JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Municipality of TEHRAN
The Islamic Republic of IRAN

The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran

Final Report

December 1997

JAPAN WEATHER ASSOCIATION

UNICO International Corporation

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PREFACE

In response to a request from the Government of Islamic Republic of Iran, the Government of Japan decided to conduct a Master plan study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran and entrusted the study to the Japan International Cooperation Agency (JICA)

JICA sent to Iran a study team headed by Dr. Osayuki Yokoyama, Japan Weather Association, associated with UNICO International Corporation, five times between April 1995 and November 1997.

The team held discussions with the officials concerned of the Government of Iran, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of The Islamic Republic of Iran for their close Cooperation extended to the team.

December 1997

Kimio Fujita

President

Japan International Cooperation Agency

LETTER of TRANSMITTAL

December 1997

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Mr. Fujita

It is my great pleasure to submit herewith the Report on the Study on an Integrated Master Plan for Air Pollution Control in the Greater Tehran Area in the Islamic Republic of Iran.

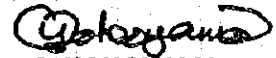
The Study Team which consists of Japan Weather Association (JWA) and UNICO International Corporation (UNICO) conducted surveys and field observations in the Islamic Republic of Iran from March 1995 to December 1997 as per the contract with the Japan International Cooperation Agency.

Based on the findings of these surveys and observations as well as the data and information collected and analyzed in Japan, the Study team held discussions with the Air Quality Control Company belonging to the Municipality of Tehran and other authorities concerned, and has formulated the Integrated Master Plan for air pollution control up to the year 2010.

On behalf of the Study Team, I would like to express my deepest appreciation to the Government of the Islamic Republic of Iran, the Municipality of Tehran, Air Quality Control Company and other authorities concerned for their great cooperation, assistance and the heartfelt hospitality which they extended to the Study Team during our stay in Tehran.

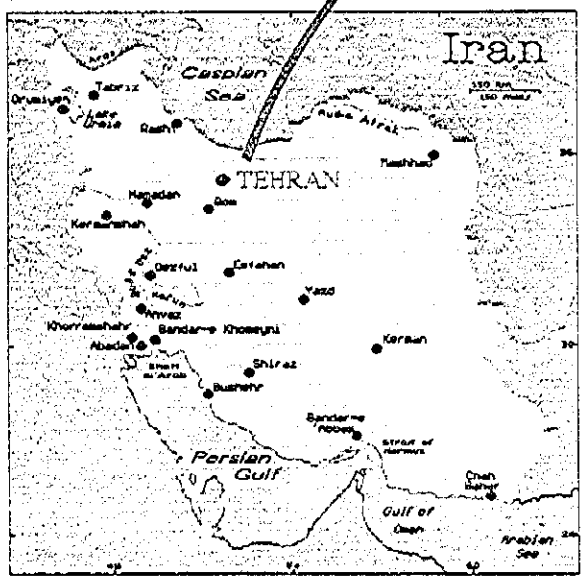
I am also greatly indebted to the Japan International Cooperation Agency, the Advisory Committee of this project, the Environmental Protection Agency, the Ministry of Foreign Affairs and the Embassy of Japan in the Islamic Republic of Iran for giving us valuable suggestions and assistance throughout the project.

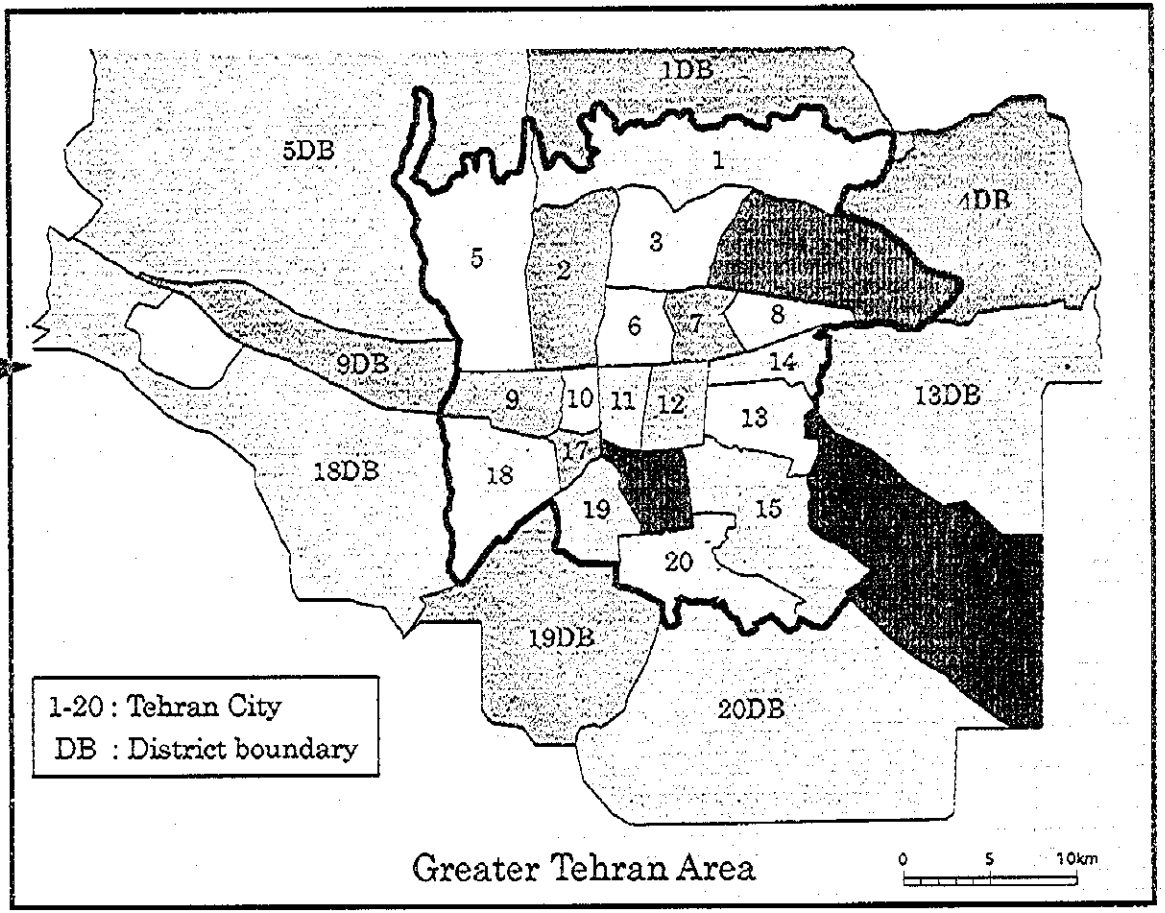
Yours faithfully,



O. YOKOYAMA
Leader of the Study Team for
the Study on an Integrated
Master Plan For Air Pollution Control
in the Greater Tehran Area

Location of the Study Site





Executive summary

The objective of the Study is to formulate an integrated master plan for air pollution control based on the research, survey and analysis on socioeconomic activities and air pollution in the Greater Tehran Area which is the area within the administrative boundary of Tehran.

The Study started from April 1st, 1995 covering survey and investigation on Municipal organizations consisting of Air Quality Control Company, Tehran Traffic Control Company, Tehran Comprehensive Transportation & Traffic Studies, the Tehran Transportation and Traffic Organization, the Organization for Relocation and Systematizing Urban Industrial and Trade Occupations and the Tehran Vehicle Technical Inspection Bureau etc. as well as the public organizations in the Central Government such as Department of Environment, Ministry of Oil, Ministry of Industry, Ministry of Energy, Ministry of Health and Iranian Meteorological Organization.

During these investigation, present capabilities and activities including facilities and man-power regarding promotion of environmental counter measures have been verified while and joint observation and measurement work with relevant organizations above have been conducted twice, in September, 1996 and February, 1997 on meteorological conditions, quality of ambient air, inspection of pollutant in flue gas, traffic volume and emission factors for the typical vehicles etc. as shown below.

-Observation of meteorological conditions over the Municipality of Tehran has been conducted for surface meteorology and upper layer meteorology using ultra-sonic anemometers, pyrometers, radiosondes and captive sondes etc..

-Measurement of ambient air quality has been mainly carried out, particularly simplified measurement of SO_2, NOx, CO, VOC, HC etc. because general ambient air quality data

are available mainly in the Department of Environment and partly in the AQCC.

-Measurement of flue gas has been conducted at four targeted model plants, i.e. a refinery plant, cement plant, power station and brick manufacturing plant. Such measurement has been carried out for two days and twice each with an infrared red type flue gas monitor for SOx,NOx,O_2 and CO and with a dust sampling apparatus for dust. Necessary arrangements for measurement and setting-up of sampling nozzles and platforms etc. have been coordinated by supervising Ministries, i.e. the Ministry of Oil, Ministry of Industry and Ministry of Energy.

-In addition to the above flue gas measurement, an Inventory of stationary emission sources in the MOT has been prepared through delivery of investigation sheets and interviews in cooperation with AQCC covering data on names of emission source, address, annual consumption of fuel, dimensions of stacks of combustion facilities and annual production amounts.

-Investigation and measurement for mobile vehicle has been conducted for investigations of traffic volume, fields driving test and Chassis dynamo test(CD test). These work has been jointly worked with Tehran Traffic Control Company(TTCC), the Tehran Transportation and Traffic Organization(TTTO), the Tehran Comprehensive Transportation and Traffic Studies(TCTTS), the Ministry of Industry, and the Automotive Industries Research and Innovation Center(AIRIC).

-A simulation model has been developed and validated using the full geographical data and dimensions on roads, location of stationary sources and meteorological data, all of which have been provided by the relevant organizations and finalized through the case studies and discussions with working groups of this study.

On the basis of the analysis of these data, present conditions of air pollution in the Municipality of Tehran and future air pollution has been projected followed by proposed

countermeasures for these projections and concrete preventive policies and measures corresponding to the roles of the Central Government, the Municipality of Tehran, enterprises and/or individual personnel.

The analysis of observed and collected data reveals that air pollution in GTA, especially for CO, is alarming. Eighty percent of the pollution is being caused by vehicular emission and 20% by stationary sources including households sources, and it's status will become worse in the year 2010, when the yearly average concentration of CO, NOx, SO_2 and SPM in ambient air will reach about 26ppm, 0.3ppm,0.2ppm,200μ g/m^3 respectively at the maximum value.

Such situations are deemed attributable to lack of environmental management systems in the public organizations, the aging structure of vehicle fleets, lack of mindset for saving of energy among industries and individuals, delayed technology development in industry, and unsatisfactory policies for fuel pricing, inconsistent foreign exchange rate systems and import restrictions. They, however, are out of the scope of the study, and therefore, are not to be commented in this report.

Measures for air pollution reduction in the GTA will be classified into three categories, e.g. ①establishment of environmental management systems in the central government and MOT, ②measures for vehicular emission sources and ③those for stationary sources;

(1) Establishment of environmental management systems in the central government and MOT

In the central government and municipal level, three key environmental activity are needed such as an emission inventory, monitoring and inspection, and environmental laws/regulations including environmental audit systems for reduction of air pollution in GTA, as will be described below and summarized in Fig. 6.1.1-1.

1) Organization of environmental management

2) Plan of environmental laws and regulations

3) Analysis of present air pollution caused by vehicles and stationary sources facilitating policy making

4) Study of environmental management systems in foreign countries

5) Establishment of environment management systems

6) Regional & wide area monitoring system including meteorological observation

7) Establishment of systems for monitoring and inspection for emission sources

8) Establishment of inventory systems

9) Improvement and research of analytical technologies for analyzing air polluting substances

10) Preparation of emission reduction guidelines

11) Research in health impacts and economic loss due to air pollution

12) Support of the private sector in reduction of air pollution

13) Research and development in energy conservation

14) Man-power development for environmental protection

15) Promotion of technical cooperation with foreign countries

(2) Management of vehicular sources

As the management system for vehicle emission reduction needs a wide range of activities to be conducted by the central government and municipality, therefore, roles of the parties of these activities is required to be defined.

1) Monitoring of transportation and traffic volume in the GTA

2) Improvement of traffic regulations and monitoring of traffic conditions

3) Execution of vehicle inspection

4) Determination of traveling modes and operation of chassic dynamo tests

5) Expansion of vehicle maintenance capacity

6) Improvement of vehicle manufacturing technology

7) Research and development in vehicle emission reduction technology targeting in-use vehicles

8) Research and development in urban planning

9) National programs for vehicle fuel renovation

10) Research and development in the energy economy

11) Promotion and coordination of introduction of foreign technology for emission reduction

(3) Management of stationary sources

At this moment in GTA, relocation of factories is being promoted on the basis of the Clean City 80 Program. Though only a few polluting emission sources have been found in GTA, in view of future economic development, light industries such as agro-based food processing, plastic and packaging as well as mechatronic industries are predicted to expand. It is therefore recommended for future development of stationary emission sources to implement following activities.

1) Improvement of emission inventory systems

2) Improvement of monitoring and inspection systems

3) Preparation of air pollution reduction guidelines through a manufacturing sector study as well as promotion of development of industrial technology

4) Promotion of activities for dissemination of technology and information among manufacturing sub-sectors on saving of energy including cleaner production technologies which are being used worldwide.

5) Improvement of combustion technology and promotion of import of technology and related equipment

6) Development of man-power relating to the key technologies described above and management of pollution control

7) Dissemination and demonstration of model facilities for air pollution technology

8) Rehabilitation of regional inspection laboratories in GTA

9) Enforcement of emission standard regulations for flue gas

10) Promotion of technical cooperation with overseas organizations

Among these environmental activities, urgent, essential and strategic countermeasures for reduction of air pollution are proposed as shown in the Table.

Table: Summary of countermeasure for air pollution control for Greater Tehran Area

No.	Countermeasure	Implemetation period 1/	Project cost (US$1000)	xpected amount of pollutants to be reduced(ton)			
				CO	SOx	NOx	Cost(US$/ton) 2/
1	Air pollution control management						
1-1.	Establishment of inventory system	1998	283		12699.3	4774.9	59.27
1-2.	Ambient air monitoring system	1999	522				
1-3.	Municipal environment research and promotion Center (establishment)	2003	24,630		5079.72	2864.94	
1-4.	Expansion of monitoring stations	1999, 2003, 2007	2,750		2539.86	1909.96	
2	Vehicular sources						
2-1.	Enhancement of public transport system	2003	231,150	124,021	1,251	5,942	1863.8
2-2.	Strengthening of I/M programme	1998	25,300	165,000			153.33
2-3.	Enforcement of emission standard	1998	354	41,340	500		8.56
2-4.	Establishment of I/M training course	2000	1050	82,680			12.7
2-5.	Establishment of vehicle engineering center	2001	8,520	110,000	500	10,000	77.45
2-6.	Improvement of main parts of car manufacture	2000	5,560	220,000			25.27
2-7.	Introduction of catalytic converter	2005	148,780	110,000		30,000	1352.55
2-8.	Desulfurization of diesel oil	1999	44780		6,000		7463.33
2-9.	Construction of MTBE plant	2007	139,980	145,000			965.38
2-10.	Implernentation of scrappage programme	1999, 2004, 2008	53,560	152,000			352.37
2-11.	Promotion of public awareness	1998	400	24804.12			
3	Stationary source						
3.1	Improvement of regional inspection lab.	1999, 2003	990		10159.4	3819.92	97.45
3-2.	Investigation and preparation of master plan on manufacturing sub-sector in GTA	1998	1,310		25398.6	11459.8	51.58
	1) Sub-sectoral study 2) Measure for saving of energy 3) Introduction of cleaner production technology 4) Nox reduction measure		114 1820 190 340				
3-3.	Construction of de-sulfur plant	2005	976,490		153,000		6382.29
3 4	Fuel conversion to natural gas	2005	3,140		200,000	40,000	16

Remarks: 1/ Operation start-up
2/ Per ton of targeted pollutants

The Study on an Integrated Master Plan for Air Pollution Control
in the Greater Tehran Area in the Islamic Republic of Iran

-Preface

-Map of the Site

-Executive Summary

Abbreviation

AQCC :	Air Quality Control Company
AIRIC :	Automotive Industries Research and Innovation Centre
CBD :	Central business District
CBI :	Central Bank of Iran
CD :	Chassis Dynamo(Test)
CDM :	Climatological Dispersion Model
CTC :	Chugai Technos Co. Ltd.
CM :	Combustion Modification
CMB :	Chemical Mass Balance
CO :	Carbon mono oxide
CO_2 :	Carbon dioxide
DOE :	Department of Environment
DTT :	Department of Transportation and Traffic of MOT
EPA :	Environmental Protection Agency, USA
FGD :	Flue Gas Desulfurization
FGR :	Flue Gas Recirculation
HC :	Hydrocarbon
HDS :	Hydrodesulfurization
IBRD :	International Bank of Reconstruction and Development
IEA :	International Energy Association
IRIB :	Islamic Republic of Iranian Bank
IRIMO :	Islamic Republic of Iran Meteorological Organization
JICA :	Japan International Cooperation Agency
LNB :	Low NOx burner
LPG :	Liquid Petroleum Gas
Gj :	Giga joule, heat value, G=9 power of 10
GTA :	Greater Tehran Area
JARI :	Japan Automobile Research Institute
JIS :	Japanese Industrial Standard
JWA :	Japan Weather Association
MHUD :	Ministry of Housing and Urban Development
MOE :	Ministry of Energy
MOH :	Ministry of Health
MOI :	Ministry of Industry
MOO :	Ministry of Oil
MOT :	Municipality of Tehran

MTBE : Methyl tertiary butyl ether
NIOC : National Iranian Oil Company
NMHC : Non methane hydrocarbon
NDIR : Non dispersion type infrared gas analyzer
NO_2 : Nitrogen dioxide
NOx : Nitrogen oxides
O_2 : Oxygen
O_3 : Ozone
OECD : Organization for Economic Cooperation and Development
ORSUITO : Organization for Relocation and Systematizing Urban Industrial and Trade Occupation
OSC : Off-stoichiometric combustion
PM10 : Particulate matter less than 10μm of particle size
PPM : Parts per Million, normally used as "ppm"
RIPI : Research Institute of Petroleum Industries
SCEP : Supreme Council for Environment Protection
SCR : Selective Catalytic Reduction
SDC : Senyo Development Co. Ltd
SO_2 : Sulfur dioxide
SOx : Sulfur oxides
SPM : Suspended Particulate Matters
SYNOP : Synoptic station in meteorological measurement
TCTTS : Tehran Comprehensive Transportation and Traffic Studies
THC : Total Hydrocarbon
TSC : Two Stage Combustion
TVTIB : Tehran Vehicle Technical Inspection Bureau
TTCC : Tehran Traffic Control Company
TTTO : Tehran Traffic & Transportation Organization
UBC : United Bus Company
UNICO : Unico International Corporation
WHO : World Health Organization

Chapter 1

Introduction

1. Introduction

Greater Tehran area with a current population of over eight millions and an area of approximately 2300 square km is suffering from life-threatening atmospheric pollution, arising from the rapid urbanization during the last few decades. Recently, there are more than 1.4 million vehicles and some 300 thousand industrial factories and offices in Tehran. Although there are few inventory data available in Tehran, some observed data reveal that concentration of CO, SO_2 and SPM (PM10) in the ambient air in Tehran very often are well over the WHO standard.

Against these background, the Government of Japan, in response to the request of the Government of Islamic Republic of Iran, decided to carry out a study on an integrated master plan for air pollution control in the Greater Tehran Area in the Islamic Republic of Iran and dispatched the Study Team through the Japan International Cooperation Agency (hereinafter referred to as 'JICA'). The Study Team headed by Dr. Osayuki Yokoyama visited Iran four times from March 30, 1995 to February 12, 1997 for investigations relating to the environmental situations in Tehran and two periods for observations and measurement work in the study area.

During the survey, the Team exchanged views and had a series of discussions with the Municipality of Tehran and relevant organizations in the central Government and authorities concerned in the Government of Islamic Republic of Iran concerning the Study and conducted the observation, measurement and investigation on meteorological, ambient air, emission from stationary sources and indicative parameters on the vehicle sectors, preparation of an inventory of stationary sources and development of a simulation model in 1st and 2nd site survey during the study period.

This Final Report has been prepared through the analysis in Japan on the basis of observation and measurement work conducted twice. And major strategic countermeasures for reduction of pollution in GTA mainly caused by vehicle emission

presented as the Draft Final Report for discussions and collection of comments of the officials concerned.

Chapter 2

Outline of social and economic situation relating to the air pollution

2. Outline of social and economic situation relating to the air pollution

2.1 Outline of the Islamic Republic of Iran

2.1.1 Outline of the Islamic Republic of Iran

Iran is located on the upland vast plateau bounded by southeast mountains, borders Turkmenistan, the Caspian Sea, Azerbaijan and Armenia in the north, Turkey and Iraq in the west, the Persian Gulf and the Sea of Oman in the south and Pakistan and Afghanistan in the east.

The Iranian southern coastline bordering the Persian Gulf is the longest coastline among the Persian Gulf countries, and along the opposite bank of this politically important sea region, there are Kuwait, Saudi Arabia, Bahrain, Qatar, United Arab Emirates and Oman.

Iranian plateau bounded by two large mountains, Alborz and Zagros, has an area of some 1,648,195 sq. km, two thirds of which consist of mountainous plateaus and/or deserts.

While Alborz mountain strides over from Turkey to the Caucasus region, stretches to the north of Afghanistan and is allied with Hindukushi mountains, the other Zagros mountains start from Turkey , and stretches to south and southeast.

Almost all people living on the plateau stay in the mountainous, hill or valley.

The inner land consists of huge deserts, Kavir desert in the north and Lot desert in the south. In the peripheries of these deserts, there are several traditional cities which has been developed through intensive development of water pumping and storage technology.

As for climate of Iran, there are four seasons similar to close in Japan, spring from the middle of march to the end of June when flower bud grows in the trees and wheat becomes fresh green , summer from the end of June to the end of the September when it is the best for the fruits, autumn from the end of September to the middle of December which is the best season for maples, winter from the end of December to the middle of March when temperature becomes below zero in the northern parts of Iran as in Hokkaido in Japan, but its climatic condition varies so much that the temperature in the southern Persian Gulf coastline parts of Iran rises to 15-20degrees as in Okinawa in Japan.

Total area	1,648,195 sq. km
Population	55.8million (1991census) 60.0million(1996 census)
Towns with populations in excess of 500,000	Tehran: 6,475 Shiraz: 965 Mashhad: 1,759 Ahwaz: 724 Isfahan: 1,127 Qom: 681 Tabriz: 1,088 Bakhtaran: 624
Climate	Continental with high temperature,
Weather in Tehran	Hottest month: July; 22-37℃ Coldest month: January; minus 3-7℃ Driest month: July; 3mm rainfall Wettest month: January; 46mmrainfall
Official language	Persian
Measures	Metric system
Calendar	-The Iranian New Year: March 21, -31 days x 6 months, 30 days x 5 months, 29 days in 12th month (Iran1375=March 1996)
Currency	Rial, IR10=1 toman, IR3,000=US$1
Time	3.5 hours ahead of GMT
Public holidays	New Year: March 21-24,

2.1.2 Outline of Tehran

Tehran city is located at latitude 35° 31′ north, and 51° 19′ longitude east while its topography is characterized by gentle upward slopes from the south to the north and from the west to the east formed by 3,500 m - 4,000m high Alborz mountains in the north and east; the difference of height between the southern area of Tehran central station and the Mehrabad international air port (1,200m above the sea) and northern parts of Tajrish district(1,500m above the sea) is 300m.

Therefore, the name of 'Tehran' means 'Valley of Alborz Mountain' combined 'tah' meaning a 'valley' and 'ran' meaning a mountain slope.

The climate in Iran varies from region to region because of its topographical complexity. The climate of most parts of the country belongs to the desert climate or steppe climate except that of the northern district of the Alborz Mountains facing the Caspian Sea characterized by its Mediterranean climate. Tehran, the Study site, is located in the southern part of the Alborz Mountains and its climate is the steppe climate.

Logical element at the meteorological bureau of Mehrabad International Airport.

The annual mean temperature is 17.0℃. Because the highest monthly mean temperature is 30.8℃ In July and the lowest is 2.5℃ In January, the annual range of temperature is wide, 28.3℃.

The temperature fluctuates widely year to year, the margin between the highest and the lowest, of each month is wide. For example, the lowest temperature in June is 5.0℃ and the highest is 41.0℃. In January, the lowest is -15.0℃ and the highest is 19.6℃. Thus, the difference in the highest margin in these months is more than 30℃. Such wide fluctuation of the temperature is caused by influence of the surrounding dry desert and inflow of the northern cold air mass.

The annual mean humidity is 40%. The highest monthly mean humidity is 65% In

January, and the lowest is 24% in June, July and August. It is mostly dry in the summer.

The annual precipitation is only 229.9mm. The largest amount of monthly precipitation is 37.4mm in March, and the smallest is 0.9mm in September. In winter (December - March), this region has about 35mm precipitation. In summer (June - September), on the other hand, the dry weather continues, and the monthly precipitation is below 10mm.

The annual most frequent wind direction is W. The monthly most prevailing wind is SE in July and August, and W-N in other months. The annual mean wind speed is 5.3m/s. The strongest monthly mean is 7.2m/s in April and May and the weakest is 3.5m/s in November.

The number of "CLEAR and PARTLY CLOUDY" days is 317 in a year. It shows the weather in this region is almost fair all the year round. The monthly number of days of fair weather is more than 27 in May - October, and 21- 26 in November - April.

On the other hand, the number of days with precipitation more than 1mm/day is 41.1 per year. The month which has the most frequent precipitation is January and the least is September.

now or sleet is observed in November - April. The annual number of days with snow or sleet is 13.2. The month which has the most frequent snow or sleet is January, 5.7 days.

The number of days of thunderstorms is 17.5 per year. Thunder storms are observed most often in April and May, about 4 days in each month.

The inversion occurrence was observed almost every day during the first and second observation periods and verified by the past data collected from the IRIMO. Therefore, inversion is said to occur on more than 250 days annually.

Since 1956 the population of Tehran has been increasing drastically. In 1996 it seems to have reached about 6.47 millions. Nowadays, Municipality of Tehran announces the annual growth rates of population in the GTA to be about 2.2 percents.

MOT consists of 20 regional districts including several surrounding suburban areas. The population of MOT is concentrated in city area, especially Districts 4, 5, 14 and 15 which are residential areas. High population density areas are also located in the east and neighboring areas such as Districts 8,10 and 17.

The history of Municipality of Tehran is short compared with that of other traditional cities in Iran, becoming the capital city when Karim Khan of the Zand dynasty, who was attracted by the fresh green belt and clear water resources in the northern parts of Tehran, moved from the town of Shiraz to Tehran in 1785.

Tehran city has the area of 558.7 sq. km (but, is to become 700 sq. km, max.) covering the 20 administrative districts and its population reached 6,475,527 in 1996. The population density of each district ranges from 3,699 to 42,081person/km^2 and averages at 11,590 person/km^2.

Most recently, however, urbanization has been accelerated in GTA because of inflow of rural population on a large scale raising its population to 10.4 million.

Tehran City stretches itself 30 km from the north to the south and 20 km from the west to the east. The central government's ministries and agencies, the parliament, municipality offices and the Iranian Central Bank are located in the Central Business District (CBD), 11 and 12 districts, and the commercial area consisting of Bazar in 11 and super markets in 12 are located in the northern area of district 11 and 12 and in the southern area. Huge fruit and vegetable super markets (district 19) and district 6 in CBD, and industrial areas in southern area. The Cement factory and power station etc. are in districts 15, 16, 18, the international air port, Mehrabad Airport in district 9, the Doshantapeh air port in districts 13, and Ghalemorghi airport in districts 19.

Means of transportation media in Tehran mainly consist of motorcycles, taxi, private passenger car, mini-buses, bus, trolley bus; park & rides are located in Azadi in northwest, district-5 and Beihaghi in northern entrance-restricted area of district 6; bus terminals are located in the west (district-5), east (district-13), south; (district-16) and trolley bus terminal is located in district-13.

Very soon, two subway lines, the 32 km north-south blue line and 20km east-west red line connecting the Tehran - Karaj 40 km line to the latter are scheduled to open.

Regarding major public facilities, museums are located in the north, CBD and south parts (districts-1,5,6,12 and 16); major parks are located in the northern part (districts-3,4 and 5) ;universities are in CBD and the northern parts(districts-1,2,4,6,12 and 16); religious places including mosques are located in the north , CBD and south parts(districts 1,7,12 and 20).

In the western part of district 10, huge program is now under construction in Navarb and two new districts are scheduled to be authorized in the western part of the city.

2.2 Outline of environmental sector of Iran

2.2.1 Organization in Iran

The Islamic Republic of Iran was founded in 1979 through the Islamic Revolution. Since the end of the Iran- Iraq War (1980-1988), the Government of Iran has been engaged enthusiastically in reconstruction. During the decade after the end of the War, recovery has been underway in all sectors. The organization of the Government of Iran is shown in Fig. 2.2.1-1.

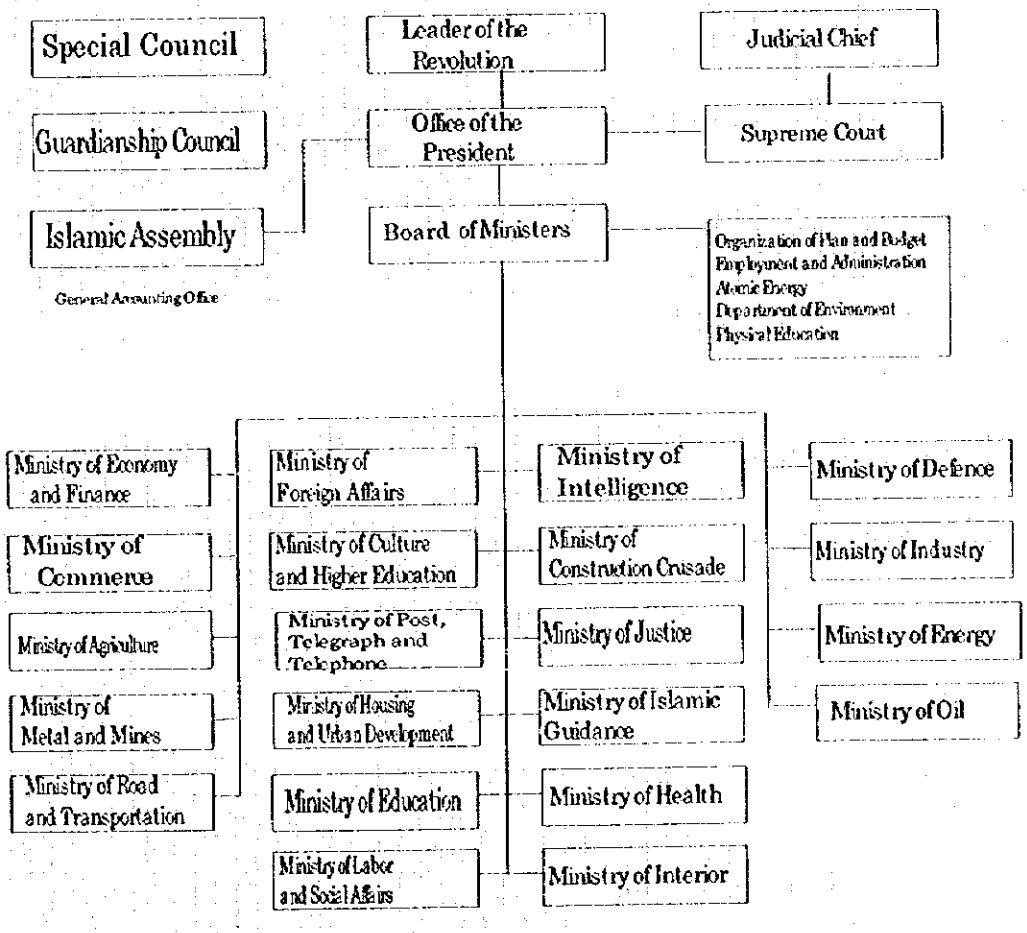


Fig.2.2.1-1 Institutions of Islamic Republic of Iran

Fundamental environmental policy is discussed and determined by the High Council which has 10 members including the President, and a bill is sent to the Diet and considered for approval. The Department of Environment is responsible for environmental policy making. Concerning air pollution, the Air Pollution Control Act was enacted in 1996, but neither the environmental standard nor emission standard has been decided yet as of March 1997. Instead of Iran's own environmental standard, the following WHO standard is used. Also, DOE is responsible for air monitoring all over Iran, on-site inspection of emission of pollutants from industries, environmental research, education and other matters. The organization of DOE is given in Fig. 2.2.1-2.

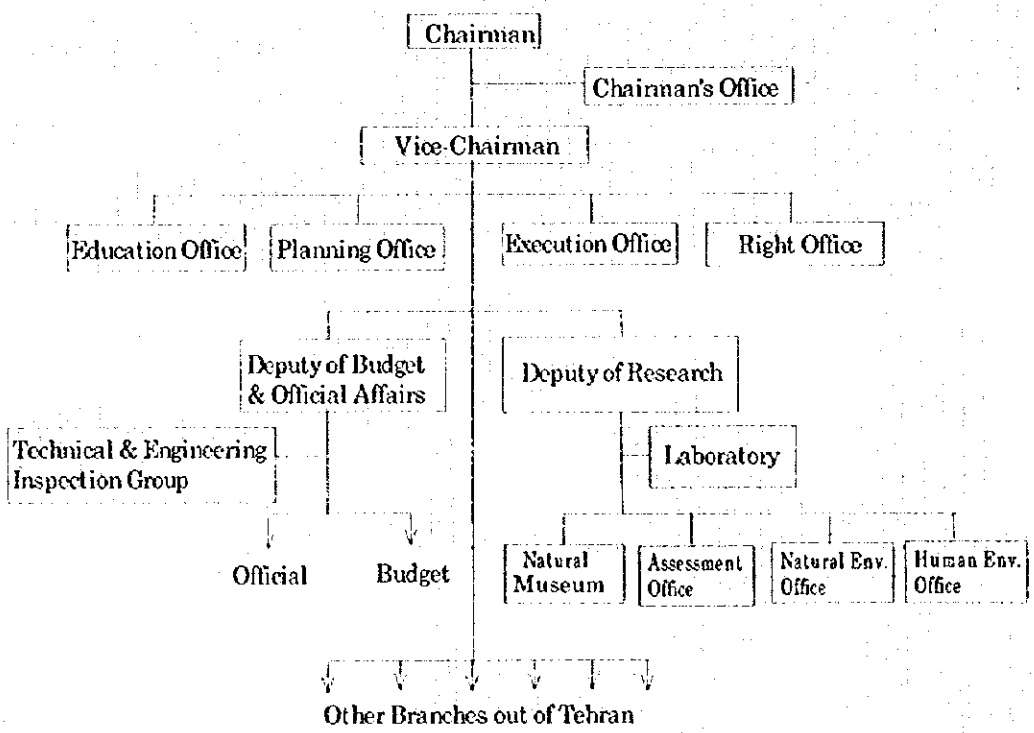


Fig.2.2.1-2 Department of Environment (1991)

As shown in Fig. 2.2.1-1, there are several ministries relating to environmental matters such as the Ministry of Health, Ministry of Industry and Ministry of Oil. For this JICA project, the following organizations have cooperated:

Ministry of Health (MOH): Air pollution concentration in Tehran is watched at 10 stations of MOH. Three stations among them are international watch stations of GEMS/WHO, the watched pollutants are SO_2 and smoke.

Ministry of Industry (MOI): All industries are under the supervision of MOI including the automobile industry. As the emission standard has not been decided yet in Iran, the ECE 15.04 standard is used. Iran Khodoro Co., biggest automobile manufacturer in Iran and other manufacturers, are making an engine satisfying this emission standard. MOI is not responsible for maintenance of cars. Industrial emission control is supervised by DOE and is not under the jurisdiction of MOI.

Islamic Republic of Iran Meteorological Organization (IRIMO): Meteorological observations are being made at the Meherabad International Airport and other 4 stations belonging to MOT and many other observatories in Iran, covering atmospheric pressure, wind direction and speed, insolation, cloud amount, temperature, humidity, visibility and so on. Cooperation of IRIMO for this project is most important.

Ministry of Oil (MOO): The Ministry of Oil supervises and controls all matters concerning oil. Quality of gasoline, gas oil, heavy oil and price of oil are key elements for environmental problems. Fundamentally, though quality of gasoline and gas oil for automobiles is good in Tehran, introduction of enriched and oxiginated gasoline seems necessarily in the future.

2.2.2 Institution under the umbrella of MOT

Since the mayor of the Municipality of Tehran (MOT), Mr. G. Karbaschi, assumed the position, a new planing approach has been introduced. Relating to air pollution, keeping clean air for Tehran people is responsibility of MOT. Various new countermeasures have been introduced and MOT became the counterpart of the present JICA project. As pointed out by the World Bank report[1], countermeasures for air pollution should address not only emission of pollutants but also city planning, land use, traffic systems, education, public awareness and so on.

Institutions under MOT are shown in Fig. 2.2.2-1. Environmental matters have been dealt with by the following organizations:

(1) Air Quality Control Company(AQCC)

AQCC was founded in May, 1993 by MOT. The main task of AQCC is improving air pollution in Tehran. Particular emphasis is on countermeasures for automobile emission. AQCC is the counterpart of this project and responsible for carrying out it on the Iranian side. The number of the staff is about 40 and it has dispatched 3 staff members to a JICA training course. In order to clarify the situation of air pollution in Teheran, AQCC is making a database with the Department of Health. On the basis of this database, pollution control improvement is assessed. Also, according to the "Tune-up Research Project" carried out by AQCC, tune-up of car engines is effective to reduce air the pollution. Nowadays, 100 tune-up stations are operated in Tehran by MOT. At present, 3 monitoring stations and 1 mobile station are measuring pollution concentration continuously. Furthermore, in order to raise public awareness, PR activities including TV commercials are carried out.

AQCC is the most active organization for controlling air pollution under MOT at present.

(2) Tehran Comprehensive Transportation and Traffic Studies(TCTTS)

TCTTS was founded in 1992 to conduct research and development in an optimal transportation system in Tehran. A survey of O/D has been done by TCTTS, so have various investigations such as a parson-trip survey, traffic volume survey, assessment of present traffic

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[1] World Bank and UNDP Government of IR Iran Project Document

systems, highway systems, public transportation systems and others. On the basis of these various surveys, a proposal for improvement of transportation systems has been made by TCTTS. Traffic data gathered by TCTTS have been fully used in the present project.

There are 4 divisions in TCTTS; for Transportation, Traffic Engineering, Land Use Planning and Information. Mainly by the Transportation division, networking is planned and traffic volume and future demand of transportation are investigated.

(3) Tehran Traffic Control Company (TTCC):

TTCC was founded in 1991 by MOT for traffic control. Traffic control is done by centralized remote computer systems. The aim of the TTCC is to create effective traffic control systems in Tehran. TTCC has 5 divisions; for Surveillance, Signaling, Geometric Design, Research and Development and Execution division. Traffic information furnished by the Surveillance division with a TV camera at main crossroads and watching data are used for avoiding heavy traffic jams.

(4) Tehran Traffic and Transportation Organization(TTTO):

Being the central facility of research and development in transportation under the MOT, TTTO plans road construction.

(5) United Bus Company (UBCT):

UBCT controls operations of buses in Tehran and the suburbs.

(6) Tehran Vehicle Technical Inspection Bureau (TVTIB):

Vehicle inspection stations are supervised and controlled by this Bureau.

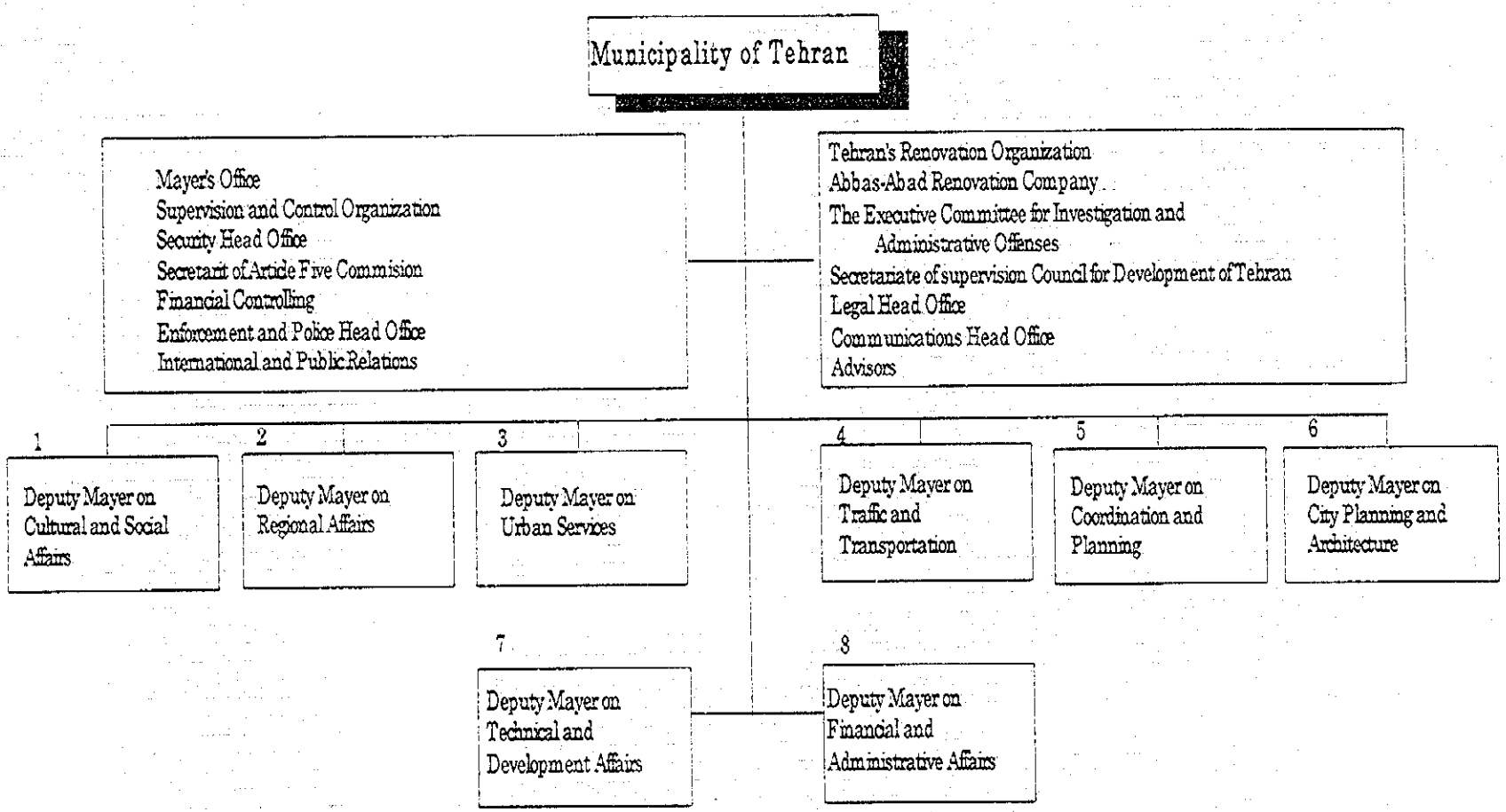


Fig. 2.2.2-1(1) The organization chart of MOT

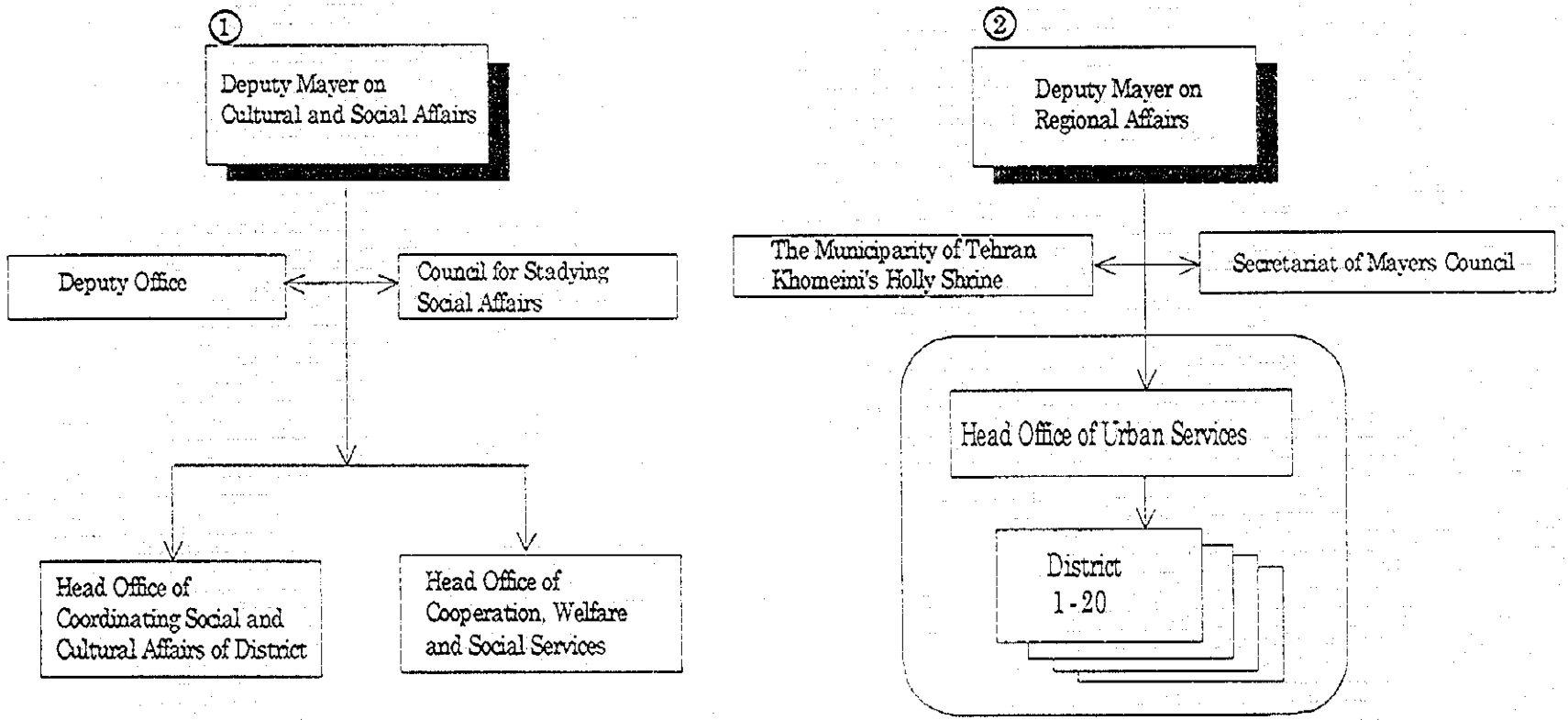


Fig. 2.2.2-1(2) The organization chart of MOT

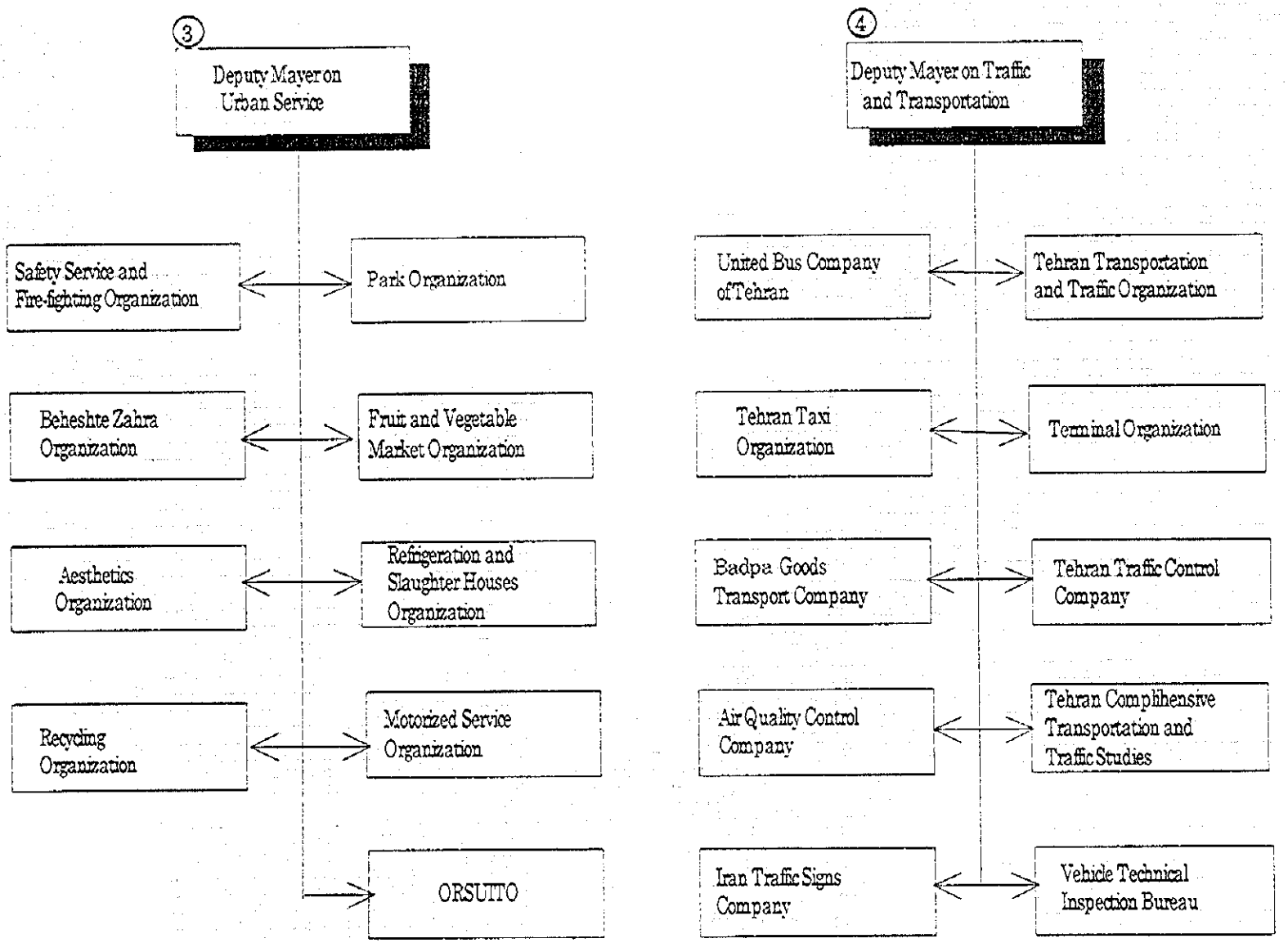


Fig. 2.2.2-1(3) The organization chart of MOT

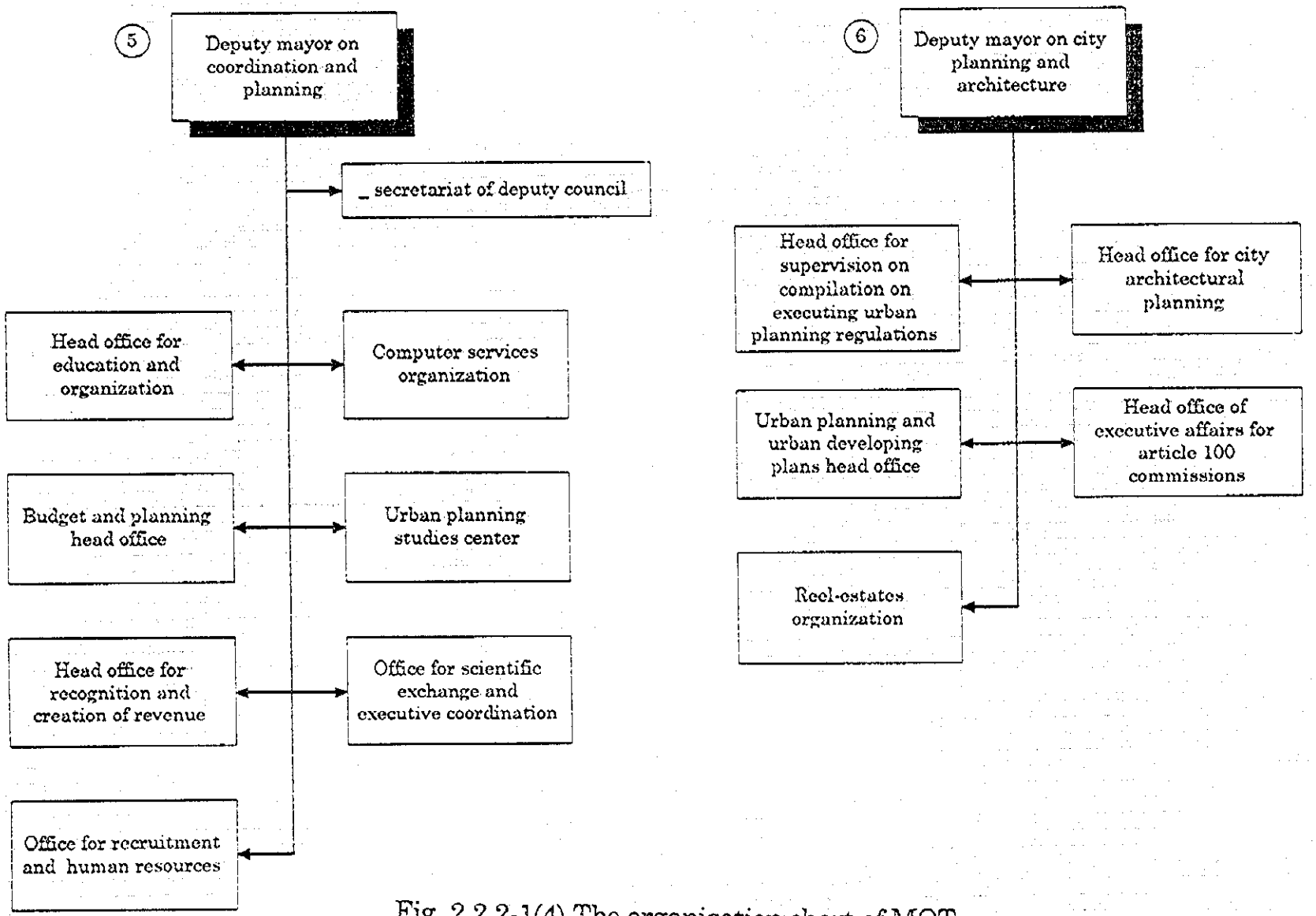


Fig. 2.2.2-1(4) The organization chart of MOT

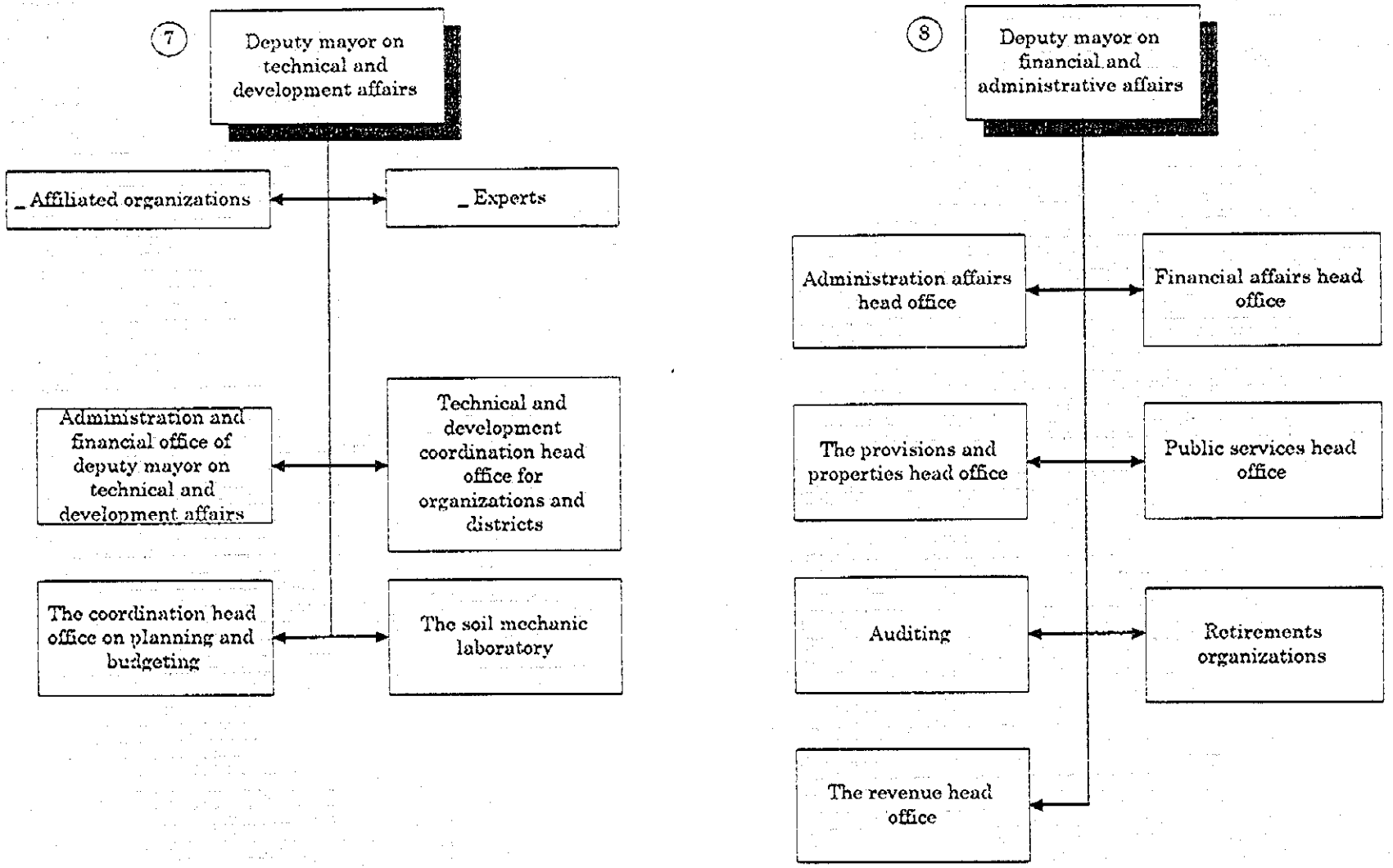


Fig. 2.2.2-1(5) The organization chart of MOT

2.2.3 Law and regulation relating to air pollution

(1) Clean Air Act

The current air pollution law (Clean Air Act: A plan for the control of Air Pollution) was enacted by the Iranian Parliament on 4/23/1995 (see appendix), although it has not been completely implemented yet. This law consists of 36 articles and classifies the air pollution sources into the following three groups:

A) Motor vehicles

B) Factories, workshops and power plants

C) Business, domestic and miscellaneous sources.

Regulations on emission standards or permitted concentration will be prepared later by DOE with cooperation of related agencies (the Municipality of Tehran, the Ministry of Industry, the Ministry of Oil) and will be approved by the Supreme Council on the Environmental Protection Affairs. This act refers to Article 50 of the Constitution of Islamic Republic of Iran, which declares environmental conservation as a public duty and prohibits polluting activities.

Main responsibility for enforcing the Clean Air Act is held by the Department of Environment (DOE), which is expected to prepare relevant regulations based on this law and to propose the standards to the Supreme Council of Environment. The Department of Environment is directly under supervision of the President of Republic, and the head of DOE is Vice President and a member of the Council of Ministers. Fig. 2.2.3-1 shows the organization chart of Department of Environment.

In this law, as mentioned before, air pollution sources are classified into three categories of Vehicles, Industry, and Residential/ Commercial sources.

The organization chrt of DOE

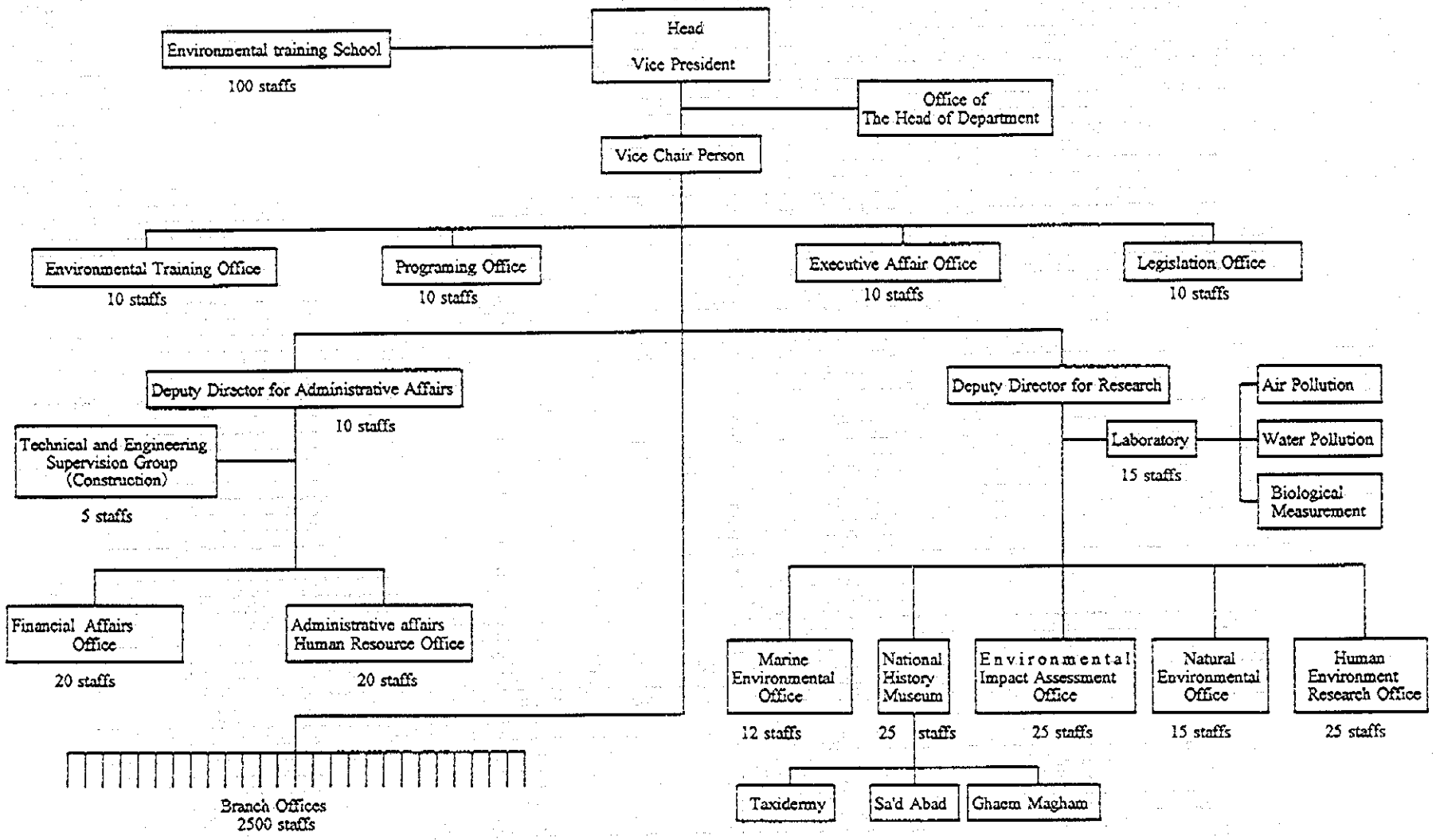


Fig 2.2.3-1 The organization chart of Department of Environment

(2) The standard for vehicle emission

For vehicles, the Department of Environment together with the Ministry of Industry is required to submit the emission standards to the Supreme Council of Environment. The approved standard for new vehicles is ECE 15.04. For in-use vehicles, the standards are set forth by the Inspection and Maintenance (I/M) program presented by AQCC and MOI and approved by DOE. The current idle emission levels of CO and HC are 6.5 % and 700 ppm respectively. These newly accepted limits which are considerably higher than those used previously by the Tehran Vehicle Technical Inspection Bureau (TVTIB, 5.0% and 500 ppm respectively), have been adopted based on a earlier research by AQCC, in order to lay a realistic ground for an effective I/M program. The levels for CO and HC are supposed to be reduced in five years to 4 % and 400 ppm respectively.

(3) The standard for industrial emission

Through the Clean Air Act clearly states that emissions from industries and households are not allowed to exceed the standard, as a practical matter, there is no emission standard for industrial activities or households. Since two years ago, it has been mandatory for all major industries to prepare Environmental Impact Assessment in the initial stage of development.

(4) The countermeasures

According to The Clean Air Act, Municipalities together with the police force are responsible for regulating urban transportation planning including establishment of traffic restricted zones. In addition, urgent countermeasures should be taken in case of serious air incidences, based on notification to a committee of representatives of Ministry of Interior, IRIB, DOE, the Municipality, Meteorological Organization, and Ministry of Health.

(5) The national ambient air quality standards

Mainly based upon the USEPA standards, the current national ambient air quality standards were determined as follows (see Table 2.2.3-1):

Table 2.2.3-1 Ambient air quality standard in Iran

Air Pollutant	Duration for Evaluation	Air Quality Standard 1	Air Quality Standard 2
CO	Max Conc. 8 hours average	9 ppm	9 ppm
SO2	24 hours average	0.14 ppm	0.1 ppm
HC(NMHC)	3 Hours average, 6-9 a.m.	0.24 ppm	0.24 ppm
NO2	Annual average	0.05 ppm	0.05 ppm
SPM	24 hours average	260 $\mu g/m^3$	150 $\mu g/m^3$

Note: Air Quality standards 1 and 2 are applied to the proper area according to the local conditions.

(6) Present situation of legislation and implementation

One of the problems of the environmental legislative system in Iran is centralization of authorities on DOE, which is responsible for enforcement of the Clean Air Act. Actually, however, many other relevant bodies are involved in decision making and implementation. Review and reconsideration of the current system is necessary for air pollution regulation. At present, DOE is not capable enough to carry out a variety of environmental management activities by itself: legislation, implementation and enforcement on a national scale. For the time being, however, a very important necessity seems to be establishment of comprehensive and realistic emission standards covering different sectors. This is obviously a prerequisite for enforcement of any air pollution regulation at present or in future.

2.2.4 Present situation of environmental education and public awareness

Since the Environmental Stockholm Conference was held at Stockholm in 1972, Iran, as well as other countries, has given its attention to environmental issues. In 1974 with the passing of the Environmental Protection and Enhancement Law, the Department of Environment was established, under which the Environmental Education Bureau and the Environmental College were set up. Many organizations including the Ministry of Education, the Ministry of Higher Education, universities and the Municipality of Tehran started campaigning for environmental education and public environmental awareness, with DOE as leader. Consequently, by the 1990's most students were well aware of environmental issues. Environmental degradation due to air pollution and water pollution, for example, has been found attributable to an increasing population, the unexpected war between 1980 to 1988 and ensuing economic development. This section is concerned with the present situation of environmental education and the promotion of public environmental awareness.

(1) Environmental education in universities, high and junior high schools and elementary schools

DOE plays an important role in the field of environmental education. DOE provides schoolbooks used at elementary and junior high schools with educational materials on environment in cooperation with the Ministry of Education. For training of DOE staff members, the agency is working together with the Environmental College. DOE also gives support to the Ministry of Culture and Higher Education in making an educational program and curricula for environmental issues.

There are 50 public universities in Iran, of which four universities, Tehran University, Sharif University, Shiraz University and Tarbiet Modaress University, offer environmental courses of study. Among private universities, Azzaad University offers environmental courses.

Tehran University set up the first environmental science department in Tehran

where B.Sc., M.Sc. and Ph.D. are conferred. Its former body was the Faculty of Natural Resources and now it consists of four fields of studies: Environmental Planning, Environmental Engineering, Environmental Design, Appropriate Technology and Environmental Education.

AQCC of MOT and Tehran University have a cooperative relationship. The Vice President of AQCC is also a professor at Tehran University. As one of its public relation activities, AQCC encourages university students to choose air pollution as the theme of their graduation thesis. The Faculty of Health at the College of Medical Science of the Univ. of Tehran is meanwhile studying how artificial environment affects people's health in the downtown area and the suburbs.

The names of universities in Iran including those that have a Department of Environment are listed in Table 2.2.4-1. Currently most of universities lack environmental departments and more are desired to open.

(2) Activity to Promote Public Environmental Awareness

There are few systematic movements to promote public environmental awareness throughout the country. In the past, campaigns were carried out on June 5, International Environment Day. Since 1981, this has been expanded to the Environment Week, held from June 6 - 13. In addition, the DOE and MOT have carried out campaigns to raise awareness of environmental issues during the Natural Resources Week (March 4-11) since 1981. MOT's main activities are as follows:

MOT has declared the six goals listed below as its policy:

1.Clean City-80 (80 means the year, 1380 of the Iranian calendar, which corresponds to the year 2001 of the Gregorian calendar, and represents the goal year.)

2. A City free from traffic congestion-80

3. Green City-80

4. A City with rich civilization culture-80

5. Dynamic City-80

6. Traditional and modern City-80

For item 1, Clean City-80, the following steps are to be taken in connection with air and noise pollution:

*Air and Noise

*Development of a suitable public transportation system and the extension of a central traffic area restricted for private vehicles.

*Conversion of vehicles to LPG giving priority to taxis, inner city buses(CNG), governmental and private vehicles.

*Announcement of Tehran's air quality on crowded roads in order to encourage public participation.

*Establishment of industrial zones for polluting industries in order to reduce all kinds of pollution.

*Development of a mandatory system of inspection and maintenance to control vehicular exhaust emissions.

*Reduction and control of urban noise pollution by introducing effective methods and a regulations.

*Providing vehicles (domestic and import) with air and noise pollution control equipment.

Also, MOT has established some goals for Water and Sewage, as well as Soil and Solid wastes. The Education, Research and Environmental Regulations declares the following goals relating to air pollution:

*Supervision and implementation of regulations to improve the standard of vehicle exhaust emissions.

*Promote and encourage public awareness of urban environmental matters.

*Follow-up of the relocation of polluter industries.

*Preparation of technical regulations in order to solve and reduce pollution from polluting industries and occupations.

Under these grand policies, each branch organization of MOT is conducting its public relations activities. AQCC, aside from displaying air quality via screens by the roadside, publishes a bulletin about air pollutants on a regular basis, distributes publications, brochures and books, provides children with cartoon books, gives radio broadcasts, produces TV programs, and regularly puts advertisements in newspapers, on buses and so on. The TV program produced by AQCC makes an impressive advertisement with its uniquely animated characters and is familiar to the general public. The main activities of AQCC during 1995 to 1996 were as follows:

a. Clean vehicle project

b. Publishing children's books on the subject of air pollution

c. Car fair

d. Sponsoring sports events and fun activities

e. Participating in a zero-emission vehicle fair

Moreover, there is a certain mass media peculiar to Islam, i.e. service on Friday, through which AQCC is taking steps to raise public awareness of environmental issues through close and constructive cooperation with a religious organization, the Center of Islamic Propaganda.

No	Activity Type	Quantity	During Years
1	Radio and T.V Program	850 Occasions	1995-6
2	Reports, Articles, News Printed in Daily Magazines	500 Occasions	1995-6
3	Bill-board	60 Units	1995-6
4	Air Quality Data via Internet	Daily	since Oct. 1996
5	Clear Air Quarterly and Brochures	12	1995-6

Table 2-2-4-(1) Name of the universities

* University which is located in Tehran

\+ University which has Environmental Engineering Courses

Esfahan University
Oroomieh University
*Alzahra University
*Emam-Hossein University
Sina University (Hamedan)
International University of Emamkhomeini
Payam-e-Noor University
Tabriz University
*+Tarbiyat Modaress University
Tarbiyat Moallem University (Arak)
Tarbiyat Moallem University (Tabriz)
*Tarbiyat Moallem University (Tehran)
Tarbiyat Moallem University (Sabzevar)
Kashan University
*+Tehran University
Zanjan University
Sistan and Balochestan University
Shahid Bahonar University
*Shahid Beheshti University
Shahid Chamran University
+Shiraz University
*The Electricity and Water Industry College(Shahid Abbass Poor)
The Oil Industry University
+Esfahan University of Science and Technology
*Amirkabir University
*The Khaj-e-Nasidrodi-e-Towsi Technical University
Ilam University
Booshehr University
*Shahed University
Shar-e-Kord University
Sepah-e-Pasdaran High EducationCenter
Tabriz Sahand Industrial University
*+Sharif University of Science & Technology
*Alame Tabatabi University
*Iran Science and Industry University
Arak Medical Sciences University
Oroomie Medical Sciences University
Isfahan-Medical Sciences University
Ahwaz Medical Sciences University
*Iran Medical Sciences University
Babol-Medical Sciences University
BandarAbbass-Medical Sciences University
Tabriz Medical Sciences University
*Medical Sciences University of Tehran
Medical Sciences University (Rafsanjan)

Medical Sciences University (Zahedan)
Medical Sciences University (Zanjan)
Medical Sciences University (Shar-e-Kord)
Medical Sciences University Shaid Beheshti
Medical Sciences University (Shiraz)
Medical Sciences University (Kordestan)
Medical Sciences University (Kerman)
Medical Sciences University (Kerman Shah)
Medical Sciences University (Gilan)
Medical Sciences University (Mazandaran)
Medical Sciences University (Mashhad)
Medical Sciences University (Hamedan)
Medical Sciences University (Yezd)
*Rehabilitation Science University
The Agricultural Science and Caltural Sources University of Gorgan
Sheikh Bahaodeen Amoli University
The Arial Techniques and Science University
Ferdowsi University of Mashhad
Gilan University
Kordestan University
Vali-e-Asr University (Rafsanjian)
Hormozgan University
Yazd University
*Art University
*The College of Occupational Health and Protection
*The College of International Relation of Ministry of Foreign Affairs
*The College of Television and Radio of Iran
Medical Science University of Ardebi
Medical Science University of Ilam
Medical Science University of Booshehr
Medical Science University of Birjand
Medical Science University of Jahrom
Medical Science University of Semnan
Medical Science University of Shahrood
Medical Science University of Fasa
Medical Science University of Kashn
Medical Science University of Lorestan
Medical Science University of Kohkiloyeh and Boyer Ahmad
*The Judicial Science and Administrative Science College-Administration of Justice
Semnan University
The Gohm High Education Buildings
The Lorestan University Aviation Technology College
*The Aviation Technology College
Birgand University
The Training High School for Scholars of Gom
The Marine Science University Buildings (Noshahr)

2.2.5 Present status of overseas technical assistance to Iran

MOT is now receiving overseas technical assistance in the environmental fields as follows:

(1) Tehran transport emissions reduction project by IBRD
(2) Railway signal education project by JICA
(3) Long term energy master plan study by JICA
(4) Study for countermeasure from flood damage
(5) Agriculture irrigation development project in the Caspian region
(6) Rehabilitation study for cement plant
(7) Municipal urban waste project
(8) Feasibility study for compost plant
(9) Construction of municipal park
(10) Healthy City project by WHO

Among these, project(1), 'Tehran Transport Emissions Reduction Project' cooperated with IBRD is intimately related to this Study, detailed contents of which will be explained as follows;

1) Objectives of the project

The project aims to prepare countermeasure and their implementation schedule including recommendation of a fuel pricing system and improvement of urban traffic services in order to reduce green house gas(GHG) and therefore regional pollutants emitted from mobile vehicles in the Municipality of Tehran.

2) Project component

In the Project, following six components are planned:

① Emissions Inventory and Quality Monitoring

Includes estimation of GHG and traditional local pollutants emitted from mobile vehicles and stationary sources, preparation of specification of monitoring systems to be utilized for assessment of changes in ambient air concentration and

identification of standard and target concentration of ambient air.

② Traffic Management & Restraint

Includes estimation of total quantity of pollutants to be reduced in the MOT through review of traffic management, recommendation and estimation of reduction amounts, study in effects of pollutant reduction through preparation of trip models in MOT, and estimation of emission factors for each driving mode for countermeasures proposed.

③ Vehicle Fleet & Fuel Improvement

Includes viability and feasibility of introduction of stepwise emission regulations for new vehicles and promotion of scrappage programs of high-aged vehicles, strengthening of I/M systems for existing vehicle fleets and introduction of alternative fuels such as CNG/LPG, unleaded gasoline, high octane value gasoline, low-volatile gasoline and low sulfur diesel oil etc..

④ Strategic Urban Transport Emissions Reduction Planning

Includes estimation of costs, amounts of pollutant reduction as a result of development of engine technology and fuel technology, fuel price reforms, traffic management and restriction, public transportation systems, urban planning and land use policy introduction etc. as well as 'trade-off' analysis on cost and effectiveness, elaboration of evaluation frameworks, recommendation of stepwise implementation of countermeasures and reviews of institutional issues relating to execution of the measures.

⑤ Project Support and Transport & Air Quality Seminar

Includes seminar titled 'Transport Emission and Air Quality' to present the results of the studies and obtain public comments on the proposed countermeasures.

⑥ International Panel of Experts

Includes a recruitment of four international experts in the fields of air pollution measurement and impact assessment, transportation fuels, vehicle technology and emission controls, and urban transport planning for provision of guidance based on international experiences and participation in the seminar.

2.3 Present status of macro economy in Iran

2.3.1 Gross domestic product(GDP)

GDP of Iran grew in the early 1980's despite the great confusion due to the revolution, but fell 4%, due to the decrease of oil price and the Iran-Iraq war in late 1980's, and grew 7.2% in an annual average until 1994. GDP values since 1991/92 including major sectors are shown in Table 2.3.1-1

Table 2.3.1-1 National accounts(at current prices)

(Unit: Billion rials)

	1991/92	1992/93	1993/94	1994/95	1995/96 1/
GDP at Factor Cost	48,672.6	64,400.8	93,518.0	129,350.8	186,124.9
Sectoral Value- Added					
Oil	3,989.7	5,839.7	16,495.0	24,433.2	29,068.6
Non-Oil	45,192.4	59,235.2	77,982.0	105,913.0	157,715.2
Agriculture	11,221.6	15,392.0	19,446.1	27,272.8	46,892.1
Manufacturing & Mining	9,778.2	12,952.7	17,389.9	24,112.0	34,961.0
Services	24,192.6	30,890.5	41,146.0	54,528.2	75,862.1

1/ Preliminary value

(Source ;CBI Report)

2.3.2 Trade balance

In 1991/92, oil and gas accounted for about 90% of the total exports. Since then, however, the government has endeavored to increase non-oil/gas export with moderate success as shown in Table 2.3.2-1. In the year ending March 20, 1997, industrial exports were projected to increase 40% mainly because of sharp increase of textile exports.

Table 2.3.2-1 Balance of payments

Unit: Million Dollars

	1991/92	1992/93	1993/94	1994/95	1995/96
Current Account					
Exports					
Oil	16,012	16,880	14,333	14,603	15,141
Non-oil	2,649	2,988	3,747	4,825	3,234
Total	18,661	19,868	18,080	19,428	18,375
Imports(fob)	25,190	23,274	19,287	12,617	12,678
Trade Balance	-6,529	-3,406	-1,207	6,811	5,697
Services(Net)	-4,919	-5,094	-4,508	-3,059	-2,215
Transfers	2,000	1,996	1,500	1,198	-4
Current Account Balance	-9,448	-6,504	-4,215	4,950	3,478
Capital Account					
Capital Account(Net)					
Short-term	4,682	-195	6,878	-11,387	-2,231
Long-term	1,350	4,894	-1,315	9,160	1,457
Total	6,032	4,699	5,563	-2,227	-774
Changes in International Reserves	-2,097	-166	232	1,233	2,868

(Source ;CBI Report)

2.3.3 Inflation rate

Inflation rates from 1983 to 1990 were 11.5, 10.40, 6.90, 23.70, 27.70, 28.90, 17.40, and 9.00% respectively. The reasons of such high rates were said due to increased consumption and investment after the war, not to the war expenses.

The inflation rates since 1991/92 are shown in Table 2.3.3-1. Especially during the recent two years, the rates have been high but the Government succeeded to control the inflation in the end when the wholesale price rose 25% at the year end.

Table 2.3.3-1 Price trends (1369=100)

(Unit: Percentage change)

	1991/92	1992/93	1993/94	1994/95	1995/96
Wholesale Price index					
General Index	26.6	33.4	25.3	42.4	60.2
Domestically Produced Goods	26.3	34.9	26.8	39.7	53.6
Exported Goods	52.7	6.7	6.6	42.9	54.4
Imported Goods	20.9	38.9	27.2	47.1	71.9
Consumer Price Index					
General Index	20.7	24.4	22.9	35.2	49.4
Goods	18.3	22.4	22.5	41.3	57.8
Services	39.5	33.1	32.7	33.1	40.5
Housing, Fuel & Lighting	19.7	25.5	18.8	20.8	28.9

(Source: CBI Report)

2.3.4 Government budget

As shown in table 2.3.4-1, the financial balance since Iranian calendar, 1370 has been remarkably improved owing to the recent high oil prices.

Table 2.3-4 Government budget

(Unit: Billion rials)

	1991/92	1992/93	1993/94 1/	1994/95	1995/96
Revenues	6,933.5	9,884.5	20,250.7	29,244.5	41,575.4
Oil & Gas	3,544.3	5,141.3	14,683.2	21,479.7	26,666.2
Tax	2,765.2	3,775.5	4,061.3	5,490.8	7,313.0
Payments	8,090.8	10,756.8	20,063.8	29,595.5	41,961.9
Current	5,563.8	7,808.0	13,639.3	20,010.0	28.789.3
Development	2,527.0	2,948.8	6,424.5	9,585.5	13.172.6
Budget Deficit	-1,157.3	-872.3	1.9	-351.0	-386.5

1/ Increase in oil and gas revenues compared with tax revenues is due to the increase in the exchange rate.

(Source; CBI Report, modified)

2.3.5 International balance of payment

Formerly, the Iranian Government was reluctant to receive any foreign investment because of the self-reliance policy which was one of the key principles of the Iranian Revolution. Though their external debt was not very large in the part, it has recently grown :their medium and long term debt and short term debt were US $ 173.9 million and 4.53 billion respectively in the Iranian calendar year 1374. External debt since 1372 is shown in Table 2.3.5-1.

Table 2.3.5-1 External debt

(Unit: Million Dollars)

	1993/94	1994/95	1995/96	1996/1997 1/
short-term	17,616	6,707	4,536	5,427
Medium-and long-term	5,542	16,030	17,392	16,058
Total	23,158	22,737	21,928	21,485

1/ End of first Qtr.

(Source: CBI Report)

2.3.6 Exchange rate

The Iranian Rial has been essentially in the downward trend since the revolution. The Government established a dual exchange rate system because they were reluctant to cut down the Rial value, i.e. there were two rates consisting of the Government formal rate and market rate. There was twenty times difference between them which caused serious obstacles in the trading sector.

Considering these situation, in 1989, the Government of Iran introduced a uniform exchange rate reflecting market situations which was intended to be a floating and competing rate, and also introduced the trading rate applicable to imports of raw materials for industrial production and expenditures by traveler's from abroad.

Table 2.3.6-1 Exchange rate

(Unit :IRR/US$)

	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97 2/
Base(Average of Selling & Buying Rates)	67.80	65.73	1,646.29	1,749.0	1,747.50	1,749.17
Export(Average of Selling & Buying Rates)					2,896.7	3,007.5
Free Market(Average Selling Rates)	1,419	1,498	1,810	2,808	4,530 1/	

1/ First Qtr., 2/ First Qtr.

(Source: CBI Report)

2.4 Government policy for air pollution reduction in the GTA

2.4.1 Central government and MOT's policy for air pollution

As reviewed in clause 2.2, environmental policy of MOT is basically decided by SCEP coordinated by DOE in the central government, as will be reviewed below:

(1) Urban planning and policy

In 1991, 'Clean City-80' was planned by MOT and determined by Urban Planning and Supreme Court of Architecture in the Central Government as a master plan for Tehran City.

The plan covers policy for population, land utilization, zoning, land regulation, and law/regulation for buildings and architectures. Under this master plan, detailed policies and measures were determined in the fields of environmental, transport and traffic including construction of roads, forestry, improvement of government administration, and rehabilitation of urban planning supervisory structures.

Key and major issues closely related to air pollution are as follows:

-The area shall be 707.51sq. km and maximum population shall be 7,650 thousand.

-Urban planning shall be targeted for reduction of traffic volume.

-Major roads and express way shall be improved.

(2) Measures for air pollution emissions from mobile sources

Clean City-80 mainly plans countermeasure for pollutant emissions from vehicular sectors, The following measures for reduction of pollutants from mobile sources are planned:

-Construction of subways and rehabilitation of trolley bus systems, existing bus lines and dedicated bus lanes including strengthening of taxi services

-Strengthening and expanding of traffic signal systems

-Improvement of quality of existing vehicle fleets

-Improvement of facilities of automobile engine manufacturing aiming at reduction of emission from mobile sources

-Establishment of scheduled automobile inspection systems

(3) Improvement of environmental management systems including reforms of organizations and institutionalization

The following at laws/regulations are planned relating to environment and improvement of environmental management systems:

-Preparation of national standards for emissions of environment polluting substances from mobile and stationary sources

-Preparation of national standards for environment pollutants

-Establishment of emissions inventory systems required for future development planning

-Expansion and improvement of monitoring stations

-Support and improvement of research and development in air pollution

(4) Improvement of fuel quality

The following measures are planned for improvement of gasoline and diesel oil:

-Expansion of utilization of alternative fuels, LPG and CNG, in the vehicular sector and LPG and natural gas in the industrial and commercial sectors

-Improvement of present fuel quality including expansion of unleaded gasoline and low sulfur diesel oil

-Reduction of emissions of natural gas flare in consideration of global warming issues

(5) Others

In addition to the above, the following measure are also planned ;

-Fuel price of gasoline and diesel oil shall be increased 20% annually in view of needs for conservation of natural resources and also in the light of a large price difference between Iranian fuel prices, which do not even cover the fuel cost, and international market prices.

-Strengthening public awareness and campaigns on adverse impacts of pollutants on human beings and other creatures.

2.4.2 Present energy status and IR government policy

(1) Present Energy status in Iran

Present energy production and consumption status are shown in Table 2.4.2-1.

Table 2.4.2-1 Energy production and amount of export

	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97 1/
Petroleum(mbd)						
Production	3,412	3,484	3,609	3,603	3,612	3,596
Export	2,464	2,404	2,184	2,290	2,290	2,378
Production of Electricity	(million kwh)					
Steam	41,947	42,362	48,166	53,376	55,901	13,216
Gas	9,463	10,866	12,419	15,402	16,145	3,407
Hydroelectric	7,056	9,330	9,823	7,445	7,275	3,153
Diesel	1,224	1,224	927	863	723	148
Total	59,710	63,782	71,335	77,086	80,044	19,924

1/ First quarter in 1997
Source: IR CBI Report

Table 2.4.2-2 Primary energy balance, 1995 (m tons oil equivalent)

Breakdown	Petroleum	Gas	Coal	Electricity	Others	Total
Primary energy						
Primary production	187.0	28.0	1.0	2.6 1/	0.7 2/	219.3
Import	8.0	0.0	0.5	0.0	0.0	8.5
Export	-135.0	0.0	0.0	0.0	0.0	-135.0
Change in inventory	0.0	0.0	0.0	0.0	0.0	0.0
Total	60.0	28.0	1.5	2.6	0.7 3/	92.8
				0.9 3/		91.9
Process/conversion						
Loss & Transit	-14.0	-14.0	0.0	-1.1	0.0	-29.1
Conversion output	0.0	0.0	0.0	6.2	0.0	6.2
Final consumption						
Transportation	20.0	0.0	0.0	0.0	0.0	20.0
Industry	12.5	6.5	1.5	1.7 3/	0.1	22.3
Domestic	10.0	4.0	0.0	4.3 3/	0.6	18.9
Non-energy	3.5	3.5	0.0	0.0	0.0	7.0
Total	46.0	14.0	1.5	6.0 3/	0.7	68.2

Source: Iran Country Profile, 1996/97
Remarks: 1/ Input base
2/Among these, 600kilo-tons oil-equivalent is from fuel wood and charcoal and 100 kilo-tons is from bag gas
3/ Output base

(2) Petroleum sector

Oil reserves in Iran are estimated to reach 92.9billion barrel, whose share in the total world reserves is 10.1%, distributed in wide areas covering the south and western parts in Iraq boundaries of the southern foot of Zagros mountain and the Persian Gulf, mainly consisting of medium to heavy components.

Though these on-shore fields were formerly operated by foreign companies all operations have been conducted by NIOC (National Iranian Oil Company (NIOC)) since the establishment of the Ministry of Oil in 1981.

While production in 1970's amounted to 5 million barrels per day(mbd), the petroleum industry went through serious confusions during the Revolution in 1979 and Iran-Iraq war in 1980's. In 1990, production recovered to 1.5mbd, but still remains 1.242 mbd as shown in Table 2.4.2-3.

Table 2.4.2-3 List of refineries complex in Iran

No	Refinery	Production (b/d)	Capacity spec.
1	Abadan	400,000	Crude oil dist'l : 430,000bdContact reforming : 24,000bd Contact Degradation : 32,000bd Cap'y : 600kiro-bd
2	Isfahan	265,000	100,000bd
3	Tehran	225,000	
4	Arak	150,000	
5	Tabriz	112,000	80,000bd
6	Shiraz	40,000	40,000bd
7	Kermanshah	30,000	20,000bd
8	Lavan	20,000	20,000bd
9	Bandar Abbas	(232,000) 1/	
	Total	1,242,000	

(Source: EIU, Country Profile, Iran)

1/ Though NIOC announced its start-up within February, 1997, this volume is excluded in view of the uncertainty, because the local contractor is obliged to install equipment due to delayed payment to the main contractor.

(3) Natural Gas

Iran's natural gas reserves including associated gas reaches 2,100 billion m^3 and ranks the second in the world next to former CIS. Its operation is supervised by NIGC (National Iranian Gas Company) in cooperation with NIOC under the Ministry of Oil. The Government

prepared a 20 year long term natural gas development plan in 1995, and at this moment plans ten natural gas projects including those for domestic use and gas injection and export promotion projects by means of already agreed gas pipe transportation to CIS, Turkey, Azerbaijan, Georgia and Ukraine.

(4) Electricity

Though the total electrical power generation in Iran reached 39,045 Mega watt(MW) in 1986, facilities suffered bomb attack damages in Iran-Iraq war, cutting production to 11,000 MW.

Therefore, at this moment, repair and construction work is under way. In Iran, power stations are mainly oil generated, but recently, the Government has decided that new stations shall burn natural gas including the gas converted from oil in the existing plants so that oil shall be exported.

Table 2.4.2-4 Electricity generation/distribution (million kwh)

Year	Generation	Purchased	Internal Con.	System loss	Network loss	Sold
1985	36,720	-	1,228	1,154	3,526	30,812
1986	39,045	-	1,744	1,175	3,509	32,619
1987	42,554	-	2,157	1,450	4,307	34,740
1988	43,775	-	2,120	1,458	4,050	36,147
1989	48,725	987	2,575	1,836	5,343	39,956

(Source: MEED)

Table 2.4.2-5 Breakdown of electricity sold (million kwh)

Type of use	Numbers of subscribers		Electricity sold	
	1988	1989	1988	1989
Total	8,826,427	9,337,797	36,147	39,956
Domestic	7,483,525	7,940,874	13,994	15,791
Public	1,269,378	1,326,896	9,569	10,867
Industrial	6,646	6,646	7,852	8,466
Agricultural	20,995	23,149	2,947	3,352
Rural Electricity and re-sale	5,459	3,491	691	371
Mosques and religious places	40,424	37,241	338	262
Thoroughfare	-	-	756	848

(Source: MEED)

(5) Price Policy

The Iranian Government started to implement its fuel price reform programme in 1994, whose main contents are shown below:

Table 2.4.2-6 Fuel price reform program Unit : Rial/L

Year	Regular gasoline	Super grade	Diesel oil	Motor oil
1994	50	70	10	-
1995	100	140	15	225
1996	130	180	30	800
1997	160	220	30	2000

Source: AQCC and MEED

In Iran, planning and decision relating to important commodities such as fertilizers, pesticides, utilities including fuels are managed by the Supreme Council of Economic Affairs, headed by the President. These prices are scheduled to be doubled by the end of the century compared with those in 1995.

2.5 City planning and land use

2.5.1 Outline of MOT's Master Plan

The Municipality of Tehran designs a Master Plan for the land use and city planning of Tehran, which follows the policy established by the High Council of Architecture and Urban Planning that convened in September and October, 1991.

The outline of the Plan is as follows:

- The area for land use is limited to 707.51 km^2.
- The population within the above-mentioned area should not exceed 7.65 millions in the final stage of the Plan.
- Tehran City's 613 km^2 will be divided into five zones and 22 districts.

  Figure 2.5.1-1 shows the MOT's conception of the five zones and 22 districts.
- Industrialization in Tehran will be restricted and 20,000 polluting factories will be moved outside of the city.
- The development and redevelopment project of Tehran will be implemented according to the order previously set forth for each district.
- The activities of construction, reconstruction and destruction of buildings are limited by various regulations before MOT makes a concrete urban plan, and otherwise permissions or certifications of MOT is necessary.

Given the above-mentioned basic ideas, the High Council has taken the initiative to make a Master Plan. It has also made an inclusive, far-reaching plan dealing with Tehran's environment, traffic and transportation, city planning and the system of administration called the Strategic Plan of Tehran. In this plan, six major goals have been set for 2001. The following is an outline of the Strategic Plan of Tehran made by MOT:

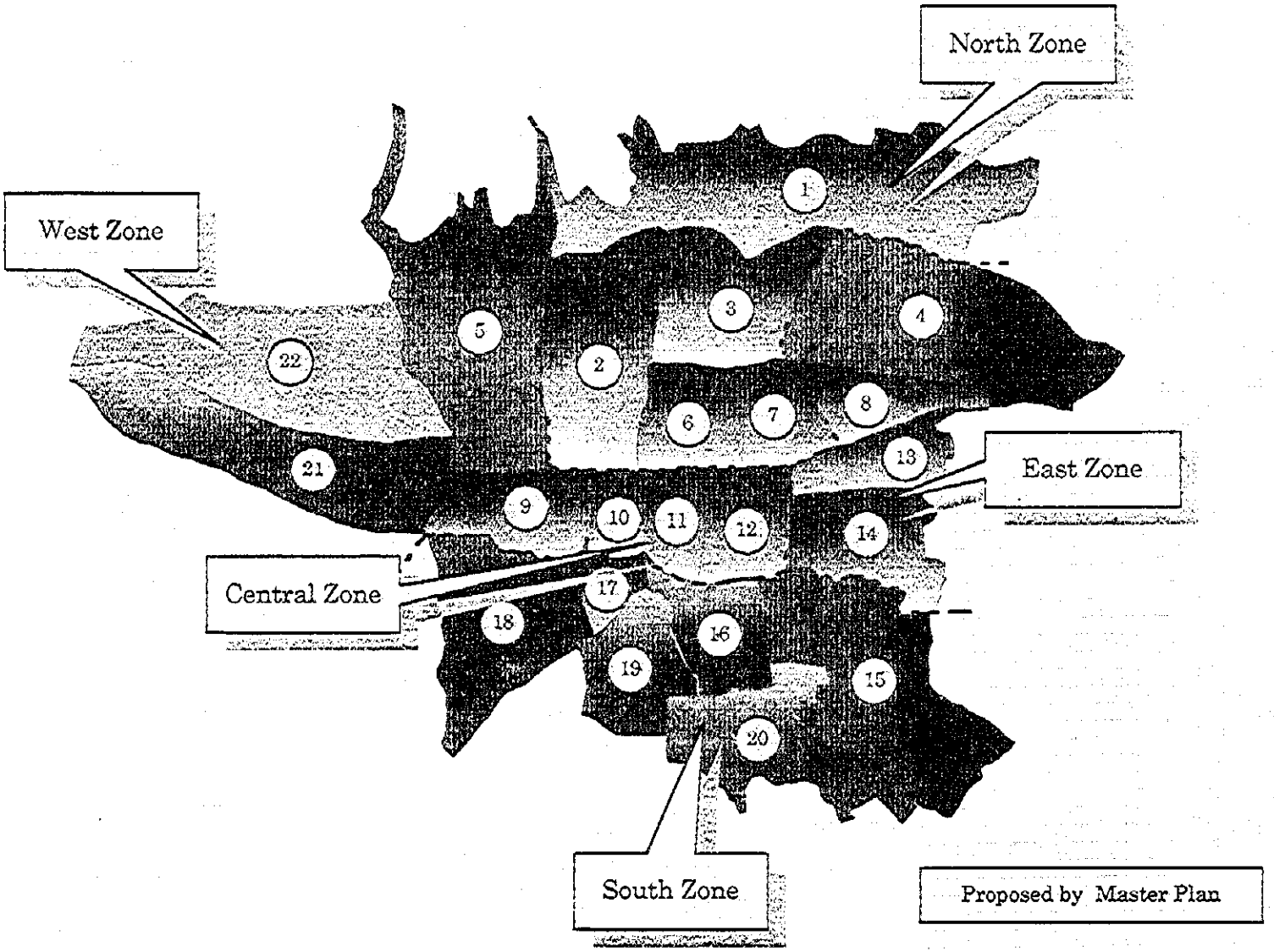


Fig. 2.5.1-1 The concept of 5 zones and 22 districts of MOT

(1) Clean City 80

Clean City 80 aims to reduce pollution such as air pollution, noise, water pollution pollution, sewage, soil pollution and wastes. Given these objectives, comprehensive improvement and consolidation of various systems are necessary. The main objectives are as follows:

1) Air pollution and noise

-Encouragement to utilize public transportation and expansion of the restricted area in the central part of Tehran for the purpose of reducing vehicular pollution.

-Conversion of fuels of vehicles such as taxis, public mini-buses and passenger cars to LPG.

-Establishment of industrial zones in order to relocate air-polluting factories.

-Establishment of an inspection and maintenance system for vehicles in order to control vehicle emissions.

-Reduction and control of vehicular noise by introducing effective methods and regulations.

2) Water pollution and sewage

A mandatory system should be introduced requiring every factory and facility to be equipped with sewage disposal tanks. Also development of sewage disposal technology should be discussed.

3) Soil pollution and city waste

The aim is to reduce municipal wastes and study the feasibility of a separation system in collecting waste. In addition, those who create waste should be obligated to see to their disposal, and countermeasures against soil pollution should be established.

4) Education, research and environmental regulations

Basic guidelines for education, research and environmental regulations against air pollution are as follows:

-Legitimization of vehicle emission standards

-Discussion on the necessity of an environmental impact assessment when implementing projects.

-Follow-up of the relocation of polluting industries.

-Sensitization of business corporations and the general public to the environmental issues in order to facilitate the implementation of environmental reforms.

-Promotion of public awareness of urban environmental issues

(2) A City Free from Traffic Congestion 80

The guidelines for management and improvement of traffic in the city are indicated here:

1) Traffic and transportation management

The aims of this plan are to implement countermeasures for reducing the number and distance of vehicular trips and to establish a traffic and transportation management system. The plan also proposes legislation concerning parking regulations.

2) Improvement and development of public transportation facilities

The aim of this plan is to work out effective ways to encourage people to use public buses and mini-buses instead of private cars and to improve the present conditions and service of taxi fleets through feasibility studies.

3) Improvement of highways and urban roads

This plan proposes alterations of the current road construction plans taking the priority of road linkage into consideration in networking the roads. For safety measures for pedestrians, the plan proposes the design of pedestrian conscious roads as well as introduction of necessary equipment.

4) Affiliated organizations and the implementation of traffic regulations.

A proposal is made that the various organizations related to transportation should be in contact with each other in order to update and optimize traffic regulations and services as well as to thus improve traffic conditions.

5) Raising public awareness and education on traffic.

Planning and implementation of seminars, conferences and traffic training sessions are encouraged. It is also proposed that legislation be made concerning vehicle traffics for better traffic conditions and transportation facilities.

(3) Green City 80

This plan proposes to expand and maintain MOT's "green" space, and suggests the necessity of land use for MOT's preservation and maintenance of environment and green space, its proper distribution within the city and the securing of water sources. For this purpose, raising public awareness of the necessity of green spaces and preparing regulations for their maintenance and preservation are crucial.

The goals of this plan are to improve parks according to the standards for a green space, to harmonize the green space with surrounding buildings, and to achieve better urban environment by means of its creation.

(4) A City with Rich Civilization Culture 80

1) Expansion of cultural facilities.

This plan suggests the expansion of facilities relating to culture, art, religion, education and recreation, and proposes further improvement of welfare and the way of spending leisure time.

2) Promotion of cultural activities.

The aim of this plan is to raise the standard of public mental health by encouraging people to use cultural facilities actively. The plan also proposes that young people be encouraged to participate in public events as well as cultural and social activities, and that the general public raise their public awareness of culture.

(5) Dynamic City 80

The aim of this plan is to further develop the existing policy and administrative system by improvement of administrative efficiency and citizen's participation in government activities. By reforming the administration and information network, the measures taken by the administration will improve and thus be able to meet various public needs promptly. It also proposes that opportunities for direct dialogue between the mayor and citizens be provided.

(6) Traditional and Modern City 80

This plan proposes plans for urban renovation, legislation for land use and security measures.

1) Urban renovation

The aim of this plan is to improve the city's traffic networks by constructing highways, trunk roads, parking places and traffic terminals in the suburban areas. The plan proposes a study of urban renovation through promotion of dispersion of municipal organizations and public service facilities. The city's renovation, based on the master plan, proposes that each district in the city represents a different feature, i.e. the north district being the municipal office area, the south the regional recreational area, the west the sports and recreational area and the east the industrial-commercial area.

As for public services, the aim of this plan is to render necessary services in accordance with needs of the population of each district, as well as to locate necessary facilities including shopping centers, sports/recreation facilities, cultural facilities, parking places and green spaces.

2) Preparation of legislation for the purpose of urban planning

This plan states that revision of laws to control disorderly development is necessary, as well as to establish an organization to supervise promotion and implementation of city plans. The plan also proposes that the government control the construction of high-rise buildings and discordant buildings.

3) Urban security measures

These measures include river improvement, measures to accommodate pedestrians (installation of sidewalks) and promotion of building-related earthquake precautions.

2.5.2 City planning

The Municipality of Tehran is making and implementing its City Planning consisting of the followings:

■Short term program

Establishment of several core parts or facilities in each zone in preparation for the Medium Term Program.

■Medium term program

Consideration of a twin city plan in which "The Great Karaj" will be the complement city of Tehran City and "The Great Tehran" will be the capital and the main metropolitan area of the country.

■Long term program

Having been approved by the High Council, the construction of five new cities around Tehran is in the planning process with the aim of population dispersion.

(1) Structure of zoning of MOT's Master Plan

The Master Plan's basic idea of zoning is to divide the city into five zones, each zone having a population of 1 to 2 millions. Each zone has its own feature: cultural facilities concentrate in the Central Zone, government facilities in the North Zone, religious facilities in the South Zone, business places in the East Zone and educational and leisure facilities in the West Zone. The Master Plan emphasizes that Tehran's population should not exceed 7,630,000.

For the next stage, the Plan proposes for the city to be divided into 22 districts, involving minor alteration of the current 20 districts. According to the Plan, the area to the west of District 5 and a western part of District 5 will be merged into the city and named District 22.

In District 21, the area to the west of District 9 will be merged into the city.

Further changes will be made in the boundary of some districts.

(2) Priority items in the implementation of the comprehensive plan

In preparation of the comprehensive plan, priority will be given to the following items:

1) Provision of urban services for urban areas.
2) Relocation of polluting industries.
3) Bulk-building construction.
4) Provision of open, green spaces according to the plan.
5) Implementation of construction plans according to the priority of urban divisions.
6) Location of the service center in the center of each district adjacent to residential areas.
7) Establishment of limitation of a building height in harmony with the surroundings.

(3) MOT's development project

MOT appropriated a budget at least for the 84 projects according to the Master Plan and the Comprehensive Plan by the end of 1996. All the projects are supposed to be completed in 1998. Figure 2.5.2-1 shows the variety of the projects. There are many kinds of projects including cultural, commercial, residential, office buildings and recreational projects, some of which are complex.

Table 2.5.2-1 and Figure 2.5.2-2 show the number of projects of each kind as well as their land and building areas. Projects for the construction of sports and cultural centers are numerous.
In building areas, the projects for construction of residential buildings cover the largest area, indicating that the municipality stresses improvement of their citizens' cultural and healthy lifestyles and the construction of high-rise residential buildings.

After completion of these projects, people in the city are likely to use the new

facilities, possibly influencing city traffics. In locating the projects, however, the restricted area is avoided as shown in Figure 2.5.2-1, and about 40 % of all the listed projects have been designed to have parking facilities. (See Table 2.5.2-1 in the supporting report) Consideration has therefore been given, to a certain degree, to the impact of these projects on traffic conditions.

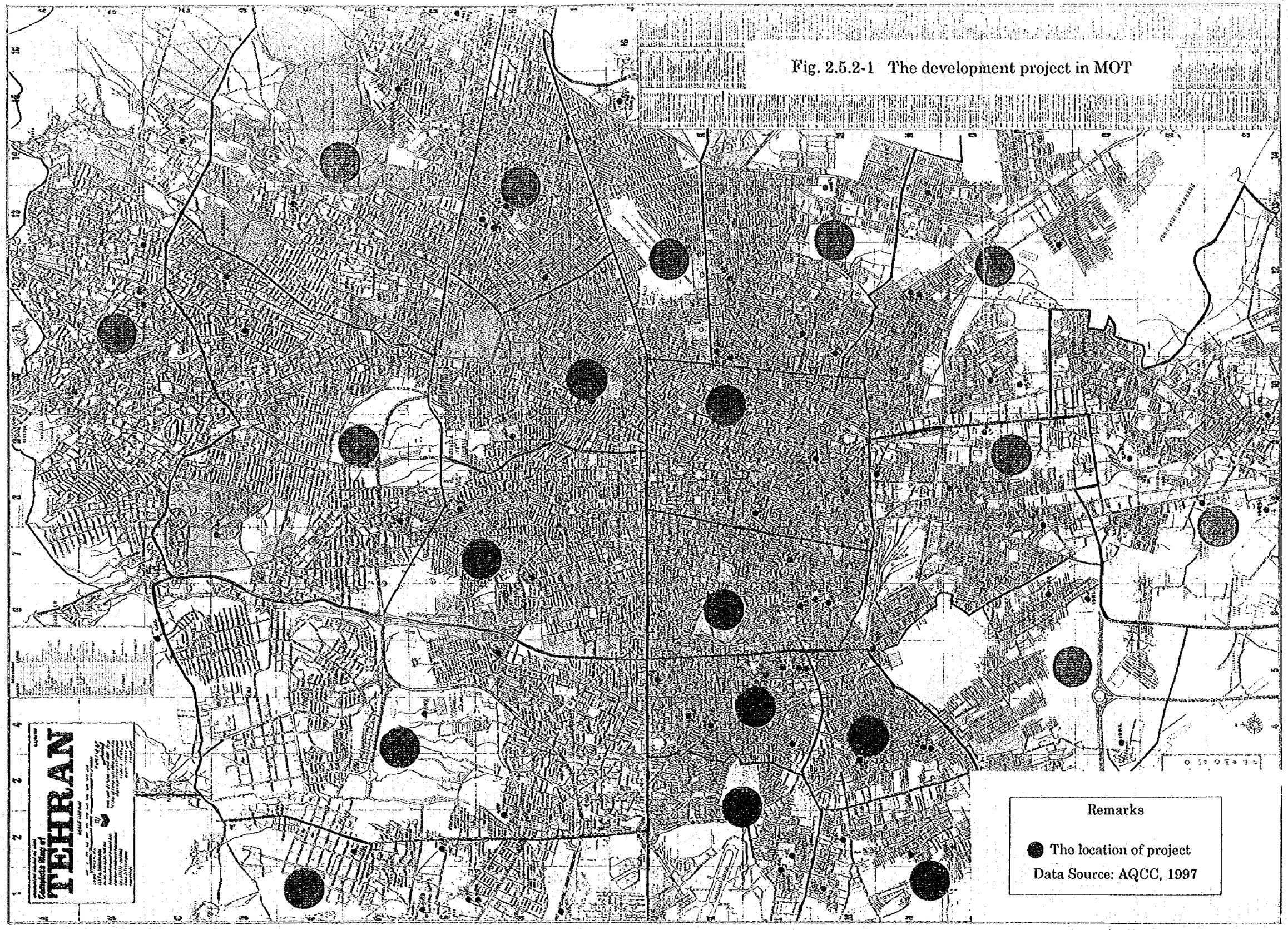
Table 2.5.2-2 and Figure 2.5.2-3 show the location of the projects in each district. Projects in District 18 will provide the largest land area. Projects' land area totals more than 100,000 m^2 in Districts 2, 14, 15 and 20.

On the basis of examination of each project feature, residential projects have been assigned to Districts 1 through 4 in the North zone, and office building projects to Districts11, 12 and 13 in the Central zone. These assignments indicate that the planning of these projects correspond to the city's land use plans. Also, projects involving the construction of super stores are noticeable in the North zone. Although construction of residential buildings is starting to take place in the west part of the city, there is no residential project in these districts.

District 10, the second smallest in Tehran, has eight projects underway, which are in the largest number among the districts according to the city's plan. Most of these projects involve the construction of cultural and sport centers. Since many citizens are likely to utilize these facilities, consideration needs to be given to the surrounding roads and parking facilities for alleviating traffic jams.

The information so far made available does not reveal the whole picture of the city authorities' plan designed to construct and improve roads and to reduce mobile source air pollution including provision of park and rides and other transportation facilities. The city's Transportation and Traffic Affairs Bureau, however, is now making plans and examining the feasibility of all kinds of measures for these purposes. It is expected that a budget will be appropriated for future projects including the measures in line with the suggestions of the JICA study team.

Fig. 2.5.2-1 The development project in MOT



Project Category	Number of Projects	Land area [m²]	Building area [m²]
Cultural Centers	25	119,857	176,267
Commercial	5	31,567	97,465
Sports Centers	28	403,924	95,024
Educational/Libraries	16	53,874	114,660
Residential	4	25,450	212,380
Office Block	5	14,060	58,385
Super Stores	5	12,000	16,250
Recreational	2	175,000	22,000
Vehicle Market	1	460,000	-
Total	91	1,295,732	792,431

Note: Number of projects are double-counted if the project was classified by plural category.

Table 2.5.2-1 The development project classified by category.

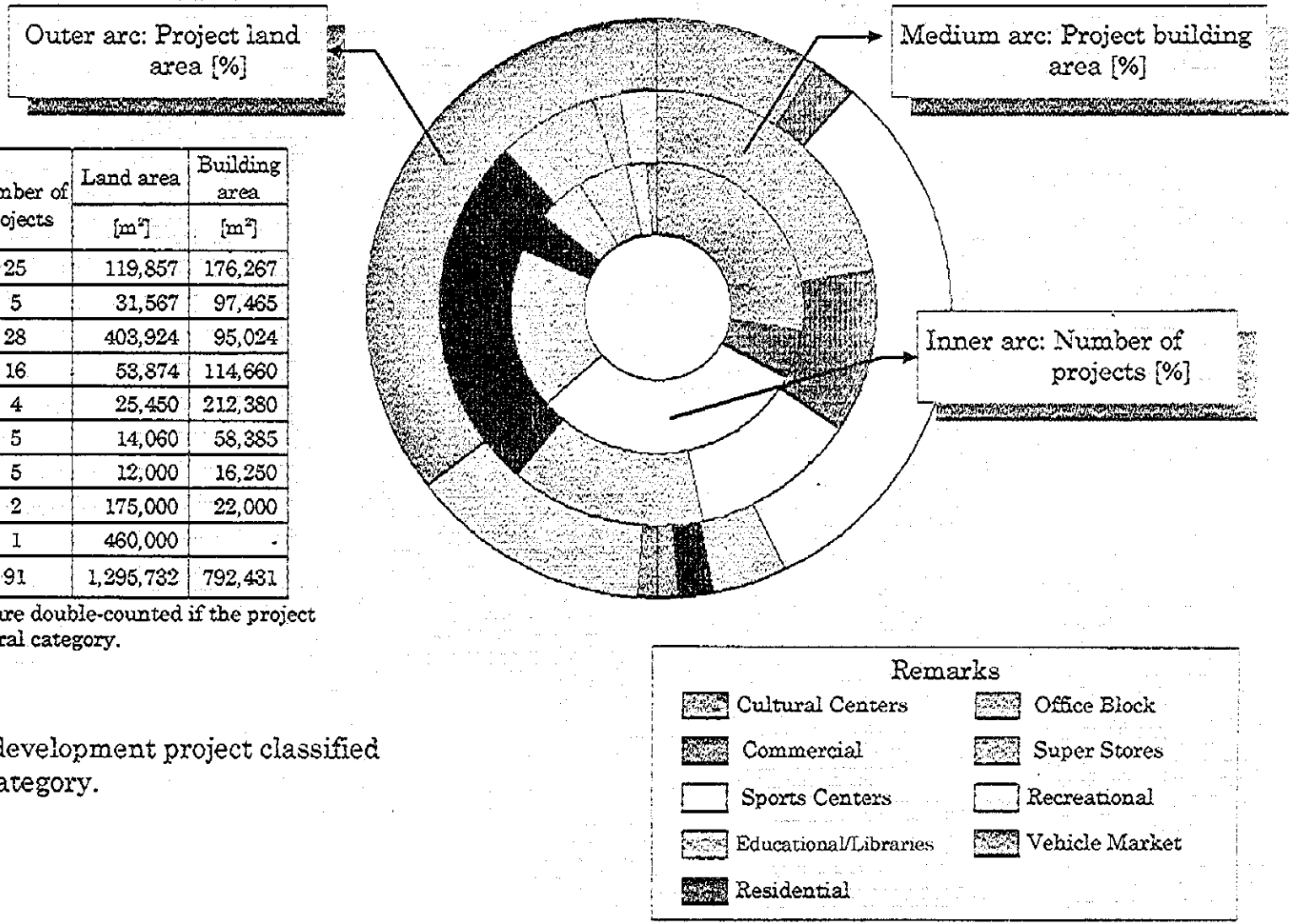


Fig. 2.5.2-2 The development project classified by category

District No	Number of Projects	Land Area [m²]	Building Area [m²]
1	6	14,500	10,350
2	7	159,210	255,480
3	2	630	17,000
4	4	13,920	16,420
5	5	36,200	28,250
6	3	4,897	7,700
7	2	12,517	9,780
8	5	9,064	111,005
9	2	2,200	1,230
10	8	31,846	10,311
11	4	21,000	31,100
12	3	30,000	36,700
13	2	6,520	4,000
14	5	183,450	14,100
15	6	103,316	46,600
16	4	6,900	27,450
17	5	21,850	16,400
18	4	492,100	3,300
19	4	14,072	-
20	3	105,300	2,400
Total	84	1,269,492	649,576

Data source:AQCC,1997

Table 2.5.2-2 The development project in each district of MOT

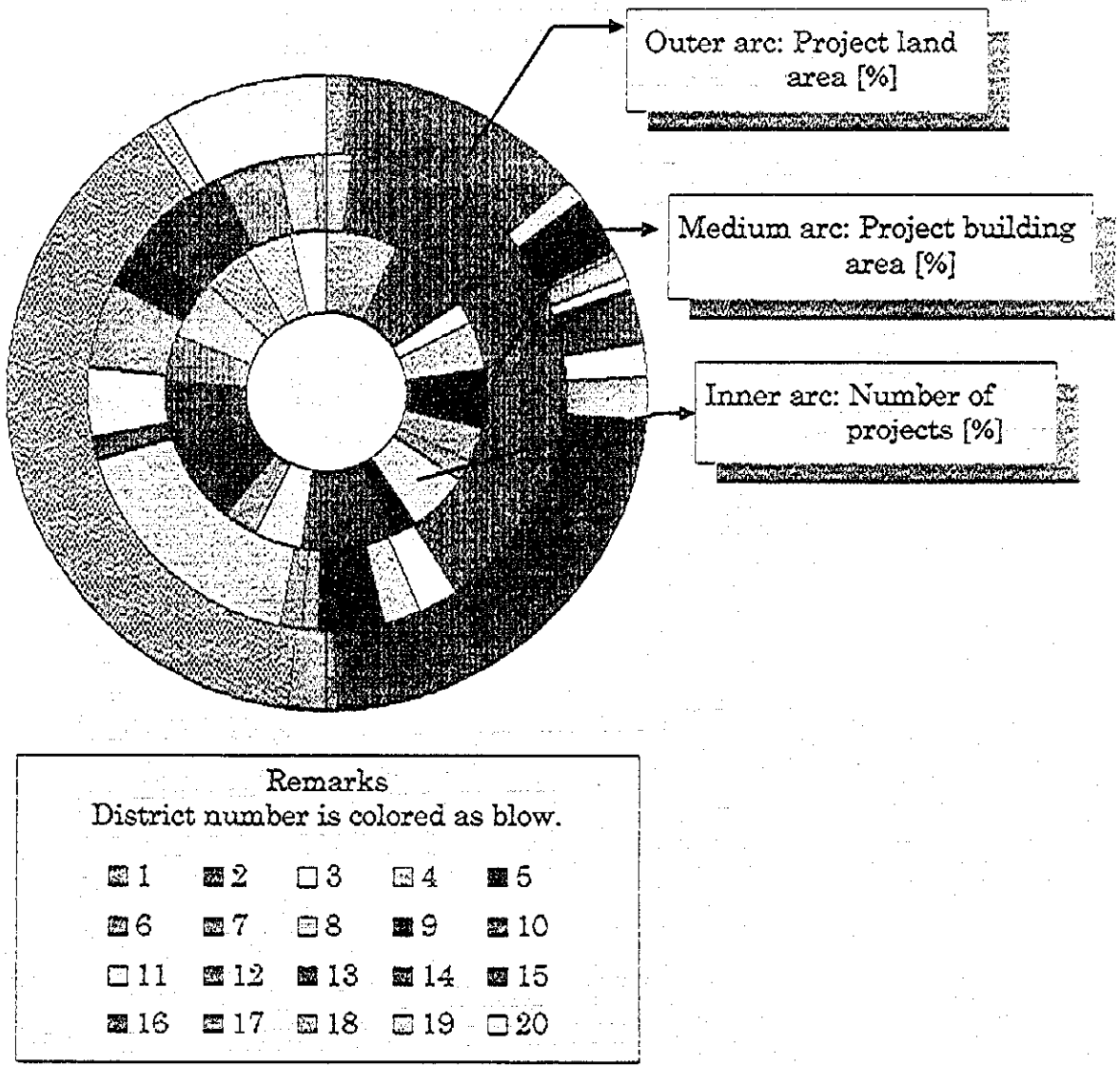


Fig. 2.5.2-3 The development project of MOT