2. Chapter Two: Gas Market

The introduction presented an overview on the methodological and analytical framework applied in this thesis. In particular, it tried to present a single-handed approach that could be applied to the complex bargaining situation for Iranian natural gas integration into world markets. The approach captures international politics and strategies, economics and energy market development as well as internal Iranian gas market issues (such as subsidies, et cetera).

As Iran has the world's second largest conventional natural gas[93] reserves in the world, with the lowest anticipated production cost worldwide, there is certainly room for such a supplier in a world seeking to diversify its energy sources and to reduce emissions in order to mitigate climate change. For companies, competition and reserves booking are central concerns in their corporate strategies. Thus there is a great interest in investing in Iran. The internal and external hurdles to such investments will be one of the issues explored in this part.

Firstly, the future role and importance of natural gas will be discussed. Secondly, the rapidly changing natural gas market is analyzed to discuss the implications for Iran's potential gas strategy. Thirdly, Iranian decision making in energy issues, its informal and formal power structure, and Iran's energy policy and strategy will be explored.

2.1 The Role of Energy and Natural Gas

As Cutler Cleveland writes: "Energy is interrelated with human development and the history of human culture can be viewed as the progressive development of new technologies and their associated energy sources. Energy fuels the economies; it transformed society and increased the ability of mankind to exploit

93 This study in general refers to natural gas or gas as conventional natural gas, unless stated otherwise. For a detailed description on unconventional gas and what the actual difference to conventional gas is, see the corresponding chapter: The advent of Unconventional Gas.

M. Kuhn, *Enabling the Iranian Gas Export Options,*
DOI 10.1007/978-3-658-00093-6_2,

additional resources." He further states that all major industrial revolutions are connected with significant changes in energy sources and information technologies. Beginning with the discovery of fire, the advent of agriculture and animal farming, and, ultimately, the development of hydrocarbon and nuclear fuels.[94]

Cleveland shows that access to affordable, reliable, and environmentally friendly energy sources is fundamental to human activities, development, and economic growth. Oil has provided such an energy source since the beginning of the century. But, as the oil markets continue to tighten and climate change forces the world to reduce carbon emissions, a switch to cleaner fuels, such as natural gas and other renewables, is taking place. Since the late 1980s the use of natural gas has constantly increased for heat, power generation, and by-products production.

In human history, the use of natural gas is nothing new; in fact, the use of natural gas dates back to 500 BC, as the Chinese are believed to have used natural gas for salt water desalination. In the seventeenth century natural gas seepages were discovered in the United States and the first gas well is believed to have been ploughed in 1821.[95] But despite the long known existence of natural gas, it has been a neglected fuel from a global perspective. As Wietfield rightly points out, "some years ago, when oil companies drilled for oil and found natural gas their effort was seen as a failure. With no market outlets available to the gas resources the gas had to be re-injected, flared or left for another day."[96] Especially in the 1980s discovery of natural gas was regarded as bad news to companies and it was seen as more of a problem than a blessing. This did not change until the 1990s when the policies toward natural gas as a `premium fuel´ reserved for `special´ use changed, and gas markets started to look more attractive as the emergence of new CCGT[97] power plants the legal restrictions on gas use in power generation was dropped.[98] While natural gas has been a rather neglected fuel from a global perspective, it is starting to gain momentum as it is increasingly seen as a viable source

94 Cleveland, Cutler J. (2004), Encyclopedia of Energy. In: Encyclopedia of Energy, edited by Robert Ayres, et al. Boston Elsevier Academic Press p. 1.

95 Bhattacharyya (2011), Energy Economics : Concepts, Issues, Markets, and Governance, p. 353.

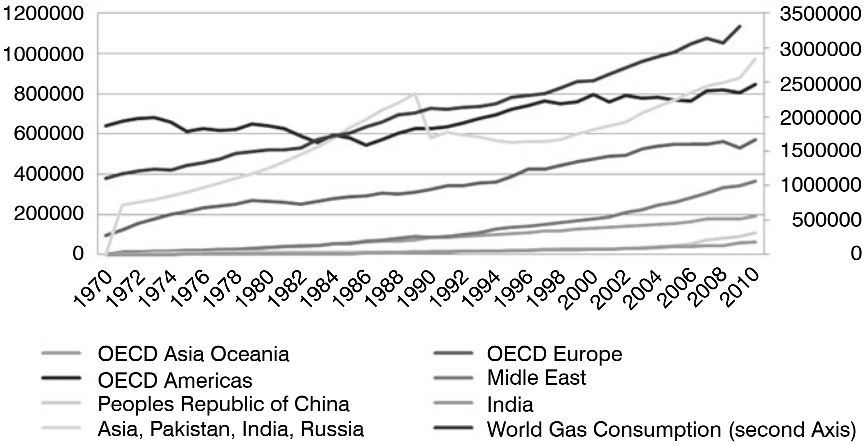
96 Wietfeld, Alex M. (2011), "Understanding Middle East Gas Exporting Behaviour."Review of The Energy Journal no. 32 (2): p. 204.

97 CCGT plants have various benefits: low capital intensity against other power plants, a high energy efficiency, are environmentally friendly and have short lead times. They can be placed close to demand centers due to their low environmental impact and the fact that they can vary between small and large scale. For investors one of the benefits is the quick payback.

98 Stevens, Paul (2010a), "The Histroy of Gas."Review of POLINARES (Working paper 5): p. 7.

of energy due to improvements in technology, a changed regulatory framework, and the fact that gas is seen as the environmentally friendliest fossil fuel.[99] With increasing environmental concerns since the late 1980s/ early 1990s, and the beginning restructuring of the natural gas market in Europe, which started in 1986 with the privatization of British Gas, natural gas has gained momentum. Figure 3-1 shows this historical development of the worldwide and regional gas consumption (in Mcm) especially during the 1980s and 1990s.

Figure 2-1: Worldwide and regional gas consumption (Mcm)



Source: IEA Natural Gas Information Statistics, DOI: 10.1787/naturgas-data-en

Before delving further into the recent historic development of the gas market, a brief aside on natural gas in the context of the dynamics of energy systems, as well as its characteristics and benefits is in order.

99 Although a study by the National Center for Atmospheric Research says that switching from coal to cleaner natural gas will not significantly slow climate change. While natural gas emits less carbon dioxide than coal, coal also releases large amounts of sulfates that help cool the planet by blocking incoming light. (UPI – Natural Gas and Power News Sept 9, 2011)

2.2 The Triple A' Argument for Natural Gas

In their study on "the Dynamics of Energy Systems" Cesare Marchetti and Nebojsa Nakicenovic developed a mathematical model for the long-term pattern of energy change in industrial economies.[100] As Montgomery writes: "The Machetti-Nakicenovic theory showed each energy source rising, peaking, and then falling as a series of partly overlapping, symmetrical curves, one replacing another, like waves smoothly running upon a shore – oil ascending as coal declines, then cresting and collapsing as it is replaced by natural gas, which then gives way to some future source (solar energy and fusion were mentioned)." [101] Robert A. Hefner III further adapted this model in the 1990s but saw it as a "progression from solids (wood and coal), to liquids (mainly oil), and finally to gases (natural gas and hydrogen), a progression that would lead to […] an 'age of energy gases'". [102]

As Robert A. Hefner, rightly states, natural gas should not be seen in the "long-held concept of 'oil and gas' where 'gas' comes second, as a little valued by-product of oil".[103] In fact, as Hefner also argues, natural gas is a better fuel for a number of reasons:

Firstly, natural gas (or sometimes also called Natgas) is chemically simple, with four hydrogen atoms and only one carbon in contrary to oil which is chemically complex and contains much more dirty carbon.

Secondly, due to its chemical status gas is lighter than air, and its leaking from the Earth's crust does apparently not have such a negative effect on the environment as oil. Thirdly, also attributed to its chemical status, natgas is compressible, unlike oil. [104] Putting forward a triple A' argument for natural gas, as it is:

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100 See Montgomery, Scott L. (2010), The Powers That Be : Global Energy for the Twenty-First Century and Beyond. Chicago; London: University of Chicago Press. pp. 23-24. And Marchetti, C., Nebojsa Nakicenovic et al. (1980), The Dynamics of Energy Systems and the Logistic Substitution Model. Laxenburg, Austria: International Institute for Applied Systems Analysis

101 Montgomery (2010), The Powers That Be : Global Energy for the Twenty-First Century and Beyond, p. 24.

102 Montgomery (2010), The Powers That Be : Global Energy for the Twenty-First Century and Beyond, p. 24. and For further reading on the future potential of natural see Robert A. Hefner III, "The Age of Energy Gases: The Importance of Natural Gas in Energy Policy," speech and paper by Robert A. Hefner III at the Aspen Institute's Aspen Strategy Group's conference "
The Global Politics of Energy," Aspen, Colorado, August 2007. Available at:
http://www.ghkco.com/downloads/ASG-ImportanceofNaturalGasinEnergyPolicy08.07.doc
And Hefner, Robert A. (2007), The Age of Energy Gases. The Importance of Natural Gas in Energy Policy. Oklahoma City: The GHK Company

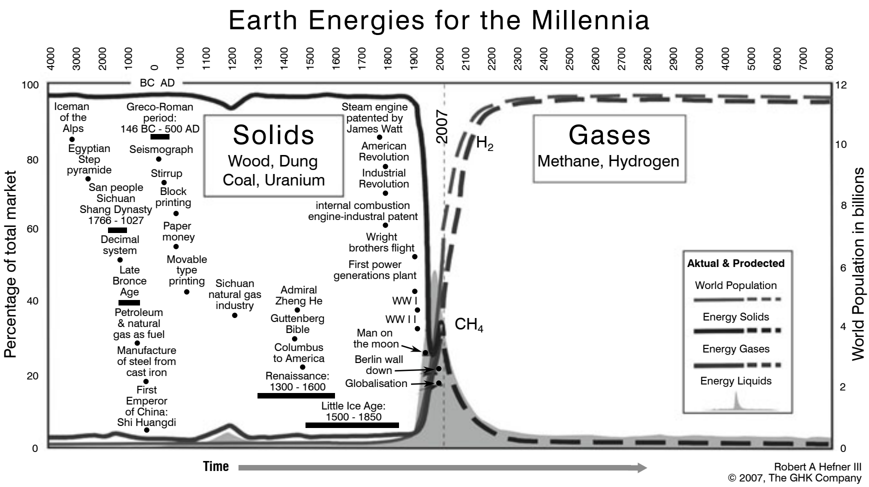
103 Hefner (2007), The Age of Energy Gases.

104 Hefner (2007), The Age of Energy Gases, pp. 4-5.

- Acceptable,
- Abundant, and
- Affordable.

Acceptable, due to its lower emissions and because it burns cleaner than coal or oil. Abundant, as natural gas resources can be "produced from all the volumes of rocks that contain oil, as well as vast volumes of rocks, particularly tight sandstones, shales and coals that contain no oil, the global volumes of sediments capable of producing natgas commercially are at least twice and probably closer to several times the volumes of rocks capable of oil production." [105] The rise of commercial gas reserves, by almost 30 percent over the last decade, has to some extent proven this assumption. However in general this is owed to the fact that oil companies have begun to search, explore, and produce gas in its own right and due to technological advances in developing and transporting natural gas.

Figure 2-2: Earth Energies for the Millennia



Source: Robert A.Hefner III (2007), The Age of Energy gases. Page 12-13.

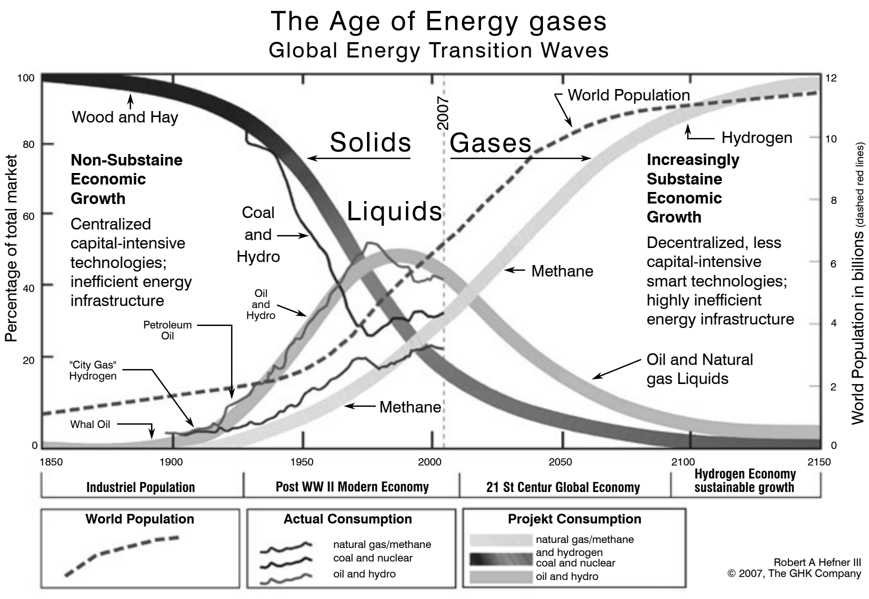
Consequently, with fewer constraints on the supply side and rapidly falling costs of production, as seen in the US "shale gale," natural gas is becoming one of the

105 Hefner (2007), The Age of Energy Gases. pp. 4-5

most affordable fuels. Moreover, natural gas will become more relevant for the renewable energy industry as "Green Gas" or so called SNG (Synthetic or Substitute Natural Gas), as it can provide storage for and also transport energy by using already existing infrastructure. Natural gas will provide a balancing option for renewable energy and the possibility to store and save electricity through conversion into gas. Thus, gas will not only be a bridge to a sustainable future energy mix, but also remain a systematic component in the provision of energy security.[106]

The way Hefner sees the development of the energy cycles in the context of human development can be best described by the next figures. First Figure 2-2: Earth Energies for the Millennia shows the long-run historic development and outlook of the use of energies in the development of society. And Figure 2-3: The Age of Energy Gases illustrates, Hefner presents by taking into account Marchetti and Nakicenovic work, how the waves of energy transition took place over

Figure 2-3: The Age of Energy Gases



Source: Robert A.Hefner III (2007), The Age of Energy gases. Page 12-13.

106 For further information see: Anonymous (1973), "Papers on Substitute Natural Gasfrom ➡

time and how "over time we have been de-carbonizing or we might say we have been "hydrogenising" our energy consumption."[107]

2.3 Natural Gas Primer - Why look at Natural Gas?

The fundamental climate, economic, and political challenges global economies are facing in the 21st century will increase global energy demand, with fossil fuels set to maintain their dominance for the next decades, unless a wild card appears, such as nuclear fusion. The general trend of rising energy demand is mainly driven by the need for transportation fuels, heating sources, and fuels for power generation. Factors influencing this energy demand and natural gas demand in particular, are: economic growth, fuel and carbon prices, and fuel switching.

In the case of natural gas demand, power generation seems to be the main driver in growth. Gas for power generation is favored as the capital cost for building a power plant is lower than for coal or nuclear plants. The following figure Table 2-1 gives an overview of the Production cost of Electricity, indicating a competitive advantage for gas.

In addition to the cost advantage for gas as gas increasingly competes against coal at the margin for power generation, while renewables eat into the share of combustible fuels.[108] But with ample resources available, the general acceptance of natural gas as a cleaner fuel and the affordability of gas make natural gas the fuel of choice. Therefore natural gas as such plays and will play a fundamental role for decades to come as a transition fuel to a renewable energy mix.

106 Hydro- carbon Liquids." Chicago, 1973 1973; Anonymous (Synthetic Natural Gas (Sng) from Coal and Biomass: A Survey of Existing Process Technologies, Open Issues and Perspectives," IN-TECH Open Access Publisher, http://www.intechopen.com/articles/show/title/synthetic-natural-gas-sng-from-coal-and-biomass-a-survey-of-existing-process-technoligies-open-issue; United States. Dept. of, Energy, Laboratory National Energy Technology et al. (2009), "Production of Substitute Natural Gas from Coal," United States. Dept. of Energy ; distributed by the Office of Scientific and Technical Information, U.S. Dept. of Energy, http://www.osti.gov/servlets/purl/993826-aTrqoP/; American Gas Association, Planning and Group Analysis (1978), Sng Fact Book. Arlington, Va.: American Gas Association; Boerrigter, H. and R. W. R. Zwart (2004), High Effiency Co-Production of Fischer-Tropsch (Ft) Transportation Fuels and Substitute Natural Gas (Sng) from Biomass. Petten: Netherlands Energy Research Foundation

107 Hefner (2007), The Age of Energy Gases, pp. 12-13.

108 OECD Natural Gas Information 2011. OECD Publishing. p. 35.

Table 2-1: Comparison of Production cost of Electricity

Energy source	Power generation technology		Production Cost of Electricity (COE) State-of-the-art 2007	Projection for 2020	Projection for 2030
			€2005/MWh	€2005/MWh	€2005/MWh
Natural gas	Open Cycle Gas Turbine (GT)	—	80 ÷ 90 (b)	145 ÷ 155 (b)	160 ÷ 165 (b)
	Combined Cycle Gas Turbine (CCGT)	—	60 ÷ 70	105 ÷ 115	115 ÷ 125
		CCS	n/a	130 ÷ 140	140 ÷ 150
Oil	Internal Combustion Diesel Engine	—	125 ÷ 145 (b)	200 ÷ 220 (b)	**230 ÷ 250 (b)**
	Combined Cycle Oil-fired Turbine (CC)	—	115 ÷ 125 (b)	175 ÷ 185 (b)	200 ÷ 205 (b)
Coal	Pulverised Coal Combustion (PCC)	—	40 ÷ 55	80 ÷ 95	85 ÷ 100
		CCS	n/a	100 ÷ 125	**100 ÷ 120**
	Circulating Fluidised Bed Combustion (CFBC)	—	50 ÷ 60	95 ÷ 105	95 ÷ 105
	Integrated Gasification Combined Cycle (IGCC)	—	50 ÷ 60	85 ÷ 95	85 ÷ 95
		CCS	n/a	95 ÷ 110	90 ÷ 105
Nuclear	Nuclear fission	—	55 ÷ 90	55 ÷ 90	55 ÷ 85
Biomass	Solid biomass	—	80 ÷ 195	90 ÷ 215	**95 ÷ 220**
	Biogas	—	55 ÷ 215	50 ÷ 200	50 ÷ 190
Wind	On-shore farm	—	75 ÷ 110	55 ÷ 90	**50 ÷ 85**
	Off-shore farm	—	85 ÷ 140	65 ÷ 115	50 ÷ 95
Hydro	Large	—	35 ÷ 145	30 ÷ 140	30 ÷ 130
	Small	—	60 ÷ 185	55 ÷ 160	50 ÷ 145
Solar	Photovoltaic	—	520 ÷ 880	270 ÷ 460	170 ÷ 300
	Concentrating Solar Power (CSP)	—	170 ÷ 250 (d)	130 ÷ 180 (d)	120 ÷ 160 (d)

Source: Presentation given by Dr. Stefan Tostmann, DG Energy, European Commission; at the EUCERS Conference on "Future of Renewables in Britain and Europe"; London 17. November 2011. Based on 2008 Strategic Energy Review (high oil and gas prices' (barrel of oil 54.5$ in 2007, 100$ in 2020 and 119$ in 2030 in 2005 prices)

2.3.1.1 But what is Natural Gas? Fundamentals of the Gas Market

In general, the term natural gas applies to a mixture of combustible hydrocarbon gases that are produced from either natural gas wells or oil wells as associated gas. When being produced from a reservoir, conventional or unconventional, natural gas consists of its chief component methane (CH4), but also of ethane, propane, butane, carbon dioxide (CO2), hydrogen sulfide (H2S), water vapor (H2O), and other compounds. When natural gas contains heavier hydrocarbons like butane, propane, and ethane – so called natural gas liquids (NGLs) [109] – it is referred to as `wet gas´; if the share of methane is significant (80 percent-95 percent) it is called `dry gas´. [110]

To market natural gas for delivery it has to go through various processing steps from the well head to its final use in the residential, commercial, and industrial sector. In this process, non-commercial gases, such as carbon dioxide and hydrogen sulfide, and other impurities are re-moved to purify the methane; in addition, water is removed during the treatment process in a gas treatment plant (GTP) to prevent damage and corrosion in tanks and pipelines. Natural gas liquids may be removed during the `stripping or extraction´ process and may be used as feedstock for petrochemical manufacturing or liquefied and used by consumers.

Natural gas is the world´s third largest source of primary energy, with reserves more geographically dispersed in the case of gas than oil. Many of the world´s top consumers hold significant domestic reserves – especially when taking unconventional gas like shale gas, coal bed methane (CBM), tight gas, and others into account; hence, considerable amounts of natural gas are globally available.

According to the 2010 BP Statistical Review, the confirmed global natural gas reserves are estimated at 1.1 tln/boe.[111] This, according to Herrmann et al., puts gas reserves at only 10 percent below the estimates for oil (or 20 percent inclusive of the oil sands). This near-parity between oil and gas reserves is a relatively new perspective. The rise of commercial gas reserves is owed to the increasing focus

109 NGLs – for further reading see: Herrmann, Lucas, Elaine Dunphy et al. (2010a), Oil & Gas for Beginners A guide to the oil & gas industry. London: Deutsche Bank Research; United States. Energy Information, Administration (1977), "Natural Gas Liquids."Review of Natural gas liquids; Prehoda, Ronald, Leonard T. Fanelli et al. (1976), Natural Gas Liquids. [Washington]: U.S. Dept. of the Interior, Bureau of Mines; Heath, Michelle and Institute Canadian Energy Research (1995), Natural Gas Liquids : Market Outlook. Calgary: Canadian Energy Research Institute

110 Herrmann, Lucas, Elaine Dunphy et al. (2010b), Oil & Gas for Beginners - a Guide to the Oil & Gas Industry. Global Markets Research. London: Deutsche Bank (DB). pp. 225 ff.

111 B.P. p.l.c (2011). Bp Statistical Review of World Energy. London: BP.

on exploring and developing gas reserves for their own sake. With the increased focus on gas reserves from IEFs, natural gas demand has not kept pace with discoveries in recent years. Consequently, according to Herrmann et al., the reserves-to-production ratio for natural is over 60 years, compared to 43 years (inc. Canadian oil sands and based on 2009 production levels) for oil. [112]

As argued earlier, besides basic challenges at the wellhead and in pre-transportation, gas differs significantly from oil. Gas is a more complex fuel because of its chemical status (as a gas), and thus, compared to oil, storage and transportation are more difficult to handle. The specific physical properties of oil (in its liquid form), and the fact that it can be stored in simple tanks and then relatively easily loaded onto ships for transportation, led to the emergence of a commodity market for oil along with a distinct pricing mechanism.[113] Finally, the lower energy content per unit and the asset specificity makes the exploration and production of natural gas different from oil.

2.3.1.2 Pipeline vs. LNG transport cost comparison for Iran

As Kim Talus writes: ”The lower energy content per unit, dependency on local infrastructure, asset specificity, capital expenditure and the need to secure a market at the early stage of a project makes the exploration and production projects for natural gas different from oil.” [114] This is the so-called `tyranny of distance´, meaning that natural gas is a high volume low value commodity, which makes transportation relatively expensive, thus the netback (i.e. the rent) is considerably lower. [115] Consequently, the dependency on expensive infrastructure (mainly pipelines) makes gas a less flexible commodity in terms of transport and trade and, in addition, sets the stage for distinct regional markets, rather than a truly global gas market.

Under economically ideal circumstances, only economic returns would have determined the long-distance transportation mode for gas (by either pipeline or

112 Herrmann, Dunphy et al. (2010b), Oil & Gas for Beginners - a Guide to the Oil & Gas Industry. London: Deutsche Bank (DB). p. 133.

113 Compared to natural gas the transportation and handling of oil is in general cheaper by tankers rather than through pipelines. For gas the opposite applies.

114 Talus, Kim (2010), Aipn Research Paper: Long-Term Natural Gas Contracts and Antitrust Law in the European Union and the United States. AIPN RESEARCH PAPER: AIPN p. 1. And see further: C. Duval, H. Le Leuch, A. Pertuzio, J. Lang Weaver, International Petroleum Exploration and Exploitation Agreements: Legal, Economic and Policy Aspects (Barrows 2009), p. 181-200.

115 Stevens (2010a), "The Histroy of Gas," p. 1.

http://www.springer.com/978-3-658-00092-9

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