Factors that Explain Investment in Cross-Border Natural Gas Transport Infrastructures: A Research Protocol for Historical Case Studies

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Preface

This working paper presents the research protocol to be employed in historical case studies that are part of the *Geopolitics of Gas Study*. A joint effort of PESD and the James A. Baker III Institute for Public Policy of Rice University, the *Geopolitics of Gas Study* examines the economic, technological and political implications of the worldwide shift to natural gas that is under way at present and expected to continue for the next three decades (and beyond).

An earlier version of this paper was presented at a workshop that launched the study, convened at Stanford University, 17-18 October 2002.

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0. Introduction

Techno-economic energy models consistently project world gas demand to rise sharply in the coming decades. The most recent *World Energy Outlook* envisions that global gas consumption will double by 2030 and other major energy scenarios anticipate similar increases in gas demand.[2] In the areas of highest expected demand—North America, Europe, China, and South and East Asia—the projected consumption of gas is expected to far outstrip indigenous supplies. These regions could import gas from regions where there is large surplus, but those are geographically distant. Indeed, surplus gas supplies—that is, reserves in excess of expected demand growth—are concentrated in a wide band stretching from the Middle East north to Siberia. Nearly half of the world's proven gas reserves are located in two countries—Russia and Iran—and three quarters of projected gas resources are located in the Middle East, Central Asia, and Russia.[3,4] Delivering gas from these sources to the future demand centers will require a major expansion of inter-regional natural gas pipelines and LNG trains, in addition to significant intra-regional, cross-border gas transport infrastructures.

The joint Stanford-Rice University study on the "Geopolitics of Gas" looks forward to this hypothesized gas-intensive world and explores a series of tightly interrelated questions. Is the construction and operation of large international networks of pipelines and LNG trains politically and economically feasible, especially as many of the pipelines

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[2] International Energy Agency, 2002, *World Energy Outlook 2002* (Paris: IEA). See also: Intergovernmental Panel on Climate Change, 2000. *Special Report on Emissions Scenarios (SRES)*. IPCC, Geneva. The SRES report attempted to incorporate all the major global energy models. Every "Illustrative Marker Scenario", chosen to reflect the range of all scenarios, projects a doubling of global natural gas consumption by 2030. Similar projections for the inexorable rise of gas are also found in N. Nakicenovic et al., 1998, *World Energy Perspectives* (Laxenburg and London: IIASA and World Energy Council).

[3] Cedigaz (2001), *Natural Gas in the World: 2001 Survey*, Paris: Institut Français du Pétrole.

[4] BP Statistical Review of World Energy 2002.

would cross contested borders and shared infrastructure projects in such settings are often not attractive to private investors? What are the geopolitical implications of a shift to gas and the vast international infrastructure that a gas-intensive world implies? The project is exploring these questions using several methods, including detailed case studies on past efforts to build and operate international gas infrastructures.[5] This paper outlines a protocol for that historical case study research.

Overview of the Question to be Addressed and the Approach Taken Here

In some parts of the world—mainly North America and Europe—extensive gas infrastructures are already in operation and it is not difficult to imagine investors building still more gas infrastructures to complement what is already present. However, even in these "easy" cases, expected rapid growth in gas demand implies substantial investment in gas import capacity to fill the growing gap between demand and indigenous resources. Given the locations of surplus gas resources, the future sources of supply for these developed markets are likely to be challenging places to invest. Furthermore, in developing countries where expected growth in gas demand is greatest—in Latin America and, especially, in South and East Asia—existing gas supply and distribution networks are minimal and the environment for investment in large-scale infrastructures, especially international projects, is risky for investors.

Building international gas infrastructures involves many risks. Once an investment is made the capital no alternative use and thus becomes a "sunk cost." The original balance of bargaining power that existed at the time of contract negotiation shifts in favor of off-takers or regulators, a condition referred to as the "obsolescing bargain".[6] Investors utilize a range of mechanisms to make credible the commitments of those parties on whom a profitable return on the investment depends (e.g. shared interest in upside opportunities, sanctions for contract deviation, etc.). The viability of these mechanisms, in turn depends on a range of factors particular to any host country. A successful venture requires revenues from decades of predictable operation. Investors and academic experts alike have identified at least five factors that appear to explain the risks involved in a cross-border gas transport project:[7]

1. The *investment climate* in source, transit and off-take countries may be unattractive to investors due to poor "rule of law," unpredictable tax codes, exposure to foreign exchange risk, a history of regulatory taking, and other obstacles.

[5] More detail on the overall effort is at http://cesp.stanford.edu/pesd

[6] R. Vernon, 1971. *Sovereignty at Bay: the Multinational Spread of U.S. Enterprises*. New York, Basic Books,

[7] PESD, 2002, *Geopolitics of Gas Meeting: Rapporteur's Report; October 17-18 2002.* (Stanford, PESD). The IEA listed similar concerns regarding International Energy Agency, 2002, *Developing China's Natural Gas Market: The Energy Policy Challenges* (Paris: IEA).

2. Many pipeline routes involve one or more *transit countries*, which complicates the tasks of negotiation and management and creates additional risks for investors once their resources are sunk
3. Many off-take markets presently have little or no gas consumption, which creates risk in the *off-take quantity* for new pipelines. Success in introducing large quantities of gas into immature off-take markets depends on large complementary investments in gas-use technologies.
4. Inexperience with regulating gas markets and the fact that gas is often more expensive than the incumbent fuels—especially when competing against paid-off coal and hydroelectric generating stations—may also create risk in the *off-take price*.
5. Finally, many of these gas transport routes would link countries that present have few or no *international institutional links*. Many problems of international coordination of investments can be eased when international cooperative institutions are in place. Institutions can help reduce transaction costs; the extensive and long-term interactions that accompany international institutions can ease enforcement of contracts by creating a shadow of the future. The absence of institutions can be both symptom and cause of inability to make investments in collective infrastructures.

In this study, we focus on these five factors—"independent variables"—with the aim of uncovering their relative importance as well as the effectiveness of strategies that have been deployed to overcome the investment risks. Indeed, despite these obstacles, there are many historical examples of countries and firms making such investments in international gas infrastructures. Our task is to mine that historical record to uncover the factors have the largest effect on whether a gas infrastructure is built. Having done that, we can then derive more solid conclusions about whether high gas scenarios are feasible and the attributes of the countries that are likely to be most attractive as sources, transit and off-takers of the gas.

In conducting this historical research, the project must be careful to avoid several methodological pitfalls. In particular, care is needed to ensure that we identify the characteristics of the major gas export routes so that we are sure that the historical case studies we select for analysis can reveal lessons that are actually relevant for the future. We must be mindful that much of the historical experience has concerned infrastructure projects built by state-owned enterprises, although many experts see the future of the gas business as one dominated increasingly by private firms and perhaps public-private partnerships for vital infrastructures. Finally, we must be sure that the selection of historical case studies is not biased. To date, the vast majority of case studies on gas infrastructures has focused on particulars of "success" stories in which a project a built, with a focus on mechanical issues such as contract mechanisms rather than the conditions (especially political factors) that systematically explain the decision to build or not to build a particular project. A rigorous study, however, must look at successes and failures to ensure that the results are not biased and the inferences regarding key factors are well founded.

We address these pitfalls and outline a method for historical case study research in three sections.

First we identify the key regions and trading relationships that are implied in future scenarios for high consumption of natural gas. With that *regional* information we then identify critical *countries* in each of the regions—key sources of gas, possible transit countries, and off-takers. Information at the country level is important because country characteristics, such as the attractiveness for private investors and the role of government in backing large-scale infrastructure projects, is critical to explaining actual investment patterns.

Having identified countries we then discuss the *major factors* ("independent variables") that are likely to affect actual investment in infrastructure projects. For each of the critical countries we code those major factors, which allows us to identify the range of characteristics that exists today and allows us to speculate about how that range will change in the future. We argue that investment in gas trading infrastructures between the advanced industrialized countries will pose relatively fewer difficulties because the major factors are conducive to investment in infrastructures—even costly and risky gas infrastructures. However, we show that those easy cases are in the minority; most of the countries projected to be major suppliers and off-takers for projected gas trade networks have characteristics that make large scale infrastructure investments like natural gas pipelines a major challenge. The discussion of key countries and attributes allows us to identify the range of values for each of the major factors, which in turn sets the stage for the selection of historical case studies. The historical case studies chosen must span the range of these major factors to ensure that the historical case studies reveal insights that will be relevant for assessing future outcomes (if, when, where, how) of gas infrastructure investment.

The second section of this memo outlines our strategy for identifying the historical case studies that will be the subject of in-depth analysis in this study. Only by comparing independent variables in cases of both success and failure (e.g. projects that are built and those that are not built) is it possible to uncover the critical factors that determine project investment. Prior studies in this area have focused on "built" projects and thus have unwittingly selected their case studies on the dependent variable, which has made prior research in this area unable to provide robust conclusions on the factors that actually explain which conditions facilitate construction of gas infrastructures[8]. Our approach aims to remedy that problem. Yet in practice it is extremely difficult to avoid selection on the

[8] The unfinished World Bank (ESMAP) study, *Removing Obstacles to Cross-Border Oil and Gas Pipelines* focuses solely on built projects and "major factors" that led to their successful completion.

dependent variable because built projects are much easier to identify than those that have not attracted investment. We identify a "universe" of possible historical case studies and select a handful of cases for in-depth analysis; we show that our selection spans the range of independent variables that we identified in section I as likely to exist in the future.

The third section presents a detailed research protocol for conducting the individual case studies. The variation in major factors identified in section I was used to select the historical case studies, and testing for any consistent relationship between these major factors and outcomes will be the core of each case study. The research protocol will ensure that each study addresses a common set of major factors that we hypothesize will affect the outcomes. The third section outlines not only those factors but also the rationale for including them.

I. Characteristics of Future Gas Trading Relationships

Projected Trade of Gas: Key Regions and Trading Relationships

Global energy projections are usually made for a small number of 5 to 15 world regions; in some cases including estimates for energy trade *between* regions. Figures 1 and 2 illustrate the growth of inter-regional gas trade projected by the International Energy Agency's *World Energy Outlook 2002* from 2000 to 2030 (IEA-WEO 2002). These projections do not include detail about configurations *within* the region, such as the particular locations of gas reserves and centers for demand. Yet the need for transportation infrastructures depends on these particularities, and the feasibility of building gas transportation infrastructures will depend on the characteristics of individual countries that are the source, transit and off-takers for piped gas or the individual countries that are the sources and off-takers for LNG. Table 1 includes regional projections for gas demand growth from the IEA-WEO reference case. This regional level of detail obscures the displacement between projected demand centers and the locations of gas reserves at the sub-regional level. Within Latin America, Brazil's gas consumption is projected to rise nearly ten-fold over the next three decades, much of this gas is likely to come from neighboring Bolivia and Argentina. In Africa, South Africa may be the largest consumer over the coming decades, but it too lacks indigenous resources so it is likely to draw from neighboring Mozambique and Namibia. Similarly, gas consumption is projected to rise precipitously in East Asia, but this growth depends on the Trans-ASEAN gas grid, linking the dispersed gas deposits of the region to markets in Singapore, Malaysia and the Vietnamese peninsula.

Figure 1. Net Inter-regional Natural Gas Trade Flows in year 2000 in bcm. From IEA World Energy Outlook 2002.

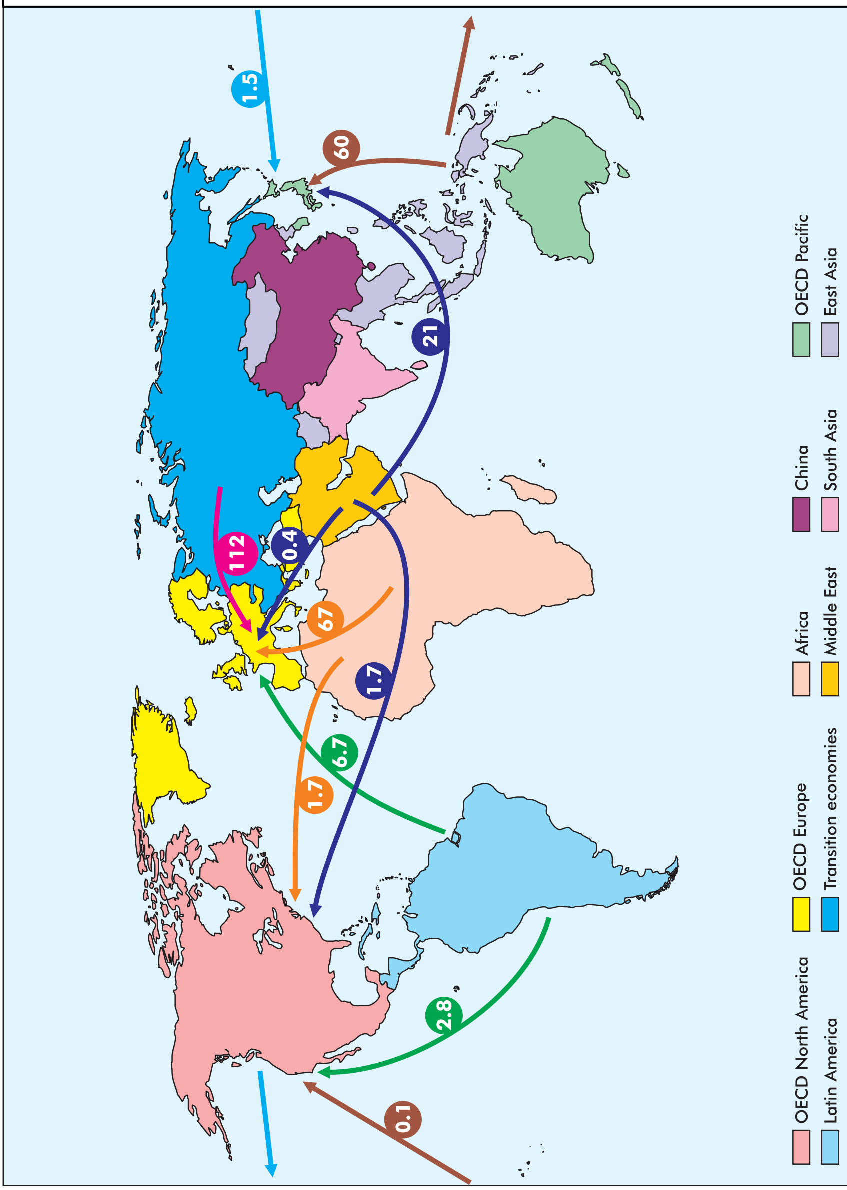


Figure 2. Projected Net Inter-regional Natural Gas Trade Flows in 2030, in bcm. From IEA World Energy Outlook 2002.

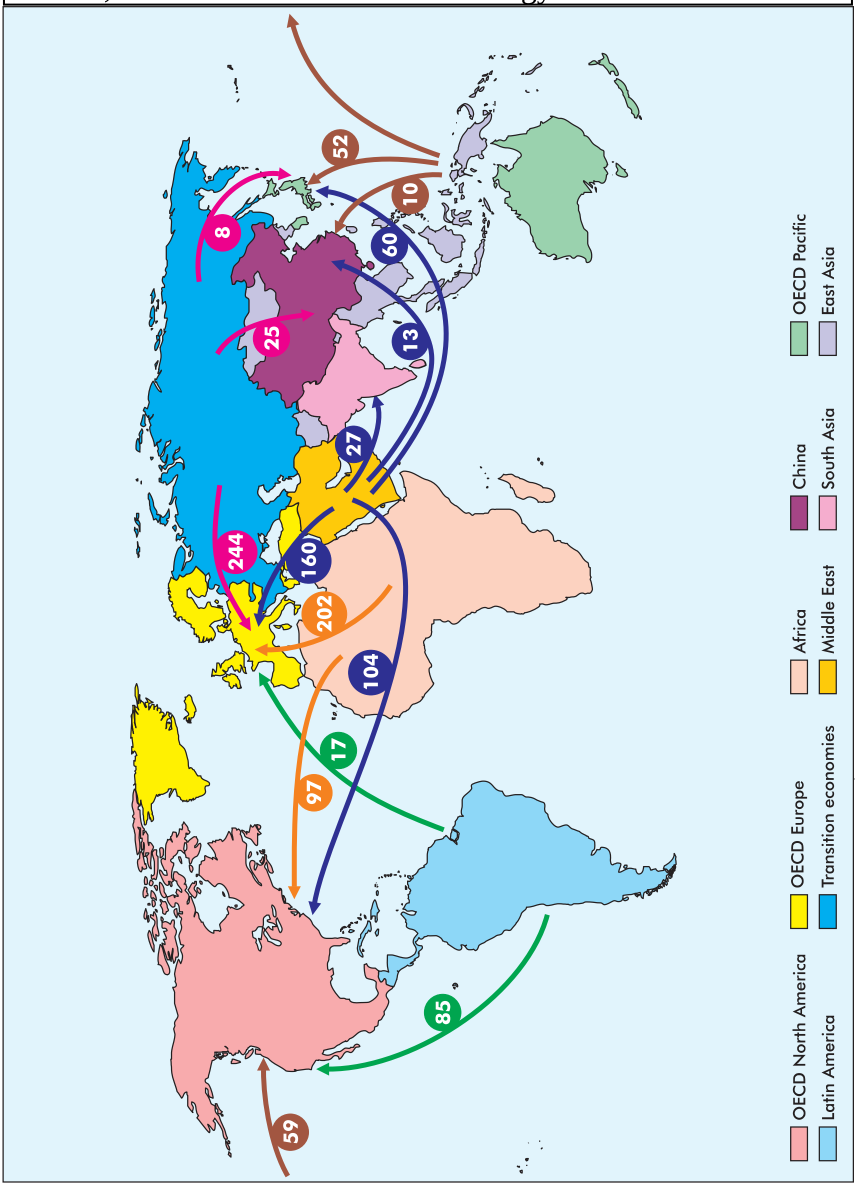


Table 1. Projected World Primary Natural Gas Demand (bcm)

IEA-WEO, 2002					
	2000	**2010**	**2020**	**2030**	**Annual Growth Rate (%)**
OECD North America	788	992	1161	1,305	1.7
OECD Europe	482	640	799	901	2.1
Transition Economies	609	748	876	945	1.5
Latin America	105	167	251	373	4.3
Middle East	201	272	349	427	2.5
Africa	53	95	155	239	5.2
East Asia	83	139	200	248	3.7
South Asia	51	96	153	205	4.7
China	32	61	109	162	5.5
OECD Pacific	122	168	201	243	2.3
World	**2,526**	**3,378**	**4,254**	**5,048**	**2.4**

The next step is to identify key source, transit and off-taking countries in each region and the particular characteristics of those countries that are likely to determine the viability of pipelines.

Projected Trade of Gas: Key Countries and their Characteristics

Now we explore the characteristics of the countries projected to be involved in future gas trade. These characteristics will help us to select historical case studies that are representative of the countries and trade routes that are expected in the future. In this section we identify the critical countries for future gas transport infrastructure expansion. We then identify the broad characteristics of these critical countries that are likely to affect whether governments and other investors will build gas transportation infrastructures that link major gas reserves to major off-taking regions.

What are the characteristics of these trading relationships that will affect whether pipelines and LNG trains are built? For gas pipelines, the list of major factors mirrors the list recounted in the introduction to this paper:

1. The overall investment climate of each host country spanned by the infrastructure;
2. Transit countries
3. Off-take quantity risk—Will complementary gas burning investments come to fruition?
4. Off-take price risk—Regulatory uncertainty or market risk
5. Institutions for cooperation

For LNG projects, the list of factors is shorter because LNG does not involve transit countries.[9] The tankers themselves are expensive but fungible resources—they can be resold and moved if the investment sours. Thus the main characteristics that affect future investment in LNG projects are:

1. The overall investment climate of each host country spanned by the infrastructure;
3. Off-take quantity risk
4. Off-take price risk.

In the past, not only have particular LNG projects not had to contend with transit country risk, but nearly all projects have been built to serve countries with high gas demand and extensive existing gas networks (Europe, Japan and the United States). The historical experience with LNG has almost exclusively involved cases with relatively stable off-take markets. Looking forward, however, the off-take risks for LNG projects may change in character. For example, China and India, are projected to be significant LNG importers, yet have a high degree of regulatory uncertainty and immature gas distribution and off-take systems. LNG export projects may also be exposed to new price and quantity risks if the world market shifts from bilateral contracts to a market characterized by multi-party trades with prices determined on a spot market. With historical case studies it is possible to explore the source country investment risks associated with LNG projects, but the historical experience is largely silent on the risks in the off-take country (#3 and #4)—in particular, the possible shift to a spot market for price formation. Thus in a different part of this project the team at Rice University will model the possible future development of the LNG market and its interaction with regional pipeline supplies.

The lists above are not exhaustive of all the factors that affect the ultimate decisions to invest in gas transportation infrastructures. For example, they do not include the mechanisms, such as take-or-pay contracts, that investors have used to hedge risks. As one probes each possible pipeline or LNG project in detail a host of special factors comes into play.

We must ensure that the cases selected span, at least broadly, the experience that we believe will be relevant for the future. To do that, we coded each of the five variables listed above—the key "independent variables" that, we think, explain whether investors

[9] To date, all LNG projects export from the same country where the gas is extracted. LNG economics, so far, have been based on large quantities of gas that is inexpensive to extract and convenient to a port. We assume that once LNG is on the high seas that it can travel safely to its destination and thus transit risks will not vary by source and off-taker. However, it might be useful to speculate about the dependence of LNG transit on a commerce-friendly law of the sea and the possibilities that certain geopolitical changes could make particular regions (or the high seas generally) less inviting to LNG tankers.

will be attracted to gas infrastructure projects—for all of the typical pipeline and LNG projects that would be needed for the future gas-intensive scenarios to be realized.

Variable #1 is used to represent the general investment climate of each host country involved in the cross-border project. We use the scores from the November 2002 edition of the *International Country Risk Guide (ICRG)*[10], a well-known source of investment risk information for foreign investors. Our variable is the compilation of ICRG indices including: government stability, investment profile, internal conflict, corruption, law and order, ethnic tensions, and bureaucratic quality.[11]We compile these component scores to compute a "General Investment Risk Index" (GIRI) with values ranging from 0-10; unstable countries with virtually no government such as Somalia had a GIRI of 2.3, while Sweden had a GIRI 9.4. For more detail on coding of all variables, see Appendix A.

Variables #2 simply codes the number of transit countries involved in a project.

Variable #3 is a very crude indicator of the risk for off-take quantity in a particular project. We calculate the value for variable #3 by measuring the share of natural gas consumption in total primary energy consumption prior to the construction of the relevant gas project. This is one measure of the maturity of the existing gas market and reflects the hypothesis that there is greater risk to investors when they build a project that would transport gas into a nascent market with little gas-burning capital stock and a short institutional history of gas trade.

Variable #4 would measure the regulatory/market pricing risk. After considerable effort, we have not found an appropriate measure for this risk and thus have not coded for this factor. The cases that are selected for in-depth study will include attention to this factor (and to all the other key independent variables), but in our universe of cases we are unable to examine this issue. Thus, we are mindful that the cases we select for in-depth study may not reflect the full range of possible experience with regulatory and pricing risks.

Variable #5 measures the strength of institutions for economic cooperation shared by host countries. Higher scores are assigned to those projects that span host countries with more significant levels of cooperation in common regional organizations, such as NAFTA, while a score of 0 might be assigned to a project connecting Iran to India and transiting Pakistan. In coding this variable we focus on trade institutions, as these are typically the most significant regional institutions that best reflect the degree of

[10] *ICRG* is a monthly publication of PRS Group Inc., East Syracuse, New York.
[11] This measurement of investment risk focusing mainly on the political risks of projects where private companies bear most of the risk. Where governments play a larger role in financing etc., measures that include government financial stability would be additional indicators of project risk.

commercial integration of the countries and the willingness of the countries to manage such affairs jointly.

The coding of each of these factors for major future gas trade routes is shown on table 2. The results are organized according to projected inter-regional trade routes illustrated in figures 1 and 2. Table 2 also includes the major projected intra-regional routes based on an expert review of resource data and demand scenarios[12]. Within each major trade unit, subsets of countries are are listed which represent the largest likely source and off-take partners.

Before we explore the variation in this data set we note that there are some gas trade routes that pose lesser obstacles to investment in gas infrastructures. Countries that are generally attractive to investors, have mature gas markets, and are served by robust international institutions are most likely cases for investment; studying them will tell us little about the incentives to invest in projects in most of the rest of the world where those conditions are not met. We exclude such "easy" settings from further study, in particular if a route involves nations all of which meet these criteria:

- Variable 1 (investment climate) greater than 8;
- Variable 3 (off-take quantity risk) greater than 15%; and
- Variable 5 (institutions) 4 or 5.

This approach excludes pipeline exports from Canada to the United States as well as pipeline exports from the North Sea fields to Europe.

Note that the exclusion of "easy" cases from table 2 does not exclude very much. In most of the world it is not obvious that investment will flow into gas transport infrastructures. Some trade routes, like Russia to OECD Europe, include relatively unattractive investment climates in the supply country (Russia GIRI=5.5), combined with varying conditions in transit countries (Belarus GIRI=5.5, Poland GIRI=7.7), and relatively attractive off-take countries (Germany GIRI=8.8). Other prospective trade routes span countries with relatively unattractive investment climates in the upstream, transit, and off-take countries (e.g. Turkmenistan, Afghanistan, Pakistan, India). Similarly, projections suggest that future gas transport investments will deliver gas to already well-developed markets, like Germany where gas is already more than 20% of current total primary energy consumption (TPEC); and new gas transport investments will also deliver to nascent markets such as China, where gas represents only 3% of current TPEC.

[12] Resource estimates from United States Geological Survey, (2000) *"World Petroleum Assessment"*. Demand estimates from IEA-WEO (2002) and SRES Scenarios.

Table 2. Projected Major Inter-Regional Trade and Representative Country Routes

Trading Region* Supply Country	Transit Country	Offtake Country	Pipe/ LNG	General Investment Risk Index #1	Gas Share Total Primary Energy (%) #3	Strength of Institution For Economic Cooperation Institution #5	Institution Referenced
1. Transition Economies --> OECD Europe							
a. Russia			Pipe	5.5	na	3	ECE
	Belarus		Pipe	5.5	na		
	Poland		Pipe	7.7	na		
		Germany	Pipe	8.8	21.6		
b. Russia			Pipe	5.5	na	3	ECE
	none						
		Turkey	Pipe	5.7	17.1		
2. OECD Europe --> OECD Europe							
a. Norway			Pipe	9.2	na	5	EFTA
	none						
		Germany	Pipe	8.8	21.6		
3. Middle East --> OECD Europe							
a. Iran			Pipe	5.8	na	2	ECO
	none						
		Turkey	Pipe	5.7	17.1		
4. Africa --> OECD Europe							
Algeria			Pipe	4.7	na	0	none
	Morocco		Pipe	7.4	na		
	Spain		Pipe	8.3	na		
		Spain	Pipe	8.3	12.1		
		Portugal	Pipe	8.3	21.2		
5. Transition Economies --> China							
a. Russia			Pipe	5.5	na	0	none
	none						
		China	Pipe	6.5	3.0		
b. Kazakhstan			Pipe	6.5	na	0	none
	none						
		China	Pipe	6.5	3.0		
6. Transition Economies--> South Asia							
Turkmenistan			Pipe	NA	na	0	none
	Afghanistan		Pipe	NA	na		
	Pakistan		Pipe	5.1	na		
		Pakistan	Pipe	5.1	42.3		
		India	Pipe	6.1	7.6		
7. Middle East --> South Asia							
Iran			Pipe	5.8	na	0	none
	Pakistan		Pipe	5.1	na		
		Pakistan	Pipe	5.1	42.3		
		India	Pipe	6.1	7.6		
8. North America --> North America							
Canada			Pipe	8.9	na	5	NAFTA
	none						
		U.S.	Pipe	8.7	25.8		
9. Latin America --> North America							
Venezuela			LNG	4.3	na	2	OAS
	none						
		U.S.	LNG	8.7	25.8		
10. Africa --> North America							
Nigeria			LNG	2.8	na	0	none
	none						
		USA	LNG	8.7	25.8		
11. Middle East --> North America							
Iran			LNG	5.8	na	0	none
	none						
		U.S.	LNG	8.7	25.8		

Table 2 (continued). Projected Major Inter-Regional Trade and Representative Country Routes

Trading Region* Supply Country	Transit Country	Offtake Country	Pipe/ LNG	General Investment Risk Index #1	Gas Share Total Primary Energy (%) #3	Strength of Institution For Economic Cooperation Institution #5	Institution Referenced
12. Latin America --> Latin America							
a. Bolivia			Pipe	5.8	na	3	Mercosur
	none						
		Brazil	Pipe	5.5	6.4		
b. Argentina			Pipe	5.3	na	3	Mercosur
	none						
		Chile	Pipe	8.0	23.5		
13. Africa--> Africa							
a. Mozambique			Pipe	5.4	na	3	SADC
	none						
		South Africa	Pipe	5.5	1.1		
14. Middle East --> OECD Pacific							
a. Iran			LNG	5.8	na	0	none
	none						
		Japan	LNG	9.0	13.8		

* Regions correspond to IEA-WEO regions.

Finally, we underscore that the purpose of table 2 is to show the range of variables and their values that is likely to affect investment in international gas pipeline projects *in the future*. All variables shown on table 2 reflect current conditions, but the most feasible prediction is that the future may look much like the present[13]. Ideally we would be able to project trends in future investment climate, but there is no method for doing that robustly. It is plausible that the spread of liberalism should generally improve the investment climate, but it is hardly clear that the path to liberalism is a one-way road—current trends may stall or even reverse. Moreover, a world served to a larger degree by markets but with immature market regulatory institutions might actually be less attractive to investors—indeed, illiberal nations can often be attractive places for investors who are well connected. The location of gas reserves may attract investment that could, in turn, accelerate the creation of more attractive investment environments; however, the "resource curse" suggests that there may be an inverse correlation between hydrocarbon reserves and an institutional climate that ultimately attracts investment. [14] So, we use the investment indicators scored for the present also as measures of the likely range in the future.

Regarding the indicators related to gas markets in off-take countries, we expect that the share of gas in those markets will rise and the off-take price and quantity risks will decline as the world shifts increasingly toward natural gas for its energy needs. Thus we must be sure that the historical cases include those that involve extensions of existing, more mature gas infrastructures upstream and downstream as well as "first projects" supplying gas to immature gas markets. Some of the large gas resources that might be

[13] GIRI scores in Table 2 are from the November 2002 edition of *ICRG*.
[14] Karl, T. L. (1997). The Paradox of Plenty: Oil Booms and Petro-states. University of California Press Berkeley, CA.

exported in a future gas-intensive world—such as the gas reserves in the Eastern Russia — are characterized by limited existing field development and minimal development in off-take markets, but many of the large reserves (e.g., Western Siberia) are already characterized by extensive development and export to mature markets (e.g., Eastern and Western Europe).

Table 3 briefly summarizes the range of values for these variables that will be relevant for selecting historical case studies. Note, again, that we have not been able to probe the "range" of values related to regulatory/pricing risk, although we expect that such risks are closely related to investment climate as the same root causes that create investment risk also introduce uncertainties about the price and regulation of gas.

Table 3. Range of Relevant Values for Major Protected International Gas Trade Routes

Variable	*Range of Relevant Values*
1. Investment climate (GIRI)	2.8 – 9.0
2. Number of transit countries	0 – 2
3. Off-take quantity risk	3% - 42%
4. Off-take price risk	NA
5. Institutions for cooperation	0 – 3

II. Historical Case Studies: The Universe of Cases and Our Selected Cases

<u>Selection of Historical Case Studies: Universe of Cases</u>

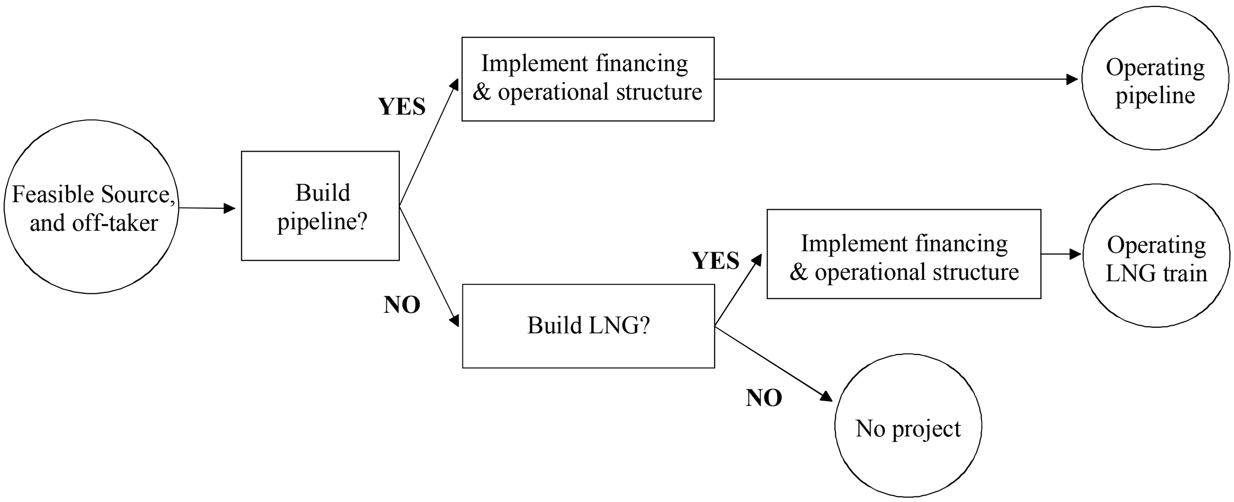
Now that we have identified the broad characteristics of the future source, transit and off-take countries we can select historical case studies that reveal whether and how these future gas transport infrastructures will attract investors. Proceeding with this task requires clarity on the definition of a case and in compiling the "universe" of cases from which we will select individual case studies.

The most obvious strategy would involve listing all built projects—gas pipelines and LNG terminals—and then selecting from that set. All previous projects on the construction of international pipelines and LNG projects have adopted this approach. This system works if the goal is to study the factors that affect the construction and operation of a pipeline *after* the decision has been made to invest in the project.[15] But this method by

[15] For example, the aforementioned World Bank (ESMAP) study, *Removing Obstacles to Cross-Border Oil and Gas Pipelines* focuses solely on built projects and "major factors" that led to their successful completion. That study is an invaluable guide to the mechanisms at work within any particular infrastructure investment,

itself does not work if the goal is to understand the decision to invest. The problem is illustrated in figure 3, which shows a simplified decision tree for a prospective gas exporter. The observable outcomes—built projects—from these decisions represent only a fraction of the possible outcomes, which include not building a project or building a LNG facility instead of a pipeline.

Figure 3. Decision Tree for Pipeline Project Investment



A second strategy would involve collecting data on all pipeline and LNG projects that were techno-economically feasible. For a give set of expectations about price and quantity of gas consumption, a range of projects could deliver that gas. We could then select from that sample of hypothetical projects a set that spanned the range of conditions that we think affect the decision to invest in projects (discussed earlier), and for each project we could measure the outcome—was the project built or not?—and trace the particular causes to outcomes. That approach is infeasible in practice because there is an infinite array of hypothetical projects. Tools do not exist to identify that universe objectively, and selecting cases at random from that universe would yield only a very tiny fraction of cases that have been built. Such a study would not take us far past the starting point of this project: there is a large array of barriers to constructing gas transportation infrastructures and a large array of techno-economic potentials. Our purpose is to understand why some of those projects, nonetheless, get built and whether the historical experience with such projects offer insights for future construction of the infrastructures that will be needed to make the rapid growth in gas consumption feasible.

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and it is not our purpose to reproduce that study. However, the approach of selecting already built projects is not valid for analyzing why some deals go forward and others do not. The sample of cases does not, by definition, include any deals that have not gone forward.

A third possible strategy also would appear more feasible than the second but leads to a dead end. We could catalog all projects for which a memorandum of understanding (MOU) or similar declaration to develop a project. It is much easier to compile that universe of possible cases because such declarations are usually covered in the trade press. The problem with this approach, however, is that MOUs cost little to compile and are not a proper reflection of the range of possible projects or of the parties' intentions. Working with MOUs as the universe would introduce substantial bias into the sample. In effect, our sample would include projects that were built as all built projects begin with some sort of MOU as well as a host of possible projects that have been nominated for a host of uncontrolled reasons—political signaling, dreams in particular regions, etc. Mindful of this difficulty, it might be tempting just to select MOUs that had attracted some substantial investment and then try to explain why some go all the way to completion and operation whereas others get stalled. But that route, also, is a dead end because investment in these infrastructures is lumpy—once the investor gets to a certain point they go all the way. We are unaware of any project that gets partially built and then fails; The key decision point lies at the first substantial investment that, once made, is sunk and transforms the project into one dominated by marginal operating costs.

These problems with identifying the universe of cases lead us to an alternative approach that is also fraught with danger. Here we outline the approach and show how we avoid the most severe pitfalls. We begin with the observation that it is practically impossible to assemble the universe of all possible projects. Thus we are left with the approach of assembling a universe of cases that is based on observable criteria: built projects. Table B, in Appendix B, lists that universe of cases. The table excludes all projects for which the source, transit and off-take country have a score GIRI of 8.0 or greater —that is, all built projects connecting Canada and the U.S. and all projects within Western Europe. It would also exclude LNG projects in countries with a GIRI score over 8.[16,17]

Normally this approach would be exactly the wrong route for the reasons cited earlier: it involves selecting on the "dependent variable." In this case, inclusion of only observable projects will bias the results because the sample will include only cases that reflect the factors that lead to building such a project. By definition, all observable projects have been built; all built projects operate.[18] But in this case there is no attractive

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[16] The values for all variables are assessed two years prior to project completion based on the crude assumption that critical decisions to negotiate contracts and begin construction were made on average two years prior to completion.
[17] To date, Australia is the only country with a GIRI score more than 8 that exports LNG; Australian LNG exports (to the U.S.) began in 2001.
[18] There is variation in the price and quantity of the delivered gas, and it would be possible to compare that information with the expectations of investors. However, such a project would yield only narrow conclusions about factors that relate to project operation and would not help much with the task of identifying the factors that explain investment and construction.

alternative for establishing the universe of cases and thus we must search for variation in outcomes—the dependent variable—using alternative means.

We seek variation in the dependent variable by pairing each case of "built" project with a plausible alternative. For pipelines, we examine a substantially alternative route, such as a route through different transit countries or to a different off-take country.[19] In selecting the alternative projects (AP) we follow a three-step process:

1. The AP is a *pipeline project constructed substantially later than the "built" project under study*; the alternative involves a different source country in the region, follows a substantially different transit route, or flows to a different off-taker. The fact that such a project was built later is evidence that the project is *technically* feasible; in the case study we ask why that project was not built earlier and why the early project was constructed first. If no such "considered alternative" exists then we seek to identify the plausible alternative following a second strategy…

2. The AP is a *pipeline or LNG project that was the subject of serious attention at the time the built project was negotiated and constructed*. This "plausible alternative" should have a signed MOU, substantial background studies, and if constructed would have involved capital expenditure and operating costs within about 50% of the project that was built. The case study seeks to explain why that alternative was not built and why the built project was selected instead. If no such "considered alternative" exists then we seek to identify the plausible alternative following a third strategy…

3. The plausible alternative is a *hypothetical pipeline or LNG project* involve capital expenditure and operating costs within about 50% of the project that was built. The case study seeks to explain why that alternative was not built and why the built project was selected instead.

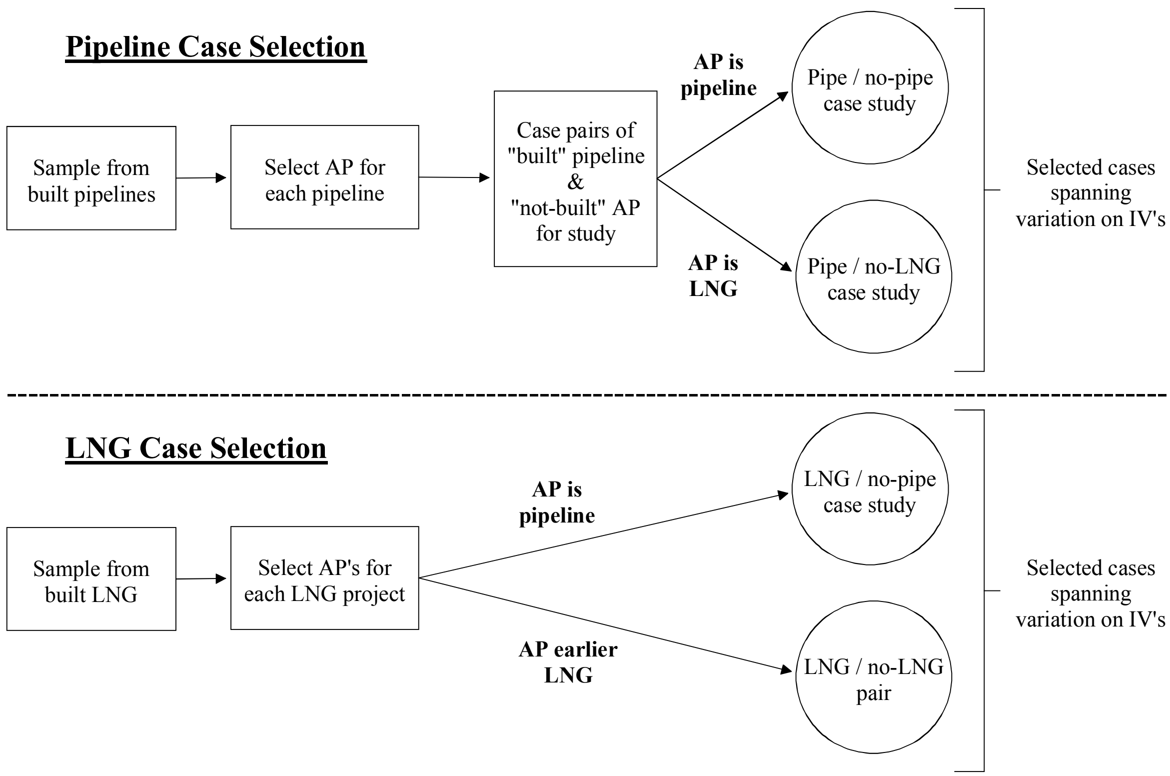
In some cases a plausible alternative project may not exist—notably LNG projects in countries that are remote from any center for gas demand. In those cases it is difficult to get variation in outcomes, although it may be possible to explore in a case study why the LNG project was not built earlier. For example, why did Qatar, sitting on its vast gas reserves that are far from markets yet convenient to the ocean, not build LNG export facilities earlier?

Figure 4 summarizes our approach to defining a case so that we obtain variation in the outcomes. The top panel shows a typical pipeline case study, and the bottom panel

[19] We focus on alternative projects that involve international trade in gas. In practice, an alternative use domestically always exists, although price and quantity may be lower than for international trade.

illustrates an LNG case study. Note that plausible alternatives for pipeline projects include LNG terminals and pipelines, while an LNG project is only paired with a plausible pipeline alternative. Thus when we select the cases some of the studies of built pipelines will also provide insight into why LNG terminals were not built, and all of the valid cases for the study of LNG terminals will also provide insight into decisions not to build pipelines.

Figure 4. Case Selection: Ensuring Variation in Outcomes



Selection of Cases

Table 4 shows the proposed selection of cases from the larger universe of built projects in Appendix B. For each selected case we also indicate our best guess for an appropriate "alternative project," and the case study protocol (next section) invites the case study researchers to assess and adjust that choice. The selection includes pipeline as well as LNG projects. Among the pipeline cases are projects that include no transit countries as well as projects that span 3 transit countries. The pipeline projects also span the full range of international institutions that we expect to exist in the future. The selected pipeline projects also include countries with essentially no usage of gas prior to the project and those with much greater gas consumption at the time of project investment (up to 40% of total primary energy consumption as gas).

Case study #1 will examine the Arun LNG export project, completed in 1977. LNG from the Arun project was liquefied and shipped across the South China Sea to Japan. The Arun gas could have been utilized for domestic consumption, shipments to the U.S. were discussed and a pipeline to Singapore was probably technically feasible at the time. The case will examine the factors affecting the ultimate decision to advance the Japanese contract, the obstacles that prevented the most likely alternative use for this gas, and the mechanisms used to complete the project.

Case study #2 pairs the Transmed-1 gas pipeline, built in 1980, with an alternative route that became the Maghreb pipeline in 1996. The case study will seek to explain why a project was chosen in the late 1970's to deliver gas to Italy and Slovenia rather than to Spain. How did energy markets in Italy and Spain influence the decisions to proceed on the Transmed rather than an earlier version of the Maghreb? How did relations with transit countries (Tunisia vs. Morocco) explicitly or implicitly affect the choices available to Algeria as an exporter? What were the key political, institutional and economic factors in Algeria, transit countries and offtake markets? What changed that allowed the Maghreb to be built in 1996? The case should seek to answer some of these questions.

Case study #3 pairs the "Yamal-Europe" Russian gas export projects of the 1990s, with two alternative projects: (1) expansion of Ukrainian pipeline capacity or (2) direct export to Germany (and further west) via a sub-Baltic pipeline, bypassing transit countries. The analytical focus of the case study will be on the role of transit countries (e.g. Ukraine, Belarus, and Poland) and the shift from monopolistic offtaker to a more market-oriented system in international transportation projects (using the example of Germany).

Case study #4 will consider the timing of Qatargas, the first Qatari LNG export project completed in 1996. Why was this project not completed five, ten, or fifteen years sooner? What unique contractual structures were required to overcome obstacles to its completion?

Case study #5 pairs the completed pipeline from Turkmenistan to Iran with the un-built alternative to pipe gas across Afghanistan to Pakistan and potentially India. The Turkmenistan to Iran pipeline was completed in 1997, at the same time that western energy companies were promoting an export route across Afghanistan. Turkmenistan's relationship with Russia as key alternative export route and dominant regional power will also be examined.

Case study #6 examines a cluster of pipelines built in the late 1990s in the Southern Cone of South America (especially pipelines from Bolivia to Brazil and Argentina to Chile) and examines the factors that prevented these projects from moving forward earlier—and what mechanisms facilitated the projects to move to fruition. Large reserves in Argentina and Bolivia were identified decades earlier and a 1972 pipeline linked Bolivia to Argentina demonstrated the feasibility of international pipelines in the region.

Table 4. Proposed Case Study Pairs/Clusters. Built projects selected from the larger "Universe of Cases."

Pair or Cluster	Description	#1 Investment Climate (0-10)	#2 Number of Transit Countries	#3 Gas as % Total Primary Energy Consumption	#4 Market Regulatory / Pricing Risk	#5 Strength of Institution for Economic Cooperation (0-5)
1. Built Arun LNG, 1977; Not-built Indonesia to Singapore pipeline; Other options included domestic consumption and export to U.S.	Malaysia to Singapore pipeline was completed in 1992	3 – 9	0	0 – 3%	[ ]	2
2. Built Transmed pipeline; Not-Built early Maghreb	Gas pipeline built to Italy in 1980; No pipeline built to Spain until 1996; Spain LNG export built in 1976;	5 – 7	1 – 2	0 – 17%	[ ]	0
3. Built Yamal; Not-Built Baltic export pipeline	Series of export options for Russian gas	5.5 – 9.5	0 – 3	10 – 20%	[ ]	3
4. Built Qatargas 1996; Not-built earlier;		4.0 – 8.5	NA	NA	[ ]	NA
5. **Built Turkmenistan-Iran** 1997; Not-built Trans-Afghan pipeline		2 – 7	0 – 2	7 – 40%	[ ]	0-2
3. **Built Southern Cone pipelines.** Bolivia to Brazil, Argentina to Chile and Argentina to Brazil via Uruguay. Not-built in decades prior	Series of pipelines constructed in Southern Cone in late 1990s.	3 – 8	0 – 1	0 – 19%	[ ]	2 – 4

III. Case Study Protocol

This section summarizes the major questions that each case study should address. The protocol begins with an overview and then examines project-specific issues. Finally, it focuses on the five major explanatory factors that we have suggested explain decisions by investors to put money into gas infrastructure projects.

A. Overview of Built Project and Alternative Projects (AP's)

Each case study should begin with a careful overview of the historical and technical details of the built project. Case researchers should also provide analogous information (to the maximum extent possible) on all other major projects involving the same supply country and all other major projects involving the same off-take market(s) as the built project, that were proposed during the same time period as the built project.

The following general information should be provided about each project (one built and all proposed projects):

1. When were the projects first proposed? What were the scopes of the projects?
2. Who were the motivating actors (e.g. supply country government, receiving country government, domestic private investor, foreign investor, or international financial institution)? Which actors were "active" supporters vs. passive supporters?
3. For gas pipelines—What was the length, diameter and projected cost of the proposed pipelines? Analogous information should be provided for other types of infrastructure projects.
4. What are the sizes and dates of major planned investments in the project?
5. A map of the project showing built project and alternative routes for instances where alternative projects involved different routes.

Based on this information, the case researcher should use expert judgment to determine the *ex ante* most plausible alternative to the project that was eventually built. Criteria for selecting the "alternative project (AP)" are described in Section II above. Prior to commissioning each case study, the project leaders will have identified an AP (shown on table 3), but one of the first tasks in each study will be to validate (or adjust and validate) that selection.

B. Project Specific Issues

Here we focus on issues that are specific to built projects and are mindful that such a full description will not be possible for the hypothetical alternative projects. Thus, answers to these project-specific questions can be brief if it would be more convenient to focus in greater depth on the information in the next section, where we ask the case study authors to analyze the major explanatory factors.

B.1 Economic Issues

On the supply side—What was the characterization of the possible resource base(s)? If gas was already being produced prior to the negotiation of the given pipeline or LNG project, what was the estimated cost of supply from this incumbent source?

For transit countries (where relevant): What were the expectations about transit fees for the pipeline? Do precedent transactions exist to benchmark costs and rents for the transit country? Is theft of gas during transit a concern? Theft may be a significant problem where gas is transported through an integrated network, complicating the ability to track actual flows of gas to specific customers. Such is the case in transit countries like Ukraine creating constant tensions between Moscow and Kiev.

In the market where the gas was to be sold: Who are the intended off-takers and at what quantities and prices? What were the prices (level and volatility) of competing energy supplies, and what infrastructures already existed (or were expected) to deliver the gas? What is the characterization of demand by sector and what were the abilities of each sector to pay for off-take from project? What were the growth prospects for gas demand and related infrastructures? Were there special factors (e.g., environmental, security) that caused decision makers or off-takers to favor or disfavor gas?

In addition to the description of the market conditions in host countries, the case studies should also analyze the role that technological change played in project development. For example, advances in deepwater pipe-laying technology may have opened a new route for the gas pipeline allowing the project to overcome political challenges associated with a land-based route. On the demand side, new end-use technologies may create markets for gas that were previously unforeseen.

B.2 Legal Issues

On the legal side, the case study should describe the most important contracts between stakeholder parties, including risk mitigation measures (e.g., allocation of price and volume risks).

What percent of project capacity was to be sold on long-term contract? If major off-takers, such as power plants, were to be built—How confident were backers of the infrastructure project that demand would actually materialize? And what legal/economic mechanisms were used to hedge these risks?

The case study should also describe the agreed and actual legal recourse for contracting parties. What confidence did investors have that domestic courts would honor the different aspects of the contract? Is there a role for arbitration (national and international), and what were the expectations about the actual availability of such arbitration in case of disputes? Analysis of legal mechanisms should, as much as possible, draw on primary documents as well as reviews of any actual disputes or interpretations.

B.3 Financial Issues

For built projects: the case study should detail the components of investment in all segments and stages of the project. Describe the sources, maturities and rates of debt financing. Who were the equity participants and what were their expectations—were they, for example, expecting a return on the project itself or was the project a stepping-stone to expected larger returns in the future? The best means to address this question is to describe the investor's engagement in any related gas infrastructure investments.

Also, what had been the track record for debt and equity returns on other projects? What was the role of international financial institutions and governments? What political risk guarantees or special financial structures were provided to overcome economic or political obstacles?

For not-built projects: the case study should describe in as much detail as possible the financing arrangements for the projects. Specific project information may be limited. However, efforts should be undertaken to provide similar contextual information as provided for the built project.

C. Explanatory Factors

Each "case study" thus consists of two projects: one built project and an alternative project. The preceding section gathered information that is specific to the project. Here, we ask the case study authors to examine that information as well as other country information to focus on the five explanatory factors identified in this protocol. In examining each explanatory factor, we ask each study to explain whether and how investors and governments were able to overcome issues that would have deterred investors (e.g., the use of special contracts or offshore arbitration) and why they may not have been able to deploy those same mechanisms in the AP.

The numbered sub-headings in this section correspond with the five main factors identified earlier.

C.1 General Investment Climate within each Proposed Host Country

Each case study should provide an overview of the broader investment climate of each of the host countries. This should include a description of political, security, economic, and legal contexts at time the project was proposed, as it changed during the construction of the project, and also relevant historical information.

Domestic Security and Political Context

The case study should first describe the level of political and constitutional stability within each of the host countries. Is there a fear of revolution or dramatic change in government that could result in expropriation?

The discussion of the political context should also describe the form of government (e.g., totalitarian, democratic), the level of centralization of powers (e.g., centralized state, federal system), and the distribution of power in the political system (e.g., authority of the executive to make credible long-term decisions, shared powers between executive and legislative, role of judicial review).

Domestic Macro-Economic Context

A description of broader economic issues should first describe the macroeconomic situation in the host countries. What were the projected growth rates of the overall economies? What were the economic risks (exchange rate, uncertain growth prospects, etc.)? What were the projected needs for energy services in countries that would be served by the projects? How did the projects fit into the strategic energy plans of the governments, and to what degree were the governments actually able to conceive and implement strategic energy infrastructure plans?

"Rule of Law"

The case should discuss the development of the "rule of law" in the upstream, downstream, and transit countries (where relevant). Were commercial laws clear and evenly enforced; if not, how effective were traditional remedies for poor rule of law (e.g., corruption, joint ventures with politically connected local firms, joint ventures with politically powerful foreign entities)? Describe the historical track record on upholding contractual agreements and the role and independence of the judiciary in deciding disputes. Describe the adherence to international legal norms and the adherence to international arbitration where utilized prior to the proposal of this infrastructure project. Was corruption a significant problem at the time that the projects were proposed?

The case should also discuss any regulations or policies concerning foreign investment—generally as well as particular rules governing investments in energy and infrastructure. What was the prior experience with private and foreign investment? What were the tax regimes for energy products and how were tax laws enforced?

We ask these questions so that each case study examines the risks and opportunities for investors *prior* to undertaking of the projects and to uncover the interactions between government policies and various investors (non-governmental and governmental). These infrastructure investments are costly and "lumpy"—especially the first such project is risky and often entails (for the importing country) a substantial shift in the energy system, which is hard for entities other than the government to engineer. The factors related to "rule of law," such as enforceability of contracts and the abilities of governments to implement long-term strategies, are important because costly infrastructures are prone to suffer the problem of the "obsolescing bargain." Once the capital is deployed the investor is in a poor position to assure that the contractual terms are met for the decades required to recoup the initial investment and secure a profit.

Regulatory

Each case should analyze the *ex ante* and status of regulation in upstream, downstream and transit markets (where relevant). Where did the market segments stand on the continuum from state run monopolies with allocation determined politically to a market open to private and foreign ownership and investment, with prices flexible for any particular project. Relevant information would include any laws governing the price and quantity of gas sales outside of the project in question. In India, for example, gas allocation is politically determined and the retail price of gas is capped by regulation, posing a challenging obstacle to any new gas import projects. Thus, *ceteris paribus,* an investor is likely to consider a project to India much differently than an export project to a country gas pricing is determined freely in the market.

The cases should also discuss proposed regulatory reforms, and historical and prospective progress in carrying out these reforms, as viewed from the investor at the time the projects were being proposed.

Right-of-way legislation in a host country is another important issue for infrastructure projects. Many countries do not have laws of eminent domain that facilitate the acquisition of land for project construction. Georgia, for example, changed its constitution to make the Baku-Tbilisi-Ceyhan oil and gas pipelines a project of "national interest," thus making it feasible to acquire the local lands needed for the pipeline routes. Similarly, a proposed natural gas pipeline from Sakhalin to Japan has been stalled in part due to difficulties in acquiring land to build the spurs that would transport gas landed in Northern Japan to other points in the country.

Environmental legislation and laws concerning indigenous peoples and protected lands are also critical issues for siting, constructing, and operating a gas pipeline. The case should detail laws such as limitations on liability for infrastructure projects or specially protected local populations or lands.

The case studies should explore any particular social and environmental problems that were deemed potential obstacles in the construction and operation of the projects.

Where relevant, the case should describe the means proposed or actually employed to resolve these disputes. In some cases legislative changes may be required, as in the right-of-way issues discussed above. In other instances, negotiations with native groups or non-governmental organizations may be able to produce non-regulatory solutions to social and environmental conflicts.

C.2 Transit Countries

Information about transit countries was already supplied earlier—in the section on project-specific economics. We ask each case study author to explain how the number and type of transit countries affected the outcomes and whether particular routes were chosen to avoid certain transit countries or regions.

C.3 Off-take quantity risk

Each case study should explain evolution of the off-take country's gas market and examine the risk that the off-take market would be unable to absorb the quantity of gas supplied by the project. Where take-or-pay contracts or other arrangements used to reduce these risks, and with what effect? Much of the basic information for examining this factor will have been supplied earlier in this protocol, such as in the discussion about basic project economics.

C.4 Regulation of off-take prices

To some degree, price risk is merely the mirror of quantity risk, but in markets where the price of gas is regulated there are special risks associated with the system for regulating price. The basic information for analyzing this factor has been supplied earlier—in the discussion of the regulatory environment. The task in this section is to examine how investors perceived price risks and attempted to hedge them.

C.5 Inter-governmental/Institutional Relationships between Proposed Host Countries

The ability to complete investments in cross-border infrastructures may also depend on how well host countries engaged in a particular project are able to cooperate on and manage collective issues. Thus this protocol seeks information in each project on the degree of integration of the host countries' economies as well as institutions that may have been established to facilitate or manage trans-border issues—in particular, trans-border capital investments and trade.

Each study should probe the operation and effectiveness of these institutional relationships. It may be useful to detail the history of cross-border conflicts or collective action by the host countries and to explore the roles of institutions in resolving the conflicts. Measures of such activities include the number of joint-governmental working groups, commissions or inter-governmental treaties. The case study authors should be mindful that effective cooperation might not take place entirely through formal institutions.

It is also important to review the expectations about the likely futures for cooperation by host countries. How, if at all, did those expectations influence or reflect the official foreign policy, security and social goals of the host country governments?

We ask these questions because the existence of effective institutions for collective action—and the expectation that such institutions will become more effective over time—should encourage investors (government and non-government) to build infrastructures that can yield benefits only if they are managed on a collective basis over a long period of time.

D. <u>Outcomes</u>

We hypothesize that the range of factors discussed above ultimately determines whether a cross-border infrastructure project advances beyond the stage of negotiations. In the case studies, we are interested in two outcomes. First, we want to know the impact of these factors on whether the project is actually built. Second, we want to understand the impact of these factors on the project's performance—did prices, quantities and costs meet expectations?

Appendix A: Notes on Coding of Variables

<u>Variable #1: Political Risk Index</u>

A composite measure of political risk borne by a private investor in each host country is constructed with data from the *International Country Risk Guide (ICRG),* published monthly by the PRS Group Inc. The following are the criteria that were extracted from the ICRG dataset over the period January 1984 through November 2002 publication: [20]

(1) **Government Stability: "**A measure of the government's ability to carry out its declared program(s), and its ability to stay in office. This will depend on the type of governance, the cohesion of the government and the governing party or parties, the closeness of the next election, the government's command of the legislature, popular approval of government policies, and so on." **Scored 0-10, with lower scores for higher risks.**

(2) **Investment Profile: "**This is a measure of the government's attitude to inward investment as determined by the assessment of four sub-components: the risk to operations (scored from zero [very high risk] to four [very low risk]); taxation (scored from zero to three), repatriation (scored from zero to three), and labor costs (scored from zero to two)." **Scored 0-20, with lower scores for higher risks.**

(3) **Internal Conflict:** "This is an assessment of political violence in the country and its actual or potential impact on governance. The highest rating is given to those countries where there is no armed opposition to the government and the government does not engage in arbitrary violence, direct or indirect, against its own people. The lowest rating is given to a country embroiled in an ongoing civil war." Intermediate ratings take into account kidnapping and terrorist threats. **Scored 0-10, with lower scores for higher risks.**

(4) **Corruption:** Incorporates "the most common form of corruption" such as bribes and protection payments, but is more focused on "actual or potential corruption in the form of excessive patronage, nepotism…and suspiciously close ties between politics and business". **Scored 0-10, with lower scores for indicating higher levels of corruption.**

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[20] Criteria definitions listed below are obtained from Howell, L. D. (2001). <u>The Handbook of Country and Political Risk Analysis</u>. East Syracuse, N.Y., PRS Group. Component scores have been re-weighted from the ICRG tables based on an expert assessment of the relative importance of individual criteria for an investor in energy (gas) infrastructure.

(5) **Law and Order:** "Law and Order are assessed separately, with each sub-component comprising [zero to seven] points. The Law subcomponent is an assessment of the strength and impartiality of the legal system, while the Order subcomponent is an assessment of popular observance of the law." **Scored 0-20, with lower scores indicating a less established legal system.**

(6) **Ethnic Tensions:** "This component measures the degree of tension within a country attributable to racial, nationality, or language divisions." This may be particularly important where an infrastructure investment may span a particular ethnic enclave, creating potential for shut-down due to uprisings or hold-up. **Scored 0-10, with lower scores for higher risks.**

(7) **Bureaucratic Quality:** "The institutional strength and quality of the bureaucracy is another shock absorber that tends to minimize the revisions of policy when governments change. Therefore, high points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services" **Scored 0-20, lower scores indicating a less efficient bureaucracy with greater political interference.**

To calculate the value for variable #1, the above criteria scores are summed with a maximum possible score of 100. (The final proxy is then scaled down to a 10-point scale).

One issue worth noting is that the proxy variable as calculated here is tuned especially to measure the risks for privately financed projects. Indeed, the ICRG data set is designed to help guide private investors. However, these large-scale cross-border projects involve strategic and foreign relations between countries and thus government stability and sovereign risk may in some cases may be the critical measures of risk, especially when these government provide funding or loan guarantees for a project.

Variable #2: Number of transit countries

This is simply the number of countries that a pipeline has to span between the source country and a given off-take country, ranging from zero to one, two etc.

Variable #3: Off-take Quantity Risk

Gas consumption as a fraction of total primary energy consumption (measured two-years prior to project completion date) is used as a proxy measure for the status of gas market development, and thus the level of risks taken by project investors. It is assumed that nascent markets, lacking deployed capital for gas consumption represent a higher level of risk for investors. Off-takers will not have experience building and operating gas systems; none of the infrastructure needed for final use of gas and for hedging uncertainties in gas supply is in place in countries that have little or no prior role for gas in the economy.[21]

Variable #4: Regulatory/Market Pricing Risk

No suitable measure of regulatory/market pricing risk has been found with a time series that spans the time period of the historical cases.

Variable #5: Strength of Institution for Economic Cooperation

As a measure of the level of political integration, we have assigned each prospective trade route a score to describe the existing institutional arrangements dealing with trade and economic integration that bind host countries together. To avoid including a nearly limitless list of international organizations, we focus on international institutions that affect trade and economic cooperation—mindful that trade and economic cooperation is particularly relevant for transborder commercial energy infrastructures.

We set a scale from 0-5, with a 5 assigned to a project whose major supplier and major off-taker are members of institutions that wield super-sovereign powers. Table A1 reports the scaling, criteria and illustrations. We assigned scores highest level of common institution of which both supply and the main off-take countries are common members (i.e. Spain is the major off-taker for the Maghreb gas pipeline, so shared institutions with Algeria are most relevant).

[21] Data source is the BP Statistical Review of World Energy, 2001.

Table A. Scale for Variable #5: "Strength of Institution for Economic Cooperation"

Score	Characteristics	Examples (each list shows highest scores first)
5	Permanent institutions; regular meetings; transfer of intrusive powers to institutions	EU/EC, COMECON, NAFTA
4	Permanent institutions; able to weather crises; regular meetings; limited but significant economic powers (e.g., common tariffs)	EFTA, Mercosur (1996-2000)
3	Permanent institutions; regular meetings; mechanism for limited collective action (e.g., co-funded projects)	SADC, ECE (since late 1980s), Mercosur (1991-1996, post-2000), Gulf Cooperation Council
2	Permanent institutions; regular meetings; mechanism for convenient coordination	ASEAN, SAARC, ECE (late 1970s-early 1980s), ECLA, ESCAP, SAARC, ECO, OAS
1	Ad hoc cooperation; repeated interactions; limited convenient coordination	Soviet-ECE cooperation in the early 1970s, Plata Basin Group
0	No cooperative institutions and no repeated interactions	USSR-Turkey in 1980s; Iran-India-Pakistan 2003

Brief Descriptions of all Economic and Trade Institutions coded in this study (in alphabetical order):

ASEAN (Association of Southeast Asian Nations)

The highest decision-making organ of ASEAN is the Meeting of the ASEAN Heads of State and Government. The ASEAN Summit is convened every year. The ASEAN Ministerial Meeting (Foreign Ministers) is held on an annual basis. Ministerial meetings on several other sectors are also held: agriculture and forestry, economics, energy, environment, finance, information, investment, labor, law, regional haze, rural development and poverty alleviation, science and technology, social welfare, transnational crime, transportation, tourism, youth, the AIA Council and, the AFTA Council. Supporting these ministerial bodies are 29 committees of senior officials and 122 technical working groups.[22]

Members include: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam

[22] Adapted from www.aseansec.org

ECE (Economic Commission for Europe)

The Economic Commission for Europe (ECE) is the principal UN body studying and promoting economic cooperation and the improvement of economic relations among countries of Europe and North America. [23]

ECLA (Economic Commission for Latin America, now ECLAC adding Caribbean)

Headquartered in Santiago, Chile, is one of the five regional commissions of the United Nations. It was founded for the purposes of contributing to the economic development of Latin America, coordinating actions directed towards this end, and reinforcing economic relationships among the countries and with the other nations of the world. The promotion of the region's social development was later included among its primary objectives. The Latin American Free Trade Agreement (LAFTA), a largely failed endeavor, and the Special Economic Commission for Latin America (CECLA) were both outgrowths of ECLA. CECLA was the vehicle for the region's first and sustained effort in collective bargaining with outside countries and international organizations. It was operational between 1964 and 1973 as an ad hoc diplomatic gathering functioning either on the expert or ministerial level.[24]

ESCAP (Economic and Social Commission for Asia and the Pacific)

The regional arm of the United Nations Secretariat for the Asian and Pacific region is the Economic and Social Commission for Asia and the Pacific (ESCAP). The main purpose of is the promotion of economic and social development through regional and subregional cooperation and integration. The main legislative organ of ESCAP is the Commission, which meets annually at the ministerial level and reports to the UN's Economic and Social Council (ECOSOC). It provides a forum for all Governments of the region to review and discuss economic and social issues and to strengthen regional cooperation. The Advisory Committee of Permanent Representatives and other Representatives Designated by Members of the Commission (ACPR), composed of ESCAP members and associate members, meets every month to advise and exchange views with the Executive Secretary on the Commission's work.[25]

[23] Adapted from www.unece.org
[24] Milenky, E.S. (1977) "Latin America's multilateral diplomacy: integration, disintegration and interdependence" International Affairs vol. 53: 73-96.
[25] Adapted from www.unescap.org. Membership information, including date of admission can be found at http://www.unescap.org/about/members.htm

ECO (Economic Cooperation Organization)

Economic Cooperation Organization (ECO), is an inter-governmental regional organization established in 1985 by Iran, Pakistan and Turkey for the purpose of sustainable socio-economic development of the Member States. ECO is the successor organization of Regional Cooperation for Development (RCD) which remained active from 1964 up to 1979. In 1992, the Organization was expanded to include seven new members, namely: Islamic State of Afghanistan, Republic of Azerbaijan, Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan.[26]

EC (European Community)

Established 8 April 1965 to integrate the European Atomic Energy Community (Euratom), the European Coal and Steel Community (ESC), the European Economic Community (EEC or Common Market), and to establish a completely integrated common market and an eventual federation of Europe; merged was into the European Union (EU) on 7 February 1992; member states at the time of merger were Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, UK.[27]

EU (European Union)

Evolved from the European Community (EC). Established 7 February 1992; effective - 1 November 1993. Aim: to coordinate policy among the 15 members in three fields: economics, building on the European Economic Community's (EEC) efforts to establish a common market and eventually a common currency to be called the 'euro', which superseded the EU's accounting unit, the ECU; defense, within the concept of a Common Foreign and Security Policy (CFSP); and justice and home affairs, including immigration, drugs, terrorism, and improved living and working conditions.[28]
Members include: (15) Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK

EFTA (European Free Trade Agreement)

On November 20, 1959, Ministers from seven West European countries that were not members of the European Economic Community (Austria, Denmark, Norway,

[26] Adapted from http://www.ecosecretariat.org/
[27] CIA World Factbook 2002, http://www.cia.gov/cia/publications/factbook/.
[28] CIA World Factbook 2002, http://www.cia.gov/cia/publications/factbook/

Portugal, Sweden, Switzerland, and the United Kingdom) approved in Stockholm the text of a Convention establishing the European Free Trade Association (EFTA), which entered into force on May 3, 1960. The Association's goal was: (a) to remove import duties, quotas and other obstacles to trade in Western Europe and (b) to uphold liberal, non-discriminatory practices in world trade. Iceland joined EFTA in 1970 while Finland became an associate member in 1961 and a full member in 1986. Liechtenstein became a member in 1991.

The membership of the EFTA has undergone significant changes since the inception of the organization. Of the original members, six have left to join the European Union (EU): the United Kingdom and Denmark in 1972; Portugal in 1985; and Austria, Finland, and Sweden, on January 1, 1995. Norway, however, decided against membership of the EU in a referendum in November 1994, after completing negotiations for accession to the EU along with the other three EFTA countries. The present members of EFTA are: Iceland, Liechtenstein, Norway, and Switzerland.[29]

GCC (Gulf Cooperation Council)

The text of the Charter for the Gulf Cooperation Council was agreed upon at a meeting of the Foreign Ministers of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, on February 4, 1981 in Riyadh, Saudi Arabia. The Charter was signed by the Heads of State of these countries on May 25, 1981, in Abu Dhabi, at which time the Gulf Cooperation Council formally came into being.

The objectives of the Gulf Cooperation Council, as stated in the Charter, are to effect coordination, integration and interconnection between Member States in all fields in order to achieve unity between them; to deepen and strengthen relations, links and scopes of cooperation prevailing between their peoples in various fields; to formulate similar regulations in various fields including, inter alia, economic and financial affairs, agriculture, industry, commerce, customs and communications, education and culture, social and health affairs, information and tourism, and legislative and administrative affairs; to stimulate scientific and technological progress in various fields, to establish scientific research centers and implement common projects, and to encourage cooperation by the private sector.

A *Unified Economic Agreement* was signed in November 1981 and ratified in 1982. Its aims include free trade among Member States in all agricultural, animal, industrial, and natural resource products of national origin. Such products are exempted from customs duties and other charges having equivalent effect. The Agreement also aims at

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[29] IMF Directory of Economic, Commodity, and Development Organizations; http://www.imf.org/external/np/sec/decdo/contents.htm

implementing a common external tariff and trade policy, and coordinating development. The initial implementation measures of the Unified Economic Agreement were taken in March 1983.[30]

Members include: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates

Mercosur (Southern Cone Common Market)

Customs Union established by the Treaty of Ascunción in March 1991 by Argentina, Brazil, Paraguay and Uruguay. The aim of increasing regional economic cooperation through internal tariff reduction and the establishment of a common external tariff. Trade rapidly expanded among its members following the treaty's inception, increasing five-fold between 1990 and 1997. Chile joined as an associate Mercosur member, followed by Bolivia in 1997 under agreements that allowed the two to keep their lower external tariffs in place, while their products gradually were to receive tariff-free status within the trade bloc.[31] Due to the economic crises in Brazil and Argentina in recent years Mercosur has been slowly eroding. The two largest trading partners have cast aside the union's defining characteristic—economic policies that are commonly decided upon, imposed and upheld. Both Brazil and Argentina have taken unilateral actions that have negatively impacted intra-union trade and effectively lowered barriers to external trade.[32]

NAFTA (North American Free Trade Agreement)

Trade pact signed in 1992 that seeks to gradually eliminate most tariffs and other trade barriers on products and services passing between the United States, Canada, and Mexico.

OAS (Organization of American States)

Established in 1890 as the International Union of American Republics. Adopted present charter in 1948. OAS aim is to promote regional peace and security as well as economic and social development. Members include: Antigua and Barbuda, Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba (excluded from formal participation since 1962), Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico,

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[30] IMF Directory of Economic, Commodity, and Development Organizations; http://www.imf.org/external/np/sec/decdo/contents.htm

[31] Foreign Trade Information System of the OAS: http://www.sice.oas.org

[32] Kraul, C., "Crisis Puts Trade Bloc at Risk", *LA Times*; July 16, 2001

Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, US, Uruguay, Venezuela.[33]

Plata Basin Group

Originally conceived in 1969. Members were to include Argentina, Bolivia, Brazil, Paraguay, and Uruguay. Purpose of group was to join countries in a multilateral effort to develop international water resources, hydroelectric power, and infrastructure in cooperation with international organizations headed by the Inter-American Development Bank. Largely failed due to tensions between Argentina and Brazil over Itaipu Dam.[34]

SAARC (South Asian Association for Regional Cooperation)

The South Asian Association for Regional Cooperation (SAARC) was established in 1985 when its Charter was formally adopted by the Heads of State or Government of the seven member countries. A SAARC Preferential Trading Arrangement (SAPTA) designed to reduce tariffs on trade between SAARC member states was signed in April 1993 and entered into force in December 1995. In 1998 at the Tenth Summit in Colombo, the importance of achieving a South Asian Free Trade Area (SAFTA) as mandated by the Male' Summit in 1997 was reiterated and it was decided to set up a Committee of Experts to work on drafting a comprehensive treaty regime for creating a free trade area. The Eleventh SAARC Summit, held in Kathmandu in January 2002, recognising the need to move quickly towards SAFTA, directed the Council of Ministers to finalise the text of the Draft Treaty Framework by the end of 2002. The Summit also directed that in moving towards the goal of SAFTA, the Member States expedite action to remove tarriff and non-tarriff barriers and structural impediments to free trade.[35]

Members include: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

SADC (Southern African Development Community)

Formed by Tanzania, Angola, Zambia, Malawi, Mozambique, Botswana, Namibia and Zimbabwe. South Africa joined in 1994, Mauritius in 1995, Democratic Republic of Congo in 1997, and Seychelles in 1997. SADC objectives include harmonization and

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[33] CIA (2002) *TheWorld Factbook 2002*. http://www.cia.gov/cia/publications/factbook/

[34] Milenky, E.S. (1977) "Latin America's multilateral diplomacy: integration, disintegration and interdependence" International Affairs vol. 53: 73-96.

[35] IMF Directory of Economic, Commodity, and Development Organizations; http://www.imf.org/external/np/sec/decdo/contents.htm

rationalization of policies and strategies for sustainable development in all areas, as well as successful implementation of the SADC Trade Protocol, which calls for an 85 percent reduction in internal trade barriers over eight years. Nine SADC members are also members of the similar Common Market for Eastern and Southern Africa (Comesa). In 2000 Comesa launched its own free trade regime, creating overlapping schedules with SADC for internal tariff reductions.[36]

[36] "Creating a Power Pool: The SAPP Experience", *Energy South Asia,* November/December, 2001.

Appendix B: The Universe of Cases

Table B. Built Projects Spanning Countries of "Less Attractive" Investment Climates

				(#1) Investment Climate (GIRI)[1]						(#3) Offtake Quantity Risk		(#5) Strength of Institution for Economic Cooperation	Institution Referenced
			Completed	Supply	Rating	Transit	Rating	End-Use	Rating	Gas as % of Total Primary Energy Consumption			
Project/Type	Source	Destination	(year)	Country	(1-10)	Country	(1-10)	Country	(1-10)	Country	Pre-Project	(0-5)	in (#5)
1 USSR-Poland Pipeline	USSR	Poland	1950 c.a.	USSR	NA	---		Poland	NA	Poland	NA	5	COMECON
2 Algeria-U.K. LNG	Algeria	U.K.	1964	Algeria	NA	---		U.K.	[8.5][2]	U.K.	0%	0	NA
3 Algeria-France LNG	Algeria	France	1965	Algeria	NA	---		France	[8]	France	4%	0	NA
4 Afghan-USSR Pipeline	Afghanistan	USSR	"late 1960's"	Afghanistan	NA	---		USSR	[4.5]	USSR	NA	0	NA
5 a-Marsa El Brega LNG	Libya	Barcelona, Spain	[1969]	Libya	NA	---		Spain	[6.5]	Spain	0%	0	NA
b-Marsa El Brega LNG	Libya	La Spezia, Italy	[1969]	Libya	NA	---		Italy	[7]	Italy	10%	0	NA
6 IGAT-I Pipeline	Iran	USSR	1970	Iran	NA	---		USSR	[4.5]	USSR	NA	0	NA
7 Bolivia-Argentina Pipeline	Santa Cruz Fields, Bolivia	Campo Duran, Argentina	1972	Bolivia	[2.5]	---		Argentina	[4.0]	Argentina	19%	2	ECLA
8 Lumut LNG	Brunei	Japan	1972	Brunei	NA	---		Japan	[9]	Japan	1%	0	NA
9 Bontang-Japan LNG	Indonesia	Japan	[1973]	Indonesia	[3.0]	---		Japan	[9]	Japan	1%	2	ESCAP
10 Transgas Pipeline Network (incl. Brotherhood, Northern Lights & below)													
a - USSR-Czechoslo	Shebelnika, Ukraine; West Siberia	Czechoslovakia	1968	USSR	[4.5]	Czechoslovakia	[6]	Czechoslovakia Austria	[6] [9]	Czechoslovakia Austria	1% 12%	1	ECE
b - TAG-I,II (Trans-/	West Siberia	Austria	1974	USSR	[4.5]	Czechoslovakia Austria	[6]	Czechoslovakia Austria Italy	[6] [9] [7]	Czechoslovakia Austria Italy	3% 16% 10%	1	ECE
c,d MEGAL (Mittel-Eu	West Siberia	Western Europe via Austria	1979[3]										
c - USSR-FRG (Ruh	West Siberia	FRG	1974	USSR	[4.5]	Czechoslovakia	[6]	Austria GDR (East Germany) FRG (West Germany)	[9] [7] [8.5]	Austria GDR FRG[4]	16% NA 7%	1	ECE
d - USSR-France	West Siberia	France	1976	USSR	[4.5]	Czechoslovakia FRG	[6] [8.5]	FRG France	[8.5] [8]	FRG[4] France	11% 10%	1	ECE

Table B. (Continued)

				(#1) Investment Climate (GIRI)[1]						(#3) Offtake Quantity Risk		(#5) Strength of Institution for Economic Cooperation	Institution Referenced
			Completed	Supply	Rating	Transit	Rating	End-Use	Rating	Gas as % of Total Primary Energy Consumption			
Project/Type	Source	Destination	(year)	Country	(1-10)	Country	(1-10)	Country	(1-10)	Country	Pre-Project	(0-5)	in (#5)
11 Orenburg ("Soyuz")	West Siberia	Eastern Europe	1975	USSR	[4.5]	Czechoslovakia Romania	[6] [4]	Bulgaria Hungary Romania	[6] [6] [4]	Hungary Bulgaria Romania	18% 1% 52%	5	COMECON
12 USSR-Finland Pipeline	Leningrad	Finland	1974	USSR	[4.5]	---		Finland	[9.5]	Finland	0%	1	ECE
13 Algeria-Spain LNG	Algeria	Spain	[1976]	Algeria	[4.5]	---		Spain	[8]	Spain	2%	0	NA
14 Algeria-U.S. LNG	Algeria	U.S.	[1976]	Algeria	[4.5]	---		U.S.	[9]	U.S.	32%	0	NA
15 Das Island LNG	Abu Dhabi	Japan	1977	Abu Dhabi	[3]	---		Japan	[9]	Japan	2%	0	NA
16 Algeria-Belgium LNG	Algeria	Belgium	1982	Algeria	[4.5]	---		Belgium	[9]	Belgium	20%	0	NA
17 Algeria-Italy LNG	Algeria	Italy	1983	Algeria	[5]	---		Italy	[7]	Italy	17%	0	NA
18 Transmed-1 Pipeline	Algeria	Italy, Slovenia, Tunisia	1983	Algeria[5]	[5]	Tunisia[5]	[5]	Tunisia[5] Italy[5] Slovenia[5]	[5] [7] [5]	Tunisia Italy Slovenia	[10%] 17% [NA]	0	NA
19 Urengoy ("Yamal-I") Pipeline	Urengoy, USSR	West Europe via Czechoslovakia	1985	USSR[6]	[4.5]	Czechoslovakia[6] FRG Austria	[7] [8.5] [9]	Austria-1.5-2.5 bcm/yr FRG-10.5 bcm/yr France-6-8 bcm/yr Switzerland-0.36 bcm/yr Italy-6 bcm/yr	[9] [8.5] [8] [9.5] [7]	Czechoslovakia Austria FRG[4] France Switzerland Italy	9% 19% 14% 12% 5% 17%	2	ECE
20 USSR-Turkey Pipeline	West Russia	Turkey	1986	USSR	[4.5]	---		Turkey	5.4	Turkey	0%	0	NA
21 Arun LNG	Indonesia	Japan, South Korea, Taiwan	1987	Indonesia	3.6	---		Japan[7]	9.0	Japan	10%	2	ESCAP
22 Bontang-South Korea LNG	Indonesia	South Korea, Taiwan	1989	Indonesia	2.7	---		South Korea[7]	6.0	South Korea	3%	2	ESCAP
23 Malaysia-Singapore Pipeline	Peninsular Malaysia	Singapore	1992	Malaysia	5.0	---		Singapore	7.6	Malaysia	0%	2	ASEAN
24 STEGAL Pipeline	Russia	Germany/France	1992	Russia	[6.2]	Czechoslovakia FRG	[7] 9.0	FRG France	9.0 8.3	FRG[4] France	17% 12%	3	ECE

Table B. (Continued)

				(#1) Investment Climate (GIRI)[1]						(#3) Offtake Quantity Risk		(#5) Strength of Institution for Economic Cooperation	Institution Referenced in (#5)
										Gas as % of Total Primary Energy Consumption			
Project/Type	Source	Destination	Completed (year)	Supply Country	Rating (1-10)	Transit Country	Rating (1-10)	End-Use Country	Rating (1-10)	Country	Pre-Project	(0-5)	
26 Bintulu LNG	Malaysia	Japan, South Korea, Taiwan	1993	Malaysia	5.8	---		Japan[7]	8.1	Japan	11%	2	ESCAP
27 Algeria-Turkey LNG	Algeria	Turkey	1994	Algeria	4.0	---		Turkey	6.7	Turkey	8%	0	NA
28 Transmed-2 Pipeline	Algeria	Italy, Slovenia, Tunisia	1994	Algeria	4.0	Tunisia	5.9	Italy Slovenia	7.2 2.2	Tunisia Italy Slovenia	[NA] 27% [NA]	0	NA
29 Ringpipeline Pipeline	Bulgaria	Macedonia	1995	Russia	4.5	Ukraine Romania Bulgaria	4.5 5.0 6.5	Romania Bulgaria Macedonia[8]	5 6.5 1.9	Ukraine Romania Bulgaria Macedonia	45% 50% 17% [NA]	3	ECE
30 Maghreb Pipeline	Algeria	Spain, Portugal	1996	Algeria	4.3	Morocco	6.5	Spain Portugal	7.3 7.5	Spain Portugal	7% 0%	0	NA
25 Methanex-PA Pipeline	Tierra del Fuego	Methanex Methanol Plant	1996	Argentina	5.3	---		Chile	6.3	Chile	12%		
32 Gas Andes Pipeline	La Mora, Argentina	Santiago, Chile	1997	Argentina	6.8	---		Chile	9.8	Chile	9%	3	Mercosur
33 Korpezhe-Kurt-Kui Pipeline	Korpezhe, Turkmenistan	Kurt-Kui, Iran	1997	Turkmenistan[9]	[4.2]	---		Iran	7.1	Iran	34%	2	ECO
34 Qatargas LNG	Qatar	Japan	1997	Qatar	7.3	---		Japan	8.3	Japan	11%	0	NA
35 Bulgaria to Greece Interc Pipeline	Russia	Greece	1997	Russia	4.2	Ukraine[9] Moldova[9] Romania Bulgaria	[4.2] [4.2] 5.8 6.4	Greece	7.8	Greece	1%	3	ECE
36 Myanmar-Thailand Pipeline	Yadana	Ratchaburi, Thailand	1998	Myanmar	5.3	---		Thailand	7.2	Thailand	19%	2	ASEAN
37 Argentina-Uruguay Pipeline	Entre Rios, Argentina	Paysandu, Uruguay	1998	Argentina	6.8	---		Uruguay	5.3	Uruguay	0%	4	Mercosur
38 Bolivia-Brazil Pipeline	Santa Cruz, Bolivia	Sao Paulo, Brazil	1999	Bolivia	4.8	---		Brazil	6.0	Brazil	3%	4	Mercosur
39 Cuiba Gas Pipeline Pipeline	Bolivia	Central Brazil	1999	Bolivia	4.8	---		Brazil	6.0	Brazil	3%	4	Mercosur
40 Norandino Pipeline	Northwest Argentina	Antofagasta region, Chile	1999	Argentina	6.5	---		Chile	8.1	Chile	11%	4	Mercosur
41 GasAtacama Pipeline	Salta Province, Argentina	Norte Grande, Chile	1999	Argentina	6.5	---		Chile	8.1	Chile	11%	4	Mercosur

Table B. (Continued)

				(#1) Investment Climate (GIRI)[1]						(#3) Offtake Quantity Risk		(#5) Strength of Institution for Economic Cooperation	Institution Referenced
										Gas as % of Total Primary Energy Consumption			
Project/Type	Source	Destination	Completed (year)	Supply Country	Rating (1-10)	Transit Country	Rating (1-10)	End-Use Country	Rating (1-10)	Country	Pre-Project	(0-5)	in (#5)
42 Gasoducto del Pacifico Pipeline	Neuqeun, Argentina	Concepcion, Chile	1999	Argentina	6.5	---		Chile	8.1	Chile	11%	4	Mercosur
31 Methanex-2 & 3 Pipeline	Tierra del Fuego	Methanex Methanol Plant	1999	Argentina	6.7	---		Chile	6.3	Chile	9%	3	Mercosur
43 Rasgas LNG	Qatar	South Korea	1999	Qatar	7.0	---		South Korea	7.6	South Korea	6%	0	NA
44 Bonny LNG	Nigeria	Italy, Spain, Turkey, France	1999	Nigeria	5.4	---		Italy[7]	8.4	Italy	30%	0	NA
45 Soyuz-Romania Intercon Pipeline	Russia	Romania	1999	Russia[9]	5.5	Ukraine[9]	5.7	Romania	6.3	Romania	40%	3	ECE
46 Yamal-Europe I	Russia	West Europe	1999	Russia[9]	5.5	Belarus[9] Poland	5.5 7.7	Belarus[9] Poland Western Europe	5.5 7.7 [9]	Belarus Poland Western Europe	57% 10% [20%]	3	ECE
47 Argentina-Brazil: Trans Pipeline	Parana, Argentina	Uruguaiana, Brazil	2000	Argentina	7.4	---		Brazil	5.8	Brazil	4%	4	Mercosur
48 Myanmar-Thailand Pipeline	Yetagun	Ratchaburi, Wangnoi	2000	Myanmar	4.5	---		Thailand	6.2	Thailand	25%	2	ASEAN
49 Oman LNG LNG	Oman	South Korea	2000	Oman	7	---		South Korea	7.3	South Korea	8%	0	NA
50 Iran-Turkey Pipeline	Iran	Turkey	2001	Iran	6.6	---		Turkey	5.5	Turkey	15%	2	ECO
51 West Natuna-Singapore a Pipeline	West Natuna, Indonesia	Jurong Islands, Singapore	2001	Indonesia	3.9	---		Singapore	9.1	Singapore	5%	2	ASEAN
52 Cruz del Sur [40] Pipeline	Neuqeun Basin, Argentina	Montevido, Uruguay and Porto Alegre, Brazil	2002	Argentina	7.6	Uruguay	6.8	Uruguay Brazil	6.8 5.2	Uruguay Brazil	1% 5%	4	Mercosur
53 Bluestream Pipeline	Russia	Turkey	2002	Russia	3.6	---		Turkey	5.3	Turkey	17%	3	ECE

Notes:

1 For a complete description of the methods and sources for calculating the indicator variables see Appendix A, "Notes on Coding of Variables".
2 [Bracketed] values indicate estimated data.
3 MEGAL was fully completed in 1979, but shipments began earlier.
4 The source of the energy consumption data, BP Global, combines data from the FRG (West Germany) and GDR (East Germany). No attempt is made here to disaggregate the data.
5 Country risk data for Algeria, Tunisia and Slovenia (Yugoslavia) are estimated from 1982 ICRG indices, as 1982 is the first year of the dataset.
6 ICRG index was first calculated for these countries in 1984. Thus, 1984 data is used, rather than two years prior estimation.
7 For purposes of simplicity, proxy variable data is provided for the largest project off-taker.
8 Yugoslav data is used as proxy (even post-independence in 1991) where Slovenia or Macedonia data is unavailable.
9 The ICRG dataset provides only one index for the former Soviet Union.
10 Connection to Brazil is not yet completed.