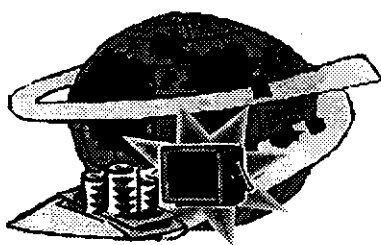


Data from the World Resources Institute show that over a period of 15 years, particulate matter loading have exceeded 230 ug/m³ in average 174 days per year in Tehran, while sulfur dioxide concentrations were higher than 150 ug/m³ during 104 days per year in average. Vehicles exhaust emissions are believed to be the major factor of air pollution (with an estimated 70% to 80% of total emission), together with emissions from industrial stacks and residential heating units. Adequate policies and targeted energy efficiency measures, especially in the households and industries in Tehran and other major cities, should be implemented urgently to help alleviate air pollution, as a complement to actions undertaken in the transport sector. In the case of Tehran, initiatives in the transport sector include construction of metro and trolley bus lines, a traffic control and management center, vehicle inspection and tune-up, and conversion of buses and taxis to LPG. A new project to reduce transport sector emissions in Tehran is under preparation with the world bank assistance and funding from the Global Environment Facility (GEF), which would consist of several components complementing ongoing initiatives, possibly including emission inventory and air quality monitoring, traffic management and restraint, vehicle fleet and fuels improvement, and evaluation of the cost-effectiveness of air pollution reduction instruments.

The Government started implementing far-reaching economic reforms in the First Five Year plan (1989-1993) aiming to revitalize market mechanisms. Key elements include: reconstruction work, fiscal measures, simplification of the exchange rate system, first step towards decentralization/ privatization, and relaxation of various controls, including decontrol of domestic prices and steep



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GIRI's main priorities in the energy sector are the following:

- * Rehabilitating the power sector to increase the reliability and efficiency of existing plants, together with the development of a least-cost power generation program and the evaluation of the prospects for commercialization and privatization in the subsector.

- * Developing the use of the huge reserves of natural gas (including flared gas and condensates) either for domestic use in competing downstream sectors, or for export.

- * Implementing price reforms to better reflect economic costs of energy

supply and to induce conservation, in particular for electricity (e.g. through time-of-use rates reflecting seasonal variations in the cost of supply, which are being experimented in the industry sector, as well as time-of-day rates to induce load-shifting in the residential sector).

- * Promoting and implementing economic conservation and substitution of energy, both at supply and demand levels.

The Ministry of Power (MOP) is in charge of planning and supervising generation and distribution of electricity; electricity supply is provided mainly by national and regional enterprises, with depend administratively on the MOP, and by some industrial enterprises (8% of total generation in 1991). The Ministry of petroleum oversees the production and distribution of petroleum products and natural gas, which is developed by the National Iranian oil company (NIOC) and the National Iranian gas company (NIGC), the latter in charge of gas distribution. The Planning and Managing Organization (PMO) is responsible for overall development strategies, investment prioritization, and budget allocation. The Policies and projects several other institutions have an influence on the development of the energy sector, as well as on the patterns of energy demand, including: the ministry of industries and mines (supervision of appliance manufacturers, and the most energy-intensive industries), the institute of standards and Industrial Research of Iran (ISIRI), the ministry of housing and Urban development, the department of environment, the Iranian nuclear Power Organization (in charge of renewable energies).

per year is average compared to countries with similar GDP. Final energy consumption per unit GDP (about 1/2 Kgoe/US \$ in 1988) is higher than that of countries such as Brazil and Korea, but it is lower than most other oil-exporting countries, e.g. Venezuela, Algeria and Mexico (with 1.085 and 0.65 kgoe/US \$ respectively). This is due to the rather unusual structure of GDP, where the service sector is predominant (62% of total GDP at current prices in 1989), while the contribution of the industry sector is very small (15% in 1989) although growing. Thus, the less energy intensive service sector makes up for large inefficiencies in the residential and industry sectors.

Iran has a fast-growing urbanization pattern. Urban population increased at 5% per year over the 1980s. (compared to 3.6% for total population over the same period). About 21% of the urban population lives in Tehran and 41% of the urban population live in cities of more than 1 million persons. This pattern of fast urban growth brings serious environment problems, some of them related to the production and use of energy. While not known precisely, the patterns of energy use in rural areas are likely to be more environment-friendly, although probably more inefficient than the ones in urban areas. Electricity access is very satisfactory compared to other developing countries: in 1985, 80% of total population had access to electricity (97% of the urban population and 61% urban population); this indicates that the growth of electricity consumption related to new customers will be accounted for mainly by new households, especially in urban areas.

Petroleum products weigh heavily in final energy demand. While the contribution of electricity is even more limited than in most oil-producing countries, the consumption of natural

gas is extremely small compared to proven reserves (300 years at medium-term projected consumption levels); in addition natural gas flaring still represented about half of total gas consumption in 1988. Total energy consumption in 1991 amounted to about 58 millions toe, with petroleum products accounting for more than two thirds of the total (69%), natural gas for 21% and electricity 7% only. In the same year, the residential and commercial sectors represented about 36% of final energy consumption, while the industry and transport each accounted for 24% and agriculture for another 8%. Demand of petroleum products grew at 6.6% per annum during the 1980s, while electricity sales have increased by about 10% per annum over the same period (with a stronger growth in the agriculture and residential sectors, 20% and 13% per year respectively). Electricity consumption in the industry sector grew at only 3.7% per annum during the 1980s; however, in the near future industrial electricity consumption is expected to grow at an annual rate of about 20%.

At about 750 kwh/year in 1988, per capita consumption of electricity is relatively small, especially when considering the high electrification rate. However, this is explained by several factors such as: the "suppress demand" due to the effect of load shedding and power cuts; the limited use of electricity in the industry (relying on cheap petroleum products), which accounted for only 21% total electricity consumption in 1988, while the combined residential and commercial sectors represented an unusually high 65% of total consumption in the same year; and, at the same time, the very limited use of electricity for energy intensive applications such as cooking and water heating.

Iran's electricity supply is characterized by widespread load shedding that affected all sectors and cost the economy more than US \$1 billion per year in 1991 (according to world bank preliminary estimates). Load shedding has however been reduced considerably since then. There are marked differences of electricity supply costs between the thermal plants used during peak hours or peak-demand seasons and the ones used for base load, which points to the need to design adequate incentives for load management.

As in most other oil-producing countries, domestic retail prices of petroleum products are heavily subsidized in terms of their opportunity costs, and the same applies to transfer prices at production level. In 1992, Kerosene, gas oil and fuel oil were all sold at less than 10% of their international equivalent; LPG price represents only about 3% of its FOB value and is therefore clearly considered as a refinery by-product. Natural gas retail tariffs are also low, although they increase in parallel with the cost of supply to different sectors (power, then industry, and finally the most expensive, residential). In the case of petroleum products, price increases have been very limited. Electricity tariffs are established for full cost recovery. However they are distorted by implicit subsidies on foreign exchange and fuel costs, and the tariff structure does not reflect the cost of supply to each customer class. Despite a strong tariff increase in 1992, the weighted average tariff of electricity was still representing only about 20% of the long run marginal cost (estimated at about 5.3 cents/kWh in 1990)

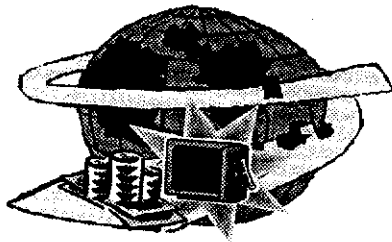
Tehran has a considerable air pollution problem, which might also exist in other large cities. High levels of sulfur dioxide and particulate matter are frequent, with potential health effects.

Introduction

Energy supply bottlenecks and shortages can be viewed as a paradox in a country endowed with large energy resources such as Iran. They have affected economic development negatively and are the result of several factors including, infrastructure damage during the war, repaid growth of energy demand combined with low and distorted energy prices, supply expansion constraints and lags, and inefficiencies at supply and end-use levels. In the power sector load shedding and power cuts have existed for many years. Despite the projected doubling of installed capacity between 1992 and 1998, it has been expected that capacity shortages would disappear only towards the end of this period. In the gas sector, depending on the pace of development of new fields, a supply deficit during high demand months could appear during the second half of the 1990s. Shortage of natural gas for the power sector during winter.

Peak months have contributed to the load shedding problems in this sector. In the petroleum sector, the high demand of kerosene in the residential sector and for gas-oil in the transport, and residential sectors results in the need to import part of the total consumption of these fuels, which is however expected to cease with projected increases in refinery capacity and recovery of condensates (LPG) contained in flared gas in the medium term.

The economic expansion and rehabilitation of energy supply should of course remain the priority in view of sustained GDP and population growth that is expected in the medium term. At the same time, enhanced efficiency in the supply and use of energy sources should also be considered when it concerns actions or measures that are more cost-effective than equivalent



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increases in energy supply, lessen environmental impacts and decrease overall investments in the energy sector. It must be noted, however, that the implementation of non-price actions to increase energy efficiency at end-use level (i.e. economic, low-cost-albeit large scale-measures) could probably decrease overall energy consumption by only about 15-25%, i.e. no more than the increase in total consumption in about 3-5 years. Reforming the price structures of energy sources to closer reflect economic costs and introducing more competition, autonomy and accountability in the energy sector would be priority actions to increase the sector efficiency, including at end-use level.

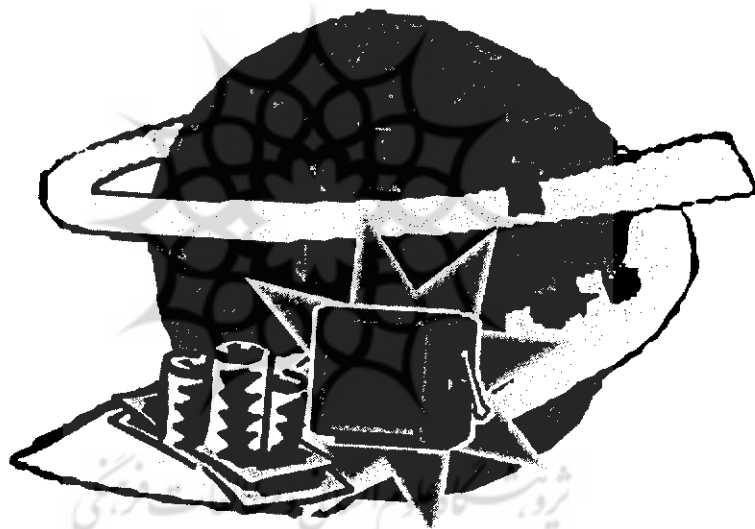
Non-cost effectiveness should always be put in perspective with efficiency improvements that will be achieved through sector reforms.

Non-price actions for enhanced end-use energy efficiency should focus on inelastic demands as well as on future consumers, and should try to lessen identified market barriers. Emphasis should be placed on identification and promotion of the potential market, information of consumers and professionals, institutional arrangements, financing aspects, development of intermediation services, and development and implementation of efficient, non-polluting technologies and equipment. This approach should be embedded in an integrated energy efficiency strategy and action program, which need to be consistent with macroeconomic and sector orientations and policies. Because of potential environment benefits and impacts on public investments, the development and implementation of such a strategy has become a priority of the Government of the Islamic Republic of Iran (GIRI), which is anticipated to be reflected in the next five year plan. The purpose of the preliminary activity described in this paper is to establish a framework that would support the development and implementation of energy efficiency in Iran. This paper briefly describes the energy sector background, identifies the major issues related to enhanced energy efficiency, and presents the scope of work, expected outputs, organization and timetable of the preliminary activity.

Energy Sector

The energy sector has traditionally played a major role in the health of the economy in Iran, as it has been the primary driving force behind GDP growth through oil revenue. Per capita consumption of energy of about 1 TOE

WORLD BANK STUDY
(PART ONE)*
ASSESSMENT OF ENERGY SECTOR
IN I.R.IRAN
(1990-2000)



The following is part (1) of an edited version of an assessment study on the energy sector of Iran prepared by the World Bank and submitted to the Division of energy Affairs of the Ministry of Power in 1995. The assessment study is rather thorough and describes the problems methodically. While several years have past since the original submission date of the study results, it appears that the identified problems were not so

important and none of the significant problems which are discussed in the paper have accured in the energy sector. It seems that the only beneficiary from this study has been the World Bank itself, as it has been able to extract sufficient information and statistics to further enhance the World Bank's shareholders projection of consumer market forecasts and needed consulting services in Iran.

* It should be noted that this study has been made by world Bank in 1995. Thus some of the predictions and also the figures of the paper are not reliable.