The Crisis of Gasoline Consumption in the Iran's Transportation Sector

S. SATTARI, H. HOURI JAFARI, A. BARATIMALAYERI
Energy Management Department
Institute for International Energy Studies (IIES), subsidiary of Ministry of Oil & Gas
No.14, Sayeh Street, Valiy-e-Asr Street, Tehran
IRAN
http://www.iies.net

Abstract: - Fossil fuels have the greatest share in energy supply of the world demand. Regarding to their limited resources, fuel consumption management and energy planning in the end-user sectors is a great matter of importance. Among the fossil fuels, gasoline is the main fuel for light duty vehicles. In Iran, fuel consumption, especially gasoline, has increased sharply (growth rate of 10.2% for the year 2006 in comparison with year 2005) and has become a big crisis in the recent years. On the other hand, enormous subsidies for importing 40% of domestic demand that have reached to more than 10 billion US$ are not tolerable for the government. In this study, we have assessed the gasoline consumption, production, imports and prices; reviewed main causes of tremendous growth rate of consumption, current conservation policies and their advantages or disadvantages (SWOT analysis) and proposed short to long term solutions and strategies for efficient gasoline consumption management. Finally, current and proposed solutions and strategies have been analyzed and evaluated. The conclusions suggest strongly not only that the low price of motor gasoline, but also mass production of vehicles with conventional technology likewise affect motor gasoline demand. A second conclusion is that gasoline crisis in Iran has no popular solution and fundamental strategies and policies are needed to solve the problem.

Key-Words: - Transportation Sector, Light Duty Vehicle (LDV), Fuel Consumption, Gasoline Crisis

1 Introduction

Assessment of the demand for transportation fuels interests many researchers and policy-makers who are considering various energy plans. Using approach of reviewing historical trends for estimation the demand for gasoline, diesel fuel and jet fuel is convenient and common between researchers.

In Europe, this approach is used to produce estimates of the price and income elasticity of demand for these three fuels for Individual European countries [1]. Also a forecast of transport activity, energy consumption and carbon dioxide emissions from transportation that has been carried out under 'business as usual' economic assumptions, is presented for the 10 countries of Central and Eastern Europe [2]. Another effort focused on fuel economy of passenger cars and light trucks, a long-disputed issue with serious implications for worldwide energy use [3]. In recently cited study the current status in Europe has explained and future developments are analyzed with the aid of historical data of the last three decades for the United States and Europe. The conclusion implied the necessity of autonomous vehicle efficiency improvements and technical progress for conventional and alternative vehicle propulsion technologies.

In America, in 1994, policies have failed to significantly reduce the enormous amount of gasoline consumption. A new multi-pronged approach comprising a gasoline tax, attribute based CAFE standards, and other supplementary initiatives such as alternative fuels and public transit was required. In combination, these policies could achieve a far greater reduction in gasoline consumption than any one could alone [4].

In Japan, a study showed gasoline demand has kept increasing constantly along with the advancement of motorization. Meanwhile, recent progress in the development of low fuel consumption vehicles has led to a gradual diffusion of direct fuel injection engine vehicles, hybrid cars and some other new automobiles that have much higher fuel efficiency than conventional motor vehicles. Japanese automobile manufacturers are likely to exert greater efforts for further development and marketing of these low-fuel-consumer vehicles [5].

In China, along with the rapid economic growth, the Chinese road transportation system is becoming one of the largest and most rapidly growing oil

consumers. A research attempts to present the current status and forecast the future trends of oil demand and CO_2 emissions from the Chinese road transportation sector and to explore possible policy measures to limit the explosive growth of Chinese transportation oil consumption. They conclude that China's road transportation will gradually become the largest oil consumer in the next two decades but improvements in vehicle fuel economy have potentially large oil-saving benefits. In particular, if no control measures are implemented, the annual oil demand by China's road vehicles will reach to a tremendous amount. The analysis suggests that China needs to implement vehicle fuel economy improvement measures immediately in order to limit the dramatic growth in transportation oil consumption [6].

In India, researchers aimed to analyze factors influencing energy consumption, using a computer-based software. The study was restricted to passenger modes of transportation in Delhi and was not include the freight model. The prime objective was to arrive at an optimal transportation policy that limits the future growth of fuel consumption as well as air pollution [7].

In developing countries, some researches concentrated on the transportation sector of six developing countries with similar common denominators, namely Turkey, Thailand, Pakistan, Morocco, Tunisia and Malaysia. The results of this study indicate that the transportation sector will be the driving force for energy and oil demand as part of economic growth in these developing countries. Its share in the future energy market structure is expected to grow. Consequently, the (pricing) policies of oil products in this sector have a crucial role for shaping rational economic and energy strategies within the framework of rising environmental concern [8].

Regarding to the current situation of Iran's LDV fleet of transportation sector, it is essential to run extensive investigation about Iran, similar to cited studies.

M. Aghaii Tabrizi investigated exiting constraints on Iran's gasoline supply and contributing factors, regarding to his so valuable experiences as former managing director of National Iranian Oil Refining and Distribution Company (NIORDC) [9, 10].

Paul Rivlin, examined Iran's energy balance and its vulnerability to international energy sanctions. He believe by subsidizing all energy products, Iran has artificially boosted demand, while U.S. sanctions limit its ability to increase supply. As a result, Iran has become reliant on imports of gasoline and other products [11]. Same analysis has been done by Roger Stern [12]. In these two recently cited studies Iran's sanctions are considered, politically.

A study by Majid Ahmadian estimates a gasoline demand function for Iran, using the structural time series model over the period 1968-2002 and uses it to estimate the change in social welfare for 2003 and 2004 which is caused by higher gasoline prices. It is found that social welfare is estimated to fall because of the higher gasoline price [13].

Unfortunately, there are not enough studies which have considered Iran's gasoline consumption, regarding to the reviewed papers. We attempt to assess Iran's motor gasoline consumption with the aim of its historical trends in last decade and extract the effective causes of tremendous amount of gasoline consumption. Finally, we have proposed fundamental solutions which are compatible with Iran's situation.

The next section of the paper, therefore, outlines the historical review of statistics about motor gasoline. Section 3 introduces the analysis of historical trends to extract contributing factors in high consumption. Current strategies for controlling gasoline crisis are analyzed with SWOT approach in Section 4. Fundamental solutions and strategies of gasoline crisis in Iran are proposed in section 5 and conclusions have presented in Section 6.

2 Historical review of statistics

In this section, the gasoline consumption, production, imports and prices data during last decade is reviewed for Iran. Also stock of vehicles is considered at the end of this section. Presented data are exactly formal published by relevant organizations [15-17]. Data of year 2006 is formally requested from ministries of oil and gas, ministry of energy and ministry of industries and mines. Due to lack of formal statistics for recent months of 2007 year, we avoided using informal or projected data for this short period.

2.1 Gasoline Consumption

Transportation sector is the main consumer of gasoline in Iran. Light duty vehicles (LDVs) fleet in transportation sector constitutes 99% of gasoline consumption. On the other hand, it implies LDV's fleet when we talk about gasoline, about Iran. Other sectors including power plants, public buildings, commercial and agriculture constitute only one percent of motor gasoline consumption.

Since 1982, Iranian gasoline consumption has increased faster than production. This has created disequilibrium in the gasoline market due mainly to

the low price of gasoline which is determined by the government [13].

Table 1 shows gasoline consumption during 1997-2006 in Iran, [17]. Gasoline consumption, with growth of 10.1% (related to year 2004), has reached to 24396 Million Litters in 2005 and with growth of 10.16% (related to year 2005), has reached to 26874 million Litters in 2006 as well. Average daily consumption of gasoline was 66.24 (M litters/day) in 2005 which reached to 73.63 (M litters/day) in 2006, respectively.

Table 1: Gasoline consumption of Iran, 1997-2006 (Thousand Litters/Year)

Year	Transportation		Other Sectors	Total
	Ships	LDVs		
1997	1631	12146246	175314	12323191
1998	2536	13500785	189463	13692784
1999	3710	14036066	181574	14221350
2000	7438	15330648	178836	15516922
2001	18275	16540862	178337	16737474
2002	26300	18239929	174194	18440423
2003	26156	20324287	187073	20537516
2004	29487	21934586	194999	22159072
2005	34463	24179207	182382	24396052
2006	37965	26636071	200914	26874950

2.2 Gasoline Production

In Iran, nine oil refineries produce gasoline. In spite of high and rapid growth rate of gasoline consumption in the last decade (9.07% on average, fig.1), production has not increased proportionally (an average growth rate of 4.6%). Table 2 shows the average daily/annual production of gasoline during 1997-2006, [16]. Average daily gasoline production was 43.5 (M litters/day) in 2006 which is equal to 60% of consumption in this year.

Iran has a combined capacity of 1.64 million bbl/d. Major refineries include: Abadan (400,000-bbl/d capacity); Isfahan (265,000 bbl/d); Bandar Abbas (232,000 bbl/d); Tehran (225,000 bbl/d); Arak (150,000 bbl/d); and Tabriz (112,000 bbl/d).

Iran plans to increase its refining capacity to 2.54 million bbl/d by 2010. One goal of this expansion is to allow Iran's refineries to process a heavier crude slate, while decreasing the fuel oil cut. Currently, Iran's refineries produce around 30 percent heavy fuel oil and just 16 percent gasoline. In addition, diesel sulfur levels are slated for a major reduction from 500 parts per million to 50 ppm by 2010, requiring significant additional hydro treating capacity.

The National Iranian Oil Refining and Distribution Company (NIORDC) plans to begin construction work as early as September 2006 on three units aimed at increasing gasoline production from the refineries [14].

However, regarding to sharp growth rate of consumption, it is hard to be optimistic that Iran releases from gasoline imports even after 2010.

Table 2: Average daily/annual gasoline production in Iran, 1997-2006

Year	(Thousand litters/day)	(Thousand litters/year)
1997	29330	10705450
1998	33215	12123475
1999	36015	13145475
2000	36328	13259720
2001	37127	13551355
2002	38551	14071115
2003	39871	14552915
2004	40157	14657305
2005	42038	15343870
2006	43543	15893122

2.3 Gasoline Imports

As we have mentioned in the previous subsections, because of the rapid growth rate of consumption, a wide gap between production and consumption has been appeared. This gap leads to great growth rate of gasoline imports in the recent years (19.9% on average). This amount of growth rate has imposed additional costs for supplying gasoline demand by importing. Table 3 shows the average daily/annual imports of gasoline during 1997-2006, [15]. Amount of imports has reached to 30.1 (M litters/day) in 2006 which is equal to 40% of gasoline consumption in this year. Costs of gasoline imports can not tolerance more by governments. Adopted strategies for mentioned concern are evaluated in section 4.

Table 3: Average daily/annual import of gasoline in Iran, 1997-2006

Year	(Thousand litters/day)	(Thousand litters/year)
1997	5800	2117000
1998	3800	1387000
1999	3400	1241000
2000	5251	1916615
2001	7790	2843350
2002	10420	3803300
2003	15110	5515150
2004	22670	8274550
2005	24810	9055650
2006	30090	10981828

2.4 Gasoline Prices & Subsidies

Fuel price is one of the most powerful tools in energy policy making. A review of historical trends of gasoline sales & imports prices in Iran (listed in table 4 during 1997-2006) shows that low prices of gasoline can be introduced as a major factor affected on uncontrollable gasoline consumption growth. Absence of policies on fuel prices in Iran is due to

political problems which described by Paul Rivlin, [11].

Multiplying values of subsidies per litter of gasoline (row 3 of table 4) by the amount of annual gasoline consumption (last column of table 1) will result in total subsidies per year which are listed in row 4 of table 4. This economic analysis of importing costs and subsidies shows that the amount of subsidies has reached to 6.6 billion US$ in 2005 and 10.2 billion US$ in 2006 as well. These subsidies are more than %10 of Iran oil income in those years [16]. These subsidies are a form of welfare payment that reduces the cost of living and helps maintain the popularity of the regime, especially among poorer sections of the population [11].

Table 4: domestic/imports prices & subsidies of gasoline in Iran, 1997-2006

Year	Domestic price (USD/litter)	Imports price, FOB Persian golf (USD/litter)	Subsidy (USD/litter)	Total subsidies (Million USD/Year)
1997	0.036	0.147	0.112	1376.2
1998	0.025	0.100	0.075	1025.2
1999	0.044	0.118	0.075	1062.9
2000	0.048	0.179	0.130	2024.8
2001	0.056	0.152	0.096	1606.0
2002	0.061	0.173	0.112	2069.5
2003	0.076	0.199	0.123	2516.3
2004	0.091	0.261	0.170	3764.7
2005	0.089	0.359	0.271	6601.8
2006	0.087	0.466	0.379	10192.9

2.5 Stock of Vehicles

Increasing the production of auto-cycle based vehicles and low level of applied technology have been major cause of gasoline consumption rise in the recent years. High average age of vehicles is another effective concern too. All of the gasoline consumption in transportation sector (99% of total gasoline consumption of Iran) is related to light vehicles and motorcycles. Number of existing and produced light vehicles/motorcycles is summarized in Tables 5 and 6 [16].

Number of gasoline vehicles in Iran has reached to approximately 8 million at the end of 2006. CNG vehicles (converted or factorial produced) are not excluded from gasoline vehicles data whereas their number was 87496 until fall 2005 and 214842 until fall 2006. Also the number of motorcycles has considerable growth. Most of motorcycles in Iran are manufactured based on technology of 70 decade. Meanwhile, 27% of produced motorcycles are 2-stroke cycle based which were phased out from fall 2004. Thus, production of motorcycles in year 2005 is much lower than 2004. Number of motorcycles in Iran has reached to 7.43 million at the end of 2005 and 8.33 million the end of 2006, as well.

Table 5: Number of existing and produced light vehicles in Iran, 1997-2006

Year	Produced	Existing
1997	160442	2773934
1998	190892	2964826
1999	226136	3190962
2000	282355	3473317
2001	363362	3836679
2002	484744	4321423
2003	633617	4955040
2004	857545	5812585
2005	971296	6783881
2006	1195906	7979787

Table 6: Number of existing and produced motorcycles in Iran, 1997-2006

Year	Produced	Existing
1997	106225	2859475
1998	113787	2973262
1999	176185	3149447
2000	279922	3429369
2001	404317	3833686
2002	709081	4542767
2003	1005785	5548552
2004	1086000	6634552
2005	800031	7434552
2006	900158	8334552

3 Analysis of Historical Trends

In fig.1, average annual consumption growth rates of main petroleum products during 1997-2006 in Iran have been illustrated. During this period, Petroleum products consumption has experienced an average annual growth rate of 2.5%. The minimum annual growth rate is for kerosene by -3.92% and gasoline has maximum annual growth rate of +9.07%.

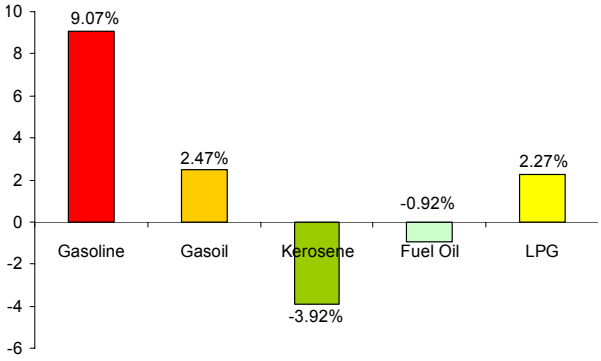

Fig.1 Percentage change in average annual consumption of petroleum products in Iran, 1997-2006

In fig.2, gasoline consumption and production trends during under-studying period have been shown. This figure shows that the difference between consumption and production has increased sharply. First solution is to increase the capacity of existing

refineries or to manufacture new ones. But adding the production capacity needs to long-term planning and excessive investment. as discussed before According to the ratified plans of the Iran ministry of oil and gas, until year 2010 gasoline production of refineries will increase to the twice of the present capacity. It is anticipatable that the gap between consumption and production will continuously grew until 2010 and eventually Iran is left importer yet, in spite of production increasing. Therefore, consideration on production can not completely curb the problem, but fuel conservation policies are of vital importance.

From the other side gasoline imports imposed tremendous costs which have become intolerable, and need to efficient strategies.

In order to comparison between the international FOB (Persian Golf) prices and domestic prices, their averages and the ratio of them are configured in fig.3. As it seems, domestic prices are much lower than FOB prices and their ratio has reached to 5.4 in 2006. In fact, fluctuations of international prices have no impression on domestic prices. Also domestic prices have had inelastic trend, particularly during 2003-2006.

In Iran, absence of fuel price policies refers to the weak economy due to intensive dependence of other goods prices on fuel prices. Governments were compelled to retain fuel prices in low levels in order to control the inflation. Political aspects and social expectations are other reasons that we prefer not to talk about these concerns.

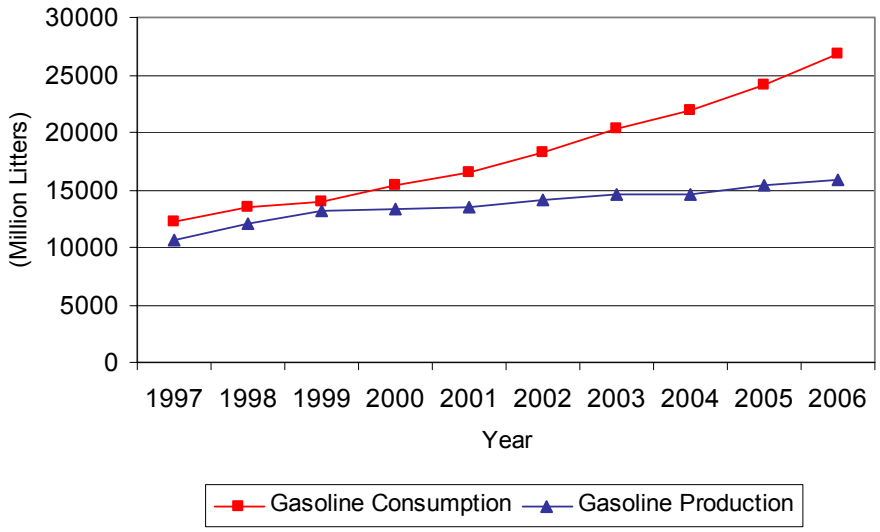

Fig.2 Gasoline consumption & production trends in Iran, 1997-2006 (Consumption, only in transportation sector is graphed)

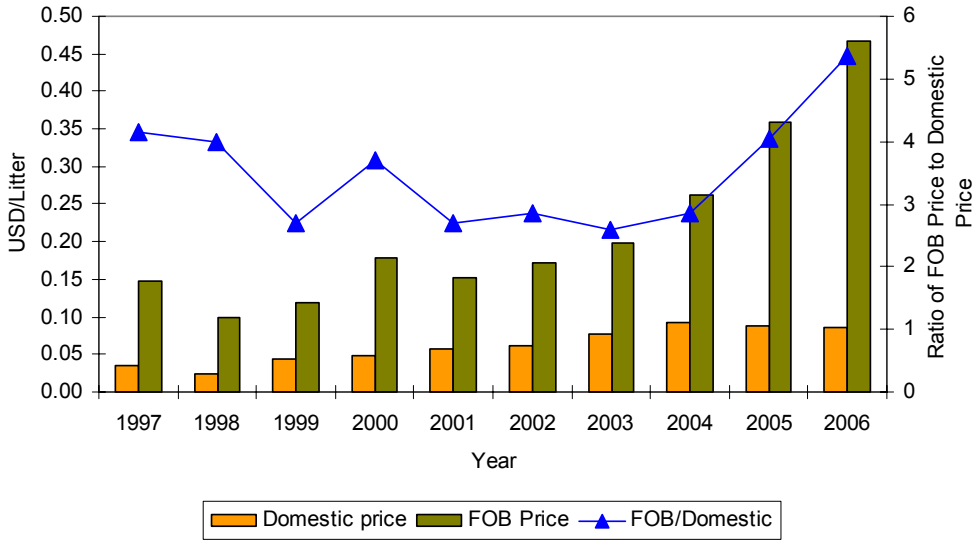

Fig.3 Comparison of average local & international prices of motor gasoline, 1997-2006 (Iran)

Figures 4 and 5 show the number of existing and produced light vehicles & motorcycles during 1997-2006. In these figures, in addition to presenting exact production data for every year, forward accumulative data is expressed too. Forward accumulative production of every year is the accumulation of its production with the production of all the next years.

For both light vehicles and motorcycles fig.4 and fig.5 imply that the production of light vehicles/motorcycles during 2002-2006 are equal to the total production and imports since begin until 2002 (cross point of existing and accumulative production curves). Begin of automobile production or imports in Iran, refers to before 1968 year.

Another concern in Iran's transportation system (light duty) is the average age of in-use vehicles which is shown in fig.6. Distribution of average age in light duty vehicles until year 2006 has been shown in fig.7 as well. As it is obvious, since 1997 automobile mass-production puts the average age of in-use vehicles on the decline. Eventually average age of in-use vehicles is about 12 years old in the end of 2005 and 11.4 in the end of 2006. 43% of in-use LDVs are under 5 years old. Despite of sharply decreasing of vehicle's average age in Iran, we have not any considerable fuel conservation, due to low level conventional applied technology. Automobile mass-production plays an increasingly important role in Iran gasoline consumption concern. Definitely, short and long term solutions and planning is required to curb the gasoline consumption rising.

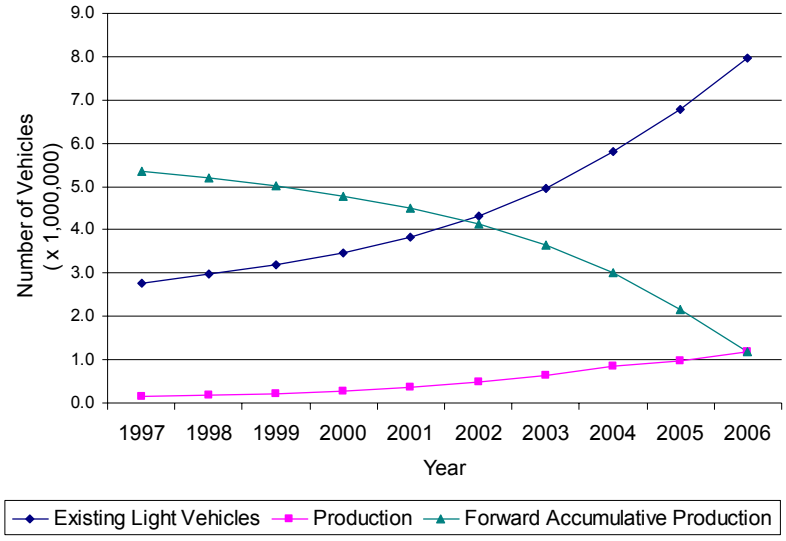

Fig.4 number of existing and produced light vehicles in Iran, 1997-2006

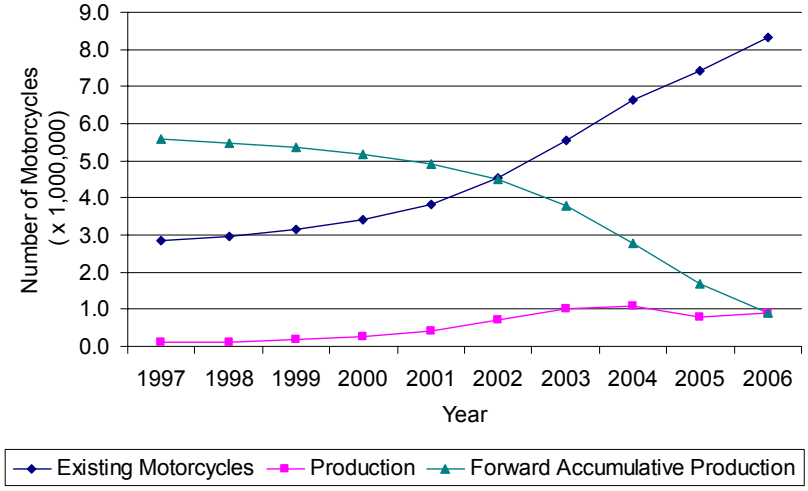

Fig.5 number of existing and produced Motorcycles in Iran, 1997-2006

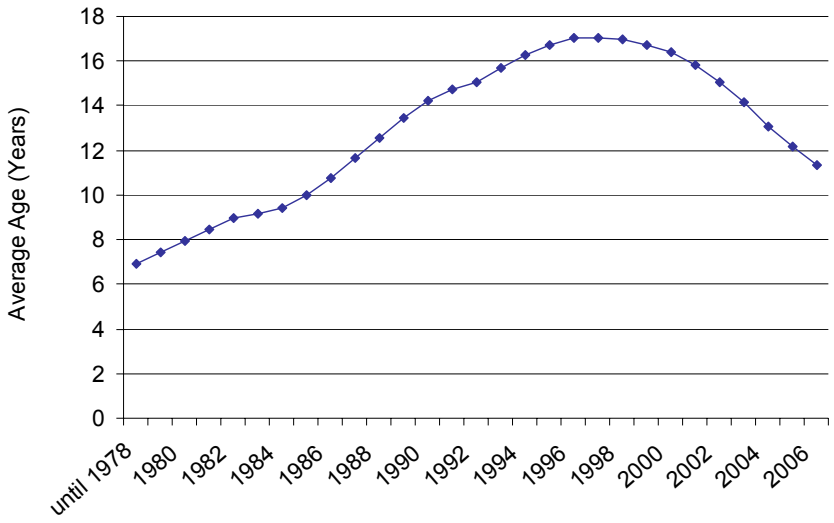

Fig.6 Average Age of Light Duty Vehicle's Fleet in Iran, 1978-2006

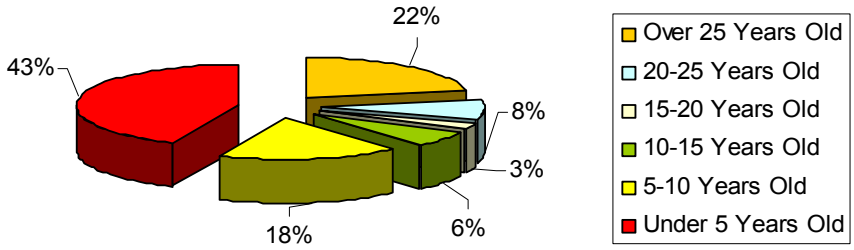

Fig.7 distribution of average age of Iran's LDVs, 2006

According to the performed analysis on historical trends of gasoline and stock of vehicles, main causes of high gasoline consumption and its crisis in Iran are as follows:

A. In Iran, price of gasoline is too low.

B. There is no policies or strategies for setting goals on fuel prices.

C. Incompatible growth rate of domestic prices with growth rate of international prices (imports), caused subsidies to increase sharply, respectively.

D. Iran's economy has intensive dependency on fuel prices which caused fear to higher price setting.

E. Automobile manufacturing has had large growth rates in the recent years and number of vehicles has increased.

F. The technologies of manufactured vehicles and motorcycles are too old, thus the average fuel consumption of most of the new-manufactured vehicles is too higher than same classes in other countries of the world (state-of-the-art vehicles), fig.8.

G. Average age of Iran's LDVs is more than developed countries, whereas it has decreased in the recent years.

H. New products can not pass the existing standards shown in fig.8. This issue will completely be investigated in the subsection 4.1.

I. The rate of gasoline production is increased but not adequately which curb the imports.

Some other effective factors that are not directly derived from historical trends analysis, whereas they are important, are as follows:

A. Undeveloped and weak public transportation.

B. Departure of rural inhabitants and increasing population of big cities that has resulted in increasingly transportation demand.

C. Lack of appropriate rules and regulations in order to decrease the number of single-passenger vehicles.

Above-reviewed facts, have leaded gasoline consumption to a big crisis in Iran. In the two next sections, current policies are assessed and new potential ones are proposed. The goal is to exit from gasoline exigency.

4 Current Strategies for Gasoline Consumption Reduction

In this section, current strategies, in forced policies and regulations to deduct the gasoline consumption, are considered. Based on advantages or disadvantages of these policies, SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is carried out. Since our attention is on consumption, we ignore assessment of emission standards and its detail issues.

4.1 Standards

Until year 2003, whole in forced standards & regulations in automobile manufacturing of Iran were safety based. Since that year, fuel consumption standards legislated and ratified as ISIRI 4241-2. It was supposed that this standards apply on new manufactured vehicles; phasing out of those models which can not pass the regulations.

The first version of Iran's Fuel consumption standard classified light duty vehicles into 16 classes, exactly the same as US EPA classification method for LDVs based on interior volume for passenger LDVs and gross vehicle weight for good vehicles. Urban and Combined (Urban and Extra Urban) Fuel consumption criteria for each class were set according to the strategy that conducts the Iran's National Averaged Fuel Consumption (NAFC) current level (10.2 lit/100 km) towards the Europe 2012 levels (5.21 lit/100 km) during a 15-year plan. Also the European Standard 80/1268/EEC is adopted as the reference for vehicle's fuel consumption measurements.

The first version of ISIRI 4241-2 standard proclamation to the automobile industries has been done in November, 2003. Extensive tests performed to determine fuel consumption rank of every local producing vehicle and designing fuel consumption label. Total cost of legislating this standard and performing fuel consumption tests was about 10 Million Dollars that financed by Iranian Fuel Conservation Organization (IFCO). A typical fuel label designed for light duty gasoline vehicles is shown in figure7 (Because in this article we have no comments on the items of Iran's fuel consumption label, therefore we present one of the real sample with no translation in English. This sample is the exact one which must paste on the vehicle).

According to the first version of ISIRI 4241-2 code, about 90% of producing vehicles (among one million light gasoline vehicles produced in 2005) are failed or falling into the G-grade category.

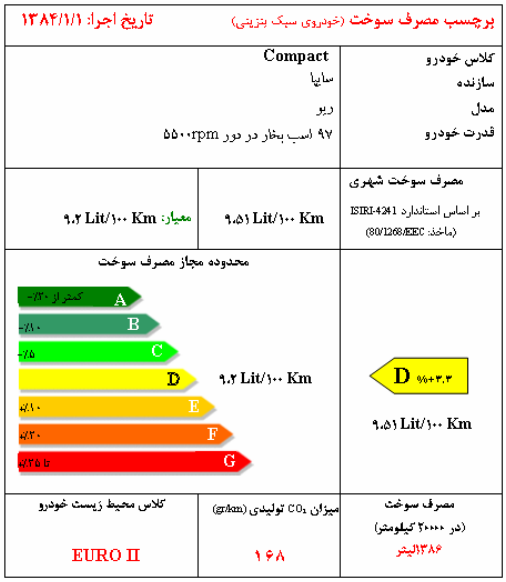

Fig.7 typical Fuel Consumption Label of Iran according ISIRI 4241-2 standard (Fuel consumption criteria is set at yellow range), [18]

Meanwhile, about 60% of them are failed absolutely (test results for some weighting classes is compared with similar world state-of-the-art vehicles in fig.8). But neither the production of failed products phased out nor fuel consumption label pasted on products. Reasons of this regretful event and inconsistency will be clear after SWOT analysis. SWOT carried out on Iran Fuel Consumption Standard (for gasoline vehicles), that is summed up in the following:

Strengths: Conformity with international standards, Awareness to the end users, Well-informing about consumption and technical specifications of products, Phasing out of rejected products, Powering governments to execute consumption policies.

Weaknesses: Expensive test facilities.

Opportunities: Properly affecting on sale prices of automobiles, Introducing fuel consumption as an important concern, Suppressing exclusive market of automobile industries in Iran, Paving the way for importing from foreign automobile manufacturers.

Threats: Institute of Standard and Industrial Research of Iran (ISIRI) as a subsystem of production sector, Third Party Inspector (TPI) companies as subsidiary of automobile industries, Exclusive local market and absence of international competitive market, unlimited support of Iranian automobile industries by governments, Low fuel prices and boundless subsidies.

Apparently, the above-mentioned SWOT shows that the existing threats never let ISIRI 4241-2 proving to be true and applicable. Therefore this code didn't apply until now, mostly because ISIRI is a subsidiary of production sector. Both ISIRI and

automobile industries are subsidiaries of Ministry of Industries and Mines. Listed threats for fuel consumption standard already exist for emission and motorcycle fuel consumption standards as well. In the two last cases, standard codes are applying but second threat (TPI companies as subsidiary of automobile industries and even some managing directors of automobile manufacturers are members of the board of TPI companies) affects the reliability and correctness of test procedures in favor of automobile manufacturers. It means reported criteria in standards are false and illegal results have become a part of law.

This scenario continues and it is a big regret for Iran automobile industries.

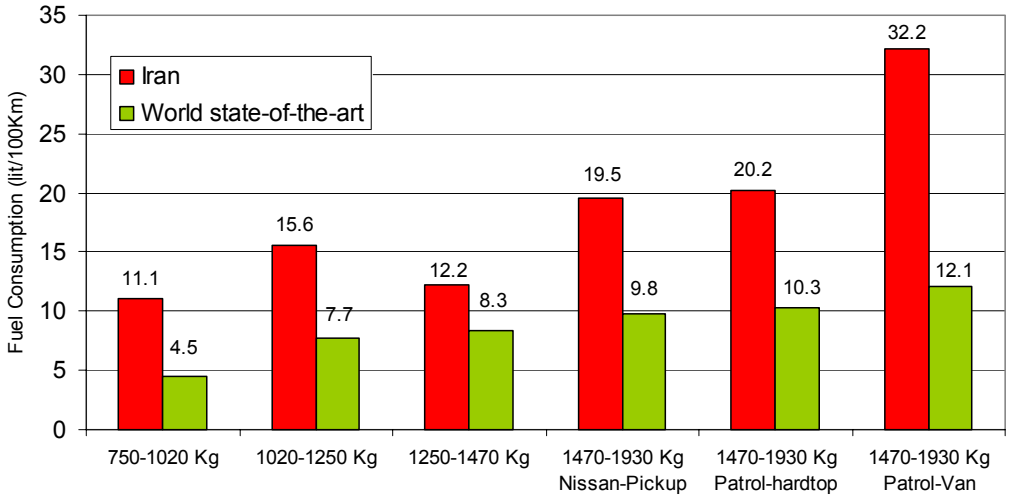

Fig.6 Fuel Consumption of some weighting classes of manufactured vehicles in Iran in comparison with similar classes of the world (Urban Cycle), [18]

4.2 Alternative Fuel (CNG)

As we said before, increasing growth rate of gasoline consumption in the last decade, has lead to need to a long-term planning in order to using an appropriate alternative fuel. Especially, regarding to current situation of average fuel consumption of light vehicles that is very higher than world norms and standards, moreover, with respect to the fact that this gap is increasing, cited requirement becomes more appear and sensible.

Iran by having more than 14.9% of the world gas reserves (27.5 Trillion m3), that is second large reserves in the world (after Russia), and widespread gas pipeline networks has a very proper infrastructure for offering Compressed Natural Gas (CNG) as a clean alternative fuel for Iran's transportation system [15].

In order to achieving the best understanding about using this alternative fuel, an SWOT analysis has been done, and a summary of its results are as follows:

Strengths: Access to huge gas reserves, widespread gas pipeline network, low cost price of CNG, ease of CNG technology development.

Weaknesses: High expenditures of development and maintenance of CNG stations and car cylinders, need to foreign technologies and imports, low mileage, high weight and volume of CNG cylinders.

Opportunities: Decreasing gasoline imports, decreasing emissions and development of clean fuels, increasing the exports of liquid oil products.

Threats: High gasoline subsidies, people phobia of gas, limited of financial resources.

This fuel has been used very limitedly from 1977. From 2000, by establishing Iranian Fuel Conservation Organization (IFCO), responsibility to development of using CNG in transportation sector assigned to this organization. Regarding to importance of this issue, an independent structure for CNG project has been created. From that time, many plans have been accomplished and many other plans are executing. Main goals of current phase of CNG development strategy have been set as follows:

A. Construction of 1760 CNG refueling stations.

B. Workshop conversion of 2100000 vehicles (to CNG or Hybrid)

C. Production of 1221000 hybrid and OEM CNG vehicles.

According to SWOT analysis results and based on various attempts in order to achieve project goals, the progress of CNG project is acceptable. The number of NGV's in Iran is 263662 (ranked 6th in

the world) and we have 199 in-operation CNG refueling stations up to Apr, 2007, [19].
However because of low number of CNG vehicles in comparison with total number of vehicles, this conservation measure has not reduced gasoline consumption effectively yet.

4.3 Gasoline Rationing

Another approach in order to control gasoline consumption that is considered in recent years is rationing. This strategy is followed by giving 'Intelligent fuel card' to all car and motorcycle owners. As we cited above, about 40% of Iran's gasoline consumption is supplied from imports. The goal of this plan is to sale domestic gasoline production to consumers with supportive price (by assigning determined quota to each vehicle) and sale importing gasoline with cost price of it unlimitedly.
Because of many executive issues and moreover a lot of political discussions, this plan has not been performed yet. This issue is on the top of internal discussions these days and it has many advocates and criticizers. This is a new experience in the world and because of many issues and expenditures it can be only a short term solution.

4.4 Other Strategies

Technical inspection of in use vehicles and excluding old vehicles (defined over 30 years old) from transportation cycle are two other in forced strategies which are applying. But these strategies are trapped in similar managing problems and threats cited about standards. According to the formal reports from IFCO, these policies have failed to significantly reduce the gasoline consumption.

5 Fundamental solutions and strategies for gasoline crisis

Regarding cited issues about the existing condition, bottlenecks and crisis of gasoline, it is obvious that we should look for fundamental solutions instead of increasing the imports and misusage of national assets. Only through such a broad range of policies can serious headway be made to reduce the current overdependence. Therefore, regarding to gasoline, solutions should be in line with four following important guidelines:
A. Demand side management with emphasis on reducing consumption along with increasing public welfare.
B. Reducing and eliminating imports.
C. Increasing production.
D. Justifying and goal-orienting subsidies.

Each of the solutions should be assessed separately by reasonable forecasting of status, resources, abilities and related risk. Then after ensuring about suitable status, resources, required abilities and selected mechanisms in order to reducing the risks, the solution should be presented with a scheduled plan. The possible solutions that should be performed in the format of short, mid and long term plans are as follows:

5.1 short-term solutions

A. To increase the number of buses.
B. Full controlling and restriction of traveling in central regions of big cities for private vehicles.
C. Registration of new light vehicles only for OEM NGV's.
D. Registration of a new gasoline or hybrid light vehicle only if an old gasoline light vehicle be excluded from transportation cycle.
E. High and rapid development of CNG refueling stations and conversion of gasoline vehicles to hybrid (CNG and gasoline) vehicles.
F. To exclude old and high fuel consumption vehicles from transportation cycle.
G. To reduce the tariffs of importing OEM NGV's and low consumption hybrids.
H. Legislation about high penalties for gasoline and other oil products contraband and domestic contraband.
I. Imminent action on applying fuel consumption standard ISIRI 4241-2.

5.2 Mid-term solutions

A. Increasing production capacity and continuous amendment of refineries with the aim of increasing exports and supplying domestic demand.
B. Justifying and goal-orienting subsidies.
C. Increasing gasoline price to international prices and then give the permission for gasoline imports to private sector.
D. To enforce banks, insurance companies, air and ground transportation companies, custom house and all governmental and non-governmental organizations to start up and quick accomplishment of electronic devices and mechanisms for many services in order to decrease intra-city travels with precise and scheduled plans.
E. Public awareness.
F. Rigorous and legal militate against traffic offenders and increasing the penalties of driving infractions.
G. Applying correct technical inspections.
H. To renovate LPG technology which there are it's infrastructures in Iran.

5.3 Long-term solutions

A. Pervasive expansion and development of intercity and intra-city rail transportation fleet.
B. Development of other alternative fuels in addition to CNG.
C. Vehicle efficiency improvements and technical progress for conventional and alternative vehicle propulsion technologies.

6 Conclusion

In conclusion, the main factors that have caused recent gasoline crisis include low fuel price and enormous amount of subsidies, lack of policy about fuel pricing, large growth rates of vehicle production and using old technologies.
Gasoline crisis in Iran has no popular solution and fundamental strategies and policies are needed to solve the problem.
Unfortunately, current conservation strategies including standards, developing alternative fuel (CNG) and gasoline rationing have not reduced consumption efficiently as yet. Finally fundamental proposed solutions have categorized into short term (such as increasing buses, restriction of traveling in central regions of big cities, registration policy-making, etc.), mid-term (such as increasing production capacity of refineries, justifying and goal-orienting subsidies, increasing fuel price to international level, etc.) and long term (developing rail systems, etc.) solutions.

References:

[1] Mark E. Rodekohr, Demand for transportation fuels in the oecd: A temporal cross-section specification, *International Journal of Applied Energy*, Vol.7, No.3, 1979, pp. 223-231.

[2] Theodoros Zachariadis, Nikos Kouvaritakis, Long-term outlook of energy use and CO2 emissions from transport in Central and Eastern Europe, *International Journal of Energy Policy,* Vol.31, 2003, pp. 759-773.

[3] Theodoros Zachariadis, On the baseline evolution of automobile fuel economy in Europe, *International Journal of Energy Policy,* Vol.34, 2006, pp. 1773-1785.

[4] Marc E. Norman, Reducing gasoline use: A multi-pronged approach, *International Journal of Energy Policy,* Vol.22, No.1, 1994, pp. 37-39.

[5] Takahiro Sakaguchi, Influence of diffusion of fuel-efficient motor vehicles on gasoline demand for individual user owned passenger cars, *International Journal of Energy Policy,* Vol.28, 2000, pp. 895-903.

[6] Kebin Hea, Hong Huoa, Qiang Zhanga, Dongquan Heb, Feng Anc, Michael Wangc, Michael P. Walsh, Oil consumption and CO2 emissions in China's road transport: current status, future trends, and policy implications, *International Journal of Energy Policy,* Vol.33, 2005, pp. 1499-1507.

[7] Ranjan Kumar Bose and V. Srinivasachary, Policies to reduce energy use and environmental emissions in the transport sector, *International Journal of Energy Policy,* Vol.25, No.14-15, 1997, pp. 1137-1150.

[8] F. Birola and N. Guerer, Modeling the transport sector fuel demand for developing economies, *International Journal of Energy Policy,* Vol.21, Issue 12, 1993, pp. 1163-1172.

[9] M. Aghaii Tabrizi, Exiting constraints on Iran's gasoline supply and contributing factors, *Journal of Energy Economic Reviews,* Vol.2, No.6, Special Issue, Autumn 2006, pp. 16-21.

[10] M. Aghaii Tabrizi, *Iran's Gasoline Challenges & Solutions*, Institute for International Energy Studies (IIES), 2006.

[11] Paul Rivlin, Iran's Energy Vulnerability, *Journal of Middle East Review of International Affairs,* Vol.10, No.4, 2006, pp. 103-116.

[12] Roger Stern, The Iranian petroleum crisis and United States national security, *International Journal of Economic Sciences, PNAS*, Vol.104, No.1, 2007, pp. 377-382. www.pnas.org_cgi_doi_10.1073_pnas.0603903104

[13] Majid Ahmadian, Mona Chitnis and Lester C Hunt, Gasoline Demand, Pricing Policy and Social Welfare in Iran, *Surrey Energy Economics Discussion paper Series,* SEEDS 117, ISSN 1749-8384, Feb. 2007. www.seec.surrey.ac.uk

[14] EIA, *Iran Energy Data, Statistics and Analysis: Oil, Gas, Electricity, Coal*, Aug. 2006. file://\\Fs-f1\l6010\PRJ\NewCABs\V6\Iran\Full.html

[15] Office of Energy and Power Affairs, *Iran's Energy Balance 2005,* Ministry of Power, 2005.

[16] Institute for International Energy Studies (IIES), *Iran's Hydrocarbons Energy Balance 2005,* Ministry of oil and gas, 2005.

[17] H. Aghayan, *Iran's Data book of Consumption of Petroleum Products*, National Company of Distribution of Iran Oil Products, 2005.

[18] Transportation Sector, *Iran's Fuel Consumption Guide for LDVs,* Iranian Fuel Conservation Organization (IFCO), 2005.

[19] Office of CNG Planning, *Annual Report of Iran's CNG National Project,* Iranian Fuel Conservation Organization (IFCO), 2006.