Air Pollution Reduction Problems

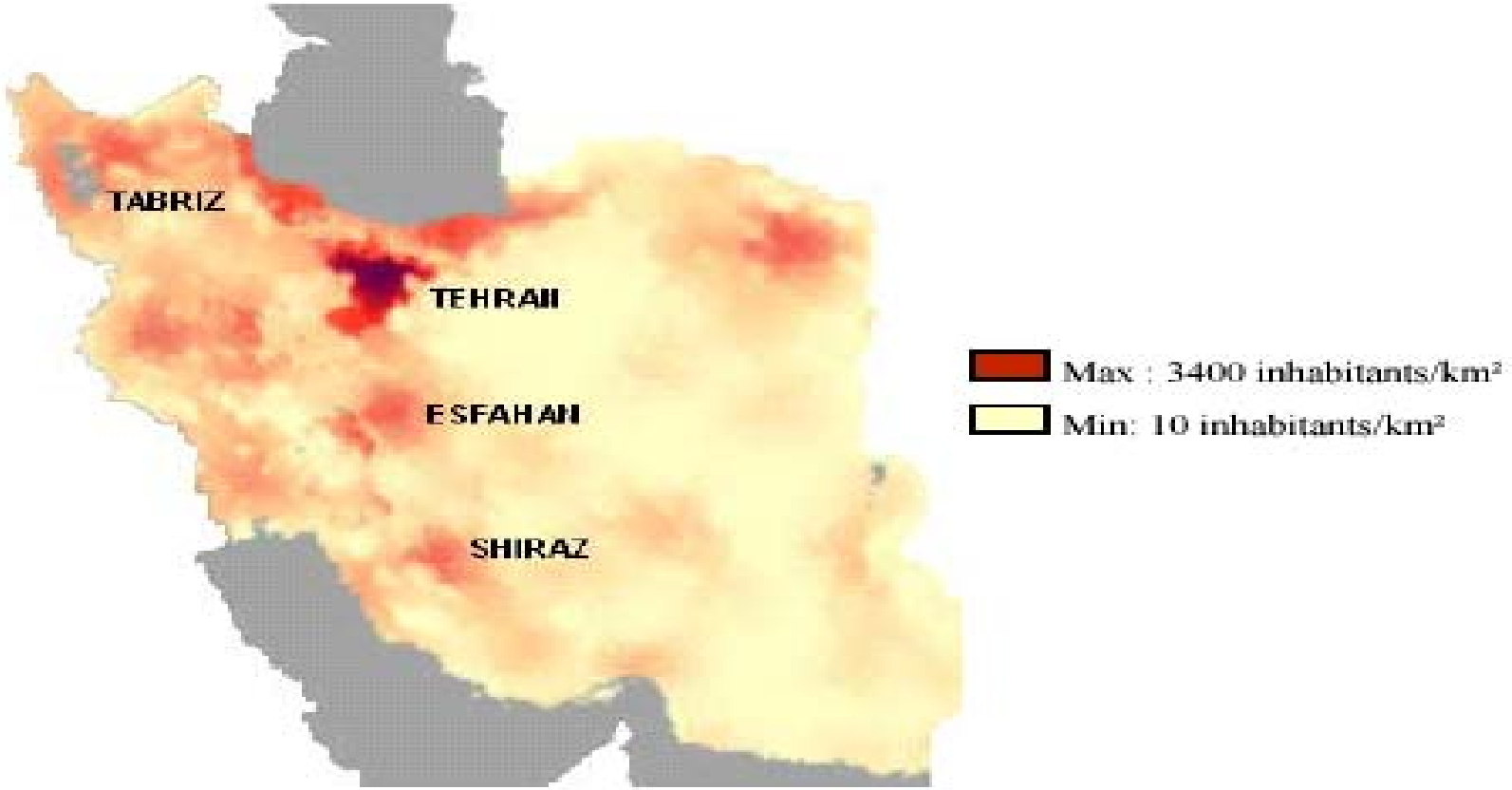
in IRAN

By : H.Naseri & S.M.Nabipour

IRAN MAP


ARMENIA
AZERBAIJAN
Caspian Sea
TURKMENISTAN
0 150 300 km
0 150 300 mi
Tabrīz
Mashhad
TEHRĀN
IRAQ
Qom
Kermānshāh
Bīrjand
Dezfūl
Esfahān
AFGHANISTAN
Tigris
Yazd
Ahvāz
Euphrates
Bandar-e Khomeynī
Kermān
Ābādān
Shīrāz
KUWAIT
Zāhedān
Būshehr
PAKISTAN
Persian Gulf
Bandar ʿAbbās
BAHRAIN
Strait of Hormuz
SAUDI ARABIA
QATAR
UNITED ARAB EMIRATES
Gulf of Oman
Chābahār
OMAN

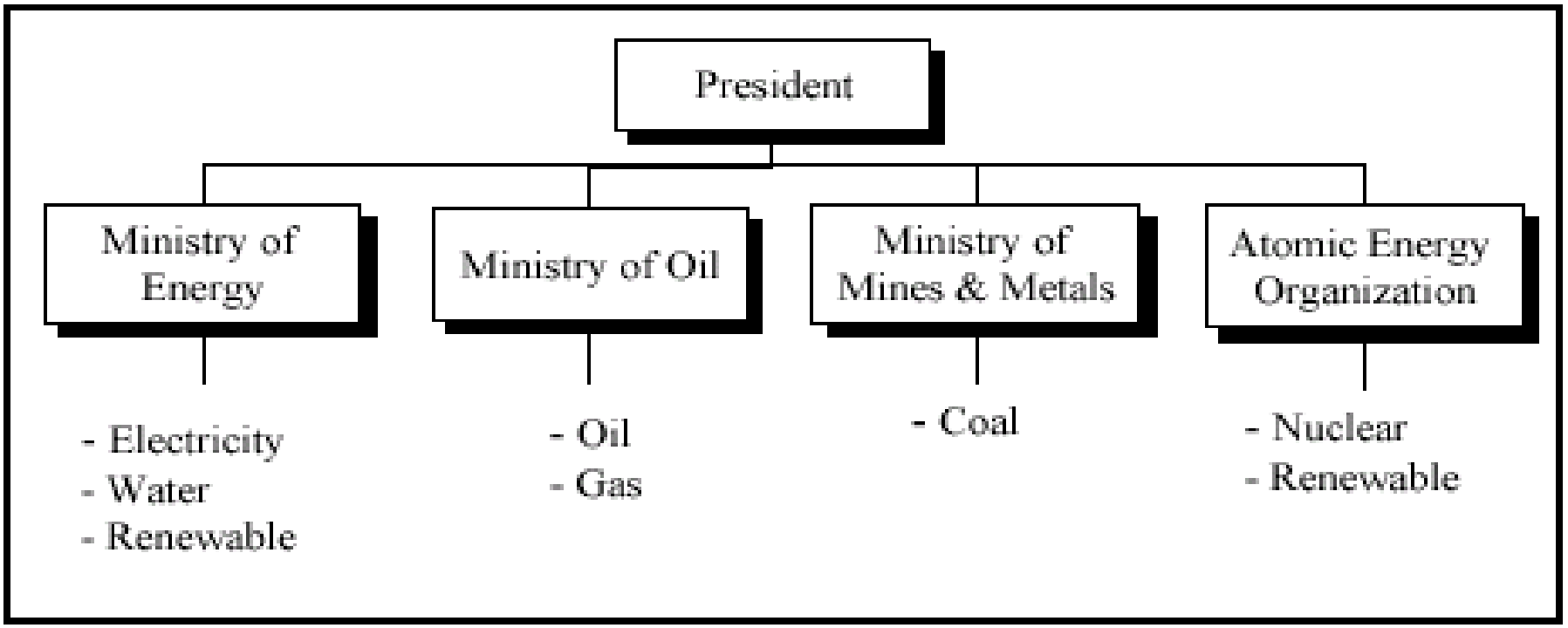
Population Density



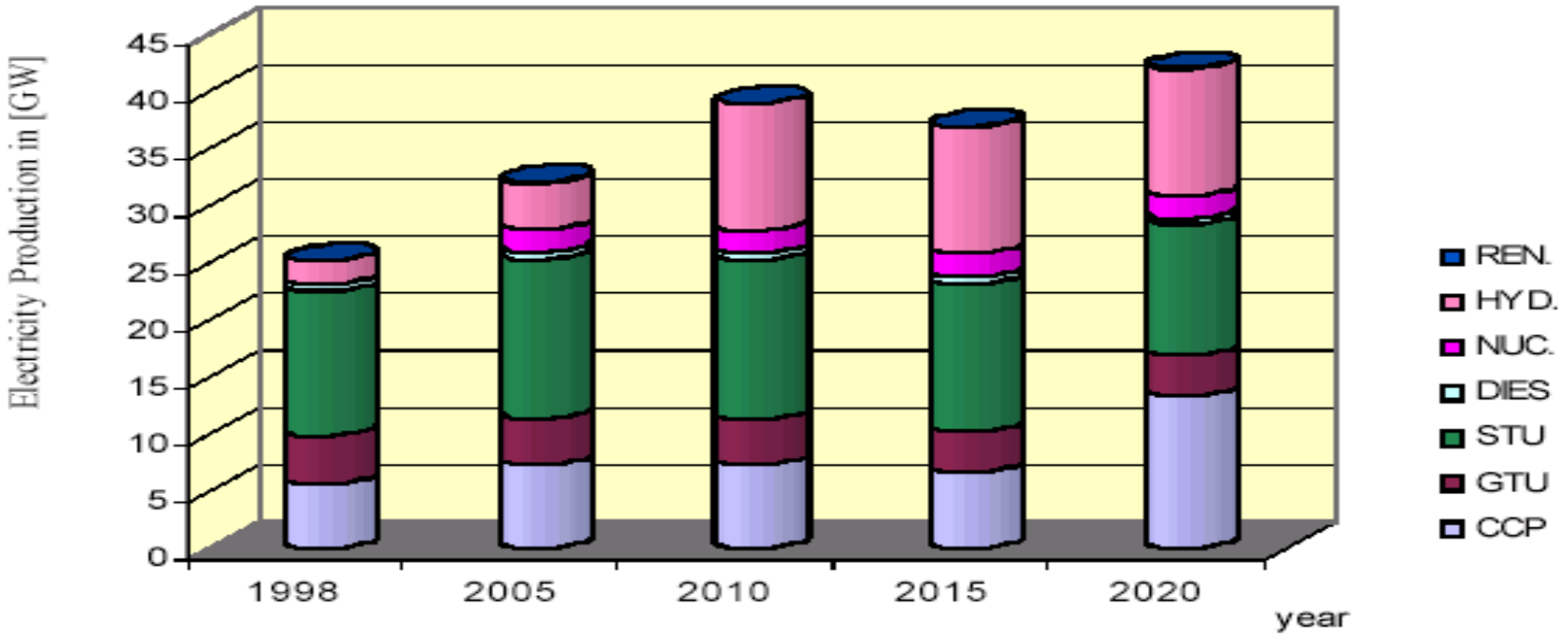
Economic Indicators

Indicator	Amount
GDP—real growth rate	4.1%
GDP—per capita: purchasing power parity	US$6,050
GDP by agriculture	26%
GDP by industry	39%
GDP by service	35%
Inflation rate (consumer prices)	14.2%
Labor force	15.4 million
Labor force—by occupation	Agriculture 33%, Manufacturing 21%
Unemployment rate	Over 20%
Exports	US$32.2 billion (f.o.b.)
Imports	US$18.4 billion (f.o.b.)

Energy Organizational Structure in Iran



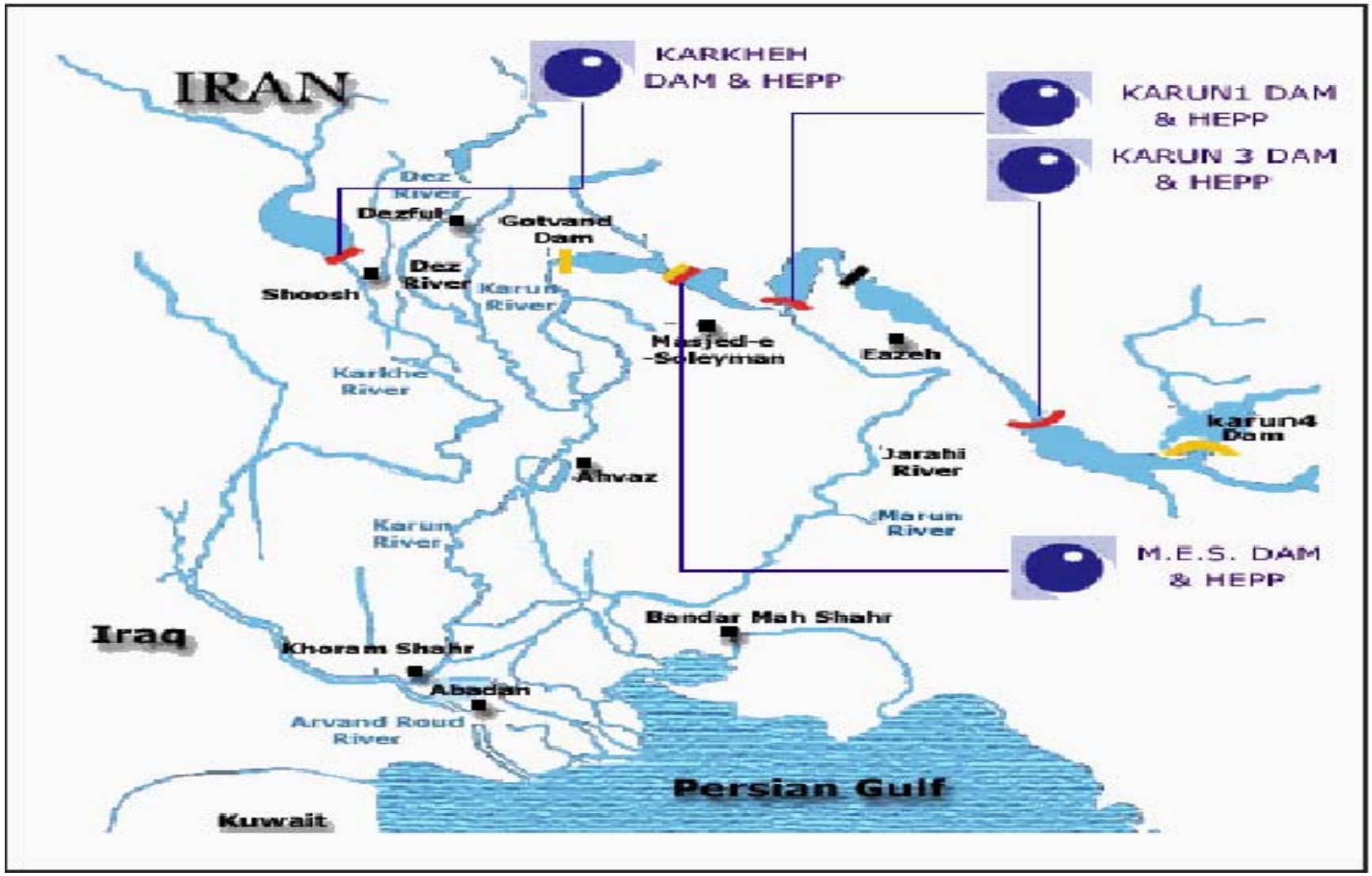
The Shares of Different Technologies in Electricity Production



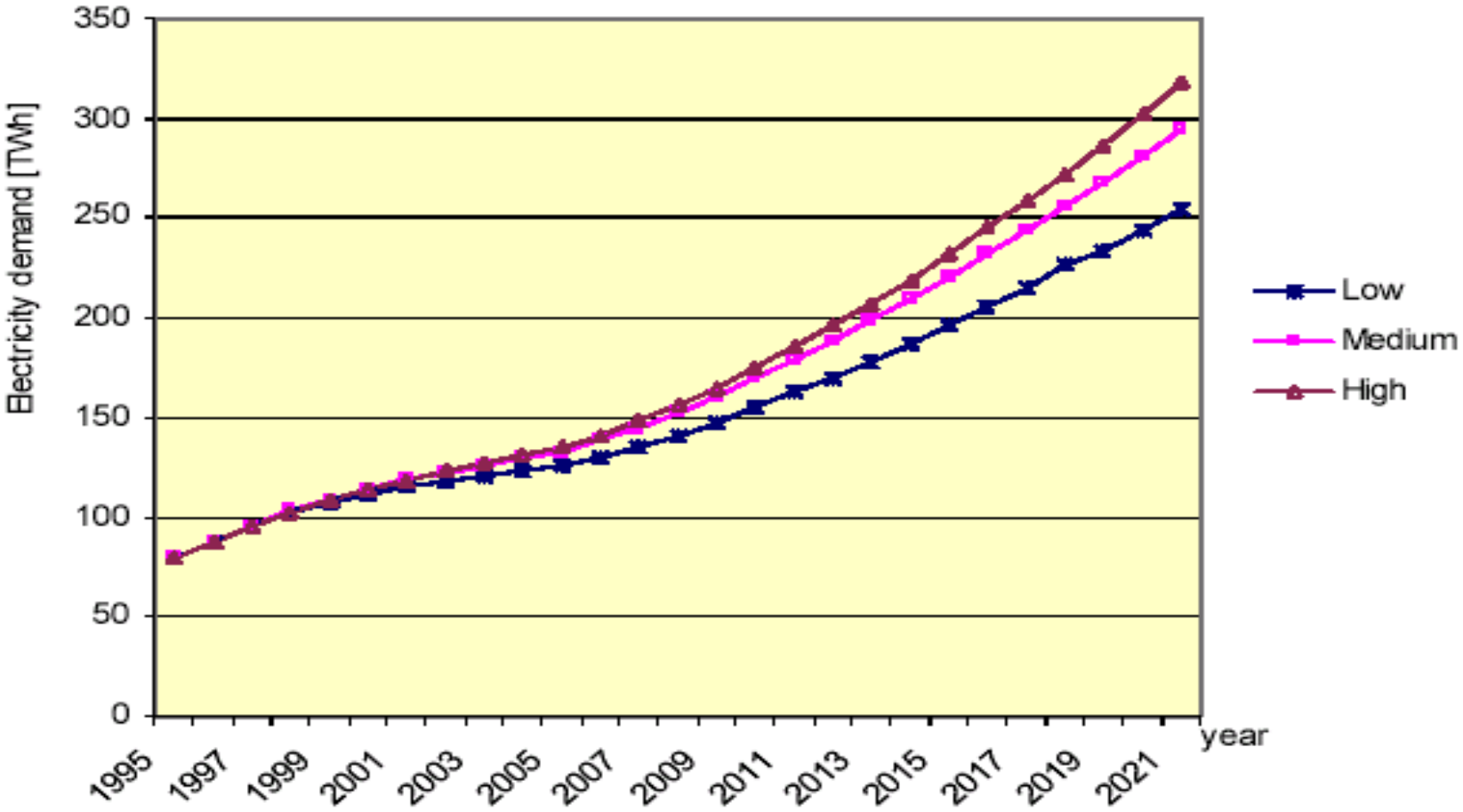
REN = Renewable
HYD = Hydroelectric
NUC = Nuclear
DIES = Diesel generator

STU = Steam turbine
GTU = Gas turbine
CCP = Combined Cycle Power plant

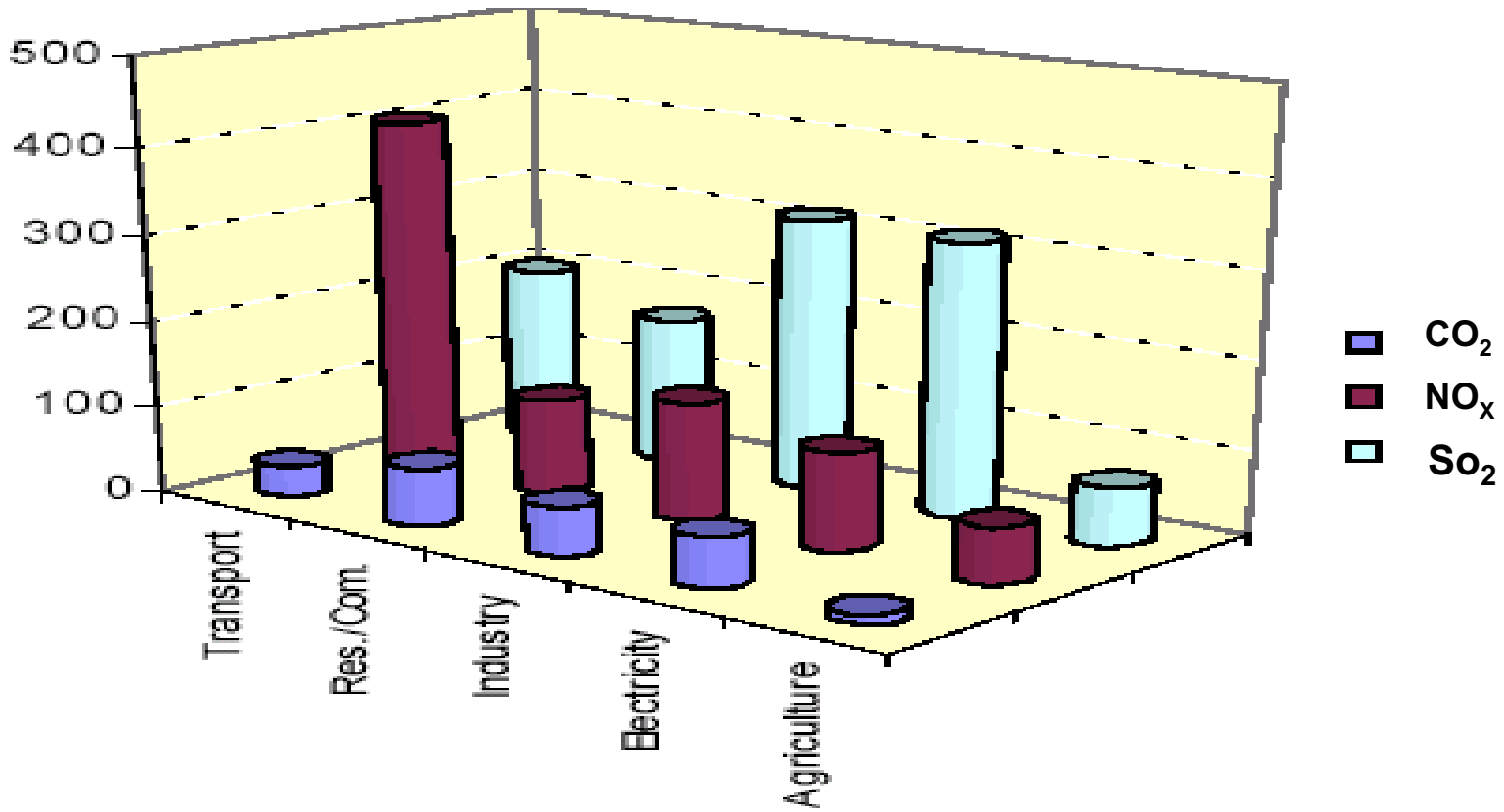
Hydro Power Plants under Construction in South of Iran



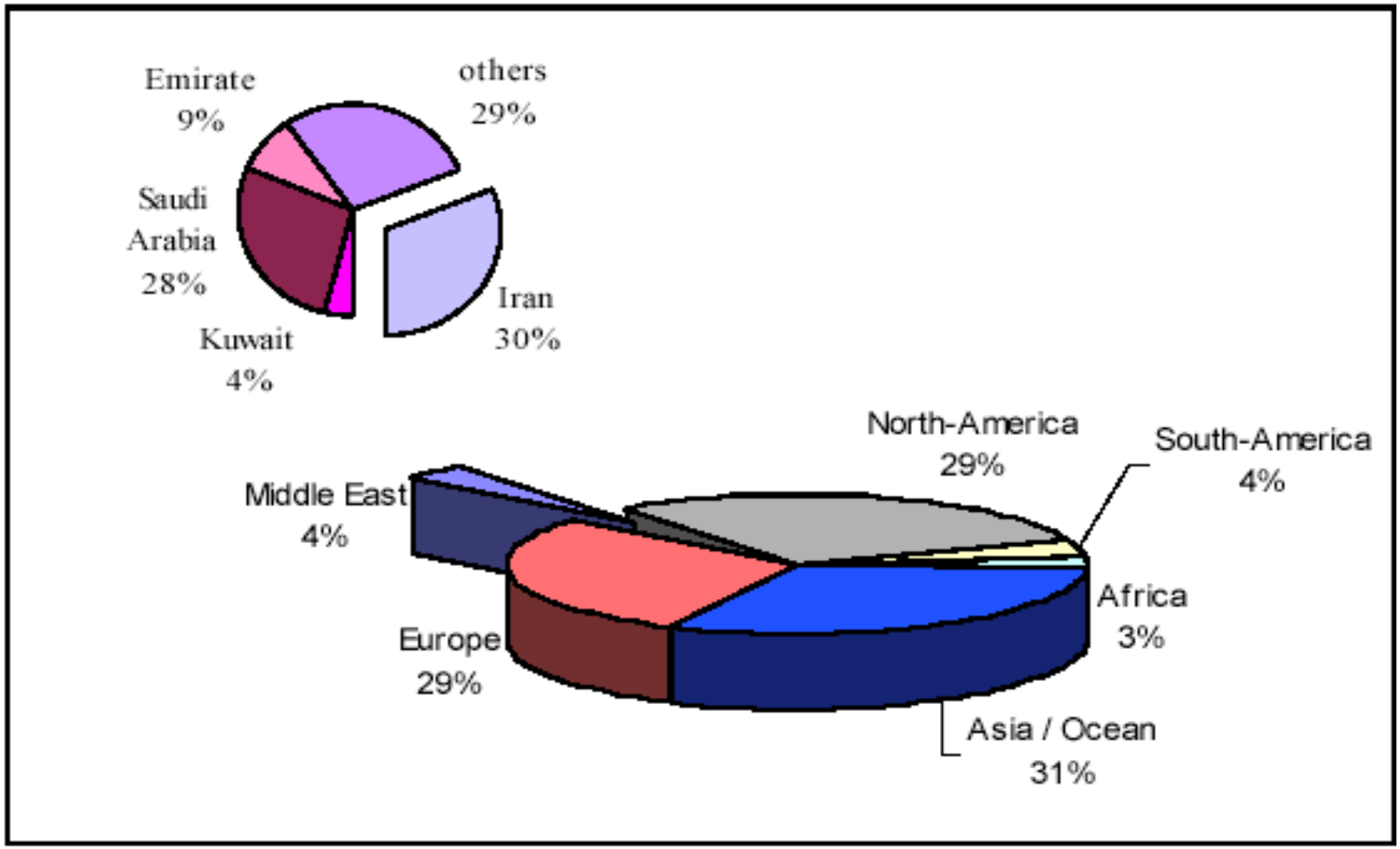
The forecast of the Electricity Demand



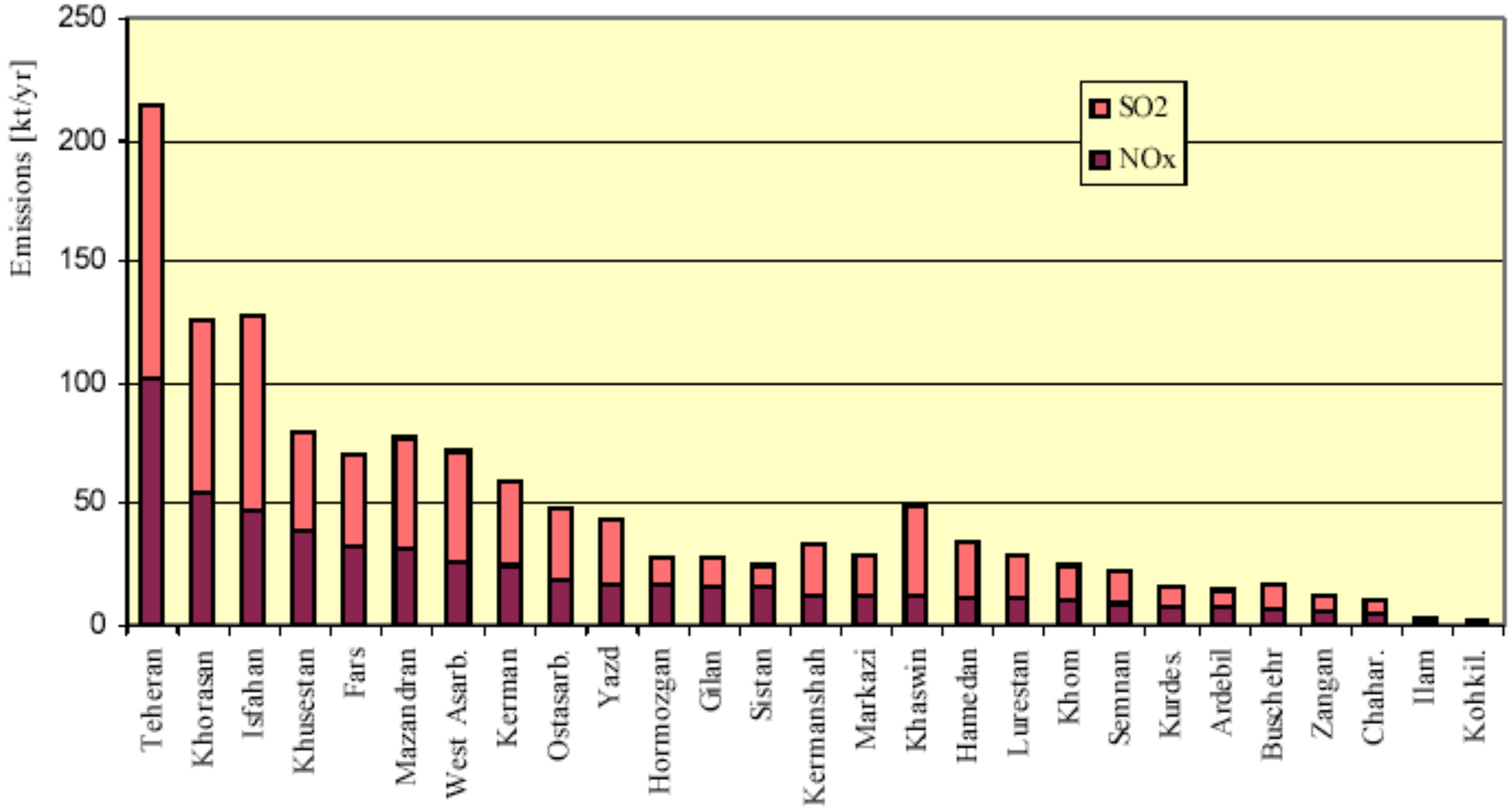
The Sectoral Contribution of Different Pollutants



The Shares of CO_2 Emissions (1997)



SO_2 and NO_x Emissions in the Different States



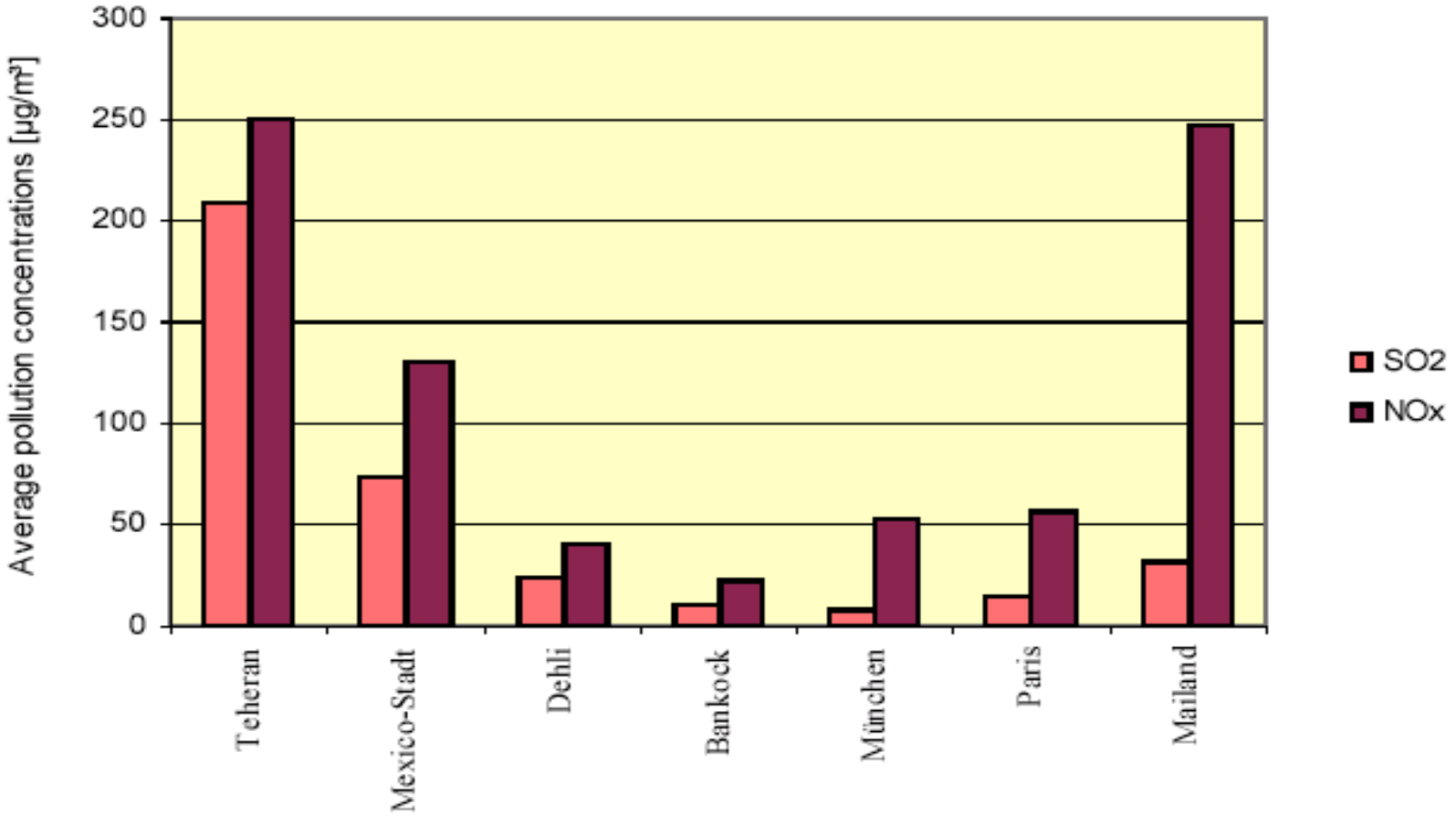
Annual Average Concentration of Air Pollutant in Tehran

	CO (ppm)	NO_2 (ppb)	SO_2 (ppb)	PM-10 ($\mu g/m^3$)
Average in 1999	9	39	48	112
Estimated in 2010	26	300	200	200
WHO/EPA Standard	2-4	50	30	50

The Power Plants Installed in Tehran

Type of power plant	Name	year	Capacity (MW)	Efficiency	Total capacity (MW)
Steam turbine	Firuzi Montazer ghaem Besat	1960 1972 1975	50 625 288	23 32.14 30.53	963
Combined cycles & gas turbine	Firuzi Motazer ghaem Besat Rey	1965 1972 1977 1978	20 696 247.5 1243	23 29.11 22.39 22.59	2207
Diesel generation	-		7.6	29.46	7.6
Hydroelectric	Amir kabir Latian Besat	1961 1969 1983	74 44 70		188

Tehran Compared to the Most Polluted City in The World (1995)



Comparison of Energy Consumed in Iran and Industrial Countries

Industry	Unit	Modern technology	Available Technology in Iran
Cement	kWh/t	85-110	130-161
Textile	kWh/t	3500-5500	7400-12600
Glass products	kWh/t	70-95	120
Metal products	kWh/t	8-12	30
Primary metal industries	Gcal/t	5.7	9
Chemical products	TOE*/US$1000	0.28	0.71-0.94

*Tons of Oil Equivalent

The Consequence of Subsidy Removal (1997)

Country or Region	Average Subsidization (% of reference price)	Annual Economic Efficiency Gains (% of GDP)	Reduction in Energy Consumption %	Reduction in CO_2 Emissions %
China	10.89	0.37	9.41	13.44
Russia	32.52	1.54	18.03	17.10
India	14.17	0.34	7.18	14.15
Indonesia	27.51	0.24	7.09	10.97
Iran	**80.42**	**2.22**	**47.54**	**49.45**
South Africa	6.41	0.10	6.35	8.11
Venezuela	57.57	1.17	24.94	26.07
Kazakhstan	18.23	0.98	19.22	22.76
Total Sample	21.12	0.73	12.80	15.96
% of Non OECD	N.a.	N.a.	7.48	10.21
% of World	N.a.	N.a.	3.5	4.59

SO_2 and Co_2 Emission Factors Used in the Model

	Lower Heating Value (MJ/kg)	Aver. Sulphur content (wt.-%*)	SO_2 Emission Factor (t/PJ)	Aver. Carbon content (wt.-%)	CO_2 Emission Factor (t/TJ)
Fuel Oil	41.03	1.5	731	85	76.0
Gas Oil	42.70	0.45	384	85.7	73.6
Kerosene	43.29	0.1	46.2	86.0	72.8
Gasoline	43.54	0.08	36.7	86.5	72.8
Gas	55.33	0.0022	0.8	84.5	56.0
LPG	46.0	0.002	0.88	82.0	65.4
Coal	31.08	1.0	643.5	83	97.9

* weight percent total (sulfur or carbon) in fuel

No_x Emission Factors for the energy sector in Iran

Sector	Type of fuel	NO_x Emission Factor (t/PJ), (t/GWh)[53]
Electricity	Gas oil	2.36
	Fuel oil	2.9
	Gas	0.54
	Coal	0.35
Industry	Diesel	60
	Fuel oil	170
	Gas	64-250
Residential/Commercial	Gas oil	60
	Fuel oil	120
	Kerosene	33
	Gas	45
	LPG	40
Agriculture	Gas oil	60
	Fuel oil	120
Transport	Gasoline	980
	Gas oil	1360

[53] (t/GWh) are applied only for power plants.

Different Scenarios