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Regulatory Reform in Mexico's Natural Gas Industry

Liberalization in the Context of a Dominant Upstream Incumbent

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Liberalization of the natural gas industry is complex because the sector combines activities with natural monopoly characteristics with activities that are potentially competitive. The challenges are compounded when the State opts to retain vertically integrated monopolies in otherwise contestable segments of the industry. Regulatory issues associated with partial liberalization of natural gas markets are analyzed through a case study of Mexico.



Summary findings

The natural gas industry combines activities with natural monopoly characteristics with those that are potentially competitive. Pipeline transport and distribution, which have natural monopoly characteristics, require regulation of price and nonprice behavior. Production is a contestable activity, but in a few countries (including Mexico) it remains a state monopoly. Gas marketing is also contestable, but the presence of a dominant, upstream, vertically integrated incumbent may pose significant barriers to entry. Market architecture decisions—such as horizontal structure, regional development, and the degree of vertical integration—are also crucial.

Rosellón and Halpern report that Mexico has undertaken structural reform in the energy sector more slowly than many other countries, but it has introduced changes to attract private investment in natural gas transport and distribution. These changes were a response to the rapid growth in demand for natural gas (about 10 percent a year) in Mexico, which was in turn a response to economic development and the enforcement of environmental regulations. The new regulatory framework provides incentives for firms to invest and operate efficiently and to bear much of the risk associated with new projects. It also protects captive consumers and improves general economic welfare.

The continued vertical integration of the state-owned company Pemex and its statutory monopoly in domestic production posed a challenge to regulators. Their response in liberalizing trade, setting first-hand sales prices, and regulating natural gas distribution makes the Mexican case an interesting example of regulatory design.

As the first phase of investment mobilization and competition for the market in Mexican distribution projects concludes, remaining challenges include consistently and transparently enforcing regulations, coordinating tasks among government agencies, and ensuring expansion of gas transport services and domestic production.

A key challenge in the near term will be fostering competition in the market. In strengthening the role of market forces, one issue is Pemex's discretionary discounts on domestic gas and access to transport services, made possible by its monopoly in domestic production and marketing activities and its overwhelming dominance in transport. The main instrument available to the regulator is proscribing Pemex contract pricing, but more durable and tractable instruments should be considered.

This paper—a product of the Finance, Private Sector, and Infrastructure Sector Unit, Latin America and the Caribbean Region—is part of a larger effort in the region to evaluate and disseminate lessons of experience in designing policies to improve the quality and sustainability of infrastructure services. Copies of this paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Katia Nemes, room 15-178, telephone 202-458-5440, fax 202-676-1821, email address knemes1@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The authors may be contacted at jrosellon@dis1.cide.mx or jhalpern@worldbank.org. January 2001. (37 pages)

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Energy plays a fundamental role in every country's economy. Poor production and distribution of energy can severely diminish an economy's aggregate efficiency. Natural gas is one of the most important sources of energy today because it is environmentally friendly and has economic and technical advantages. After a period of intervention by their governments in the energy sector, countries in Asia, Europe, and North and South America are introducing reforms to promote efficiency and attract private investment to the natural gas industries.

Liberalization of this sector is complex because the natural gas industry combines naturally monopolistic activities with potentially competitive ones. Pipeline transportation and distribution have natural monopoly characteristics and require regulation of price and non-price behavior. Production is a contestable market, though in a few countries such as Mexico it is still maintained as a state monopoly. Gas marketing is also contestable, but the presence of a dominant upstream vertically integrated incumbent may pose significant barriers to entry. Market architecture decisions such as the degree of vertical integration, horizontal structure, and regional development are also crucial.

This paper examines how Mexican policymakers have addressed these issues. After a brief overview of the early structural reform process, the paper describes the reforms introduced in the natural gas industry and the policymaking and regulatory processes, highlighting the principal results. It then assesses the policy decisions made for the national natural gas industry and regulation of gas transport and distribution. The final section presents outcomes to date and future challenges for the continued development of the industry.

1. Sector Characteristics and Policy Context

The Mexican government initiated a program of structural reform in 1988 after a period of stagnation and high inflation caused by a debt crisis. The program included trade liberalization that culminated in free trade agreements signed during the 1990s between Mexico and Bolivia, Canada, Chile, Colombia, Costa Rica, Nicaragua, the United States, Venezuela, and, most recently, with the European Union and Israel.¹ The program's broad goals were achieving macroeconomic stability and microeconomic efficiency. The microeconomic strategy had as its centerpiece the deregulation plan announced in 1989 that called for a review of the regulatory framework in all economic sectors to eliminate artificial entry and exit barriers in contestable markets. Such sectors as ports, transport, and telecommunications were included in this plan.

In 1992 the government initiated modest changes to permit entry of private participants in power generation, and a more ambitious reform in natural gas was begun in 1995. Before this, state companies had controlled energy activities: *Petróleos Mexicanos* (Pemex) in the oil and gas sector and *Comisión Federal de Electricidad* (CFE) and *Luz y Fuerza del Centro* (LFC) in the electricity industry. No decisions have been made on private participation and structural reform in gas production, oil extraction and processing, and

¹ Mexico is also close to signing free trade agreements with El Salvador, Guatemala, Honduras, and Singapore.

production of petrochemicals. Structural reform of the electricity sector has been postponed.

A new regulatory institution—the Energy Regulatory Commission (CRE)—was created to provide limited regulatory oversight of private investment in power generation.² The reform of the natural gas sector allowed for private investment in new transportation projects and in distribution and marketing, but kept the Pemex monopoly in production and processing. The CRE's mandate was expanded and clarified in tandem with these reforms. The Natural Gas Regulations provide the regulatory framework to permit implementation of the liberalization measures.

The Industry before 1995

Pemex has been the main agent in developing hydrocarbon fuels. The supply of these and other products is determined by the company's strategies, which in turn are conditioned by the crucial role of Pemex as a source of tax revenue for the government. Pemex's main goal has been to maximize export receipts through sale of crude oil and to provide finished fuels to the domestic (captive) market. Even though it conducted an extensive rationalization program—reducing its direct labor force by almost half—investments declined in 1996–1997, and a further reduction is expected in 2000 in real terms. Investments were particularly low in areas that are not of strategic importance to the company, such as natural gas development.

Gas production in Mexico is mainly associated with oil extraction in the southeast and the offshore zone. Of total associated natural gas extracted, 11.7 percent is vented or flared. Mexico has approximately 63 trillion cubic feet of gas reserves (14th in the world) and its reserve-to-production ratio implies reliable supply for 36 years. Under-investment in exploration, field development, and gathering facilities limited increases in natural gas production, despite the fact that in recent years more than 38 trillion cubic feet of non-associated gas reserves have been discovered near Burgos in the northeast. Burgos' reserves represent 57.1 percent of total natural gas reserves but contribute only 17.3 percent to total natural gas production (table 1, figure 1).

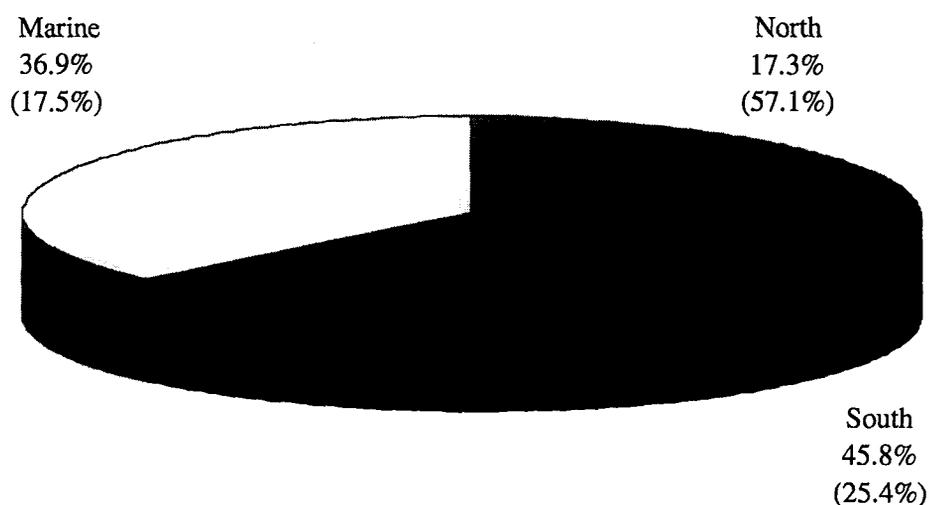
² CRE's role in oversight the electricity industry is largely limited to issuing permits and approving wheeling and buyback charges for private sector generators. The Secretary of Finance has a decisive role in setting retail tariffs and government guarantees, while the Federal Electricity Commission predominates in the definition of bidding documentation and contract content for independent power projects.

Table 1. Natural Gas Extraction by Type, 1991-97
Thousands of cubic meters a day

Region	1991	1992	1993	1994	1995	1996	1997
<i>Associated gas</i>							
South	49,753	48,903	48,790	46,468	46,694	50,630	52,499
Offshore	32,848	33,244	35,226	37,916	39,049	44,259	46,694
North	3,455	3,511	3,540	3,625	3,568	3,625	3,625
Subtotal	86,055	85,658	87,556	88,009	89,311	98,514	102,818
<i>Non-associated gas</i>							
South	6,881	6,201	4,729	4,701	5,182	5,720	5,437
Offshore	0	0	0	0	0	0	0
North	9,939	9,628	8,948	9,939	11,950	14,583	18,264
Subtotal	16,820	15,829	13,677	14,640	17,132	20,303	23,701
Total	102,875	101,487	101,233	102,648	106,443	118,817	126,520

Source: Pemex, 1998.

Figure 1. Natural Gas Production (Reserves) by Zone, 1997

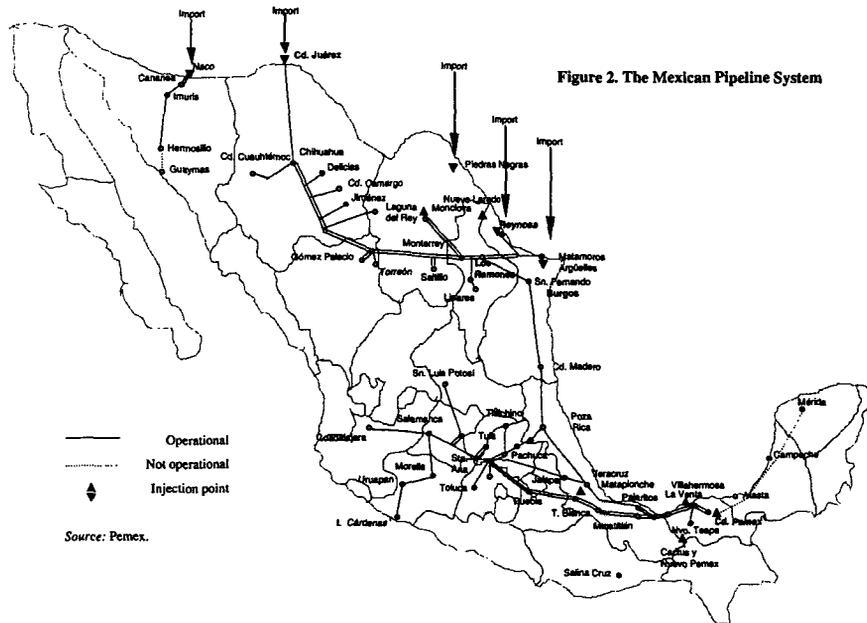


Source: Secretaría de Energía 1998

Until 1995 Pemex had a complete monopoly in trade, production and transporting natural gas since the 1940s. Pemex's gas transportation network is 12,000 kilometers long (figure 2). It reaches all main industrial centers except the northwest and the north Pacific, where liquefied petroleum gas is used for residential consumption, and fuel oil and diesel are used for industrial consumption.³ In 1994 the pipeline system transported 2.4 billion cubic feet of natural gas, including 130 million cubic feet of gas imports, 140 million cubic feet of non-associated gas, and 2.1 billion cubic feet of associated gas. In contrast, distribution networks were barely developed with some private participation.

³ Exceptions are Mexicali in northern Baja California and Hermosillo in Sonora, where the use of natural gas is more widespread.

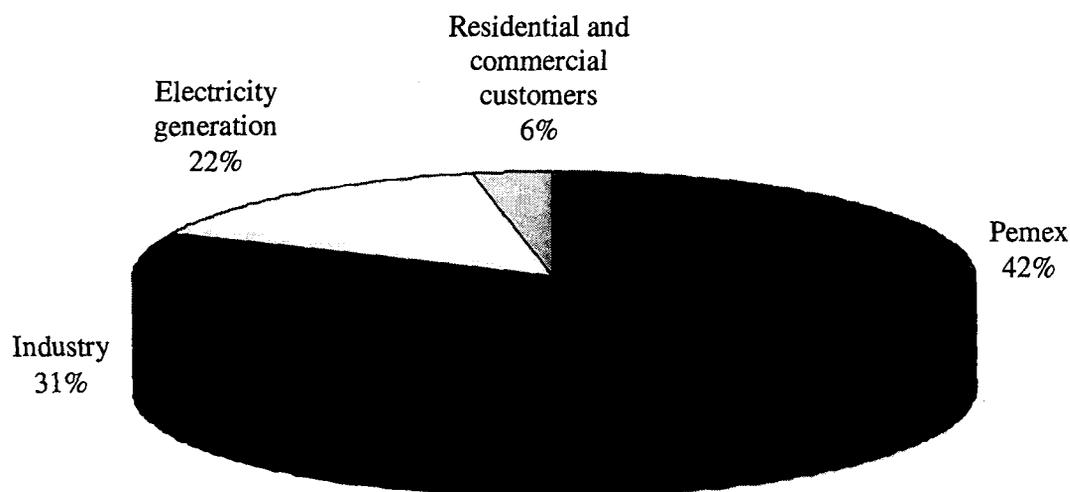
Figure 2



Before 1995 Pemex was the sole importer of natural gas and remains today its main consumer. In 1999 it used 42 percent of the gas supply. Industry consumed 31 percent, electricity generation 22 percent, and residential and commercial customers 6 percent (figure 3). In the United States oil production and processing account for 8.9 percent of the natural gas supply, industry 40 percent, residences 37.6 percent, and electricity generation 13.5 percent. As shown, residential consumption for natural gas in Mexico is low. Liquefied petroleum gas is used instead and is fairly well distributed in large cities. Its price is regulated by the CRE since Pemex also has a statutory monopoly in liquefied petroleum gas trade and production, as in all hydrocarbons in Mexico.⁴

⁴ The liquefied petroleum gas regulatory price formula, which started to operate in 1997, links the price of Mexican liquefied petroleum gas to that in Mont Belvieu, Texas, and includes a 12-month adjustment to hedge consumers from abrupt changes in Mont Belvieu's price. These adjustments are such that Pemex sometimes incurs temporary losses and other times realizes temporary surpluses.

Figure 3. Domestic Consumers of Mexico's Natural Gas, 1999



The main natural gas substitute for industrial consumption is domestic fuel oil, which has a high-sulfur content (more than 4 percent) and is therefore polluting and inefficient (in thermal terms). This fuel is heavily used in thermoelectric generation and in industry because it is cheaper than other energy sources. As Pemex has had limited refining capacity to process cleaner fuels, and because there is very little international demand for the high-sulfur residual produced, this product was allocated to the domestic market. But the final stages of new air pollution emission standards, which will come into force by 2002, are driving industrial consumers and electricity generators to substitute natural gas for fuel oil to meet reductions in permissible levels of NOX, SOX and particulate emissions. Since 1997 the final price of natural gas has remained below that of liquefied petroleum gas and diesel, but generally above that of fuel oil.

The institutional setting before 1995 was plagued by overlaps and ambiguities regarding the State's roles in the sector as owner of natural resources, policymaker, regulator, and producer of goods and services. In most cases Pemex played the roles of producer, energy prospects analyst, and autoregulator. In addition, regulatory authority in the energy sector was scattered across several institutions. For example, an interministerial committee—typically including representatives from Pemex, the Energy Ministry, and the Finance Ministry—regulated gas prices.

The CRE was created in October 1993 as the main energy regulatory authority and commenced operations in January 1994. The CRE was initially conceived as an advisory body to the Energy Ministry, with no financial or operational autonomy. The CRE was established to regulate the electricity sector after private investment was permitted in electricity generation in 1992, but only in self-supply, cogeneration, and independent power projects that are obliged to sell any generation surplus to the CFE.

New Gas Policy Framework

The need to restructure Mexico's natural gas sector was clear as its industrial and institutional structures were not up to the challenges posed by the rapid expansion of the natural gas market. Demand grew by 42 percent in 1997–99 and is projected to increase by 10 percent annually from 2000 to 2007 due to expanding private distribution networks, accelerating electricity demand, and entry in force of environmental regulations. An industry structure with inefficient production and lack of competition would not be able to meet these growing demands without imposing a huge fiscal burden on the government.

The gas law (Regulatory Law of Constitutional Article 27) was amended in April 1995 to allow private investment in new transportation projects and distribution, storage, and commercialization of natural gas. The law established general principles for developing the country's natural gas industry. Putting these principles in practice required creating a regulatory framework that specified the organization, operation, and regulations of the industry.

This framework was designed in 1995 and presented in the *Reglamento de Gas Natural*. It explicitly took into account noncompetitive conditions in production and included most of the industry because transportation, storage, and distribution activities are highly interconnected. A first step in determining the market architecture was to define the main market players: producer (Pemex), transporters, operators of storage facilities, distributors, marketers, and consumers. Pemex was to focus on maintaining its existing large transportation network and gas exploration and production. Thus its statutory monopoly was reduced to production. Economic relations among market players are more abundant in the projected structure of the Mexican natural gas industry

The current structure of Mexico's natural gas industry shares characteristics with market structures in other countries. In some European nations, markets are controlled by a large entity. In North America there are hundreds of producers; several transportation companies participate in a competitive environment, local distribution companies have exclusive franchises and freely purchase gas from producers, pipelines, or marketers; and many large end-users are directly linked to transportation pipelines and have several supply sources. The Mexican structure is halfway between vertical integration and full competition. Up to the present, gas production and processing activities have remained a state monopoly for political, historical, and even cultural reasons. Nationalized in 1938, Pemex has traditionally supported the official political party and has been a major source of tax revenue for the government.⁵ The company was excluded from the ambitious privatization program launched by President Carlos Salinas in 1989 and will remain a state-owned enterprise in the foreseeable future.

The new regulatory framework was designed in a context in which market players possessed private information regarding technological and market characteristics. This asymmetry of information posed a challenge to regulators in dealing with pricing, vertical

⁵ Pemex provides about 30 percent of Mexico's federal tax revenues.

integration, exclusivity, open access, commercial and physical bypass, international trade, marketing, bidding processes, and secondary markets. They attempted to do so in a way that maximized social welfare subject to costs of regulation and operators' rationality constraint.

In the development of the gas industry in Mexico, as with other nascent network infrastructure, maximizing social welfare typically depends on two opposing elements: incentives to rapidly develop infrastructure and ways of putting downward pressure on prices to consumers. Welfare increases as transportation and distribution networks are developed and as prices and tariffs fall. Additionally, regulators considered the characteristics of the Mexican natural gas sector: market power would remain in production, there was a dominant incumbent in transportation, and there were almost no distribution systems. Consequently, pricing of domestic gas and developing distribution systems were focal points of sector regulation.

Key Policies and Regulatory Instruments

In setting the value for the described vector of variables, Mexican regulators had three primary goals: to develop infrastructure (policy measures regarding exclusivity and vertical integration), regulate market power (price and tariff regulation and liberalization of international trade), and promote competition (liberalization of marketing activities and open access to services).

Permit Regime. Issuing permits was selected as a fundamental regulatory instrument because it provides certainty to investors, unlike the traditional alternative of allowing economic agents to operate under provisional approvals by city or state authorities. Regulators grant permits to ensure more technical and economic uniformity in projects across the country.

Pemex and private transporters, distributors, and operators of storage facilities must obtain permits from the regulatory authority to carry out their activities. Users that wish to construct pipelines for their own use must also obtain permits. Permits are issued for 30 years and are renewable. Transportation and storage permits are issued under market risk with no exclusivity, for specific capacities, and, in the case of transportation, for defined routes. Permits are assigned to applicants that present technically sound proposals, and the market decides which licensed project is finally carried out. For transportation projects promoted by the government, transportation permits are issued through public bidding. For instance, the CFE recently bid independent power projects together with the pipeline that connects the generation plant to the natural gas field.

Distribution permits are granted for geographic zones defined by the regulatory authority through a public tender. Definitions of zones consider the feasibility of projects and the characteristics of the area (population density, consumption patterns, and the like). The first distribution permit grants 12-year exclusivity in gas distribution but not in gas marketing (see section 3).

Vertical Integration. Because Pemex dominates the industry, the new gas law permits other market participants some degree of vertical integration. Highly competitive markets in Canada and the United States have dealt with the historic market power of pipelines through unbundling, secondary markets for capacity, open access, and state-of-the-art communications. The United Kingdom regulatory authorities were able to regulate the vertical integration of British Gas by imposing accounting separation (*chinese walls*) for commercial and service activities. British Gas marketing activities were separated in 1997. A new marketing firm, Centrica, was created and has been able to retain 75 percent of small consumers, though it has lost most of its large consumers.

Other Western European markets are characterized by a dominant, state-owned utility with statutory monopolies in transport and wholesale trading. In some cases they even hold an interest in distribution companies. Even in Germany, where most of the gas industry is privately owned, large traders also own and operate pipelines and control regional transportation networks. In contrast Argentina and Colombia established stringent limitations on vertical integration. Transporters are not allowed to buy or sell gas for commercial purposes and cannot own or have an interest in companies that produce, distribute, or market gas.

The policy decision in Mexico was to prohibit vertical integration between transportation and distribution, restricting Pemex to transport and thereby encouraging entry of new participants in distribution. Vertical integration between transportation and distribution is authorized when a transportation permit is necessary for a distribution project or a distribution permit is necessary for a transportation project. If a company wants to establish a distribution network in an isolated area where there are no transportation pipelines and no other party interested in constructing them, the distributor may construct and own the transportation system.

Producers, transporters, distributors, and operators of storage facilities can buy and sell gas. But they have to unbundle their services and have separate accounting systems for their commercial and service activities in order to prevent cross-subsidies.

International Trade. Since Pemex remains the sole producer, the price of domestic gas was regulated and imports of natural gas from the United States were permitted without an import license and without import duties.⁶ Since competition prevails in the North American market, this policy sought to establish a credible threat for Pemex in prices and possibilities of contracts. This would be especially relevant for consumers in the north of the country—such as local distribution companies and power generators—that wished to import gas either directly from the United States (as in Mexicali or Ciudad Juárez) or by bypassing the Pemex transportation pipeline (as in Monterrey).

Marketing Activities. Gas marketing can be highly competitive. Sunk costs in this business are low since the main assets are working capital and contracts with producers and consumers. Experiences in several countries, such as the United States and Canada, confirm that marketing activities are important in promoting competition through price

⁶ Mexico eliminated the import tariff on natural gas in August 1999.

arbitrage. Mexican policymakers sought to encourage vigorous competition in gas marketing activities.⁷ Marketers need no permit to operate and may carry out such commercial transactions as:

- Buying gas, transporting it through the transportation network, and selling it to distributors or to consumers directly connected to the transportation system.
- Selling gas to consumers within a distribution franchise area (commercial bypass).
- Buying and selling transport pipeline capacity.

Open Access. Open access for consumers to transportation and distribution capacity can limit market power and create competitive conditions for providing goods and services in the natural gas industry. For example, a consumer in a distribution area may wish to bypass the local distribution company to buy gas in the gas field or storage facility and transport it through the pipelines, paying the transport and distribution charges. This action restricts the market power of both transporters and distributors in their gas marketing activities. But for this to work both the transporter and distributor must provide access to their networks. The open access policy becomes more complex in light of preexisting contracted capacity and real-time congestion. Usually the company that owns the pipeline network is required to provide open access when there is enough available capacity and in a “not-unduly discriminatory manner.”

The value of open access in creating competition is confirmed by experience in Argentina, Canada, and the United States. This prompted Mexican policy makers and distributors to insist on open access to the transportation and storage systems when there is enough capacity (Comisión Reguladora de Energía 1995, articles 63–69). Likewise, distributors must allow open access to their distribution network (commercial bypass) starting from the first day of operation.

Regulatory Authority. Argentina, Canada, Colombia, Great Britain, and the United States have strong autonomous regulatory institutions empowered with regulatory instruments and financial independence. They are typically concerned with prices and tariffs, permits and contracts, and overseeing safety, service quality, and environmental matters. The existence of these institutions ensures credibility and transparency of the regulatory framework, something which has proven to be decisive for mobilizing private investment on the scale required.

The reform of the policy framework for natural gas included institutional changes with a view to separating and more clearly defining responsibilities for policy and planning, regulation, and service provision. Previously, the functions of owner, operator, and regulator were implicitly carried out by Pemex and the Treasury. The new institutional arrangements include the following:

⁷ The recent directive on firsthand sales that seeks to regulate Pemex’s marketing activities is an indication that the success of this policy in practice is questionable.

- The Energy Ministry's role was strengthened. It became the administrator of the nation's energy resources and was charged with planning and supervising the state-owned firms in the sector.
- Pemex's role was restricted to operations. It was to disclose previously classified information to the authorities.
- The CRE was assigned regulatory authority for granting permits, price and tariff regulation, regulation of access to services, oversight of distribution franchise award processes, and dispute resolution.

The changes in the law also gave CRE greater technical, operational, and financial autonomy from the Energy Ministry.⁸ This was considered essential to providing investors with a stable, predictable regulatory framework. In theory the CRE has the authority to ensure compliance with regulations. It can require the presentation of any relevant information, take a company to court, and revoke a permit for violations of regulations.⁹ Sanctions and penalties are made public in the *Diario Oficial* in a resolution that requires the permittee to take appropriate measures within a specific time period. Likewise, affected parties are able to use public resolutions to take legal measures against violators. The Ministry of Finance, through its local representatives, usually collects monetary penalties. Technical and financial audits are performed based on Official Mexican Standards. The CRE and international standards verification units approved by the Energy Ministry carry out such audits.¹⁰

2. Regulation of the Firsthand-Sale Price of Domestic Gas

Theory and practice suggest that production and processing of natural gas are contestable activities (Armstrong and others 1994, p. 246). As discussed, Mexico is unusual in that its natural gas supply has remained a legal monopoly of Pemex, even after the regulatory reforms of 1995. One of the principal tasks confronting policymakers was therefore to design regulations for the price of domestically produced gas (the firsthand-sale price).

In many countries market forces determine the price of natural gas. For example, in the United States and several European countries, wellhead prices reflect competition in the market for gas production. In the United Kingdom competition among producers for contracts determines gas prices.¹¹ Before they were opened to competition in 1998, such contracts were arranged with British Gas, a single purchaser that was able to obtain low

⁸ The CRE's budget is directly authorized by the Finance Ministry and is independent from the Energy Ministry budget.

⁹ When a permit is revoked the distribution company must provide gas service until another company acquires the distribution assets. In extreme cases the government might temporally expropriate the distribution network to keep providing the public service.

¹⁰ Verification units are typically specialists or private independent companies.

¹¹ British Petroleum, Shell, Statoil, Norsk Hydro, and Exxon are examples of companies that competed with British Gas in the production of natural gas. However, British Gas remained the main producer. In March 1992 the United Kingdom Continental Shelf's three largest producers were British Gas with a share of 18.7 percent, British Petroleum with 14.9 percent, and Shell-Exxon with 21.6 percent (Ofgas 1993).

prices and longer terms because of its monopsonistic position.¹² Now both physical and contractual markets have developed.

In most of continental Europe methods for gas pricing differ significantly among countries. Contracts are usually with national gas companies, such as Statoil (Norway), Sonatrach (Algeria), and Gazprom (Russia). Countries in the Organisation for Economic Cooperation and Development use two main techniques for natural gas pricing. In some countries (Denmark, Germany, the Netherlands, Spain, Sweden, and Switzerland) gas prices are set according to prices of competing fuels; in others gas prices are set according to cost (International Energy Agency 1991). Belgium, France, Italy, and the United Kingdom use a mix of the two principles. In Japan and the United States the price of imported gas is set by adding the price at the border to costs for transportation, distribution, and storage.

Mexico considered three options for pricing domestic natural gas (table 2):

- Pricing based on costs at the wellhead. This is a passthrough mechanism that would allow Pemex to transfer the costs of gas acquisition to consumers.
- Comparison with other fuel prices on a netback basis.
- Pricing based on a benchmark, such as the price of imported gas at the border.

Mexico chose the third alternative. This pricing method compares the performance of Pemex to that of similar North American firms in comparable settings. Finding a yardstick with desirable conditions for the Mexican gas market was feasible because Mexico is physically linked to the U.S. natural gas market. The regulatory formula uses the benchmark of the dynamic behavior of the Houston Ship Channel, a gas trading hub close to the physical connection between Pemex and the U.S. pipeline system.¹³ It is a highly liquid market and has an associated hedging market. This methodology is not so different from the netback methodology that Pemex had previously used.¹⁴

¹² Before 1998 British Gas had the legal monopoly of consumers using less than 2,500 therms per year.

¹³ Texas Eastern Transmission (Tetco) and Valero Transmission (Valero) are the south Texas pipelines that have a physical connection to the Pemex network. The historical price differential between Tetco and Valero and Houston Ship Channel is \$.07.

¹⁴ Pemex's methodology takes the average price of the Tetco and PG&E (previously Valero) pipelines and adds the cost of transportation to Ciudad Pemex, in the southeast of Mexico.

Table 2. Pros and Cons of Pricing Options for Natural Gas

<i>Price based on</i>	<i>Pros</i>	<i>Cons</i>
Costs	<ul style="list-style-type: none"> • Reflects costs. • Prices are related to costs at the wellhead in most countries with a competitive natural gas market. 	<ul style="list-style-type: none"> • No marginal cost of extracting Mexican natural gas because it is a byproduct of oil. • Does not reflect the opportunity cost of selling Mexican natural gas in the North American market.
Comparisons with other fuel prices	<ul style="list-style-type: none"> • Reflects prices in international markets. • Prices of substitutes are economically related. • There are price series data. 	<ul style="list-style-type: none"> • Potential prices of substitutes subsidized in non-explicit ways. • International markets of substitutes have different dynamics to the natural gas market. • Accounts for opportunity cost of other markets, not the natural gas market.
A benchmark	<ul style="list-style-type: none"> • Considers the opportunity cost of Mexican natural gas in the North American market. • The relevant benchmark, the Houston Ship Channel, is a liquid market, it has an associated hedging market, it is close to the physical connection to the Pemex pipeline system. • Methodology has some similarities with prior Pemex methodology. • Marginal costs of imported gas and domestic gas are the same at the arbitrage point. 	<ul style="list-style-type: none"> • Brings disturbances from U.S. weather into the Mexican market.

The economics of transportation is key to understanding the market for natural gas and the way the CRE's netback formula works. The Mexican pipeline system looks like a "Y," with Ciudad Pemex—where 80 percent of total domestic natural gas is produced (associated gas)—at the bottom. Reynosa-Burgos is in the northeast arm and produces non-associated gas (17.3 percent of total production). Ciudad Juárez, an import point, is in the northwest arm. Los Ramones marks the junction of the three branches.

The netback formula is based on the benchmark price in southeast Texas, the arbitrage point, and net transport costs. The arbitrage point is where northern and southern flows meet, and where prices from both sources are equal (Los Ramones). This point moves north as northern flows decrease and south as northern flows increase. The price cap for Mexican natural gas is the price at Ciudad Pemex, which in turn is equal to the price in Southeast Texas plus transport costs from Texas to the arbitrage point minus transport costs from the arbitrage point to Ciudad Pemex.

One attractive feature of this method is that the marginal costs of imported gas and domestically produced gas are the same at the arbitrage point. But even though linking

U.S. and Mexican natural gas prices introduces competition from the U.S. market, it may also bring increased price volatility caused by externalities in the North American gas market. For example, during the winter of 1996 customers in Mexico City saw a dramatic increase in their natural gas bills due to a very cold winter in the northeast United States.¹⁵ More recently, large increases in gas prices have also been experienced in the U.S. influenced by increased power demand (driven by higher than expected economic growth), and by low natural gas storage levels.

AN ASSESSMENT OF THE NETBACK FORMULA

Brito and Rosellón (1998) evaluated mechanisms for linking the Mexican market for natural gas with the North American market. The netback formula is shown to be an application of the Little-Mirrlees principle (Little and Mirrlees (1968)), and relies on the fact that the Houston hub has a liquid market of futures contracts to hedge against externalities. The formula, however, can also lead to incentives to increase the price of domestic natural gas by diverting production from the regulated market. Pemex can sell gas to its own subsidiaries or simply reduce its production in order to bring the arbitrage point south and increase the price of domestic natural gas two times more than the value of marginal cost of transportation.

Reducing import tariffs does not increase imports of natural gas from the US and will have little impact on the price. Additionally, the study finds it socially optimal to develop new gas production sources closest to the arbitrage point rather than to load centers. These results are due to the existence of a monopoly in production and the netback formula is shown to be the second best option to liberalization in production.

Moreover, Brito and Rosellón (1999) find that the netback policy is critically conditional on the existence of adequate pipeline capacity. If there is insufficient capacity, the movement of gas will not clear markets and it will be impossible to implement the netback rule. Rents will accrue to Pemex. For example, Pemex can capture the rents associated with the constraint by selling output forward and could then become a monopoly in the forward firm-service market. While PEMEX should not be prohibited from entering into spot or futures contracts to sell gas, the price of gas should be the netback price based on the Houston Ship Channel at the time of delivery. PEMEX should not be permitted to discount the price of gas from the Houston netback price, or the regulated transport tariffs.

3. Regulation of Natural Gas Distribution

Distribution of natural gas has natural monopoly characteristics, so pricing of this service is regulated. In Mexico natural gas distribution has “greenfield project” characteristics because liquefied petroleum gas has traditionally been used for household purposes, and fuel oil for industrial and electricity generation purposes. Greenfield investments carry demand, financing, and operating risks that are typically not present in divestiture and acquisitions of existing assets. These considerations influenced the design of distribution regulation.

Mexico’s natural gas distribution networks are to be developed through temporary regional monopolies in defined geographic zones. Even though there are natural economic entry barriers to construction of distribution networks, Mexican regulators

¹⁵ Natural gas prices in Mexico increased 135 percent between October 1996 and January 1997.

wanted to ensure that no city would be adversely affected by disorderly entry of distribution companies that could result in poor network design and construction and unreliable service.

Deciding how long the regional monopolies should maintain exclusive rights to distribution involves several trade-offs. In theory, duration should depend on implied tariffs for consumers and risks and amount of investments. A relatively short period of exclusivity implies a shorter period to recover investment costs and commensurately higher tariffs. In contrast, long periods of exclusivity might be unnecessary due to natural market barriers that arise after a distribution network is constructed.

The optimal length of the exclusivity period is influenced also by the extent to which consumers inside the distribution area are able to bypass the local distribution companies to purchase gas from other agents. If commercial and physical bypass are not allowed, exclusivity gives the distributor de facto monopoly power over marketing and adjacent transportation. This is a powerful investment incentive but may also generate undue market-power. If bypass is allowed, the distributor's exclusivity would be restricted to gas distribution services. This implies less market power for the distributor and greater uncertainty for investors. The international trend is for exclusivity to be granted in distribution with no physical or commercial bypass (box 1).

Box 1. Exclusivity in Natural Gas Distribution

Argentina

- No complete exclusivity due to “subdistributors” and bypass (physical and commercial).

Canada

- In Alberta exclusive franchises are granted for 20 years and renewable for 10 or more years.
- Renewals require a public hearing.

Colombia

- Exclusive areas based on public interest.
- Low tariffs for poor consumers are necessary to obtain exclusive rights to serve economically attractive consumers.
- Duration of exclusivity is at most 20 years.

Mexico

- Regulated private regional monopolies have an exclusivity period of 12 years.
- Exclusivity only in the distribution of natural gas.
- Commercial bypass is allowed from the first day of operation.
- Physical bypass is phased in gradually over 5 years.

Spain

- Enagas has the exclusive right to serve large industrial customers.
- Concessions are granted to local distribution companies with an exclusivity period that may last up to 75 years. Exclusive rights include medium and small industrial consumers and residential and commercial consumers.

United Kingdom

- British Gas no longer has exclusive rights to serve consumers of less than 25,00 therms per year.

The policy decision in Mexico was to grant 12-year exclusivity in conjunction with the initial distribution permit. This is an apparent effort to reconcile different criteria, such as international experience on exclusivity periods and opinions from market players and government agencies. Some government parties considered five-year exclusivity to be sufficient, while energy officials believed that the long period required to construct a distribution system as well as its long life made a period of at least 15 years necessary to recover investments.

It was also decided that commercial bypass was acceptable from day one in local distribution zones but physical bypass had to be gradually implemented. During the first two years only consumers inside local distribution zones with more than 60 thousand cubic meters per day could construct their own connection to the transportation system. In years three and four this privilege would be extended to consumers of more than 30 thousand cubic meters per day, and to all others after year five. It must be pointed out that physical-bypass is meant for self consumption rather than to provide service to other consumers inside the exclusive distribution area. This system introduces gradual

competition between Pemex's transportation subsidiary and the local distribution company, which would assure competitive contracts for consumers inside local distribution zones.

Distribution zones are tendered through an open bidding process, and the winner is granted an exclusivity period. For each tender the CRE defines a distribution geographical zone and sets a minimum consumer-coverage target that the firm must reach by the end of the first five years. Participants present technical and financial proposals, including a market demand study. Evaluation is carried out in two stages. In the first stage the technical quality of the project is evaluated. Those that pass this test are evaluated according to the lowest quoted value of the average revenue for the first five years. Distributors that had a distribution concession prior to April 1995 are also incorporated into the permit regime.

Regulation of Distribution Tariffs

Decisions on how to regulate distribution tariffs were also influenced by the greenfield nature of natural gas distribution in Mexico. The choice was between cost-of-service regulation and price caps to regulate price level, and between tariff basket and average revenue to regulate price structure.¹⁶ The main features of these types of regulation are shown below

¹⁶ Price-level regulation refers to the long-run distribution of rents and risks between consumers and the regulated firm. Price-structure regulation refers to short-run allocation of costs and benefits among the different types of consumers (Vogelsang 1999).

Mechanism Considered	Main Features	Pros	Cons
Cost of Service	1) Price equal to average cost. 2) Price setting is the result of equating total revenues to total costs. 3) It imposes a restriction on the rate of return on capital. 4) Prices remain fixed until one of the parties involved asks for a modification of prices. 5) Each set of tariffs must be established according to a prediction of revenues and costs consistent the regulated level of the rate of return. 6) Example US utilities.	1) Provides investors with certainty. 2) Makes the long run commitment of the governing authority credible. 3) Since investors face lower risk, may reduce cost of capital. 4) May stimulate system expansion. 4) Regulator can monitor and constrain cross subsidies. 5) Opportunity for manipulation is likely to be small in practice.	1) Weak incentives for investors to reduce costs and operate efficiently. 2) Perverse incentives to over invest in capital. 3) Cross subsidization is a common practice. 4) Determination of a "fair" rate of return is inherently subjective. 5) Rate of return usually exceeds cost of capital. 6) Firm produces more than an unregulated monopoly but with inefficient input combinations (<i>Averch-Johnson</i> effect. 7) Ad-hoc mechanism, lacking a theoretical framework. 9) Administratively demanding; huge data requirements.
Price Cap	1) Authority sets ceiling prices. 2) Usually combined with cost of service exercises at the end of pre-determined periods. 3) usually incorporates adjustments for inflation and efficiency. 4) Rate of return on capital can take any value as long as the price cap is met. 5). When combined with cost-of service regulation, revisions are carried out at the end of pre-determined periods (usually 4 or 5 years).	1) Incentives for cost minimization and efficient operation. 2) Benefits due to productivity improvements higher than anticipated can be kept by firms. 3) More forward-looking philosophy than cost of service regulation.	1) Too low a cap could elicit a disincentive for firms to participate. 2) Too high a cap could permit a monopolist to enjoy excessive profits at the consumers' expense. 3) Investors face greater risks under this system which could increase costs of capital. 4) It may not stimulate system expansion.
Tariff Basket	1) The price cap is set over the weighted sum of the prices of different products or services offered by the monopolist. 2) Weights are usually set according to previous period's output composition. 3) Example: British Telecomm.	1) Under stable cost and demand conditions: a) The firm chooses a price vector that will converge to Ramsey prices, b) It has a positive effect on welfare. 2) Productive efficiency is enhanced. 3) There is very small opportunity for manipulation. 4) Simple to define and monitor. 5) It does not require a correction factor.	1) Tariff rebalancing is less flexible than in average-revenue regulation. 2) Under cost and demand uncertainty, prices set do not converge to the Ramsey structure. 3) Cross subsidies have to be prevented through additional regulation. 4) Inclusion of a cost pass-through term is difficult. 5) Must define full list of tariffs for implementation.
Average Revenue	1) Cap set on the firm's revenue per unit output. 2) It is more appropriate for firms whose costs depends on total output.	1) Less demanding in terms of information. 2) Greater flexibility in adjusting relative prices than in tariff-basket. 3) Represents a more lax constraint for the firm. 4) Simple to include cost pass-through terms in cap.	1) When the products are not substitutes, pricing under will be inconsistent with Ramsey pricing. 2) Separate regulation required to constrain cross-subsidies. 3) Correction factor required. 4) Needs homogeneous output measures.

Pure cost-of-service was not chosen to regulate the price level. Even though this regime is attractive to investors—it provides certainty and makes the long-run commitment of the governing authority credible—it does not give operators strong incentives to be more

efficient, cut costs, innovate, and take appropriate risks. Additionally, this kind of regulation is usually quite burdensome to implement. Thus the international trend has been to substitute incentive mechanisms for cost-of-service regulation to regulate utilities. This is the case even in countries like the United States and Canada that have a long tradition of cost-of-service regulation.

Mexico chose a combination of price cap and cost-of-service regulation. At the beginning of every five-year period a price cap is determined on a cost-of-service basis. This initial value remains fixed and is adjusted during the period for inflation, efficiency, and other correction factors.

The two usual methods of regulating price structure rely on weights (tariff basket regulation) or average revenue. Since the average revenue methodology does not fix weights for prices of distinct services, it grants more flexibility in tariff rebalancing than the tariff basket method. It is thus a looser constraint and provides the firm with the needed flexibility to set tariffs in a risky environment (Bradley and Price 1991, pp. 103–07).

Mexico opted to use average revenue regulation in the first five-year regulatory period because most natural gas distribution projects are greenfield and thus characterized by greater cost shocks—or unexpected changes in market conditions—at the beginning than in later phases of build-out and operation of the distribution network (Rosellón 1998a). After the first five years—when cost and demand conditions stabilize—tariff basket regulation might be used because it induces firms to set prices that imply redistribution of social surplus, which permits the firm to recover its long-run fixed costs while facilitating intertemporal maximization of consumer surplus (Comisión Reguladora de Energía 1996, article 6.12). The CRE's average revenue plan allows the firm to choose its relative prices at the beginning of each year based on forecasts of the volume that will be demanded at the end of the year.¹⁷

Acquisition Pricing

Marketing gas inside a geographic distribution zone constitutes a contestable activity when the distributor's gas sales compete with those of marketing companies. Therefore a primary role of regulation is to ensure that no artificial entry barriers hinder competition.

When there are not enough marketers or competing fuels, competition may be weak. The distribution company might be the only supplier for a group of customers. A trade-off exists between risk and incentives in a distributor's gas marketing activities. While the distributor would like to recover all gas procurement costs (for gas purchasing, storage, and transportation), distributors may not purchase gas as cheaply as possible unless they face competition from other agents or other fuels.

¹⁷ Ramírez and Rosellón (2000) show that the CRE's average revenue plan implies incentives for the regulated firm to engage in strategic nonlinear pricing. The former effect generally implies reductions in consumer surplus while the stochastic effects generated by demand forecasts may positively affect consumer surplus under low economic uncertainty.

This regulatory issue has been faced in several countries. In Argentina, tariffs for natural gas charged to end users in a distribution zone are the sum of the price of gas at the point of entry into the transportation system, the transportation tariff, and the distribution tariff. The regulatory authority (*Enargas*) can limit passthrough of gas costs if it finds that gas prices to end users exceed those negotiated by other distributors in similar situations. In the United Kingdom the price cap formula that regulated British Gas sales to customers who consumed less than 25,000 therms a year included a term to regulate the passthrough of gas costs.¹⁸ The term only permitted the pass-through of an index of gas costs that was based on the escalation clauses in British Gas contracts.

In Mexico the regulatory mechanism to protect captive consumers is the acquisition price, which sets the maximum price that can be passed through to the final user by the distributor to cover costs of gas purchase, transportation, distribution, and storage. Several policy options were considered:

- A simple mechanism allowing the distributor to pass through its procurement costs of gas.
- A yardstick basis for passing through the cost of gas based on the average cost of gas for all distributors.
- A variation or combination of the two.

A simple passthrough mechanism was discarded—it provides little incentive for the distributor to purchase gas efficiently. The yardstick was also discarded—there was no history of competition in gas marketing inside Mexican local distribution zones. The method chosen was to allow the distributor to transfer the cost of acquiring gas as long as it is less than or equal to a predetermined benchmark. This benchmark is the regulated price of domestic gas plus the regulated tariffs for transporting and storing it. When the distributor is not connected to a national production field, and therefore imports most of its gas, the regulatory authority may authorize a reference price different from the regulated price of domestically produced gas (firsthand sales price). In practice, Mexican regulators have approved prices for imported gas in such northern distribution systems as Mexicali and Ciudad Juárez. The local distribution companies in these cities import gas from western North America and from New Mexico (Permian Basin). The typical monthly bill in Mexicali (84.42 USD/month) is below Mexico's national average (107.68 USD/month), and the gas price in Ciudad Juárez is proportionally above the national average. These data provide some evidence that the acquisition price methodology has been so far applied by the CRE through national benchmarks.

¹⁸ The price cap formula started to operate in 1992.

Results and Future Challenges

Distribution Franchises

Since the first distribution permit was granted to the geographic distribution zone of Mexicali in 1996, 18 more have been awarded, including those for existing concessions and new projects (table A1). The existing distribution infrastructure that belonged to Pemex or the CFE in the distribution zones was privatized. The value of these networks was included in the respective distribution bid packages that the winning bidder paid.¹⁹ Distributors have acquired around 700 kilometers of distribution pipelines, and it is expected that 300 kilometers more will be privatized in 2000.

The number of consumers served by distribution franchises is projected to increase fourfold between 1995 and 2004. Moreover, distributors have made investment commitments of almost \$869 million. The first phase of competition *for* the market has been successful. A second phase of competition *in* the market and of enforcement of regulation is just beginning.

Natural gas distribution systems will be developed in Pachuca (expected investment of \$11.3 million), Cuernavaca (expected investment of \$15.2 million), and Guadalajara (expected investment of \$111 million). Other distribution zones are expected to be defined in Veracruz, Mérida, Nogales, Orizaba, and Cancún.

Transport Pipelines

Sixteen transport permits have been granted, carrying investment commitments of \$1,100.4 million. This will finance construction of 11,175 kilometers of pipeline and related facilities with a capacity of 214,459 thousand cubic meters per day (table A2). Many of the new pipelines are to supply gas to the new independent power production generation plants bid by the CFE. Recent power generation projects include constructing, operating, and maintaining the gas transport spurs that supply the power plants.²⁰

Annual growth rates of demand for natural gas for power generation projects (14.89 percent), the industrial sector (5.14 percent), and the oil sector (5 percent) from 2000 to 2007 will require substantial additional gas transport capacity. Moreover, interconnections with the U.S. gas transportation system will also be required in the short run to support the very rapid growth in gas demand in the northern part of the country. However, Pemex is by far the dominant actor in transport and marketing, and the interplay in both activities may continue to discourage private interest in developing gas transport infrastructure. The combined independent power production and gas transport projects tendered by the CFE can be seen as stop-gap measures to deal with this problem.

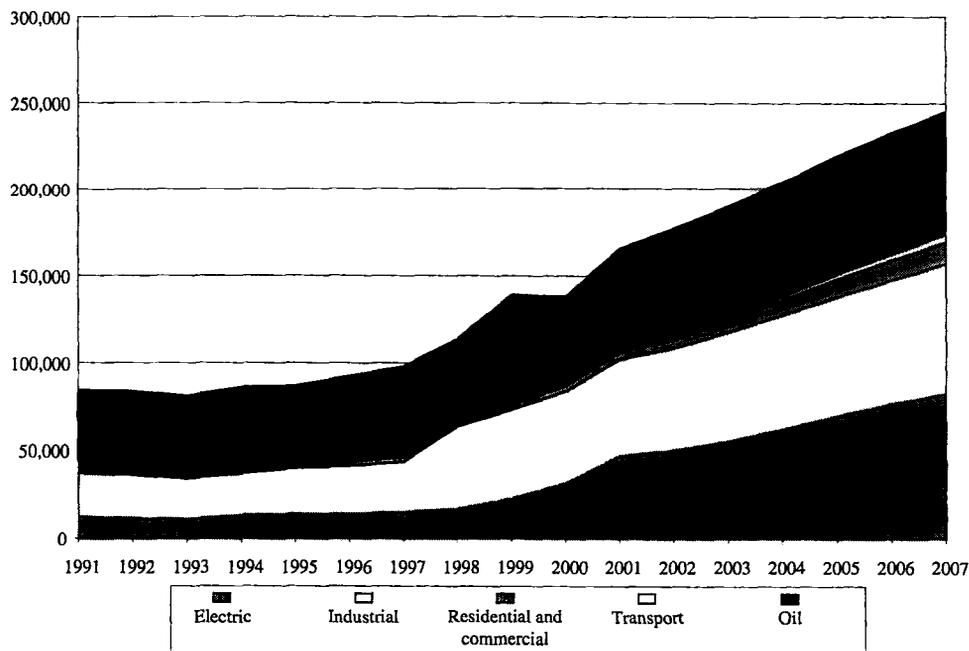
¹⁹ This was the case of Monterrey, Mexico City's metropolitan area, and Querétaro.

²⁰ This is the case of Mérida III, Monterrey III, Samaluyuca, and Rosarito.

Demand

Demand for natural gas is expected to grow at about 10 percent a year in the next decade (figure 4). Key drivers are demand for electricity generation, environmental standards that require fuel oil–run industrial facilities in critical zones to convert to natural gas, and the build-out and operation of distribution systems throughout the country. The Gulf region will continue to absorb a large, but decreasing, share of gas consumption based on projected increases in crude extraction and refining/petrochemicals processing activities in Pemex installations that require large quantities of natural gas. These figures for demand growth imply a significant increase in gas penetration in the energy matrix. Between 1998 and 2007 the share of natural gas in energy consumption is expected to increase from about 18 percent to 58 percent for thermal power generation, 50 percent to 70 percent for industrial use, and, most remarkably, from 7 percent to 25 percent for distribution systems serving residential, commercial, and municipal users (figures 5 and 6, tables A3 and A4).

Figure 4. Growth in National Natural Gas Consumption, 1991–2007
Thousands of cubic meters a day

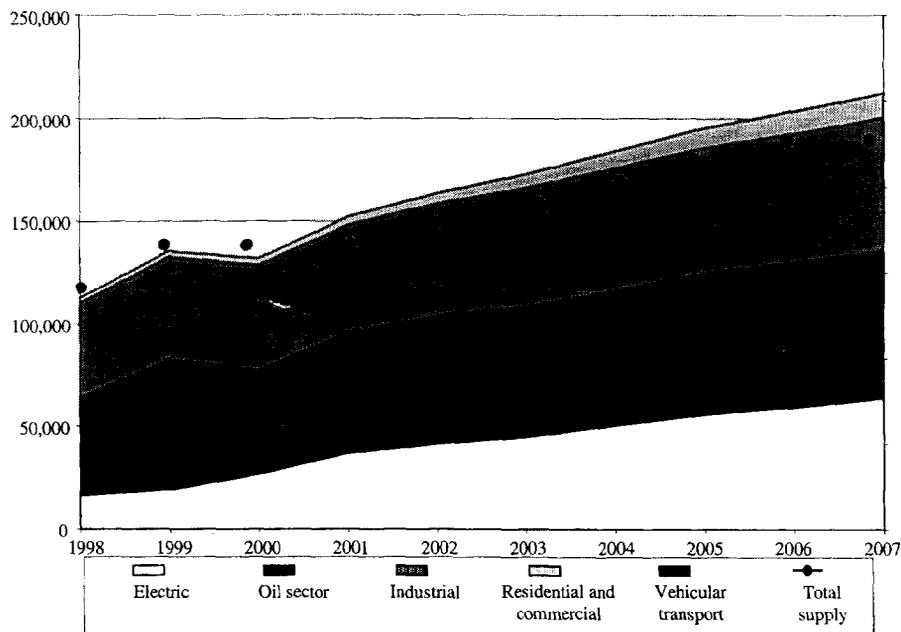


Production

Domestic production increased 33 percent, from 3.6 billion cubic feet per day in 1994 to almost 4.8 billion cubic feet per day in 1999. In the offshore zone, production decreased in 1999 and 2000 from 1.353 billion cubic feet per day to 1.120 billion cubic feet per day. But production is expected to increase to 1.418 billion cubic feet per day during 2001. In the south zone production is expected to decrease from 2.69 billion cubic feet per day to 1.966 billion cubic feet per day during 2000, with a further reduction to 1.933 billion

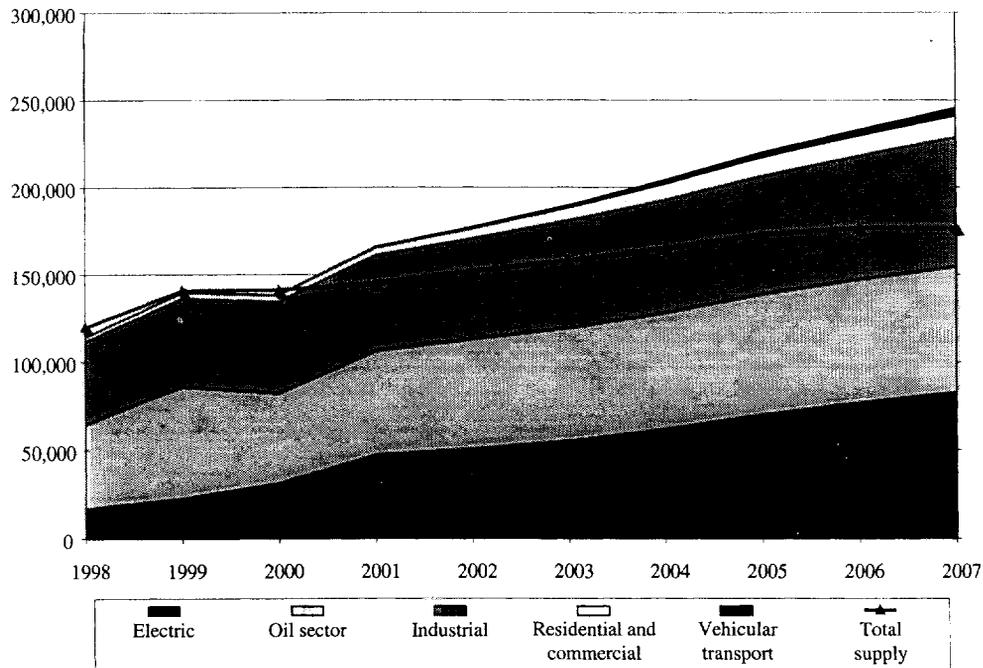
cubic feet per day in 2001. In the Burgos region production grew from 0.773 billion cubic feet per day in 1997 and is expected to reach 1.653 billion cubic feet per day by 2001. The Energy Ministry expects more natural gas production efforts in the exploration of known dry gas producing basins offshore, as well as in Macuspana, Veracruz, and Tampico-Misantla and Sur de Burgos, Tamaulipas; the installation of a cryogenic complex in Reynosa, near Burgos Basin; and the reduction of gas flaring by Pemex in the Gulf of Mexico.

Figure 5. Moderate Scenario of Consumption and Net Production, 1998–2007
Thousands of cubic meters a day



Source: Secretaría de Energía, 1998

Figure 6. Base Scenario of Consumption and Net Production, 1998–2007
Thousands of cubic meters a day



Source: Secretaría de Energía, 1998

Comparison of current production projections with expected consumption growth shows deficits in national production growing from 10 million cubic feet per day in 2001 to 70 million cubic feet per day in 2007 (see figure 6 and table A.4). The government hopes to redress this rising imbalance by investing heavily in gas exploration and development. The recently announced Strategic Plan for Natural Gas calls for the State to significantly increase investment in natural gas production.²¹ Over the next 10 years Pemex plans to invest about \$1 billion annually in upstream gas development. In 2000 \$400 million is to be devoted to exploring and developing nonassociated gas basins, including Burgos, the Grijalva, and Macuspana.

The underlying premise of this program—increasing extraction capacity by 60 percent over the next decade—merits some skepticism. Pemex’s budget is determined annually by the Mexican Congress and is frequently cut to accommodate other national priorities. Natural gas is generally a poor relation to its priority business: extraction and export of crude as well as production of cleaner vehicle fuels required by current and prospective emission standards. Moreover, Pemex’s record in managing finding, development, and exploitation costs is not impressive. It is therefore far from certain that the program will be fully funded or that the resources invested will yield the expected magnitudes of increased production.

²¹ At the time this paper was written (April 2000), the Secretaría de Energía had not released the details of either the new natural gas prospective nor the new strategic gas production plan

For Mexico to quickly and economically exploit its natural gas resources and avoid soaring sustained increases in gas imports, new arrangements for risk sharing with experienced private companies should be considered in the short term, with associated changes in licensing, taxation, and audit policies and practices. Without significant changes in upstream gas development policies, the accelerating growth in imports volumes together with the current netback methodology for pricing domestic natural gas may result in higher absolute levels and increasing volatility of domestic wholesale gas prices.

Gas Marketing Activities

On February 23, 2000 the CRE issued the Directive on Firsthand Sales of natural gas (see Comisión Reguladora de Energía 2000). This directive was issued five years after liberalization began—regulators initially believed that competition in gas marketing was assured by its contestable nature. But vertical integration of Pemex in production, transportation, and commercialization has proven an obstacle to compliance with regulations and introducing competition in gas marketing.

The new directive requires Pemex to unbundle its production, transportation, and marketing activities. It also permits Pemex to negotiate long-term contracts at prices below the maximum allowed by regulation while stipulating that Pemex not make cross-subsidies between marketing activities and firsthand sales. Pemex is also now required to present to the CRE detailed information on its marketing activities, transportation, distribution, and storage contracts, as well as on gas sales, prices, gas availability, import and export volumes, national gas balance, and methodologies for price discounts. Additionally, the directive elaborates the general terms and conditions required in Pemex's contracts on firsthand sales.

The directive also requires that Pemex not unduly discriminate among consumers. For example, Pemex will have to offer similar terms to northern power generation plants that have access to competing supplies (because of proximity to the U.S. market) and to southern generators that have access only to Pemex gas. If Pemex offers price discounts to a power generator in the north, it has to offer the same discount to a similar generator in the south. Requiring similar pricing for firsthand gas sales contracts means that competition among power generators would be driven by technical and financial concerns rather than Pemex's market power.

The underlying assumption of the Directive on Firsthand Sales is that Pemex will retain a de facto monopoly in gas marketing and therefore must be regulated. According to Brito and Rosellón (1999), the asymmetry of information between the state monopoly and the regulator will make this task extremely difficult.²² Moreover, even though the Directive permits consumers to modify gas contracts with Pemex—which opens the door for

²² The Directive also requires that Pemex officials involved in firsthand sales and marketing have no access to information regarding applications, contracts, and operative conditions of the transportation system not previously made public.

possible contracts with other gas marketers—the market power Pemex wields is likely to deter entry of marketing competitors.

This could have undesirable consequences for the competitive evolution of the Mexican gas industry. Pemex will have a monopoly in any kind of gas (spot or futures), and therefore the current model of generation enhancement based on independent power producer generation will be between a monopsony buyer (CFE) and a monopoly supplier (Pemex). If the government proceeds with wholesale restructuring of the power sector, it is not clear that the monopolistic structure of gas marketing in Mexico will be able to respond with the same flexible kind of contracts that competitive gas markets permit. Moreover, most industrial users and local distribution companies will also be constrained by Pemex's control over supply conditions.

Regulatory Institutions and Processes

The capacity of the regulator to administer the regulatory framework is difficult to judge because the CRE has only begun to formally regulate participant conduct. Until now the CRE has been primarily concerned with issuing permits, promoting distribution and transportation projects, and incorporating Pemex into the regulatory framework. In particular, the relation with the Federal Competition Commission has not formally begun. It is possible, however, to analyze specific instances of regulatory decision-making:

- Pemex has at times hampered granting of rights-of-way to private transporters or distributors whose networks will pass close to Pemex oil pipelines. The legal offices of the Energy Ministry, the CRE, and Pemex are meeting to address this. If they do not resolve the problem, a next step would be a decree from the executive power.
- Two entities of the Ministry of Environment—the National Ecology Institute and the Water Commission—are working on an arrangement with the CRE to simplify the requirements and procedures that must be met by local distribution companies. With the Water Commission, there is already an agreement to facilitate crossings of pipelines with rivers and water lines. The Ministry of Transportation will also participate in these arrangements.
- The existence of specific local regulatory conditions in different states and municipalities has required coordination of the federal regulatory authorities and the local authorities. The Ministry of Environment, the Energy Ministry, the Ministry of Transportation, the CRE, the CFE, and the Ministry of Social Development are working to establish unique agreements of coordination with the states and municipalities that will simplify regulatory procedures and foster public awareness of the natural gas industry.

The CRE has an appeal mechanism that was recently used successfully in Bajío Norte. Likewise, in Mexico anyone can use the judicial recourse of the Amparo against any penalty or sanction from a government party, such as the CRE.

The CRE's formal structure and attributions are designed to achieve autonomous operation and financial independence from the Energy Ministry. For instance, the CRE's

commissioners hold their posts for five years and can be renewed for another five, and two commissioners do not leave their jobs in the same year. This last measure is to ensure continuity in the CRE's policies, independently from the six-year presidential cycle.

But there is still the question of whether public and private interests will be able to filter their regulatory preferences through informal means. Since the CRE is decentralized, its functions could be drastically changed in Congress without a qualified majority (Moreno-Jaimes 1998). The likelihood of this happening in practice is low based on Mexico's experience with other decentralized organizations. For example, in its seven years the Federal Competition Commission has had a steady institutional structure, and its resolutions have been contested through such legal means as the Amparo.²³ But the Telecommunications Commission twice removed its chair amidst rumors of political pressure from allies of the domestic incumbent.

Regarding the scope for regulatory capture, too few years have elapsed to assess whether the Commission has favored specific agents. But recently two agents that lost distribution tenders have appealed the CRE's award decisions. One was the Río Pánuco bidding (September 1997), in which Gaz de France and Shell asked for reconsideration of the CRE decision to award the distribution franchise to Noram-Gutsa. The CRE maintained its decision on a technical basis. The other case was in Bajío Norte, in which the CRE initially disqualified Gas Natural de Mexico. In November 1999 it reconsidered its decision and, based again on transparent technical criteria, granted the permit to the Spanish firm.

Conclusions

Structural reform in Mexico's energy sector has proceeded at a slower pace than in many other countries, but important changes have been introduced to attract private investment in natural gas transportation and distribution. These changes were a response to the rapid growth in demand for natural gas in Mexico, which was in turn a response to economic development and the enforcement of environmental regulations. The new regulatory regime provides incentives for firms to invest and operate efficiently and to bear much of the risk associated with new projects. It also protects captive consumers and enhances economic welfare in general.

Pemex's continued vertical integration and the retention of a state monopoly in production posed important challenges to regulators. Such innovative responses as regulation of firsthand sales prices and natural gas distribution make the Mexican case an interesting example of regulatory design.

Regulation of distribution tariffs is not necessarily the same for incipient and mature industries. In general, a new industry requires a transition phase when regulation is

²³ In the Federal Competition Commission's history there has only been one change in the staff of commissioners that could be interpreted as politically motivated. At the beginning of President Ernesto Zedillo's administration the chairman moved to the Finance Ministry even though he had not finished his duties in the commission. Other changes of commissioners were motivated by old age, but this criterion for removal was already considered in the commission's law.

flexible enough to encourage initial development and attract investment. Tariff flexibility permits new entrants to appropriately handle risk and uncertainty.

As the first phase of investment mobilization and competition *for* the market in the Mexican distribution projects is now concluding, regulators and policymakers face enormous challenges in the next few years. One will be to consistently and transparently apply and enforce regulations and to coordinate among government agencies to successfully perform these tasks.

Another challenge is how to handle projected growth in Pemex's transportation system—estimated at an annual rate of 11 percent and spurred by growth in demand from electricity generators (annual growth rate of 14.89 percent). According to the permit granted by the CRE to Pemex for transporting natural gas, Pemex will meet this new demand by expanding its pipeline capacity, but there could still be bottlenecks during peak periods (table 3).²⁴ Especially important is the 1,597 kilometer-long pipeline system in the Reynosa and Monterrey operating sectors, where a huge increase in demand is expected and where two of the three compression stations are obsolete.²⁵

Table 3. Maximum Average Transport Capacity of Pemex's National Pipeline System

Units	Year 1	Year 2	Year 3	Year 4	Year 5
MMGcal/Year	421.5	445.3	445.3	459.5	459.5
MMCFD	4,824	5,096	5,096	5,259	5,259

Source: Comisión Reguladora de Energía (1999).

Government policy for ensuring sufficient pipeline capacity to clear gas markets is premised on consumers paying Pemex for expansion of the pipeline system. This is presumed to generate enough savings to gas consumers that they would be willing to pay for such investment.²⁶ According to Pemex's transportation permit, pipeline expansion can be financed in two ways. A "rolled in" methodology can be applied when the expansion will benefit all consumers; an incremental cost method is applied in other cases.

Perhaps the greatest issue in the immediate term will be the evolution of competition *in* the market. In the Directive on Firsthand Sales the CRE identified some regulatory mechanisms for Pemex gas marketing activities. Asymmetry of information is most pronounced in this area. The many strategic games that Pemex can play with contracts for different types of consumers will be difficult for a small regulator to cope with.

²⁴ These calculations are based on estimates of injection and extraction requirements at each node (Comisión Reguladora de Energía 1999, appendix 3.1), flow and capacity technical information for each transportation sector (annex 3, appendix 3.1 and 3.2), repowering needs at each compression station (appendix 3.1), and investment needs for expansion of the pipeline network (annex 6.2.1).

²⁵ There are three compression stations. Two are old "reciprocating" compression stations, "Ojo Caliente" and "Santa Catarina," with more than 30 years of operation which experience huge drops in pressure and low volumes. In the Reynosa sector a "turbo compression" station was constructed in 1997.

²⁶ Brito and Rosellón (1999).

Additionally, marketing is a contestable activity (maybe more contestable than production), and there is no apparent reason to leave gas commercialization with a State monopoly.

Hence, one of the first issues to be tackled to enhance the role of market forces in the sector is Pemex's discretionary discounts on domestic gas and access to transport services made possible by its monopoly in domestic production and its overwhelming dominance in transport. In the near term the principal instrument available to the regulator is regulating Pemex's contract pricing, but more durable and tractable instruments will need to be considered (Comisión Reguladora de Energía 2000, sections 3 and 5). These include arrangements permitting risk sharing with new participants in domestic gas development and production, full legal and financial separation of Pemex-Gas and Pemex-Transport from Pemex-“Holding,” and more efficient pricing of competing fuels (electricity and liquefied petroleum gas) driven by structural and regulatory reforms pending in those sectors.

Annex

Table A1. Characteristics of Natural Gas Distribution Permits

Concessionaire	Location	Granting date	Length (kilometers)	Capacity (thousands of cubic meters a day)	User coverage	Investment (millions of U.S. dollars)
DGN de Mexicali, S. de R.L. de C.V.	Mexicali	27/09/96	402.69	708.00	25,346.00	18.14
Cía. Nacional de Gas, S.A. de C.V.	Piedras Negras	20/03/97	336.00	197.00	25,608.00	0.70
DGN de Chihuahua, S. de R.L. de C.V.	Chihuahua	20/05/97	1,196.00	1,451.00	51,453.00	46.42
Gas Natural México, S.A. de C.V. (Saltillo)	Saltillo-Ramos Arizpe-Arteaga	20/06/97	656.00	744.00	40,027.00	39.03
Gas Natural del Noroeste, S.A. de C.V.	Hermosillo	9/06/97	505.00	430.00	26,250.00	21.40
Gas Natural México, S.A. de C.V. (Toluca)	Toluca	3/09/97	595.30	1,931.00	47,279.00	31.60
Cía. Mexicana de Gas, S.A. de C.V.	Monterrey	9/09/97	921.00	3,254.00	50,079.00	11.26
Gas Natural México, S.A. de C.V. (Nuevo Laredo)	Nuevo Laredo, Tamaulipas	17/11/97	366.00	182.00	25,029.00	11.22
Gas Natural de Juárez, S.A. de C.V.	Ciudad Juárez	2/12/97	1,828.00	996.00	129,045.00	12.74
Gas Natural del Río Pánuco, S. de R.L. de C.V.	Río Pánuco	19/12/97	334.68	1,459.00	28,338.00	14.30
Tamauligas, S.A. de C.V.	Norte de Tamaulipas	27/03/98	451.00	1,020.36	36,447.00	23.70

(continues)

Table A1. Characteristics of Natural Gas Distribution Permits (*continued*)

Concessionaire	Location	Granting date	Length (kilometers)	Capacity (thousands of cubic meters a day)	User coverage	Investment (millions of U.S. dollars)
Gas Natural México, S.A. de C.V. (Monterrey)	Monterrey	24/04/98	7,239.00	3,500.00	557,052.00	184.10
Distribuidora de Gas Natural del Edo. de México, S.A. de C.V.	Distrito Federal	3/09/98	2,619.00	4,300.00	439,253.00	109.04
Consortio Mexi-Gas, S.A. de C.V.	Valle Cuautitlán- Texcoco	3/09/98	3,517.00	7,600.00	374,698.00	199.70
Distribuidora de Gas de Querétaro, S.A. de C.V.	Querétaro	10/12/98	870.08	2,446.56	50,001.00	47.20
Gas Natural México, S.A. de C.V. (Bajío)	Silao-León- Irapuato	15/01/99	788.00	3,974.40	72,384.00	27.10
DGN la Laguna-Durango, S. de R. de C.V.	Torreón-Gómez Palacio-Ciudad Lerdo-Durango	18/06/99	1,075.03	1,150.36	50,084.00	35.40
Distribuidora de Gas de Occidente, S. A. de C.V.	Cananea, Sonora	9/08/99	4.63	104.77	6,684.00	35.40
	Puebla-Tlaxcala	28/01/00	800	2,600.00	68,196.00	34.80
Gas Natural (Bajío Norte)	Bajío Norte	22/02/00	719	1,200.00	55,715	34.55
Total			23,704.41	35,448.45	2,035,057.00	868.45

a. In the fifth year of the permit.

Source: Comisión Reguladora de Energía.

Table A2. Open Access Transportation Permits

Concessionaire	Location	Route	Main investor	Grant date	Pipeline length (kilometers)	Capacity (thousands of cubic meters a day)	Investment (millions of U.S. dollars)
MidCon Gas Natural, S.A. de C.V	Nuevo León	Cd. Mier-Monterrey	KN Energy (U.S.)	Oct-96	148.23	7,600.00	45
Gasoductos de Chihuahua, S. de R.L. de C.V. ^a	Chihuahua	San Agustín Valdivia-Salamanca	El Paso Natural Gas (U.S.)	Jul-97	37.70	6,200.00	18.24
IGASAMEX Bajío, S.A. de C.V	Guanajuato	Huimilpan-San José Iturbide	Igasamex (México)	Jul-97	2.55	359.67	0.36
Energía Mayakan S.de R.L. de C.V. ^a	Tab., Camp., Yuc.	Cd. Pemex-Valladolid	TransCanada Pipelines (Canada)	Oct-97	698.00	8,700.00	276.9
Tejas Gas de México, S. de R.L. de C.V.	Palmillas-Toluca	Palmillas-Toluca	Tejas Gas (U.S.)	Jan-98	123.20	2,720.00	31
Transnevado Gas, S. de R.L. de C.V.	Jilotepec-Toluca	Palmillas-Toluca	TransCanada Pipelines (Canada)	Jan-98	127.00	2,330.00	23.156
FINSA Energéticos S. de R.L. de C.V.	Tamaulipas	Matamoros	FINSA Energéticos (México)	Jun-98	7.97	164.38	0.3
Compañía Mexicana de Gas S. A. de C.V.	Nuevo León	Apodaca-Carralvo	Compañía Mexicana de Gas (México)	Jul-98	73.21	580.43	11.2

(continues)

Table A2. Open Access Transportation Permits (*continued*)

Concessionaire	Location	Route	Main investor	Grant date	Pipeline length (kilometers)	Capacity (thousands of cubic meters a day)	Investment (millions of U.S. dollars)
Transportadora de Gas Zapata S. de R.L. de C.V.	Puebla-Morelos	Puebla-Cuernavaca	Williams International Ventures (U.S.)	Jul-98	146.80	1,302.00	19.58
Transcanada del Bajío, S.A. de C.V.	Guanajuato-Aguascalientes	Valtierra-Aguascalientes	TransCanada Pipelines (Canada)	Oct-98	203.00	2,550.00	56.47
Transportadora de Gas Natural de Baja California, S. de R.L. de C.V. ^a	Baja California	San Diego-Rosarito	Sempre Energy	Dec-98	36.00	22,923.00	28.4
Transportadora de Gas Natural del Centro, S. de R.L. de C.V.	Guanajuato	El Durazno-Pabellón de Arteaga	Tejas Gas (U.S.)	Jan-99	228.00	2,114.00	61.91
Midcoast, S.A. de C.V.	Guanajuato	Valtierra-León	Midcoast Energy Resources (U.S.)	Mar-99	100.80	2,610.00	15.9
PGPB. Sistema Naco-Hermosillo ^b	Sonora	Naco-Hermosillo	Pemex-Gas y Petroquímica Básica (México)	Mar-99	339.00	2,207.23 ^b	22.14
PGPB. Sistema Nacional de Gasoductos	SNG	SNG	Pemex-Gas y Petroquímica Básica (México)	Jun-99	8,704.00	148,938.0	436.5
TGT de México, S.a. de C.V.	Aguascalientes	Valtierra-Aguascalientes	Techint (Argentina)	Sep-99	200.00	3,160.00	53.46
Total					11,175.46	214,458.7	1,100.52

a. Integrated Project (natural gas/electricity).

b Average of the five initial years.

Source: Comisión Reguladora de Energía.

Table A3. Moderate Scenario of Consumption, Net Production and Logistic Imports of Dry Natural Gas, 1998–2007

Thousands of cubic meters a day

Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Electric	15,916.9	19,011.9	26,354.4	36,338.9	41,223.6	44,463.0	50,358.6	55,755.8	59,335.0	64,205.5
Oil	47,888.8	63,387.4.3	50,758.7	58,747.6	62,064.8	63,415.2	65,391.1	68,485.9	70,184.8	71,474.3
PEP	34,158.6	48,473.1	33,045.4	32,496.1	34,498.3	35,500.1	37,162.7	38,824.1	40,210.3	41,304.7
PGPB	7,275.5	8,456.4	9,123.0	9,657.3	10,048.9	10,314.0	10,414.2	11,611.1	11,734.6	12,051.7
PR	6,420.3	6,423.4	8,555.9	16,559.7	17,482.3	17,566.6	17,789.7	18,016.3	86,205.4	18,083.4
PC	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
Industrial	46,323.8	49,588.6	50,715.0	52,684.2	54,875.7	57,977.4	59,642.6	61,227.6	62,890.6	64,736.3
Tendencial	29,963.5	31,180.8	32,461.0	33,788.4	35,161.3	36,576.6	38,032.0	39,527.3	41,058.4	42,658.2
New infrastructure	396.4	424.8	424.7	576.4	919.6	1,167.4	1,257.0	1,353.5	1,458.0	1,571.4
PPQ	15,963.9	17,982.9	17,829.3	18,319.4	18,794.8	20,233.4	20,353.6	20,346.8	20,374.1	20,506.7
Residential and commercial	2,452.2	2,933.6	3,409.3	4,111.6	5,323.6	6,796.0	8,543.2	9,961.9	10,924.6	11,556.1
Vehicular transport	0.0	96.3	407.8	747.6	1,178.0	1,687.7	2,205.9	2,749.6	3,409.3	4,496.7
National consumption	112,580.4	135,017.7	131,645.3	152,629.9	164,664.9	174,339.4	186,141.4	198,180.7	206,744.3	216,468.9
Total supply	119,665.2	140,703.3	140,922.7	144,645.2	151,596.2	157,704.6	164,864.9	172,785.2	176,584.9	176,531.1
Net balance	7,084.8	5,685.6	9,277.4	-7,984.7	-13,068.6	-16,634.8	-21,789.6	-25,395.5	-30,179.3	-39,937.7
Logistic imports ^a	4,014.1	5,738.2	8,044.3	10,002.1	11,801.7	12,513.6	14,213.0	15,311.5	16,929.0	18,401.8
Commercial exchange	11,099.0	11,423.8	17,321.7	2,017.4	-1,266.9	-4,121.1	-7,576.6	-10,894.0	-14,246.1	-21,535.9

a. Logistic imports are imports done by Pemex so as to maintain an adequate gas balance of the transportation pipeline system.

Source: Secretaría de Energía

Table A4. Base Scenario of Consumption, Net Production and Logistic Import of Dry Natural Gas, 1998–2007
(Thousands of cubic meters a day)

Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Electric	16,870.50	22,466.40	31,351.60	47,175.60	50,366.70	55,513.10	62,470.80	70,052.80	76,751.30	82,819.20
Oil	47,888.80	63,387.40	50,758.70	58,747.60	62,064.00	63,415.20	65,391.10	68,485.90	70,184.80	71,474.30
PEP	34,158.50	48,473.10	33,045.40	32,496.10	34,498.30	35,500.10	37,152.70	38,824.10	40,210.30	41,304.70
PGPB	7,275.50	8,456.40	9,123.00	9,657.30	10,048.90	10,314.00	10,414.20	11,611.10	11,734.60	12,051.70
PR	6,420.30	6,423.40	8,555.90	16,559.70	17,482.30	17,566.60	17,789.70	18,016.30	18,205.40	18,083.40
PC	34.50	34.50	34.50	34.50	34.50	34.50	34.50	34.50	34.50	34.50
Industrial	46,607.60	50,402.30	52,242.60	55,012.00	58,108.00	62,205.30	64,956.40	67,772.20	70,822.00	74,201.50
Tendencial	30,247.30	31,994.60	33,988.50	36,107.70	38,358.30	40,742.90	43,268.30	45,976.40	48,873.80	51,984.90
New infrastructure	396.40	424.80	424.80	584.90	954.90	1,229.00	1,334.50	1,449.00	1,574.10	1,709.90
PPQ	15,963.90	17,982.90	17,829.30	18,319.40	18,794.80	20,233.40	20,353.60	20,346.80	20,374.10	20,506.70
Residential and commercial	2,453.90	2,937.60	3,414.70	4,124.80	5,371.80	7,053.10	8,937.40	10,506.70	11,612.70	12,373.80
Vehicular transport	0.00	96.30	407.80	747.60	1,178.00	1,687.70	2,205.90	2,749.60	3,409.30	4,496.70
National consumption	113,820.90	139,290.00	138,175.40	165,807.60	177,088.40	189,874.30	203,961.60	219,567.20	232,780.20	245,365.50
Total supply	119,665.20	140,703.30	140,922.70	144,645.20	151,596.20	157,704.60	164,864.90	172,785.20	176,564.90	176,531.10
Net balance	5,844.40	1,413.30	2,747.20	-20,986.20	-25,492.20	-32,924.40	-39,096.70	-46,782.10	-56,215.20	-68,834.40
Logistic imports ^a	4,109.50	6,221.80	7,434.10	10,118.90	11,661.90	12,708.20	14,185.40	15,933.20	17,019.40	19,112.90
Commercial exchange	9,953.90	7,635.00	10,181.30	-10,867.30	-13,830.40	-20,216.20	-24,911.30	-30,848.90	-39,195.80	-49,721.40

a. Logistic imports are imports done by Pemex so as to maintain an adequate gas balance of the transportation pipeline system.

Source: Secretaría de Energía

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