Integrated Strategy for a
Sustainable Traffic Development in Tirana, Albania

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Prepared by ECAT – Tirana:
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Preface


The project was undertaken by ECAT Tirana (Environmental Center for Administration and Technology). ECAT Tirana was established in October 1995 by The Life Third Countries, European Commission General Directorate for the Environment and the Federal Ministry for Economic Co-operation of Germany and has served as an advisory and consultative body for the Ministry of Environment, Forests, and Water Administration. In its twelfth year of its existence, ECAT Tirana is acknowledged as an active and specialized environmental center, managing successfully a number of projects with a focus on environment.

SUSTRAFFTIA project seeks to improve the traffic situation in Tirana city by developing a legal and planning framework presenting a long term solution for a sustainable and integrated traffic in Tirana city.

The present document is the result of the vast efforts of a group of international and Albanian experts and of a co-operation with Ministry of Environment, Forests and Water Administration, Ministry of Public Works, Transport and Telecommunication and Municipality of Tirana.

Tirana Urban Transport Improvement Study (TUTIS)” of 2001 financed by World Bank served as a starting point for the present Draft Strategy. Data on population, including perspectives for further growth, car ownership and economic activities, were updated and traffic counts at key intersections were taken. Based on the results of the traffic forecasts of 2014 and 2021, two different scenarios were developed giving proposals for the future organizational structure of the local traffic in the city and a new design for the optimization of the public transport services.

The first scenario is a road traffic oriented strategy giving priority to the needs of the fast growing road traffic. Major improvements and extensions of the road infrastructure are necessary under this strategy.

The second scenario proposes a public transport oriented strategy. The new public transport system will change the modal split so that fewer roads must be built.

The economical and ecological consequences of both strategies were analyzed and recommendations for Tirana transport planning, emission standards for new and in-use vehicles, fuel quality, vehicle inspection and maintenance were developed. The implementation of the approved and selected measures will considerably improve the traffic situation in Tirana city.
Executive Summary

The Tirana / Durres region is one of the fastest growing regions in Europe. During the 7 years from year 2000 to year 2007 the gross domestic product (GDP) of this central region of Albania went up at a rate of 10 % per year. Parallel to the GDP-growth during the whole 7 year period the car traffic increased by 13.1 % per year. Unfortunately visible negative effects accompany this positive development. Despite important investments into the Tirana road network congestions not only during peak hours are becoming more and more frequent. Moving within Tirana is becoming more and more difficult. At the same time the air pollution created by all the cars, buses and trucks circulating in the Albanian capital has achieved an unacceptable high level. Recent measurements of the amount of particles (PM10) in the air are showing concentration of 100 to 150 $\mu$g/m$^3$ which is well above the actual EU limit value of 40 $\mu$g/m$^3$. The concentration of NO2 is also high. The hot spots in town are showing concentrations of 47 to 75 $\mu$g/m$^3$. Experts from the World Health Organization (WHO) assume, that hundreds if not more than thousand inhabitants of Tirana are dying every year due to air pollution.

Seeing these constantly growing problems an integrated strategy for a sustainable traffic development in Tirana is needed. With the support of EU Life Program and the German Government ECAT-Tirana has developed such a strategy (SUSTRAFFTIA). The work of ECAT and its experts has been supervised and supported by a Steering Committee composed of representatives of the Ministry of Environment, the Ministry of Public Works, Transport and Telecommunication, the Institute of Public Health, the Institute of Transport Studies, COPLA and the Municipality of Tirana.

The proposed strategy to achieve the goals of improving the traffic situation and reducing air pollution at the same time includes the following key components:

- Integrated urban transport planning and demand management,
- Stringent emission standards for new and in-use vehicles,
- Introduction of clean fuel and
- Proper inspection & maintenance of all vehicles.

1. Integrated urban transport planning and demand management (Chapter 1)

The starting point of the study was the analysis of the actual volume of traffic and a traffic forecast for the future (years 2014 and 2021). For these traffic forecasts SUSTRAFFTIA has used the same computer model and the data of the World Bank Study “Tirana Urban Transport Improvement Study (TUTIS)” from January 2002. The data on population, car ownership and economic activities have been updated to the year 2006 and traffic counts at key intersections were made in January and February 2007.

The results of the traffic forecasts made are showing that the future road traffic in Tirana will
- double by the year 2014 and
- triple by the year 2021.

To solve the actual and future traffic problems in Tirana short-term activities and a clear long-term strategy are needed. For the long term SUSTRAFFTIA has analysed two options, a road oriented strategy (Option A) and a public transport oriented strategy (Option B).
a) Necessary short-term activities

Actually the intersections are the main bottlenecks of the Tirana road system. The municipality has already established a program to improve the traffic situation at 9 major intersections. Some of these must be equipped with bridges, others like the intersection of Rruga Kavajes with Unaza e Re and the Boulevardis Zhan d’Arc/Bajram Curri do need a totally new design. Many other intersections need minor improvements. In addition more intersections must be equipped with traffic lights and a central synchronization system for all traffic lights should be created.

The existing bus lines of Tirana have a length of 61.9 km. Two more lines with together 6 km are foreseen. The main problems of the actual bus system are:

- The very low speed of the buses, since they are obliged to mix with the normal (congested) traffic.
- Low fares (30 LEK per ride) and lacking subsidies are creating financial problems. They are the main reason for the insufficient number of lines, the old buses and the overcrowding of the buses during peak hours.

The necessary main activity to improve the actual bus system is the introduction of “Bus only Lanes” at all congested road sections. Wherever possible, these bus lanes should be situated in the middle of the street, so that delivery vehicles and parking cars are not disturbing the buses. In this case the bus stops should be situated the intersections.

![Example for a bus lane in the middle of an urban street](image)

Other activities necessary to make the actual bus system more attractive are:

- A new regulatory structure of the Tirana bus service concentrating all competence (e.g. fixing the price of the tickets) at the level of the Tirana Municipality
- Efficient Quality Control after the tendering of bus services
- Integrating the buses from surrounding communes into the Tirana bus system
- Good information, so that the existing buses are becoming easier to use.

Further urgent short-term actions are

- The introduction of a parking system for Tirana covering the whole area within the middle ring road and
- Measures making walking and bicycling safe and attractive in Tirana.
b) **Long-term traffic strategy for Tirana**

Looking 15 years ahead there will be probably three times more vehicles circulating in Tirana than today. To cope with this situation, two different strategies are possible. Under Option A to satisfy the future demand the Municipality would invest primarily into the road network. Such a network containing several ring roads has been designed by the Tirana Municipal Road Department. 36 projects including tunnels and bridges will be necessary to realize this network. SUSTRAFFTIA is estimating the probable costs of this program to be 200 to 300 million EURO. In addition big parking spaces (many underground) will be necessary. The traffic forecasts made by SUSTRAFFTIA are showing, that despite all these important investments many main streets within the city and the most important roads entering Tirana (Rr. Durresit and Rr. Kavajes) will have even more traffic problems than today.

[Map of Tirana showing traffic flow]

Seeing these results SUSTRAFFTIA developed as an alternative a Public Transport oriented Strategy (Option B). The goal of this strategy is to create an attractive high capacity public transport system for Tirana. It is designed not only for those having no private car but also for those living and working in the city centre and suffering under noise and air pollution.

This public transport oriented strategy (Option B) is accompanied by a clear policy limiting non-resident parking in the centre of town. Having an attractive public transport system available, many car owners will so be obliged to use public transport especially for their way to work. Therefore the need for new roads will be considerably lower than under Option A.

Such a double strategy of substantially improving public transport and at the same time restricting car traffic is actually successfully being implemented in Paris. The French capital managed to reduce the car traffic within the last 5 years by 30 %.

SUSTRAFFTIA has studied different options for a new transit system for Tirana. Seeing the size of the city and the Greater Tirana Area the choice has to be made especially between a tramway (light rail) and a high quality bus based system.
a) **Light Rail**, a tramway system which has been created in many European cities at the end of the 19th or the beginning of the 20th century and still in use.

b) **Bus Rapid Transit (BRT)**, which is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective urban mobility. In the last 20 years many South American and Asian cities have constructed such a system.

The main characteristics of BRT are its
- segregated right-of-way infrastructure (bus ways, bus stops, bus terminals),
- rapid and frequent operations, and
- excellence in marketing and customer service. Seeing these advantages, SUSTRAFFTIA proposes Bus Rapid Transit as the backbone of the public transport oriented strategy for Tirana.

A modern Light Rail System would need much more time to realize, be significantly more costly and in the case of Albania would increase the existing electric supply problems and introduce a new sophisticated technology. SUSTRAFFTIA is proposing the following BRT corridors, which should be realized in two phases. In phase 1 three main corridors (Kavajes, Durres and Bulevardi) with a total length of 25.3 km will serve important sections of the
Phase 1 BRT-Corridors

In phase 2 this network is completed by two more corridors (Middle Ring Road and North South) with a total length of 12.2 km will complete the system.
Phase 2 BRT-Corridors The investment costs of the above-described BRT-infrastructure (busways, bus stations, terminals, bus depot etc.) of the 5 selected bus rapid transit corridors with a length of 37.5 km will be about 73 million EURO for phase 1 and 24 million EURO for phase 2. On the other hand the necessary investment costs to extend the road network of this public transport oriented Option B – estimated by SUSTRAFFTIA to be 75 million EURO – are substantially lower than under Option A (estimated to be about 250 million EURO).

Example: Bus Rapid Transit in Quito (Ecuador)

The comparison of the expected traffic flows on the Tirana road system, the yearly occurring social costs from air pollution caused by this traffic and the necessary investment costs of both strategies is clearly showing the advantage of Option B over Option A. SUSTRAFFTIA is therefore proposing to realize the public transport oriented strategy with a good Bus Rapid Transit System as its backbone.

As soon as the necessary political decisions to build a Bus Rapid Transit System in Tirana are taken a detailed feasibility study including the different possibilities to finance the necessary investments should be made by a competent agency having experience with realizing BRT-Systems. In the meantime all above described short-term activities should be realized.

2. Stringent emission standards for new and in-use vehicles (Chapter 2) As the example of the US and the EU shows, introducing more and more stringent emission standards for new cars, trucks and buses is by far the most effective measure to reduce air pollution from traffic. Despite a constantly growing volume of traffic, the pollution due to transport has visibly decreased in these countries.

EU emission standards for buses and trucks

- EURO 0 (1990)
- EURO I (10/1993)
- EURO II (10/1996)
- EURO III (10/2001)
- EURO IV (10/2006)
- EURO V (10/2009)
- EEV (optional)
- EURO VI (10/2012?)

* In der Diskussion
In Albania, the percentage of high polluting old and very old cars is extremely high. In 2005
- 47.6% of all vehicles were more than 21 years old and
- 43.7% between 11 and 20 years old.

Therefore, a program to modernize the Albanian vehicle fleet and to retrofit in-use vehicles
should be initiated. To achieve this SUSTRAFFTIA proposes:

1. Vehicles not fulfilling the EURO 3 requirements should no more be allowed to enter
   into Albania. Starting 2010 this limit should be tightened to EURO 4.

2. To initiate a retrofit program for in-use-vehicles. This retrofit program should be
   financed by an increase of the vehicle tax on all vehicles not being in accordance with
   EURO 3.

3. To initiate a scrap program for very old in-use vehicles.

3. **Introduction of clean fuel (Chapter 3)**

Since 85% of all vehicles in Albania are diesel vehicles, introducing high quality diesel fuel
has a high priority. The main problem of the diesel fuel sold in Albania is its high sulphur
content. The Albania domestic diesel fuel has 2 000 ppm sulphur, the Albania imported diesel
fuel 350 ppm sulphur, whereas the EU 2005 standard is 50 ppm sulphur. The reduction of the
maximum sulphur level of all the diesel fuel sold in Albania from 2,000 ppm to 350 ppm will
at the same time reduce the traffic generated PM emissions by 8 to 9 percent.

In April 2007 the Albanian government has passed a law concerning future fuel quality
standards. It has been decided, to reduce the maximal sulphur content to the level of
- 350 ppm from January 2009,
- 50 ppm from January 2011 and
- 10 ppm from Jan 2015.

Seeing the health damages caused by the actual high concentration of PM and NOx in the air
of the Greater Tirana Region SUSTRAFFTIA proposes

a) to tighten earlier than January 2011 the quality standard of imported “Euro Diesel”
   from 350 ppm sulfur to the EU 2005 level of 50 ppm sulfur.

b) to reduce the fuel tax on low sulfur diesel fuel accompanied at the same time by an
   increase of the fuel tax on high sulfur diesel fuel, so that high quality diesel has at
   least the same price at the gas station as higher sulfur “normal” diesel.

c) to speed up the planned nationwide change to low sulfur diesel fuel by introducing
   a special regulation for the whole Tirana / Durres region. Since this region is
   suffering most under the actual air pollution caused by traffic it should be imposed
   to the gas stations in the Tirana / Durres area, to sell only low sulfur diesel fuel,
   while the rest of the country is still selling higher sulfur diesel fuel.
4. **Proper inspection & maintenance of all vehicles (Chapter 4)**

Especially in a situation like in Albania where the vehicle fleet is extremely old and fuel quality standards are low, an effective inspection & maintenance and roadworthiness system is one of the most cost-effective and quickest ways of improving both air quality and road safety. A properly maintained vehicle consumes between 3 and 7% less fuel, and hence leads to a similar reduction of emissions including CO2.

A major problem in Albania concerning the vehicle inspection is, that not all car owners are regularly presenting their vehicles to the Technical Control Centres. According to data from the Ministry of Public Works, Transport and Telecommunication in the year 2005 only 61% of the passenger cars, 40% of the buses and minibuses and 65% of the trucks underwent technical inspection. It is obvious, that especially the owners of badly maintained gross polluters avoid presenting their vehicles to the test centres.

To make the vehicle inspection & maintenance program in Tirana more effective, SUSTRAFFTIA proposes

1. to start rigorous action to assure that all vehicles are being regularly presented to the Technical Control Centres. To facilitate the work of the road policy supervising the vehicles running in the streets all vehicles having passed the test should receive from the test centre in addition to the written report an irremovable sticker on their rear license plate identifying the date of the next obligatory inspection.

2. to change the emission test procedure in the future from idle and free acceleration testing to loaded tests, so that all more recent vehicles can be tested properly.

3. to initiate a close cooperation between the Albanian technical control centres and a technical inspection company of an EU member state to assure the constant modernization of the equipment according to EU regulations and the continuous training of the staff of the control centres.
0 Introduction

As the air quality monitoring in Tirana has shown, traffic is the major source of air pollution of the fast growing Albanian capital. The circulation of private vehicles, trucks and buses are contributing the most to the health problems due to air pollution.

In the course of the ECAT project an air quality monitoring has been made in Tirana during the years 2007 and 2008. The results are showing high concentrations of particulates (PM 10) and NO2. Both are directly related to the amount of traffic and the emission levels of the vehicles circulating in Tirana. The results of the monitoring campaigns are shown in Figure 0.1. and Table 0.1.

![Figure 0.1. Annual average concentration of PM10 year 2007](image)

<table>
<thead>
<tr>
<th>Site</th>
<th>NO2 concentration (µg/m³)</th>
<th>Location (nearest main road)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>75.48</td>
<td>Rruga Qemal Stafa</td>
</tr>
<tr>
<td>13</td>
<td>63.42</td>
<td>Rruga Dëshmorët e 4 Shkurtit / Blv. Zahn Dark</td>
</tr>
<tr>
<td>18</td>
<td>50.89</td>
<td>Bulevardi Dëshmorët e Kombit</td>
</tr>
<tr>
<td>11</td>
<td>48.60</td>
<td>Rruga Barikadave</td>
</tr>
<tr>
<td>6</td>
<td>47.88</td>
<td>Rruga Mine Peza</td>
</tr>
</tbody>
</table>

Table 0.1: Top five concentration values of NO2 in Tirana city

The six pollutants categorized as classical pollutants of the transport sector by the World Health Organization are shown in table 0.2. The magnitude of damage to health from air pollution depends on four factors: the toxicity of the pollutant, the concentration to which people are exposed, the duration of exposure, and the size of the population that is exposed.

The toxicity of the pollutant differs widely. VOC, NOx, SO2 and particulates are by far more dangerous to human health than CO. Table 0.1. is showing the toxicity of the different substances.

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>VOC</th>
<th>NOx</th>
<th>SO2</th>
<th>Particulates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human health</td>
<td>1</td>
<td>500</td>
<td>333</td>
<td>333</td>
<td>114</td>
</tr>
<tr>
<td>Vegetation</td>
<td>1</td>
<td>500</td>
<td>333</td>
<td>333</td>
<td>114</td>
</tr>
</tbody>
</table>

Table 0.2. Toxicity of pollutants given in CO Equivalents per unit of emission
(Source: Standardisierte Bewertung ... Annex 1, Table 4-9)
As table 0.3 indicates, pollutants can be considered as primary or secondary. Primary pollutants are emitted directly and include lead, PM, sulphur dioxide (SO₂), oxides of nitrogen (NOₓ), and carbon monoxide (CO). Secondary pollutants are formed in the atmosphere from primary pollutants; the two most common examples are ozone, and PM from NOₓ and SO₂.

### Table 1: Principal Air Pollutants and Their Sources in Transport

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Lead retards the intellectual development of children and adversely affects their behavior. At high levels, lead increases incidence of miscarriages in women, impairs renal function, and increases blood pressure. More lead is absorbed when dietary intake of calcium or iron is low, when the stomach is empty, and by children. Young and poor malnourished children are therefore particularly susceptible to lead poisoning. Lead emissions in transport are entirely from the use of leaded gasoline.</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>The health effects of exposure to particulate matter include chronic bronchitis, asthma attacks and other forms of respiratory illness, and premature death from heart and lung disease. Diesel-fueled and two-stroke engine gasoline vehicles are two significant sources of PM emissions.</td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>SO₂ causes changes in lung function in persons with asthma and exacerbates respiratory symptoms in sensitive individuals. SO₂ also contributes to acid rain and to the formation of small particles, called secondary particulates, through atmospheric reactions. The amount of SO₂ emitted is directly proportional to the amount of sulfur in the fuel. Sulfur occurs naturally in crude oil and consequently is found in both gasoline and diesel fuel unless it has been removed.</td>
</tr>
<tr>
<td>Nitrogen dioxide (NO₂)</td>
<td>NO₂ causes changes in lung function in persons with asthma, contributes to acid rain and secondary particulate formation, and is a precursor of ground-level ozone. Vehicles emit nitric oxide (NO) and NOₓ, which are jointly referred to as NOₓ. NOₓ is formed in high-temperature combustion, mainly from air in the combustion chamber.</td>
</tr>
<tr>
<td>Ozone</td>
<td>Ozone, the main chemical in photochemical smog, has been associated with lung function decrements, asthma attacks, other forms of respiratory illness, and premature death. Ozone is not emitted directly but is a secondary pollutant formed in the atmosphere through photochemical reactions of NOₓ and volatile organic compounds.</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>CO inhibits the capacity of blood to carry oxygen to organs and tissues. People with chronic heart disease may experience chest pain when CO levels are high. At very high levels, CO impairs vision, manual dexterity, and learning ability and can cause death. The majority of CO emissions in transport are from gasoline-fueled vehicles.</td>
</tr>
</tbody>
</table>

**Table 0.3. Air pollutants from transport and their health effects**  
A broad based approach to the identification and implementation of policies and actions aimed at reducing air pollution from traffic is therefore needed. A comprehensive strategy to achieve this goal includes four key components:

- Integrated transport planning and demand management,
- Adoption of the increasingly stringent emission standards of the EU for new vehicles accompanied by incentives for the retrofit of in-use-vehicles,
- Introduction of clean fuel,
- Proper inspection and maintenance of in-use-vehicles.

These four elements are interrelated and need

<table>
<thead>
<tr>
<th>Key elements for a sustainable traffic development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport planning and demand management</td>
</tr>
<tr>
<td>(less congestion, less costs)</td>
</tr>
<tr>
<td>Vehicle inspection &amp; maintenance</td>
</tr>
<tr>
<td>(less high polluting veh.)</td>
</tr>
<tr>
<td>Clean fuels</td>
</tr>
<tr>
<td>(less sulphur, less lead)</td>
</tr>
<tr>
<td>Emission standards</td>
</tr>
<tr>
<td>(new cars with better technology)</td>
</tr>
</tbody>
</table>

The SUSTRAFFTIA project is studying these 4 key components and their impact on air quality. Based on this analysis SUSTRAFFTIA is proposing actions in each of these 4 fields. The implementation of these proposals will considerably improve the living conditions in Tirana. Albania will finally be able to meet the clean air standards of the European Union.
<table>
<thead>
<tr>
<th></th>
<th>Date by which limit value is to be met</th>
<th>Limit value</th>
<th>Averaging period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO</strong></td>
<td>01. 01. 2005</td>
<td>10 μg/m³</td>
<td>8-h-average</td>
</tr>
<tr>
<td><strong>NO₂</strong></td>
<td>01. 01. 2010</td>
<td>40 μg/m³</td>
<td>annual average (calendar year)</td>
</tr>
<tr>
<td></td>
<td>01. 01. 2010</td>
<td>200 μg/m³</td>
<td>1-h-limit not to be exceeded more than 18 times a calendar year</td>
</tr>
<tr>
<td><strong>Benzene</strong></td>
<td>01. 01. 2010</td>
<td>5 μg/m³</td>
<td>annual average (calendar year)</td>
</tr>
<tr>
<td><strong>Particles</strong></td>
<td>01. 01. 2005</td>
<td>40 μg/m³</td>
<td>annual average (calendar year)</td>
</tr>
<tr>
<td>(PM 10)</td>
<td>01. 01. 2005</td>
<td>50 μg/m³</td>
<td>24-h-limit not to be exceeded more than 35 times a calendar year</td>
</tr>
<tr>
<td></td>
<td>01. 01. 2010 (goal)</td>
<td>20 μg/m³</td>
<td>annual average (calendar year)</td>
</tr>
<tr>
<td></td>
<td>01. 01. 2010 (goal)</td>
<td>50 μg/m³</td>
<td>24-h-limit not to be exceeded more than 7 times a calendar year</td>
</tr>
</tbody>
</table>

Table 0.4. **EU Clean air standards for the protection of human health**  
(Source – Documents 96/62/EC, 1999/30/EC, 2000/69/EC)
1 Integrated Urban Transport Planning and Demand Management for Tirana

The contribution of transport to air pollution can be viewed broadly as the product of emissions per unit distance travelled and the total distance travelled. To lower these two factors and thereby reduce the adverse effect of urban transport on the environment, transport managers have a menu of options, such as limiting the number of vehicles on the road, optimizing traffic flow, improving the efficiency of transport operators and citywide transport systems, restricting traffic in heavily concentrated pedestrian areas, and reducing total demand for transport. Table 2 describes different measures that have been used and their potential effects on air pollution. Some measures fall directly under transport and land use policy of the municipality.

The driving pattern has a significant influence on emissions. Both fuel consumption and pollutant emissions are many times higher per unit distance during acceleration than during cruise. Engines are most polluting when they are cold, making short trips disproportionately polluting for PM, CO, and hydrocarbon emissions. The optimum steady speed from an emissions perspective is usually in excess of 60 kilometres per hour (km/h) and is rarely achieved in congested urban traffic. PM emissions from conventional diesel vehicles can rise exponentially below 20–30 km/h. These observations suggest that congestion worsens air pollution.

Traffic speed and its variability are also affected by the extent to which different types of traffic are mixed and how traffic is managed. For example, mixing buses and other vehicle categories reduces the speed of both. Traffic mix is especially problematic when motorized and non-motorized traffic share road space. Unnecessary stops and starts can be caused by uncoordinated traffic signals, contributing to higher fuel consumption and emissions.
The starting point for all transport planning is the knowledge about the expected volume of traffic in the near and longer future. For these traffic forecasts SUSTRAFFTIA has used the same computer model and some data of the World Bank Study “Tirana Urban Transport Improvement Study (TUTIS)” from January 2002. The data on population, car ownership and economic activities have been updated to the year 2006 and traffic counts at key intersections were made in January and February 2007. This simplified approach had to be used due to time and budget restrictions of this study.
Based on the results of these traffic forecasts two different scenarios have been developed by SUSTRAFFTIA. Strategy A is a road traffic oriented strategy giving priority to the needs of the fast growing road traffic. Major improvements and extensions of the road infrastructure are necessary under this strategy. Strategy B is a public transport oriented strategy. The key element of this strategy is the creation of a high capacity Bus Rapid Transit system. This new public transport system will change the modal split so that less roads must be build.

The economical and ecological consequences of both strategies are analyzed and recommendations for the Tirana transport planning developed.

### 1.1 Future Transport Demand of Tirana until the Year 2021

#### 1.1.1 Future overall Growth

The future transport demand in Tirana and the Greater Tirana Area is depending on
- the expected growth of the population and
- the future car ownership which is closely linked to the growth of the regional gross domestic product (regional GDP).

Actually a study is being conducted on the “Sustainable and Integrated Development of the Tirana – Durres Region”. The experts working on this study assume that the future population of the Greater Tirana Area (Tirana City and its suburbs) will grow in the coming 15 to 20 years from actually around 700,000 to about 1 Million. They also consider that the actual regional GDP growth rate of this area of 8 to 12 % per year will approximately be the same in the coming years. The National Institute of Statistics of Albania is forecasting a population growth of Tirana going up to 850,000 in the year 2021 and for the Greater Tirana Area to about 1.1 million inhabitants.

Taking the development of the last years into account, for the purpose of this study the following assumptions concerning the future growth of population, reg. GDP and car ownership have been made:

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2005</th>
<th>2014</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population of Tirana Municipality</td>
<td>442,000</td>
<td>585,000</td>
<td>734,000</td>
<td>850,000</td>
</tr>
<tr>
<td>Population of Greater Tirana</td>
<td>630,000</td>
<td>800,000</td>
<td>959,000</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Tirana Region GDP growth rate</td>
<td>10 %</td>
<td>10 %</td>
<td>7.1 %</td>
<td>3.0 %</td>
</tr>
<tr>
<td>Tirana car ownership</td>
<td>32,740</td>
<td>75,844</td>
<td>209,000</td>
<td>296,000</td>
</tr>
<tr>
<td>Cars per 1 000 people</td>
<td>70</td>
<td>146</td>
<td>315</td>
<td>348</td>
</tr>
</tbody>
</table>

**Table 1.2.**  Growth factors determining future traffic volumes
In the process of updating the TUTIS-Study from 2001/2002 traffic counts have been made by SUSTRAFFTIA in January and February 2007. Automatic traffic counts were carried out during two weekdays for each counting stations from 7:00 hour till 19:00 hour. Nu-Metrics magneto-inductive traffic analysers were used to carry out these operations. Manual traffic counts were carried out at the same sections during peak hours in order to validate automatic counts and check traffic composition.

The comparison of these data with those collected in June and July 2000 is showing a sharp increase of the car traffic.

Table 1.3. Comparison of traffic counts conducted in the years 2000 and 2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dual direct.</td>
<td>sum</td>
<td>dual direct.</td>
<td>sum</td>
</tr>
<tr>
<td>Biv. Bajram Curri</td>
<td>14752</td>
<td>28314</td>
<td>6215</td>
<td>13960</td>
</tr>
<tr>
<td>Blv. Gjergj Fishta</td>
<td>13562</td>
<td>7745</td>
<td>9985</td>
<td>19218</td>
</tr>
<tr>
<td>Rr. Durrresit ext. exit</td>
<td>22955</td>
<td>44631</td>
<td>9233</td>
<td>19218</td>
</tr>
<tr>
<td>Rr. Durrresit int. exit</td>
<td>15818</td>
<td>30116</td>
<td>5079</td>
<td>10697</td>
</tr>
<tr>
<td>Rr. Durrresit int. entry</td>
<td>14298</td>
<td>5618</td>
<td>5079</td>
<td>10697</td>
</tr>
<tr>
<td>Rr. Elbasanit exit</td>
<td>5051</td>
<td>9861</td>
<td>2886</td>
<td>4865</td>
</tr>
<tr>
<td>Rr. Elbasanit entry</td>
<td>4811</td>
<td>1979</td>
<td>1979</td>
<td>4865</td>
</tr>
<tr>
<td>Rr. Kavajes exit</td>
<td>5185</td>
<td>9884</td>
<td>3587</td>
<td>6472</td>
</tr>
<tr>
<td>Rr. Kavajes entry</td>
<td>4699</td>
<td>2885</td>
<td>2885</td>
<td>6472</td>
</tr>
<tr>
<td>Rr. Dajiti exit</td>
<td>3248</td>
<td>6856</td>
<td>647</td>
<td>1389</td>
</tr>
<tr>
<td>Rr. Dajiti entry</td>
<td>3609</td>
<td>742</td>
<td>742</td>
<td>1389</td>
</tr>
</tbody>
</table>

Values referred to a time between 7:00 and 19:00 hours
On the average the traffic volume increased by 13.1% per year during the last 7 years.

The hypotheses that can be realistically assumed in order to establish a forecast of the road traffic demand for the next years (until years 2014 / 2021) can be based on the above collected information. A combination of the GDP growth and elasticity factor can be used in order to establish yearly growth rates.

The above hypotheses lead to the following growth factors for years until 2021:

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP growth</th>
<th>Elasticity Factor</th>
<th>Yearly traffic growth</th>
<th>Actual growth (base year 2007 = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>10.0%</td>
<td>1.30</td>
<td>13.0%</td>
<td>113</td>
</tr>
<tr>
<td>2009</td>
<td>10.0%</td>
<td>1.30</td>
<td>13.0%</td>
<td>128</td>
</tr>
<tr>
<td>2010</td>
<td>9.4%</td>
<td>1.30</td>
<td>12.2%</td>
<td>143</td>
</tr>
<tr>
<td>2011</td>
<td>8.8%</td>
<td>1.30</td>
<td>11.5%</td>
<td>160</td>
</tr>
<tr>
<td>2012</td>
<td>8.3%</td>
<td>1.27</td>
<td>10.4%</td>
<td>176</td>
</tr>
<tr>
<td>2013</td>
<td>7.7%</td>
<td>1.23</td>
<td>9.4%</td>
<td>193</td>
</tr>
<tr>
<td>2014</td>
<td>7.1%</td>
<td>1.20</td>
<td>8.5%</td>
<td>209</td>
</tr>
<tr>
<td>2015</td>
<td>6.5%</td>
<td>1.16</td>
<td>7.5%</td>
<td>225</td>
</tr>
<tr>
<td>2016</td>
<td>5.9%</td>
<td>1.13</td>
<td>6.7%</td>
<td>240</td>
</tr>
<tr>
<td>2017</td>
<td>5.3%</td>
<td>1.09</td>
<td>5.8%</td>
<td>254</td>
</tr>
<tr>
<td>2018</td>
<td>4.8%</td>
<td>1.06</td>
<td>5.0%</td>
<td>267</td>
</tr>
<tr>
<td>2019</td>
<td>4.2%</td>
<td>1.02</td>
<td>4.3%</td>
<td>278</td>
</tr>
<tr>
<td>2020</td>
<td>3.6%</td>
<td>0.99</td>
<td>3.5%</td>
<td>288</td>
</tr>
<tr>
<td>2021</td>
<td>3.0%</td>
<td>0.95</td>
<td>2.9%</td>
<td>296</td>
</tr>
</tbody>
</table>

Table 1.4. Growth factors

The above hypotheses belong to a “do nothing” option. This means that the forecasted values are those that could be considered as trend values without the adoption of any corrective measures. The introduction of an efficient public transport system (as explained in the following chapters) is one of these possible measures. The existing transport model of the TUTIS-Study does not allow to exactly calculate these changes, since public transport was considered as an exogenous factor. A very detailed and costly new transport study including household interviews would be necessary to exactly predict the reduction in car traffic due to better public transport. However, it is obvious, that car owners will not use their car for trips into the centre, if

a) the streets leading to the centre are constantly congested
b) it is difficult to find a parking and
c) fast and comfortable public transports are offering a better alternative.

As soon as this alternative exists, the amount of car traffic will drop down and then rise on a much lower level as predicted above.

1.1.2 The Traffic Model

The traffic model adopted inside SUSTRAFFTIA is an update from that used inside the former TUTIS / World Bank study of years 2000 – 2001, and it basically maintains the same characteristics of its predecessor.
The model used in order to estimate the traffic demand for the different scenarios was developed with TransCAD, from Caliper Corporation (USA). This is the same software used by the TUTIS study. The updating process was referred both to:

- the representation of road transport offer (i.e. the road network);
- the representation of the road transport demand (i.e. the origin / destination matrices).

The assignment techniques used in this updated version are the same yet used in the past, as better described below.

**The Network**

The Tirana road network was represented by means of a graph composed by 857 links and 600 nodes (76 nodes are O/D centroids, as better explained in the following part of the present text). The graph was built over a database containing the most representative characteristics of the network. Such database was simplified in comparison with the other one formerly used for the TUTIS study, taking into account that many of the information collected into the old database was not actually used for the simulation process. The structure of the updated database (as regards the road links) is the following:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Integer (4 bytes)</td>
<td>Unique identifier for each link</td>
</tr>
<tr>
<td>Length</td>
<td>Real (8 bytes)</td>
<td>Length of each link</td>
</tr>
</tbody>
</table>
| Dir        | Integer (2 bytes) | Direction of each link:  
0 = bi-directional link 
1 = mono-directional (one way) link oriented towards the topological direction of the link (from node A to node B) 
-1 = mono-directional (one way) link oppositely
Table 1.5. Structure of the updated database

The overall length of the network considered into the graph is 153 km.

A graphical representation of the three categories is given in the next picture
The performance of each link was represented using the BPR (Bureau of Public Roads) function, that is widely used in the traffic engineering field to represent the speed-flow relationship on congested roads.

The BPR function is given by the formula:

\[
t = t_f \left[ 1 + \alpha \left( \frac{v}{c} \right)^\beta \right]
\]

where:
- \( t \) = congested link travel time
- \( t_f \) = link free-flow travel time
- \( v \) = link volume
- \( c \) = link capacity
- \( \alpha, \beta \) = calibration parameters

The common values of 0.15 and 4.0 for alpha and beta respectively were considered in this study. The value of basic capacity was calculated on the basis of 1500 equivalent vehicles per lane per hour. This value was reduced where only one lane per direction is available up to 1000 equivalent vehicles per lane per hour.

### 1.1.3 The Assignment Process

After defining the network characteristics and the demand, different assignment procedures were carried out in order to acquire a credible skeleton of the present and future traffic scenarios in Tirana.
A calibration of the 2007 O/D matrix was preliminarily carried out by:

- first, by defining an uncalibrated O/D matrix by applying adequate growth factors to the former TUTIS matrix, and then
- then, by calibrating the O/D matrix by using the traffic flows estimated during the traffic counting campaign of January / February 2007.

TransCAD implements the Nielsen’s algorithm\(^1\) in order to update origin/destination matrices and re-calibrate them from on-site surveys. Nielsen’s method is an iterative (or bi-level) process that switches back and forth between a traffic assignment stage and a matrix estimation stage. The procedure requires an initial estimate of the O/D matrix that, in our case, was given by the preliminary update of the old TUTIS O/D matrix.

It is important to point out that what is presented here is a general description of the full procedure, but the general process was an iterative operation that led to a final calibration of the traffic model. Any step of this calibration led to changes to the network (at some point minimal, in other cases more consistent), until a satisfactory framework capable to represent the present situation was achieved.

As yet said above, the public transport component was not assigned. This component could be considered as an exogenous factor able to modify the general road transport demand.

The traffic assignment procedure used in this study was the User Equilibrium (UE)\(^2\) method. The UE method utilizes an iterative process to achieve a convergent solution in which no traveller can improve his travel time by shifting routes. For any iteration, network link flows are computed, which incorporate link capacity restraints effects and flow-dependent travel times (see previous chapter for details about link performances and capacities).

The actual traffic flows during the morning peak hour on the main roads of Tirana are shown in Figure 1.2.. The actual (2007) overall peak hour traffic volume in Tirana is 101.579 vehicle kilometres.

Based on the peak hour traffic volume of 101.579 vehicle kilometres it is possible to calculate the daily, weekly and annual traffic flows. The long term traffic monitoring of Tirana Municipality is giving the following relationships:

<table>
<thead>
<tr>
<th>Flow Type</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak factor 12h</td>
<td>9.0%</td>
</tr>
<tr>
<td>Expansion factor 12h -&gt; 24h</td>
<td>1.5</td>
</tr>
<tr>
<td>Weekends reduction factor</td>
<td>0.9</td>
</tr>
<tr>
<td>Summertime reduction factor</td>
<td>0.7</td>
</tr>
<tr>
<td>No. of summertime weeks</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 1.6. Factors relating the peak hour flows to daily, weekly and annual flows**

---


2. User equilibrium (UE) models are deterministic. They assume that all drivers are rational, have complete and perfect information regarding network conditions, and behave identically. In these models, congestion is represented by means of a capacity restraint (speed – flow functions), and the user equilibrium is found in accordance with Wardrop’s first principle (Wardrop, 1952). Here, all drivers choose the route with the shortest travel time or, equivalently, the lowest travel cost, and equilibrium is reached where no driver can unilaterally achieve a reduction in time or cost by changing route.
Taking these factors, the year 2007 traffic flows in Tirana are

- Daily traffic volume 1,691,862 vehicle kilometres
- Weekly traffic volume 11,504,663 vehicle kilometres
- Yearly traffic volume 577,534,070 vehicle kilometres

Figure 1.4. Year 2007 traffic flows on Tirana main roads

1.1.4 The future Traffic Demand

The future scenarios (years 2014 and 2021) were calculated by applying the estimated growth factors to the calibrated 2007 O/D matrix. This actually means to maintain the existing distribution of traffic demand between O/D pairs (not in absolute values, of course, but in terms of proportions between O/D pairs). A different growth of the city will lead to a redistribution of the activities and consequently to a different pattern of the O/D matrix. Similar observations could be made as regards the modal redistribution between private and public transport: significant investments into the public transport sector will change the pattern of the Tirana transport demand.

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak hour veh. kilometres</th>
<th>24h vehicle kilometres</th>
<th>Average week vehicle kilome.</th>
<th>Yearly vehicle kilometres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2007</td>
<td>101,579</td>
<td>1,691,862</td>
<td>11,504,663</td>
<td>577,534,070</td>
</tr>
<tr>
<td>Year 2014</td>
<td>218,562</td>
<td>3,640,310</td>
<td>24,754,105</td>
<td>1,242,656,051</td>
</tr>
<tr>
<td>Year 2021</td>
<td>321,932</td>
<td>5,362,004</td>
<td>36,461,627</td>
<td>1,830,373,682</td>
</tr>
</tbody>
</table>

Table 1.7. Traffic volumes in Tirana year 2007, 2014 and 2021

For the above reason, this scenario can be considered as typical “road oriented scenario”. Unfortunately, it was not possible to collect enough detailed information about the possible
future scenarios in terms of redistribution of activities, population, land use, etc., since the new Tirana urban Master Plan is actually only at its first stages of its development and hence not available at present time.

The network used in order to represent the future scenarios is the existing one plus a set of new infrastructures yet planned by the former city Master Plan of year 1989 and partially analysed and re-proposed also by the TUTIS study. They mainly consist of:

- the external Ring Road;
- the extension of the two boulevards parallel to the Lana river on both sides (East and Northwest)
- a set of other improvements into the city centre, like the completion of the inner and the intermediate rings.

The results of the assignments can be observed in the annexed flow-chart diagrams.

Figure 1.5. - Year 2014 Traffic flows under Strategy A (road oriented)

The following preliminary consideration can be made:

- there will be not a full and extensive use of the new planned infrastructure if the pattern of road transport demand will be the same of the present one for the following years;
- the high levels of road congestion shown off by the traffic model for years 2014 and 2021 will not justify (apart some exceptions) an use of the external ring as a bypass to be used by drivers in order to avoid traffic jams, if their final destinations (or starting origins) will be the same as the present ones;
- in general, the scenarios evaluated by the model appear to be not sustainable in terms of road congestion levels, and investments into the public transport sector appear to be unavoidable.
Finally, more realistic evaluation of the future scenario should be carried out when clear indications from the new Master Plan will be available. But in this case the new Master Plan should be able to give clear information in terms of relocation of activities and population, thus giving the opportunity for a re-consideration of the above results.

1.2 Necessary short-term activities

To improve the actual traffic situation and the living conditions in Tirana short-term action is needed in

- the road infrastructure,
- the actual public transport system,
- the creation of a new parking system,
- creating better conditions for pedestrians and bicyclers and
- improving road safety.

1.2.1 Short-term improvements of the Road Infrastructure

Actually on a normal weekday Tirana is suffering under constant congestion on practically all principal roads. The investments into the road infrastructure made during the last years have helped to avoid the collapse of the whole system. But, the growing car ownership of the last 10 years has been faster than all the efforts made by the municipality to solve the traffic problems.

It is therefore necessary to quickly attack the most urgent infrastructure problems and, at the same time, a big step forward in making bus transport in Tirana more attractive is necessary.
Actually the intersections are the main bottlenecks of the Tirana road system. Many of them do need a better design and an appropriate signalling system. The municipality has already established a program to improve the traffic situation at 9 mayor intersections. The location of these intersections is shown on figure 1.7. The investment costs of this program is estimated to be 1,420 million LEK (11.64 million EURO). At the intersections

- Unaza e Re me rrugen e Durresit tek Dogana
- Unaza e Re me rrugen e Kavajes, mbikalimi tek shkolla Teknologijke and
- Unaza me rrugen e Elbasanit (tek Vellezerit Kondi)

new bridges are foreseen. At all the other intersections only minor changes will be made.

Since these critical intersections are at the same time the most important bottlenecks of the Tirana bus system, the special needs of the buses have to be integrated into the plans of the necessary redesign of these intersections.

Parallel to the redesign of the mayor intersections a close look to the traffic lights in Tirana is necessary. There are currently 55 sets of traffic signals in Tirana. The City intends to install an additional 20 sets in the near future. None of the traffic signals are coordinated or synchronized. All traffic lights have fixed programmers which only alternate between daytime and night time.

Some traffic lights are not operational, as people have stolen the copper cables for the electricity supply; other signals do not have functioning light bulbs.

![Figure 1.7. Location of critical intersections](image)

The City now wants to install a simple UTC system that will allow linear synchronization of traffic lights. This very important activity would enable bus priorities and "green waves", thus benefiting the traffic flow. At the same time the design of all mayor intersections should be analyzed and necessary changes quickly be implemented. Often minor changes e.g. a longer...
special line for turning traffic or better coordinated green times will help to improve the situation. The necessary investment to increase the number of intersections equipped with traffic lights and to create a centralized traffic lights control centre will be analysed in the near future by a planned pre-feasibility study. In addition the costs of operating the control room and constantly maintaining the traffic lights have to be considered.

In addition to these activities concerning important intersections, the process of rehabilitating major roads, which has already been started, has to continue. The main rehabilitation project - the completion of the “middle ring road” - is already under way and will be finished in 2007/2008. Other projects are foreseen and will be realized by using funds from the city budget in the coming years.

Taking all necessary and planned short term improvements of the road infrastructure into account, SUSTRAFFTIA is estimating the costs of these projects to be about 20 million EURO.

1.2.2. Improvement of the existing Public Transport System

The existing public transport system is entirely relying on buses and microbuses. Actually there are 10 bus lines serving the people of Tirana. The total length of all 10 lines is 61.9 km (see Figure 1.8., 1.9. and Annex 5). Two more lines (Mihal Grameno and Liqeni Artificial) with together 6 km of length are foreseen, but not yet functioning, because subsidies will be necessary to assure the operation.

Figure 1.8. Daily passenger trips on the Tirana bus network

Until 2001 the national operator “Urban Transport Park of Passengers (PTUU)” was the only bus operator in Tirana. Since this state run company did not provide a sufficient service, many microbuses were operating in town. The municipality was putting an end to this uncoordinated and insufficient service by tendering most of the bus lines. Today, only the line
Kombinat – Kinostudio is operated by PTUU, whereas 4 different private companies operate the other 9 lines. In the meantime the service has considerably increased, but is still insufficient for a city with roughly 600,000 inhabitants and 75 % of the population depending on public transport or walking.

The buses are obliged to mix with the normal traffic. Especially during peak hours this means that their average speed is seriously slowed down by the constantly occurring congestions. Due to these congestions in the morning and in the late afternoon and the lack of enough vehicles the buses are often heavily overcrowded.

Figure 1.9. Existing and planned bus lines of Tirana

Compared with the general price level in Tirana the normal fare of 30 LEK per ride ( = 0.23 € per ride) is very low. On the other hand this socially oriented price does not allow the bus companies to offer a good level of service. The buses running in Tirana are all old second hand buses from EU countries. Due to their age they do have high emission levels, thus contributing to the pollution problems of Tirana. The bus companies also suffer from a rapidly increasing number of passengers identifying themselves as handicapped and so riding for free. The bus companies don’t get any compensation for these free riders.

The main tasks to make the existing bus system more efficient are:

1.2.2.1 Reduction of the Door-to-Door Travel Time

All transport studies show that for all those people having the free choice between using private cars or taking public transport the travel time needed to get from door to door is by far the most important factor determining the preferred transport mode. The ticket price is
compared with the travel time much less important. In the case of Tirana it is therefore necessary, to make the buses quicker, to increase the number of bus-lines and to reduce the waiting time for all the passengers having to change from one bus-line to another.

a) **Restructure the most congested intersections and give priority to buses at traffic lights**

Figure 1.7. is showing the most critical intersections of Tirana. These frequently congested intersections are slowing down the buses of all mayor bus lines. Annex 7 is giving the number of buses per hour passing these intersections.

Since these intersections are at the same time the critical bottlenecks of the road network, their improvement and their restructuring are part of the necessary investments program of strategy A concerning road transport. These expenditures are already included in the costs of this strategy. Only minor additional costs, e.g. the introduction of bus priority at traffic lights, are necessary to improve the situation of the buses.

b) **Bus only lanes at congested road sections**

On many main roads and often ahead of important intersections the buses are slowed down due to congestion. In these cases a special bus lane is allowing the buses to quickly move and to easily approach to the intersection. In most of these roads and intersections eliminating the existing parking lane can create the necessary width needed for either one or two bus lanes.

On all roads with a high volume of bus traffic (e.g. more than 12 buses per hour and direction at peak time) the possibility of creating special bus lanes should be studied in detail. The space required for these bus lanes is depending on the chosen design characteristics. The normal width is 3.50 meters. In case the available space very limited the bus lane might be limited to 3.25 meters or even 3.00 meters.

As examples from many cities show, it is possible to allow police cars, ambulances, suburban buses and taxis to use the dedicated bus lanes. This does not disturb the free flow of the buses. It therefore should also be foreseen in Tirana. In some cities, bicyclers are also allowed to use the bus lanes. In the case of Tirana with its few bicyclers and bus drivers not used to this, bicycling should not be allowed on the bus lanes. The risk of accidents would be too high.

According to the experience in many cities the following solutions for the dedicated bus lanes are possible:

b1) **One bus lanes on each side of the street**

The bus is running on the right side of the road and has a special lane reserved for him. This “classical solution” has the advantage that the bus stops remain where they are. Since the bus stops remain on the sidewalks, no extra space is needed. The disadvantage of this solution is coming from cars and delivery trucks serving clients along the road. Especially on roads with dense commercial activities (shops, restaurants etc.) this is a frequent conflict. The buses are blocked by these vehicles and are forced to merge with the normal traffic.
b2) Two bus lanes in the middle of the street

The buses are running on dedicated lanes in the middle of the road and can no longer be blocked by delivery trucks and other cars. The space needed for the bus lanes is approximately 7 meters. The bus stops – usually situated close to an intersection - do need additional 3 meters each. So, the space needed – at least near the intersections – is approximately 17 to 18 meters.
Figure 1.12. Example from Paris – both bus lanes in the middle of the street

Figure 1.13. Example from Paris – bus stop and both bus lanes in the middle of the street
b3) Two bus lanes on one side of the road

Since one of the bus stops remains on the sidewalk, this solution with both bus lanes being situated on one side of the road has the advantage of needing less space than solution (b). If this solution is chosen for a one-way street, the space needed is approximately 14 meters.

Figure 1.14. Both bus lanes on one side of the street

Figure 1.15. Example from Paris – both bus lanes on one side of the street
c) Better correspondence between bus lines

The existing bus lines are not well interconnected. Especially in the city centre there are often long walking distances if passengers need to change from one bus line to another. A better correspondence will be achieved by creating more bus lines passing through the city centre instead of having their terminal near Sheshi Skenderbej and at the same time creating bus stops that are served by several lines. If this is done, the door to door travel time of all passengers changing lines will seriously decrease.

d) Coordinate the time tables of the different bus lines

Especially in the evening when the buses only run every 15, 20 or 30 minutes the passengers need a coordination of the timetables of the different bus lines. If not, they are loosing much time changing from one line to another.

1.2.2.2 Increasing the Number of Bus Lines

As compared to other cities of approximately the same size, Tirana has a very limited bus network. Seen the growing population, the increasing number of jobs and the continuing construction of new residential areas new bus lines have to be created. They should predominantly serve newly developing residential and industrial areas not yet properly linked to the public transport system.
1.2.2.3  Tendering Bus Services and efficient Quality Control

During the last years the City of Tirana has made good experiences with tendering bus lines. The contracts made with the bus operators usually cover a period of 3 years. This relatively short period is possible because the buses acquired for the contract are old second hand buses. If the city does wish to have more modern and less pollutant buses, a longer contract period should be foreseen.

The buses circulating in Tirana should also contribute to the needed reduction of pollution. Therefore, in the tendering process the municipality should require at least buses fulfilling the EURO 2 standard, which came effective in the EU in 1998 (see table 1.10. and chapter 2, Figure 2.1.). The requirement of the EURO 3 emission standard, which came effective in 2001, would be better.

To assure, that the level of service (e.g. number of buses in operation during peak time, qualification of the drivers, age and environmental standards of the buses) laid down in the tendering requirements is really fulfilled by the operator, the bus contracts should foresee a system of penalties in case of constant bad service. To make the constant quality control and the constant contract verification functioning the municipality has to install either its own control unit or to contract a specialized local consultant.

If some bus lines cannot be operated profitably, the municipality should tender high profitable lines together with unprofitable ones, so that on an overall basis no subsidies are necessary.

In preparing a tendering usually the general question comes up

a) should the operator be paid by the bus kilometres he is producing within the contract (gross contract) or
b) should he keep all the fare revenues collected on his line and, if this is not sufficient to cover all costs, a small extra subsidy might be paid by the city (net contract).

The gross contract (solution (a)) has the advantage of being clear and simple. On the other hand the municipality has to assume the risk, whether the fare revenues collected are sufficient to cover the expenditures for paying the bus company. Other important disadvantages of this kind of contract are, that the contractor – as he is paid by the bus kilometre – has no special interest to attract passengers and to assure, that all clients are really paying. It is also difficult for the municipality to exactly control whether due to congestion or technical and organizational problems of the contractor all the bus kilometres laid down in the contract are really being produced.

If a net contract (solution (b)) is made, the contractor and not the municipality is taking the risk whether the revenues collected are sufficient to cover his costs. So he has a high own interest in increasing the number of passengers through good service and in assuring that everybody is really paying the fare. Another advantage is, that the quality control by the municipality can be less stringent. The risks of fraud occurring under solution (a) - e.g. Have all the fares collected really been indicated by the contractor? Have all the bus kilometres really been produced? - don’t occur in the case of the net contract.
For the time being, SUSTRAFFTIA proposes, that the contracts with the bus companies should be made on a “net basis”, which means that the contractor and not the municipality is bearing the financial risk of the contract.

1.2.2.4 Integrating the Buses from surrounding Communes

There are many buses coming into Tirana from the surrounding communes. By integrating these buses into the system of bus lines within Tirana and also into the Tirana bus tariffs, a better service can be offered to the passengers without creating additional costs. The goal for the whole Greater Tirana Area should be one integrated passenger oriented system. This means:
- One ticket for the entire journey – independently whether and how often the passenger changes the different bus lines
- One integrated network of all bus lines
- Coordinated timetables for all lines

This integration should be made step by step, allowing the bus companies to become more and more familiar with this concept. As integration becomes more and more intense, more passengers will use the buses. The different steps are:

Phase 1 Tariff association
- Permission of the bus companies from surrounding communes to transport passengers within Tirana and vice versa for the Tirana bus companies.
- All public transport companies in Greater Tirana accepting each other’s tickets and all following the motto “One ticket for the entire journey”.

Phase 2 Transport Association
This association, created by all bus companies serving the Greater Tirana area, will coordinate marketing, establish a coordinated network of bus lines including the correspondence between lines and coordinate the timetables. Another important task of this association is to further develop the pricing system (see 1.2.2.5) and the organization of a unified sales system.

Phase 3 Tariff and Transport Association
Members of this fully integrated association should be not only the bus companies but also the City of Tirana and all the communes of the Greater Tirana Area. In addition to phase 2 this organization will decide on the tariffs and the tariff structure. It will also establish a method for the distribution of the common fare revenues to the different bus companies serving the area. Usually this is done according to the revenues created by each line. To do all this work, this association does need a permanent staff.

1.2.2.5 Optimise the existing ticket structure
Until May 2008 the ticket structure of the buses circulation in Tirana was:
- Simple one way ticket 20 LEK (0.16 €)
- Monthly ticket (one bus line) 600 LEK (4.87 €)
- Monthly ticket (pass for all bus lines) 800 LEK (6.50 €)
- Monthly student ticket (pass for all bus lines) 400 LEK (3.25 €)
Due to the sharp increase of the oil prices, in May 2008 the price of the tickets was raised to 30 LEK for the one way ticket.

The actual revenue share of the monthly tickets is between 18% and 46% depending on the line served and the selling efforts of the different operators.

The bus companies should make bigger efforts to increase the share of the monthly tickets. This would not only reduce the time needed in the buses to control the tickets but also increase the number of constant users of the public transport system. For the same purpose the bus companies should introduce an annual ticket. Generally the price of such an annual ticket is equivalent to 10 monthly tickets.

In addition, new price offers should complete the range of tickets available and thus attract new potential customers. One possibility is the creation of combined tickets for big events e.g. important football matches or big pop concerts. In these cases the entrance ticket would include the free ride on all bus lines to and from this event. To make this possible, the representative of the bus companies should make a contract with the stadium or the concert hall, so that the entrance price of each ticket is increased e.g. by 20 LEK and that this supplement is going to the bus companies. On the entrance ticket a mark “Ticket also valid for the bus trip within Tirana to and from the event” would indicate this. The advantage of such a combination is that the parking problems created by the spectators are seriously being reduced and the access to the event is getting much easier.

1.2.2.6 Making the existing Buses easier to use

The most important activity to make the existing buses easier to use is good information. Actually this does practically not exist. At none the bus stops the necessary information about the bus network, the line served, the name of the bus stop and the timetable of the respective line can be found. This is true even for the newly constructed bus stops (see Figure 1.17.). The bus stop is only used for publicity purposes.
Public transport is a service that needs publicity like phone companies or bank corporations. It is therefore necessary, that

- on all bus stops and within all buses the map of the whole bus network can be found,
- all bus stops do have at least a bus stop sign, the name of that stop, the number of the line serving that stop and a timetable,
- there is an easy access to monthly tickets and
- information about the Tirana bus system is given to the clients by phone and at the selling points of the monthly tickets.

The municipality should also ask the bus companies to make their actual selling points for monthly tickets more attractive (indicating the name of the company, using colour, having windows etc.).
1.2.2.7 Modification of the regulatory Structures of the Tirana Bus Service

a) Concentrating all regulatory competence at the Municipality

The Albanian “Road Transport Law” (Law Nr. 8308 dated on 03/18/1998) has given the authority for urban public transport to the municipalities and communes concerned. Article 13 of that law defines, that “the urban transit is a special service which fulfills the needs of the urban population, by completing regular bus services within its limit lines or by connecting important economic and social centres with other parts of the city”. Article 14 continues, that “the municipality council, based on the urban transit needs, organizes, directs, finances and contract for the operation of this transit bus services within its jurisdiction.” Concerning the lines connecting the suburbs and communes within a district article 20 is giving this authority to the District Council. It says: “The beyond the city lines network and their schedules are determined by the District Council.”

Law Nr. 8652 on the “Organization and Operation of the Local Government” dated on 07/31/2000 is again giving this authority to the municipalities and to the communes.

However, the authority to fix the fares is still with the Central Government. Law Nr. 7581 on the “Fees and Fares” dated on 07/07/1992 and its respective amendments have not been changed, neither by the law on “Road Transport (1998) nor by the law on “Organization and Operation of the Local Government” (2000). So, all the bus fares in Albania are set by the council of ministers. Prior to the meeting of the Council of Ministers the Interior Ministry, the Ministry of Finance and the Transport Ministry jointly have to prepare the decision-making. This whole process is very difficult and time consuming. It also explains, why the bus fares
are so extremely low. As a consequence, the bus companies are cutting their costs as much as possible. They are buying old used buses and during peak time they are not putting enough extra buses into service.

SUSTRFFTIA therefore proposes:
Since the law on “Road Transport” is giving the authority “to organize and finance” the local bus services to the municipality and the communes (article 13), they also should have the authority to fix the fares. This would allow them to better take the local costs of service into account, which are not the same all over the country.

b) Compensation for the obligation of the bus companies to give free rides

The categories of the passengers eligible for free ride are determined based on the following laws:
- law number 7889 related to “The status of the invalids” dated on 12/14/1994,
- law number 7874 on “The veterans of the war against Nazi-fascist occupiers” dated on 11/17/1994,
- law number 8098 on “The Blinds” dated on 03/28/1996, and
- law number 8153 on “The Orphans” dated on 10/31/1996.

Problems exist concerning the categories of the citizens, like the war veterans, invalids and the children related to the transit service. At the time this regulative legislation was passed, the respective organs had taken into consideration the fact that the urban transit service was offered by the sole (State) public operator, called the Urban Transit Lot (centre) of the passengers. Being the sole State operator was not a problem for the reimbursement of the expenses related to the free riding of the above categories. In the present conditions, where the above service has gone forward with the contracting of private operators, this legal commitment related to the free riding must be reviewed and become more accurate.

Problems are noticed concerning the issued certificates by the invalids associations, the Veterans Organization, the organization of the veterans’ descendents, where, for instance it is not distinguishable whether the individuals are war or labour invalids, war or labour veterans and if invalids, to which group of the invalidity they belong to and are they or their custodian eligible for the free ride. This problem is becoming a concern as many of them take many rides during the day and they do not seem to be invalids or veterans.

SUSTRFFTIA therefore proposes:
The laws obliging the bus companies to transport handicapped, veterans, blinds and orphans for free should be revised. If the Central Government does want this benefit for all members of these groups, the Central Government has to compensate the bus companies for their respective service. This obligation to compensate would also lead to a better definition of the criteria exactly determining the group of citizen having the privilege of free transport. To begin with this compensation, a very simple flat-rate system for compensating the bus companies according to the percentage of handicapped among the population should be established.
1.2.3 Introduction of a Parking System for Tirana

Parking is a mayor problem in Tirana. There is a lack of public off-street parking. In addition to the parking needs of those living in the centre, there are many people from outside who are coming into town by car and are also looking for parking space. They use their car, because the actual bus service is unreliable and not comfortable. The traffic problems caused by parking are aggravated by the bad behaviour of many drivers. They do not respect existing regulations. Most are parking wherever they like. In many cases not only parallel parking along the roads but even parking or stopping in a “second parking lane” sometimes even in third lane is seriously reducing and slowing down the traffic on the moving lanes.

The Municipality of Tirana has therefore commissioned in 2005 the British company “Peter Guest Parking Consultant” to develop a parking system for Tirana. The main proposals of the consultant are:

- The City should implement parking controls on an area rather than a street by street basis.

Since the main parking area is within the Middle Ring Road, with some extensions outside, the consultant suggests, that four parking areas should be created within which all the streets would be controlled. The exact boundaries should be based on a more detailed knowledge of local conditions.

- There should be four zones initially.

![Figure 1.19. Suggested Parking Areas](image)

- All residents should pay 1,500 LEK per year in year one, thereafter the charge should be set at cost recovery; however this may be adjusted to recognize different levels of demand.

- Residents zones should be implemented as simply as possible and thereafter controls should be made more explicit.
• Charges for the reserved spaces (hotels, banks etc.) should be increased to represent the value of the space to the City.

• To start with three levels of parking fees should be foreseen. The charge should be 100 LEK per hour in the area close to the city centre, 40 LEK per hour in the area further away from the centre and 10 LEK per hour in the most distant area.

• The City should use two different technologies for the payment of the parking fees. One should be the payment via a mobile phone and for those not having or not using this technology parking vouchers would be the secondary parking payment system.

However vouchers are widely used in other countries with considerable success. The vouchers would be sold via local shops and kiosks. In this case the City enters into a contract, usually with the voucher supplier, to secure agents to sell the vouchers, usually for about 5-10% commission. Local shopkeepers are usually quite supportive because it provides and extra source of income for them and attracts more people to come to their shop and may also buy other things when buying the voucher. It also allows the shopkeeper to take initiatives such as "Spend more than 1,000 LEK today and get a free parking voucher to encourage customers.

Figure 1.20. Scratch Cards

These cards when sold through outlets offer a simple and flexible system which offers a high level of security. Vouchers also have the advantage that because there is no investment in equipment, other than signs there is no
maintenance costs and the system is quite flexible in that streets can be added or removed from the scheme quickly with no need to install or remove parking equipment.

The system also offers good accountability and cash flow because the Contractor is responsible for managing the accounting of card sales and the Municipality is paid by the contractor when the cards are provided to the outlets, not when the cards are used. Random audits and a careful choice of contractor can reduce the risk of fraud at this point.

- To establish an agency within the City to provide and operate this parking.

The consultant estimates, that the Municipality will have to be prepared to make an investment of around 300 million LEK to implement the scheme. The annual costs would be around 250 million LEK and the annual income would be of the order of 1,000 million LEK.

- To enforce this parking (Street patrol, removal of badly parked cars, clamping of cars, fines)

- To provide a number of underground car parks for public use.

1.2.4. Making Walking comfortable

Short journeys, which typically account for a majority of trips in the central city, are disproportionately polluting if done by car. They are most suitable for walking and cycling, referred to collectively as non-motorized transport. Unfortunately, in many parts of Tirana, walking or using other non-motorized forms of transport is so inconvenient and dangerous that even very short motorized trips are common.

The 2001 household survey showed that walking represents 44% of all trips in Tirana. To reach school even 57% of the pupils are walking. So, taking the number of trips, walking is far the most important “mode of transport”.

a) Making Walking safe

The little emphasis, the municipality is giving to the situation of the footpaths in town is in evident contradiction to the number of people using their feet to reach their destination. While some streets do have safe and attractive sidewalks – for example Myslym Shyri - others in the same neighbourhood are in bad and often in dangerous conditions. Figure 1.19. is showing one of these cases. During the rainy season little “lakes” on the sidewalks or on the roads at the intersections are making walking even more difficult.
Figure 1.21. Dangerous situation for pedestrians

Especially in the city centre pedestrians are pushed to the road by shops, hotels or restaurants which are occupying fully or partly the sidewalks (see picture 1.4). The municipal building authority either does not have the power or are not interested in defending the rights of the pedestrians.
There is also an obvious disrespect of pedestrians by some car drivers. Often parking cars are blocking the sidewalks. Since the road police is having more important other tasks, this misuse of sidewalks does not have consequences for the driver. This shall change, as soon as the new parking system will be installed in Tirana.

b) Creating Pedestrian Zones

Pedestrian zones should also be foreseen to encourage walking. These zones will help to reduce car traffic and to improve the quality of life as well as the urban environment especially in the city centre.

As a first step the small section of Rruga Deshmoret between Rruga Myslym Shyri and Bulevardi Zhan d’Ark should be changed into such a zone. Delivery cars serving the shops and restaurants should only be allowed in the morning between 6 a.m. and 11 a.m..

As a next step, this small pedestrian zone could be enlarged by including the section of Rruga Myslym Shyri between Rruga Sami Fasheri and Rruga Deshmoret into the pedestrian area. If this is done, the section of Rruga Myslym Shyri between Rruga Sami Fasheri and Rruga Muhmet Gjollesha, which is actually a one-way street should be changed to a normal two-way street.

The municipality is also discussing to change the whole Sheshi Scanderbej square into a pedestrian zone. In that case the buses actually passing through this square should be allowed to pass there also in the future. As examples from many cities show, buses passing pedestrians
zones don’t create important problems. In the contrary the possibility to directly reach the pedestrian zone by bus is increasing the attractiveness of these zones.

Figure 1.23. Pedestrians pushed to the road by parking cars and a day long open gate

To substantially change the situation for pedestrians SUSTRAFFFTIA proposes, that the municipality is creating a special unit of 2 or 3 persons and a special budget within the planning department with the sole objective to improve the sidewalks and the footpaths within the housing blocs. Starting with the city centre they should

- examine the actual situation,
- enforce the existing building laws towards the owners of shops, hotels, restaurants etc. occupying the sidewalks and
- reconstruct and newly construct sidewalks and footpaths
- introduce pedestrian zones.

In coordination with the road police this group should work with high priority in analyzing and improving the situation in the vicinity of schools with special respect to road safety.

1.2.5 Making safe Bicycling possible

Bicycles can account for as much as 50 percent of all trips if efficient measures to encourage this mode of transport are implemented. Despite its advantages, the bicycle either tends to be neglected or is actively discriminated against. This is partly because the bicycle is considered by many to be associated with poverty, and hence to be a mode that should disappear as incomes increase.
An environmentally friendly policy response is now being adopted in a number of European industrial countries and cities (e.g. Amsterdam, Muenster or Paris). They are viewing the bicycle as a suitable mode for shorter trips and are proactively making it attractive. Eliminating impediments to non-motorized transport by providing adequate sidewalks and bicycle lanes and ensuring the safety of pedestrians and cyclists can discourage short motorized trips.

1.2.6 Improving road safety

Reducing the number of people killed or injured in road accidents is an important task of law makers and administration at all levels. As the experience in many European countries show, important reductions of the number of severe accidents are possible while at the same time the volume of traffic is increasing.

The most successful actions to improve road safety are:

1. **Obligatory use of safety belts.**
   As experience has demonstrated, the law alone is not sufficient. The respect of the law has to be supervised by police and fined if not respected.

2. **Obligation to transport children only in special safety seats.**
   Since normal safety belts don’t fit for little children, special safety seats for them are necessary. This obligation has also to be supervised and fined by police if not respected.

3. **Obligatory use of safety helmets for motor bikers.**
   This obligation has also be supervised and fined by police.

4. **Introduction of a general speed limit of 50 km/h on main roads and of 30 km/h in residential areas.**
   Locations where these speed limits often are not respected have to be checked regularly by police.

5. **Analysis of all locations with frequent accidents and redesign of the respective road.**
   In cooperation between the police and the municipality all locations with frequent accidents have to be identified and analysed. Often a minor redesign of the road or the construction of a safe crossing for pedestrians leads to important safety improvements.

1.3 Road traffic oriented long-term strategy (Strategy A)

The aim of this strategy is to adopt the road infrastructure to the growing traffic demand. Since two thirds of the population of Tirana still depend on public transport major improvements of the existing bus system are also foreseen under this strategy.

The traffic forecasts show, that under this strategy the future road traffic will double by the year 2014 and triple by the year 2021 as compared to 2007.
Seen the predicted traffic-growth within the next 15 years (see figures 1.5. and 1.6.), the short term activities alone are not sufficient. To avoid constant congestion on the roads of Tirana, the existing road network has to be improved and substantially extended. Figure 1.8. is showing the future road network of the year 2021 the Road Department of the Municipality has designed to accommodate the highly growing demand of road traffic under this strategy.

Figure 1.24. Map of future roads under strategy A

The list of all the new roads foreseen under this program contains 36 projects (see Annex 4). The necessary investment costs of this program during the coming years until 2021 is estimated by the Road Department of the Municipality to be 9,593,028,403 LEK (78.6 million EURO) for a total of 41.721 kilometres of new road. Taking these figures the average costs of these roads with generally a width of 4 lanes are 1.885 million EURO per kilometre. According to the municipality these costs do not include the costs for the intersections of these roads with existing roads and do not include the costs for the acquisition of land.

Even without taking the costs for intersections and land acquisition into account, the construction costs seem to be widely underestimated. Project number 16 – the tunnel near Tirana Lake south of the universality – with a length of 1,840 meter is calculated to cost only about 1.5 million EURO per kilometre. The same is true for projects number 25, 26 and 27 – the eastern parts of the external ring road on the slope of Dajty Mountain – where several bridges and small tunnels must be build to cross this area. Here the calculated average costs of between 1.5 and 2.5 million EURO per kilometre are also not realistic.

Since construction costs have gone up in the last years and the costs of the necessary tunnels, bridges and intersections as well as the acquisition of land are not included in the cost calculations of the Road Department, SUSTRAFFTIA presumes that the actual costs of this program will be probably in the range between 200 and 300 million EURO.
In addition to these major projects the rehabilitation of many secondary roads has to continue. Under this road oriented strategy it will also be necessary to construct additional parking space especially in the city centre, which mostly will be underground. SUSTRAFFTIA is estimating the costs of the necessary additional parking space to be 25 million EURO.

Comparing the calculated traffic forecasts (see Figures 1.5. and 1.6) with the road network proposed by the municipal Road Department the following remarks have to be made:

- All the radial axes will be interested by high traffic flows.
- By-pass infrastructures (e.g. most parts of the ring roads) apparently will not be able to “drain” traffic entering into the city (at least with the existing travel demand pattern).
- Such high flows will lead to (as a general repercussion) a high level of congestion inside all the central area.

### 1.4 Public Transport oriented long-term Strategy (Strategy B)

The goal of this strategy is to create an attractive high capacity public transport system for Tirana. It is designed not only for those having no private car but also for those living and working in the city centre and suffering under noise and air pollution from the steadily growing car traffic. This strategy is accompanied by a clear policy limiting the non-resident parking in the centre of town.

On the other hand, seeing the future traffic flows (Figures 1.5. and 1.6.) in the short term it must be absolutely compulsory to contain the dramatic growth of traffic demand entering into the city centre. Tirana is a radio-centric city, and the distribution of the traffic demand is a consequence of this urban structure. It is important to have in mind that it is:

- not realistic to consider an alteration of the existing distribution of the transport demand in a short time horizon,
- not pragmatic in terms of traffic management to believe that the existing road infrastructure could absorb such growth of demand (both in terms of capacity of roads and junctions and in terms of parking capacity),
- not realistic also to imagine raising the existing infrastructure to a level of capacity able to absorb all the transport demand increases, considering the costs associated to such investments, the environmental impacts and any other urban design issue.

Therefore the only feasible answer in the short term is to transfer as much demand as possible on an efficient public transport system. Also, having an attractive public transport system many car owners will use public transport especially for their way to work, so the need for new roads will be considerably lower than under Strategy A.

The ability to access jobs, education, and public services is a fundamental part of human development. In Tirana actually only 15 % of the population do have a private car. Even if the car ownership is going up to 30 % by the year 2020 still the majority of the population is relying on public transport. An efficient and cost-effective public transport system essentially connects people to daily life. It is an indispensable element in creating a city where people and community come first.

That is why in this strategy “B” emphasis is given to a fundamental change towards better public transportation. At the same time the need for constructing new roads is substantially decreasing in comparison to strategy “A”. The improvements of the existing urban bus system proposed under strategy “A” basically are also being part of strategy “B”. They should be
realized as fast as possible. In addition a new mass transit system will be created to fulfil the needs of the growing population of Tirana.

It is also obvious, that within Tirana the space available for new and bigger roads as well as parking is limited. So, in order to build the necessary roads, highways and parking areas, the strictly car oriented strategy necessitates the demolition of quite a few buildings. Within the city centre with its high demand of car traffic and of parking this would mean a total change of the existing urban structure. On the other hand, an efficient transit system needs much less space for its infrastructure. The following comparison is visualizing this difference.

By allowing Tirana to provide a functional network of public transport corridors, a new transit system, will be the backbone of this public transport oriented strategy. It must serve effectively the public’s daily travel needs. However, this new system is not just about transporting people. Rather, it represents one element of a package of measures that will transform Tirana into a more liveable city. Integration of a high quality transit system with

a) non-motorised transport,

b) progressive land-use policies, and

c) car-restriction measures

forms part of a sustainable package that can underpin a healthy and effective urban environment. In this sense, the transit system represents one pillar in efforts to better urban quality of life for all segments of society, and especially in providing greater equity across the entire population.

Figure 1.25. Amount of space required to move the same number of persons
1.4.1 Selecting the future Transit System of Tirana

SUSTRAFFTIA has studied different options for a new transit system for Tirana. Seeing the size of the city and the Greater Tirana Area the choice has to be made especially between a tramway system (light rail) and a high quality bus based system. While most European cities have opted in the last 30 years to modernize and extend their existing tramway system, which usually date from the beginning of the 20th century, big cities in Latin America (Brazil, Columbia, Ecuador) have developed in the last 20 years a totally new bus based system, called Bus Rapid Transit. The Latin American example is now being adopted by many cities in Asia and Australia to solve their transport problems.

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective urban mobility through the provision of

- segregated right-of-way infrastructure,
- rapid and frequent operations, and
- excellence in marketing and customer service.

BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost. A Bus Rapid Transit system will typically cost 4 to 20 times less than a light rail transit (LRT) system and 10 to 100 times less than a metro system. The rise of BRT as an effective option relates mostly to its relatively low infrastructure costs and ability to operate without subsidies. BRT’s ability to be implemented within a short period (1-3 years after conception) also has proven to be a significant advantage.

<table>
<thead>
<tr>
<th>Bus</th>
<th>LRT</th>
<th>Metro</th>
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<td>12,000</td>
</tr>
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<td>25,000</td>
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</table>

Figure 1.26. Transit capacities of different public transport systems

Seeing these advantages, SUSTRAFFTIA proposes Bus Rapid Transit as the backbone of the public transport oriented strategy for Tirana. A modern Light Rail System would need much more time to realize, be significantly more costly and in the case of Albania would increase the existing electric supply problems and introduce a new sophisticated technology.
The elements that constitute the BRT concept include

- high-quality infrastructure (bus ways, bus stations, bus terminals),
- efficient operations,
- effective and transparent business and institutional arrangements,
- sophisticated technology, and
- excellence in marketing and customer service.

From a customer’s perspective, a car-competitive transit service is one that competes in terms of total travel time, comfort, cost, and convenience. Thus, designing a BRT system to handle high passenger demand in a rapid manner is one of the pillars to delivering a car-competitive service. The capacity and speed characteristics of BRT are defining features that set it apart from conventional bus services.

A standard BRT system without passing lanes for express services will provide a maximum of approximately 13,000 passengers per hour per direction. Most high-quality BRT systems achieve average commercial speeds of approximately 23 to 30 kilometres per hour. Seeing the passenger demand in Tirana, the standard BRT system with a maximum capacity of 13,000 passengers per hour and per direction will be sufficient.

BRT alone will not solve all the myriad of social, environmental, and economic challenges facing Tirana. However, BRT has shown to be an effective catalyst to help transform cities into more livable and human-friendly environments. The appeal of BRT is the ability to deliver a high quality mass transit system within the budgets of most municipalities, even in low and medium income cities. BRT has proven that the barrier to effective transit is not cost or high technology. Planning and implementing a good BRT system is not easy. The principal ingredient, however, is not technical skill: it is the political will to make it happen.

A Bus Rapid Transit project usually encompasses a multi-phase process since it would be unrealistic to build a complete network in a single, brief period. The size of the initial phase will depend upon many factors, but generally a project’s first phase should capture enough passengers to establish the new system on a sound financial basis. Generally it will encompass
few major corridors for a total of 10 to 30 kilometres of exclusive bus ways as well as 40 to 120 kilometres of feeder services.

The following considerations of SUSTRAFFTIA are basically concerning the initial phase of a BRT project for Tirana. According to the future growth of the Greater Tirana Area and taking the experiences with BRT in phase 1 into account, it will be possible to define and implement following phases.

### 1.4.2 Corridor selection for the Tirana BRT-System

SUSTRAFFTIA has based his choice of the proposed BRT-corridors on a range of factors, including existing bus passenger flows (Annex 1), customer demand, network advantages, roadway characteristics, ease of implementation, costs, urban planning considerations and social equity. The chosen corridors will likely serve popular origins and destinations in order to prove the technology as well as achieve financial sustainability.

SUSTRAFFTIA is also proposing to start with a phase 1 network following three main axes of development and traffic in Tirana. As soon as this phase 1 system is effectively running a first extension (phase 2) can be studied and realised.

The following corridors have been selected for phase 1:

#### A Kavajes Corridor

This corridor has a length of 8 kilometers. It starts at Kombinat, crosses the Lana River, is following Rruga e Kavajes until Sheshi Skanderbej, is then taking Rruga e Dibres (separating into two one way sections with 4 Deshmoret) until Sheshi Hafiz Ibrahim Dalliu, mounting Rruga e Dibres further and finally to it’s terminal at Myslym Keta.

#### B Durres Corridor

This corridor is 8.1 kilometers long. It starts at Kamez, is then taking the Durres freeway and then Rruga e Dutrresit until Sheshi Skanderbej, is turning south to the Lana River and then following the Lana River along Bulevardi Bajram Curri/Bulevardi Zhane d’Arc and has it’s terminal at the eastern end of these bulevardis close to the Lana River.

#### C Bulevardi Corridor

This corridor has the same terminals (Kamez and Lana River) as corridor B but it is serving other parts of Tirana City. The total length of this corridor is 9.2 kilometers. Like corridor B it starts at Kamez, runs on the Durres freewy parallel to corridor B but is then turning into Unaza e Re, is meeting corridor A at the bridge crossing Lana River and is then going up Bulevardi Bajram Curri/Bulevardi Zhane d’Arc until the Lana River Terminal.
As soon as phase 1 will be in service the following extension (phase 2) can start to be realized:

**D Middle Ring Road Corridor**

This Corridor is starting at the Lana River Corridor and is serving in both directions the whole inner ring road. It’s total length is 7.7 kilometers. Since this corridor is mostly running parallel to the above described corridors only 0.9 kilometers of new busway and 3 stations have to be constructed. The aim of this corridor is to interconnect the corridors A, B and C.

**E North South Corridor**

This corridor is starting near Tirana Park at the university, is following the north-south axle of the city passing Sheshi Skenderbej to the train station and then going further north crossing the Tirana River and having its terminal in the newly developing areas north of the river. The details of the whole section north of the train station will depend on the future urban development of this part of the city.

Figure 1.28. Proposed Bus Rapid Transit Phase 1 corridors for Tirana
Figure 1.29. Proposed Bus Rapid Transit Phase 2 corridors for Tirana

1.4.3 Major Design Characteristics of the proposed BRT-System for Tirana

a) Busways

For BRT systems using heavy vehicles, the reconstruction of the busway can typically represent approximately 50 percent of the total infrastructure costs.

If the BRT vehicles are standard large articulated BRT vehicles, these vehicles are very heavy and may require reconstruction of the entire road bed with materials able to withstand these heavier axle loads. The total vehicle weight is around 30.000 kg, and the maximum axle load is 12.500 kg, so roads using this type of bus need to be built to withstand this axle load. The total vehicle length is 18 meters.

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3 Major parts of chapters 1.4.3, 1.4.5 and 1.4.6 have been taken from Wright, L. and Hook, W., Bus Rapid Transit Planning Guide, New York, 3rd edition, June 2007
In terms of longevity, concrete is typically a better choice than asphalt. Concrete, so long as locally available concrete is of a constant and reasonable quality, is more resistant to the forces of heavy buses passing on a frequent basis. While concrete is generally more costly than asphalt, the longer life of the surface will justify the higher initial cost. Concrete paving if done properly can last 10 or even 15 years with only minor maintenance, while asphalt often requires resurfacing as often as every two to four years in warm climates with heavy use. Because of these considerations SUSTRAFFTIA proposes a concrete made busway.

The space required for a BRT busway usually is 3.5 meters, which goes down to 3.0 meters at the stations. A typical cross-section of a road with busway in the middle of the road is shown in Figure 1.30.

While some busways are not physically separated from mixed traffic, most are separated by a physical barrier. This barrier can range from a fully landscaped median to simple blocks, bollards, curbing, permanent traffic cones, walls, metal fencing, or other types of barrier devices. The design of the separator should be sufficient to physically prohibit mixed traffic vehicles to enter the busway. The most typical and least expensive dividers are simple curbstones.
The standard dimensions of a Typical BRT corridor cross section as shown in the above figure are:

<table>
<thead>
<tr>
<th>Recommended Minimums Per Direction</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk</td>
<td>3.0</td>
</tr>
<tr>
<td>Bike Lane</td>
<td>2.5</td>
</tr>
<tr>
<td>Bus Lane at Station</td>
<td>3.0</td>
</tr>
<tr>
<td>Bus Lane along Corridor</td>
<td>3.5</td>
</tr>
<tr>
<td>Divider</td>
<td>0.5</td>
</tr>
<tr>
<td>Curb Lane Mixed Traffic</td>
<td>3.5</td>
</tr>
<tr>
<td>Other Mixed Traffic Lanes</td>
<td>3.0</td>
</tr>
<tr>
<td>Bus Stop</td>
<td>3.0 to 4.0</td>
</tr>
</tbody>
</table>

Table 1.8. Standard dimensions of a typical BRT corridor cross section

b) Bus terminals and the bus stations

Terminals

For the initial BRT System of Tirana SUSTRAFFTIA proposes 4 terminals. They will be located at:
- Kombinat – serving corridor A and southwest feeder lines
- Kamez – serving corridors B and C as well as north west feeder lines
- Lana River East – serving corridors B, C and D as well as southeast feeder lines
- Myslym Keta – serving corridor A and northeast feeder lines.

Terminals generally provide transfer facilities between feeder bus lines and one or more main trunk lines. They also generally have extensive bus parking for service adjustment.

Typically, in BRT systems, terminals are the most important transfer points. They are normally located at the end of each trunk corridor, and provide important transfers between trunk lines and feeder bus lines serving surrounding areas. The design of the interchange facility should minimise both customer and vehicle movements to the extent possible. Thus, the most likely transfer points between complementary routes should be located closely together. As both feeder vehicles and trunk-line vehicles will be staging at the terminal, the movement of vehicles should be devised to avoid congestion. Most typically, feeder vehicles arrive on one side of a platform area with trunk-line vehicles wait on the opposite side.
At important terminals space for shopping facilities, serving the passengers passing through the terminal as well as the population living in the vicinity of the terminal should be foreseen. These commercial activities will either help to reduce the investment costs to be covered by the public or will create rent revenues which will help to finance the BRT system.

In the case of the above-proposed BRT-corridors for Tirana the Kamez-Terminal would be a perfect location for this combination of an important BRT bus-terminal and shopping as well as amusement facilities. There is already a big housing complex and a new university in the vicinity. During the next years there will be even more housing complexes and economic activities. In addition there is a growing number of feeder buses serving Kamez, Vore and the industrial/commercial zone along the motorway.

If the BRT-bus terminal is located near the junction of Tirana-Durres motorway with the road leading to Kamez this terminal would also allow to combine the BRT-terminal with a new and well designed terminal for all long distance buses coming via the motorway to and from Tirana. Since they represent the majority of all long distance buses serving Tirana this would allow to close down most of the existing bus terminals within the city.

Combining the terminals of BRT and long distance buses with shopping facilities will – on a smaller scale - also be possible and necessary at Kombinat and Lana River East. If this is realized, all existing bus-terminals within Tirana city can be closed and re-used for much more valuable purposes.

**Bus Stations**

The station design will largely be a function of the projected number of passengers boarding and alighting at any particular station, and the frequency of buses that need to be accommodated at that station.
BRT stations constitute three elements: the bus platforms, the space between the platforms, and any integration infrastructure such as necessary pedestrian walkways, space for vendors, bike parking, or other commercial activity.

Figure 1.33. Typical example of a BRT busway and a BRT bus Station (Example from Quito (Ecuador))

The height of the bus stop is largely a function of aesthetics. From the standpoint of waiting passenger crowding, the critical factor is the width of the station rather than the length. Additional platform length beyond the length of the bus does not contribute much to the comfort and efficiency of boarding and alighting passengers, as boarding passengers will cluster around the doors waiting to board, and exiting passengers disperse quickly.

Protection from weather is a major consideration in station design. The image of the station as a refuge from the outside world can help attract customers. In Tirana, high temperatures in summer time are a concern. Open designs can also be an option, especially in warm locations. More open designs, though, do increase the need for protection against fare evasion. However, examples show that it is possible to achieve both an open design and relatively good natural deterents to fare evasion. However, open designs will likely make waiting customers more exposed to wind and rain.

Stations and terminals require electrical energy in order to power a range of supporting infrastructure, including lighting, fare collection and fare verification equipment, automatic station doors, and climate control. The normal method is to supply the bus stop with power directly from the power grid. However, if the grid is unreliable and the ticketing system relies on a supply of electric power, a power failure can cause major problems in terms of the security and integrity of the fare collection system. In such cases, reliance on electric power at the station should be minimized to the greatest extent possible, or back up power generation systems should be included in the physical design from the beginning.

Station spacing is a very important question affecting speed, capacity and customer friendliness of the system. The customers prefer on the one hand to have short walking distances to the bus station but on the other hand they want a high speed of the buses, which means stations far apart.
Locating BRT station stops close to popular destinations is the best way to minimize walking times. Thus, BRT stations are typically located near major destinations such as commercial centres, large office or residential buildings, educational institutions, major junctions, or any concentration of trip origins and destinations. Usually this is done based on intuitive local knowledge, because traffic modelling is rarely detailed enough to provide much insight. In general, distances of approximately 400 to 500 meters between stations tend to be the current standard for BRT corridors. However, the actual spacing can range from 300 and 1,000 meters, depending on the local circumstances.

c) Bus Depot

The depot usually provides secure overnight parking for the entire fleet of vehicles, facilities to clean, maintain, and repair the buses, services for the employees, and administrative offices for the bus operators.

![Diagram of a bus depot]

Figure 1.34. Standard layout of a bus depot

If the local conditions do allow it, the bus depot might be combined with one of the bus terminals.

d) Control Centre

A centralised control centre will help ensure smooth and efficient BRT operations. Controlling a high-volume BRT system spread across a major developing city is a complex and highly-involved activity. A centralised control and management system brings with it the following benefits:

- Immediate response to changes in customer demand
- Immediate response to equipment failures and security problems
- Efficient spacing between vehicles and avoidance of vehicle “bunching”
- Automated system performance evaluation
- Automated linkages between operations and revenue distribution

The control center can either be located in one of the BRT terminals or in the bus depot.
e) Fare Collection System Technology

The first step in selecting an appropriate fare collection and verification technology is deciding what sort of operational plan, what sort of fare policy, and what sort of institutional structure is needed for the specific BRT system. The method of fare collection and fare verification has a significant impact on the operational efficiency of the BRT system, the ability of the system to integrate bus routes with each other and with other transit systems, and the fiscal transparency of the system. Before making a final decision on a fare collection system technology, critical decisions regarding the operation of the fare collection system and the fare policy need to have already been made. Decisions that should already have been made include:

- Operational plan for the fare collection system
- Tariff policy
- Institutional structure of the fare collection system

The operational plan needs to decide if fare collection will be only off-board, only onboard, or both on board and off board. Many systems being developed now are considering having the flexibility of both on-board and off-board payment systems. Most BRT systems offer free transfers within the BRT system, both between trunk lines and between trunk and feeder lines. Some BRT systems may also offer free or discounted transfers between buses inside the BRT system and other modes of transport like metros, commuter rail lines, and standard buses. If the system designers have built physically enclosed stations where passengers can transfer between lines without having to again pass through a turnstile, then cash and token-based ticketing systems can still be used. However, electronic ticketing systems can make possible free and discounted transfers both within the BRT system and between the BRT system and other modes.

Normally, the physical equipment of the ticketing system consists of the following:

- Medium of payment. The medium of payment is usually cash, tokens, paper tickets, smart cards, or cash.
- Point of Sales (POS) terminals. These are cash points where a ticket, token, or smart card can be purchased, or value can be added onto smart cards.
- Deduct-value points, usually turnstiles or card readers,
- Central Computer, Telecommunications and GPS links between the Point of Sales terminals, the deduct value points, and the central computer.

Medium of Payment

The following payment mediums are in common use in BRT systems around the world:

- Coin or token systems
- Paper systems
- Magnetic strip technology
- Smart card technology
- Proof of payment systems

Each system has specific advantages and disadvantages. Magnetic-strip technology has long been utilised in leading metro systems worldwide. However, the costs of each strip card are about 0.01 to 0.05 EURO per card. On the other hand simple coin- or token-operated machine
have proven to be a robust and highly cost-effective solution. Their disadvantage is, that they only can work under a flat rate tariff structure.

Figure 1.35  Bogota – turnstiles with magnetic strip technology – Magnetic strip card

Figure 1.36  Token system
In the case of Tirana SUSTRAFFTIA proposes
- a token system for single trips and
- the magnetic strip technology for monthly tickets and for passengers changing from or to other urban bus lines.

This system would allow operating the BRT on a simple fare structure. The fare for the BRT trunk lines would be one token. For the feeder lines a second token would be required. A similar structure would apply for monthly tickets. For passengers changing within Tirana from or to urban non-BRT buses to a BRT-bus, the tariff would be somewhere between one and two token. They would receive a magnetic strip card allowing them to use both systems, BRT buses and normal urban buses.

The token system as well as the magnetic card system does have two main advantages. First, fare adjustments are easily possible. If the tariff is changed, only the token or the magnetic card vending machines must be newly programmed. Second a discount rate for frequent users can be introduced by selling e.g. 10 token or 10 cards at a reduced rate.

f) Vehicle Technology

Regardless of whether the vehicle procurement is public or private, the technical specifications of the vehicle selected will largely have to be set by the system’s designers so that they interface properly with the infrastructure. The current common practice is for the public agency to set vehicle standards while the private sector actually purchases and operates the vehicles. Thus, while a standard set of basic requirements must be met, many decisions, such as vehicle manufacturer, are actually left to the bus operating companies. The public agency will likely develop a detailed set of vehicle specifications that each operator will be required to fulfil. However, it is up to the bus operator, who is paying for the buses, to determine how to best meet the specifications. Thus, within one system, different operating companies may select different vehicle manufacturers. However, thanks to the detailed specifications, from the perspective of the customer, all of the buses look and operate identically. This is important to creating and preserving a clear system identity.
Manufacturers typically produce vehicles with a set range of interior dimensions. The actual number of passengers that can be accommodated in a given interior space will depend on interior layout, the number of seats provided, and the amount of space available for standing customers. The table below summarises typical passenger capacity ranges for standard vehicle sizes.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Typical number of passengers</th>
<th>Typical vehicle length (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vans</td>
<td>10-16</td>
<td>3 metres</td>
</tr>
<tr>
<td>Mini-buses</td>
<td>25-35</td>
<td>6 metres</td>
</tr>
<tr>
<td>Standard buses</td>
<td>60-80</td>
<td>12 metres</td>
</tr>
<tr>
<td>Tandem bus</td>
<td>90-120</td>
<td>15 metres</td>
</tr>
<tr>
<td>Articulated buses with two bodies</td>
<td>120-170</td>
<td>18 metres</td>
</tr>
<tr>
<td>Bi-articulated buses with three bodies</td>
<td>240-270</td>
<td>24 metres</td>
</tr>
<tr>
<td>Double Decker buses</td>
<td>80 - 110</td>
<td>&lt;15 metres</td>
</tr>
</tbody>
</table>

Table 1.9. Standard vehicle types and passenger capacities

Standard OECD Euro II or EURO III diesel buses sold in Europe are sold at 200,000 – 350,000 EURO. Diesel with advanced emissions controls meeting Euro IV or better are 5,000 to 10,000 EURO more expensive than comparable standard diesel buses.

A common mistake involves assuming that larger vehicles are somehow “better”. In truth, the best vehicle size is one that allows for a cost-effective operation and for the given volumes and service frequency. If a large bus requires ten minute headways between vehicles so that
the optimum load levels can be achieved, then choosing a lower capacity vehicle might be more convenient. Passengers prefer headways in the range of one to four minutes. Long wait times will ultimately lead passengers to choose alternative modes of transport, such as private vehicles. It is important that the operational design include a preference analysis that studies time valuation by customers in such a way that the optimum vehicle type and fleet numbers can be chosen and that an appropriate quality level can be achieved with the allocated budget.

In addition to complying with the governing legislation, the project must define its minimum environmental standards. Because of the profitability of BRT, it is usually possible to set a higher environmental standard on BRT buses than is required under the law without compromising the profitability of bus operations. As BRT projects play an important role in improving environmental conditions, raising environmental standards as high as can be financially sustained is generally recommended.

Generally, the following must be considered:
- Maximum emission levels
- Maximum levels on interior and exterior noise.
- Minimum ventilation and temperature standards (air renewal/time unit)

<table>
<thead>
<tr>
<th>Euro category</th>
<th>Date in EU</th>
<th>NOx (g/kWh)</th>
<th>PM (g/kWh)</th>
<th>Engine control requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro II</td>
<td>1998</td>
<td>7.0</td>
<td>0.15</td>
<td>Minor diesel engine improvements, good maintenance, proper operating settings, and diesel fuel with 500 ppm sulphur or less</td>
</tr>
<tr>
<td>Euro III</td>
<td>2000</td>
<td>5.0</td>
<td>0.10</td>
<td>Further engine improvements (e.g., closed loop system) and probably a diesel oxidation catalyst. NOx system may require an EGR system</td>
</tr>
<tr>
<td>Euro IV</td>
<td>2005</td>
<td>3.5</td>
<td>0.02</td>
<td>Ultra-low sulphur diesel (&lt; 50 ppm) and a catalytic particulate filter, with additional NOx control such as advanced EGR</td>
</tr>
<tr>
<td>Euro V</td>
<td>2008</td>
<td>2.0</td>
<td>0.02</td>
<td>Further NOx reduction such as NOx absorber or SCR technologies</td>
</tr>
</tbody>
</table>

Table 1.10. “Euro” emission standards for heavy vehicles
(Source: IEA, 2002, p. 64)

A strategy incorporating each of these components will be most effective. However, each component has a different ramification in the Tirana context. If fuel quality is the focus of the strategy, can the quality of the incoming fuel be assured and how will adulteration of fuels be avoided? If advanced engine and emission-control technologies are utilised, how robust are these technologies? If an improved driver and maintenance programme is established, what mechanisms and incentives are in place to ensure follow-up and compliance?

In addition to emission standards, system planners may also specify the maximum allowable age of buses operating on the system. The age specification will help to maintain long-term system quality as well as ensure all private operators are competing on an equal basis. The
maximum age will also play a fundamental role in calculating the operator’s amortisation rate for the vehicle.

Within the vehicle specifications set by the public agency, a decision must be made to specify a particular technology or to only specify a particular emission standard. In general, it is preferable to only specify a particular emission standard, and then allow the private sector find the best means of fulfilling the standard. The operator will need to consider a range of factors such as fuel costs, fuel availability, maintenance, reliability, refuelling times, and performance. These factors will vary by location and situation, and the private sector may be in the best position to weigh the relative economic value of each factor. In the case of Tirana, buses should meet a minimum Euro III emission standard and later on move towards Euro IV standards.

Acceptable noise levels should also be specified within the bus procurement specifications. Excessively loud vehicles are both a health hazard as well as a detriment to the marketing image of the transit service.

The presence or absence of climate control inside the vehicles can have an enormous impact on the quality of service but also on the costs of operations. In some climates air conditioning is not that critical to customer comfort, but in other cases, the lack air conditioning alone may be enough to induce middle and upper income passengers to stay in private motor vehicles. Requiring air conditioning is critical to a high status image for the system, but it will also put upward pressure on the fare. As a general rule, climate control inside the vehicles is preferred if it is at all possible given the profitability of the system.

The vehicle industry is nowadays offering a wide range of fuel options for public transport vehicles. These are:

- Standard diesel
- Clean diesel
- Bio-diesel (biomass fuel - diesel)
- Compressed natural gas (CNG)
- Liquid petroleum gas (LPG)
- Hybrid-electric (diesel-electric and CNG-electric)
- Electric
- Hydrogen (fuel cell technology)

In the case of Tirana the option “clean diesel” has major advantages. All other fuel options are much more expensive and they require very special equipment, which is for the moment not available in Albania.

Clean diesel is a technology that both produces relatively low emissions and also is within the technology experience of the bus companies operating in Tirana. A “clean diesel” system implies that the propulsion system technology and the fuel quality are such that the end result is much lower emissions than a standard diesel vehicle. The International Energy Agency notes that (IEA, 2002, p. 61):

“Diesel engines are recognised and favoured worldwide for their fuel efficiency, excellent durability and low maintenance requirements. They offer the convenience of using a liquid fuel that is easily dispensed through an established fuelling infrastructure. The technology is mature, widely produced and competitively priced. Although diesel engines have historically produced high levels of pollutant emissions, especially oxides of nitrogen (NOx) and particulate matter (PM), recent improvements in engines, fuel and emissions-
control technology have resulted in new diesel systems for buses that are substantially cleaner than they were only a few years ago."

A main drawback of high quality diesel engines is that they require the availability of low sulphur diesel fuel, which may be beyond the capacity of the transit operators to influence. The sulphur and aromatic content of the diesel fuel is a particularly telling measure of the fuel quality. To achieve Euro II standards, a sulphur level of less than 500 ppm is likely to be required. To achieve “ultra-low-sulphur diesel” (ULSD), the fuel must contain less than 50 ppm. Many emission-control technologies will only function properly if the fuel sulphur levels are below acceptable levels. Diesel emissions will also vary depending on local conditions such as altitude, atmospheric pressure, humidity, and climate. The quality of ongoing vehicle maintenance and the integrity of the fuel supply chain will also affect specific system emissions. Albania has foreseen improving the quality of the diesel fuel sold in the country by reducing the sulphur content step by step within the next 5 to 15 years.

In the case of Tirana SUSTRAFFFTIA proposes the “clean diesel option” for the BRT-vehicles. In a later stage, compressed natural gas (CNG) could be an alternative. The required emission standards should be EURO III in the beginning and at a later stage – according to the availability of ultra-low-sulphur diesel – the emission level should be strengthened to EURO IV or EURO V.

1.4.4 Investment costs of the Infrastructure of the Bus Rapid Transit System

The investment costs of the above-described infrastructure (busways, bus stations, terminals, bus depot etc.) of the 5 selected bus rapid transit corridors with a length of

- 25.3 kilometres in Phase 1 (corridors A, B, C) and
- 12.2 kilometres in Phase 2 (corridors D, E)

will be of about

- 73 million EURO for phase 1 and
- 24 million EURO for phase 2.

The detailed calculation of these costs is given in Annex 8.

The costs for buying the vehicles are not included in these costs. The private operators will purchase the buses. As examples from well functioning BRT systems show, it will be possible for the bus operators to finance their expenditures for buying and operating the buses through the ticket revenues coming from the users.

1.4.5 Integrating BRT with Land-use Policy

Local land use patterns significantly affect transit system performance. Travellers will generally only use transit if it requires walking less than 500 to 1,000 meters. Increasing the portion of destinations (homes, worksites, shops, schools, public services, etc.) located near
transit stops, and improving walking conditions in areas served by transit, makes the system more effective to users and profitable for operators. This type of land use is called transit oriented development (TOD) or smart growth.

BRT projects can provide a catalyst for transit-oriented development. A transit station can be the nucleus of a transit centre, also called an urban village (Figure 1.3.7.). A typical village contains an appropriate mix of housing, a school, shops and public offices, employment centres, and religious (church, mosque), recreation and entertainment facilities. As much as possible major destinations should be located within view of the transit stop so they are easy for visitors to find. Each urban village should have its own name and identity, which can be encouraged with appropriate signs and public art, and special events, such as a neighbourhood festival. Higher density housing, such as multi-story apartment buildings and condominiums, should be located near transit stations. Medium-density housing, such as low rise apartments, townhouses, and small-lot single-family homes, can be located further away, but still within convenient walking distance of the transit centre.

Figure 1.38. Transit Oriented Urban Development

A typical urban village has a diameter of 1 to 1.5 kilometres, a size that allows most destinations to be located within half a kilometre walking distance of the transit stop. This contains an area of 80 to 160 hectares, enough to house 2,000 to 4,000 residents with medium density housing (25 residents per hectare), or more with higher density housing. Of course, not every urban village will follow this exact design, some may be primarily commercial, industrial or recreational centres, and others are limited in size due to geographic features such as parks and waterways. Some may be smaller or larger, depending on demographic and land use factors. Each urban village should be carefully planned to take advantage of its unique features.

Transit-oriented development provides many benefits compared with more dispersed land use patterns, and poor walking and cycling conditions. It increases the number of destinations within walking range of transit stops. This, in turn, increases transit system rider ship and revenues, and reduces local traffic problems. More compact development with well-planned urban villages tends to reduce the cost of providing public services such as utilities, roads, policing, and schools. Improved walking conditions, reduced motor vehicle traffic, and better
public services tends to increase neighbourhood liveability. It also provides economic efficiency benefits, including increased lower business costs for parking and goods distribution, and an expanded labour pool. These efficiencies tend to increase overall economic productivity, business activity and tax revenues. Even people who do not use transit benefit from having BRT service transit-oriented development in their communities.

1.4.6 Regulatory structure of a newly created BRT-System in Tirana

Once it has been decided to build and operate a new BRT system, it is time to make a decision concerning the future regulatory structure. Within the European Union a mixed system having public oversight over a competitive market is more and more adopted in public transport. The municipality of Tirana has also chosen this organizational structure for its actual bus services.

Based on their experience with BRT in many countries Lloyd Wright and Walter Hook suggest in their “Bus Rapid Transit Planning Guide”:

“There is an emerging consensus that certain regulatory structures tend to work better than others. The key elements of this structure are as follows:

1. BRT bus operations are better managed by private operators, but in a market regulated by the public sector.

   This will avoid the problems of mismanaged public bus operators, while protecting customer service. It will also avoid the problems of unregulated private free competition, such as dangerous competition for passengers, insufficient profitability to provide funds for vehicle investment, weak environmental regulation, etc.

2. Bus procurement should be handled by private bus operators.

   This structure will allow the efficiency of private sector decision making in the bus procurement, ensure that the physical asset is protected by private owners, and avoid corruption in the procurement process.

3. Bus operations should be self financing from the fare revenues.

   This will reduce the burden on taxpayers, and make sure that the bus operators have a stake in retaining passengers and providing good quality service. It will also protect the sustainability of the system from the vicissitudes of the political process.

4. Infrastructure investment should be paid for from public sources.

   Forcing the passengers to cover infrastructure investments from the fare when normal motorists do not cover the cost of infrastructure investment would put an unfair economic bias in favour of private motorists at the expense of low-income passengers.

5. Trunk line operators should be paid by the bus kilometre rather than by the passenger. Feeder bus operators can be paid a combination of bus passengers and bus kilometres.
Paying the operators by the kilometre rather than the passenger removes the dangerous competition for the cent, the incentive for operators to stop at places other than the stations, and severs bus operator control over the fare revenue.

6. **Operators should be exposed to demand risk by allowing flexibility in the contract to adjust the number of bus kilometres to be operated each day.**

Paying bus operators by the bus kilometre would insulate them entirely from demand risk if it were not for the fact that the regulatory agency retains the right to adjust the number of bus kilometres assigned to them each day. If demand is falling, bus kilometres assigned will also fall, and the revenues of the bus operators will drop. Because the bus operators have a stake in retaining passengers, they will work harder to provide a good quality service.

7. **Service contracts for bus operators are better than concession contracts linked to specific corridors, as they allow for more service flexibility.**

Having the bus operating contracts linked to a promise of a certain number of bus kilometres but not necessarily in a specific corridor allows the BRT regulatory authority to more easily adjust services to changes in demand between corridors, and allows revenues from the more profitable parts of the system to be more equitably distributed among private operators.

8. **Fare revenue should not be collected by the bus operator but by an independent agency.**

Allowing the bus operator to collect the revenue in practice means that only the bus operator really knows how much money the system is receiving, undermining the ability of the government to negotiate the best deal from the operators. Having an independent fare collection system also means that all of the private bus operators have a vested interest in the transparency of the fare collection system (to make sure they get their fare share) rather than a vested interest to conceal fare receipts. (for the avoidance of taxes)

9. **Contracts with bus operators should include incentives to provide better quality service**

The system of rewards and punishments included in operating contracts ensures ongoing good quality service that is enforceable on a daily basis rather than only once every ten years when the concession contract is renegotiated.

10. **All operating contracts should be competitively bid between private investors**

Competitive bidding of the operating contracts is absolutely critical to insuring a transparent governance process and insuring that the government is getting the lowest possible price for the service.

11. **The new BRT authority needs to focus on the BRT system alone and not be burdened with other administrative responsibilities that it cannot handle.**
Designing, implementing and managing a BRT system is an extraordinary undertaking that requires the brightest and best minds with their attention fully focused on the system. Assigning the administrative leaders too many conflicting responsibilities at the same time can undermine the system.”

Based on these considerations, Lloyd Wright and Walter Hook are proposing the following organizational structure:

**Figure 1.39. Recommended BRT organizational structure**
1.4.2 Road Infrastructure Investments under Strategy B

Due to the good public transport system of strategy B the modal split between road transport and public transport will be different between strategy A and B. There will be less people using their car within Tirana and thus the need to build new roads and new parking space in the city center will be much smaller than under strategy A.

The calculations of the expected traffic flows in the years 2014 and 2021 have shown, that especially the very costly southern and eastern parts of the outer ring road will, if constructed, not be very much used. On the contrary the problems on Rruga Durresit, Rruga Kavajes, along the Lana River and in the city center will become even more severe than today. Since, without destroying the city center it is not possible to build freeways with 6 or 8 lanes in the middle of town, the only solution for Tirana is

- to improve the existing roads, to restructure the intersections and to install a well coordinated traffic light system and at the same time
- to create an efficient and attractive public transport system.

![Figure 1.40. Year 2021 traffic flow of the road oriented Strategy A (the main roads going towards the center are visibly overloaded)](image)

The necessary investments of Strategy B into the road network are shown in figure 1.40. In contrast to the projects shown on that map the tunnel passing south of the university between Tirana Lake and Rruga Elbasani will not be necessary, because there is no real demand for that link (see figure 1.39.). Since there is no important traffic passing through Tirana, the need for the northern sections of the outer ring road between Rruga Durresit and Rruga M. Keta is solely depending on the future urbanization of that area.
The list of the new road projects under this strategy B can be taken from the list of Annex 4 with the exception of projects number 15, 16, 25, 26, 27, 28 and 32 which, at the same time are the most expensive projects (tunnels, bridges, slopes). The Road Department of the Municipality is estimating the necessary investment costs of these roads to be 6,750,000 LEK (= 55,3 million EURO). Taking into account that these costs do not include the intersections, the necessary land acquisition and the general increase in the construction cost, SUSTRAFFTTIA assumes that this investment program realistically will cost about 75 million EURO.
1.5 Costs and Benefits of the future Tirana Urban Transport Strategies

The main differences between the road oriented (Strategy A) and the public transport oriented strategy (Strategy B) are

- the volume of car traffic and
- the total investment costs.

Other important factors as pollution, accidents and the costs of the car traffic are directly depending on the volume of car traffic.

Volume of Traffic

As mentioned before, under the restricted financial possibilities of this study it was only possible to calculate the volume of traffic under Strategy A. On the other hand it is evident, that a good public transport system will lead to less car traffic since the users are shifting from using their car to the proposed bus system. SUSTRAFFTIA assumes, that under the public transport oriented strategy the overall car traffic under Strategy B in comparison with Strategy A will be

- 10 percent less in the year 2014 and
- 30 percent less in the year 2021.

Figure 1.41 is showing the differences of the overall volume of traffic between both strategies.

![Graph showing volume of traffic between strat A and strat B](image)

**Figure 1.42. Volume of Traffic in Tirana under Strategy A and Strategy B**

Emissions of toxic Pollutants

The German handbook for the evaluation of transport investments, which has been updated in 2001, is giving in Annex 1, Table 4-11 the following emission factors:
Table 1.11  Emission factors for private cars in g per km in the year 2000  
(direct and indirect emissions)  
(Source: Standardisierte Bewertung..., Annex 1, Tab. 4 – 11)

Since the car fleet in Tirana is very old (see Table 4.1.), SUSTRAFFTIA assumes, that the actual (year 2007) emission levels in Tirana are 15 percent higher than those in Germany in the year 2000. On the other hand the modernization of the Albanian car fleet and the ongoing tightening of the EU emission standards will lead to further reductions of the emission factors. Therefore SUSTRAFFTIA assumes that the 2014 emission levels in Tirana will be equivalent to those in 2000 in Germany and that they will be 30 percent lower than those of Table 1.11 in the year 2021.

Based on these assumptions the total emissions from the car traffic in Tirana are:

Table 1.12  Total emissions from car traffic in Tirana in tons per year

The amount of damages these emissions are creating to the health of the population, to vegetation, to buildings and material is very different. HC is 500 times more dangerous than CO and NOx. SO2 is 333 times more dangerous than CO and particles are 114 times more dangerous. (Source: Standardisierte Bewertung..., Annex 1, Tab. 4 – 9).
Figure 1.43. Emissions per year under Strategy A and Strategy B

It is very difficult to calculate the costs of these damages to the population, the vegetation and the buildings/materials are creating. According to studies made in Germany, the social costs of air pollution from car traffic are 0.34 EURO Cents per vehicle kilometre (Source: Standardisierte Bewertung..., Annex 1, Tab. 4 – 14). The similar French handbook is
evaluating these costs much higher. They are attributing 2.9 EURO Cents per vehicle kilometre to the social costs created by pollution. *(Source: Le ministere de l'Equipment, des Transports ..., Paris 2004)*.

Seeing these differences SUSTRFFTIA is taking the average of both values and is attributing 1.6 EURO Cents per vehicle kilometre to the social cost of air pollution.

![Figure 1.44. Annual Social Costs of Air Pollution in Tirana](image)

**Carbon Dioxide Emissions**

Recent studies evaluating the costs and benefits of transport project are also considering the negative effects of the carbon dioxide (CO₂) emissions. The German handbook *(Source: Standardisierte Bewertung..., Annex 1, Page 52)* is attributing costs of 231 EURO to each ton of CO₂ emitted. The French handbook is estimating the climate costs to be 100 EURO per ton of CO₂.

Since this pre-feasibility study could not calculate the bus kilometres needed and their CO₂ emissions under Strategy A and Strategy B to serve the population of Tirana SUSTRAFFTIA is not taking the emission costs of carbon dioxide into account. But it is evident, that the CO₂ emissions of the public transport oriented Strategy B and the costs of these emissions are much lower than those of the road oriented Strategy A.
Road Accidents

A cost-benefit analysis of transport projects necessarily also includes the social cost of road accidents. The German handbook is calculating the social costs of persons killed, of those seriously or slightly injured and of the damages of material (cars etc.) to be 61,800 EURO per vehicle kilometre *(Source: Standardisierte Bewertung..., Annex 1, Tab. 3 – 10).*

The social costs of road accidents are closely linked to the income situation and the health costs of the country concerned. Since the necessary data to adopt the German cost estimates to the situation of Albania are not available, SUSTRAFFTIA is not calculating the social cost of road accidents. But it is evident, that the road oriented Strategy A will be accompanied by a significantly higher number of car accidents and their social costs.

Avoided private car operating costs

Under Strategy B less car traffic is necessary in Tirana than under Strategy A. This effect has to be included into the comparison of both strategies. Less consumption of fuel, less maintenance costs, less wearing down of tires etc. are creating benefits not only to the car owners but also to society as a whole. The German handbook as well as the French are estimating the benefits of avoided operating costs to be 0.25 Euro per vehicle kilometre *(Source: Standardisierte Bewertung..., Annex 1, Tab. 4 - 2).* Since the costs of operating a car don’t differ very much from country to country, SUSTRAFFTIA is therefore also using 0.25 EURO per vehicle kilometre for each avoided car km.

Infrastructure Investment Costs

The necessary investment costs have been evaluated in the previous chapters. In Chapter 1.2.1.1 the short term road investment costs have been calculated to be 20 million EURO. They are necessary under Strategy A as well as under Strategy B. The long term road investment costs differ between both strategies. For Strategy A (road oriented) they probably will be 250 million EURO (Chapter 1.2.1.2). For Strategy B (public transport oriented) they are estimated to be 75 million EURO (Chapter 1.3.2).

Concerning the costs of the necessary parking space SUSTRAFFTIA has made a rough calculation. They probably will be 25 million EURO for Strategy A and 6 million EURO for Strategy B.

To improve the situation of the existing bus system short term investments into the existing road infrastructure are necessary. The main objective of these investments is to create bus lanes and to improve the situation at congested intersections. They are necessary under both strategies and will cost about 10 million EURO (Chapter 1.2.2). The construction of the proposed Bus Rapid Transit System (Strategy B) will probably cost 75 million EURO for the realization of phase I and 25 million EURO for the realization of phase II (Chapter 1.3.1 and Annex 7). Under the road oriented strategy it will also be necessary to avoid the collapse of the bus services. Therefore 10 million EURO are foreseen for investments into the public transport system under Strategy A.
Figure 1.45. Infrastructure Investment Costs for Roads, Parking and Public Transport under Strategy A and Strategy B
### Table 1.13  Comparison of costs, benefits and investment costs of Strategy A and Strategy B

<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Traffic Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle kilometres per year</td>
<td>578</td>
<td>1.243 million veh. km</td>
<td>1.830 million veh. km</td>
<td>1.119 million veh. km</td>
<td>1.281 million veh. km</td>
</tr>
<tr>
<td>Social costs of air pollution from traffic (0.016 € per vehicle km)</td>
<td>10.64 million € per year</td>
<td>19.89 million € per year</td>
<td>20.50 million € per year</td>
<td>17.90 million € per year</td>
<td>14.35 million € per year</td>
</tr>
<tr>
<td>Social benefits of avoided car operation costs</td>
<td></td>
<td></td>
<td>0.50 mill. € per year</td>
<td>2.20 mill. € per year</td>
<td></td>
</tr>
<tr>
<td>Road investment costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) short term (2007 – 2014)</td>
<td>20 million €</td>
<td>20 million €</td>
<td>250 mill. €</td>
<td>20 million €</td>
<td></td>
</tr>
<tr>
<td>b) long term (2010 – 2021)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Costs of parking facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) short term (2007 – 2014)</td>
<td>5 million €</td>
<td>3 million €</td>
<td>20 million €</td>
<td>3 million €</td>
<td></td>
</tr>
<tr>
<td>long term (2010 – 2021)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public transport infrastructure investment costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) short term (2007 – 2014)</td>
<td>10 million €</td>
<td>10 million €</td>
<td>10 million €</td>
<td>10 million €</td>
<td></td>
</tr>
<tr>
<td>b) long term (2010 – 2021)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase I + II: 75 million € 25 million €</td>
<td></td>
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</tr>
</tbody>
</table>

This comparison of the costs and benefits of both strategies is clearly showing the advantage of Strategy B over Strategy A.

**SUSTRAFFTTIA is therefore proposing to realise the public transport oriented strategy (Strategy B). Following this pre-feasibility study the necessary political decision should be taken. Following the political decision a complete feasibility study of a Bus Rapid Transit System (BRT) for Tirana should be made by a competent agency having experience with BRT-Systems.**
2 Emission standards for new and in-use vehicles

As the example of the US and the EU shows, introducing more and more stringent emission standards for new cars, trucks, buses and motor cycles is by far the most effective measure to reduce air pollution from traffic. Despite a constantly growing volume of traffic, the pollution due to transport has visibly decreased.

Figure 2.1 EU Emission standards for buses and trucks
(note: EURO VI is actually under discussion)

The EU Emission standards for passenger cars and light commercial vehicles are summarized in the following tables. Since the Euro 2 stage, EU regulations introduce different emission limits for diesel and gasoline vehicles. Diesels have more stringent CO standards but are allowed higher NOx. Gasoline vehicles are exempted from PM standards through the Euro 4 stage. Euro 5/6 regulations introduce PM mass emission standards, numerically equal to those for diesels, for gasoline cars with DI engines.

All dates listed in the tables refer to new type approvals. The EC Directives also specify a second date—one year later (unless indicated otherwise)—which applies to first registration (entry into service) of existing, previously type-approved vehicle models.
<table>
<thead>
<tr>
<th>Tier</th>
<th>Date</th>
<th>CO</th>
<th>HC</th>
<th>HC+NOx</th>
<th>NOx</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diesel</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro 1†</td>
<td>1992.07</td>
<td>2.72 (3.16)</td>
<td>-</td>
<td>0.97 (1.13)</td>
<td>-</td>
<td>0.14 (0.18)</td>
</tr>
<tr>
<td>Euro 2, IDI</td>
<td>1996.01</td>
<td>1.0</td>
<td>-</td>
<td>0.7</td>
<td>-</td>
<td>0.08</td>
</tr>
<tr>
<td>Euro 2, DI</td>
<td>1996.01</td>
<td>1.0</td>
<td>-</td>
<td>0.9</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td>Euro 3</td>
<td>2000.01</td>
<td>0.64</td>
<td>-</td>
<td>0.56</td>
<td>0.50</td>
<td>0.05</td>
</tr>
<tr>
<td>Euro 4</td>
<td>2005.01</td>
<td>0.50</td>
<td>-</td>
<td>0.30</td>
<td>0.25</td>
<td>0.025</td>
</tr>
<tr>
<td>Euro 5</td>
<td>2009.09</td>
<td>0.50</td>
<td>-</td>
<td>0.23</td>
<td>0.18</td>
<td>0.005(^e)</td>
</tr>
<tr>
<td>Euro 6</td>
<td>2014.09</td>
<td>0.50</td>
<td>-</td>
<td>0.17</td>
<td>0.08</td>
<td>0.005(^e)</td>
</tr>
<tr>
<td><strong>Petrol (Gasoline)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro 1†</td>
<td>1992.07</td>
<td>2.72 (3.16)</td>
<td>-</td>
<td>0.97 (1.13)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Euro 2</td>
<td>1996.01</td>
<td>2.2</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Euro 3</td>
<td>2000.01</td>
<td>2.30</td>
<td>0.20</td>
<td>-</td>
<td>0.15</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 2.1. EU Emission Standards for Passenger Cars (Category M1*), g/km

<table>
<thead>
<tr>
<th>Tier</th>
<th>Date</th>
<th>CO</th>
<th>HC</th>
<th>HC+NOx</th>
<th>NOx</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro 4</td>
<td>2005.01</td>
<td>1.0</td>
<td>0.10</td>
<td>-</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>Euro 5</td>
<td>2009.09b</td>
<td>1.0</td>
<td>0.10c</td>
<td>-</td>
<td>0.06</td>
<td>0.005d,e</td>
</tr>
<tr>
<td>Euro 6</td>
<td>2014.09</td>
<td>1.0</td>
<td>0.10c</td>
<td>-</td>
<td>0.06</td>
<td>0.005d,e</td>
</tr>
</tbody>
</table>

* At the Euro 1..4 stages, passenger vehicles > 2,500 kg were type approved as Category N1 vehicles
† Values in brackets are conformity of production (COP) limits

- a - until 1999.09.30 (after that date DI engines must meet the IDI limits)
- b - 2011.01 for all models
- c - and NMHC = 0.068 g/km
- d - applicable only to vehicles using DI engines
- e - proposed to be changed to 0.003 g/km using the PMP measurement procedure

Source: EU-Directive 70/220/EEC

Besides optimizing the motor technology the two main equipments making vehicles less pollutant are

- the three way catalyst for gasoline cars and
- the particle filter for diesel powered vehicles.

Both require high quality fuel. The effectiveness of the three way catalyst is destroyed, if leaded gasoline is used. Therefore leaded fuel is no more sold in the EU. Modern diesel engines and especially those equipped with a particle filter require diesel fuel with a low content of sulphur. That is, why modern low polluting vehicles and high quality fuel are needed at the same time.

Seeing the experience in the EU, the challenge for Albania is, to tighten the emission standards for new vehicles. Albania is therefore planning to adopt the EU emission standards for all new vehicles being imported. Since stringent emission standards can only be achieved when low sulphur diesel fuel and lead free gasoline are available the starting date of such a regulation is depending on the Albanian fuel legislation (see Chapter 3). Since high quality fuel will be introduced step by step in Albania, the regulation concerning the requirements concerning the emission standards of imported vehicles should also be tightened step by step.

As the number of new cars in Albania will increase over the next years, the stringent emission standards will on the long run lead to declining emissions from traffic.
A special problem for Albania is the extremely high number of old and very old cars and the continuing import of used cars (Tab. 2.2).

<table>
<thead>
<tr>
<th>Motor vehicles</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 21 years old</td>
<td>132,970</td>
<td>47.6 %</td>
</tr>
<tr>
<td>11 to 20 years old</td>
<td>121,848</td>
<td>43.7 %</td>
</tr>
<tr>
<td>6 to 10 years old</td>
<td>13,180</td>
<td>4.7 %</td>
</tr>
<tr>
<td>0 to 5 years old</td>
<td>11,083</td>
<td>4.0 %</td>
</tr>
</tbody>
</table>

Source: Ministria e Puneve Publike, Transportit dhe Telekomunikacionit, 26/04/2006

Tab. 2.2. Age of motor vehicles registered in Albania in 2005

It is evident, that substantially lower emissions from traffic will only be achieved, when the process of the modernization of the Albanian vehicle fleet is speeded up and a retrofit program for in-use vehicles is initiated.

SUSTRAFFTIA therefore proposes:

1. The planned law regulating the import of new and used cars, trucks and busses should be passed within short delay. Vehicles not fulfilling the EURO 3 requirements should no more be allowed to enter into Albania. Starting 2010 this limit should be tightened to EURO 4.

2. To initiate a retrofit program for in-use-vehicles. Through this program the retrofitting of in-use-vehicles with catalysts would be subsidized and at the same time the vehicle tax of these cars reduced. This retrofit program should be financed by an increase of the vehicle tax on all vehicles not being in accordance with EURO 3.

3. To initiate a scrap program for very old in-use vehicles. Through this program the owners of pre EURO 1 vehicles (vehicles produced before the year 1992) would get a subsidy of 100 to 200 EURO if their car is put out of service and scraped. This scrap program should also be financed by the proposed increase of the vehicle tax on all vehicles not being in accordance with EURO 3.
3 Fuel Quality

Motor vehicles emit large quantities of carbon monoxide, hydrocarbons, nitrogen oxides and toxic substances as fine particles and lead. Each of these, along with secondary by-products such as ozone, causes serious adverse effects on health and the environment. Pollution control experts around the world have realized that cleaner fuels are the critical prerequisite of an effective clean air strategy. Fuel quality is not only necessary to reduce or eliminate certain pollutants (e.g. lead) directly but also a precondition for the introduction of many important pollution control technologies. Cleaner fuel has a rapid impact on both new and existing vehicles.

In Albania 3 different types of fuel are sold at the gas stations. Theses are
- Unleaded gasoline
- Domestic diesel fuel (Diesel) and
- Imported diesel fuel (Euro Diesel).

Since 85 % of the vehicles of Tirana are diesel vehicles, the focus of this SUSTRAFFTIA study is mainly on these vehicles. However, in the course of the next 10 to 15 years private cars with gasoline engines will be getting more important in Albania. It is therefore necessary to continue tightening step by step the regulations concerning diesel cars and diesel fuel but also the regulations concerning gasoline cars and the fuel quality of gasoline.

Diesel vehicles emit significant quantities of both NOx and particulate. Reducing PM emissions from diesel vehicles tend to have the highest priority because PM emissions in general are very hazardous and diesel PM, especially, is likely to create cancer. To reduce PM and NOx emissions from a diesel engine, the most important fuel characteristic is sulphur because sulphur in fuel contributes directly to PM emissions and because high sulphur levels preclude the use of the most effective PM and NOx control technologies.

The current standards of Albania concerning the quality of the diesel fuel sold in the country are as followed:

<table>
<thead>
<tr>
<th>Diesel Fuel Parameter</th>
<th>Albania Domestic 2006</th>
<th>Albania Imported 2006</th>
<th>EU 2005 (Linked with Euro 4 vehicle Standards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetane number (min.)</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Density (15 °C kg/m³, max.)</td>
<td>860</td>
<td>845</td>
<td>845</td>
</tr>
<tr>
<td>Distillation (95 %, v/v °C, max.)</td>
<td>370</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Polyaromatics (% v/v, max.)</td>
<td>-</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Sulphur (ppm, max.)</td>
<td>2,000</td>
<td>350</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 3.1. Fuel specification limits

According to the Inspectorate of Fuel Quality Control about 80 % of the diesel fuel sold in Albania is domestic diesel and only 20 % is imported low sulphur “Euro Diesel”. This is because the price of domestic high sulphur diesel at the gas station is 10 LEK lower than Euro
Diesel. Tests made at the gas stations also showed, that due to blending with high sulphur diesel oil for other purposes (heating, fishing etc.) the actual sulphur content of domestic diesel sold to the car owners varies between 2,000 and 4,000 ppm.

Since PM and SOx emissions from diesel vehicles, both of which are harmful pollutants, are emitted in direct proportion to the amount of sulphur in diesel fuel. Lowering the sulphur in the fuel lowers the SOx fraction in PM thus lowering the overall mass of PM emitted. The relationship between particulates and sulphur level was found to be linear. For every 100 ppm reduction in sulphur, there will be a 0.16 % reduction in particulate from light duty vehicles (e.g. passenger cars) and a 0.87 % reduction from heavy duty vehicles (trucks, buses).

Taking these figures, the reduction of the actual sulphur level of 2,000 ppm to 350 ppm will reduce the overall particulate emissions from light duty diesel vehicles by 2.6 % and from heavy duty vehicles by 14.4 %. Since

a) the relationship between registered passenger cars and registered buses, trucks and minibuses in Albania is 70 : 30 and
b) the annual distance travelled of a commercial vehicle is at least more than twice the annual mileage of a private car

it can be roughly estimated, that the reduction of the maximum sulphur level of all the diesel fuel sold in Albania from 2,000 ppm to 350 ppm will at the same time reduce the traffic generated PM emissions by 8 to 9 percent.

Lower sulphur levels are not only leading to reduced PM emissions, but also reduce acidification rates and engine corrosion, potentially offering significant cost savings by increasing maintenance intervals and reducing maintenance costs. The largest benefits in this regard occur by reducing sulphur levels from thousands of ppm to 350 ppm. Acid formation is already low at 350 ppm, and prolonged engine life due to less corrosion is not expected when comparing 350 ppm and 10–50 ppm sulphur, though these levels are desirable and necessary for the introduction of low polluting vehicles.

All these reasons are showing, that the reduction of sulphur to 350 ppm yields high returns.

In April 2007 the Albanian government has passed a law concerning future fuel quality standards. It has been decided, to reduce the maximal sulphur content to the level of
- 350 ppm from January 2009,
- 50 ppm from January 2011 and
- 10 ppm from Jan 2015.

Seeing the health damages caused by the actual high concentration of PM and NOx in the air of the Greater Tirana Region SUSTRAFFTIA proposes

1. to tighten as early as possible the quality standard of imported “Euro Diesel” from 350 ppm sulfur to the EU 2005 level of 50 ppm sulfur. By introducing this high quality diesel fuel with less than 50 ppm the owners of EURO 4 cars are getting not only at some gas stations but nationwide the fuel they need for the proper functioning of their vehicle.

2. to reduce the fuel tax on low sulfur diesel fuel accompanied at the same time by an increase of the fuel tax on high sulfur diesel fuel, so that high quality diesel has at least the same price at the gas station as higher sulfur “normal” diesel. This
would give an incentive to the car owners to switch more and more from the traditional diesel fuel to low sulfur Euro Diesel.

3. to speed up the planned nationwide change to low sulfur diesel fuel by introducing a special regulation for the whole Tirana / Durres region. Since this region is suffering most under the actual air pollution caused by traffic it should be imposed to the gas stations in the Tirana / Durres area, to sell only low sulfur diesel fuel with at least less than 50 ppm sulphur, while the rest of the country is still selling higher sulfur diesel fuel.
4 Vehicle Inspection & Maintenance

Setting high emission standards will not achieve the desired emission reductions if vehicles are not well maintained. Particulate emissions can increase substantially where engines are underpowered or poorly maintained or adjusted. Black diesel smoke results from overfueling (the injection of diesel into the combustion chamber in too high a ratio of fuel to air), dirty injectors, and injection nozzle tip wear. Overfueling is a common phenomenon worldwide. It increases power output, although at the expense of fuel economy. Underpowered engines (which is what happens when a vehicle is overloaded, carrying much more weight than the maximum specified by the vehicle manufacturer) exacerbate the tendency to overfuel. Dirty injectors are common because injector maintenance is expensive in terms of both repair costs and losses stemming from downtime. Reducing fuel injection rates to match the fuel-air ratio with the manufacturer’s specifications and maintaining fuel injectors are relatively low-cost measures for emission reductions compared to adoption of more advanced vehicle technologies.

Especially in a situation like in Albania where the vehicle fleet is extremely old (Table 4.1) and fuel quality standards are low, an effective inspection & maintenance and roadworthiness system is one of the most cost-effective and quickest ways of improving both air quality and road safety.

<table>
<thead>
<tr>
<th>Age</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years</td>
<td>- running on gasoline: 5,767 - running on diesel: 3,732</td>
<td>7.6 % - 64.7 %</td>
</tr>
<tr>
<td>6 to 19 years</td>
<td>- running on gasoline: 29,050 - running on diesel: 21,653</td>
<td>38.3 % - 74.5 %</td>
</tr>
<tr>
<td>20 to 25 years</td>
<td>- running on gasoline: 12,723 - running on diesel: 11,731</td>
<td>16.8 % - 92.2 %</td>
</tr>
<tr>
<td>More than 25 years</td>
<td>- running on gasoline: 28,304 - running on diesel: 27,500</td>
<td>37.3 % - 97.2 %</td>
</tr>
<tr>
<td>Total</td>
<td>- running on gasoline: 75,844 - running on diesel: 64,616</td>
<td>100 % - 85.2 %</td>
</tr>
</tbody>
</table>

Source: Ministria e Puneve Publike, Transportit dhe Telekomunikacionit, 26/04/2006
Table 4.1 Registered motor vehicles in Tirana 2005

A proper and fully respected I/M-system helps ensure that all vehicle owners maintain their vehicles regularly which in turn helps ensure that these vehicles comply with emission limits. Even though the number of old and very old vehicles in Albania is extremely high and consequently their emissions, I/M leads to emission reductions which would not be possible if the vehicles were not maintained and inspected at all. A properly maintained vehicle consumes between 3 and 7% less fuel, and hence leads to a similar CO2 reduction.

Technical inspection of vehicles in Albania is carried out under the General Directorate of Road Transport in 14 Technical Control Centres (4 units in Tirana), which were equipped in the last 3 years for measuring emission of air pollutants.
Highly polluting diesel vehicles emit large amounts of particulates (PM) under high load conditions (e.g., accelerating after stop). The test procedure used in the Albanian Technical Control Centres for the emission short test is the measurement of opacity at free acceleration. In that case, the engine is accelerated with transmission in neutral (no load) from idle up to maximum speed and the smoke opacity is measured. This simple unloaded test is identifying gross polluters, but is associated with many errors compared to real life. Experience shows, that idle and free acceleration testing is appropriate for pre-EURO 1 standard vehicles to control emissions, but loaded tests are more effective for EURO 1 and more recent vehicles.

In Albania the limit for pollutants emitted from vehicles are:

<table>
<thead>
<tr>
<th>1. Vehicles without catalytic converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of vehicle production</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Before 1.10.1986</td>
</tr>
<tr>
<td>From 1.10.1986 to 30.12.1995</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Vehicles with catalytic converter and Lambda sonde</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of vehicle production</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>After 1.10.1996</td>
</tr>
<tr>
<td>After 1.10.1996</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Vehicles with diesel motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of vehicle production</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Before 1998</td>
</tr>
<tr>
<td>Before 1998</td>
</tr>
<tr>
<td>After 1998</td>
</tr>
<tr>
<td>After 1998</td>
</tr>
</tbody>
</table>


Tab. 4.2. Allowable limit values for pollutants emitted from vehicles in use in Albania (Temporary limits from 1.01.2005)
A major problem in Albania concerning the vehicle inspection is, that not all car owners are regularly presenting their vehicles to the Technical Control Centres. According to data from the Ministry of Public Works, Transport and Telecommunication in the year 2005 only
- 61 % of the passenger cars
- 40 % of the buses and minibuses and
- 65 % of the trucks
underwent technical inspection. It is obvious, that especially the owners of badly maintained gross polluters avoid presenting their vehicles to the test centres.

<table>
<thead>
<tr>
<th>To make the vehicle inspection &amp; maintenance program in Tirana more effective, SUSTRAFFTIA proposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. to start rigorous action to assure that all vehicles are being regularly presented to the Technical Control Centres. To facilitate the work of the road policy supervising the vehicles running in the streets all vehicles having passed the test should receive from the test centre in addition to the written report an irremovable sticker on their rear license plate identifying the date of the next obligatory inspection. So all vehicles having no sticker would quickly be identified by the road police and also those having exceeded the inspection date.</td>
</tr>
</tbody>
</table>
| 2. to further lower for all vehicles before 1998 the limit for the maximum coefficient of light absorption (opacity) to a value of
  - 2.5 m⁻¹ for naturally aspirated diesel engines and
  - 3.0 m⁻¹ for turbo-charged diesel engines. |
| 3. to change the emission test procedure in the future from idle and free acceleration testing to loaded tests, so that all more recent vehicles can be tested properly. |
| 4. to initiate a close cooperation between the Albanian technical control centres and a technical inspection company of an EU member state to assure the
  - regular calibration of the emission control equipment of all Technical Control Centres in Albania
  - constant modernization of the equipment according to EU regulations
  - continuous training of the staff of the control centres. |
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ANNEX A
Annex 1 Tirana road map

Figure 1.1. Tirana road map of the city centre
Figure 1.2.  Tirana road map
Annex 2 Land Use

Figure 2.1. Monuments and valuable objects
Figure 2.2. Green and sportive areas

Figure 2.3. Social and economic areas
Annex 3 Actual and future traffic flows in Tirana
The complete list of the traffic flows in the years 2000, 2007, 2014 and 2021 on the different sections of the Tirana road network is given in ANNEX B.
Annex 4 Road Investment Projects of the Tirana Road Department
Table 4.1. Road Investment Projects (Strategy A)
(Source: Municipality of Tirana, Road Department)
<table>
<thead>
<tr>
<th>Nr.</th>
<th>Project</th>
<th>Length (meter)</th>
<th>Width (meter)</th>
<th>Construction Cost per km (EURO/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UNAZA I - 1</td>
<td>160</td>
<td>11.50</td>
<td>3.125</td>
</tr>
<tr>
<td>2</td>
<td>UNAZA I – 2</td>
<td>450</td>
<td>11.50</td>
<td>1.340</td>
</tr>
<tr>
<td>3</td>
<td>UNAZA I – 3</td>
<td>230</td>
<td>11.50</td>
<td>1.461</td>
</tr>
<tr>
<td>4</td>
<td>UNAZA II - 1</td>
<td>263</td>
<td>11.50</td>
<td>2.400</td>
</tr>
<tr>
<td>5</td>
<td>UNAZA II – 2</td>
<td>230</td>
<td>11.50</td>
<td>1.404</td>
</tr>
<tr>
<td>6</td>
<td>UNAZA II – 3</td>
<td>366</td>
<td>11.50</td>
<td>1.393</td>
</tr>
<tr>
<td>7</td>
<td>UNAZA II – 4</td>
<td>431</td>
<td>11.50</td>
<td>1.369</td>
</tr>
<tr>
<td>8</td>
<td>UNAZA III - 1</td>
<td>222</td>
<td>11.50</td>
<td>2.545</td>
</tr>
<tr>
<td>9</td>
<td>UNAZA III – 2</td>
<td>397</td>
<td>11.50</td>
<td>4.317</td>
</tr>
<tr>
<td>10</td>
<td>UNAZA III - 3</td>
<td>530</td>
<td>11.50</td>
<td>0.985</td>
</tr>
<tr>
<td>11</td>
<td>UNAZA IV - 1</td>
<td>400</td>
<td>11.50</td>
<td>1.506</td>
</tr>
<tr>
<td>12</td>
<td>UNAZA IV – 2</td>
<td>400</td>
<td>11.50</td>
<td>1.414</td>
</tr>
<tr>
<td>13</td>
<td>UNAZA IV – 3</td>
<td>400</td>
<td>11.50</td>
<td>1.506</td>
</tr>
<tr>
<td>14</td>
<td>UNAZA IV – 4</td>
<td>875</td>
<td>11.50</td>
<td>---</td>
</tr>
<tr>
<td>15</td>
<td>UNAZA V - 1</td>
<td>2,140</td>
<td>2 x 8 = 16</td>
<td>1.794</td>
</tr>
<tr>
<td>16</td>
<td>UNAZA V – 2</td>
<td>1,840</td>
<td>2 x 8 = 16</td>
<td>1.491</td>
</tr>
<tr>
<td>17</td>
<td>UNAZA V – 3</td>
<td>1,920</td>
<td>11.50</td>
<td>1.195</td>
</tr>
<tr>
<td>18</td>
<td>UNAZA V – 4</td>
<td>1,450</td>
<td>15.00</td>
<td>1.436</td>
</tr>
<tr>
<td>19</td>
<td>UNAZA V – 5</td>
<td>3,250</td>
<td>15.00</td>
<td>1.912</td>
</tr>
<tr>
<td>20</td>
<td>UNAZA V – 6</td>
<td>550</td>
<td>15.00</td>
<td>1.279</td>
</tr>
<tr>
<td>21</td>
<td>Rrugjet paralele rr. Durreci – rr. Kavaje</td>
<td>2.120</td>
<td>2 x 11.50</td>
<td>1.556</td>
</tr>
<tr>
<td>22</td>
<td>Unaza e Jashtme seg. Durresit – Don Bosco</td>
<td>1.750</td>
<td>2 x 11.50</td>
<td>2.526</td>
</tr>
<tr>
<td>23</td>
<td>Unaza e Jashtme seg. Don Bosco – 5 Maji</td>
<td>1.770</td>
<td>2 x 11.50</td>
<td>3.469</td>
</tr>
<tr>
<td>24</td>
<td>Unaza e Jashtme seg. 5 Maji – M. Keta</td>
<td>1.650</td>
<td>2 x 11.50</td>
<td>2.679</td>
</tr>
<tr>
<td>25</td>
<td>Unaza e Jashtme seg. M. Keta - IKV</td>
<td>1.000</td>
<td>2 x 11.50</td>
<td>2.702</td>
</tr>
<tr>
<td>26</td>
<td>Unaza e Jashtme seg. IKV - Shkoze</td>
<td>1.250</td>
<td>2 x 11.50</td>
<td>2.554</td>
</tr>
<tr>
<td>27</td>
<td>Unaza e Jashtme seg. Shkoze – Kthes.Senat</td>
<td>2.700</td>
<td>2 x 8.00</td>
<td>1.480</td>
</tr>
<tr>
<td>28</td>
<td>Unaza e Jashtme seg. Kthes.Senat – Hotel Balkan</td>
<td>2.860</td>
<td>2 x 8.00</td>
<td>1.545</td>
</tr>
<tr>
<td>29</td>
<td>Unaza e Jashtme seg. Hotel Balkan – Rr. Kavajes</td>
<td>3.060</td>
<td>2 x 11.50</td>
<td>1.846</td>
</tr>
<tr>
<td>30</td>
<td>Bul. Zhan D’Ark seg. Materniteti I ri-Shkoze</td>
<td>1,090</td>
<td>11.50</td>
<td>1.309</td>
</tr>
<tr>
<td>31</td>
<td>Bul. Bajram Curri seg. Materniteti I ri-Shkoze</td>
<td>1,090</td>
<td>11.50</td>
<td>1.309</td>
</tr>
<tr>
<td>32</td>
<td>Rr. Grameno seg. Tregu Elektrik – Pularia Shkoze</td>
<td>1,620</td>
<td>11.50</td>
<td>1.522</td>
</tr>
<tr>
<td>33</td>
<td>Rr. Don Bosco seg. Mine Peza – Unaza e Jashtme</td>
<td>1,722</td>
<td>15.00</td>
<td>1.796</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Length</td>
<td>Width</td>
<td>Height</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>34</td>
<td>Rr. e re ne krah te Pl. Kongreseve</td>
<td>205</td>
<td>9.00</td>
<td>0.740</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>41,721.00</td>
<td></td>
<td>1.885</td>
</tr>
</tbody>
</table>

Table 4.2. Length and width of Strategy A Road Investment Projects
(Source: Municipality of Tirana, Road Department)
Annex 5: Existing Tirana City Bus lines

PARAMETRAT TEKNIK DHE TEKNOLOGJIK QË DUHEN TË RESPEKTOHEN NGA SHËRBIMI TRANSPORTIT QYTETES

| Nr. | EMERTESA E LINJES | stacionet e qendrimit | Dist. plotë linjës (km.) | Koha e plotë e ciklit (min.) | Frek.lëvizjes autobuze (min.) | Autobuze per linje (copë) | Nr.rug. që nevoji kryhen | AUTOBUZAT | në ditë/autob | në dité total | Nr. vendëve Total | ulur këmb |
|-----|------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| 1   | Komb.-Kinos.     | 19                | 8.7            | 80             | 3                | 30              | 10             | 250            | 100            | 40            | 60            | 150            | 100     |
| 2   | Unaza            | 23                | 7.4            | 40             | 2                | 45              | 14             | 500            | 100            | 40            | 60            | 150            | 100     |
| 3   | Stac.Tren.Tr.Re  | 21                | 7.5            | 40             | 3                | 28              | 12             | 250            | 100            | 40            | 60            | 150            | 100     |
| 4   | Kambëz          | 14                | 7              | 70             | 3                | 22              | 10             | 150            | 100            | 40            | 60            | 150            | 100     |
| 5   | Laprak           | 6                 | 3.2            | 30             | 4                | 7               | 20             | 110            | 100            | 40            | 60            | 150            | 100     |
| 6   | Komb. Autotra.  | 17                | 6              | 55             | 4                | 13              | 14             | 100            | 100            | 40            | 60            | 150            | 100     |
| 7   | Porcelan        | 9                 | 3.5            | 35             | 4                | 10              | 20             | 150            | 100            | 40            | 60            | 150            | 100     |
| 8   | Sauk             | 8                 | 4.5            | 42             | 5, 10, 30        | 15              | 10             | 150            | 60             | 20            | 40            | 150            | 60      |
| 9   | Tufin            | 12                | 5.2            | 50             | 5                | 9               | 10             | 80             | 100            | 40            | 60            | 150            | 100     |
| 10  | Uzina Dinamo    | 18                | 8.9            | 82             | 5                | 16              | 10             | 150            | 100            | 40            | 60            | 150            | 100     |
| 11  | Mihal Grameno   | 8                 | 6              | 55             | 5                | 10              | 10             | 80             | 60             | 20            | 40            | 150            | 60      |
| 12  | Liqeni Artificial | 5               | 3              | 30             | 5                | 6               | 20             | 100            | 60             | 20            | 40            | 150            | 60      |

(Source: Municipality of Tirana, Transport Department)
Annex 6  Passengers on the different bus lines of Tirana
(Entering passengers at the different bus stops)
## Annex 7: Year 2006 bus passengers and bus vehicles on major corridors in Tirana

### PASSENGERS AND VEHICLES FLOW

<table>
<thead>
<tr>
<th>NAME OF STREET</th>
<th>CITY BUS LINE</th>
<th>FREQUENCY</th>
<th>Passengers for half cycles</th>
<th>Buses/hour Approximately</th>
<th>TOTAL passengers / hour per direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DURRESI</strong></td>
<td>Qëndër - Institut</td>
<td>5 min</td>
<td>80</td>
<td>10</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>Qëndër - Kamëz</td>
<td>5 min</td>
<td>100</td>
<td>9</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>Qëndër-Laprakë</td>
<td>5 min</td>
<td>100</td>
<td>10</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Qëndër-Vorë</td>
<td>5 min</td>
<td>40</td>
<td>4</td>
<td>160</td>
</tr>
<tr>
<td><strong>INFORMAL TRANSPORT</strong></td>
<td>Qëndër-Instit. Informal buses</td>
<td>30 min</td>
<td>50</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Zogu i Zi - Institut. Informal minibuses</td>
<td>5 min</td>
<td>30</td>
<td>30</td>
<td>300</td>
</tr>
<tr>
<td><strong>INTERCITY BUSES</strong></td>
<td>Zogui zi - Rrethet</td>
<td>5 min</td>
<td>30</td>
<td>20</td>
<td>600</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3850</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAME OF STREET</th>
<th>CITY BUS LINE</th>
<th>FREQUENCY</th>
<th>Passengers for half cycles</th>
<th>Buses/hour Approximately</th>
<th>TOTAL passengers / hour per direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KAVAJA</strong></td>
<td>Kombinat. - Qëndër</td>
<td>3 min</td>
<td>100</td>
<td>15</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td>Qëndër - Kinostudio</td>
<td>3 min</td>
<td>80</td>
<td>15</td>
<td>1200</td>
</tr>
<tr>
<td><strong>PRIVATE ENTERPRICE</strong></td>
<td>Komb.- Qëndër</td>
<td>3 min</td>
<td>80</td>
<td>15</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>Qëndër-&quot;Sh.Usht&quot;</td>
<td>5 min</td>
<td>60</td>
<td>10</td>
<td>600</td>
</tr>
<tr>
<td><strong>INTERCITY BUSES</strong></td>
<td>Nga Rrethet</td>
<td>5 min</td>
<td>30</td>
<td>12</td>
<td>360</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4860</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAME OF STREET</th>
<th>CITY BUS LINE</th>
<th>FREQUENCY</th>
<th>Passengers for half cycles</th>
<th>Buses/hour Approximately</th>
<th>TOTAL passengers / hour (both directions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle ring road</td>
<td>UNAZA LINE (both directions)</td>
<td>2 min</td>
<td>110</td>
<td>40</td>
<td>4400</td>
</tr>
<tr>
<td>Bul. Bajram Curri / Bulevardi Zhahane D'Arc</td>
<td>Deshmoret e Tirana e re- line</td>
<td>4 min</td>
<td>150</td>
<td>16</td>
<td>2400</td>
</tr>
</tbody>
</table>

(Source: Municipality of Tirana, Transport Department)

Cost calculation for Bus Rapid Transit in Tirana (Phase 1)

<table>
<thead>
<tr>
<th>Phase 1 (Corridors A, B and C)</th>
<th>Number of units</th>
<th>Cost per unit (EURO)</th>
<th>Total costs (million EURO)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Kavajes Corridor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Busway</td>
<td>8 km</td>
<td>1.0 mill/km</td>
<td>8.00</td>
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<tr>
<td>Busway overpass at Lana River</td>
<td>1</td>
<td>2.8 mill</td>
<td>2.80</td>
</tr>
<tr>
<td>Bus terminals at Kombinat and Myslym Keta</td>
<td>2</td>
<td>3.0 mill</td>
<td>6.00</td>
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<tr>
<td>Bus stations</td>
<td>15</td>
<td>0.3 mill/station</td>
<td>4.50</td>
</tr>
<tr>
<td>Green light phase extension for BRT at intersections</td>
<td>3</td>
<td>0.2 mill/intersection</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Subtotal corridor A</strong></td>
<td></td>
<td></td>
<td><strong>21.90</strong></td>
</tr>
<tr>
<td><strong>B Durres Corridor</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Busway</td>
<td>8.1 km</td>
<td>1.0 mill/km</td>
<td>8.10</td>
</tr>
<tr>
<td>Busway overpass at Kamez/Durres Rd. and Vangjel Hote</td>
<td>2</td>
<td>2.8 mill</td>
<td>5.60</td>
</tr>
<tr>
<td>Bus terminals at Kamez and Lana River</td>
<td>2</td>
<td>3.0 mill</td>
<td>6.00</td>
</tr>
<tr>
<td>Bus stations</td>
<td>16</td>
<td>0.3 mill/station</td>
<td>4.80</td>
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<tr>
<td>Intersection restructuring and green light phase extension for BRT</td>
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<td>0.40</td>
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<tr>
<td>Restructuring Sheshi Skanderbey</td>
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<td><strong>C Bulevardi Corridor</strong></td>
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<tr>
<td>Busway</td>
<td>4.5 km</td>
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<tr>
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<td>Bus depot</td>
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<td>Fare collection</td>
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<tr>
<td>- Token-based fare collection readers</td>
<td>2/station</td>
<td>1.500 /reader</td>
<td>0.15</td>
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<tr>
<td></td>
<td>5/terminal</td>
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<td></td>
</tr>
<tr>
<td>- Magnetic-strip based fare collection readers</td>
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<td>7.000 /reader</td>
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<tr>
<td></td>
<td>5/terminal</td>
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<tr>
<td>- Rotating turnstiles</td>
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<td></td>
<td>10/terminal</td>
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<tr>
<td>- Vending machines</td>
<td>2/station</td>
<td>7.000 /turnstile</td>
<td>1.43</td>
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<td></td>
<td>10/terminal</td>
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<td>- Token-based fare system software</td>
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<tr>
<td></td>
<td>0.1 mill/softw.</td>
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<td>- Magnetic strip fare system software</td>
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<td>0.3 mill/softw.</td>
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</tr>
<tr>
<td>Control Center (radio-based, equipment and software)</td>
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<td>0.1 mill/center</td>
<td>0.10</td>
</tr>
<tr>
<td>Information</td>
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<tr>
<td>- Maps at stations, terminals and in buses</td>
<td>50</td>
<td>6.000 /station</td>
<td>0.30</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>5</td>
<td>30.000 /kiosk</td>
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<tr>
<td>- Information kiosks in town and terminals</td>
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<td>Subtotal General expenses</td>
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<td>Overall Total Phase 1</td>
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# Cost calculation for Bus Rapid Transit in Tirana (Phase 2)

## Phase 2: (Corridors D and E)

### D Inner Ring Road Corridor

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Busway</td>
<td>4.3 km</td>
<td>1.0 million/km</td>
<td>4.30</td>
</tr>
<tr>
<td>Bus stations</td>
<td>10</td>
<td>0.3 million/station</td>
<td>3.00</td>
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<tr>
<td>Busway overpass at Sheshi Karl Topia</td>
<td>1</td>
<td>2.8 million/overp.</td>
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<td><strong>Subtotal corridor D</strong></td>
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### E North-South Corridor

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<thead>
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</thead>
<tbody>
<tr>
<td>Busway</td>
<td>4.0 km</td>
<td>1.0 million/km</td>
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</tr>
<tr>
<td>Bus stations</td>
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<td>0.3 million/station</td>
<td>3.00</td>
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<tr>
<td>Busterminal at Pakuqani</td>
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<td>3.0 million</td>
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<td><strong>Subtotal corridor E</strong></td>
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## General expenses

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Bus depot</td>
<td>0</td>
<td>5.0 million/depot</td>
<td>0.00</td>
</tr>
<tr>
<td>Fare collection</td>
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</tr>
<tr>
<td>- Token-based fare collection readers</td>
<td>2/station</td>
<td>1.5 million/reader</td>
<td>0.07</td>
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<tr>
<td>- Magnetic-strip based fare collection readers</td>
<td>5/terminal</td>
<td>7 million/reader</td>
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<td>- Rotating turnstiles</td>
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<td>7 million/turnstile</td>
<td>0.63</td>
</tr>
<tr>
<td>- Vending machines</td>
<td>10/terminal</td>
<td>10 million/machine</td>
<td>0.50</td>
</tr>
<tr>
<td>- Token-based fare system software</td>
<td>0</td>
<td>0.2 million/softw.</td>
<td>0.00</td>
</tr>
<tr>
<td>- Magnetic strip fare system software</td>
<td>0</td>
<td>0.3 million/softw.</td>
<td>0.00</td>
</tr>
<tr>
<td>Control Center (radio-based, equipment and software)</td>
<td>0</td>
<td>0.1 million/center</td>
<td>0.00</td>
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<tr>
<td>Information</td>
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</tr>
<tr>
<td>- Maps at stations, terminals and in buses</td>
<td>20</td>
<td>6 million/station</td>
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<tr>
<td>- Information kiosks in town and terminals</td>
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<td><strong>Subtotal General expenses</strong></td>
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<p>| | | | |</p>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Subtotal</strong></td>
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<tr>
<td>Contingency</td>
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<td>Contingency</td>
<td><strong>2.18</strong></td>
</tr>
</tbody>
</table>

**Total Phase 2**

**23.85**

**Property acquisition (if necessary)**

? **Overall Total Phase 2**