Table 6. Prediction of decreasing CO2 emission potential caused by energy labeling in some home appliances in Iran (2000)

Type of home appliances	Decreasing CO_2 emission (ton)	Energy saving (Gwh)
Refrigerator & Freezer	435139	765
Washing machine	7764.1014	14.3
Cooler	32073.5653	57
Samovar, Iron, Pump and Domestic compressor	35070.4547	60.80
Total	510047.11	897.1

Table 7. Comparison of CO2 emission in diesel and power- driving motors of deep wells in Iran (1996)

Type of gas	Emission from diesel motors (ton)	Emission from power -driving motors (ton)
CO_2	7944000	555683.62
Differences of two amounts	2387416.38	

evaluations revealed that technical

Table 8. Classification and preference of energy sectors in Iran for technical energy saving

Energy Sector	Cost for energy saving (MUS$)	Cost for CO_2 decrease (US$/ton)	Potential of decreasing CO_2 emission (ton)	Year
1- Steel industry	31.29	-60.67	397349.79	1997
2- Residential illumination	127	-20.26	10709053.54	2000
3- Glass industry	1.4	-11.32	75063.22	1997
4- Weaving industry	9.27	-7.25	137908.65	1997
5- Residential home appliance	-	0.07	510047.11	2000
6- Cement industry	7.69	4.61	115873.91	1997
7- Chemical industry	9.84	10.68	51172.95	1997
8- Agriculture water pump	1348	27.96	2387416.38	1996
9- Power plant steam[1]	294.19	28.1	534505.50	1999
10- power plant- combined cycle	221.26	216	19932	1999
Total	1922.94	128.72	14938343.05	1996-2000
Average	192.29	12.87	1443834.31	1996-2000

1 -According to scenario I: mentioned in table 2.

Note: gas-burning power plants, cube sugar and sugar, and vegetable oil (Meal) industries are not included due to high cost of decreasing CO2 emission.

power - driven one, will be totally 5991.03 and 1680.26 MUS$,respectively. By considering Iranian Rials to US Dollar exchange rate [13], elimination emission cost per 1000 kg CO2 will be equal to 27.96 US$/yr. Total time for returning of investing capital cost will be a maximum period of 3.5 years.

3- CONCLUSION

According to the surveys in the previous sections, the preference for doing technical energy saving can be seen in table 8.

saving potential in Iran from global warming and attenuating CO2 emission aspect is so high and approximately 14 billion kg CO2 emission could be reduced. In addition in this assessment we find out the following preferences for applying different measures in various power plants: 1- Steam, 2-Combined cycle, and 3- Gas power plants.

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scenario II, this cost will be about 35.98 US$.

From 1996 to 1998, an energy survey has been performed in 7 industrial sub-branches (steel, chemistry, cement, glass, weaving, sugar/ cube sugar and meal) [8]. Attenuation potential of energy consumption in different industries are depicted in table 3. On the other hand, elimination potential of CO2, SO2 and NOx emission can be seen in table 4.

If we assume that power saving per each kwh at the price of 0.038 US$ could be sold to foreign countries, then, the saling benefit of power in residential sector will be 34089.80 US$/yr. Consequently, decreasing emission cost per 1 ton of CO2 will be about 0.07 US$.

Average lifetime of string lamp is about 900 hours and lifetime of low consumption lamps is about 10000 hours [11]. In Iran for residential and public consumption, 85% of illumination is produced by string lamps and the remainder by fluorescent. If replacement peak load percent is assumed 50%, peak load attenuation percent, nominal capacity of production, net work capacity, total value of capacity, lamp number, replacement cost and its energy value will be respectively about: 12.8%, 3584 MW, 2368 MW, 2.7 billion US$, 44.9 Million, 127 Million US$ & 344 billion US$ [11]. According to the aforementioned characteristics, decreasing CO2 emission potential will be about 10709053.54 tons/yr. If we consider the cost for energy saving (127 MUS$), the cost for decreasing each ton of CO2 in this sector will be -20.26 US$.

In Iran the number of diesel motor powered deep wells in agriculture sector is higher than 40000. The fuel of these motors is gas/diesel oil and each year up to 3 billion liters of it must be consumed. If all diesel motors would be replaced power - driven ones, power consumption for each and all motors will be about 219681.28 kwh and 8.79 MMwh[12]. The amount of CO2 emission in these motors is depicted in table 7. In agriculture sector, ministry of petroleum and ministry of power (energy), the cost - benefit of transforming / changing diesel motors to

Table 4. Decreasing emission potential of CO2, SO2 & NOx due to technical energy saving in Iran industries (1997)

Type of Industry	CO_2(tone)	SO_2(tone)	NOx (tone)
Steel	397349.79	1834.6	609.92
Chemical	51172.95	811.02	171.12
Cement	11873.91	1457.54	326.48
Glass	75063.22	1199.02	252.52
Weaving	137908.65	642.02	211.82
Cube sugar & sugar	913.4	4.07	1.93
Vegetable oil (Meal)	49.58		0.07
Total	778331.5	5948.27	1571.86

In table 5, decreasing emission cost for 1 ton of CO2 is delivered. In zero year or at the beginning of steel, weaving, and glass industries' saving energy activities, all the consumption or costed financial / capital facilities have been returned. It is clear that monetary saving for each ton of CO2 in mentioned industries are about 60.67, 11.32 and 7.52 US$, respectively.

About 100% of urban and 70% of rural families use power network in Iran and 40% of power production in our country is used in residential sector. Yearly about 22 billion kwh are consumed in houses and commercial sector which is equal to 40 million barrel of oil [9]. In table 6 we can find some prediction about decreasing emission potential of CO2 in home appliances regarding energy labeling. All this evaluations are based on energy consumption potential in various home appliances [10].

Table 5. Decreasing cost of each ton of CO2 in subdivision of various industries due to technical saving (Scenario I)1

Type of Industry	profit from saling fuel and power (MUSS)	Cost for saving energy (MUSS)	Investment return time (year)	Total Investment (MUSS)	Cost of decreasing 1 ton of CO_2 (USS)
Steel	55.4	31.29	0.0	-	-60.67
Chemical	1.5	9.84	6.35	8.2	10.68
Cement	4.78	7.69	1.60	2.9	4.61
Glass	2.25	1.4	0.0	-	-11.32
Weaving	10.27	9.27	0.0	-	-7.25
Cube sugar & Sugar	7.74	14.6	1.87	6.87	3174.95
Vegetable oil (Meal)	0.93	1.36	1.72	0.43	8672.8

1 - Mentioned in Table 2 .

1- INTRODUCTION

Concern over global climate change (GCC) has been growing over the past decade as scientific evidence appears to indicate that increased concentrations of GHGs in the atmosphere will cause changes in global temperature, precipitation, sea level and other weather - related effects (e.g. in creased storm intensity) [1].

The present community capability for qualification of anthropogenic effects on climate change is limited. According to the UN estimation at 1990, energy intensity in Iran is 0.548 kg oil equivalent per GNP/ $, per capita energy consumption is 1158 kg oil equivalent and energy consumption is 63.2 million Metric toe [2]. In 1997 CO2 intensity was 174 kg CO2 / US$. If this intensity is evaluated by power purchasing rate in Iran the aforementioned CO2 intensity will be 3.51 kg CO2 / US$ [3]. If the above-mentioned amounts are evaluated in terms of Mt CO2 /Twh 3.682 will be yielded for Iran which in comparison with other countries is the highest amount [4].

2- TECHNICAL ENERGY POTENTIAL SAVING AND REDUCING CO2 EMISSION

Technical criteria in energy saving potential and reducing CO2 emission survey are as follow: Improving management, process changing, and instrumental changing or modification.

According to the work on two typical power plant in Tabriz and Esfahan [5] it is possible to increase the efficiency of power plants by 3%. Costs of increasing power plant efficiency, according to the descriptive power statistics [6] is 5,000,000 US$ for each turbine [5] (Table 1). According to the results of table 1, CO2 emission decreasing rate is 607199.1 ton/yr and in a 15 years period this amount will behigher than 9107986.5 ton. In table 2 investment return time and cost of removal of each ton of CO2 in each power plant (In Iran) in 1999 is depicted.

Up to the year 2005 role of combined cycle power plants will be improved by about 42% while contribution of gas-fired power plants to energy generation will remain unchanged and that of steam power plants will be decreased [7].

In 1999 the share of combined cycle, steam and gas power plants in the whole power production in Iran was 9%, 20%, 60%, respectively. Based on scenario I, decreasing emission cost per 1 ton of CO2 in the three mentioned power plants will be averagely 59.59 US$. In

Table 1. Optimization energy consumption cost and saving amount of fuel consumption in Iran P.P. at 1999.

Type of P.P	Optimization energy consumption cost (US$)	Saving amount of fuel (×1000)		
		Gas / diesel oil (lit)	Fuel Oil (lit)	Gas (m^3)
Steam	325×10^6	831.03	178368.15	369316.11
Gas	630×10^6	19860.75	0.0	70150.14
Combined cycle	230×10^6	7367.91	0.0	197542.98

Table 2. Capital cost return time andconsumption cost (US$) removal of each ton

Type of P.P.	Investment return time (Year)		Cost of removal 1 ton of CO_2 (US$)	
	Scenario [1]	Scenario [2]	Scenario I	Scenario II
Steam	10.5	7.1	28.1	49.7
Gas	124	80.1	47.9	74.2
Combined cycle	26.3	13.8	216	297

1 - with 50% decrease in gas purchasing price for refining and transport to the border.

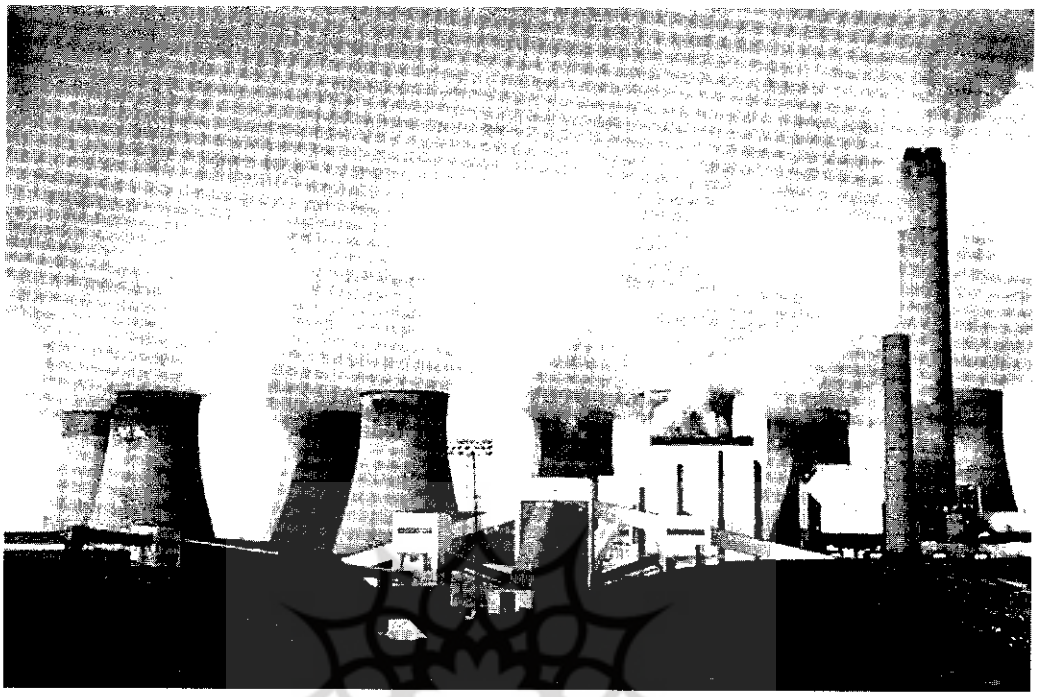
2- without any decreases in gas purchasing price for refining and transport to the border.

Table 3. Technical saving potential (A.E.C)1 in energy -carrier

Type of Industry	Natural gas ($1000m^3/y$)	Power (Mwh/y)	Fuel oil (Kl/y)	Costs (MUSS)
Steel	725354	694623	-	31.29
Chemical	-	990	16983	9.84
Cement	-	61800	27191	7.69
Glass	-	-	25189	1.44
Weaving	25992	242804	-	9.27
Cube sugar & sugar	192556	1545	-	14.64
Vegetable oil (Meal)	23243	-	-	1.36
Total	967145	1001762	69363	75.53

1 -Accelerated Energy Conservation

Global warming and technical savings in energy sector in Iran



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ABSTRACT

It is highly important to introduce energy saving policies in the residential/ commercial sectors where the highest rates of energy consumption and energy intensity are involved. Significant amount of capital/investments for construction of power plants and also high rate of fossil fuel utilization makes it necessary to pay more attention to energy saving. In the present investigation, areas of energy saving by technical means have been studied. The amount of CO2 production and reduction potentials in power plants, industrial, agricultural and residential/ commercial sectors have been evaluated. The results of present investigation reveals that more than 14 million tons of CO2 could be reduced through technical means in the various energy sectors. Utilization of combined cycle power plants could highly improve the reduction of CO2 compared to other conventional power generations. Highest priority must be given to steel, glass and textile industries and also residential sector for reducing CO2.

Key words: Global warming, CO2, Energy saving, Power plants, Energy sector