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INTRODUCTION

The metropolitan area of Beirut, usually referred to as Greater Beirut Area (GBA) is the core of the service-based economy of Lebanon with one third of the population and contributes in excess of two thirds of the total value added in the economy. The city and its metropolitan area, however, suffer severe traffic congestion, a result of an extremely deficient transportation system. This implies high economic losses and deteriorating air quality. As sustained growth of the service-oriented economy is underpinned by efficient infrastructure, Beirut needs to improve the operational and economic efficiency of its urban transport system.

In its heyday, Beirut had an extensive urban transport system including a well-developed bus system and even a trolley-bus system. Due to the prolonged period of conflict this infrastructure deteriorated. Also, over the last two decades major changes have occurred in Lebanon’s demography due to urbanization and displacement of residents from the South and relocation of businesses from Beirut to various locations along the coast. These have resulted in important changes in traffic patterns throughout the Greater Beirut Area (GBA), which, in turn, generates severe congestion both in and around Beirut and particularly at the connections with the coastal highway to the north and south. The problem of congestion is exacerbated by a heavy reliance on the use of private cars, which amounts to approximately 300,000 cars for a population of some 1.2 million in the GBA (about 250 cars per 1000 inhabitants). Over 70 percent of total motorized person trips, more than half of which are home-to-work, are made by private car. Shared taxis account for nearly 20 percent of all trips, while just 10 percent of the population is served by privately and publicly operated bus services. In addition, latent travel demand is high and would materialize with improving supply of transport capacity.

For Beirut to develop as a competitive regional center for finance, trade, services and tourism, it should have an efficient transport system. To this end, the Government prepared a comprehensive Greater Beirut Area Transportation Plan (GBATP) which addresses the most serious urban transport issues, analyzes needed investments through the year 2015, and recommends a large phased investment program. The prioritization and phasing of this program, which will be the largest single investment need in Lebanon over the next ten years, will require a significant planning, consensus building, and resource mobilization effort.

The Beirut Urban Transport Project (BUTP) is an element of the GBATP. Other projects are anticipated to be implemented to address the issues related to public transportation as described below in the GBATP background and summary section. The BUTP has been proposed to provide the fundamental urban transport apparatus needed to address part of the extremely diverse and complex transport issues the city faces. The project consists of establishing a traffic management organization; constructing of grade separations at highly congested intersections; and parking provision and controls.

Financial support for the proposed project is being sought through a loan from the World Bank. Loan provisions dictate the preparation of an environmental assessment for the project. The present report (Volume 2) contains the technical appendices that are an integral part of the overall Environmental Assessment report (Volume 1).
GBATP BACKGROUND AND SUMMARY

Seventeen years of war sustained by Lebanon has had grave negative consequences on the economic frame of the country: destruction of buildings and infrastructure networks, accumulated delay of public investments, and lack of town planning control.

In the absence of public transport, which nearly disappeared during the war, private cars and taxi services provide today the (quasi) only traveling means for Beirut inhabitants. The road network is congested by bottlenecks that can paralyze some vital thoroughfares of the city for hours. Chaotic parking in central areas reduces the capacity of the street network and makes pedestrian trips especially onerous. For Greater Beirut inhabitants, traveling in the city is a costly experience in time as well as money. Bad traffic conditions form a stumbling hurdle against developing interaction and they seriously handicap the restarting of the economy.

Urgent measures should be taken to reestablish acceptable traffic conditions in Beirut in order not to annihilate the first benefits of the reconstruction works. They should be completed by a long-term policy that will enable Greater Beirut to meet future needs.

Greater Beirut in 1994

Collecting recent and reliable data about Greater Beirut population and urban economy is a prerequisite task of any planning activity. Preparation of the transportation plan has necessitated the execution of numerous surveys of traffic, trips, and land use in the Metropolitan Region. A large-scale socio-economic survey has thus been carried out, comprising a sample of 4300 households.

The study area included the territories spreading from Nahr El Damour to the South to Nahr el Kalb to the North, below an average 400 m altitude. It covers 23 000 ha. The GBA was populated by 1,165,00 inhabitants in 1994, with some 400,000 of them within Municipal Beirut. Due to the destruction of Beirut Downtown and to war years insecurity, new business and commercial centers have developed outside the City, and suburban areas have been intensely urbanized.

Few and Polarized Trips

With 1,500,000 motorized person trips executed every day in Greater Beirut area (900,000 of which by inhabitants of the Region), Greater Beirut is a metropolitan area where people did not travel much in 1994 (0.79 daily motorized trips per inhabitant of Beirut City compared to 1.21 twenty five years earlier), and mainly for work (55% are work trips). Car ownership in Greater Beirut is quite high reaching 250 per 1000 population, resulting in a strong reliance on the automobile. Less than 1% of the trips were served in 1994 by the Public Transport Company. Automobile use is prominent, with 90% share of the total trips (71% for private cars and 19% for taxi-services). Traffic volumes along a number of road axes are very high, reaching 200,000 per day.
AN IMMEDIATE ACTION PLAN (IAP) TO RESPOND TO URGENT NEEDS

The emergency measures proposed in the Immediate Action Plan (IAP) aim at restoring tolerable traffic conditions in Greater Beirut Area without additional costly infrastructure works nor extra right-of-way.

The First Fold: Traffic System Management

Greater Beirut road network suffers from many insufficiencies: lack of network hierarchy, traffic lanes invaded by chaotic parking and intersections without signals. If better managed, the network can cope with much higher traffic volumes than it accommodates today.

The methodology used to prepare the Immediate Action Plan has relied on a functional analysis of the network and on a set of network simulations allowing the testing of various alternatives. It has led to optimum network utilization ensuring the best efficient use of the existing network.

Emergency measures are concentrated on a limited number of corridors that accommodate the main part of the traffic. The basic network candidate for traffic management measures is 200 Km long (107 Km in Municipal Beirut, 93 Km in suburbs). A clear hierarchy will be established among the various streets according to their role (through traffic versus local access). The circulation plan will be reviewed to increase network capacity.

The main intersections of the built-up area will be signal controlled. Parking will be prohibited along a number of major axes and systematically banned in the vicinity of intersections. A signing plan will guide drivers and facilitate traffic management. Spot improvements (grade-separations for instance) will be executed on a limited number of intersections whose level-of-service cannot be sufficiently improved relying on less drastic measures.

The investment cost of the traffic management scheme proposed in the IAP reaches about US$ 20 million.

Proposed traffic improvement measures integrate the proposals made for restructuring the bus network. Bus Transport will directly benefit from the new street organization.

A large public information campaign will be launched, since an active participation of users is one of the main conditions to make the Immediate Action Plan a success. It will be followed, by strict enforcement of the traffic code.

The present scattering of responsibilities is a serious handicap to successful implementation of an overall traffic policy. A close coordination of responsible governmental and municipal departments will have to be ensured. Municipal technical departments in charge of traffic management will be established.
The Second Fold: Restarting A Public Transport System

Traffic improvement in Greater Beirut Area cannot be obtained without setting up an efficient public transport system. Many users have no cars, and taxi-services cannot answer mass transit needs. Reliance on the automobile solely will progressively increase congestion.

The transport supply provided by the Public Transport Company (OCFTC) was reduced in 1994 to nearly nothing. Many buses have been damaged during the war and a part of the depots are the same. Only 25 buses carrying every day less than 20,000 passengers were operating in 1994. A number of privately operated buses provided transport services, but without any coordinated planning or any system coherence.

More expensive and a source of permanent congestion due to their anarchical and uncontrolled operation, taxi services (traditional jitney service in Beirut) have quickly grown in number. They provide the main supply for public transport. Captive users of public transport are today confronted with a quite restricted transport supply and this can partially explain the low level trips per person observed in Greater Beirut.

Restarting a modern mass transit system necessitates institutional and technical measures:

Only a Metropolitan Transport Authority is able to plan, organize, and control a public transport system: Selecting the lines to serve, the level of service to ensure, and the operators. Controlling the quality of service is undoubtedly under the responsibility of public authorities, and a specialized body should be instituted to assume this role. Conversely, network operation itself should be largely open to competition. But this is not contradictory with the maintaining and the upgrading of a public transport company. The target should be to provide users with a good service at the lowest cost.

Future public transport network should be designed as a coherent system including trunk bus lines (13 of which are proposed in the Immediate Action Plan along the heaviest demand corridors), complementary feeder bus lines and taxi services lines. Taxi-services will continue to play an important role in the short-term to meet transport needs, but they should be strictly organized and controlled (stations and lines).

The implementation action of a trunk bus network in Greater Beirut will necessitate purchase of about 400 buses, to equip 3 depot-garages and to set up complementary facilities. The total investment cost of this program has been estimated at US$ 100 million, with an estimated annual patronage of 80 million passengers.
A LONG TERM PLAN TO ANSWER FUTURE NEEDS

Challenges of the Future

Beirut revival as a large international metropolis necessitates to plan a transportation system well suited to this ambition. In 2015 (retained study horizon) Greater Beirut will be populated with about 2 million inhabitants who will enjoy an income level and a vehicle ownership rate much higher than today. Beirut Central District (BCD) would have been rebuilt and it would have recovered its former role of largest service and business center of Greater Beirut Area. Other secondary centers would have been developed in the outskirts of Beirut, allowing to reorganize and restructure Beirut suburbs.

The division of the city into two parts would have disappeared. Exchanges would have been re-established with all neighboring countries, creating intense goods and people flows.

Trips by Greater Beirut residents shall grow by more than twice during the next 20 years and reach an average value of 1.75 daily motorized trips per person in 2015. Combining all these trends, trip demand should reach nearly 5 million daily motorized person trips in Greater Beirut by 2015, that is more than 3 times the present value.

Options for the Future

Facing the huge future needs, Greater Beirut possesses a number of characteristics liable to orient decisions regarding transport systems, notably the choice between road and mass transit.

- Beirut urban agglomeration is very dense in the city itself, as well as in its suburbs. Residential densities exceed 500 inhabitants/ha in some neighborhoods. This high density may present difficulties in searching for road alignments and liberating the necessary right-of-way, but it also satisfies a prerequisite for setting up a rapid mass transit system.

- Greater Beirut area owns an urban and natural heritage comparable to that of many large world cities. Mountains are at the door of the built up area. Network alignments would have to integrate this constraint and be respectful to the environment.

Two Contrasted Scenarios

In order to highlight possible network structure alternatives and assess their performance, two contrasted scenarios have been constructed, the first privileges road network development, the second integrates the construction of a rapid mass transit system in dense areas.

These scenarios have been tested and operation simulations have been carried out, highlighting peak hour traffic on road network, load on mass transit lines, and average access time by each to the poles of the Metropolitan Region. Construction cost of proposed networks has been estimated. An optimal scenario has been defined, based on both technical and financial considerations, in a manner which allows to maximize the respective advantages of the two tested scenarios.

Mass Transit, a Necessity of the Future

Computer simulations demonstrate that, in the absence of a modern mass transit system, meeting future needs will remain an illusion. Devoted to serve the dense areas of the Metropolitan Region, in the first place, a rapid mass transit network is necessary to solve future trip problems of Greater Beirut Area.
LONG TERM MASS TRANSIT NETWORK

Targets
The long term mass transit network should provide all inhabitants of the dense agglomeration with a mass transit line on its own right-of-way less than 1 Km from home. It will thus supply an attractive alternative to the automobile, and public transport will ensure an easy access to the large development poles of this area (BCD, Airport). The proposed network should enable mass transit (taxi services excluded) to capture about 26% of total daily motorized trip market.

Components
The long term mass transit network include:

- A regional commuter service line that will use the rehabilitated railway line Saida-Beirut Tripoli, from Damour to Jounieh (38 Km).
- Two modern metro lines ensuring the basic backbone of mass transit, servicing the interior of the dense Beirut urban agglomeration.
  - an East-West line (MA) linking Ras Beirut to NBT station, via Hamra and BCD, and extended to the South (Hazmieh) and to the East (Nahr El Mott). It will be 17 Km long.
  - a North-South line (MB) from the Lebanese University and Airport to St. Michel Terminal (15KM), via south suburbs and BCD.
- Three bus lines on their own right-of-way ensuring the secondary servicing of the urban agglomeration and totaling 28 Km.
- A complementary bus network.
- Multimodal exchange stations located along the boundaries of the urban agglomeration, close to the Beirut Peripherique Boulevard (Nahr El Mott, Laylake).

With all its components fully integrated with each other and the street network, future mass transit network would allow to carry nearly 500 million passengers per year, with line loads compatible with the selected technologies (15,000 passengers per direction at peak hour on metro lines for instance). Mass transit investment cost has been estimated at US$ 2.5 billion, with US$ 1.7 billion of which for the two metro lines.

Implementing such a network over a 20-year period, will necessitate both an institutional reorganization (strengthening of the Metropolitan Transport Authority proposed in the Immediate Action Plan) and resort to new financing sources. The private sector could notably be invited to participate in the building and operation of the metropolitan network, as practiced in many large world metropolises.
LONG TERM ROAD NETWORK

Targets
Complementary to mass transit, the long-term road network has three main targets:

- ensure the connection between Greater Beirut and its national and international surroundings
- open up and improve the Beirut suburbs
- serve the large development poles of Greater Beirut Area (BCD, Airport, Port...)

Components
The long term road network is a hierarchical and meshed network composed of motorway, expressways and urban boulevards. It is organized around a major axis: Beirut Peripherique Boulevard (BPB). The basic future road network is 248 Km long. It includes:

- Boulevard Peripherique, located along the limits of the urban agglomeration, extending from Khalde to Antelias (18 Km)
- Five long distance motorways linking Beirut to the rest of the country: two to the North (A1, A2), one to the east (Damascus Motorway), two to the South, existing coastal motorway (A3) and a new mountain highway linking Choueiflate to Damour.
- Seven urban penetrators ensuring the primary linking of the urban agglomeration with BPB
- A network of expressways (23 Km) and urban boulevards (122 Km) ensuring the secondary servicing of Greater Beirut area.

Half of the proposed road network is composed of already existing roads or an upgrade of existing ones, while the other half includes entirely new roads whose right-of-way was previously reserved in most other cases.

The investment cost of the long-term road network has been evaluated at US$ 4 billion, 75% of which will be devoted to motorways. Land expropriation will be quite costly: it will represent more than half of the total cost of the program.

The Parking Master Plan
The current parking conditions in most parts of GBA, and especially in Municipal Beirut, are over congested. This over congestion of parking is the main reason for traffic problems, and has downgraded the quality of urban life. The current parking space deficit is estimated at 60,000.

The causes of this serious problem were diagnosed to include:

- Deficient urban panning and building code regulations.
- Absence of mass transit and heavy reliance on the automobile.
- Low cost of vehicle operation (including parking) perceived by users.
- Deficient enforcement

Various scenarios for dealing with the parking problem were considered, simulating various levels of tolerance to congestion and ability to pay for additional parking. The proposed master plan has a first short term target to reduce the level of parking congestion and a second longer term target of bringing the parking to a normal condition by the horizon of the study. To achieve these targets, the parking master plan proposes four types of intervention:

- Organizing on-street parking, timing the use and making it for-a-fee in business areas
- Building dedicated parking structures at specified locations
- Encouraging providing public parking as part of new buildings
- Applying stricter parking requirements for all buildings and especially for commercial and office uses.

The parking Master Plan is a long term coordinated effort with well-defined roles for the state and the private sector. The enabling role of government is essential and when properly exercised will turn over the financing and cost recovery responsibilities entirely to the private sector.