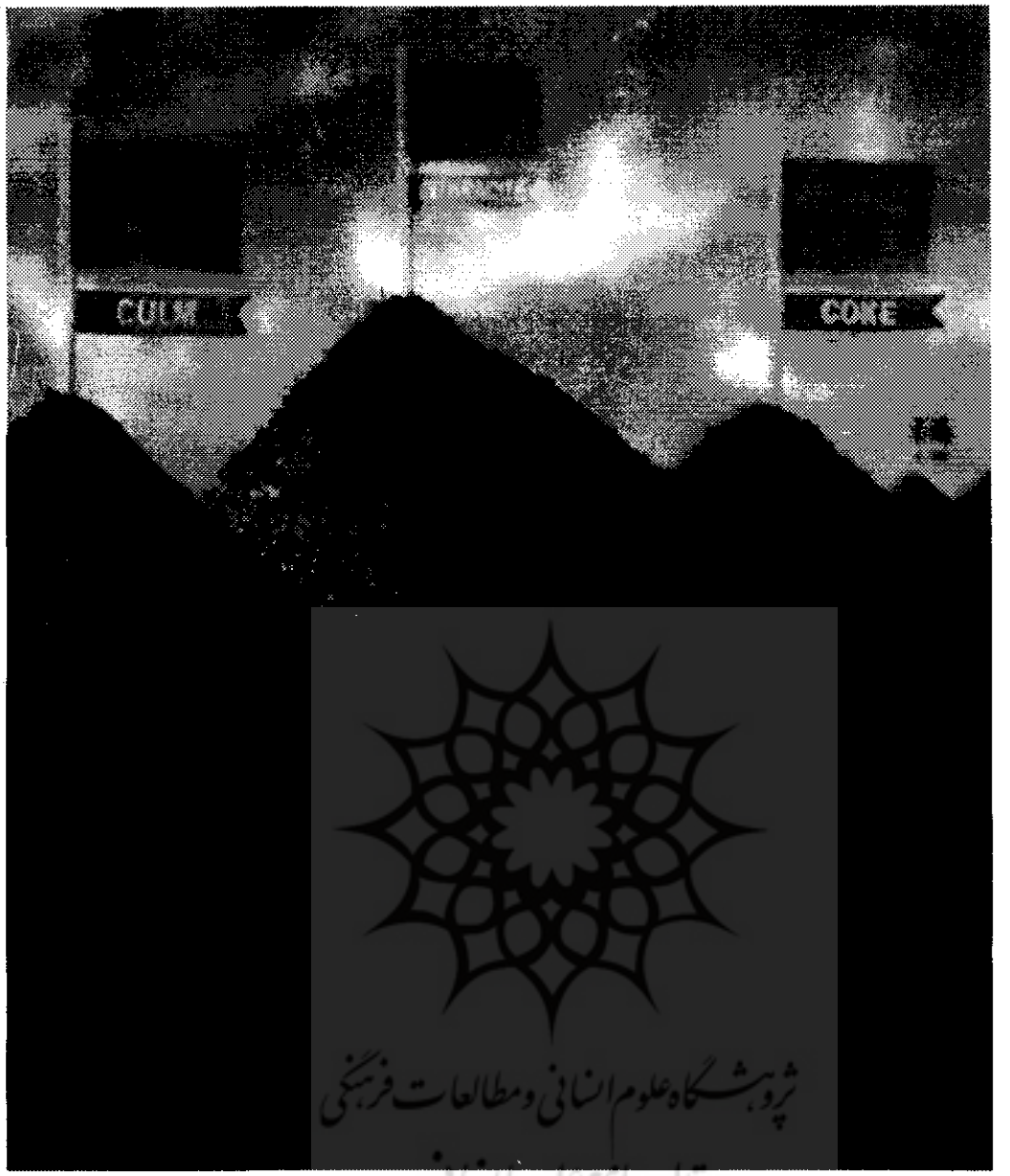

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Due to availability of gas in Iran and its lower environmental impacts, efforts are being made to create a shift from utilizing gas in place of kerosene (Table 1). The demand for natural gas is expected to grow from 89.8 to 375 million barrels of oil (equivalent) during a 20-year period (1997-2017).

New Standards

The research activities conducted on the adaptation of efficiency standards has finally resulted in better set of standards for electric and fossil fuel home appliances. The efficiency standards for refrigerators and freezers were introduced in 1999 and the same is being accomplished for gas and kerosene water heaters with storage tanks and space heaters, instantaneous gas water heaters, gas cooking stoves and ovens, and gas forced-draft heating systems this year. Several standards and energy-efficiency labels such as those in BS, JIS, and DOE were studied and one was adopted for use in Iran.

As an example, the details for energy efficiency standard and label for gas water heaters with storage tank is discussed in this article. The first standard for gas water heaters in Iran (National Standard No. 1219) was adopted in 1996 which was based on the ANSI Z21.10.1-1971 where the minimum required efficiency is 70% with no restrictions on stand-by losses, operation of pilot and its energy consumption. Also the lack of considerations for operation dynamics and effects of storage volume on energy consumption contribute to the inefficiencies of the 1219 National Standard. At the current production rate of 240,000 water heaters per year in the country, adaptation of new standards that would make improvements in operational energy efficiency of these appliances is desired. The standards that were studies included, JIS S 2109-1997, ANSI Z21.10.1-1990, and DOE 10 CFR Ch II: Part 430-1999. The JIS standard mandates a minimum efficiency of 60% and the ANSI standard does not specify any requirements for energy efficiency. The DOE standard introduces Energy Factor parameter (EF), which takes into account the effects of (a) transfer efficiency from heat exchanger to the storage tank and (b) water heater stand-by losses, given by EF = 0.62 - (0.0019 *V), where V is the storage volume in gallons. First hour rating (FHR) of a water heater is also introduced by the DOE standard as the second important parameters and it defined as the maximum volume of heated water delivered in one hour after the thermostat has cut off the fuel to the burner. Clearly, FHR is a function of the storage volume and recovery rate. The detail of testing procedure and definitions of other parameters such as water heating energy consumption are given by the noted reference.

recovery efficiency and daily and annual

The needed systematic methodology to identify solutions and to promote efficiency requires tools such as demonstration facilities and development of performance indices and consumption standards for all sectors

the lack of considerations for operation dynamics and effects of storage volume on energy consumption contribute to the inefficiencies of the 1219 National Standard

The energy efficiency label is considered as an effective means for displaying the facts about a particular product. While water heaters energy label as introduced by DOE relies on displaying the energy consumption based on therms/year, the label designed for use in Iran is more figurative and utilizes an intuitive approach where a range for EF is displayed from excellent (0.6) to poor (0.3) (Fig. 1).

Also a numerical model of gas water heaters is developed by the author which allows for examination of various control strategies such as PID, PSD (Ardehali et al., 1997) and optimal controls based on the dynamic behavior under various ambient conditions. The employment of newer standards and control methodologies is expected to lower energy intensity and achieve the higher efficiency in the country.

Table 1: Fosil fuel energy consumption (MBOE)

Fuel type	1978	1998	2018
Kerosene	36.2	79.4	375
Liquid Gas	3.5	21.3	18.5
Natural Gas	0.7	89.8	375
Appliance Energy Consumption in Residential Commercial Buildings	40.4	181.5	497.5
Total Value ($ Million)	428	5445	24850

Introduction

Establishing the necessary grounds for utilizing the available energy resources in developing a stable economic growth rate has been recognized, and the newest role of the government in Iran has been to encourage and, whenever possible, assist in these endeavors. Efforts have been made by the government since 1975 to establish the basic grounds for utilizing manufacturing standards as key component intheindustrialization growth process, however, there has been limited work done on energy efficiency standards. There are many social and economic benefits that are gained from the use of such standards. Realization of these benefits is an ongoing and changing process that must be sensitive to the specific technology itself and its potential for effective change or improvement. The factors responsible for the slow development of energy efficiency standards are identified as:

* Lack of understanding for importance of energy (heavily subsidized fossil fuel and electrical energy).

* Low and inconsistent income (nature of government-supported job market).

* Lack of proper management and adequate basic infrastructures for energy matters (inadequate legislative support).

* Uneven development within the country (investment mainly in the government holdings).

The causes for slow development are inter-related and they form a closed cycle making it difficult to approach problems on individual basis. Of course, the key factor contributing to this phenomenon is the uneven development at the global scale as the government manages 87% of the economy (Country Report 2nd quarter: Iran, 1998). The single most influential reason affecting the energy development is the improper distribution of fossil fuel subsidies. Energy pricing policies should be reviewed so as to eliminate distortions that have created barriers to development (World Energy Council, 1995). The heavily subsidized fuel prices allow for energy consumption rate in Iran to equal to world's average and several times higher than majority of developing countries. The low cost fossil fuel, electricity, and gas make it impossible to have a reasonable payback period for implementing an energy efficiency measure such as building envelope insulation. In larger cities, the insufficient incomes can only be complemented with supplementary earnings from activities that require low cost fuel. It is estimated that annually 40% of the total energy consumed in the country, 630 toe in 1997 (Energy Balance, 1997), can be conserved. The difficulty with high energy intensity stems from the fact that people do not separate out problems of energy from their other problems. Also in the process of industrialization, the transfer of technology has been primarily focused on energy intensive manufacturing processes, which has put a greater demand on internal consumption of energy produced.

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The difficulty with high energy intensity stems from the fact that people do not separate out problems of energy from their other problems

In search for solutions, the key element to note is that fossil fuel resources are utilized to serve as a source for energy and as a national income distributed through subsides to people. The plan for enhancement of resource utilization should include two complementary stages, namely, (i) development of energy efficiency standards by the government and (ii) distribution of subsides as encouragement for participation in implementing the standards.The needed systematic methodology to identify solutions and to promote efficiency requires tools such as demonstration facilities and development of performance indices and consumption standards for all sectors. In support for the efficient use of energy, the activities are to address energy requirements in the following sequence:

(a) Minimize the impact of the functional requirements,

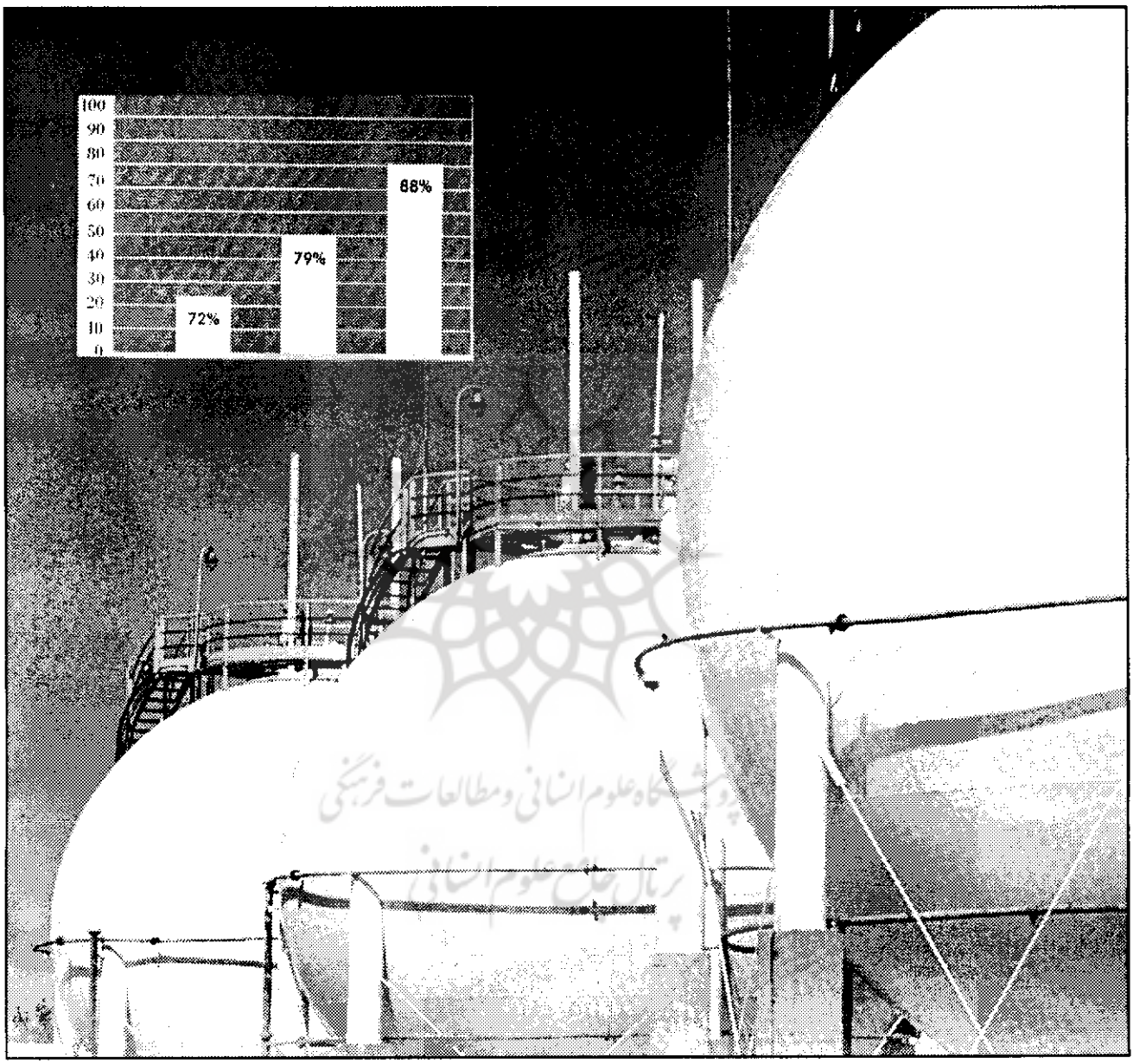
(b) Minimize loads,

(c) Improve the efficiency of distribution and conversion system, and

(d) Integrate subsystems into an efficient whole.

More recently, upon reviewing and consulting with numerous energy efficiency laws and regulations from other countries, there is a special section of the law (Subsection of Provision 19 in the second- and third-five-year development plan) developed and written for promotion and implementation of energy efficiency matters in the country.

Development of New Fossil-Fuel Appliance Energy Efficiency Standards in Iran



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