Islamic Republic of Iran
Tehran Transport Emissions Reduction Project

Project Document
October 1993
GEF Documentation

The Global Environment Facility (GEF) assists developing countries to protect the global environment in four areas: global warming, pollution of international waters, destruction of biodiversity, and depletion of the ozone layer. The GEF is jointly implemented by the United Nations Development Programme, the United Nations Environment Programme, and the World Bank.

GEF Project Documents - identified by a green band - provide extended project-specific information. The implementing agency, responsible for each project, is identified by its logo on the cover of the document.

Global Environment
Coordination Division
Environment Department
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CURRENCY EQUIVALENTS
(As of July 1, 1993)

Currency Unit = Rial (RLs)

RLs 1000 = US$0.625
US$1.0 = RLs 1600

WEIGHTS AND MEASURES

The Metric system is used throughout this report.

GLOSSARY OF ABBREVIATIONS

CBD - Central Business District
CFC - Chlorofluorocarbon
DTT - Department of Transport & Traffic
GEF - Global Environment Facility
GET - Global Environment Trust Fund
GHG - Greenhouse Gases
GOIRI - Government of the Islamic Republic of Iran
GWP - Global Warming Potential
HC - Hydrocarbons
I/M - Inspection/Maintenance
IPE - International Panel of Experts
MTBE - Methyl Tertiary Butyl Ether
NMOC - Non-Methane Organic Compounds
PAG - Project Advisory Group
TM - Tehran Municipality
UNDP - United Nations Development Programme
UNEP - United Nations Environment Programme
VOC - Volatile Organic Compounds

FISCAL YEAR

Islamic Republic of Iran
Municipality of Tehran

March 21 - March 20
Recipient: ISLAMIC REPUBLIC OF IRAN
Beneficiary: Tehran Municipality
GEF Category: Global Warming
Amount: SDR 1.50 million (US$2.00 million)
Terms: Grant
Relending Terms: The Recipient will pass the proceeds of the GET Grant on to Tehran Municipality in the form of a grant.
Financing Plan:
- GET Grant $2.00 million equivalent (foreign cost)
- Tehran Municipality $2.00 million in RLs (local cost)
Total Cost $4.00 million
Economic Rate of Return: Not applicable
Map: IBRD No. 25050
Background

1. Urban transport in the rapidly growing cities of developing countries is of considerable concern from a global warming standpoint. Worldwide, transport sector contributions to the greenhouse effect have been estimated to be on the order of 12 to 15 percent of total emissions of all greenhouse gases (GHG), and about 30 percent of GHG emissions from the use of fossil fuels. While developing countries as a group now account for only a small portion (2 to 3 percent) of transport related GHG emissions, they are responsible for a disproportionate share of increases in these emissions due to increases in automobile use and the continued use of obsolete, fuel-inefficient automotive technologies. Improving efficiency, and managing urban transport demand to minimize emissions will require interventions in a number of inter-related areas: pricing of transport services and fuels, provision of efficient public transit, maintenance/renewal of existing vehicle fleets, upgrading domestic vehicle technologies, etc. Tehran was selected as the location for the project for a number of reasons: the city suffers from severe air pollution for which transport is the primary cause and a strong potential exists for exploiting the joint benefits of local air pollution abatement and GHG emissions reduction, and for examining the trade-offs between them. The city has also embarked on a number of initiatives for improving air quality which provide a rich diversity of technologies and regulatory interventions to be studied under the proposed project.

2. In Tehran, urban transport operations consume an estimated 2.0 million tons of gasoline/diesel fuel per year, releasing about 6 million tons of CO2; transport operations generate almost as much carbon emissions per capita (0.7 tons p.a.) in Tehran as in Mexico City (0.9 tons p.a.) which suffers from one of the worst air pollution situations in the world. For instance, the maximum 8-hour average for CO concentrations was 100 ppm (in 1987) which is about 10 times above the WHO Guidelines of 9 ppm and considerably worse than the situation in Mexico City. Partly, this high level of carbon emissions is due to a weak public transport system, causing an excessive reliance on the automobile which accounts for about 60 percent of all passenger trips in the city. By way of comparison, in Mexico City the automobile accounts for less than 30 percent of passenger trips. Historically low fuel prices in Iran, while promoting the use of automobiles, have also reduced the incentives for introducing fuel efficient technologies. Existing cars in the fleet are inefficient due to older engine designs (fuel consumption 50 percent higher on average than more up-to-date technologies), and lack of maintenance, with about 40 percent of the fleet being in such poor condition that they can no longer be tuned-up without replacement of some engine components.

3. An environmental action plan under preparation for Iran, identifies air pollution in Tehran as a key environmental issue for the country. Since local air pollution abatement would be a joint product of the Greenhouse Gas (GHG) abatement measures identified under the project, Tehran's deteriorating air pollution situation, and obsolete transport technology which is typical of those found in many developing countries, provide a perfect setting for this pilot GEF project. Background studies for the Environmental Action Plan have been completed and it is expected that the Plan itself will be formulated during calendar 1994, and therefore this GEF project will be able to provide timely inputs to that process.

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1/ Local air pollutants include: carbon monoxide, nitrogen oxides, ozone non-methane hydrocarbons, sulfur oxides, lead and suspended particulate matter. Automotive-related greenhouse gases are mainly carbon dioxide as well as methane, and nitrous oxides.
4. The primary cause of air pollution in Tehran is the exhaust from about 1.4 million motor vehicles, including about 0.5 million motorcycles, operating in an extremely congested road space; it is estimated that between 70 and 80 percent of total emissions in the Greater Tehran area are related to urban transport operations. Reported average concentrations of pollutants such as carbon monoxide (CO) and nitrogen dioxide (NO2) in central Tehran in 1986 were two to three times maximum average levels recommended by WHO, and growth in traffic over the last five years has made the situation even more severe. The problem is compounded by topographical (mountains to the north and east) and climatological factors (frequent temperature inversions), which favor photochemical transformation of volatile organic compounds (VOC) and nitrogen oxides (NOx) to produce smog and tropospheric ozone, and there is reason to believe that Tehran suffers from high ozone concentration levels.

Rationale for GEF Funding

5. Transportation energy use in developing countries is rapidly becoming a critical issue. Recent projections by the US Department of Energy indicate that the overwhelming majority (80 percent) of growth in world oil consumption to the year 2010 could come from developing countries. For the 15 largest developing countries about 50 percent of the growth in oil consumption in the 1970 to 1984 period has been in transportation. There are good reasons for selecting Tehran as the first city to address urban transport related greenhouse gas emissions and air pollution. Tehran is a highly polluted city with considerable potential for low cost interventions that would reduce both GHG emissions and local air pollutants. Tehran Municipality has a rich diversity of transport related developments planned or under implementation, and these provide a good opportunity for a pilot program such as this to develop the methodological basis and information base necessary to introduce emission reduction concerns into standard urban transport planning practices. Further, the Islamic Republic of Iran is strongly committed to addressing global climate change issues, and is a signatory (June 14, 1992) to the U.N. Framework Convention on Climate Change.

Project Objectives

6. With the support of GEF funding, authorities in Tehran will assess measures, including efficient pricing of inputs and urban transport services, that would reduce GHG emissions from vehicular traffic, while simultaneously improving local air quality. GHG abatement can be achieved through a variety of measures, all of which will produce some reductions in local air pollution. The GEF project would identify a schedule of measures, to achieve a target air quality improvement, which serve both objectives at the lowest incremental cost for GHG abatement. Such a schedule of GHG abatement maximizing measures, and the associated incremental costs, will provide decision makers with the information necessary to design a program of local air pollution abatement that simultaneously, and cost effectively, addresses global warming concerns.

Project Description

7. The project will be a joint effort between Tehran Municipality and the GEF to study options for future development of the Tehran transport system in an environmentally sustainable manner. The GEF contribution will enable the study to address concerns related to global warming which would otherwise not receive priority from a national perspective. The Tehran Municipality contribution of 50 percent of the project cost reflects the local air pollution benefits which will result from GHG abatement measures. Joint financing is provided for as this is a "type 3" project under the GEF criteria, i.e. a project which is justified in the country context, but the country would need to incur additional costs to bring about additional global benefits, as opposed to a project that can only be justified on global benefit grounds. The following provides brief details on the project components.
(a) **Emissions Inventory & Air Quality Monitoring:** (i) Development of emissions estimates, covering both mobile and stationary sources, for those pollutants (GHG and conventional) emitted by transport operations; (ii) Specification of the air quality monitoring system to be used in assessments of air quality changes; and (iii) Establishment of baseline air quality data, and target air quality standards.

(b) **Traffic Management & Restraint:** (i) Estimation of an appropriate travel modal shift model, calibrated for Tehran; (ii) Estimation of emission factors associated with various transport modes under various operating conditions; (iii) Development of a transport model for all urban transport modes to assess potential emission reductions; and (iv) Assessment of traffic management strategies, including parking management, with respect to air quality impacts.

(c) **Vehicle Fleet & Fuels Improvement:** (i) Design of a comprehensive policy for accelerated fleet renewal; (ii) Enhancement of Tehran's Inspection/Maintenance and tune-up program, aimed at establishment of effective emissions tests; (iii) Study of the feasibility of introducing alternative fuels such as natural gas, and higher quality fuels such as reformulated gasoline; and (iv) development of a program to introduce Emission Standards for new vehicles, which take into account target air quality standards.

(d) **Strategic Urban Transport Emissions Reduction Planning:** (i) Identification of costs and impacts of various pollution abatement measures including economic pricing of energy supplies and transport services and the associated elasticities. Costs will include implementation, user costs, and other public and private costs - "supply curves" showing the costs of various interventions per unit of GHG/local pollutant emission reduction would be developed; (ii) Analysis of institutional and other constraints to implementation of options; (iii) Synthesis of the results in an evaluation framework; and (iv) Preparation of implementation plan.

(e) **Project Support and Transport & Air Quality Seminar:** funding of administrative support and of a seminar to present the results and obtain public comment on the measures proposed.

(f) **International Panel of Experts (IPE):** Funding of fees and travel expenses for a panel 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.

A more detailed project description is in the Technical Annex (para. 4.12).

**Global Environmental Benefits**

8. The project would quantify the costs of various interventions to reduce greenhouse gas and local air pollutant emissions from urban transport in a setting characterized by in-use technologies that are typical for non-industrialized and newly industrializing countries. This information should prove invaluable in guiding policy decisions for urban transport development in developing countries and to the work of international bodies dealing with climate change issues. Secondarily, the project would assist the Tehran Municipality and GOIRI in embarking on urban transport policies which are environmentally sustainable from a local and global standpoint.
Project Implementation

9. Tehran Municipality will execute the project which would be implemented in three phases. In Phase I, the International Panel of Experts (Component F) would specify the studies to be carried out in detail, and prepare Terms of Reference for the studies. In Phase II, Components A, B, and C would be undertaken. Upon satisfactory completion of all Phase II studies, the strategic planning studies, Component D would be initiated in Phase III. Consultants will be engaged to assist in implementing Components A, B, C, and D of the project. The consultants will be managed by a project office within the Department of Transport and Traffic (DTT), Tehran Municipality, which will also coordinate the various agencies involved in project implementation, i.e., the Air Quality Control Co., the Tehran Vehicle Technical Inspection Bureau, and the Tehran Comprehensive Transportation and Traffic Studies Project. A Project Advisory Group comprising representatives of the Ministry of Oil, the Department of Environment and other national agencies would also be established to guide the project. Component F of the project will be implemented by Tehran Municipality by engaging the experts as individual consultants.

Project Sustainability and Replicability

10. It is expected that the recommendations of these studies will be incorporated into the future investment plan for urban transport development in Tehran. Sustainability will depend on the implementation of the investments/policy measures identified. In particular, petroleum pricing policies adopted by GOIRI will be key to achieving energy efficiency improvements. This project would also contribute to the preparation of environmentally sustainable urban transport investment projects to be financed by the Bank in various developing countries.

Project Risks

11. Given the strong commitment of GOIRI and Tehran Municipality to this project, no specific issues or risks are foreseen in the actual implementation of the project, other than the normal implementation risks of a program of studies. There is however some risk that the level of inter-ministerial coordination necessary to generate solutions that are institutionally feasible may not be forthcoming. To address this concern, the project design requires that Tehran Municipality establish (with GOIRI’s support) a Project Advisory Group (PAG) with representation from seven agencies/ministries involved in various aspects of environmental regulation, transport energy supplies, health and the transport industry. UNDP, Tehran will also be represented in the PAG.

Agreements Reached

12. During negotiations the Bank reached with GOIRI and Tehran Municipality that there would be:

(a) An undertaking in the GET Grant Agreement that GOIRI will take all actions necessary on its part for the establishment and functioning of the PAG.

(b) An undertaking in the Project Agreement that Tehran Municipality will establish for the project a bank account in a commercial bank on terms and conditions satisfactory to the Bank. Withdrawals from such account will be made only to pay for project costs. The Municipality will make deposits in Rials into such account at such times and in such amounts as the Bank deems necessary, up to an aggregate maximum of the Rial equivalent of US$2 million.
(c) A condition of effectiveness in the GET Grant Agreement that a subsidiary grant agreement, on terms and conditions approved by the Bank, shall have been executed by GOIRI and Tehran Municipality.

(d) A condition of effectiveness in the GET Grant Agreement that Tehran Municipality shall have established the bank account referred to in (b) above, and shall have made an initial deposit therein of the Rial equivalent of at least US$500,000.
### Expected Project Cost and Financing Plan

#### Estimated Cost:

<table>
<thead>
<tr>
<th>Description</th>
<th>Foreign</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Emissions Inventory &amp; Air Quality Monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Studies</td>
<td>400</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>ii) Equipment</td>
<td>300</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td><strong>B. Traffic Management &amp; Restraint Studies</strong></td>
<td>300</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td><strong>C. Vehicle Fleet &amp; Fuels Improvement Studies</strong></td>
<td>350</td>
<td>200</td>
<td>550</td>
</tr>
<tr>
<td><strong>D. Strategic Urban Transport Emissions Reduction Planning</strong></td>
<td>400</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td><strong>E. Project Support and Transport Emissions &amp; Air Quality Seminar</strong></td>
<td>400</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td><strong>F. International Panel of Experts</strong></td>
<td>250</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>2000</td>
<td>2000</td>
<td>4000</td>
</tr>
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#### Financing Plan:

<table>
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</thead>
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<tr>
<td>GET Grant</td>
<td>2000</td>
<td></td>
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<tr>
<td><strong>Totals</strong></td>
<td>2000</td>
<td>2000</td>
<td>4000</td>
</tr>
</tbody>
</table>
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Procurement

The following procurement methods will apply to Components A, B, C, D, and F of the project: All contracts for goods of a value of US$50,000 or greater will be awarded through International Shopping on the basis of price quotations from at least three suppliers from at least two different countries. Contracts below US$50,000 will be awarded on the basis of comparison of price quotations solicited from at least three local suppliers. All procurement of goods will be in accordance with Bank Guidelines. Procurement of consultant services will follow the Bank’s Guidelines for the Use of Consultants.

Table 1. Summary of Proposed Procurement Arrangements (US$'000)

<table>
<thead>
<tr>
<th>Project Element</th>
<th>Procurement Method</th>
<th>ICB</th>
<th>LCB</th>
<th>Other</th>
<th>N.G.F.(^{2/})</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(300)</td>
<td>(300)</td>
</tr>
<tr>
<td>2. Consultancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3000(^{2/})</td>
<td>400(^{2/})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1700)</td>
<td>(1700)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3300</td>
<td>700</td>
</tr>
</tbody>
</table>

\(^{2/}\) NGF (Non-Grant Financed): Those amounts to be financed by Tehran Municipality and to which Bank procurement procedures do not apply.

\(^{2/}\) Services will be procured in accordance with Bank Guidelines on the Use of Consultants. Figures in parentheses are the respective amounts to be financed by the GET Grant.
### Table 2(a). Disbursement Categories and Amounts

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount of the GET Grant Allocated</th>
<th>% of Expenditures to be financed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Goods</td>
<td>SDR 180,000</td>
<td>100% of foreign expenditures</td>
</tr>
<tr>
<td>(2) Consultants' services</td>
<td>SDR 1,220,000</td>
<td>100% of foreign expenditures</td>
</tr>
<tr>
<td>(3) Unallocated</td>
<td>SDR 100,000</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>SDR 1,500,000</td>
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### Table 2(b). Estimated Schedule of Grant Disbursements (US$ Million)

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<tr>
<th>IBRD Fiscal Year</th>
<th>1994</th>
<th>1995</th>
<th>1996</th>
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<tr>
<td>Annual</td>
<td>0.80</td>
<td>1.00</td>
<td>0.20</td>
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<tr>
<td>Cumulative</td>
<td>0.80</td>
<td>1.80</td>
<td>2.00</td>
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TEHRAN TRANSPORT EMISSIONS REDUCTION PROJECT

Timetable of Key Processing Events

(a) Time taken to prepare: 18 months

(b) Staff Preparing the Project
    George Tharakan, Task Manager, MN2IN
    Zissis Samaras, Consultant
    Kumares C. Sinha, Consultant
    Viren Sirohi, Consultant

(c) First Bank Mission
    January 1992

(d) Appraisal Mission Departure
    May 1993

(e) Negotiations
    August and September 1993

(f) Planned Date of Effectiveness
    October 30, 1993

(g) Summary Supervision Plan
    FY1994 FY1995 FY1996
    Staffing (----Staff Weeks----)
    Transp. Spec.  8  8  8
    Env. Spec.    7  7  7

(h) Relevant PCRs or PPARs
    Not applicable
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TEHRAN TRANSPORT EMISSIONS REDUCTION PROJECT

TECHNICAL ANNEX
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TEHRAN TRANSPORT EMISSIONS REDUCTION PROJECT

TECHNICAL ANNEX

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<td>Parking Management</td>
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<td>Bus Operations</td>
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<td>Conversion of Urban Buses to LPG</td>
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<td>Tehran Comprehensive Transportation and Traffic Studies</td>
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<td>Department of Environment</td>
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This report is based on the findings of an appraisal mission that visited Iran in May, 1993. Mission members included Messrs. George Tharakan (Task Manager, MN2IN) and Viren Sirohi (Consultant).
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## ATTACHMENTS

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<td>27</td>
</tr>
<tr>
<td>II</td>
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<td>29</td>
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MAP: IBRD Map No. 25050.
1.1 Urban transport in the rapidly growing cities of developing countries is of considerable concern from a global warming viewpoint. Worldwide, transport sector contributions to the greenhouse effect have been estimated to be on the order of 12 to 15 percent of total emissions of all greenhouse gases (GHG), and about 30 percent of GHG emissions from the use of fossil fuels. Within the sector, motor vehicles account for a majority of GHG emissions (about 80 percent). While developing countries as a group now account for only a small portion (2 to 3 percent) of transport related GHG emissions (see Table 1), they are responsible for a disproportionate share of increases in these emissions due to increases in automobile use and the continued use of obsolete, fuel-inefficient automotive technologies. The global motor vehicle fleet grew by more than 25 percent in the 1980s to a little under 700 million vehicles, and is expected to grow by more than 30 percent in the 1990s with the majority of this increase expected in the developing world. Increased motorization in developing countries is closely linked to the rapid urbanization taking place in these countries, with most motor vehicles being concentrated in large urban centers. In countries such as Iran, Mexico and Thailand which have very significant primate cities, as much as 50 percent of the motor vehicle fleet may be concentrated in these cities.

Table 1: Estimated anthropogenic emissions of air pollutants and contribution from motor vehicles, 1986-87

<table>
<thead>
<tr>
<th>Total World</th>
<th>Estimated Contribution from Motor Vehicles**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions*</td>
<td>Quantity</td>
</tr>
<tr>
<td>(million metric tons)</td>
<td>(million metric tons)</td>
</tr>
<tr>
<td>Greenhouse Gases:</td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide@</td>
<td>5,600</td>
</tr>
<tr>
<td>CFCs@@</td>
<td>1.11</td>
</tr>
<tr>
<td>Conventional Pollutants:</td>
<td></td>
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<tr>
<td>Carbon Monoxide</td>
<td>300-1,600</td>
</tr>
<tr>
<td>Nitrogen Oxides</td>
<td>68-75</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>55-57</td>
</tr>
<tr>
<td>Particulate Matter##</td>
<td>57-300</td>
</tr>
<tr>
<td>Sulfur Oxides</td>
<td>160-180</td>
</tr>
<tr>
<td>Lead</td>
<td>0.33</td>
</tr>
</tbody>
</table>

@ From fossil fuel combustion in million metric tons of carbon in 1987.
@@ The quantity of CFCs is the aggregate consumption of CFC-11, CFC-12, CFC-113, CFC-114 and CFC-115 in 1986.
# Order of magnitude estimates, and may deviate from actual figures by 5 to 10 percentage points.
## Particulate matters from fossil fuel combustion only.
1.2 Transport related GHG emissions in developing countries is therefore closely linked to the conditions of automobile use and of urban transport in the major cities of these countries. Improving efficiency, and managing urban transport demand to minimize emissions will require interventions in a number of inter-related areas: pricing of transport services and fuels, provision of efficient public transit, maintenance/renewal of existing vehicle fleets, upgrading domestic vehicle technologies, etc. This GEF project will study these elements and their linkages, and assess options for reducing GHG emissions from urban transport operations. Tehran was selected as the location for these studies for a number of reasons: the city suffers from severe air pollution for which transport is the primary cause and therefore a strong potential exists for exploiting the joint benefits of local air pollution abatement and GHG emissions reduction, and for examining the trade-offs between them; the city has also embarked on a number of initiatives for improving air quality which provide a rich diversity of technologies and regulatory interventions to be studied under the proposed project.

II. TRANSPORT EMISSIONS & THE GREENHOUSE EFFECT

2.1 The study is intended to estimate the emissions of greenhouse gases from urban transport operations, covering the full fuel-cycle and the manufacture, assembly and operation of transport equipment. Greenhouse gases (GHG) generated from transport operations include carbon dioxide (CO2), carbon monoxide (CO), chlorofluorocarbons used in transport equipment (CFC-11, CFC-12, CFC-113), methane (CH4), non-methane organic compounds (NMOCs), nitrous oxide (N2O), and nitrogen oxides (NOx). Tropospheric ozone (O3), which is also an important GHG, while not produced directly by motor vehicles, is generated through interactions among automobile exhaust gases in the atmosphere. Carbon dioxide and CFC emissions, which typically account for about 80 percent of total CO2-equivalent emissions from transport, are the most important from a global warming standpoint. Carbon monoxide and oxides of nitrogen (N2O, NOx) make up most of the remaining GHG emissions, with methane and NMOCs contributing less than 5 percent.

2.2 Carbon dioxide emissions are almost directly proportional to the amount of fuel consumed - for every kilogram of fuel consumed by a motor vehicle, about 3 kg of carbon dioxide is released to the atmosphere. There is considerable scope for reducing motor vehicle energy consumption, and corresponding CO2 emissions, in developing countries - the typical domestically manufactured car in China, India or Iran is half as fuel efficient (17 - 20 mpg) as the current best practice in OECD countries (42 mpg). Poor vehicle maintenance and older vehicle fleets in these countries, also reduce average fuel efficiencies and increase the GHG emissions per vehicle-km travelled. The developing country motor vehicle fleet is expected to about double in the 1990s from around 110 million vehicles at the end of the 1980s to over 200 million vehicles by the year 2000. The annual demand for motor vehicles in developing countries is expected to increase from around 5 million in 1988 to 16 million in the year 2000, in comparison with only a 10 percent increase in demand expected in OECD countries (see Table 2 below).
Automotive energy conservation and efficiency improvements in developing country fleets are therefore clearly important for curbing the growth in global CO₂ emissions.

Table 2. Annual Demand for Motor Vehicles, 1988 & 2000 (million vehs)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD Countries</td>
<td>30</td>
<td>11</td>
<td>41</td>
<td>34</td>
<td>12</td>
<td>46</td>
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<td>Eastern Europe</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Developing Countries</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>14</td>
<td>49</td>
<td>49</td>
<td>20</td>
<td>69</td>
</tr>
</tbody>
</table>

2.3 Chlorofluorocarbons, whilst released in much smaller quantities than CO₂, are also of concern due to their much higher impact on global warming. The Global Warming Potential (GWP) of CFCs has been the subject of some debate, but it could be as high as 2000 times that of CO₂, i.e. one ton of CFC in the atmosphere being equivalent to 2000 tons of CO₂. Presently, global CFC emissions from motor vehicles is estimated to be about 0.3 million tons or 600 million tons carbon equivalent, which is three-quarters of the estimated emissions of CO₂ from transport. CFCs are used in transport as a working fluid for air-conditioners (CFC-12), in foam seats, padding and insulation (CFC-11), and as a cleaning solvent for electronic components (CFC-113). Motor vehicles consume about 25 percent of CFCs produced worldwide, however, the contribution of developing countries to CFC use in motor vehicles is still low due to most cars not being equipped with air-conditioning. As incomes increase, the potential exists for rapid increases in CFC use in motor vehicles, unless measures are taken to forestall this through the introduction of substitutes. In this connection it should be noted that some of the promising substitutes (e.g. HCFC-22, HFC-34a) being considered in connection with the Montreal Protocol to protect the ozone layer, while less damaging to stratospheric ozone, are however active greenhouse gases.

2.4 Improving fuel efficiency, cleaning-up automotive exhausts, and managing transport demand more effectively, will in general reduce both GHG emissions and emissions of local air pollutants. For instance, the introduction of catalytic converters, and the unleaded fuels needed to do this, will simultaneously reduce both local pollutants (e.g. lead, CO), and GHG emissions (e.g. CH₄, NOₓ and NMOCs). These joint benefits are likely to provide the strongest incentives for actions to reduce GHG emissions. However, some interventions to reduce local air pollution may result in an increase in GHG emissions. Examples of such conflicting interventions are the use of substitute fuels under certain circumstances: e.g. electric vehicles

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1/ Local air pollutants include: carbon monoxide, nitrogen oxides, non-methane hydrocarbons, sulfur oxides, lead and suspended particulate matter.
where the primary fuel for electricity production is coal, or ethanol fuels where ethanol is produced from corn for which full fuel-cycle analyses indicate an increase in the overall CO2 emission levels over gasoline powered vehicles.

2.5 Policy makers in developing countries need to be informed about these synergies and potential conflicts between various options for reducing local air pollution and GHG emissions. Information, and the tools needed to develop this information in specific situations, are a necessary pre-requisite to informed policy analysis and decision making. Serving the dual objectives of local air pollution abatement and GHG emissions reduction will sometimes involve an incremental cost over the costs entailed in addressing the former objective alone. The magnitude of these increased costs, and the changes in the mix of interventions needed to formulate an effective strategy to address both objectives simultaneously, will be of considerable interest. Such information will be particularly useful if it is found that small increases in national costs will allow the adoption of strategies that are of much greater value to the global community. Figure 1 depicts an evaluation framework for such an assessment.

2.6 Due to the difficulties entailed in quantifying the benefits of air pollution abatement, the evaluation framework shown in Figure 1 relies instead on the least cost to achieve target air quality improvements to assess various strategies. The mix of policies that result in the least cost to achieve a given level of emissions reduction, measured in tons of carbon equivalent emissions, determines the optimal strategy. A schedule of policy/investment options (1...n) is first developed and costed to provide the types of information shown at the top of Figure 1. For each option, the cost per ton of local and GHG emissions reduction, "cn" and "gn" respectively, would be calculated. Supply curves for each would then be constructed by rank ordering the options by their respective costs for local and GHG emissions reduction. A total cost curve for local air pollution abatement could then be prepared from which the cost of a given level of local air pollution abatement could be determined as shown at the bottom of Figure 1. A different total cost curve for local pollution abatement could also be constructed from the supply curve of GHG emission reductions; this total cost curve however is based on rank ordering the options to maximize GHG reductions. This procedure is only feasible because any option with a finite cost "gn" must also have a finite cost "cn"; the converse is not true, ie. some options will have no GHG abatement benefits thereby causing "gn" to be infinite even though their "cn" is finite.

2.7 The divergence between the two total cost curves is the additional cost of GHG abatement at any given target for local air quality. There could be an initial reduction in local air pollution which simultaneously maximizes GHG reduction, for a given level of expenditure, without any increase in local air pollution abatement costs; this initial set of policies are sometimes referred to as "no regrets policies", ie. the local and global objectives coincide. If the targeted air quality levels are below the "no regrets" point (see Figure 1), then no additional costs need be incurred to achieve the maximum GHG reduction possible at that level of expenditure for local air
Figure 1: Methodology for Assessing Strategy

SCHEDULE OF POLICIES AND ABATEMENT IMPACTS

<table>
<thead>
<tr>
<th>Policy</th>
<th>Tons of Local Poll</th>
<th>Cost/Ton Local Poll</th>
<th>Tons of GHG</th>
<th>Cost/Ton GHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T₁</td>
<td>c₁</td>
<td>G₁</td>
<td>g₁</td>
</tr>
<tr>
<td>2</td>
<td>T₂</td>
<td>c₂</td>
<td>G₂</td>
<td>g₂</td>
</tr>
<tr>
<td>3</td>
<td>T₃</td>
<td>c₃</td>
<td>G₃</td>
<td>g₃</td>
</tr>
<tr>
<td>⋮</td>
<td>⋮</td>
<td>⋮</td>
<td>⋮</td>
<td>⋮</td>
</tr>
<tr>
<td>K</td>
<td>Tₖ</td>
<td>cₖ</td>
<td>0</td>
<td>∞</td>
</tr>
<tr>
<td>N</td>
<td>Tₙ</td>
<td>cₙ</td>
<td>Gₙ</td>
<td>gₙ</td>
</tr>
</tbody>
</table>

POLLUTION ABATEMENT SUPPLY CURVE

Ambient air quality target

Emission reduction (G or T)

ABATEMENT TOTAL COST CURVE

Local pollution abatement

Greenhouse gas abatement maximizing

No regrets policies
pollution abatement. To achieve air quality improvements beyond this point, policy makers would have to choose between a set of options which minimize costs (Options 1, 2 and 3 in Figure 1) versus a set of policies which achieve the same level of local air pollution abatement and also maximize GHG emission reductions (Options 1, 3 and 4 in Figure 1) albeit at some increase in total costs.

2.8 Establishment of appropriate targets for air quality improvements would also therefore be an essential element of policy formulation for GHG abatement, since these targets determine the level of excess costs incurred. Such targets may be adopted from those already developed in the industrialized countries, but it is preferable that some thought be given to local conditions and the feasibility of achieving a target over a specified period of time. It may be advantageous to establish a phased program whereby improvements in air quality are to be accomplished over say a 10-year horizon. Once such a set of targets has been established, the emission reductions needed from various sources, stationary and mobile, would need to be derived for use in the evaluation framework described above. Derivation of the emission reduction levels needed to achieve specified air quality targets is a non-trivial exercise requiring the use of sophisticated air-quality models, and research is needed to adapt existing methodologies to the conditions of developing countries. The proposed project would undertake the establishment of such methodologies and their application to Tehran as a test case.

III. TEHRAN'S URBAN TRANSPORT SYSTEM

3.1 Tehran's air pollution problem has been identified by the Government of the Islamic Republic of Iran (GOIRI) as a high priority environmental and health issue. An important cause of air pollution is the exhaust from about 1.4 million motor vehicles, including about 0.5 million motorcycles, operating in an extremely congested road space (average vehicle speeds below 18 kmph); it is estimated that between 70 to 80 percent of total emissions in the Greater Tehran area are related to urban transport operations. Reported average concentrations of pollutants such as carbon monoxide (CO) and nitrogen dioxide (NO2) in central Tehran in 1986 were two to three times maximum average levels recommended by WHO, and growth in traffic over the last five years has made the situation even more severe. The problem is compounded by topographical (mountains to the north and east) and climatological factors (sunshine, frequent temperature inversions), which favor photochemical transformation of volatile organic compounds (VOC) and nitrogen oxides (NOx) to produce smog and tropospheric ozone, and there is reason to believe that Tehran suffers from high ozone concentration levels.

3.2 Urban transport in Tehran provides an excellent opportunity for studying the issues described above, and identifying cost effective options for reducing the global warming impacts of transport emissions. Tehran's vehicles consume an estimated 2.0 million tons of gasoline/diesel fuel per year, releasing about 6 million tons of CO2; transport operations generate almost as much carbon emissions per capita (0.7 tons p.a./capita) in Tehran as in Mexico City (0.9 tons p.a./capita) which suffers from one of the worst air
pollution situations in the world. Tehran’s per capita transport related carbon emissions are three times the average per capita carbon emissions from all energy use for developing countries in Asia (0.19 ton p.c. in 1985). Partly, this high level of CO2 emissions is due to a weak public transport system, causing an excessive reliance on the automobile which accounts for about 60 percent of all passenger trips in the city. By way of comparison, in Mexico City the automobile accounts for less than 30 percent of passenger trips. Historically low fuel prices while promoting the use of automobiles, have also reduced the incentives for introducing fuel efficient transport technologies. Existing cars in the fleet are inefficient due to older engine designs (fuel consumption 50 percent higher on average), and lack of maintenance, with about 40 percent of the fleet being in so poor condition that they can no longer be tuned-up without replacement of some engine components. Tehran’s deteriorating air pollution situation, and obsolete transport technology which is typical of many developing countries, provides a perfect setting for a pilot GEF project, such as this, to address the global warming problem caused by inefficient, and rapidly expanding, urban transport operations in developing countries.

A. THE URBAN TRANSPORT FLEET

3.3 It is estimated that there are about 0.75 million passenger cars and light duty trucks (< 3.5 t) in the Greater Tehran area. Around 0.5 million passenger cars, on average, are operating on any given day, each making 8.9 trips/day with an occupancy of 1.96 passengers, and the total passenger trips generated is around 8.5 million pax-trips/day. Light duty trucks number about 60,000, and make on average 5.4 trips/day with an occupancy of 1.6, generating an additional 0.5 million pax-trips/day. In total, passenger cars and light duty trucks account for about 9 million (51 percent) of an estimated total of about 17.5 million pax-trips generated each day in the city.

3.4 In addition to the above passenger cars, there are about 20,000 taxis which operate either as share taxis on a fixed route, or as regular taxis. The former charge a fixed fare per passenger (Rials 200) irrespective of distance. It was estimated (1990) that there are on average 9000 active taxis operating on a given day, with each generating 175 pax-trips/day, for a total of 1.6 million pax-trips/day. Passenger cars, light trucks and taxis therefore account for about 60 percent of all passenger trips in the city.

3.5 The number of motorcycles in the city is not known precisely; there are about 350,000 registered motorcycles, but it is estimated that the total number could be as high as 600,000. Based on an average of 7.5 trips/day and an occupancy of 1.5, it is estimated that motorcycles generate about 2.7 million pax-trips each day.

3.6 Buses and mini-buses account for an additional 4.2 million pax-trips per day. There are about 3500 buses and a similar number of mini-buses, though the latter are planned to be phased out as larger buses become available. Public transit services (bus and mini-bus) therefore account for less than a quarter (24 percent) of total passenger trips.
3.7 It is estimated that there are about 20,000 heavy trucks in the Greater Tehran area, and about 2000 of these are government owned. About 60 percent of goods imported to Iran pass through Tehran for distribution to other parts of the country. Much of the truck traffic could be bypassed around the city if freight distribution facilities were available on the periphery, and heavy trucks could be kept away from the city center by using smaller trucks for urban goods delivery. Several distribution centers for goods are currently being planned for construction along the periphery of the city. For instance, one such center for fruit & vegetable distribution is being located to the south of the city.

B. URBAN TRANSPORT OPERATIONS

3.8 At present little or no data exist on capacities or traffic volumes on various road sections in the city. However, visual observations indicate that a high level of congestion takes place during most of the day, particularly in the city center. Average vehicle speeds are said to be below 18 kmph in this Central Business District (CBD) area. There are several E-W and N-S arteries that operate at or near capacity, with the E-W corridors carrying somewhat more traffic. Bottlenecks are common at intersections which are not designed for high volume flow, and many major intersections are roundabouts. Also, poor enforcement of traffic regulations results in frequent disruptions.

Traffic Management

3.9 In order to manage the spiralling growth of traffic in Tehran, the city center was designated as a restricted traffic area about a decade ago. This area, covering about 23 sq.km. (see map attached), is the focus of current and planned traffic management schemes. Presently, about 10 percent of the vehicles in Tehran have been issued stickers which allow them to access this area during restricted hours (0630 to 1330 hrs). About two-thirds of these permitted vehicles are Government owned vehicles, another 12 percent are physician’s cars and the remainder include taxis and other vehicles. Each permit costs between Rials 30,000 and 300,000 per year depending on the type of user. A survey conducted 5 years ago indicated that about 3.5 million daily passenger-trips were either originated or destined in this area. In addition, there is a larger area, covering about half the city, where truck restrictions apply. In this area only about 10 percent of the truck fleet can enter during restricted hours (0500 to 2100 hrs). No restrictions are placed on motorcycles throughout the city. Although no data exist, traffic personnel of TM believe that these restrictions have significantly reduced automotive traffic in the city center.

Demand Management

3.10 In order to manage peak demand on road facilities, a staggered work hours program was instituted in Tehran about two years ago. The program called for separation of educational (school), government, and commercial start times (0700, 0800, 0900 hrs respectively), but was abandoned when found to
be too rigid for most needs (e.g. dropping school children off could not be combined with the work trip). Alternative programs can be pursued, particularly employer-based and flexi-time programs, which have been found to be successful in many countries.

Parking Management

3.11 A major component of an urban transport system is parking, and this aspect appears not to have received much attention in Tehran so far. Much can be accomplished through careful controls on the amount and pricing of parking facilities. At present, most of the streets in the city center allow on-street parking, and zoning codes discourage or even prevent the construction of multi-story off-street parking. As a result considerable road space is lost, and traffic separation/discipline is adversely affected. Any future program of traffic management should include development of a detailed parking management scheme for the city center as a high priority.

Bus Operations

3.12 Urban bus services in Tehran are provided by the United Bus Co. (UBC), a government subsidized public sector company. There are 3500 buses in the UBC fleet, 73 percent of which are 16 or more years old. All units are diesel powered (see LPG conversion below). The number of buses operating each day on the road is about 2500. The level of maintenance, as evidenced by observed emissions, of most of the buses is poor. The age, poor condition, along with overcrowding and high N-S gradients found in the city, cause the buses to emit a high level of air pollutants. There are 151 bus routes with a total route length of 1800 km. Average bus speed is about 10 kmph. Total current ridership is about 3 million passengers/day which is up 32 percent since 1991. A Park & Ride facility (2000 cars), served by express bus service, located to the east of the restricted CBD area has proved successful, and three more such facilities are planned to the north, south and west. Bus fares currently are very low, Rls 10 for regular service and Rls 50 for express service. Parking in the Park & Ride costs Rls 200. The operating cost of regular bus service has been estimated at Rls 60 per passenger trip (July 1992), and according to this estimate the tariff covers only one-sixth of costs. This cost analysis however used the old official exchange rate (Rls 70/US$, now abolished) to value foreign exchange costs. Using a more market related exchange rate (e.g. the old floating rate, Rls 1430/US$) would increase the cost per trip to about three times the estimate. There are about 3500 mini-buses in Tehran. However, they are being phased out and replaced with regular buses in view of the difficult congestion situation in the city. The current public transport system is poorly integrated, and in the future it is expected that with the development of other mass transit modes (see below) a more integrated service can be offered to effect a significant shift away from private automobile use.

2/ The exchange rate has since been unified and presently all transactions are valued at Rls 1600 to US$1.
C. VEHICLE TECHNOLOGY

3.13 The major characteristic of all vehicle sub-fleets in Tehran is their high average age. The mission estimated the average age of the passenger car fleet to be 15 years, and the trend is to higher average age. According to data from the United Bus Co., the average age of the bus fleet is also high, exceeding 16 years. As regards the composition of the passenger car & light duty truck fleet, there are a limited number of vehicle types: based on domestic production data about 73 percent of the fleet is medium size cars (1.4 to 2.0 lt engine), mostly Paykan (1600 cc Hillman Hunter engine), and 20 percent small size cars, mostly Saipa/Renault 5 (1100 cc engine). The rest being distributed among a number of other locally produced vehicles (eg. Mazda pick-ups, Land Rover, Peugeot 504, etc.). About 90 percent of the motorcycles in use are of domestic manufacture, and of those larger than 50 cc, most are Honda (4-stroke) or Yamaha (2-stroke), while those less than 50 cc are all 2-stroke (eg. Vespa, Bravo, Peugeot, etc.). The bus fleet consists mainly of locally produced Iran-Mercedes Benz (0302) which make up 65 percent of the total, and imported vehicles (Mercedes Benz, Ikarus, Volvo) make up the remainder. Three types of mini-buses (FIAT, IVECO, Mercedes Benz) are locally produced. No data exist on the composition of the heavy duty truck fleet, however, the fleet consists of a large variety of imported and locally produced trucks.

Engine Technology and Emission Controls

3.14 As more than 90 percent of Tehran's vehicle fleet consists of the above-mentioned types produced locally under license, the engine technology of the in-use fleet is mostly of European technology from the early 1960s (the Paykan produced since 1966, the Renault since 1977). This means that no emission controls at all are used, and fuel efficiency is poor (low compression, no engine modifications). Therefore it is believed that the so-called pre-ECE emission levels of the European cars are most representative of the actual emissions of the Tehran fleet. A preliminary calculation using EC COPERT90\(^3\) suggests the following representative emission and fuel consumption factors for the light vehicle fleet of Tehran:

- CO: 63 g/km
- HC: 5.2 g/km
- NOx: 1.7 g/km
- Fuel Cons: 18.1 lt/100km

The above assume an average speed of 18 kmph and includes cold start and evaporative emissions (in the case of HC) and do not account for altitude and slope effects. The CO, HC, and fuel consumption figures above are particularly disturbing: a well tuned conventional engine of the 1970s could generate about 40 percent less CO and HC, and the fuel consumption could be on the order of 12 lt/100 km.

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3/ European Community's "Computer Program to Calculate Emissions from Road Traffic".
Domestic Automotive Production

3.15 In Iran there are 10 manufacturers of road vehicles, and 3 manufacturers of engines. As regards the production of light vehicles, while capacity exists to produce 150,000 vehicles per year, the actual yearly output now is about 25,000. Plans are also underway to manufacture more modern vehicles, and it was noted that these vehicles are of the latest European conventional technology with regard to emission controls. The studies planned under this project would also examine the regulatory and tariff constraints on the importation of more efficient transport equipment and technologies.

D. FUELS

3.16 The mission estimated fuel consumption in Greater Tehran to be 1.6 million tons of normal (87 octane rating) gasoline and 350,000 t of diesel for transportation, which is about a quarter of the total fuel consumption in the country. Motor cycles in Tehran account for about 1.5 million liters out of the total 6-7 million liters of fuel sold daily. Only a minor quantity (about 6000 kl) of super (high octane number) gasoline was consumed, which is a further indication of the poor fuel efficiency of the in-use vehicle fleet. The quality of fuels is also rather poor: 2.11 g/gal (or 0.56 g/l) lead content in the gasoline, and 1 percent by weight sulphur content in the diesel. Fuel volatility is also high, and the mission estimated the Reid Vapor Pressure to be 90/80 kPa. (winter/summer). There is a need to introduce independent testing of fuels.

3.17 A recent attempt to introduce unleaded gasoline was not accepted by consumers partly because the fuel had a low octane rating which caused engine knocking. Only 2 percent of petroleum sales in the Tehran area is unleaded gasoline, and this low level is also due to difficulties in supply and lack of education about the advantages of unleaded gasoline. The Ministry of Oil plans to phase out leaded gasoline by 1996. They are planning to install two units for MTBE production which will be used to provide additives for unleaded gasoline. The Ministry of Oil also plans to export surplus MTBE from these facilities which indicates sufficient supplies of MTBE will be available in the future. Efforts are also being made to introduce LPG for use by fleet vehicles (see paras 3.34 & 3.35).

E. AIR POLLUTION SITUATION

3.18 According to available air quality data, the city of Tehran faces severe pollution from CO, suspended particulate matter (SPM), sulfur dioxide (SO2), airborne lead (7 ug/m3 yearly average) and NO2, and the levels often exceed WHO Guidelines. Average annual concentrations of SO2 and SPM have ranged between 30 to 200 percent and 200 to 800 percent, respectively, of WHO Guidelines. Although no recent measurements of ozone are available, it is strongly believed that photochemical episodes occur frequently. The topography of the city (mountains to the north and east, and flat terrain to the south and west), wind direction and speed (calm most of the time with mild winds
from the west/northwest), sunshine (35.4N latitude), and frequent temperature inversions (about 260 in one year, usually occurring during the night and lasting till mid-morning) provide the necessary conditions for photochemical transformation of the high VOC and NOx concentrations to produce tropospheric ozone.

**Emission Sources**

3.19 To date no emission inventory exists for Tehran. Apart from road traffic, all of the "traditional" emission sources are to be found around the city: industries (metal and chemical factories situated mostly upwind to the west of the city, and a refinery to the south), as well as small factories located throughout the city. The city authorities, based on a theoretical approach, estimate that road traffic is responsible for 70 to 80 percent of the overall emissions, while the rest is attributed to industrial and residential emissions. The annual road traffic emissions for Tehran (reference year 1990) are estimated to be: CO 750 kt; VOC 90 kt; NOx 25 kt; Lead 1 kt; SO2 5 kt; and Particulates 0.9 kt. Greenhouse gas (GHG) emissions were estimated based on fuel consumption (including industrial activities) in the urban agglomeration of Tehran in 1989, and taking into account the estimates with regard to road traffic, emissions of CO2 were estimated to be as follows:


<table>
<thead>
<tr>
<th>Consumption (kt)</th>
<th>CO2 Emissions (kt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>1459</td>
</tr>
<tr>
<td>Diesel</td>
<td>2473</td>
</tr>
<tr>
<td>of which transport</td>
<td>250</td>
</tr>
<tr>
<td>Kerosene</td>
<td>1099</td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>984</td>
</tr>
</tbody>
</table>

Note: No data for natural gas consumption are included.

The above indicates that road traffic accounts for approximately 23 percent of the CO2 emissions, however, the total does not include natural gas which is used by nearly three quarters of Tehran households for cooking and heating. Apart from CO2, the other greenhouse gases are also emitted in minor quantities by road traffic in Tehran, eg. CH4 3.7 kt, N2O 0.1 kt.

**Air Pollution Monitoring**

3.20 Ambient concentrations of a number of pollutants are systematically monitored by the following institutions:

* The Department of Environment operates one (used to be 5 in 1991) station measuring CO, NOx and SO2 ambient concentrations (until recently total hydrocarbons and suspended particulates were also measured).
The Ministry of Health operates 10 stations, monitoring SO2, TSP, smoke, lead, and CO, in the framework of WHO's GEMS program.

Ministry of Oil operates 2 stations (one mobile), monitoring SO2, NO2, particulates, sulfation rates, haze, and meteorological data.

The Atomic Energy Organization of Iran measures trace elements (e.g., lead, etc.).

Health impact studies have shown high lead concentrations in the blood of Tehran's residents. The relatively frequent occurrence of temperature inversions (as many as 260 days in a year), would indicate that the health impacts of air pollution should be significant. CO concentrations usually reach 35 ppm for 1 to 2 hrs, while peaks of up to 45 ppm are quite frequent.

F. POLICIES AFFECTING URBAN TRANSPORT

3.21 A number of policies adhered to by earlier governments in Iran have lead to or exacerbated the air pollution problem now confronting the city. Among these, policies relating to fuel pricing, provision of public transport, and land-use have been especially detrimental to the development of an environmentally sustainable urban transport system in Tehran.

Fuel Pricing

3.22 Fuel prices in Iran have historically been set at extremely low levels. Presently, gasoline is priced at Rls. 50 /liter (US$ 0.14 /gallon\(^4\)), and diesel at Rls. 10 /liter (US$ 0.03 /gallon). These low fuel prices have several implications for urban transport and air pollution in Tehran. Automobile use is favored over public transit, since the latter cannot compete at such extremely low fuel prices. Further, fuel efficiency is not an important consideration, and the continued use of extremely inefficient and obsolete vehicles (about 40 percent of Tehran's automobile fleet can no longer be tuned-up) is the major cause of high vehicle emission factors, and the consequent high contribution of urban transport to air pollution in Tehran. Introduction of unleaded gasoline has also been hindered by the low prices which make the cost of producing such fuels uneconomic.

Provision of Public Transit

3.23 Public policy has long favored automobile ownership over the provision of public transport. In fact, previous governments had made the ownership of one automobile per family an objective of public policy. As a result, development of public transport services in Tehran was not, until recently, accorded much priority, and even today public bus services are generally regarded as a socially inferior form of transport. Bus tariffs have

\(^4/\) This was calculated at the floating rate of Rials 1430/US$ prevailing in July 1992.
accordingly, and in line with the low cost of automobile use, been kept extremely low (Rls. 10 /trip) with the result that the public bus company recovers about one-sixth of costs, and on some routes only minimal services are provided. The Municipality is now actively pursuing a number of public transport initiatives such as express buses from Park & Ride locations, the Metro and Trolley Bus (see below), however the success of these efforts will depend to a large extent on either rectifying the distortions caused by low fuel prices, or reliance on heavy subsidies for public transport.

**Land Use Policies**

3.24 Land use policies adopted to accommodate rapid increases in population have also had an indirect impact on urban transport in the city. Tehran has grown rapidly from a city of less than one million people in 1946, 4.5 million in 1976, to over 6 million in 1986. The resident population now is estimated to be about 7.2 million, and including the people who come into the city during the day, the population served by the urban transport system is estimated to approach 10 million. This rapid growth in demand has led the city to increase zoning densities in the downtown areas, with densities being tripled in some cases. These increases in densities have not been coupled with increased provision of competitive public transport facilities, and even though the city is adequately endowed with road space (24 percent of land area), the resulting increase in vehicular traffic has caused severe congestion in the downtown area. Agglomeration diseconomies may already have set in; there now appears to be a net out-migration from the city, with the urban growth rate, which was over 4 percent pa. recently, declining to 1.8 percent, which is below the rate of natural increase for the nation.

G. **URBAN TRANSPORT DEVELOPMENT PLANS**

3.25 In response to the increasing problems of urban transport and air pollution, Tehran Municipality has undertaken a number of initiatives to improve both physical infrastructure and the management of urban transport operations. The following describes some of the key initiatives.

**The Tehran Metro**

3.26 The metro system is expected to commence operations in about three years when the N-S Blue line will be completed. The first phase of the project (N-S Blue and E-W Red lines) includes a total of 90 route km. of which 30 km. are underground. The Red line will eventually reach the satellite town of Karaj (pop. 4 mln), allowing travel between Tehran and Karaj, a distance of about 40 km, in less than half an hour. It is expected that ridership will cross 2.5 million per day once the Karaj line is completed. All of the lines now envisaged are expected to be completed in about 10 years. Stations on the Metro will generally be spaced 1 km apart. The Metro will be powered by a dedicated gas fired power plant of 140 MW capacity.
Trolley Bus System

3.27 A pilot trolley bus system comprising 17.5 route km. is under construction, and the first phase (7 km) is scheduled to open for traffic in about two months. The pilot project is located on a congested E-W corridor passing through Imam Hosseini Square and Enquelab Square. The Trolley bus will operate in a physically separated dedicated bus lane. The cost of the first phase, including 65 Trolley Buses, is expected to be about US$30 million. If the pilot project is successful, a trolley bus system of about 150 route km could be possible based on the existing road network, with about 50 km of this network being in dedicated trolley bus lanes. Power requirement for the 17 km pilot project is 10 MW. The trolley bus fare will be Rls 20.

Tehran Traffic Control Center

3.28 The Traffic Control Center of Tehran Municipality was established in 1991 to develop a computerized traffic control system as well as to monitor air quality at strategic locations of the city on a real time basis. The air quality monitoring system will be used to provide a citizen advisory, and to take actions such as closing off areas to traffic, once certain air quality thresholds are exceeded. Pollution advisory messages will be given through variable message signs and through radio broadcasts. Details on the air quality monitoring project are given in paragraph 31 below. The Traffic Control Center is also currently engaged in developing real time traffic signal coordination for about 250 intersections in Tehran. In addition, projects are underway to implement a traffic surveillance system using video monitoring and image processing in 35 downtown and 10 non-CBD squares (meydans) and critical intersections. Studies are also underway to develop a computerized route guidance system to assist drivers in avoiding congested parts of the network. Work on development of an electronic road pricing system has also been initiated with a local university, and such a system is intended to be implemented initially in the CBD, and later throughout the metropolitan area.

Dedicated Bus Lanes

3.29 Tehran has about 60 km. of dedicated bus lanes physically separated from other traffic lanes. These lanes have greatly increased bus speeds. While the average bus speed in mixed traffic lanes is about 5-10 kmph, the average bus speed in dedicated bus lanes is about 18 kmph. Often the fastest means of travelling across the city, particularly north-south, is by bus using dedicated lanes. Ridership of the bus service using dedicated lanes is high. A recent survey along a East-West corridor indicated that the average hourly ridership is about 12,500, while the peak hour ridership is about 20,000 passengers/hour. Although dedicated bus lanes have generally proved to be successful, their effectiveness can be increased by strict enforcement of the ban against their use by motorcycles and other vehicles (or by making contra-flow bus lanes), by improving intersection geometrics, and by overall improvements in the level of bus service.
Air Quality Monitoring

3.30 The Traffic Control Center plans to purchase air pollution monitoring stations and install them at critical locations throughout the city to monitor O3, CO, CO2, HC, NO2, H2S, and SO2. optimum location of these stations is presently being studied. Additionally, 10 heavy metal samplers are to be installed in the greater Tehran area (to sample on a weekly basis), and 20 high volume samplers for particulates are also planned.

Tehran Vehicle Technical Inspection Bureau

3.31 An extensive inspection and maintenance (I/M) program (called Tune-Up) for private passenger cars and light duty trucks has been started in Tehran. Its pilot phase (comprising one fully equipped facility) has recently been completed, and is aimed at training personnel in the use of the equipment. The I/M program addresses both safety (eg. brakes, lights) and emission issues. With regard to emissions, CO and HC concentrations are measured at idling, and the engine is adjusted according to manufacturers specifications. All private vehicles must be tested once every six months, and the public vehicles such as taxis must be tuned every three months. Stickers are issued to cars which have passed the inspection and emission test. Rejected cars must be repaired and retested, and there is a penalty of 10,000 Rials on cars without a current sticker.

3.32 During the first six months of the pilot phase some 1500 vehicles had received tune-ups; the facility has the capacity to tune-up about 30 vehicles per day and it is expected that as it becomes better known, demand will pick-up. The equipment increases the productivity of tune-up work many fold and will therefore pay for itself in a very short period. Another 249 units have been procured, and personnel from various tune-up workshops around the city have been trained. The equipment is scheduled to be distributed in the near future, and will create a capability to inspect and tune-up 50,000 vehicles per month. Initial results are very encouraging; for some vehicles, the tune-up resulted in reductions in emission as high as 80 percent, and on average for 1971 model cars reductions of 50 percent in HC and 25 percent in CO were achieved.

3.33 It is important to note here that about 40 percent of the vehicles tested were in such poor condition that they could not be restored to the specified condition. Based on international experience, it can be estimated that this 40 percent of the vehicle fleet could be responsible for more than 90 percent of total road traffic emissions in Tehran, at least in regard to CO emissions. This clearly reflects the high average age of the cars in the city, and the low levels of maintenance.

Conversion of Taxis to LPG

3.34 In a pilot scheme, 300 taxis from the in-use fleet have been converted to LPG fuel in order to test the conversion equipment (mainly Italian and Dutch), and to convince taxi drivers of the safety features and procedures. Another 3,000 in-use taxis are scheduled to be converted in the
coming months, and a further 10,000 new taxis will be required to comply with specifications for LPG use. It is not yet decided whether these new taxis will be procured equipped with LPG systems, or will be retrofitted to allow dual fuel use. According to Tehran Municipality, the converted vehicles suffer a more than 30 percent deterioration in fuel efficiency, however, the user is more than compensated for this drop in fuel efficiency via the pricing of LPG: the taxi driver pays only US$ 3.5 per month for LPG regardless of the amount consumed. To the extent that LPG used in the program is presently being flared, it is expected that this program will have beneficial impacts both on local as well as on Global pollution levels. However, the ramifications of the innovative pricing strategy adopted need to be studied to determine if improvements are possible. With regard to the availability of LPG, the present distribution network consists of 5 gas stations, and an additional two are planned to be opened in the coming months.

Conversion of Urban Buses to LPG

A program for conversion of the diesel engines of the urban bus fleet is being considered; the engine is to be converted into an Otto (spark ignition) engine to run on LPG, with the objective of eliminating particulate and SO2 emissions. Although no data are available, it must be expected that this intervention will strongly increase (on the order of 50 percent) the fuel consumption of buses. Moreover, it will result in higher CO, HC, and NOx emissions, if no other measures are taken. Finally, as in the case of taxis, significant incentives are being considered, and would be provided through very competitive pricing of LPG.

Tehran Comprehensive Transportation and Traffic Studies

No organized traffic and transportation related data base exists for Tehran. Nor has there been any systematic planning of land use coordinated with transportation facilities planning in recent years. About 20 years ago an urban transportation study was conducted. However, this is now outdated and no data base has been maintained. Consequently, a unit under the Deputy Mayor for Transport and Traffic Affairs, Tehran Municipality, has recently been set up to conduct a study and develop a comprehensive urban transport data base. The study will have the following elements: data collection and analysis of the current situation; land use - transport modelling and travel demand forecasts; and evaluation and selection of alternative action programs. As a part of the evaluation process, the environmental effects of transport will be explicitly considered. The study will take 30 months to complete. The proposed study will provide a much needed resource center for data collection and analysis of strategic traffic and transportation issues. When coupled with the air quality data base to be maintained by the Traffic Control Center, the study would generate the type of information critical to decisions regarding urban transport investment, and various regulatory and policy measures.
In the current 5-year plan, the Dept. of Environment is establishing a laboratory for testing of exhaust gas emissions of motor vehicles, with a budget of US$500,000. The Department of Environment also promulgated rule by which diesel engines have been prohibited for use by passenger vehicles and light duty trucks on environmental (primarily particulates) grounds.

IV. THE GEF PROJECT

4.1 There are good reasons for selecting Iran as the first country to address urban transport related air pollution and greenhouse gas emissions in tandem. As discussed above, Tehran is a highly polluted city with considerable potential for low cost interventions that would reduce both GHG emissions and local air pollutants. Tehran Municipality has a rich diversity of transport-related developments planned or under implementation which provide a good opportunity for a pilot program of the nature envisaged under this project. Further, the Islamic Republic of Iran is strongly committed to addressing global climate change issues, and is a signatory (June 14, 1992) to the U.N. Framework Convention on Climate Change.

A. PROJECT OBJECTIVE

4.2 With the support of GEF funding, authorities in Tehran will assess measures that would reduce GHG emissions from vehicular traffic, while simultaneously improving local air quality. GHG abatement can be achieved through a variety of measures, all of which will produce reductions in local air pollution. The GEF project would identify a schedule of measures which serve both objectives at the lowest incremental cost for maximizing GHG abatement. Such a schedule of GHG abatement maximizing measures, and the associated incremental costs, will provide decision-makers with the information necessary to design a program of local air pollution abatement that simultaneously addresses global warming concerns. This project would also contribute to the design of urban transport investment projects that are responsive to global warming concerns, in all developing countries facing transport related air pollution problems in their major cities.

B. KEY ISSUES TO BE ADDRESSED

4.3 The above review of the urban transport situation in Tehran raises a number of issues which would need to be addressed in preparing a strategic plan to reduce local air pollution and greenhouse gas emissions. The following briefly reviews these issues as a preface to the description of the project itself.

4.4 Transport Sector Development & Pricing: Development of an energy efficient urban transport system will require that investment decisions are
based on appropriate criteria, and that transport services are priced efficiently. Presently, the urban transport system in Tehran suffers from a number of distortions in pricing and service characteristics, and removal of these distortions are a priority for improving air quality in the city.

4.5 **Transportation Fuels:** Use of appropriate fuels appropriately priced can have a significant impact on local and global air pollution impacts of the urban transport system. Low fuel prices, poor quality fuels, limited availability of unleaded fuels, and lack of energy efficient transport modes using alternate fuels, are critical factors causing the high pollution levels of the present transport system.

4.6 **Emission Standards for Vehicles:** For implementation of a comprehensive emissions reduction policy, adoption of appropriate emission standards for new vehicles is absolutely necessary. Such standards can improve fuel efficiency, which directly translates into a reduction in greenhouse gas emissions, as well as reduce conventional pollutants (CO, HC, NOx). Also, phasing of standards is critical to effective implementation of such a policy.

4.7 **Emissions Inventory Development:** Lack of an emissions inventory must be addressed as a priority, since this is necessary both to establish a baseline data set and a predictive model for the assessment of planned interventions, and for monitoring their success in the future.

4.8 **Baseline Air Quality Data:** Presently numerous air quality assessments are being carried out, and there is incompatibility among the results due to the use of different measurement techniques. It is necessary to establish an agreed baseline air quality data set and the related monitoring mechanisms, so as to ensure that future assessments can be carried out on a consistent basis.

4.9 **Fleet Improvement:** As already noted, a large part of the fleet consists of very old, poorly maintained vehicles. Any attempt to improve the emissions and fuel consumption of these vehicles will be of limited effectiveness. Therefore, a fleet renewal effort needs to be undertaken, aimed at the scrapping of old, highly polluting, low efficiency vehicles.

4.10 **Inspection & Maintenance of Vehicles:** The current I/M program needs to be enhanced. Present testing only comprises idling tests, which are of limited value in predicting actual emissions or fuel consumption. A representative short test could be developed to better relate test conditions to actual (city) driving conditions.

4.11 **Traffic Management:** Although several traffic control measures have been taken, many of them have not been able to achieve their full potential, or even have proven ineffective. For instance, the area traffic restriction program can be greatly enhanced by implementing a careful parking management program within the restricted CBD area. Similarly, staggered working hours could have been effective if experience elsewhere could have been incorporated in the design of the program. The effectiveness of
exclusive bus lanes could also be enhanced through allowing the facilities to be utilized by high occupancy vehicles. Furthermore, some control measures should be taken at the currently uncontrolled intersections, using either signs or signals.

C. PROJECT DESCRIPTION

4.12 The GEF project has the following components:

(A) Emissions Inventory & Air Quality Monitoring.
(B) Traffic Management & Restraint.
(C) Vehicle Fleet & Fuels Improvement.
(D) Strategic Urban Transport Emissions Reduction Planning.
(E) Project Support and Transport Emissions & Air Quality Seminar.
(F) International Panel of Experts.

The following describes each of these components.

Component - (A) Emissions Inventory & Air Quality Monitoring: This component will comprise the following:

(i) Development of an emissions inventory, covering both mobile and stationary sources, and including all pollutants (GHG and conventional) emitted by urban transport operations. Based on this inventory, a suitable emissions forecast model (eg. COPERT) will be adapted for the investigation of policy options. As fuel switch and intermodal shifts are likely, the inventory and forecast models should allow for full fuel cycle emissions analysis.

(ii) Specification of the air quality monitoring system to be used in evaluating the effects of interventions in urban transport operations. A phased program of improved air quality targets will also be established.

(iii) Establishment of a baseline air quality data set, to serve as a benchmark against which future plans and actual accomplishments can be evaluated. An air quality prediction model (eg. CALINE) will be adapted to allow evaluation of specific urban transport interventions.

Component - (B) Traffic Management & Restraint: This component will assess the emission reduction potentials of various traffic management and restraint
strategies that are currently being planned or to be considered as a part of the GEF project. The component would consist of the following sub-components:

(i) Identification and assessment of traffic management and restraint strategies, including improved enforcement of regulations. Compilation of case studies on the basis of international and Iranian experience. These case studies should include information on effectiveness with respect to traffic flow and air quality, and the associated costs and implementation procedures.

(ii) Development of a modelling framework for assessing the extent of reduction of emissions of both GHG and local pollutants resulting from the adoption of various traffic management strategies. The framework should be dynamic (i.e. time dependent) in nature so that temporal changes in fleet mix, fuel quality, engine technology, travel patterns, land use, and other elements are explicitly considered.

(iii) Development of an appropriate travel modal shift model, calibrated with data from Tehran, in order to estimate the impact of various pricing, regulatory and investment strategies on travel demand and behavior and GHG emissions.

(iv) Identification of appropriate emission factors associated with expected driving conditions under various strategies. Estimation of emission reductions that can potentially be accomplished through various strategies separately or in combinations.

Component - (C) Vehicle Fleet & Fuels Improvement: This component will comprise the following:

(i) Development of a phased program of Emission Standards for new vehicles (possibly including CAFE type corporate fuel efficiency standards), which take into account target air quality standards, and programs to enable local industry to respond effectively to the new requirements.

(ii) Design of a comprehensive policy for accelerated fleet renewal through a program of incentives for scrapping of older, highly polluting, low efficiency vehicles.

(iii) Enhancement of the I/M program for in-use vehicles, aimed at the establishment of effective emissions short tests, and linking the actual emissions and fuel consumption to type approval standards.

(iv) Feasibility of introducing alternative fuels such as CNG/LPG, and higher quality fuels such as unleaded gasoline of higher
octane rating, gasolines with lower volatility, diesels with lower sulphur content.

Component - (D) Strategic Urban Transport Emissions Reduction Planning: This component will evaluate the cost-effectiveness of various strategies and prepare a strategic plan for implementation. The sub-components will include:

(i) Identification of costs and likely GHG and local pollutant emission reductions of various strategies, including strategies involving engine technology, fuel technology and pricing, traffic management and restraint, public transport improvement, and urban growth guidance and land use. Costs will include implementation costs, changes in user costs, and other public and private costs.

(ii) Detailed trade-off analyses between costs and different effects with regard to local and global pollution. In effect, this sub-component would develop "supply curves" of the costs of various interventions per unit of GHG and local air pollution emissions reduction achieved.

(iii) Synthesis of the results in an evaluation framework. The framework should incorporate the dynamics of the underlying systems so that the timing of specific interventions can be explicitly considered.

(iv) Review of possible institutional constraints in the implementation of various options.

(v) Preparation of recommendations for a phased implementation plan.

Component - (E) Project Support and Transport Emissions & Air Quality Seminar: This component will fund (i) administrative support and facilities for the project, and (ii) a seminar in Tehran on "Transport Emissions and Air Quality" to present the results of the studies and obtain public comment on the measures proposed.

Component - (F) International Panel of Experts: This component will fund fees and travel expenses for a panel of four international experts in the fields of air pollution measurement and impact assessment (special emphasis on global warming), transportation fuels, vehicle technology and emission controls, and urban transport planning. The International Panel of Experts will provide guidance on international experience, will participate in detailed design of components, and will review the outputs from the first four components. In addition, the International Panel of Experts will participate in the seminar on Transport Emissions & Air Quality.
D. ORGANIZATION & IMPLEMENTATION

4.13 The Department of Transportation and Traffic (DTT), Tehran Municipality, will be the Implementing Agency for the project. A DTT staff member will be appointed Project Coordinator with overall responsibility for the project. It is not expected that DTT will engage any additional staff for this project. Within DTT, implementation responsibility for components A to D of the project will be distributed as follows:

- Component A - Air Quality Control Co.
- Component B - Tehran Comprehensive Transportation & Traffic Studies Project
- Component C - Tehran Vehicle Technical Inspection Bureau
- Component D - Tehran Comprehensive Transportation & Traffic Studies Project

4.14 Implementation of the project will be carried out in three phases. In Phase I, the International Panel of Experts (IPE) would be appointed and would specify detailed Terms of Reference for the Studies to be carried out in Phase II of the project. In Phase II consultants will be engaged to undertake the studies under Components A, B and C. In Phase III, a consulting contract will be awarded for Component D of the project.

Project Advisory Group

4.15 While the DTT is the implementing agency for the project and will bear full responsibility for its implementation, the project will benefit greatly from consultations with various national and international agencies which have expertise in the subjects of interest to the project. In order to promote such consultations and cooperation, it was agreed that a Project Advisory Group (PAG) would be established consisting of representatives of the following agencies:

(a) Department of Environment, GOIRI
(b) Transport Department of the Plan and Budget Organization, GOIRI
(c) Ministry of Economic Affairs and Finance, GOIRI
(d) Ministry of Health and Medical Education, GOIRI
(e) Ministry of Heavy Industries, GOIRI
(f) Ministry of Oil, GOIRI
(g) Ministry of Roads and Transport, GOIRI
(h) United Nations Development Programme, Tehran

Meetings of the PAG will be chaired by the Department of Environment, and will be convened by the DTT at three month intervals or more frequently. At each meeting the DTT will brief the PAG on project status, and will arrange to produce written minutes of PAG meetings which will be distributed to the PAG, International Panel of Experts (IPE), and the Bank. All draft final reports
will be circulated to the PAG, and their comments will be provided when submitting the reports for review by the IPE and the Bank. Attachment I details the role of the PAG and responsibilities of the DTT with respect to the PAG.

**International Panel of Experts (IPE)**

4.16 Tehran Municipality will appoint the four member IPE, under Terms of Reference as set out in Attachment II. The four members of the IPE will be experts in the following fields:

(a) Air Pollution and Global Warming Impacts;
(b) Transportation Fuels;
(c) Vehicle Technology and Emission Controls; and
(d) Urban Transportation.

The IPE will establish the Terms of Reference for the studies, review and comment on intermediate and final project outputs, and will participate in the Transport and Air Quality Seminar to be held in Tehran.

**Project Budget**

4.17 The Table below presents the project budget.

<table>
<thead>
<tr>
<th>Description of Components</th>
<th>GEF Contr.</th>
<th>TM Contr.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Emissions Inventory &amp; Air Quality Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Studies</td>
<td>400</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>ii) Equipment</td>
<td>300</td>
<td>300</td>
<td>600</td>
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<tr>
<td>B. Traffic Management &amp; Restraint</td>
<td>300</td>
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<td>600</td>
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<tr>
<td>C. Vehicle Fleet &amp; Fuels Improvement</td>
<td>350</td>
<td>200</td>
<td>550</td>
</tr>
<tr>
<td>D. Strategic Urban Transport Emissions Reduction Planning</td>
<td>400</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>E. Project Support &amp; Transport &amp; Air Quality Seminar</td>
<td>400</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>F. International Panel of Experts</td>
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</tr>
<tr>
<td>Totals</td>
<td>2000</td>
<td>2000</td>
<td>4000</td>
</tr>
</tbody>
</table>

**Procurement**

4.18 The following procurement methods will apply to Components A, B, C, D, and F of the project: All contracts for goods of a value of US$50,000 or
greater will be awarded through International Shopping on the basis of price quotations from at least three suppliers from at least two different countries. Contracts below US$50,000 will be awarded on the basis of comparison of price quotations solicited from at least three local suppliers. Procurement of goods will be in accordance with Bank Guidelines. Procurement of consultant services will follow the Bank’s Guidelines for the Use of Consultants.

Disbursements & Special Account

4.19 Disbursement withdrawal applications will be prepared and submitted to the Bank by the DTT. Disbursements against all items will be based on full documentation, except for contracts below US$100,000 equivalent, which will require only statements of expenditure (SOEs). Supporting documents for SOE claims will not be submitted to the Bank but will be retained by the project implementing agency and made available for inspection by Bank Supervision missions and project auditors.

4.20 A Special Account will be set up to finance eligible expenditures under the GET Grant, and will follow standard Bank procedures in this regard. The Special Account will be established at a commercial bank on terms and conditions satisfactory to the Bank, to which the Bank will make an initial deposit of US$200,000.

4.21 Tehran Municipality will establish a separate account at a commercial bank on terms and conditions satisfactory to the Bank, and will make an initial deposit US$500,000 equivalent in local currency therein as a condition of effectiveness of the GET Grant Agreement.

Project Supervision

4.22 The project would be supervised by Bank staff/consultants every six months, and these supervision missions would be coordinated with visits to Iran by members of the International Panel of Experts. Bank staff would also participate in the Transport Emissions & Air Quality Seminar to be organized under the project to review and disseminate the results of the studies carried out. A project inception mission would also be undertaken with the participation of the IPE upon effectiveness of the Grant Agreement.

V. PROJECT BENEFITS

5.1 The project would quantify the costs of various interventions to reduce greenhouse gas and local air pollutant emissions from urban transport in a setting characterized by in-use technologies that are typical for non-industrialized countries. This information would prove invaluable in guiding policy decisions for urban transport development in developing countries, and to the work of international bodies dealing with climate change issues. Secondarily, the project would assist the Tehran Municipality and GOIRI in embarking on urban transport policies which are environmentally sustainable from a local air pollution as well as global stand point.
Project Sustainability

5.2 It is expected that the recommendations of these studies will be incorporated into the future investment plan for urban transport development in Tehran. Sustainability will depend on the implementation of various policy measures identified. In particular, petroleum pricing policies adopted by GOIRI will be key to achieving energy efficiency improvements. This project would also contribute to the preparation of environmentally sustainable urban transport projects to be financed by the Bank in various developing countries.

Project Risks

5.3 Given the strong commitment of GOIRI and Tehran Municipality to this project, no specific issues or risks are foreseen at present, other than the normal implementation risks of a program of studies.

V. AGREEMENTS AND RECOMMENDATIONS

6.1 During negotiations the Bank sought and received agreement from GOIRI and Tehran Municipality that there would be:

(a) An undertaking in the GET Grant Agreement that GOIRI will take all actions necessary on its part for the establishment and functioning of the PAG.

(b) An undertaking in the Project Agreement that Tehran Municipality will establish for the project a bank account in a commercial bank on terms and conditions satisfactory to the Bank. Withdrawals from such account will be made only to pay for project costs. The Municipality will make deposits in Rials into such account at such times and in such amounts as the Bank deems necessary, up to an aggregate maximum of the Rial equivalent of US$2 million.

(c) A condition of effectiveness in the GET Grant Agreement that a subsidiary grant agreement, on terms and conditions approved by the Bank, shall have been executed by GOIRI and Tehran Municipality.

(d) A condition of effectiveness in the GET Grant Agreement that Tehran Municipality shall have established the bank account referred to in (b) above, and shall have made an initial deposit therein of the Rial equivalent of at least US$500,000.

Recommendation

On the basis of the above agreements and conditions, the proposed project will be suitable for a GEF Grant of SDR 1.50 million (US$2.0 million equivalent) to the Government of the Islamic Republic of Iran.
1. The Project Advisory Group (PAG) for the project will comprise representatives of the following agencies:

(a) Department of Environment;
(b) Transport Department of the Plan and Budget Organization;
(c) Ministry of Economic Affairs & Finance;
(d) Ministry of Health and Medical Education;
(e) Ministry of Heavy Industries;
(f) Ministry of Oil;
(g) Ministry of Roads and Transport; and
(h) United Nations Development Programme, Tehran.

The representative of the Department of Environment will chair the PAG.

2. The primary role of the PAG will be to advise the implementing agency for the project, the Department of Transport and Traffic (DTT), Tehran Municipality, and to review and comment on intermediate and final outputs of the project. In carrying out this role the PAG will undertake to:

(a) Guide DTT on the implementability of various schemes in light of various national/other constraints of which the DTT may not be aware;

(b) Inform DTT on the availability of various data and on research efforts/studies that may be relevant to the project;

(c) Identify and designate counterparts within the agencies represented on the PAG, for specific activities of the project on which DTT may require collaboration with such counterparts; and

(d) In general provide DTT with the benefit of their expertise in their respective technical areas.

3. Meetings of the PAG will be chaired by the Department of Environment, and will be convened by DTT at three month intervals or more frequently if necessary. At each meeting DTT will brief the PAG on project status, and will arrange to produce written minutes of PAG meetings which will be distributed to the PAG, International Panel of Experts (IPE), and the Bank. All draft
final reports will be circulated to the PAG, and their comments will be provided when submitting the reports for review by the IPE and the Bank.

4. Whereas DTT, in keeping with its sole responsibility for project implementation, may choose not to accept specific advice/opinions offered by the PAG, in rejecting such advice DTT should explain its reasons in writing and for the record.
ISLAMIC REPUBLIC OF IRAN

TEHRAN TRANSPORT EMISSIONS REDUCTION PROJECT

International Panel of Experts

Terms of Reference

1. The International Panel of Experts will comprise four members, each representing and responsible for one of the following subject areas:

   (a) Air pollution and global warming impacts of transport operations;
   
   (b) Production, distribution and use of transportation fuels and electricity for transport;
   
   (c) Vehicle emission control technology, and vehicle inspection/maintenance programs; and
   
   (d) Urban transportation planning, traffic restraint, demand management including parking management, and pricing of fuels and transport services.

2. These Terms of Reference (TORs) set out the responsibilities of the IPE in the three phases of the project. During Phase I (duration about 2 months), the IPE will prepare the detailed Terms of Reference for the work to be carried out under the project. During Phase II (duration about 12 months), the IPE will review and comment on all outputs of Components A, B and C of the project (see paragraph 8 of the MOD for description of project components). During Phase III (duration about 10 months), the IPE will review and comment on the output of Component D, the Strategic Urban Transport Emissions Reduction Plan, and will participate in the Seminar on Transport Emissions & Air Quality, in Tehran, to present the results of the project and seek public comment. The following details specific responsibilities of the IPE in each of the three project phases.

Phase I

3. In Phase I, the IPE will prepare the detailed TORs for the project. In preparing the TOR the following aspects are to be covered:

   (a) In each of the areas covered by the TOR, the IPE shall identify specific transport technologies, fuels, traffic management systems, and pricing mechanisms to be considered in the work program;
(b) Where desirable, the IPE shall specify small scale pilot projects, eg. gas conversion of diesel fleet vehicles, mobile exhaust testing equipment, etc., to be included in the work program; and

(c) In preparing the TOR, the IPE will make a detailed cost estimate to assess the feasibility of accomplishing the work envisaged within the project budget, and if found to be excessive the IPE will revise the TORs to bring the cost estimate in line with the overall budget allocation, noting any work eliminated which would detract significantly from the project's ability to achieve its objective.

Phase II

4. During Phase II, the IPE will review intermediate and final outputs of the project, and in particular will comment on any issues raised by the Project Advisory Group (see Attachment I of Technical Annex to MOD). Upon completion of the draft final reports for Components A, B and C the IPE will provide detailed comments to the Department of Transport and Traffic (DTT) and to the Bank within 15 calendar days of receiving the draft reports.

Phase III

5. During Phase III, as earlier, the IPE will review intermediate and final outputs of Component D. Prior to production of the final Strategic Urban Transport Emissions Reduction Plan, a draft of the plan and the results of the various studies carried out will be discussed at an international seminar organized by DTT on Transport Emissions & Air Quality, to be held in Tehran, to seek public comment on the results of the project. The IPE will participate in this seminar, and the IPE comments on the draft final Strategic Urban Transport Emissions Reduction Plan will reflect the comments received at the seminar. These comments will be provided to DTT and the Bank within 15 days of receiving the draft report.

Liaison

6. The IPE member responsible for "Air Pollution and Global Warming Impacts of Transport" will also liaise with the Intergovernmental Panel on Climate Change (IPCC) and the Secretariat of the U.N. Framework Convention on Climate Change.

General

7. At various times, during implementation of the project, the IPE as a group or individual members of the IPE may be requested to join World Bank project supervision missions to review progress or resolve specific issues arising during implementation of the project. Such participation in missions will be under specific TORs prepared for these missions.