Energy Balance of Iran

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: - Regarding to limited resources of Fossil fuels, supply-demand management and energy planning in the end-user sectors is a great matter of importance. Energy Balance is one the most important tools for reviewing historical trends of energy supply and demand for petroleum, natural gas, coal, electricity, renewable energies and other energy carriers. We attempt to assess Iran's energy balance with the aim of its historical trends in last decade and extract the effective causes of tremendous amount of energy consumption. In fact, we have presented Iran's energy information at a glance for year 2005. This information is exactly extracted from oil and gas industry due to the study performed by Institute for International Energy Studies, and published by the name of Iran's Hydrocarbons Energy Balance. In this way, Total Primary Energy Production of Iran was 2606.3 MMBOE. Final Energy Consumption with a growth rate of 5.6%, in comparison with 2004, reached to 935.61 MMBOE. Also GDP experienced 5.39% Growth rate and from 398234 million Rials (1997 constant prices) in 2004 reached to 419705 million Rials in 2005. Therefore, Primary Energy Supply Intensity from 3.19 Barrels per million Rials in 2004 (1997 constant prices) increased to 3.20 in 2005. The conclusions suggest strongly not only that the low price of energy, but also low capacity of crude oil production and refining with conventional technology likewise affect on tremendous consumption. Therefore production will not cover the demand, especially about natural gas, in the near future.

Key-Words: - Energy Balance, Petroleum, Natural Gas, petrochemical industries

1 Introduction

Assessment of the supply and demand for energy, interests many researchers and policy-makers who are considering various energy plans. Respectively, Energy Balance is one the most important documents for reviewing historical trends of energy supply and demand for petroleum, natural gas, coal, electricity, renewable energies and other energy carriers. Most countries publishing their energy balance annually. Presenting the true and exact information of energy section is so important and effective in policy making.

Paul Rivlin, examined Iran’s energy balance and its vulnerability to international energy sanctions. He believes 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 some energy carriers and petroleum products [1]. Same analysis has been done by Roger Stern [2]. In these two recently cited studies Iran's sanctions are considered, politically.

Also the Iran's energy statistics are presented and annually updated in reports of Energy Information Administration of U.S. Department of Energy [3].

In Iran, Office of Energy and Power Affairs, Subsidiary of Ministry of Power, publishing Iran's energy balance annually [4].

Unfortunately, the cited studies, even energy balance of ministry of power, have not exact and reliable data in Iran's oil and gas industry field. We attempt to assess Iran's energy balance with the aim of its historical trends in last decade and extract the effective causes of tremendous amount of energy consumption. In fact, we have presented Iran's energy information at a glance. Mentioned statistics are base on exactly extracted data form oil and gas industry due to the study performed by Institute for International Energy Studies (IIES, a subsidiary of ministry of oil and gas), and published by the name of Iran's Hydrocarbons Energy Balance [5]. IIES is supposed to publish Iran's Hydrocarbons Energy Balance in every year for it's previous one.

The next section of the paper, therefore, outlines the statistics of energy sector in Iran. Sections 3 & 4 introduce the analysis of historical trends of petroleum and natural gas. Petrochemical industries are analyzed in Section 5. Electricity situation in Iran are proposed in section 6 and conclusions have presented in Section 7.

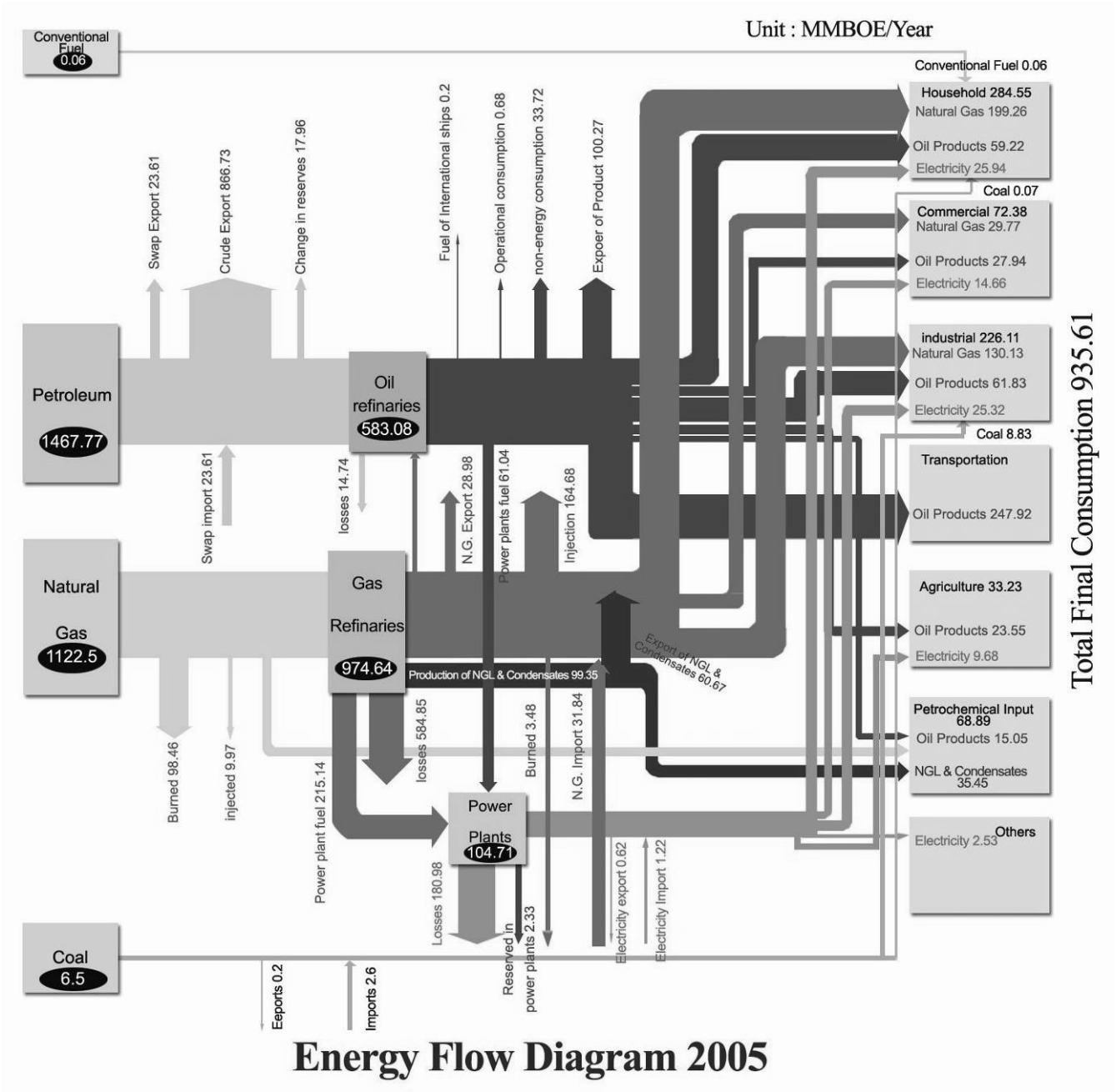

Fig.1 Iran's Energy Flow Diagram, 2005

2 Energy Sector

Iran's Energy Flow Diagram has shown in figure 1. As it is illustrated, in 2005, Total Primary Energy Production of Iran was 2606.3 MMBOE[1]. From this amount, shares of oil, rich natural gas, hydropower and coal and other energy carriers was 56.32%, 43.07%, 0.36% and 0.25% respectively.

Final Energy Consumption with a growth rate of 5.6%, in comparison with 2004, reached to 935.61 MMBOE.

Also GDP experienced 5.39% Growth rate and from 398234 million Rials (1997 constant prices) in 2004 reached to 419705 million Rials in 2005. Regarding to growth rate of final energy consumption, growth rates of energy consumption and economic activities are approximately equal.

Primary Energy Supply Intensity from 3.19 Barrels per million Rials in 2004 (1997 constant prices) increased to 3.20 in 2005 and Final Energy Consumption Intensity from 2.22 Barrels per million Rials reached to 2.23 which experienced a slight increase [5].

[1] Million Barrels of Oil Equivalent

During 2005, energy subsidies with a high growth rate of 42% reached to 265907 billion Rials (excluding power plants subsidies from total electricity subsidies).
Table 1 shows sectoral energy consumption along with growth rates.

Table 1: sectoral energy consumption and related growth rates, 2005

sector	Energy Consumption (MMBOE)	Growth rate (%) 2004-2005
Residential and commercial	356.93	6.4
Transportation	247.92	7.6
Industry	226.11	5.25
Agriculture	33.23	3.7

3. Petroleum

Total primary and secondary oil and gas-liquids reserves of Iran in 2005 was 203.496 billion barrels, from that 81.79% was onshore and 18.79% was offshore. By the end of 2005, the amount of recoverable oil and gas-liquids reserves were 136.926 billion barrels. Discovered oil and gas-liquids reserves in 2005 were 1990.4 million barrels.
Oil production was 4027.3 thousand barrels per day in 2005, which in comparison with 2004 had a growth rate of 6.35%.
Crude oil exports were 866.73 million barrels in 2005 (fig.1), which in comparison with 2004 had a negative rate of -2.2%.
In 2005, crude oil imports from central Asian countries were 76184.5 barrels per day which was 11% lower than 2004. The same amount of crude oil to this importing amount (swap) has been exported from exporting ports [5].
By using domestic crude oil and gas-liquids and some importing crude oil, total feed of refineries was 1609 thousand barrels per day. Average refining cost of a barrel of oil or gas-liquids was 1.96 US$.
In 2005, gasoline imports were 22.81 million liters per day. Liquid gas production of petrochemical complexes was 2190 m3 per day, in 2005.
Total amount of oil products exports in this year were 99.03 MMBOE. Exports of fuel oil, gas oil and kerosene were 95.05 MMBOE (36.88 million liters per day), 3.29 MMBOE (1.46 million liters per day) and 0.69 MMBOE (0.32 million liters per day), respectively. Oil products exports, in 2005, were 5.8% lower than 2004.
Crude oil shipment, in 2005, was 28487.06 ton-km and 60075 million liters of crude oil transported[5].
In 2005, total activity of various product shipment modes was 35451 million ton-km which was 5.8% more than the previous year.
Total consumption of oil product, in 2005, was 499.58 MMBOE, which was 5.44% more than 2004. During this period, oil products consumption of final sectors was 435.50 MMBOE, which was 4.1% more than 2004 (fig.1).
Domestic sale of oil products, in 2005, was 26395.8 billion Rials and with considering regional prices, the amount of subsidies is estimated 237366.8 billion Rials [5].

4. Natural Gas

Total recoverable gas reserves of Iran, by the end of 2005, were 28.259 trillion m^3. The number of gas fields was 47 which from that, 34 fields were non-associated gas fields and 11 fields were associated oil fields.
In 2005, total rich gas production was 435.6 million m3, from which 299.69 million m^3 was from independent and associated onshore gas fields and 135.91 million m^3 was from associated offshore fields (fig.1).
From total production of rich gas, 86.6% delivered to refining plants, 0.9% used for injection, 1.6% delivered to petrochemical plants, 1.9% used for operational utilization and 8.8% of that was burnt.
In 2005, the capacity of dehydration units and gas refineries was 383.1 million m^3 per day.
Total production of lean gas, in 2005, was 2.4% more than 2004 and reached to 351.73 million m^3 per day [5].
Average natural gas imports (from Turkmenistan) was 14.17 million m3 per day, in 2005, and its daily exports (to Turkey) was 12.9 million m^3.
In 2005, from total daily rich gas production amount of 435.6 million m3, daily amounts of lean gas injection, operational utilization, burnt gas and final uses and power plants consumption were 73.28 million m3, 21.74 million m3, 1.55 million m3 and 255.56 million m3, respectively.
Production of gas-liquids, in 2005, was 128479.8 thousand barrels, from which 35.68% delivered to petrochemical units, 61.01% exported and 3.25% delivered to domestic refineries.
Total number of households that were connected to domestic gas grid was 11613000 households, in 2005, which was 10% more than 2004.
Lean gas consumption of residential-commercial sector, industry sector and power plants, in 2005, were 37200 million m^3, 21135.6 million m^3 (excluding oil and gas refineries and pumping

stations) and 34943 million m^3, respectively. Gas consumption of final using sectors, in 2005, has a growth rate of more than 8.8%.
Domestic sale of natural gas, in 2005, was 7149.3 billion Rials and considering regional prices, the amount of subsidies was 34826 billion Rials[5].

5. Petrochemical Industries

In 2005, petrochemical production was 15756 thousand tons which was 4.6% more than 2004. Domestic sale with a growth rate of 1% reached to 4893 thousand tons. The value of domestic sale, in 2005, was 16052 billion Rials which was 27% more than 2004.
The amount of exports, in 2005, was 5216 thousand tones which was 0.3% more than 2004. The value of the exports was 2323 million US$ which was 35% more than 2004 (fig.1).
In 2005, average daily feed of petrochemical complexes from refineries was 7822 m3 which was 3.5% lower than 2004.
The amount of gas-liquids feed of petrochemical complexes, in 2005, was 3900 thousand tones which was 6% more than 2004 and feed and consuming gas of them with a growth rate of 11.7%, reached to 547516 million m3 [5].

6. Electricity

In 2005, nominal power of power plants had a growth rate of 10% and reached to 41003 MW.
Total gross production of power plants, in 2005, was 178071 million KWh which was 9.3% more than 2004 and the shares of hydroelectric stations and steam power plants and gas and combined-cycle power plants were 9.03%, 52.44% and 38.37%, respectively. The remains of gross production were from diesel and wind power plants.
Electricity imports, in 2005, were 2074 million KWh (fig.1).
In 2005, from total domestic electricity sale amount of 435.6 million m3, sale amounts of residential, public, commercial, industry, agriculture and other sectors were 44108, 16390, 8542, 43062, 16469 and 4305 million KWh, respectively.
In 2005, delivery of gas oil to power plants was 2649 million liters which was 21% more than 2004; also, their fuel oil consumption was 6329 million liters which was 10% more than 2004. Natural gas consumption of power plants, in 2005, was 34943 million m3 which was 4% more than 2004.
Efficiency of non-hydro power plant, in 2005, was 35.8%, on average [5].
Number of electricity customers, in 2005, was 19690000 which more than 83.29% of them were from residential sector.
By the end of 2005, number of villages with electricity accessibility reached to 50194. in 2005, 795 villages connected to electricity grid.
Total domestic sale of electricity, in 2005, was 20699 billion Rials and its subsidy was 33115 billion Rials (excluding fuel subsidy) [5].

7. Conclusion

In conclusion, regarding to the cited data and statistics, the main factors that have caused tremendous energy consumption are low fuel price and enormous amount of subsidies, lack of policy about fuel pricing, no growth in production and using old technologies.
Unfortunately, current conservation strategies have not reduced consumption efficiently as yet. Finally fundamental solutions are needed such as increasing production capacity of refineries, justifying and goal-orienting subsidies, increasing fuel price to international level, decreasing of energy intensity by conservation policies, establishment of road maps in energy end-users sectors (including Transportation, Households, Industries and Agriculture), implementation and development of renewable energy, increasing energy efficiency in all end-users and in primary and secondary energy conversion systems (including refineries, power plants, petrochemical industries and product transportation systems), increasing international energy exchange and energy policy making.

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