



consumers do not have any tendency toward continuation of past trend. because of NG easy accesses, cleanness and high efficiency. High price of electricity and technological limitation of using electricity prevent their tendency to increase its consumption share at least in short and medium terms. Therefore energy competition and NG competition is out of question in residential sector but what influences NG consumption trend is initial capital cost and other fees that must be paid by new NG consumers (especially low - income and vulnerable families).

NG consumption advantages (compared with NG competing fuel basket) are too much in commercial and industry sectors therefore their willingness to pay is well. Commercial and industry sectors have paid 66% and 95% per NG unit thermal equivalent more than NG competing fuels respectively in 1998. For the time being, there is high NG potential demand in these sectors. Therefore it is logical that their willingness to pay for NG shall be higher than now in future.

In view of what was said above, conduction of NG consumption to sectors, which have higher willingness to pay than the others, shall have more economic and social benefits and shall be a first step towards optimizing of NG consumption.

Optimization of NG consumption within the framework of industry sector (NG industrial consumer basket) is the next step. Different industrial units are producing different commodity and services, thus they have various willingness to pay for energy (e.g. Natural gas) and each of them influence economy in a different manner. Therefore classification of industrial units on the basis of economic efficiency and their effects on national economy (industries that are producing internally used, exportable and import substitute goods) can help us to provide a more efficient pricing system in industry sector. In this way not only we accept more benefits, but also we can prevent indirect export of natural gas or other kinds of energies.

With taking into consideration of

conventional technologies used in power plant sector, competition of NG (the same of industry sector) with the other competing fuels is very important.

Our studies show that NG price in power plants has been lower than industry, in spite of similarity of their NG supply cost. It caused that NG relative price has been so much diminishing trend in this sector, as it is reduced to 40% in 1998.

Apart from natural gas advantages, in the basis of economic criterions, each consumer of each energy carrier (e.g. Natural gas) has at least willingness to pay as much as competing fuels basket price, therefore this important economic principle should not be forgotten in a predefined and controlled pricing policy.

Comparing studies of gas supply to industry and power plant sectors raises some questions as follows:

How can we change natural gas allocation (between two major consumers, industry & power plant), In order to maximize economic and social benefits? What happens if we increase NG share in industry's energy consumption basket at the expense of reduction of it in power plant sector?

Don't we help continue low efficiency of power plants by supplying them with cheaper energy in long term? Regarding new trend of privatisation of some industries (energy industry or others) whether the continuation of this trend would not make Industry too vulnerable and revolution of this trend would not put our economy in a very weak position.

References:

- Energy statistical bulletin - Ministry of energy - 1997
- Demographic census bulletin - statistic center of Iran - 1996
- BP Amoco statistical review of world energy, 1999

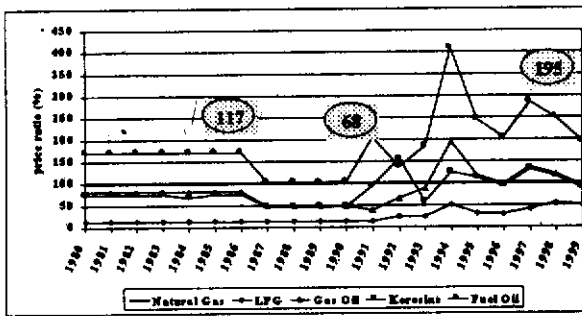


Fig 13 : Natural Gas Relative Price in Industry Sector

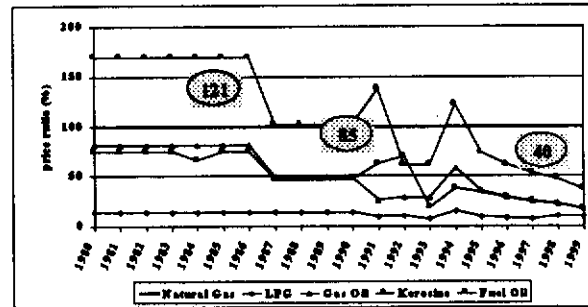


Fig 14 : Natural Gas Relative Price in Power Plant Sector

more than other sectors, since NG price in 1998 increased more than the competing fuels prices, then NG relative price increased to 195% (Fig.13).

At the higher NG relative price it may seem that NG cannot compete with the other fuels in industry, but there are some other reasons that make its usage prosperous for industrial consumer: working capital is reduced as there is no need for storage, NG is burned in equipment with higher efficiency than liquid fuels, NG is a cleaner fuel and there is no need for expensive anti-pollution equipment.

NG supply cost in industry sector is much lower than the residential and commercial sectors, because of high consumption and therefore *economies of scale*.

In 1994, the gap between NG price and its cost has been lowest in industry sector (first scenario), although its cost has been higher than the price. In others scenarios economic benefits of NG substitution has been considerable (Fig.10).

Comparative studies of NG relative cost and price show that there is a much *willingness to pay* for the natural gas. In 1994, NG relative price was 315% whereas its relative cost in the first, second & third scenarios were 229%, 72.6% and 82.4% respectively (Fig11).

NG competitor fuels consist of gas oil & fuel oil in *power plant sector*. At the end of 1998, 31 power plants consumed natural gas (24 power plants

Econometric Studies show there is not any relationship between NG price & other fuels prices in Iran

in south, 6 in northwest and one of them in southeast) Neka power plant was the main user of NG in 1998.

The share of NG consumption has always been more than 30% of total supplied gas in power plants. This sector consumed almost 40% of total supplied NG in 1998. Average efficiency of power plants has been 34%.

Power plant's energy pricing policy was the same as the other productive sectors (commercial & industry)- ie. Inexpensive and constancy of energy prices. Although NG competing fuels basket changed the same as productive sectors in 1990s, but changing of NG price was much lower than it in power plant sector. The reasons of this policy are as follows:

- Governmental administrating of power plants
- Reduction of consumer's electricity expenditure, because of prevention of cost-oriented inflation in different economic sectors and also reduction of social welfare in non-economic sectors.

In the mid.1980s, NG relative price has been more than 100% (121%) but at the end of this decade, it reduced to

85%. In 1990s, the price of NG competing fuels basket grew more than the NG price; therefore, NG relative price reduces to 40% in 1998 (Fig.14).

In spite of similarity of NG supply cost between power plant and industry, NG price in power plants has been lower than industry. Therefore in 1994, the gap between NG price and its cost in power plants has been more than industry sector (first scenario) - (Fig.10). With taking into consideration of intrinsic values of fuels, economic benefits of NG substitution were lower than industry, because of structure of NG competing fuels basket (the share of fuel oil in this sector has usually been more than industry's one).

In 1994, comparison of NG relative price and its cost showed that in the first scenario NG relative cost was much higher than NG relative price in power plants (it was vice versa in industry sector) - (Fig11). NG relative price was 103% in 1994 whereas NG relative cost in the first, second and third defined scenarios were 229.4%, 75.7% and 86.8% respectively.

Conclusions

NG has no competitor in residential sector at present, because of the general condition of supplying NG competing fuels, quality of substituting energy, structure of NG competing fuels and conventional technologies (especially for households consuming kerosene).

Concerning NG competing fuels

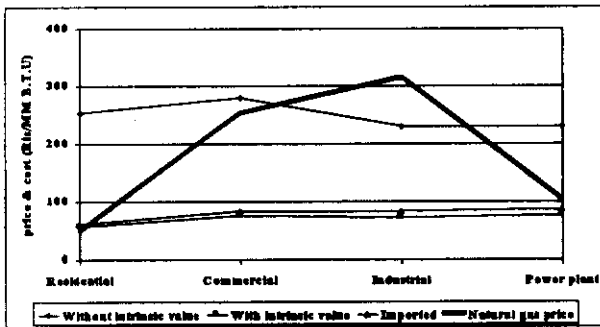


Fig.11 : Natural Gas Relative Price Vs Relative Cost by Sector (Mid. 1990s)

Trend coefficient, $B_{NG, F}$, refers to the linear regression, and indicates the whole trend of price ratios for the whole period of interest. $B_{NG, F}$ is not statistically significant in these sectors, because of some reasons such as: prices constancy, jumpy and irregular changes in some periods and continuation of said conditions with an annually constant and predefined growth. NG relative cost has estimated by following scenarios:

- 1/ without taking into account intrinsic values of fuels
- 2/ with taking into account intrinsic values of fuels
- 3/ importing fuels

NG competing fuels basket in residential sector consists of valuable carriers (e.g. kerosene, gas oil and LPG) which producing or importing of them would impose much cost on the whole economy. Therefore with taking into account intrinsic value and importing fuels, NG supply cost is lower than of NG competing fuels (Fig.10). Thus in the second and third scenarios, NG relative costs (1994) were 56% and 60% respectively, but these were higher than the NG relative price - 50.2% (Fig.11).

Without taking into account intrinsic value (first scenario) NG supply cost was much higher than the competing fuels cost, and NG relative cost would be 253% versus 50.2% NG Relative price (Fig.11).

NG competing fuels basket consists

Constancy of all Nominal Energy Prices and High Energy Subsidies are Important Characters of Energy Policy in Iran In 1980s

of kerosene, gas oil, fuel oil and LPG in commercial sector. In 1998, the number of commercial units consuming NG was about 130000. In 1980s inexpensive energy and constancy of energy prices were important energy policy characteristics in commercial sector. In that decade, average price of NG competing fuels basket was lower than the energy content of the natural gas, as NG relative price has always been more than 100%. It's been 293% in 1985 and 176% in 1990. At 1990s, NG price growth has been lower than the NG competing fuels price growth, therefore NG relative price reduced to 166% in 1998(Fig.12).

Econometric studies have done during two recent decades show no significant relationship between price of NG and the other energy carriers consumed in this sector as the others sectors.

Economic studies of substitution of NG with other energy carriers show that in the first scenario, NG supply cost was more than the cost of NG competing fuels basket cost (in 1994) but in the

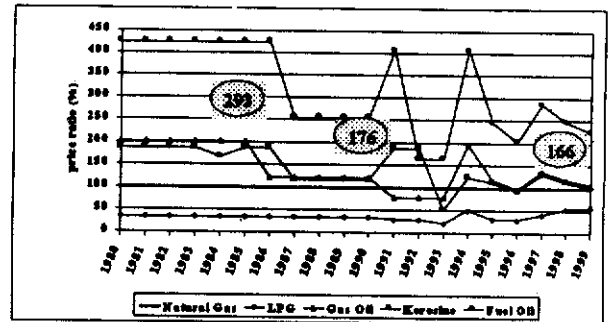


Fig.12 : Natural Gas Relative Price in Commercial Sector

second and third scenarios were vice versa. Economic benefits of NG substitution in commercial sector have been much lower than the residential sector, due to structure of NG competing fuels basket (Fig.10). In 1994, NG relative price was 253% whereas NG relative cost in the first, second and third scenarios were 288%, 75% and 85% respectively (Fig.11).

NG competing fuels basket consists of kerosene, LPG, gas oil, fuel oil in industry sector. Fuel oil & gas oil is dominant energy in this basket (more than 90%, according to thermal equivalent). There were 1840 NG Industrial consumers at the end of 1998 and this sector consumed 27% of total NG consumption in Iran.

Energy pricing in industry sector is very important because of its influence on economy and also on energy competition ability and efficiency. In industry sector, substitution of energies with others is done easily. Therefore ability to pay and willingness to pay are very important factors in selecting different kinds of energies.

In 1980s, the price of NG competing fuels basket was the same as commercial sector but its NG price was almost half of that. Fuel Oil was the most inexpensive energy in this sector in Mid.1980s but later on NG was also added. Therefore NG relative price in Mid.1980s was 117% and reduced to 68% at the end of this decade (Fig.13).

At 1990s, industrial NG price grew

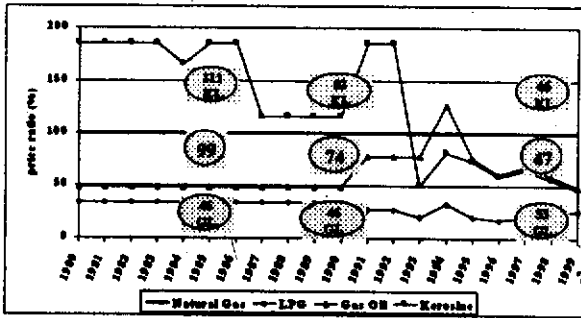


Fig.9 : Natural Gas Relative Price in Residential Sector

pricing (lower bound); but non of them are applied in Iran.

Energy pricing policy has been determined by the government up to now. The government provide the energy price vector by considering the social / welfare factors and supporting the low - income families. Discrimination price policy of energy carriers is influenced by economic, political and social factors. Comparative studies of conventional energy prices show the preference of social / welfare and political factors to economic factors.

One of the important characters of energy policy was constancy of all nominal energy prices in 1980s. The main reason of this policy refers to reduction of social pressures. This trend continued till the beginning of 1990s. It is worth to note that paying high rate energy subsidies has been unavoidable too. All energy carrier prices were changed at the beginning of the 1990s, but not continuously and regularly. At the end year of the first five-year plan (1994) and the first year of second five year plan, energy prices were changed with a jump in early stage (some energy carriers prices jumped more than 100%) and then continued upward steadily.

According to the second five year economic / social plan energy, energy carrier prices must increase at least 20% annually (from 1995 till end of plan in 1999).

Natural gas has mainly penetrated to energy basket of residential, commercial,

Discrimination Pricing Policy of Energy in Iran Influenced by Economic, Political and Social Factors

industry and power plant sectors (its share in the other sectors, such as agriculture, transportation and, ... is very low) and four conventional energy carriers - kerosene, gas Oil, LPG and fuel oil - are substituted by it.

The objective of this paper is examining the natural gas competition ability, from the viewpoint of economic & social welfare. This paper uses the methodological approach of comparative analysis to examine NG pricing policies for each sector. Ratio of NG price (cost) to price of its competing fuels basket (NG relative price or cost) shall be the best criterion for examination of NG competition ability in each sector. These are examined as follow:

$$RP_t^{NG, F} = P_t^{NG} / \sum P_t^F$$

$$RC_t^{NG, F} = C_t^{NG} / \sum C_t^F$$

Where $RP_t^{NG, F}$ ($RC_t^{NG, F}$) is the ratio of NG price (cost) relative to its competing fuels basket in year t, P_t^{NG} (C_t^{NG}) is the NG price (cost) in year t, P_t^F (C_t^F) is the price (cost) of NG competing fuels basket in year t, F is the number of NG competing fuels in

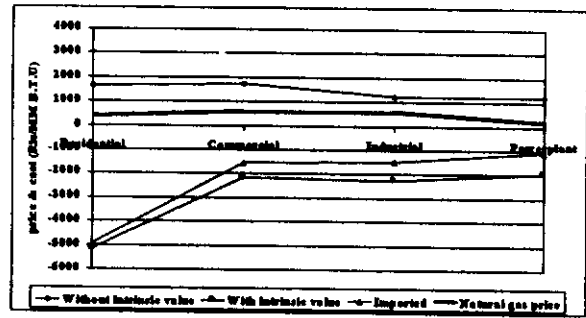


Fig.10 : Net Value of Substituted Oil Product Vs Gas Price by Sector (Mid. 1990s)

energy basket of each sector.

Evolution of NG Relative Price by Sector

Kerosene, gas oil and LPG are NG competing fuels in residential sector in Iran. In 1996, almost 67% of all households consumed this energy basket, 5.5% of them consumed gas oil & LPG (GL) and 94.5% of them consumed kerosene & LPG (KL).

NG relative price was 99% in mid.1980s, with attention the share of kerosene in this basket, its clearly shows that the kerosene consumers has lost part of their surplus, because their relative price of NG has been more than 100%(110.8%), versus, the gas oil consumers has gained more surplus, because their relative price of NG has been much lower than 99% (42.1%).

The NG relative price reduced to 74% at the beginning of 1990s (81.5% for kerosene consumers and 45.7% for gas oil consumers) and then dropped to 47% in 1998 (46.1% for kerosene consumers and 53.1% for gas oil consumers)-Fig.9. This trend increases the consumer's surplus of this sector (especially for kerosene consumers, kerosene is a *social product* because of it's most use by low - incom families).

Econometric studies show there are not any significant relationship between NG price and the other consumed energy carrier prices in this sector during two recend decades.

$$RP_t^{NG, F} = A_{NG, F} + B_{NG, F} \cdot T$$

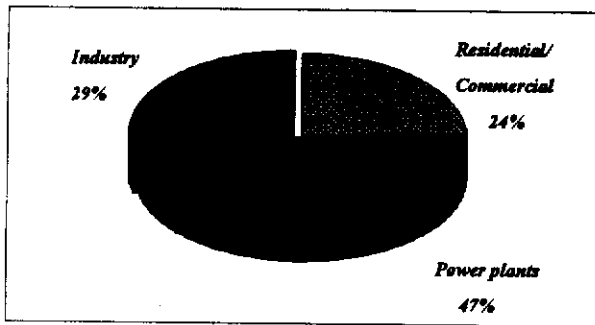


Fig.3 : Structure Of Natural Gas Consumption in Iran (1990)

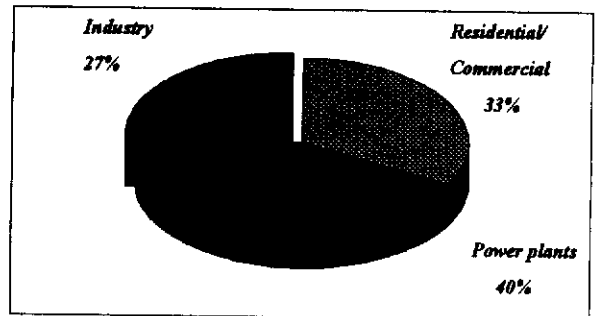


Fig.4 : Structure Of Natural Gas Consumption in Iran (1998)

period.

Considering of natural gas consumption basket in 1990, shows that 47% of supplied gas is consumed by power plant sector and the industry & residential/Commercial sectors consumed 29% and 24% respectively (fig.3).

In 1998, power plant sector was the main user of natural gas (40% share). Share of NG in residential & commercial sectors increased rapidly to 33% but consumption of NG in industry has not grown as speed as the other sectors, therefore it's NG share decreased to 27%(Fig.4).

In 1986, only 6% of total Iranian households consumed natural gas in which, 95% were urban and 5% were rural households (Fig.5&6). Due to increased penetration of NG in residential sector in 1986-98, share of NG consumer households increased to 40%, that is 99% were urban and only one percent were rural households (Fig.7&8).

Natural Gas Pricing Policy and Methodological Approach

The major factors affecting NG pricing policies are; total unit cost, the price of competing fuels, income and

price elasticities of demand, and input substitution elasticities in production. The prices of competing fuels normally form an upper bound for NG price, whereas total unit cost places a lower bound, NG price is expected to be located somewhere between these two bounds. Therefore NG relative price (NG price to the price of competing fuels basket) may significantly contribute to the establishment of appropriate pricing policies.

Generally, two main NG pricing principles have been applied by some countries are market - oriented pricing (upper bound) and cost - oriented

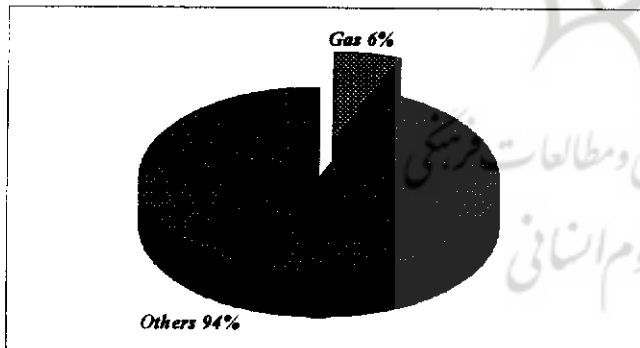


Fig.5 : Household Energy Consumer in Iran (in 1986)

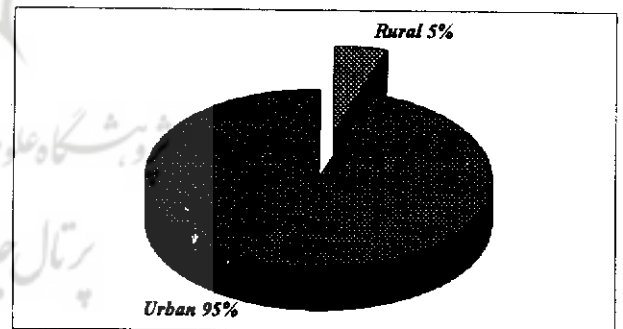


Fig.6 : Household Natural Gas Consumer in Iran (by Urban/rural Residence - in 1986)

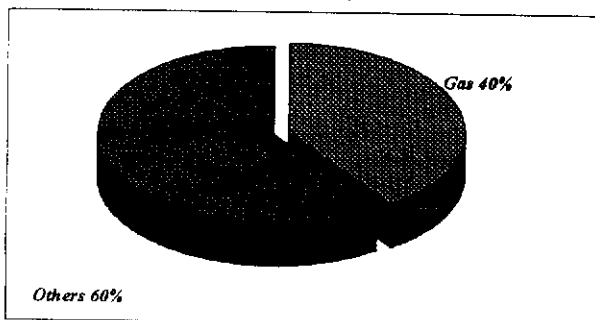


Fig.7 : Household Energy Consumer in Iran (in 1998)

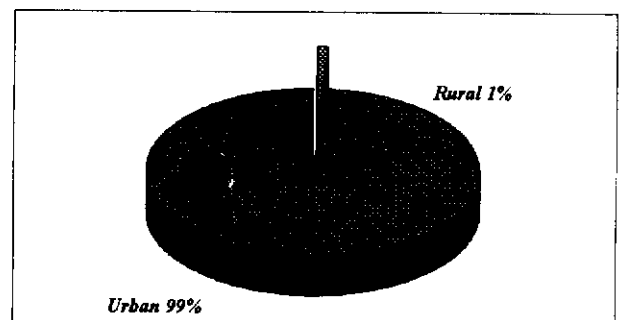
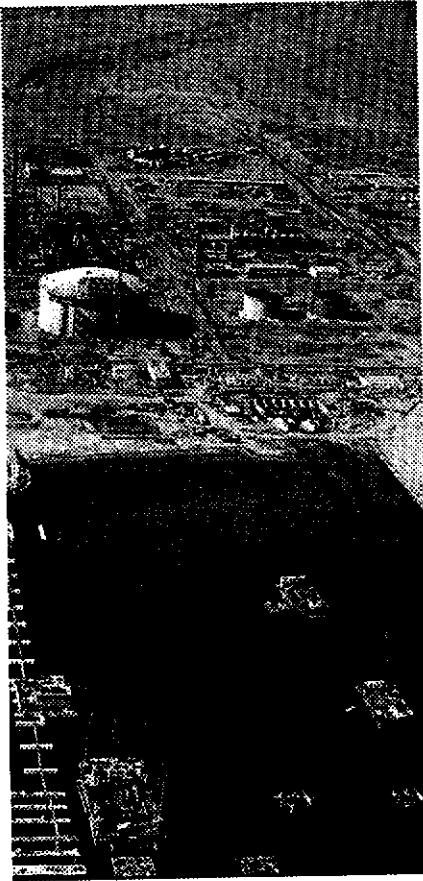


Fig.8 : Household Natural Gas Consumer in Iran (by Urban/rural Residence - in 1998)



Natural Gas Competition Ability

Shahla Khaleghi (MSc.)
Energy Economist, NIGC

23rd Annual IAEE
International Conference
Energy Markets and
the new millennium:
Economic, environment,
security of supply
June 7-10, 2000
Sydney - Austral

In this paper the price of natural gas evolution is examined in all the economic sectors of Iran. The methodological approach based on comparative analysis. Studies show that NG relative price has changed toward supporting of low - income and vulnerable families in residential sector but increased in industry sector, it refers to increase their "willingness to pay" for natural gas. An attempt is undertaken to examine relationship between the price of NG and its competing fuels, but didn't find any significant relationship between them in all the NG consumer sectors.

Iran is one the countries which is richly endowed with hydrocarbon resources. In 1998, 12% of world oil & gas reserves located in Iran, including 9% and 16%

of world Oil & gas reserves respectively. Studying of hydrocarbon reserves basket shows that NG is dominant energy in it. The proven reserves of NG constitute

46% of the energy content of the Iran's hydrocarbon reserves. The share of the other hydrocarbon reserves consists of, crude Oil: 30%, coal: 19%, condensate: 5% (Fig.1).

Gas/Oil ratio of proven reserves (GOR) of Iran has always been greater than that of the world. In 1998, GOR of Iran was 153.5% and GOR of the world was 98.3%, figure 2 illustrates GOR of proven reserves in Iran and in the world.

Relative advantage of hydrocarbon reserves, especially natural gas, in Iran is the important factor in the economic development trend and forming the energy consumption basket. Substitution of natural gas with the other kinds of energy carriers, those that the country economy must pay much cost for them (crude Oil & products), in addition to the self - sufficiency of the country and positive externalities, will cause the convenient social welfare.

In two recent decades, the average of annual growth rate of NG consumption (15.6%) has been more than twice the total energy consumption (7.2%), versus Oil products consumption grew lower than energy consumption (5.2 %).

Penetration of NG in the energy consumption basket has been very fast in this period. Share of NG in energy consumption basket increased from 10% in 1980 to 37% in 1998, on the opposite, share of Oil products decreased from 77% to 55% in this

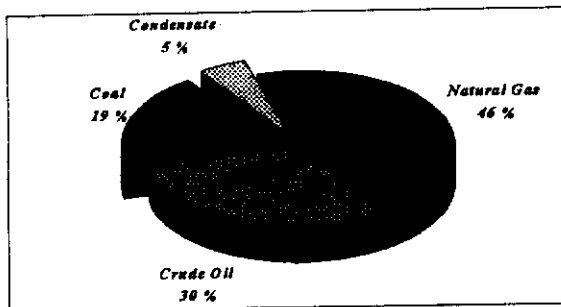


Fig.1: Structure of Hydrocarbon Reserves Basket in Iran (in 1998)

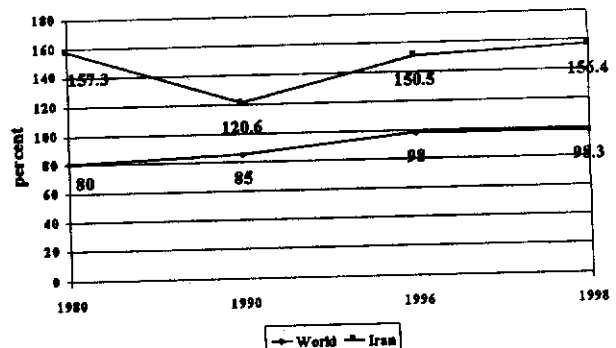


Fig.2 : Gas /Oil Ratio of Proven Reserves