DEVELOPING GAS MARKETS IN PERSIAN GULF
CASE STUDY: IRAN

Main Author

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IRAN
ABSTRACT

Natural gas will turn into one of the world's main energy source in only less than two decades. Due to increasing global energy consumption, it could be expected for countries that are somehow enriched with such scarce resources and capable of having the necessary technology in upstream and downstream industries, to play a significant role in the future economy of the world.

Natural gas still maintains the fastest consumption growth rate among the world's primary energy sources and has the highest consumption growth rate among the developing countries. Based upon "International Energy Prospect" scenario, the global natural gas consumption during years 2001-2025 will experience an average growth rate of 2.9-3.2 % per year which is comparable to annual growth rate of 1.8% for oil and 1.5% for coal.

Based on supply-demand models, Declining indigenous gas production in some regions will lead to a growing supply-demand gap, In fact industrial countries (especially North America & west Europe) which are also the largest natural gas consumers will lose their key roles in the global natural gas supply on next two decades. Middle East countries with considerable increase in gas production and due to their economical, political and geopolitical situations could be the best players in the future demand-supply scenarios. Islamic Republic of Iran as a major state in Persian Gulf has the world's second largest natural gas reserves (around 15.3%, after Russia) and despite the fact that domestic natural gas demand is growing rapidly, Iran has the potential to become a significant natural gas supplier (exporter) due to its enormous reserves, key development projects, and geopolitical point of view.

Based on natural gas developments which happen quickly in Persian Gulf region especially in Iran, most analysts are now predicting the competitive role of Iran in global natural gas markets. Currently, natural gas accounts for nearly half of Iran's total energy consumption, and the government plans billions of dollars worth of further investment in coming years to increase this share. The price of natural gas to consumers is state-controlled at extremely low prices, encouraging rapid consumption growth and replacement of fuel oil, kerosene and LPG demand.

This case study will examine in more depth the fastest growing natural gas supplier-consumer country in Persian Gulf that is Islamic Republic of Iran, which has the world's second largest natural gas reserves (around 15.3%, after Russia). The analysis will be undertaken to cover the following areas:

- Iran's country and economy overview
- Overview of Iran's energy supply sources and key players
- Country natural gas facts and outlooks
- Developing gas markets within Iran
- Key natural gas projects
- Issues and challenges
- New Iranian natural gas industry vision
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2.1 INTRODUCTION

World's resources of natural gas, although finite, are enormous, while estimates of its size continue to grow as a result of innovations in exploration and extraction techniques. Natural gas resources are widely and plentifully distributed around the globe. Of the world's gas resources, 40.6% lies in the Middle East. In 2004 total world reserves were 179.53 Tcm and the ratio of proven natural gas reserves to production at current levels is between 60-70 years. In Middle East (Persian Gulf states) the R/P ratio is over 100 years.

![Global Proven Gas Reserves by Region 2004e](Source BP)

Figure 1- Global Proven Gas Reserves by Region 2004e.

Based on the projection made by the OWEM and DOE/EIA model, natural gas will be the fastest growing form of energy through 2025. The most important energy agencies in the world are now predicting global gas demand will continue to grow at 2.9 – 3.2 %/year until at least 2025. (Table 1). Demand for natural gas is growing because it is relatively cheap; it is the cleanest burning fossil fuel. These traits make it vital not only to nation's energy future, but also to the challenge of reducing harmful emissions from power plants, including CO2, the chief culprit in global warming.

<table>
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<th>Model/Year</th>
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<th>2010</th>
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<th>2020</th>
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<td>3356</td>
<td>3809</td>
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<tr>
<td>DOE/EIA%</td>
<td>2.5</td>
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<td>2973</td>
<td>3341</td>
<td>3794</td>
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</table>

Table 1- Estimated Average Growth of Global Demand (% Bcm)

To satisfy this demand growth, worldwide net trade is expected to more than double between 2001 and 2010, and more than triple by 2025. By the end of the next decade, worldwide demand for natural gas will be about 2.2 billion cubic meters per day.
Based on DOE/EIA forecast model; the world natural gas production through 2010-2025 will continue to grow at average 2.1% annually. (See Table 2).

<table>
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<tr>
<th>Region - Countries</th>
<th>2001</th>
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<th>2025</th>
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<td>North America, Mexico</td>
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<td>838</td>
<td>866</td>
<td>929</td>
<td>951</td>
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<tr>
<td>Western Europe</td>
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<td>254</td>
<td>254</td>
<td>252</td>
<td>277</td>
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<td>Japan, Australia</td>
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<td>65</td>
<td>84</td>
<td>91</td>
<td>96</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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<td><strong>1157</strong></td>
<td><strong>1204</strong></td>
<td><strong>1272</strong></td>
<td><strong>1324</strong></td>
<td><strong>0.7</strong></td>
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<tr>
<td>Russia Federation</td>
<td>728</td>
<td>855</td>
<td>988</td>
<td>1121</td>
<td>1260</td>
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</tr>
<tr>
<td>Eastern Europe</td>
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<td>25</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>-5.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>753</strong></td>
<td><strong>880</strong></td>
<td><strong>1011</strong></td>
<td><strong>1144</strong></td>
<td><strong>1283</strong></td>
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<td>Asian Developing Countries</td>
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<td>289</td>
<td>317</td>
<td>371</td>
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<td>Middle East</td>
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<td>277</td>
<td>343</td>
<td>442</td>
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<tr>
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<td>229</td>
<td>280</td>
<td>337</td>
<td>399</td>
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<tr>
<td>Central &amp; South of America</td>
<td>102</td>
<td>156</td>
<td>201</td>
<td>243</td>
<td>300</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>716</strong></td>
<td><strong>951</strong></td>
<td><strong>1141</strong></td>
<td><strong>1393</strong></td>
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<tr>
<td><strong>Global</strong></td>
<td><strong>2582</strong></td>
<td><strong>2988</strong></td>
<td><strong>3356</strong></td>
<td><strong>3809</strong></td>
<td><strong>4274</strong></td>
<td><strong>2.1</strong></td>
</tr>
</tbody>
</table>

Table 2- Natural Gas Production Trend 2010-2025

Based on supply-demand models, Declining indigenous gas production in some regions will lead to a growing supply-demand gap. In fact industrial countries (especially North America & west Europe) which are also the largest natural gas consumers will lose their key roles in the global natural gas supply on next two decades. Middle East countries with considerable increase in gas production and due to their economical, political and geopolitical situations could be the best players in the future demand-supply scenarios.

Europe will require the most dramatic import increase. Natural gas imports are expected to grow to about 65 percent of demand in 2020. This is an increase of nearly 25 billion cubic feet per day over today’s statistics. Currently, gas imports account for only 36 per cent of European supply. Imports into North America and Asia Pacific are relatively small today, but to meet rising demand, they will each grow about 10 billion cubic feet per day by 2020.

It’s an exciting time to be part of the gas business. However, that excitement doesn’t come without challenges. One of the implications resulting from this gas outlook is the significant investment
required to connect gas sources -- predominantly Russia & the Caspian region, Africa and the Middle East with the main demand centers in Europe, the U.S. and Asia Pacific. One of the key drivers of this growth in inter-regional trade will be of pipeline gas and LNG.

Islamic Republic of Iran as a major state in Persian Gulf has the world's second largest natural gas reserves (around 15.3%, after Russia) and despite the fact that domestic natural gas demand is growing rapidly, Iran has the potential to become a significant natural gas supplier (exporter) due to its enormous reserves, key development projects, and geopolitical point of view. Based on natural gas developments which happen quickly in Iran, most analysts are now predicting the competitive role of Iran in global natural gas markets.

2.2 IRAN AT A GLANCE

2.2.1 Country Overview

- Iran or its official name "Islamic Republic of Iran" is strategically located in Middle East between the Persian Gulf and Caspian Sea with the size of 1,648,195 sq. km. in area., Iran is situated both in the northern hemisphere and east of Greenwich meridian on 25-40 degree lat and 43-63 degree long.

- Iran is ruled by Islamic spiritual leader Ayatollah Ali Khamenei and President Dr. Ahmadi negad who elected on 25 June 2005.

- Islamic Republic proclaimed on 1 April 1979 by revolution.

- Major ethnic groups are: Persian (58%), Azerbaijani (24%) and Kurdish, Luri, Baluch, Arabic (18%)

- Religions of Iranian people are: Shi'a Muslim (89%), Sunni Muslim (10%), others (1%)

- Neighboring countries are: Iraq with 1,280 km border and Turkey with 470 km border neighbor Iran in the west. Armenia, Azerbaijan and Turkmenistan republic together constitute a 1,740 km shared border with Iran in the north where as Afghanistan and Pakistan also share 1680 km borders with Iran in the east.

- Geographical and administrative divisions: Islamic Republic of Iran is officially divided into 30 provinces, 195 cities, 500 districts and also the city of Tehran and its suburbs, with over 10 million inhabitants, constitute the capital.

- Population is 69.0 million in the year 2004 and the capital is Tehran. Majority of population is in north, and middle region of Iran.

- Major cities are: Tehran, Shiraz, Esfahan, Tabriz, Mashad, Bandar Abbas, Ahvaz, Rasht and located in middle and north.

- From north to the south of the country, climate and temperature change abruptly (-20°C, +50°C). Central and Southern Iran is dry and hot with low precipitation. On the whole, it has four distinct seasons. The southern part, nearby Persian Gulf, where Oil and Gas reserves is situated has long, hot and humid summers and moderate winters. The northern Iran is dry and cold with high population.
2.2.2 Economy Overview

- The Real GDP (2004E) is about US$155.4 billion and GDP Growth Rate is about 6.7% for 2003E, 5.8% for 2004E and 5.8% for 2005F. Real GDP for 2005E estimated US$199.1 billion.

- Inflation Rate for 2004E is 14.8% and for 2005E is 14.0%

- Other Iran's key economic data are summarized below:

<table>
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<tr>
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<tbody>
<tr>
<td>Population (millions)</td>
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<td>60.1</td>
<td>64.7</td>
<td>66.4</td>
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<td>GDP (US $ billions)</td>
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<td>101</td>
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<td>137.1</td>
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<td>Inflation Rate (%)</td>
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<td>15.6</td>
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<td>14.0</td>
</tr>
<tr>
<td>GDP per Capita (US$)</td>
<td>2.2</td>
<td>3.1</td>
<td>5.7</td>
<td>5.2</td>
<td>4.1</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Table 3: Iran's Economy Overview Data

- Currency is Rial (R) and exchange rate is R9097 per US$


- Merchandise exports: $54.2 billion

- Exports – commodities: Petroleum 80%, chemical and petrochemical products, fruits and nuts, carpets

- Export – Partners (2004) : Japan 18.4%, China 9.7%, Italy 6%, South Africa 5.8%, South Korea 5.4%, Taiwan 4.6%, Turkey 4.4%, Netherlands 4%

- Merchandise Imports (2005E): $41.5 billion

- Imports – Commodities: Industrial raw materials and intermediate goods, capital goods, foodstuffs and other consumer goods, technical services, military supplies

- Imports – Partners (2004): Germany 12.8%, France 8.3%, Italy 7.7%, China 7.2%, UAE 7.2%, South Korea 6.1%, Russia 5.4%

- Current Account Balance (2005E): $8.7 billion

- Iran's economy relies heavily on oil export revenues - around 80-90 percent of total export earnings and 40-50 percent of the government budget. Despite higher oil revenues, Iranian budget deficits remain a chronic problem, in part due to large-scale state subsidies on foodstuffs, gasoline, etc. Expenditures on fuels were estimated at $4.7 billion in 2004

- In addition, Iran is attempting to diversify its economy by investing some of its oil revenues in other areas, including petrochemicals. In 2004, non-oil exports rose by a reported 9 percent. Iran also is hoping to attract billions of dollars worth of foreign investment to the country by creating a more favorable investment climate (i.e., reduced restrictions and duties on imports, creation of free-trade zones).

- Large-scale state subsidies on foodstuffs, gasoline, natural gas, electricity, etc are paid annually to support of people and domestic producers.
2.3 IRAN ENERGY SITUATION

Iran has the variety of energy sources. On the supply side, more than 97% of primary energy is derived from oil and gas resources and only less than 3% is from hydro, coal and non-commercial energies. Likewise, in the electrical sector, more than 92% of the present installed capacity (26,000 MW(e)) is based on oil and gas fired turbines and less than 8% of it (about 2,000 MW(e)) is hydro power (FIG 5 shows the energy reserves according to US department of energy on 2003).

Based on EIA reports (2004E), Total Energy Consumption of Iran is 6 quadrillion Btus, of which Oil (49%), Natural Gas (46%), Hydroelectricity (2%), Coal (1%), Nuclear (0%), Other Renewable (0.01%). Iran’s total per capita energy consumption (2004E), is about 87.6 million Btus. Energy Intensity (2004E) in all Iranian sections is estimated about 13,766 Btu per $2000-PPP.

![Comparison of Iran's Energy Reserves](image)

FIG 3: Energy Reserves in Iran (2003E)

Due to a very cheap price of primary energy and the increase in population in Iran, the final energy consumption has increased more than 7% annually and electricity production has risen 10% per year in the last two decades. In other words, while the size of population is nearly doubled, the final energy consumption is quadrupled and electricity production is more than sixfolded to meet the existing demand. These figures show a very high level of consumption and an incremental trend of energy intensity.
2.3.1 Energy Supply Sources

2.3.1.1 Oil

Iran is OPEC's second largest oil producer and holds 10 percent of the world's proven, conventional world oil reserves. Most oil is located in the southwestern part of Iran, near the Iraqi border and Persian Gulf. According to the Oil and Gas Journal, Iran held 125.8 billion barrels of proven oil reserves as of January 1, 2005, roughly 10 percent of the world's total. The vast majority of Iran's crude oil reserves are located in giant onshore fields in the southwestern Khuzestan region near the Iraqi border. Overall, Iran has 32 producing oil fields, of which 25 are onshore and 7 offshore.

Iran currently has crude oil production capacity of around 4.0 million bbl/d, which it would like to increase to 5 million bbl/d by 2010. Iran exports around 2.7 million bbl/d, with major customers including Japan, China, South Korea, Taiwan, and Europe. Iran has potentially significant Caspian reserves of its own, although only a small amount (0.1 billion barrels) has been proven as "recoverable." Currently, Iran has no oil or natural gas production in the Caspian region.

2.3.1.2 Natural Gas

Islamic Republic of Iran as a major state in Persian Gulf has the world's second largest natural gas reserves (around 15.3%, after Russia). In respect to domestic consumption, the share of natural gas within the country's energy consumption basket has reached to 59% (2005E) which by the end of the year 2009 will climb to 69%.

2.3.1.3 Coal

Iran has limited recoverable coal reserves (2003E) of around 461.9 million short tons and has coal production capacity (2003E) of around 1 million short tons. Coal consumption (2003E) in Iranian major industries is about 1.8 million short tons per year.

2.3.1.4 Hydro-power

The whole potentials of hydro power in Iran is estimated to be approximately 42,000 MW (e). According to the latest information released by Ministry of Power, the practical hydro potential of the country is projected to be only 23,000 MW (e). Up to now around 2,000 MW (e) has been exploited and another 9,000 MW (e) is in process of execution, about 1,700 MW (e) is under consideration and more than 7,000 MW(e) is at the sage of recognition.
2.3.1.5 Nuclear

Iran has limited Uranium reserves as energy primary sources (6.0 Quadrillion BTU). Uranium resources of Iran are not considered a rich one. The results of the Atomic Energy Organization of Iran (AEOI) exploration activities have shown proven reserves of about 3,000 tons of Uranium so far. According to the discovered indices (more than 350 anomalies) and the results of the field discoveries, the expected resources of Iran could be at the range of 20,000-30,000 tons of U3O8, throughout the country. Therefore Iran's domestic reserves might be sufficient enough to supply the raw material for needed nuclear power plants in future. In the mid 1970s, a major nuclear power program was planned and construction of two nuclear power plants, two 1,200 MW (e) PWR units started at Bushehr by KWU. In 1979, this nuclear power plant construction program was suspended and construction activities halted, at a fairly advanced stage of the civil work for the two units.

The Islamic Republic of Iran resumed the nuclear power programmed in 1991 with a bilateral agreement with China for the supply of two 300 MW (e) PWR units of Chinese design, similar to the Qinshan power plant. The agreement was confirmed in 1993 (but never realized).

In 1994, the Ministry of Atomic Energy of the Russian Federation (MINATOM) and the Atomic Energy Organization of Iran (AEOI) agreed on the scope of work for completing the Bushehr nuclear power plant unit 1 (BNPP-1) with a 1000 MW(e) PWR unit of WWER-1000 type. The contract was signed in 1995. Nuclear power has not gone in operation yet.

2.3.1.6 Renewable

There are ample potentials of renewable energies in Iran. The annually average daily solar radiation is about 2,000 kW·h per m². There are also good potentials of wind and geothermal energies in some parts of the country. However, because of the limitation of the existing technologies for steady and reliable supply of energy and much higher unit cost of electricity generated by these resources, it is not expected that renewable play a major role in Iran's electricity system in near future.

Due to a very cheap price of primary energy and the increase in population in Iran, the final energy consumption has increased more than 7% annually and electricity production has risen 10% per year in the last two decades. In other words, while the size of population is nearly doubled, the final energy consumption is quadrupled and electricity production is more than six folded to meet the existing demand. These figures show a very high level of consumption and an incremental trend of energy intensity.
2.3.2 Institutional Structure; Key Players in Energy

The Ministry of Petroleum (MoP) has overall responsibility for the country's energy sector. The MoP has four subsidiaries which function autonomously for the most part, but ultimately report to the Ministry: 1) National Iranian Oil Company (NIOC) - oil and gas exploration and production, refining and oil transportation; 2) National Iranian Gas Company (NIGC) - manages gathering, treatment, processing, transmission, distribution, and exports of gas and gas liquids; 3) National Iranian Petrochemical Company (NPC) - handles petrochemical production, distribution, and exports; and 4) National Iranian Oil Refining and Distribution Company (NIORDC) handles oil refining and transportation, with some overlap to NIOC. The National Iranian Offshore Oil Co. (IOOC) is in charge of offshore oil fields in the Persian Gulf.

The National Iranian South Oil Fields Co. (NIIOC South) is in charge of onshore oilfields in southern Iran. Pars Oil & Gas Co. (POGC) is in charge of the offshore North and South Pars gas fields. Khazar Exploration & Production Co. is in charge of Iran's Caspian Sea sector. Also, the National Iranian Tanker Company (NITC) controls the second largest fleet of tankers in OPEC.

- NIGC: National Iranian Gas Company as one of the four principal Co.’s affiliated to oil ministry of Islamic Republic of Iran with 25 billions Rials. Initial capitals have established in 1344 A.H or 1965 AD. Presently NIGC has 26 Provincial Gas companies, 7 gas treating companies and 8 gas transmission regions. These companies are responsible for natural gas treating, transmission, distribution and consumption throughout the country, NIGC main activities are:
  - Gas Treatment
  - Gas Transmission
  - Gas Distribution
  - Research & Development
  - Engineering & Construction
  - Gas Trade (Export & Import)
  - Underground Storage
• NIOC. Fifty five years have passed since the National Iranian Oil Company (NIOC) was established in February 1948 with the objective of the exploration, development, production, marketing and sales of crude oil and natural gas. NIOC, having in possession huge hydrocarbon reserves, is considered as one of the largest oil firms of the world. NIOC's oil and gas in place reserves are 561.9 bn barrels and 41.14 trillion cubic meters, respectively which give it a unique status in the global energy supply. In fact, in recent years, NIOC has been invariably ranked as one of the biggest four global oil companies. Current NIOC production capacities include over 4 million barrels of crude oil and in excess of 300 million cubic meters of natural gas per day. On the export side, the company benefits from its modern extensive facilities on the three islands of Kharg, Lavan and Siri consisting of 17 jetties capable of berthing tankers of all sizes to lift and export its crude oil.

• NIORDC. Although National Iranian Oil Refining and Distribution Company (NIORDC) is formed nearly in the past decade and began its activities within a new framework, the company is actually inherited 90 years of Iran’s Oil Industries experiences in the fields of refining, transferring and distributing of oil products, as well as, engineering and construction of installations of oil industries. NIORDC and its subordinate companies have been established to separate oil upstream activities from downstream activities. NIORDC was established on March 08 / 1992 and undertook to perform all the operations related to refining crude oil and transfer and distribution of oil product.

• NPC. The National Petrochemical Company (NPC), a subsidiary to the Iranian Petroleum Ministry, is owned by the government of the Islamic Republic of Iran. It is responsible for the development and operation of the country's petrochemical sector. Founded in 1964, NPC began its activities by operating a small fertilizer plant. Today, NPC is the second largest producer and exporter of petrochemicals in the Middle East. NPC's major activities are production, sale, distribution and export of chemicals and petrochemicals. Currently allied with more than 50 subsidiaries, including 9 production complexes and 18 project implementing companies, NPC operates as a mother company handling policy-making, planning, directing and overseeing the activities of its subsidiaries and affiliates.

2.4 IRAN’S NATURAL GAS FACTS AND OUTLOOKS

2.4.1 Natural Gas Supply Sources

According to the BP statistical review of world energy 2005, Iran contains an estimated 27.50 trillion cubic meter (Tcm) in proven natural gas reserves—the world's second largest and surpassed only by Russia. Around 62 percent of Iranian natural gas reserves are located in non-associated fields, and have not been developed, meaning that Iran has great potential for future gas development. Major non-associated gas fields include:

- South Pars: 8-14.2 Tcm Persian Gulf basin
- North Pars: 1.42 Tcm Persian Gulf basin
- Kangan: 0.82 Tcm Persian Gulf basin
- Nar: 0.37 Tcm Persian Gulf basin
- Khangiran: 0.31 Tcm North-East basin
Iran's largest natural gas field is South Pars, geologically an extension of Qatar's 25.5Tcm North Field. South Pars was first identified in 1988 and originally appraised at 3.62 Tcm in the early 1990s. Current estimates are that South Pars contains 8.0 Tcm or more (some estimates go as high as 14.2 Tcm) of natural gas, of which a large fraction will be recoverable.

In addition to above fields, the 0.18 Tcm, non-associated Khuff (Dalan) reservoir of the Salman oil field (which straddles Iran's maritime border with Abu Dhabi, where it is known as the Abu Koosh field); the 22.65 Bcm Zireh field in Bushehr province; the 0.11 Tcm Homa field in southern Fars province; the 0.4 Tcm Tabnak natural gas field located in southern Iran, the 0.37 Tcm Aghar and Dalan fields in Fars province, and the Sarkhoun and Mand fields. Iran had discovered two new natural gas fields in the Persian Gulf, one at Balal and the other beneath Lavan Island (with possible reserves of 0.2 Tcm).

Of the Iran's natural gas resources, 32.7% lies in on-shore and 67.3% lies in off-shore. Almost 60% of Iran's off-shore natural gas fields are common with neighbored countries (Qatar, Oman, UAE, and Saudi Arabia). Although majority of natural gas fields are in the south of Iran-Persian Gulf- but population and major industries are located in middle and north, gas transmission is very critical issue.
2.4.2 Natural Gas Supply and Demand

Currently, natural gas accounts for nearly half of Iran's total energy consumption, and the government plans billions of dollars worth of further investment in coming years to increase this share. The price of natural gas to consumers is state-controlled at extremely low prices, encouraging rapid consumption growth and replacement of fuel oil, kerosene and LPG demand.

The country energy policy is based upon maximum allocation of natural gas resources and increasing gas share in basket of energy carriers through expansion of domestic gas networks and enhancement of Iran's disposition in gas exports to international markets, which would provide substantial savings in the consumption of crude oil and oil products to increase export incomes to the country. Directives of Iran are based upon supply of gas to:

- Industries mainly power plants.
- Domestic household consumers
- Injection to oil fields for recovery enhancement
- Export

Based on Iran's supply-demand outlooks, Declining gas demand in some Iranian energy sectors through 2010-2025, will lead to a growing supply-demand gap, In fact Iran could has the competitive role in global natural gas markets.
2.4.3 Natural Gas Treating Capacity

The country’s gas treating capacity during years 1997-2005 indicates a substantial of 189.6 million cubic meters per day. The treating and dehydration capacity during this period with period with average annual growth of 14.3 percent, increased from 128.5 million cubic meters per day in year 1996 to 383 million cubic meters per day in 2005. This increases were mainly attributed to the Fadjr, South Pars, Khangiran and Parsian treating and dehydration plants.

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<tr>
<td>FADJR</td>
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<td>79.3</td>
<td>90.7</td>
<td>105</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
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<tr>
<td>KHANGIRAN</td>
<td>24</td>
<td>26.4</td>
<td>27.5</td>
<td>27.5</td>
<td>27.5</td>
<td>44.5</td>
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<td>14.4</td>
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<tr>
<td>DALAN</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
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<td>GAVARZIN</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
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<tr>
<td>SOUTH PARS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>75</td>
<td>125</td>
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<tr>
<td>PARSIAN</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>25</td>
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<tr>
<td>OTHERS</td>
<td>5.2</td>
<td>5.2</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
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</tr>
<tr>
<td>TOTAL</td>
<td>128.5</td>
<td>142.2</td>
<td>154.8</td>
<td>189.1</td>
<td>194.1</td>
<td>211.1</td>
<td>268</td>
<td>318.1</td>
<td>383</td>
<td>383</td>
</tr>
</tbody>
</table>

Table 4: Iran's Capacity of Natural Gas Treating

The country according to year 2005 statistics was capable of treating 383 million cubic meters per day of natural gas. The new treating plants Illam, Bid Boland 2, Parsian, and some trains of South Pars with total capacity of 250 million cubic meters per day will increment the country’s gas treating capacity in the year 2009 to 576 mmcm/d. According to BP statistical report (2004E), Iran is the world's 5th largest natural gas producer and holds 3.2 percent of the world’s share (85.5 billion cubic meters).

![FIG 8: Location of Iran's Natural Gas Treating Plants](image-url)


2.4.4 Natural Gas Transmission

The activities of the National Iranian Gas Company in the frame work of high pressure natural gas pipelines indicates construction of approximately 7700 Kilometers of pipelines during years 1999-2004. The average yearly activity during years 1999-2004 has been 1283 Kilometers while at the end of year 2005 total length of transmission pipelines reached 21500 Kilometers. Major Iran's existing and under construction (projects) high pressure pipelines include:

- The Iranian Gas Trunk line I. The (IGAT-I) was commenced in year 1970. The pipeline begins from Bid Boland treating plant with a diameter of 42 inches and extends to Pataveh for a length of 157 Kilometers. The pipeline extends north bound to Kuh-e Namak. The total length of 42 inch pipeline is 605 kilometers. From this location the diameter of pipeline is reduced to 40 inches and extends to Astara. The total length of pipeline is 1104 kilometers. The pipeline has 10 compressor stations en route.

- The Iranian Gas Trunk line II. The IGAT-2 with a length of 1039 kilometers and diameter of 1400 millimeters (56 inches) has been constructed in 4 phases to transmit 80 million cubic meter/day of gas from the Fadjr treating Plant to Qazvin. The transmission capacity of the pipeline can be incremented to 105 million cubic meters per day by installation of compressor stations.

- The Iranian Gas Trunk line III. The IGAT-3 with a length of 870 kilometers and diameter of 1400 millimeters (56 inches) has been constructed for transmission of South Pars gas reservoir to the northern regions of the country between Kangen and Saveh. The transmission capacity of the pipeline with associated compressor stations could reach a figure of 90 million cubic meters per day.

- The Iranian Gas Trunk line IV Project. To transmit the gas production of Parsian and Assaluyeh Gas Treating Plants for a quantity of 110 million cubic meters/day to northern regions of the country, the IGAT IV trunk line has been designed for a length of 1034 kilometers and diameter of 56 inches extending in the vicinity of assaluyeh/Eastern Shiraz/Abadeh/Esfahan/Tehran with 10 Compressor Stations en route. Construction and completion plans are set for year 2006 through installation of compressor stations.

- The Iranian Gas Trunk line V Project. The construction of IGAT-V from Assaluyeh to Agha Jari for total length of 504 kilometers and diameter of 56 inches will consist of 5 compressor stations, communications and other related facilities. The pipeline design has been completed and in year 2003, route construction for 346 kilometers has been concluded and mechanical and construction activities has commenced in year 2004.

<table>
<thead>
<tr>
<th>Transmission Project</th>
<th>Specification</th>
<th>Investment (Forecast) Million $US</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGAT- IV</td>
<td>1052 Km Length 56 inch Dia.</td>
<td>230</td>
</tr>
<tr>
<td>IGAT- V</td>
<td>505 Km Length 56 inch Dia.</td>
<td>203</td>
</tr>
<tr>
<td>IGAT- VI</td>
<td>500 Km Length 56 inch Dia.</td>
<td>122</td>
</tr>
<tr>
<td>IGAT VII</td>
<td>860 Km Length 20 &amp; 42 in Dia.</td>
<td>149</td>
</tr>
<tr>
<td>IGAT-VIII</td>
<td>1047 Km Length 56 inch Dia.</td>
<td>221</td>
</tr>
<tr>
<td>North &amp; North East</td>
<td>790 Km Length 48 inch Dia.</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 5: Main Iran's Pipe lines Projects (2004-2009)
• The Iranian Gas Trunk line VI. To supply gas to Bushehr and Khoozestan Provinces, the construction of IGAT-6 has been planned for a length of 492 Kilometers and diameter of 56 inches and the system will be connected to Assaluye in Phase two. The general route of the project is parallel to IGAT-5 with operating pressure of 1305 Psi and pipeline construction has been planned within 43 months.

• The Iranian Gas Trunk line VII. To supply natural gas requirements of Sistan and Baluchestan province and some gas deficiencies of Hormuzgan province through transmission of South Pare gas production, IGAT – 7 extending from Assaluye / Bastak / Sarkhun / Kahnooj / Iranshahr and respectively to Zahedan and Chaboahar with 56 & 42 & 30 inches pipe lines has been included in NIGC-S agenda.

• The Iranian Gas Trunk line VIII Project. IGAT – 8 has a diameter of 56 inches for a length of 1047 kilometers and operating pressure of 1305 Psig and design pressure of 1400 Psig. There are eleven compressor stations for total power of 1800 thousand horse powers to be installed en route the pipe line. Presently route survey for section Safashahr – Naein for a length of 230 kilometers underway and after conclusion of route survey, mapping and geological survey and design activities will commence.

• The design of this section will be completed in December 2004. In the meantime, for the span of Jahrom to kharameh in the vicinity of compressor station. No.4 of IGAT -4 , Loop Lines that in future will constitute sections of IGAT – 8 and located in the operating boundary of IGAT – 4 is under construction and trench for a length of 36 kilometers has been already prepared.

• The Northern and North-Eastern Pipeline Project. The purpose for construction of this pipeline Project is expansion of gas delivery activities to Southern-Khorasan and also development of consumption plans in the North – Eastern regions. The pipeline is 48 inches in diameter for a length of 790 kilometers and will have 60 million cubic meters/day transmission capacities.
FIG 8: High Pressure Natural Gas Transmission Pipe Lines route
2.4.5 Natural Gas Consumption

To meet the fast growing domestic demand of natural gas (average 13% growth per year) by all sectors, NIGC has supplied 97.7 bcm at the end of 2004 and planned to satisfy 156.2 bcm in the end of year 2009. Currently, natural gas accounts for nearly 59% of Iran’s total energy consumption, and the government plans billions of dollars worth of further investment in coming years to increase this share to 69% in the year 2009. Supply of gas to industries, power plants and domestic household consumers are priorities of country.

![Natural Gas Consumption Breakdown by Sector (2005E)](image)

Number of cities using natural gas, Number of households’ consumers and developing length of natural gas distribution networks shows the fastest growing in favor of country’s industrial-economic development. Table 5 indicates tendency for optimum utilization of country advantages in the natural gas sector.

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</tr>
</thead>
<tbody>
<tr>
<td>Gas Distribution Networks (1000Km)</td>
<td>59</td>
<td>69</td>
<td>79</td>
<td>87</td>
<td>105</td>
<td>115</td>
<td>125</td>
</tr>
<tr>
<td>Gas Consumers Households (Million-No)</td>
<td>6.6</td>
<td>7.4</td>
<td>8.4</td>
<td>9.1</td>
<td>10.5</td>
<td>11.3</td>
<td>12</td>
</tr>
<tr>
<td>Cities Using Natural Gas (No)</td>
<td>379</td>
<td>392</td>
<td>445</td>
<td>480</td>
<td>515</td>
<td>548</td>
<td>690</td>
</tr>
</tbody>
</table>

Table 6: Domestic Demand Facilities Growth
Despite the fact that domestic natural gas demand is growing rapidly, Iran has the potential to become a significant natural gas supplier (exporter) due to its enormous reserves, key development projects, and geopolitical point of view. Based on natural gas developments which happen quickly in Iran, most analysts are now predicting the competitive role of Iran in global natural gas markets.

Nowadays, natural gas export, gas injection to oil fields to enhance throughput and safeguard oil production, are very small part of Iran's consumption sectors. LNG export is Iranian under study prospects.
2.4.6 Natural Gas Trade

With its enormous natural gas reserves, Iran is looking to export large volumes of gas. Besides Turkey (see below), potential customers for Iranian gas exports include: Ukraine, Europe, India, Pakistan, Armenia, Azerbaijan, Georgia (interested in receiving Iranian gas via Armenia), Taiwan, South Korea, and even China. Exports could be via pipeline and/or LNG tanker, with possible LNG export terminals at Asaluyeh or Kish Island. As of February 2005, BG and NIOC reportedly remained interested in developing a $2.2 billion LNG plant at Bandar Tombak on the Persian Gulf coast. The plant is to comprise two LNG trains, with capacity of at least 4 million tons per year each, and with possible completion in 2008.

In late January 2002, Iran and Turkey officially inaugurated a much-delayed natural gas pipeline link between the two countries, following several years of delays due to economic, political, and technical factors. Exports of Iranian natural gas to Turkey could reach 10 Bcm per year by 2007.

FIG 12: Natural Gas Export Plan to Turkey

Iran reportedly is aiming for large-scale natural gas exports to Europe via Turkey. In March 2002, Greece and Iran signed a $300 million agreement which calls for extending the natural gas pipeline from Iran to Turkey into northern Greece. After that, gas could be transported to Europe via Bulgaria and possibly Romania. A memorandum of understanding (MOU) was signed on this possibility in January 2003, and a joint working group set up in October 2003. Alternatively, gas could be transported via an undersea pipeline to Italy, where gas demand is expected to grow rapidly in coming years. A deep water option could be extremely expensive, however, making an overland route more likely. In January 2004, Austria's OMV signed an MOU with the National Iranian Gas Export Co. (NIGEC) on possible cooperation regarding the proposed $5 billion “Nabucco” gas pipeline from Iran through Turkey to Austria. A decision on the Nabucco line was supposed to have come by the end of 2005, but was delayed in part due to the Iranian nuclear issue. If Nabucco goes ahead, gas could start flowing in 2011.

Another option to Nabucco is Ukraine, which has offered two possible routes for Iranian gas exports to Western Europe. Each of these routes would cross Armenia, Georgia, and Ukraine, and possibly utilize the IGAT I and II lines in Iran. In July 2005, Iran and Ukraine signed a Memorandum of Understanding on the supply of up to 1 Tcf per year of Iranian natural gas to Ukraine. Although India and Iran in 1993 signed an MOU on an overland natural gas pipeline, a variety of economic and political issues to date have blocked completion of a feasibility study. Meanwhile, in February 2002, Iran and Pakistan signed an MOU on a pre-feasibility study for a possible 1,600-mile, $3-$4 billion gas pipeline from southern Iran to southeastern Pakistan and on to India. Australia's Broken Hill Proprietary (BHP) is the main foreign backer of the idea. Iran is offering to cover 60 percent of the construction costs of the pipeline. Pakistan could earn about $200-$500 million annually in transit fees from the pipeline and also would be able to purchase gas from the pipeline.

Given a thaw in India-Pakistan relations over the past couple of years, the pipeline idea is again gaining interest. Indian officials have stated that the plan could be considered if Pakistan can...
provide security guarantees for the $3 billion project. Two other options would be a pipeline serving only Pakistan, or separate pipelines for Pakistan and India. Gas piped from Iran to India reportedly would cost around $2.10-$2.49 per million Btu at the Indian border. There also has been discussion of extending the pipeline to China. In September 2005, India and Pakistan agreed to seek third-party verification of Iran’s natural gas reserves before proceeding with the pipeline project.

Another possibility would involve LNG exports to India. In January 2005, Gas Authority of India Ltd. (GAIL) and the National Iranian Gas Export Corp. signed a 30-year deal with Iran for delivery of 7.5 million tons per year of LNG starting in 2009-10. One sticking point revolves around price, with Iran asking around $4 per million Btu (based on a formula calculated off of Brent crude at around $45 per barrel), and India looking more at the $2.50 per million Btu it is paying Qatar for LNG. In the end, a compromise around $3.50 per million Btu, including shipping, was reached (although negotiations continue for additional volumes of gas above what has already been agreed upon).

In addition, NIOC offered Indian companies service contracts towards developing the Yadavaran (previously known as Kushk and Hosseinieh) and Jufeyr oilfields. Combined, India’s shares in the two oil fields will produce 90,000 bbl/d. Iran reportedly will build three LNG plants at Assaluyeh, using South Pars gas as a feedstock. If successful, LNG exports most likely would flow to Dahej, in the western Indian state of Gujarat (and/or Cochin in the southwest), either from South Pars or North Pars. The latest news is that India’s state-owned Oil and Natural Gas Corp. (ONGC) as an option for 20 percent of Yadavaran, plus 100 percent of Jufeyr.

In addition to India, China has expressed interest in LNG imports from Iran. In October 2004, Iran signed a $100 billion, 25-year contract with China’s Sinopec for the production and export of LNG to that country (possibly 10 million tons per year), plus construction of a refinery for natural gas condensates and development of the Yadavaran oilfield. Under terms of the deal, Sinopec would have rights to purchase half of Yadavaran’s 300,000-bbl/d peak oil output over the 25-year contract period. However, Iran also received bids on Yadavaran from other foreign companies, so the field’s status is not completely clear.

Iran is also looking to export natural gas to Kuwait, most likely via pipeline from South Pars. In March 2005, Iran and Kuwait signed a preliminary memorandum of understanding for natural gas sales, possibly 300 Mmcf/d for 25 years starting in 2007. The gas would be used for power generation and water desalination. Another possible market for Iranian gas is the UAE.

In May 2004, Armenia and Iran agreed on a long-term deal, under which Iran will supply around 1.3 Tcf of natural gas to Armenia over 20 years (starting in 2007), in exchange for electricity supplies from Armenia. As part of the deal, the two countries are to build an 85-mile gas pipeline at a cost of more than $200 million (construction on the line began in late November 2004). Armenia also reportedly is looking to receive credit from Iran for building hydro plants on the Araks River in exchange for supplies of hydropower to Iran.
Turkmenistan. This natural gas is for use in Iran's northern areas, far from the country's main natural gas reserves in the south. In December 1997, Turkmenistan launched the $190 million Korpezhe-Kurt Kui pipeline to Iran, the first natural gas export pipeline in Central Asia to bypass Russia. According to terms of the 25-year contract between the two countries, Iran will take between 177 Bcf and 212 Bcf of natural gas from Turkmenistan annually, with 35 percent of Turkmen supplies allocated as payment for Iran's contribution to building the pipeline.

2.4.7 Key Natural Gas Projects in Iran

Iran has many significant projects in study step or under construction. For increasing of capacity of natural gas treating for supplying domestic and export needs, the following projects are considered:

- Parsian Dehydration Plant (capacity 50 mmscm/d)
- Ilam Treating Plant (6.8 mmscm/d)
- Bid Boland-2 Treating Plant (56 mmscm/d)
- Masjed Soleyman Treating Plant (1 mmscm/d)
- South Pars Treating Plants Phase 6,7,8,9 (100 mmscm/d)

To supply domestic natural gas requirements and for expansion of gas delivery capacity many high pressure pipelines and compressor stations are under construction as noted in 2.4.4. For supply and peak shaving of increasing domestic demands of northern provinces in winter time, two underground storage facilities are under construction include:

- Varamin Yortshy underground storage (annual storage capacity 650 million cubic meters)
- Ghom Sarajeh underground storage (annual storage capacity 1.5 - 2.0 billion cubic meters)

<table>
<thead>
<tr>
<th>PROJECT / Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
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<td>210</td>
<td>352</td>
<td>425</td>
<td>263</td>
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<td>Treating Plants</td>
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<td>674</td>
<td>78</td>
<td>18</td>
<td>0</td>
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<tr>
<td>Underground Storage</td>
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<td>80</td>
<td>35</td>
<td>15</td>
<td>0</td>
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<td>375</td>
<td>375</td>
<td>375</td>
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<tr>
<td>Maintenance</td>
<td>270</td>
<td>300</td>
<td>330</td>
<td>360</td>
<td>400</td>
</tr>
<tr>
<td>Total</td>
<td>2,727</td>
<td>2,452</td>
<td>1,771</td>
<td>1,415</td>
<td>1,135</td>
</tr>
</tbody>
</table>

Table 7: Forecast of Investment for Natural Gas Projects (million $US)

2.5 IRAN’S NATURAL GAS INDUSTRY SWOT ANALYZE

2.5.1 Strengths

- Islamic Republic of Iran as a major state in Persian Gulf has the world's second largest natural gas reserves (around 15.3%, after Russia)
- Iran is strategically and geopolitically located in Middle East between the Persian Gulf and Caspian Sea, in fact Iran is a bridge between important natural gas resources and major gas markets in Europe. In other hand the country is the best location for access to world market through Persian Gulf by LNG.
- Iran is owner of the largest natural gas resources which are cost effective for production.
- Low cost expert manpower who have more experience in oil & gas fields.
- Despite the fact that domestic natural gas demand is growing rapidly, Iran has the potential to become a significant natural gas supplier (exporter) due to key development projects.
2.5.2 Weakness

- Non-competitive, state-controlled environment governs in Iranian natural gas industries.
- Political conditions govern on major Iran's economics management and decision makings.
- Non-competitive organizational structure in oil & gas up-stream sectors.
- Privatization trend is very slow.
- Lack of enough attention to new technologies in natural gas production sectors.
- Lack of enough attention to world gas trades.
- The largest country's gas source (Sought Pars) is common with Qatar.
- Iran's economy relies heavily on oil export revenues - around 80-90 percent of total export earnings and 40-50 percent of the government budget.
- Large-scale state subsidies on foodstuffs, gasoline, etc.
- Inflation is running at around 15 percent per year.
- Another problem for Iran is lack of job opportunities for the country's young and rapidly growing population.
- Foreign investors appear to be cautious about Iran due to uncertainties regarding its future political & economical directions.
- The price of natural gas to consumers is state-controlled at extremely low prices, encouraging rapid consumption growth.

2.5.3 Opportunities

- Fast growing of global gas markets.
- Geopolitical location of Iran among far east, Europe, Africa, Russia and central Asia.
- The major role of Iran in the most important gas sources of world.
- New markets in eastern Asia (China, India ...) and close to Iran.
- Existing of new competitive trade and industrialized condition in world.

2.5.4 Threats

- Industrialized countries which hold new innovation technologies of gas industries.
- International Financial limitations for investment.
- Changing international political/economical structure.
- Entering new players in investment on natural gas international projects.

2.6 ISSUES & CHALLENGES

2.6.1 Gas Pricing

The price of natural gas to consumers is state-controlled at extremely low prices. Due to a very cheap price of natural gas, the increase in population in Iran and priorities of country to supply of gas to industries, power plants and support of domestic house holds consumers; the final gas consumption has increased more than 13% annually. The average of domestic gas price in Iran through 1997-2005 was 0.66 cent per cubic meters. In comparison of world gas price average (9 cent per cubic meters), natural gas price in Iran is only 7% of world average. The reason of low pricing is for supporting of low salary people and developing industries within Iran.
Natural gas pricing for import and export gas is according to world gas trade prices.

2.6.3 Key Strategic Priorities, Vision and policies

Iran's key strategic priorities in natural gas industry are:

- Providing necessary facilities and potentials to meet fast domestic growing markets and access to world gas trade share.
- Privatization
- Improvement of assets and maximizing their efficiencies.
- Focusing on new technologies, R& D activities, innovations
- Interactive with international technology and market owners.

Respect to above, strategic challenges of Iran will be:

- To find natural gas effective applications to add values and grow country economy.
- To attract foreign investments for contribution in major projects.
- To access good situation in world gas trade shares.
- To transfer activity levels of natural gas industry from national toward regional and international levels at up stream facilities.
- To optimum use of Iran's geopolitical location for creating new competitive advantages.
- To improvement of natural gas consumption and country energy intensity index.
- To revamping of physical assets and processes and re-construction of institutional management systems toward national and international private sectors.

Based on mentioned strategic issues, the new vision of Iran in natural gas industries has published for 2005-2025 period as below:

"Iran will be the 3\textsuperscript{rd} largest world's gas producer and will supply 8-10 percent of global gas demand."
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