

## Renewable Energies and Sustainable Development in Iran

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Energy is one of the main factors that must be considered in discussion of sustainable development. There are several definitions for sustainable development including "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Dincer, 1999). Sustainable development within a society demands a sustainable supply of energy resources, which in long term, is readily and sustainably available at reasonable cost and can be utilized for all required tasks without causing negative societal impacts. It also needs an effective and efficient utilization of energy resources. Negative social impacts or so-called social costs occur as a result of limitation in assimilative capacity of the environment. Therefore, planning for sustainable development needs to plan for sustainable energy supply. In this way, environmental amenity would not be sacrificed for achieving a rapid economic growth. Thus, the study of inter-linkages between economy and environment is of commanding importance for policymakers and planners alike.

It is apparent, therefore, that economics has a role to play, since much of economics is concerned with allocating resources to conflicting demands. However, it will also become clear that economic systems, primarily the market system, works very poorly in allocating environmental resources. In other words, market failure occurs. The price system is unable to solve the problem of absolute scarcity, even with a correct set of relative prices in place. Such a failure is only solvable with some limitations on resource use and on population. This makes the role of government more essential both in national and international scenes.

Energy has an essential role in the Iranian economy. It is not only a production input in the productive sectors, but also the revenue gained from energy export has been considering a prime source of finance for development purposes.

In some developing countries, governments do not pay attention to environmental issues due to the extreme limitation in investment resources and a strong appetite for rapid growth. In Iran, recently, environmental issues have become more apparent, while they were almost not a consideration in the distant past. Fossil fuels have more harmful impacts on the environment than other sources of energy, i.e., renewable energies or clean energies. In Iran, the traditional domestic pattern of energy supply and use until the early 1900s was mostly based on noncommercial and self-production energy carriers. Even after exploration of Iran oil in 1908 the pattern was unchanged. Petroleum products had limited use (only for lighting) and were imported from Russia/Azerbaijan. Since 1929, with establishment of Petroleum Product Distribution Company in Iran, the consumption of petroleum products have been increasing (Razaqi, 1988), which in turn tends to increase the share of fossil fuels in the energy basket. Since 1973, along with a rapid growth in Iranian oil export revenues, the pattern of traditional energy demand and supply has moved to a fossil based energy basket. This factor and others such as

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the great increase in population, energy consumption, industrial activities, etc., has accelerated the rate of environmental destruction in Iran.

Iran has rich natural energy resources including oil, gas and renewable energies. For more than a century Iran has played an important role among energy exporters in the world. Iran holds 90 billion barrels of proven oil reserves, or roughly 9% of the world's total. Iran contains an estimated 812 trillion cubic feet (Tcf) in proven natural gas reserves — the world's second largest and surpassed only by those found in Russia (EIA, 2000). Studies show that Iran also holds a capacity of 6500 MW wind electricity, 7400 MW Geothermal electricity, 42000 MW Hydroelectric powers, and 1800 kWh/m<sup>2</sup> solar electricity. In addition, some preliminary estimations shows that there is capacity to produce 4.6 billion cubic meters per year of bio-gas from municipal wastes and 2.3 million cubic meters methanol from the waste of the sugar industry in Iran (Ministry of Energy of Iran, 1999a).

In spite of the rich potential of renewable energies including geothermal, wind, hydro, solar, etc., the shares of these sustainable energy sources have diminished in recent decades. In 1997, the share of renewable energy (excluding large hydro) in total energy consumption was 0.0004 (Ministry of Energy Iran, 1999a). Real prices of fossil fuels in Iran are much more than nominal prices, since fossil fuels are implicitly subsidized and the social costs and negative externalities of consumption of these fuels are not taken into consideration. On the other hand, because of the relatively low prices of fossil carriers, they are inefficiently consumed, and mismanagement has occurred in almost all economic sectors. Given the exchange rate of the national currency (rial) as one dollar equal to 3000 rials (this is an official export rate), energy intensity is equal to 7.12 barrels of oil equivalent primary energy per one thousand U.S. dollars of GDP. Therefore, energy supply is neither sustainable nor effective and efficient, which as mentioned earlier, are necessary conditions for sustainable development.

Therefore, relatively cheap fossil carriers, and the availability and accessibility of them, have encouraged the limitation of renewable energies in the energy basket of Iran. This has caused some critical environmental problems in the country. Major environmental issues in Iran include air pollution, especially in urban areas, from vehicle emissions, refinery operations, and industrial effluents; deforestation; overgrazing; desertification; oil pollution in the Persian Gulf; and inadequate supplies of potable water. These problems levy a serious financial burden on Iranian government. There is no doubt that in Iran, the allocation of energy resources is inefficient. Therefore, the current pattern of energy supply/demand deters Iran from a path of sustainable development. In this regard, the close connection between renewable energy sources and sustainable development comes out.

Table 1 indicates the private and partial social cost of electricity production by different types of power plants. It is called partial social cost because it is only based on a few kinds of pollutants. Excluding social costs, fossil based power plants produce cheaper electricity. Whereas, taking social costs into consideration, renewable power plants are more economic. The social costs appear as the costs people have to pay for medical treatment as a result of diseases caused by pollution. Figure 1 ranks the power plants by the total production cost of electricity production. The social costs relating to CO<sub>2</sub> are

**Table 1**  
**Private and Social Cost of Electricity Production in Different Power Plants in Iran**  
 (U.S. cent /kWh)

Type of Generator	Private Production Costs	Social Costs		Total Cost	
		SO <sub>x</sub> ,NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>x</sub> ,NO <sub>x</sub>	+CO <sub>2</sub>
Steam using Fuel Oil	4.0	2.9	1.9	6.8	8.8
Steam using Natural Gas	2.7	1.1	1.4	3.8	5.3
Combined Cycle	2.0	0.8	1.0	2.8	3.8
Gas turbine using Natural Gas (Base Load)	2.4	1.2	1.5	3.5	5.0
Gas turbine using Gas Oil (Base Load)	6.1	2.4	1.9	8.5	10.5
Gas turbine using Natural Gas (Peak Load)	3.3	1.2	1.5	4.5	6.0
Gas turbine using Gas Oil (Peak Load)	7.1	2.4	1.9	9.5	11.5
Small Hydro	3.6	0.0	0.0	3.6	3.6
Wind	3.4	0.0	0.0	3.4	3.4
Solar (Photo Voltaic)	64.9	0.0	0.0	64.9	64.9
Solar (Linear Parabolic)	18.2	0.0	0.0	18.2	18.2
Solar (Central Tower)	22.7	0.0	0.0	22.7	22.7
Solar (Sterling dish)	35.7	0.0	0.0	35.7	35.7
Geothermal	3.1	0.0	0.0	3.1	3.1
Biomass	8.5	0.0	0.0	8.5	8.5
Nuclear	8.9	0.0	0.0	8.9	8.9
CHP, (Elec+Heating), Steam using Natural Gas	2.9	1.2	1.5	4.0	5.6
Fuel Cell, Electricity + Heating	12.6	0.0	0.0	12.6	12.6

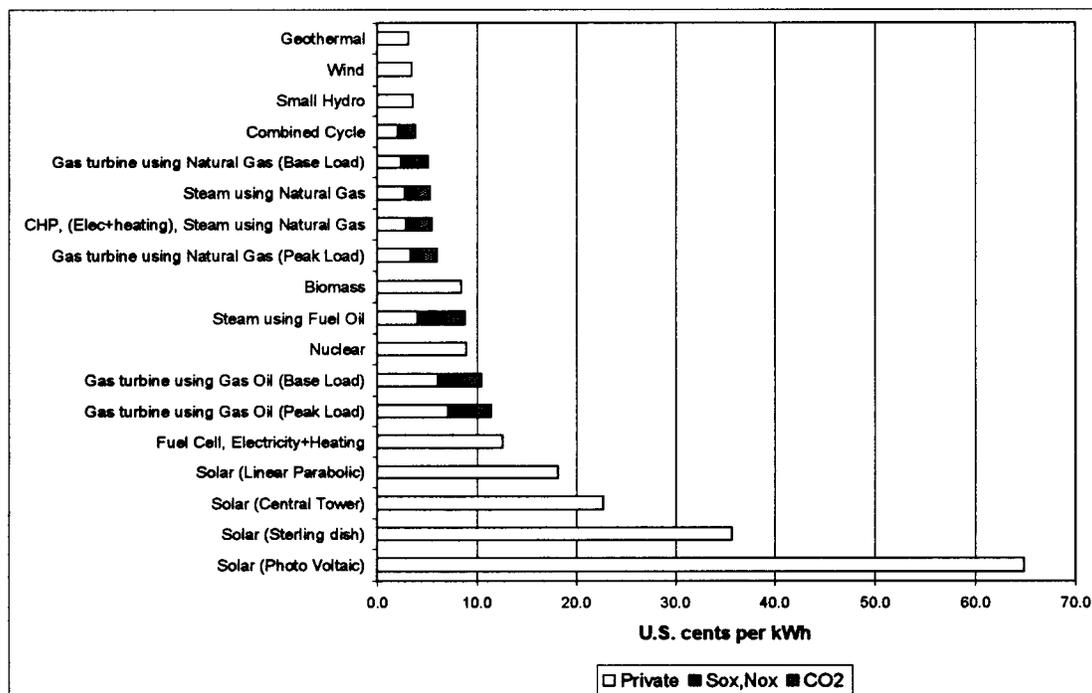
Source: Ministry of Energy of Iran, 1999b

not a small problem for Iran. The amount of GHG emission in Iran is not inconsiderable, when the rankings in Figure 1 includes the social costs related to CO<sub>2</sub> as well as SO<sub>x</sub>/NO<sub>x</sub> emission. Figure 2, which ranks the power plants on the basis of private costs plus SO<sub>x</sub>/NO<sub>x</sub> social costs, is more helpful for decision making.

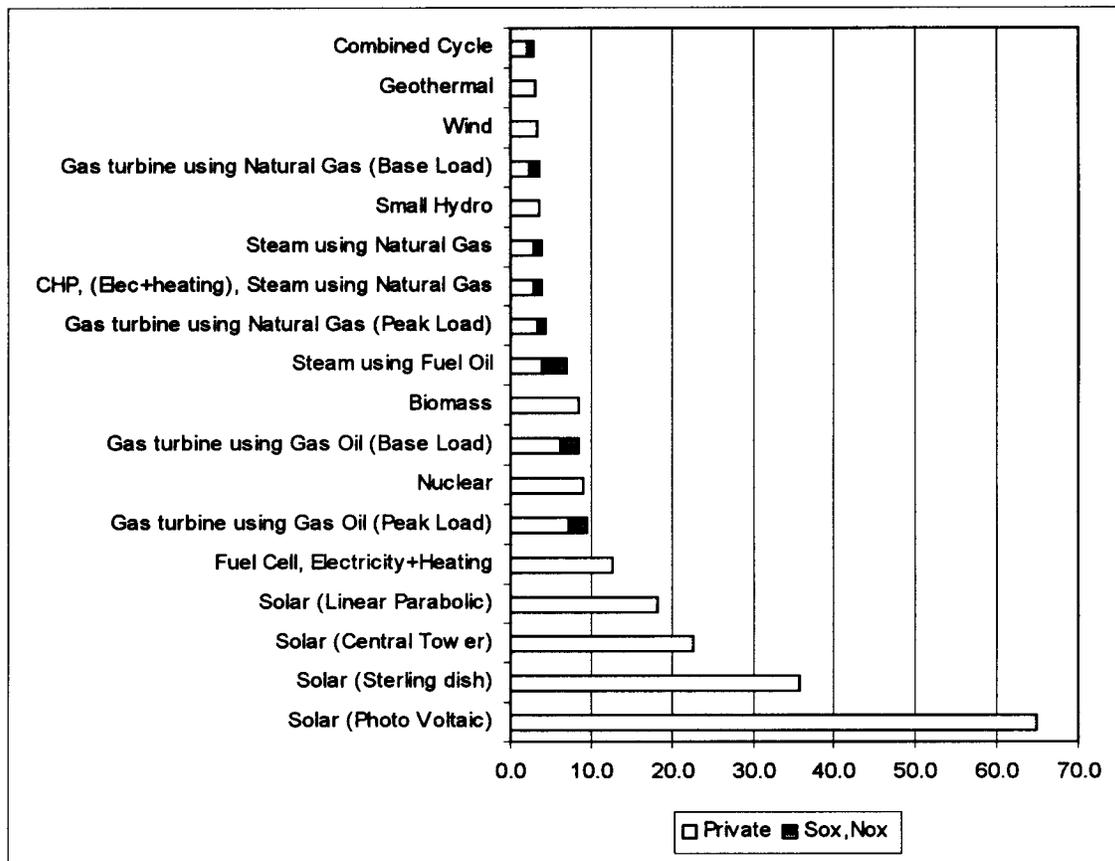
To sum up, the Iranian government is well aware of the environmental problems and their harmful short/long run effects on the process of sustainable development. The main efforts to achieving sustainable development are: continuing and accelerating conservation policy; reconstructing the

*(continued on page 22)*

**Figure 1**  
**Total Production Cost of Electricity by Type of Power Plant**



**Figure 2**  
**Production Cost of Electricity Including SO<sub>x</sub> and NO<sub>x</sub>**



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structure of energy pricing by promoting privatization policy and removing problems in this regard; elimination of implicit subsidies in nonproductive sectors; transforming the implicit subsidies in productive sectors that have relative advantage in international markets into explicit ones; taking social costs into consideration and internalizing the externalities via tradable tariffs, etc.; imposing carbon tax on fossil based energy supply; and stimulating private sector to invest on renewable plants.

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