

Energy Balance of Iran, 2006

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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 2006. 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 2723.65 MMBOE (Million Barrels of Oil Equivalent). Final Energy Consumption with a growth rate of 10.3%, in comparison with 2005, reached to 1034.82 MMBOE. Also GDP experienced 6.2% Growth rate and from 420928 billion Rials (1997 constant prices) in 2005 reached to 446880 billion Rials in 2006. Therefore, Primary Energy Supply Intensity from 3.20 Barrels per million Rials in 2005 (1997 constant prices) increased to 3.29 in 2006. 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: - Iran, Petroleum, Natural Gas, Petrochemical Industries, Electricity, Coal, Renewable Energies, Traditional Fuels, Energy Balance.

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 publish their energy balance annually. Presenting the true and exact information of energy section is so much 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 [2]. Same analysis has been done by Roger Stern [3]. 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 [4]. In Iran, Office of Energy and Power Affairs, Subsidiary of Ministry of Power, publishes Iran's energy balance annually [5].

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've attempted 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. Another study has been done for 2005 [1], but in this report the energy balance of Iran for 2006, with more details and discussions, has been studied. 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 petroleum), and published by the name of Iran's Hydrocarbons Energy Balance

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[6]. IIES is supposed to publish Iran's Hydrocarbons Energy Balance in every year for its previous one. The next section of the report, 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. The situation of other energy carriers, containing the electricity, coal, traditional fuels and renewable energies (wind and thermal-solar), are reviewed in section 6 and conclusions have presented in Section 7.

2 Energy Sector

Iran's Energy Flow Diagram has shown in figure 1. As it is illustrated, in 2006, Total Primary Energy Production of Iran was 2723.65 MMBOE (Million Barrels of Oil Equivalent) of which, share of oil, rich natural gas, traditional fuels, hydropower, coal and other energy carriers was 54.37%, 43.95%, 0.93%, 0.39%, 0.35 and 0.013%, respectively. In 2006, domestic supplied primary energy has been 1468.15 MMBOE which is only 54% of the total primary energy production.

Final Energy Consumption with a growth rate of 10.3%, in comparison with 2005, reached to 1034.82 MMBOE. Also GDP experienced 6.2% Growth rate and from 420928 billion Rials (1997 constant prices) in 2005 reached to 446880 billion Rials in 2006. Regarding to growth rate of final energy consumption, growth rates of energy consumption and economic activities are approximately equal.

Primary Energy Supply Intensity from 3.20 Barrels per million Rials in 2005 (1997 constant prices) increased to 3.29 in 2006 and Final Energy Consumption Intensity from 2.23 Barrels per million Rials reached to 2.32 which experienced remarkable increase, [6].

During 2006, energy subsidies with a high growth rate of 30% reached to 343804 billion Rials (excluding power plants subsidies from total electricity subsidies).

Table 1 shows energy consumption by sectors along with growth rates.

Table 1: energy consumption by sectors and related growth rates, 2006

sector	Energy Consumption (MMBOE)	Average Annual Growth Rate % 2005-2006
Residential & commercial	411.85	6.27
Transportation	266.44	6.35
Industry	212.23	3.55
Agriculture	36.32	1.58

3 Petroleum

Total primary and secondary oil and gas-liquids reserves of Iran in 2006 was 206.32 billion barrels, from that 81.18% was onshore and 18.82% was offshore. By the end of 2006, the amount of recoverable oil and gas-liquids reserves were 138.22 billion barrels. Discovered oil and gas-liquids reserves in 2006 were some 9260 million barrels. Oil production was 4056.9 thousand barrels per day in 2006, which in comparison with 2005 had a growth rate of 0.88%.

Crude oil exports were 881.6 million barrels in 2006 (fig.1), with a growth rate of 1.7% in comparison with 2005. In 2006, crude oil imports from central Asian countries were 131406 barrels per day which was 72.5% more than 2005 and nearly the same amount has been exported (swapped) from exporting ports, [6].

By using domestic crude oil and gas-liquids and some importing crude oil, total feed of refineries was 1658 thousand barrels per day and average refining cost of a barrel of oil or gas-liquids was 1.96 US\$.

In 2006, gasoline imports were 27.5 million liters per day. Liquid gas production of petrochemical complexes was almost 2660 m³ per day, in 2006.

Total amount of oil products exports in this year were 101.13 MMBOE. Exports of fuel oil, kerosene and naphtha were 100.18 MMBOE (38.86 million liters per day), 0.58 MMBOE (270 thousand liters per day) and 0.37 MMBOE (207 thousand liters per day), respectively. Oil products exports, in 2006, were 0.86% more than 2005.

In 2006, Crude oil shipment was 27515 million ton-km and 57575 million liters of crude oil transported and total activity of various product shipment modes was 39152 million ton-km which was 10.6% more than the previous year, [6].

Total consumption of oil product, in 2006, was 533.67 MMBOE, which was 6.5% more than 2005. During this period, oil products consumption of final sectors was 449.79 MMBOE, which was 3% more than 2005 (fig.1).

Domestic sale of oil products, in 2006, was 28493.3 billion Rials and with regard to regional prices, the amount of subsidies is estimated 291867.2 billion Rials [6].

4 Natural Gas

Total recoverable gas reserves of Iran, by the end of 2006, were 28.13 trillion m³. Total number of active gas fields was 22 of which 15 fields were non-associated gas fields, 5 fields were associated

onshore gas fields and 2 fields were associated offshore gas fields.

In 2006, total rich gas production was 464.49 million m³ of which 322.84 million m³ were produced from independent and associated onshore gas fields and 141.65 million m³ from associated offshore fields (fig.1).

From total production of rich gas, 88% delivered to refining plants, 0.94% used for injection, 1.44% delivered to petrochemical plants, 1.22% used for operational utilization and 8.4% of that was burnt.

In 2006, the capacity of dehydration units and gas refineries were 440 million m³ per day; Total production of lean gas was 7.3% more than 2005 and reached to 377.45 million m³ per day [6].

Average natural gas imports were 17.25 million m³ per day, in 2006, and its daily exports were 15.69 million m³.

In 2006, from total daily lean gas production amount of 394.7 million m³, daily amounts of lean gas injection, operational utilization, burnt gas and final uses and power plants consumption were 68.8 million m³, 28.38 million m³, 7.09 million m³ and 268.04 million m³, respectively.

Production of gas-liquids, in 2006, was 154398.65 thousand barrels, from which 34.65% delivered to petrochemical units, 52.18% exported and almost 10% delivered to domestic oil and gas refineries.

Total number of households that were connected to domestic gas grid was 12457 thousand households, in 2006, which was 7.3% more than 2005.

Lean gas consumption of residential-commercial sector, industry sector, transportation sector and power plants, in 2006, were 41846 million m³, 19771 million m³ (excluding oil and gas refineries and pumping stations), 522 million m³ and 34701 million m³, respectively. Gas consumption of final using sectors, in 2006, has a growth rate of more than 12%.

Domestic sale of natural gas, in 2006, was 8235 billion Rials and considering regional prices, the amount of subsidies was 53271 billion Rials, [6].

5 Petrochemical Industries

In 2006, petrochemical production was 17994 thousand tons which was 14.2% more than 2005. Domestic sale with a growth rate of 24% reached to 6066 thousand tons. The value of domestic sale, in 2006, was 26520 billion Rials which was 65% more than 2005.

The amount of exports, in 2006, was 6044 thousand tons which was 15.8% more than 2005. The value of the exports was 3298 million US\$ which was 42% more than 2005 (fig.1).

In 2006, average daily feed of petro-chemical complexes from refineries was 7724 m³ which was 1.2% lower than 2005.

The amount of gas-liquids feed of petrochemical complexes, in 2006, was 5327 thousand tones which was 36.5% more than 2005 and feed and consuming gas of them with a growth rate of 6.8%, reached to 5845.5 million m³ [6].

6 Other Energy Carriers

6.1 Electricity

In 2006, nominal power of power plants, with 10% increase, reached to 45111 MW.

Total gross production of power plants, in 2006, was 192535 million KWh which was 8.1% more than 2005 and the shares of hydroelectric stations and steam power plants and gas and combined-cycle power plants were 9.4%, 48% and 42.3%, respectively; and the remaining were generated in diesel and wind power plants. Electricity imports, in 2006, were 2498 million KWh (fig.1).

In 2006, from total domestic electricity sale amount of 144598 million KWh, sale amounts of residential, public, commercial, industry, agriculture and other sectors were 48085, 18329, 9320, 46590, 17666 and 4608 million KWh, respectively.

In 2006, delivery of gas oil to power plants was 4664 million liters which was 61.2% more than the same amount in 2005; also, their fuel oil consumption was 7581 million liters which was increased about 17.6% in comparison with 2005. Natural gas consumption of power plants, in 2006, was 35605 million m³ which was almost 1.9% more than 2005.

Efficiency of thermal power plant, in 2006, was some 35.5%, on average [6].

Number of electricity customers, in 2006, was 20559 thousand; while more than 82.6% of them were from residential sector. By the end of 2006, number of villages with electricity accessibility reached to 53059 of which 709 villages connected to electricity grid in year 2006.

Total domestic sale of electricity, in 2006, was 22571 billion Rials and its subsidy was 57247 billion Rials (excluding fuel subsidy) [6].

6.2 Coal

In 2006, Total production of concentrated coal was about 1.97 million tons which was nearly 45.2% more than 2005, and total imports of this energy carrier, with some 2.7% increase in comparison with 2005, reached to 0.56 million tons.

Total consumption of coal has been near 2.5 million tons in 2006 which was considerably 33% more than the last year. Total coal export has also increased in 2006 and, with a 28% increase, reached to about 0.05 million tons.

6.3 Traditional Fuels

According to the official reports of The Forests & Range Organization, the total production (about 300 thousand m³) of traditional fuels (wood and charcoal) has been considerably less than their total consumption (17.5 million m³) which implies that most of rural and woodmen are yet consuming the wood, charcoal, bushes and thorns and animal excrements instead of the oil products as fuels; Although regarding the fast growing natural gas network and broad distribution of liquid fuels in the country these reports seems unlikely.

Finally, according to the official statistics (Census Data of 2006), the total consumption of traditional fuels in Iran has considerably increased from some 0.06 MMBOE in 2005 to almost 25.4 MMBOE in 2006.

6.4 Renewable Energies (Wind and Solar)

The potential wind power of about 45 wind sites of 26 regions in Iran has been estimated near 6500 MW, while only 47 MW of which have been developed till the end of 2006. Statistics of wind energy utilization, in the form of wind electricity, has been presented under the electricity data. The wind electricity generation has started in 2001 in Iran and been steadily growing till 2006 with average annual growth rate of 33.7%.

Iran, regarding its geographic position and suitable sun shine potential and the need of energy distribution among more than 60 thousand countries and villages, has an appropriate potential and advantage in solar energy utilization. On the matter of the same facts, Iranian Fuel Conservation Organization has been performing two solar projects, the residential solar water-heater and the public solar water-heater, in several small cities and villages with appropriate climate conditions, since 2001.

Total installed residential solar water-heater and public solar water-heaters, with average annual growth rate of more than 134%, have reached to 13230 and 420 units, respectively; which has led to a considerable amount of energy (kerosene and fuel oil) conservation equal to 0.355 MMBOE in 2006.

7 Conclusion

In conclusion, though Iran has rich and abundant oil and gas reserves and has an elite energy position in the world, considering its social/political structure and the social security policies, is one of the most energy-consuming countries.

According to the world statistics, Iran's final energy intensity (0.91 TOE per thousand dollars) is almost 3 times more than the same index for the world (0.25 TOE per thousand dollars) which means that energy consumption per production unit in Iran is considerably greater than the same index in other countries, even the countries in the same region (such as Turkey, KSA, etc.), and the world average. The final energy intensity of Iran has been increasing gradually up to about 4% in 2006, with the average annual growth rate of 0.74% between 1996 and 2006, [6].

Regarding to the cited data and statistics of energy consumption in Iran, not only considerable share of total energy consumption is being consumed in non-productive sectors such as residential (32.55% of total energy consumption) which produce no added value, but also this huge energy consumer sector has had a 20% growth rate in 2006, which is considerably high, in comparison with the previous year. Also in the other energy consuming sectors, with regard to old energy consuming technologies, inappropriate energy management and low price of energy carriers, more energy consumption and low energy efficiency in production could obviously be understood.

Shortly speaking, the main factors that have caused tremendous energy consumption are low fuel price and enormous amount of subsidies, disregarding the fuel consumption standards and lack of such limiting standards in some cases, lack of policy about fuel pricing, changing the energy consumption pattern (extending the power network and fuel distribution to small cities and villages), no growth in production and using old and high energy intensive industries, technologies and products.

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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