization, perceptions about energy fuels and the resulting approaches. Where government-based solutions for energy are in evidence, countries may exhibit such goals as securing energy supplies for their citizenry (if they are large net consumers) or increasing revenues from energy exports (if they are net producers). Also, countries with largest oil and/or gas reserves tend to be least open to private investment. Nevertheless, as the following chart represents, there seems to be a well-established worldwide industry structure with respect to state involvement. Obviously, Saudi Arabia is a very attractive country for oil companies, but since the nationalization of oil assets in the early 1970s, the country did not allow any foreign oil company to operate within its borders. Russia and other former Soviet Republics, especially resource-rich countries of the Caspian region are attractive to international energy companies, but investment conditions are bad.

Government Control in the Oil & Gas Industry



Source: Developed by Dr. Michot Foss, $\bar{\alpha}$ University of Houston

Many governments also have goals to improve the efficiency of their policies or to introduce some aspects of market-based solutions. State-owned enterprises (SOEs), which produce and provide energy products and services in many countries are often considered to be inefficient and a political medium for lowering unemployment. As a result, many governments have sought solutions to improve the performance of their SOEs or, in several instances, have chosen to privatize their SOEs in order to instill the performance incentives associated with competition. For countries where market-based solutions are prevalent, many governments may have goals to “protect” the market from anticompétitive practices, to improve transparency, or to minimize the impact of government policies like taxation.

When it comes to introducing or expanding market-based solutions, governments have many options. Since the late 1970s, competitive advantage and corporate viability have become more critical than ever before for most countries. To cope with these new realities, the U.S., Canada and Western Europe have significantly relaxed government control of several industries including many sectors of the energy industry. A similar, albeit relatively partial movement towards freer and more open markets is under way in Latin America and Central and Eastern Europe (CEE) as well as the Asia/Pacific region.

Governments have opted to restructure their national energy sectors in order to create more competitive markets, especially in industries, like energy utilities, that traditionally have been treated as natural monopolies. However, restructuring can take many forms. Where state ownership has been prevalent, privatization and commercialization are the common approaches. Where private ownership has been prevalent but with government control, deregulation, "re-regulation" or liberalization are typical strategies. All of these concepts involve price, entry, exit and vertical or horizontal business integration. In more mature industries and where the pace of technological change is rapid, "contestability" or potential competition may yield benefits similar to what could be achieved with full competition, further reducing the role of government or need for regulation.

Since the late 1980s, privatization and commercialization have become the twin pillars of economic engagement in the emerging market economies (EMEs). In terms of international practices, privatization refers to a reduction in state ownership. As a result, SOEs in a majority of developing countries have become private

enterprises, the equity of which is at least partially owned by the public. This is also known as "denationalization." The rationale for privatization is that firms and assets owned and operated by the private sector will generally be more efficient and more responsive to the needs of the public than those owned and operated by the state. Many countries have already reaped the benefits of privatization. In the longer run, commercialization proves to be a bridge between privatization and liberalization or deregulation. This connection, however, requires effective regulatory reform in the majority of EMEs. In most cases, this reform entails creation of relatively independent regulatory commissions and regulatory rules in order to prevent monopoly activity by private owners and operators.

Nevertheless, the strength and endurance of the trend toward market-based solutions for energy is a subject of intense debate around the world. Most recent financial and economic crisis, which started in Asia and is now threatening other parts of the world, disheartens reformers and encourages opponents of economic liberalization in many countries. Low oil prices are having a negative impact on the economies of not only oil exporting countries but also those who trade extensively with them. In some countries, this may lead to the delay or even reversal of reforms. In this environment, it is even more important to provide evidence for what many have come to believe: freer markets provide more efficient solutions.