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Cairo Traffic Congestion Study

Executive Summary

May 2014

Acknowledgments

This study was undertaken by a World Bank team led by Ziad Nakat (Senior Transport Specialist) and including Santiago Herrera (Lead Economist) and Yassine Cherkaoui (Infrastructure Specialist), and it was executed by Ecorys in collaboration with Sets and Cambridge Systematics.

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Executive Report

I. INTRODUCTION

The Greater Cairo Metropolitan Area (GCMA), with more than 19 million inhabitants, is host to more than one-fifth of Egypt's population. The GCMA is also an important contributor to the Egyptian economy in terms of GDP and jobs. The population of the GCMA is expected to further increase to 24 million by 2027, and correspondingly its importance to the economy will also increase.

Traffic congestion is a serious problem in the GCMA with large and adverse effects on both the quality of life and the economy. In addition to the time wasted standing still in traffic, time that could be put to more productive uses, congestion results in unnecessary fuel consumption, causes additional wear and tear on vehicles, increases harmful emissions lowering air quality, increases the costs of transport for business, and makes the GCMA an unattractive location for businesses and industry. These adverse effects have very real and large monetary and nonmonetary costs not only for the economy of the GCMA, but given its size, for the economy of Egypt as well. As the population of the GCMA continues to increase, traffic congestion is becoming worse and the need to address this congestion is becoming more urgent.

In recognition of the seriousness of the problem of traffic congestion, and upon the request of Government, primarily the Ministries of Finance, Transport, Housing, and Interior, the World Bank funded an investigation into its magnitude, causes, and potential solutions in the GCMA. This report documents the results of the study. The results of this study should be of interest to policy-makers and practitioners in the GCMA, the Egyptian Government, other cities facing similar problems, and international financial institutions.

Objectives and Scope

This study was intended to conduct a macro-level investigation of congestion in the GCMA: its magnitude, causes, and potential solutions. Specifically, the objectives of this study were to:

- Identify the causes of congestion in the GCMA;
- Estimate the costs of congestion;
- Analyze the performance of policy options designed to address congestion in the GCMA; and
- Develop policy packages (combination of policy options).

In order to deliver on the abovementioned objectives, the findings of this report are organized under three main sections :

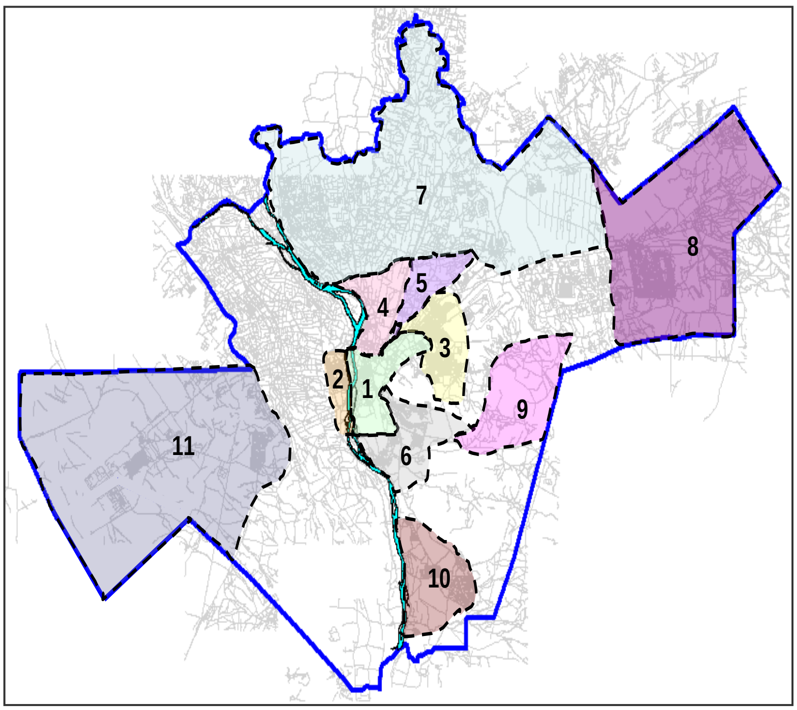
1. Data analysis and causes of congestion in GCMA;
2. The current and projected economic costs of congestion;
3. Policy options and recommendations.

II. DATA ANALYSIS AND CAUSES OF CONGESTION IN GCMA

The Study Area

The GCMA includes the governorates of Cairo, Giza, and Qalyobiyain, in addition to the new cities of New Cairo City, 6th of October City, 15th May City, 10th of Ramadan City, El-Obour City, and Badr City. It is consistent with the study area defined by the Greater Cairo Urban Transport Master Plan (CREATS) funded by the Japan International Cooperation Agency (JICA) (see Figure ES.1).

Figure ES. 1: GCMA Major Districts



1. Central Cairo
2. Central Giza
3. Heliopolis/Nasr City
4. Shoubra/Shoubra El Kheima
5. Mataryia
6. Maadi/Qatamiya Road
7. Shibin El Qanater/ El Obour
8. 10th of Ramadan/Badr/El Shorook
9. New Cairo
10. Helwan/15th of May
11. 6th of October/El Sheikh Zayed

Source: JICA, CREATS, 2003.

Approach and Methodology for data collection

The GCMA covers a very large geographic area and includes many thousands of kilometers of different types of roads. It is obviously not possible to include the entire GCMA road network in this study. The results of this study, however, had to be valid for the entire GCMA. Thus, we needed a representative sample that could be used to extrapolate, with a reasonable margin of error, to the entire GCMA.

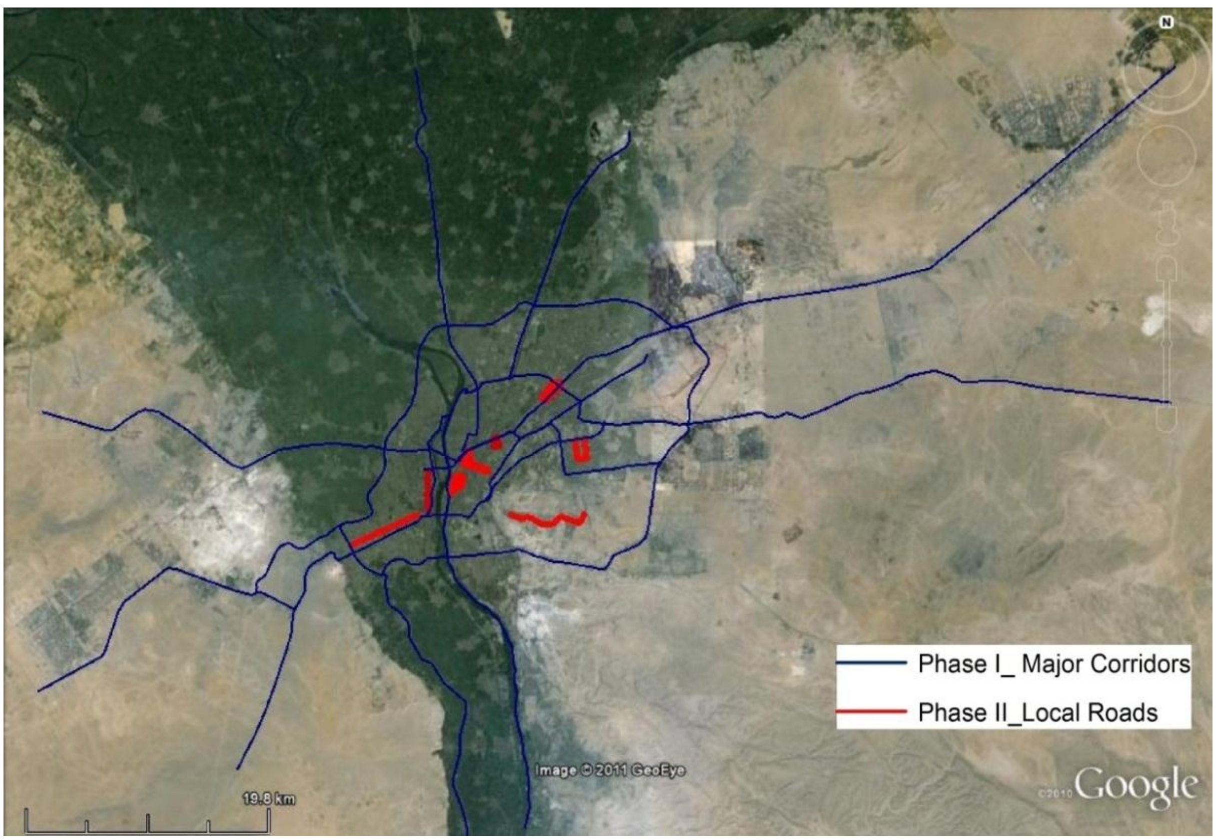
To create this representative sample of the different type of roads, we placed all streets into two broad categories: 1) major corridors and 2) surface streets. We further distinguished among four types of major corridors and three types of surface streets. We included roads to cover the four categories of major corridors and the three categories of surface streets (see Table ES.1).

Table ES. 1: Categories of Major Corridors and Surface Streets

Major Corridors	Surface Streets
1. Interurban Primary Arterial Highway	1. Urban Secondary Arterial
2. Regional Primary Arterial Highway	2. Collector/Distributor Street
3. Urban Expressway	3. Local Street
4. Urban Primary Arterial Street	

The sample route network included in the data collection exercise is shown in Figure ES.2. The network included in the study had a total length of 865 kilometers and 2,300 lane-kilometers (see page 19-22 in main report as well as its annex 1 for more details on the selected roads and classification). This sample of roads forms the basis for this study.

Figure ES. 2: Route Network with Major Corridors and Surface Streets



Two techniques were used for collecting the necessary data: 1) a floating car survey and 2) manual traffic counts. The floating car survey was conducted along the selected routes with a record being kept at five-minute intervals and manual traffic counts were carried out at 24 locations; 10 of these were classified traffic counts. Traffic count locations were selected along the floating car survey routes to allow for the validation of the volume and speed data collected from the floating car survey. Both the floating car survey and the traffic counts were carried out during peak periods between 7:00 a.m. to 11:00 a.m. and 3:00 p.m. to 7:00 p.m. The floating car survey was also conducted during the off-peak period from

5:00 a.m. to 6:00 a.m. This was necessary in order to obtain traffic speeds during "congestion-free times" in order to be able to estimate "free-flow" speeds.

In addition to traffic counts, *local experts and stakeholders* were involved and consulted during the course of the study to:

- Inform stakeholders about the purpose of the study and its progress;
- Gather input for developing a comprehensive list of policy measures;
- Carry out an initial screening of policy measures based on their potential effectiveness, and the feasibility of their being implemented in the GCMA;
- Understand local priorities; and
- Gather information that could be relevant for the conduct of the study.

The outreach campaign relied on interviews and discussion as well as email exchanges. The interviews were undertaken to help identify policy measures, assess the feasibility of their implementation in the GCMA, and any barriers that may exist to their implementation. Further, the interviews were focused on understanding the institutions, organization of and practices to the legal, policy, and regulatory framework for transport in the GCMA, i.e., transport planning, infrastructure development, management and financing, traffic management, enforcement and policing, relevant taxation and subsidies, and land use.

Current Traffic Situation in GCMA

Traffic volume are in the range of 3,000 to 7,000 veh/hr *per lane* on major corridors, with the 6th of October bridge and the Ring Road at Carrefour al Maadi witnessing some of the highest volumes (about 7,000 veh/hr per lane per direction for AM and PM peaks). For the surveyed local streets, volumes are in the range of 1,000 to 4,000 veh/hr per lane with the highest volumes observed on Al Dogi street and Gasr Al Suiz street.

In the GCMA **cars are, by far, the dominant mode of transport.** On both surface streets and on the major corridors, the bulk of the vehicles are private cars, and the share of private cars is higher on the major corridors than on surface streets. The next highest share is of taxis, followed by micro/mini buses (Figure ES.3 and Figure ES.4).

Given the dominance of the private car and taxis, it should come as no surprise that the GCMA is extremely congested[1]. **During peak periods, average speeds on sampled surface streets are between 6 to 25 kilometers per hour.** Also during the peak periods, **average speeds on the sampled major corridors, all of which are within the Ring Road, are between 20 to 45 kilometers per hour.**

Most speeds on corridors are in the range of 50 to 60 percent of free flow speeds (see Figure ES.5), while on local streets they could reach 20 to 30 percent (Figure ES. 6), meaning that many trips can take more than double the time. Lower speeds are particularly observed at the 15th of May bridge and Nasr Road, as

[1] Congestion, defined based on the Road Congestion Index (RCI) a well known measure of congestion developed and used by the Texas Transport Institute (TTI), implies that commute times are on average 25 percent longer than off-peak travel time, or when the average speeds are a lower than 80 percent of the free-flow speeds.

well as on Ramses street. Worse, this congestion is not just during the morning and evening peak periods, but **traffic conditions are congested for most of the day** (see Figure ES.7).

Finally, in part because of the extreme congestion, **road travel within the GCMA is a very unreliable affair; travel times between two points within the GCMA can vary a lot, sometimes by a factor of three**.

Figure ES. 3: Modal Split on Surface Streets

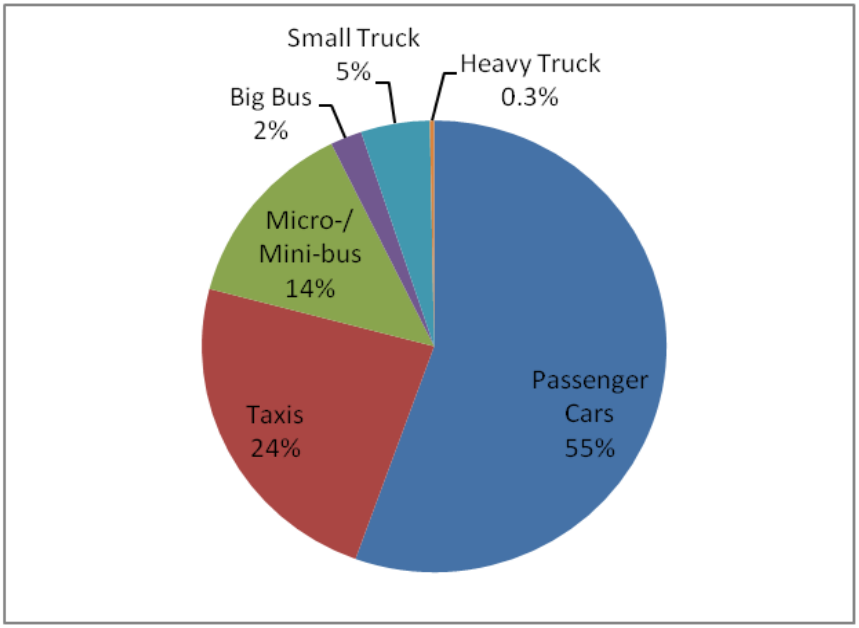


Figure ES. 4: Modal Split on Major Corridors

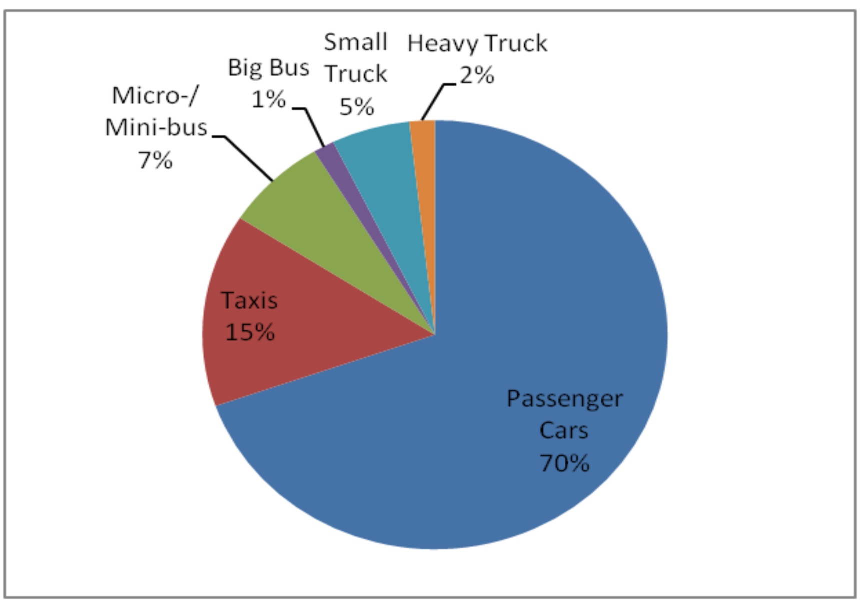


Figure ES. 5: Speed Index for Major Corridors for AM and PM Peak

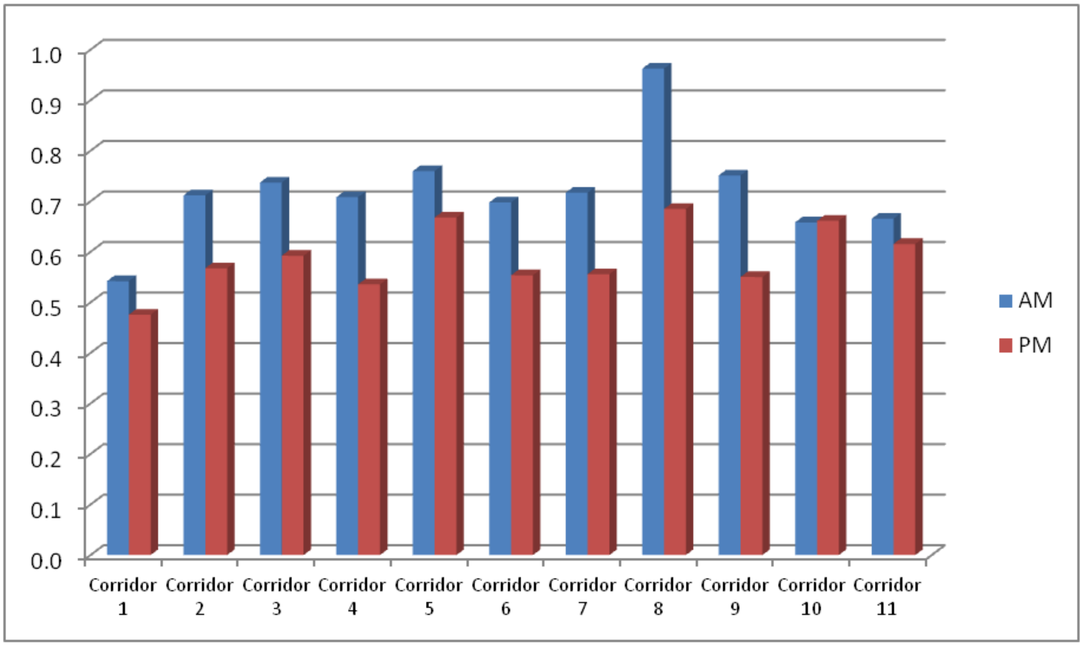


Figure ES. 6: Speed Index on Surface Streets

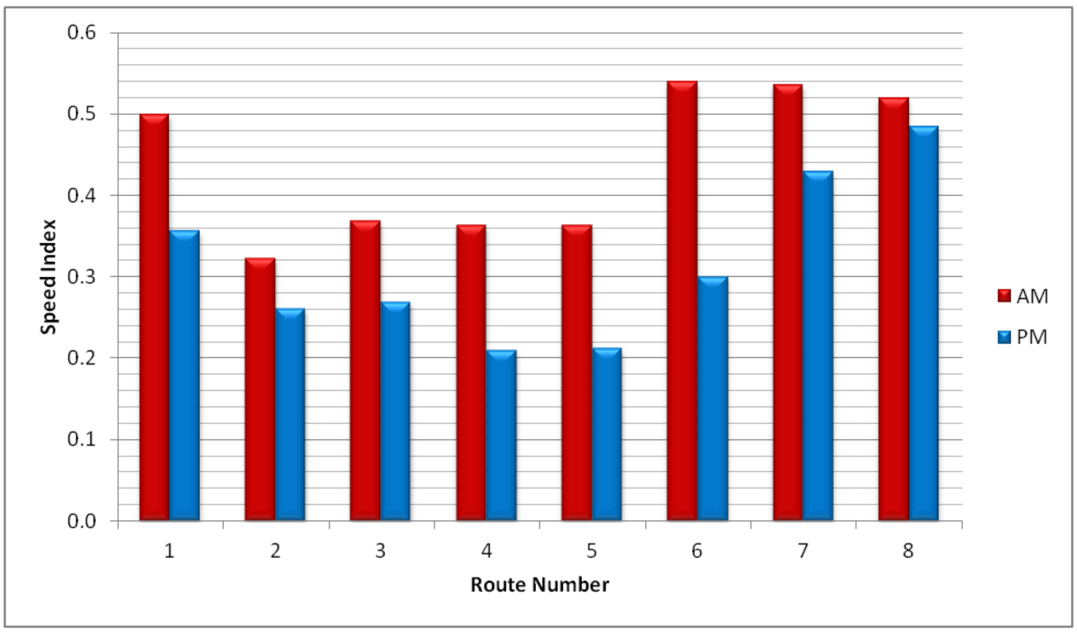
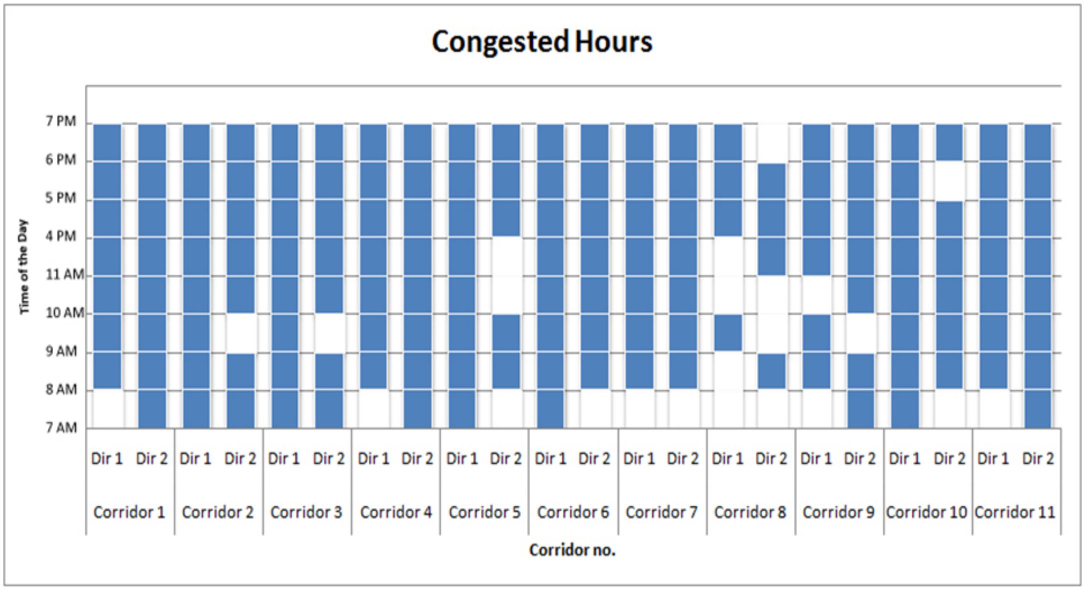


Figure ES. 7: Congestion during the Day on the Major Corridors



Causes of Congestion in GCMA

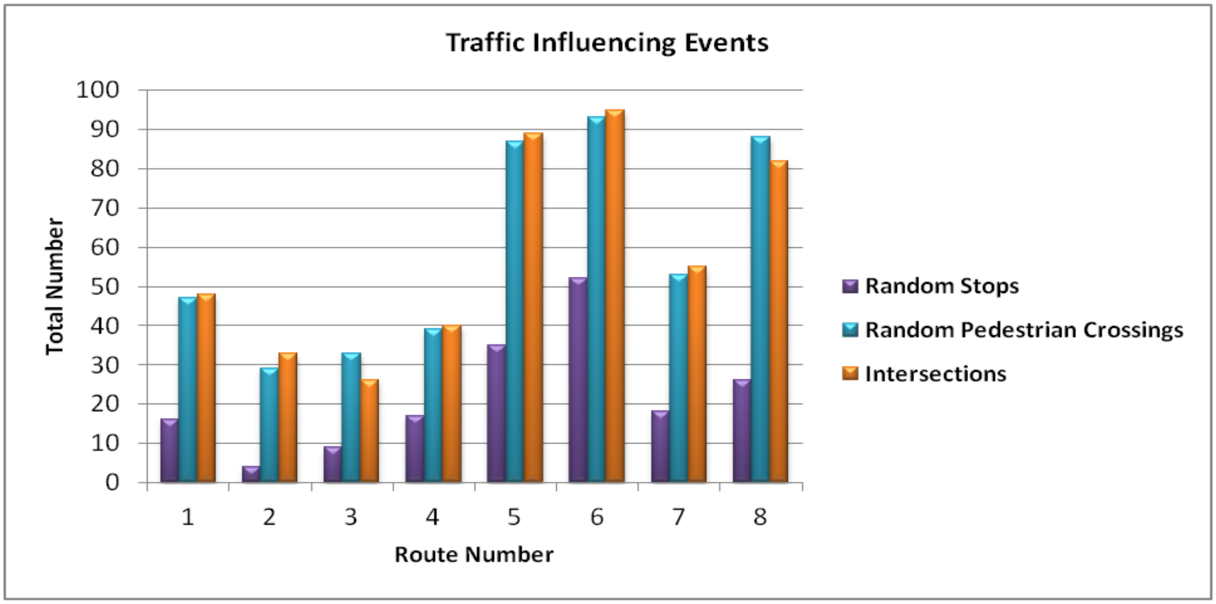
Poor Traffic Management: This is probably the most important cause of congestion: limited parking capacity, few traffic signals, random stops by cars and minivans, no proper pedestrian crossings and U-turns are examples of poor traffic management in GCMA. Table ES.2 lists the main traffic management challenges in Cairo. It should be noted that the causes of congestion on the major corridors and the surface streets are different: On the major corridors the most important causes of congestion are vehicle breakdowns, security checks, and accidents; mostly observed on the May 15th bridge and the Moneeb bridge. The most important causes of congestion on surface streets are U-turns at intersections, random stops of vehicles, and pedestrian crossings, and those were mostly observed on El Malek Faisal Street, Abbas Al Akkad Street, and Al Mokatam Street (Figure ES.8).

Table ES. 2: Causes of Congestion in the GCMA – Traffic Management Problems

Category	Specific Causes
Design features of the road network	• Physical bottlenecks • U-turns • Poor road surface quality • Speed bumps
Awareness of road etiquette and manners by various entities	• No lane discipline • Ubiquitous jaywalking • Illegal stops by transit and other vehicles
Parking supply and behavior	• Limited parking capacity • Illegal on-road parking
Law observance and enforcement	• Poor observance and enforcement of traffic laws and road occupancy policies (e.g., on-street vendors, animal-drawn carts).

Traffic influencing events	• Road accidents • Vehicle breakdowns • VIP motorcades
Traffic management and control	• Poor control at intersections • Lack of modern technologies for traffic management
Traffic demand-related factors	• Special events • Inflexible work hours

Figure ES. 8Example of measured traffic influencing events on local streets

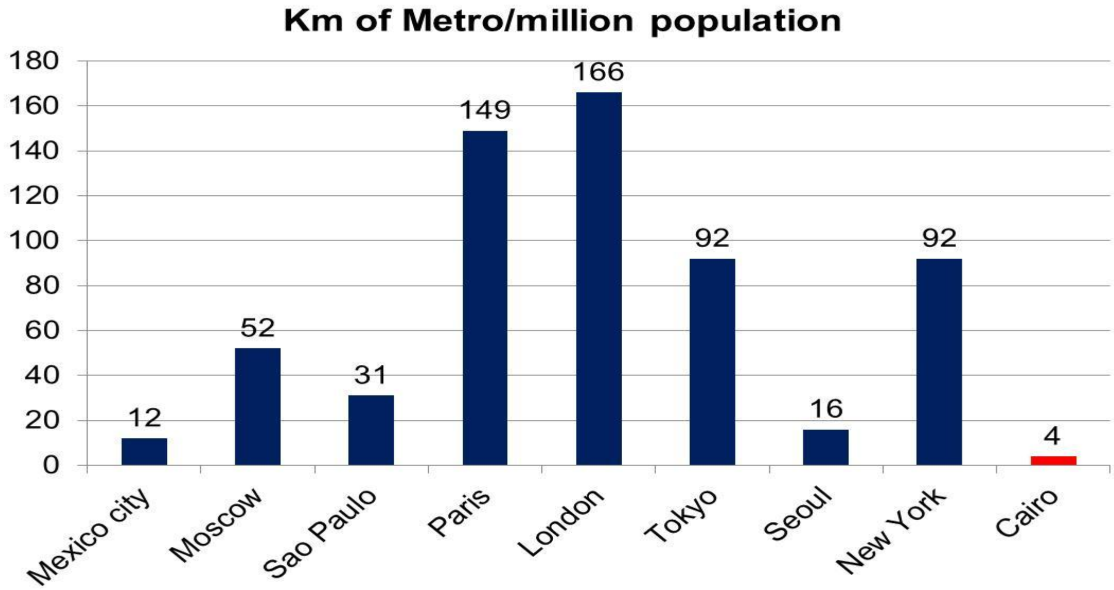


Low transport prices and vehicle operating costs: owning and operating a car in Cairo is relatively cheap, creating little incentives for people to rationalize their travel or carpool. There are no on-street parking charges, no tolls on most major corridors, and gasoline and diesel are heavily subsidized in Egypt (up to 50%). In addition a large number of vehicles are outdated, making their purchase and operation cheaper. The relatively cheap cost of owning and operating a car in Cairo, especially when compared to similar large cities around the World (London, New York, Sao Paulo…) creates little or no incentive for people to rationalize their travel based on need, or to carpool. Public transport prices (minibus, buses, taxis) are generally low and affordable, sometimes at the expense of the quality and reliability of the services. The low operation cost of vehicles and the poor regulation and enforcement of transport services are partially contributing to the oversupply of taxis and minibuses. Taxis and minibuses often compete aggressively and in an unorganized manner on some major routes, further contributing to congestion.

Inadequate supply of mass transit: There is only about 1,500 standard buses and 70 km of metro lines in Cairo. No Bus Rapid Transit (BRT) system currently exists, while the Heliopolis tram needs major upgrading and rehabilitation. For a large megacity, GCMA's supply of transit and mass transit, be it large/standard busses, trams or metros is very limited especially when compared with comparable cities around the World (see Figures ES.9). It should be noted that there is strong demand for public transport in Cairo as observed with the high ridership on buses and metro, especially during peak hours (see Figure

ES.10). However the required modal shift from private cars and taxis to mass transit is largely constrained by the limited supply of transit solutions.

Figure ES. 9: Metro and Bus supply in Cairo and Other Major Cities in the World



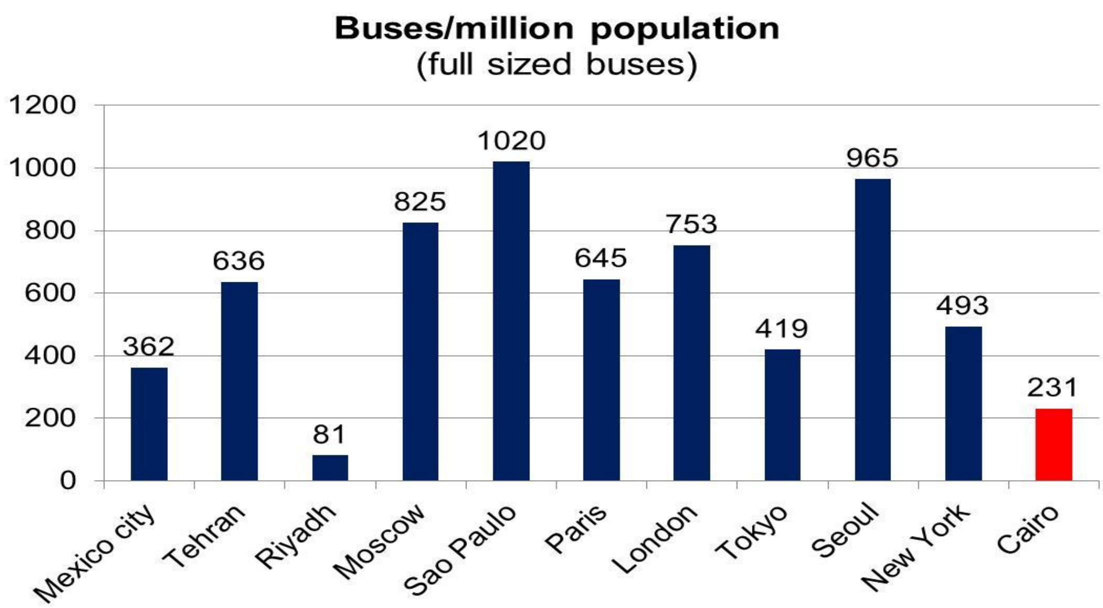
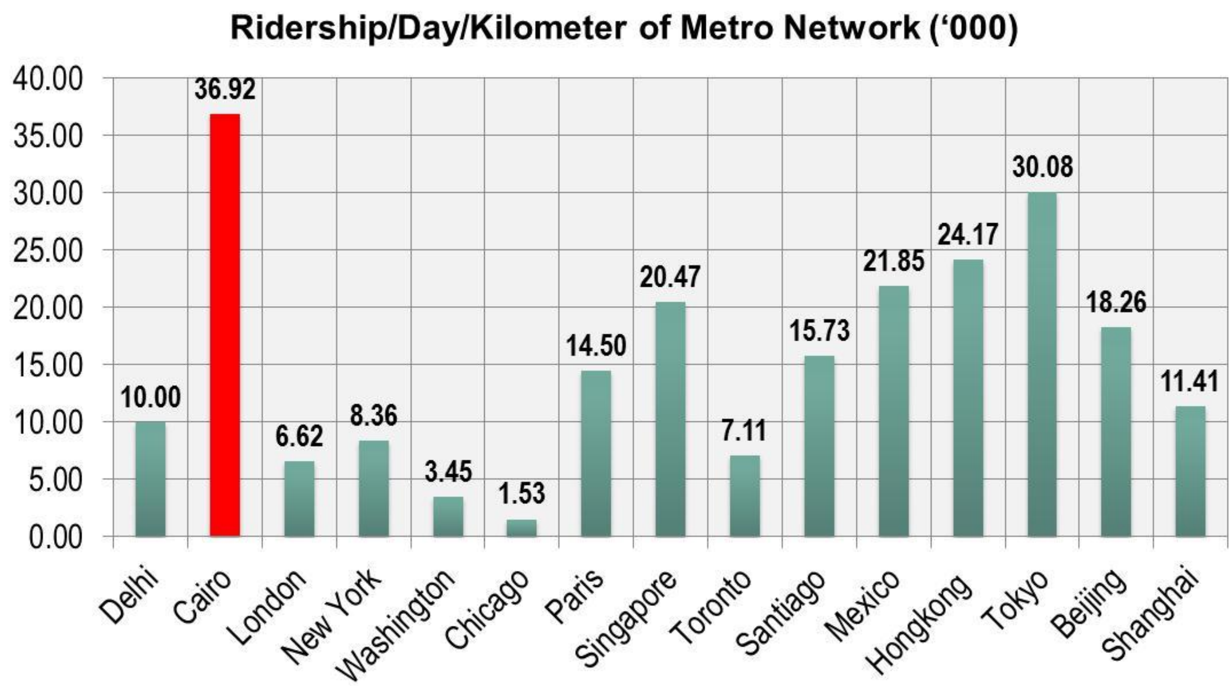


Figure ES. 10: Metro Ridership and Demand in Cairo and Other Major Cities



III. The Current and Projected Economic Costs of Congestion in GCMA

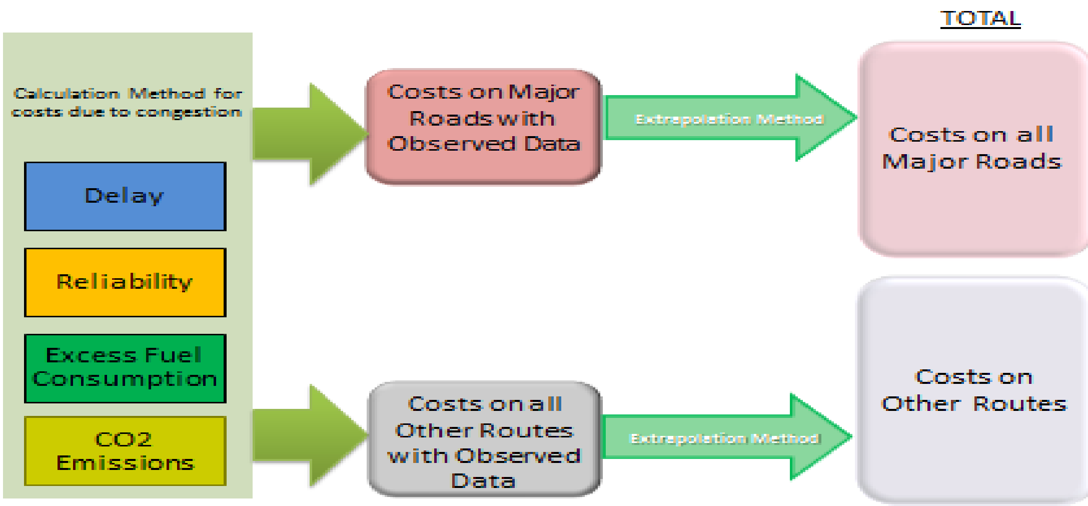
Methodology

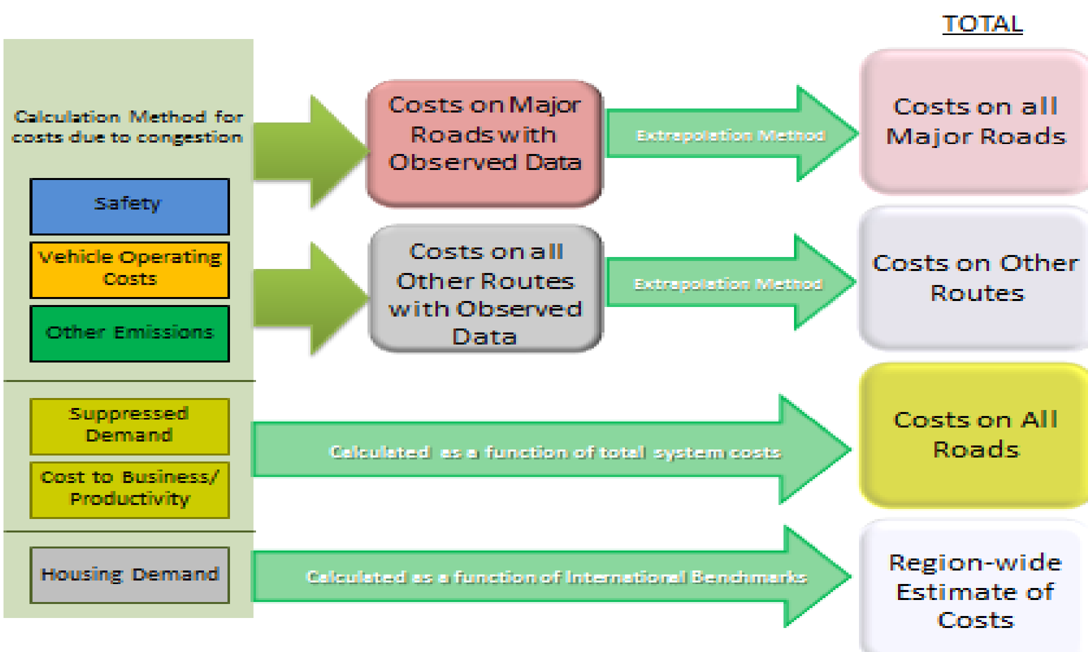
The study first estimated the economic costs of congestion in 2010 due to the following components:

- Travel time delay (both recurring and nonrecurring delays);
- Travel time reliability;
- Excess fuel consumption and excess fuel subsidy;
- CO_2 emissions due to excess fuel consumption;
- Road Safety;
- Vehicle operating costs;
- Health and environmental impacts from poor air quality;
- Labor productivity, business operations, and agglomeration effects;
- Housing; and
- Suppressed demand.

The economic costs of these components were first assessed for the corridors and streets surveyed under this study, and then extrapolated for all of GCMA. For some costs (suppressed demand, housing…) it was only possible to produce using a citywide analysis. Figure ES.11 illustrates how the economic cost of each of the above components was assessed.

Figure ES. 11: Estimating the Economic Costs of Congestion





In order to make recommendations and test various policies and investments for reducing congestion, it was important to project the cost of congestion in the future under a baseline or do minimum scenario. This was done by first forecasting traffic in 2030, then assessing the baseline (the cost with minimal improvements) cost of congestion in 2030. A sketch-level model was developed to forecast travel demand and costs of congestion to 2030, and assess the performance of policy measures to reduce congestion (Figure ES.12). This sketch-level model has a roadway network with the major corridors in the GCMA and fixed trip tables based on socioeconomic data. The model has no mode-choice component, meaning that transit or nonmotorized strategies are tested by making "off model" adjustments to model inputs, inputting these revised values, and rerunning the model.

We extrapolated the estimates of travel demand from the sampled surface streets and major corridors to the entire road network in the GCMA (see Figure ES.13). **Traffic volumes are close to or exceed capacity in most of central Cairo. Forecasted to 2030, the situation becomes even worse** (see Figure ES.14).

Figure ES. 12: Steps in Forecasting Demand in GCMA

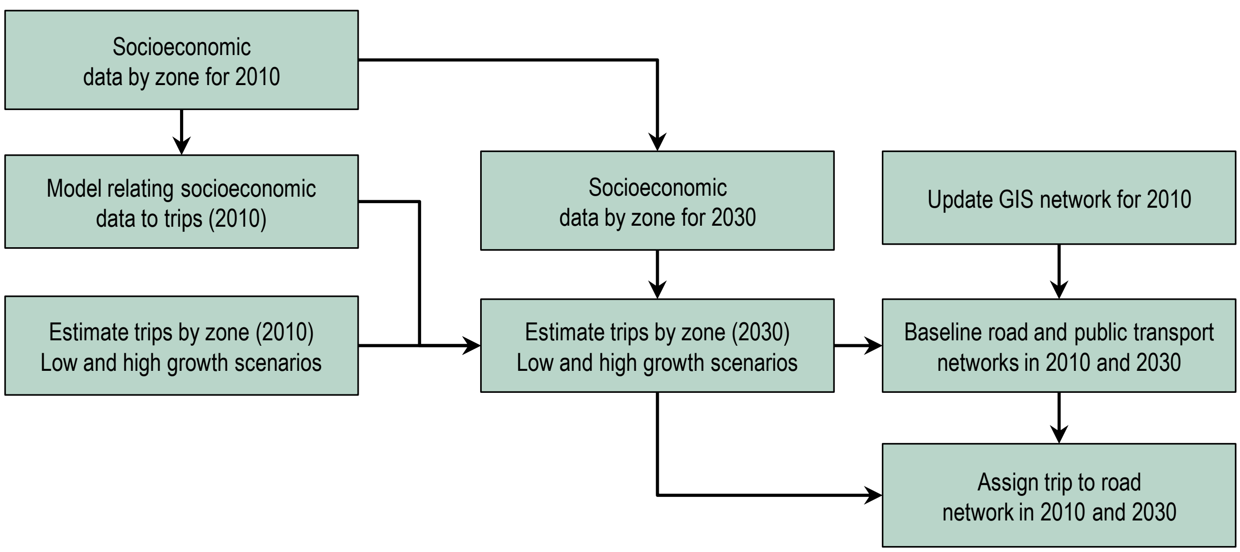


Figure ES. 13: Estimated Volume/Capacity Ratios in 2010

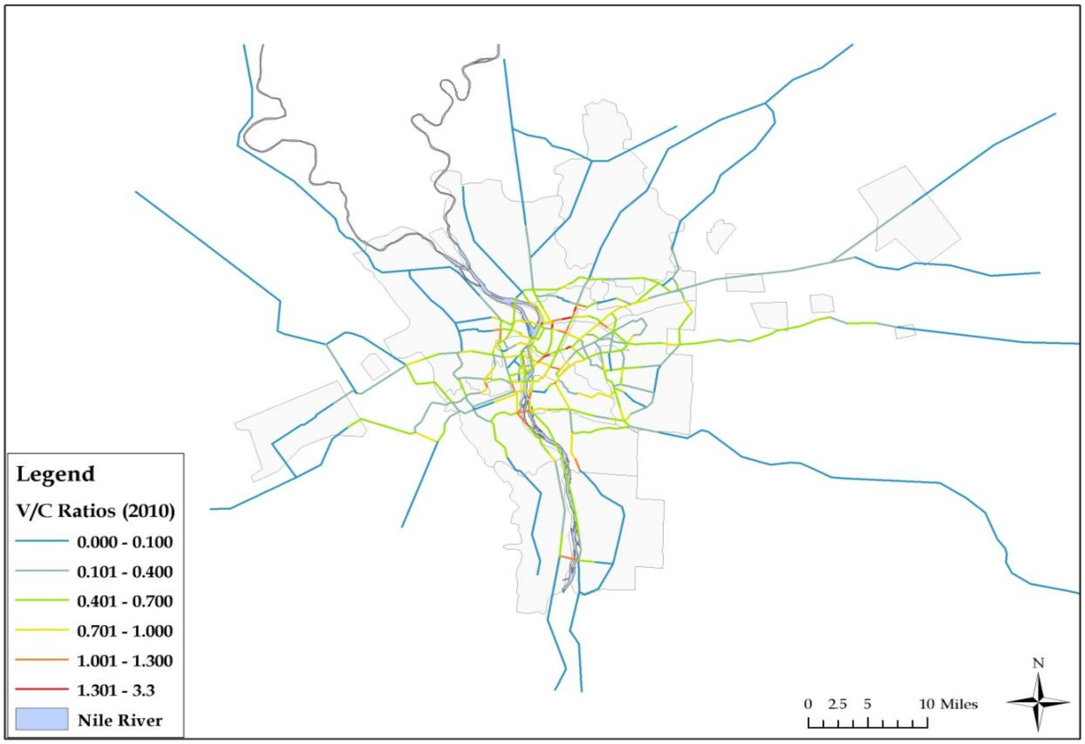
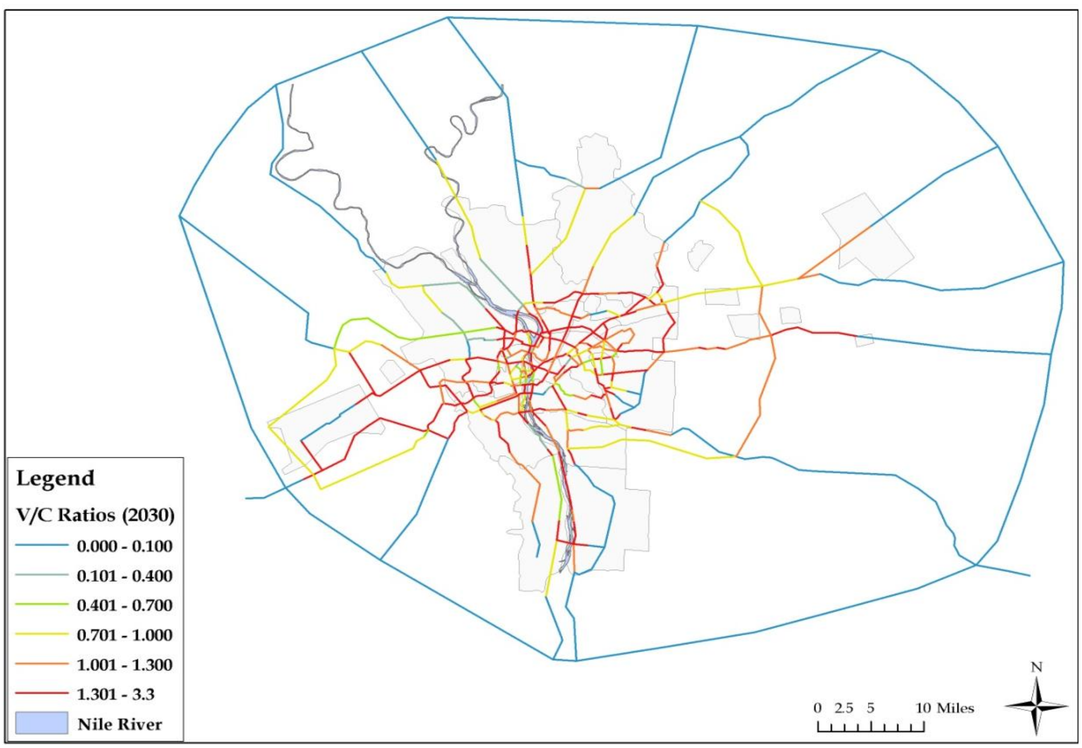


Figure ES. 14: Forecast Volume/Capacity Ratios in 2030



The Economic Cost of Congestion

Approximately 47 billion LE, or 8 billion USD, are wasted every year in the GCMA due to congestion; this is expected to increase to 105 billion LE by 2030 (Tables ES.3 and ES.4). With Egyptian's GDP estimated at USD 229.5 billion in 2011, **the economic costs of congestion in GCMA are estimated at about 3.6 percent of Egypt's total GDP**. Assuming that the burden of this cost is primarily distributed across a population of 19.6 million people living in GCMA, this results in a per capita cost of about LE 2,400 (USD 400). and represents about 15 percent of their GDP per capita, estimated at USD 2,700 in 2010 by the World Bank. The relative share of congestion cost is also expected to continue to rise through 2030 unless proper actions are taken.

The single largest driver of costs is delay costs, which represents 31 percent of the total costs. If we add the costs associated with the lack of reliability, the extra time travelers need to build into their trip, to the costs of delay, the value of wasted time constitutes 50 percent of the costs of congestion in the GCMA.

Emissions of carbon monoxide (CO), volatile organic compounds, nitrous oxide (NO_x), and particulate matter (PM_{10}), are the second largest contributor to congestion costs, largely due to their impacts on public health and the environment. Though smallest in terms of actual volume of pollutant, PM_{10} comprises 82 percent of emissions costs due to its high impacts on human health. CO_2 contributes a relatively small amount to total costs (about 1 percent).

Wasted fuel is another contributor to costs, both in terms of its cost to the government due to the subsidy and the direct cost to users. Agglomeration and business productivity losses that can be linked to congestion constitute 11 percent of costs. Suppressed demand and the impacts on demand for housing together constitute about 3 percent of total costs. Finally, congestion helps to improve the safety situation in the GCMA due to lower speeds and hence lower fatalities, reducing the cost of road safety by 0.5 billion LE (see Figure ES.15).

Table ES. 3: Summary of the Economic Costs of Congestion in 2010

Cost Component	Value	Annual Cost (Million USD)	Annual Cost (Billion LE)	Percent of Total Cost	Annual Cost per Capita (USD)
Delay	2.2B hours	2,443	14.7	31%	125
Reliability	1.4B hours	1,526	9.2	19%	78
Fuel	1.9B liters	1,094	6.6	14%	56
CO_2	7.1B kilograms	63	0.4	0.8%	3
Safety	0 fatalities; -3,100 injuries; 34,800 PDOs	-92	-0.5	-1%	-5
VOC	N/A	371	2.2	4%	19
Other Emissions	44 million kilograms	1,478	8.8	18%	75
Agglomeration/productivity	N/A	875	5.2	11%	45
Suppressed Demand	N/A	204	1.2	3%	10
Housing Demand	N/A	10	0.1	0.2%	0.5
Total	**N/A**	**7,972**	**47.7**	**100%**	**406**

Figure ES. 15: Direct and Indirect Costs in 2010 (Billion LE)

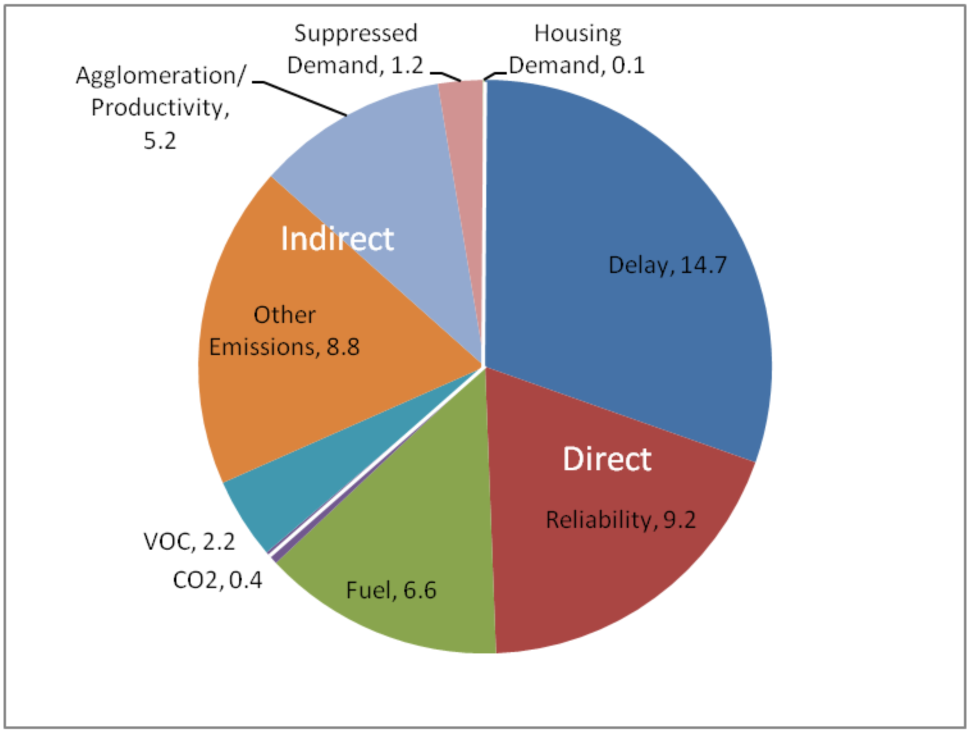


Table ES. 4: Summary of Economic Costs in 2030

Cost Component	Value	Annual Cost (Million USD)	Annual Cost (Billion LE)	Percent of Total Cost	Annual Cost per Capita (USD)
Delay	4.5B hours	5,435.0	32.6	31%	192
Reliability	2.9B hours	3,391.7	20.4	19%	120
Fuel	4.0B liters	2,431.7	14.6	14%	86
CO_2	14.9B kilograms	141.7	0.9	0.8%	5
Safety	0 fatalities; -6,890 injuries; 78,570 PDOs	-191.7	-1.1	-1%	-7
VOC	N/A	836.7	5.0	4%	30
Other Emissions	99.2 million kilograms	3,329.4	19.8	18%	117
Agglomeration/Productivity	N/A	1,677.4	10.0	11%	59
Suppressed Demand	N/A	418.1	2.5	3%	15
Housing Demand	N/A	10.7	0.1	0.2%	0.5

Total	**N/A**	**17,480.7**	**104.7**	**100%**	**617**

The World Bank estimates total Egyptian GDP to be USD 229.5 billionin 2011. Adjusting for purchasing power parity (PPP), Egypt's GDP is approximately USD 525 billion. According to a 2008 Price-Waterhouse Cooper estimate, the GRP at PPP for the city of Cairo proper is USD 150 billion. Adjusting back to absolute terms, and scaling for population within the city of Cairo relative to the entire GCMA, a gross regional product (GRP) for the GCMA is estimated of USD 150 billion. Adding up all the different elements of congestion costs in the GCMA and comparing these costs to the GCMA's estimated GRP, congestion costs add up to 5.2 percent of the GCMA GRP and 3.6 percent of Egypt's total GDP.

Comparison to Other Regions

Given that this study is based on several secondary sources of data, and that it uses assumptions from parts of the world other than Egypt and Cairo, it was important to subject our results regarding congestion to a test of reasonableness. We did this by comparing our estimates of the costs of congestion to estimates for other cities. In making this comparison, we encountered several issues that served to make this comparison quite difficult. First, the literature and data for making this comparison are limited. This is especially true for cities in the developing world. Lacking much data for cities that are like Cairo in terms of their size and economic development, we had to rely primarily on data from the U.S., Canada, and Australia to benchmark Cairo's congestion problem and provide a reality check for the calculations in this report. The comparison was also made more difficult by the fact that most studies define congestion and its costs differently; sometimes the direct and indirect costs are combined together, other times individual components of the costs of congestion are combined in different ways. Finally, the estimates of the costs of congestion are often calculated using different approaches and methodologies, which further complicate the comparison. These difficulties notwithstanding, the comparison presented in Table ES.5 is useful for putting the problem of congestion in the GCMA in some context.

The comparison of costs of congestion in the GCMA with other cities suggests that our estimates of congestion in the GCMA are reasonable, and if anything, our estimates of the costs of congestion are quite conservative. All the studies we reviewed had the costs of delay as a large proportion of the total costs of congestion. The estimates of the costs for excess fuel consumption and vehicle operating costs in the GCMA are lower than most other cities. Our estimates of the costs of emissions are in line with other studies, with CO_2 being a small part of the costs, and PM_{10} being a large part of the costs of emissions. In terms of the costs of congestion relative to GDP and population, our estimates of the costs of congestion fall somewhere in the middle of the range with congestion costs adding up to about 5.2 percent of the GRP of the GCMA. Meanwhile, the per capita costs of congestion in the GCMA are lower than for other cities included in Table ES.5. This is expected given that the cities in the table have both a generally higher income than Cairo (hence value to time per capita higher for instance).

Table ES. 5: Congestion Cost Benchmarks Normalized by GRP and Population

Urban Area	Costs Included	Cost (Million USD)	Cost per Capita	Percent of GRP	GCMA Cost Equivalent (Million USD)	GCMA Cost per Capita	GCMA Percent GRP	GCMA Difference with Benchmark	
Jakarta (2010)[a]	Fuel, other VOC, delay	$5,200	$542	5.7%	$3,908	$199	2.6%	-63%	-55%
Sydney (2005)[c]	Fuel, other VOC, delay, reliability, CO_2, other emissions	$3,500	$761	1.6%	$6,975	$356	4.6%	-53%	179%
Chicago Area (2010)[d]	Fuel, delay	$8,200	$921	1.1%	$3,537	$180	2.3%	-81%	108%
New York-Newark, NY-NJ-CT (2010)[d]	Fuel, delay	$9,800	$527	1.8%	$3,537	$180	2.3%	-66%	26%
Los Angeles-Long Beach-Santa Ana (2010)[d]	Fuel, delay	$11,000	$618	1.5%	$3,537	$180	2.3%	-71%	55%
Chicago Area (2010)[e]	Fuel, delay, other emissions (not CO_2), reliability, VOC	$4,599	$517	0.6%	$6,912	$353	4.5%	-32%	627%
New York-Newark, NY-NJ-CT (2010)[e]	Fuel, delay, other emissions (not CO_2), reliability, VOC	$7,137	$384	1.3%	$6,912	$353	4.5%	-8%	239%
Los Angeles-Long Beach-Santa Ana (2010)[e]	Fuel, delay, other emissions (not CO_2), reliability, VOC	$11,986	$673	1.6%	$6,912	$353	4.5%	-48%	179%
Beijing, inside ring road[f]	Delay	$4,718	$472	N/A	$2,443	$125	1.6%	-74%	N/A
Toronto[g]	Fuel, delay, CO_2	$1,282	$233	0.5%	$3,600	$184	2.4%	-22%	366%
GCMA	All direct and indirect	–	–	–	$7,972	$407	5.2%	–	–

Source:

1. Congestion Costs Jakarta Rp 46 Trillion, The Jakarta Post, 16 March 2011. http://www.thejakartapost.com/news/2011/03/16/congestion-costs-jakarta-rp-46-trillion.html.
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IV. POLICY OPTIONS AND RECOMMENDATIONS

Methodology

A comprehensive list of over 50 policy and investment measures was developed by reviewing best practices worldwide and gathering stakeholder input to assess those most relevant for Cairo. This list was combined with policy measures suggested by local experts in Phase 1. Some of the individual measures were assessed separately, other were combined in packages. The quantitative evaluation included measures primarily in the following categories:

- Major additions to road capacity such as road widening and the completion of the ring road;
- Major mass transit investment (metro lines);
- Improvement of transit (Bus & BRT) operations;
- Travel demand management (such as work from home, change of location/time of Gov services);
- Pricing including the removal of subsidies and the introduction of charges such as for parking;
- Traffic management, including access management and Intelligent transportation systems.

Each of the above measures was analyzed using a combination of quantitative and qualitative approaches. The assessment of policy measures involved the following steps:

- Estimating travel and congestion in a baseline scenario in 2010 and 2030.
- Estimating the effect of the policy measure on annual vehicle travel to the year 2030. For the policy measures for which this was not possible, we used estimates of the effectiveness of the policy measure based on experience in other parts of the world.
- Translating the reduction in vehicle travel into reduction in congestion on the road network.
- Translating the reduction in congestion into other direct and indirect benefits (for example, reduced emissions and lower vehicle operating costs).
- Applying the weights based on the feasibility and effectiveness criteria to each policy measure to come up with the overall relative (to other policy measures that were considered) attractiveness of each policy measure.
- Estimating the cost of each policy measure to include both capital and operating costs. The operating costs were for a 20 year period.

Some of the policy measures were evaluated using off-model assumptions (e.g., assumed transit ridership based on observation in existing corridors, or estimates of TDM benefits from other studies). These off-model assumptions were applied to specific travel markets as determined from the model.

The quantitative assessment was conducted at a sketch-level, given that an assessment needed to be made of the benefits to all of the GCMA with very limited data and modeling resources. The results, therefore, should be considered order-of-magnitude estimates to show the size of benefits that might be achieved. A more precise estimate of any policy measure would require detailed local data collection and analysis that is well beyond the scope of the current study.

Table ES.6 shows the estimated annual percent reduction in congestion costs compared to the baseline and the final results of the analysis of the policy options. Columns 1, 2 and 3 give the name of the policy measure, its description and how it was defined for purposes of this evaluation, respectively. Column 4 provides the estimated reduction in congestion cost associated with the implementation of the measure, relative to the baseline scenario. Columns 5 and 6 give our assessment of the institutional feasibility and the degree of support/acceptance (among the local population) for the policy measure. The assessment of institutional feasibility represents expert judgment of the degree to which the relevant institutions are capable and competent to implement the policy measure. Thus, for example, while the relevant authorities and organizations are capable and competent to implement the more technical and operational measure, they are less able to properly implement some "soft" measures such as enforcement of traffic rules and regulations. The degree of local support/acceptance for policy measures is high for new infrastructure and facilities, but is less when it involves changes to traffic behavior via enforcement, pricing or any other means. Column 7 provides the costs of implementing the policy measure in its entirety. Thus, for example, the cost of implementing the policy measure "New Highways," i.e., the new ring road is almost 3.2 Billion Egyptian Pounds. For the policy measures where it was not possible to develop a sensible estimate of the costs we have indicated whether in our assessment the costs are small or large. The cost shown are the net costs over a 20-year timeframe, including one-time capital costs and 20 years of annual operating costs (costs are not discounted). Column 8 provides the cost effectiveness ratio. This ratio was calculated by adding up the discounted (we assumed a discount rate of 4%) benefits to 2030 and dividing these by the estimated costs. It is assumed that all capital costs are incurred in 2010; operating costs were discounted over 20 years. The final column gives our assessment of the time it would take to implement the policy measure.

Table ES. 6: Analysis of Policy Options

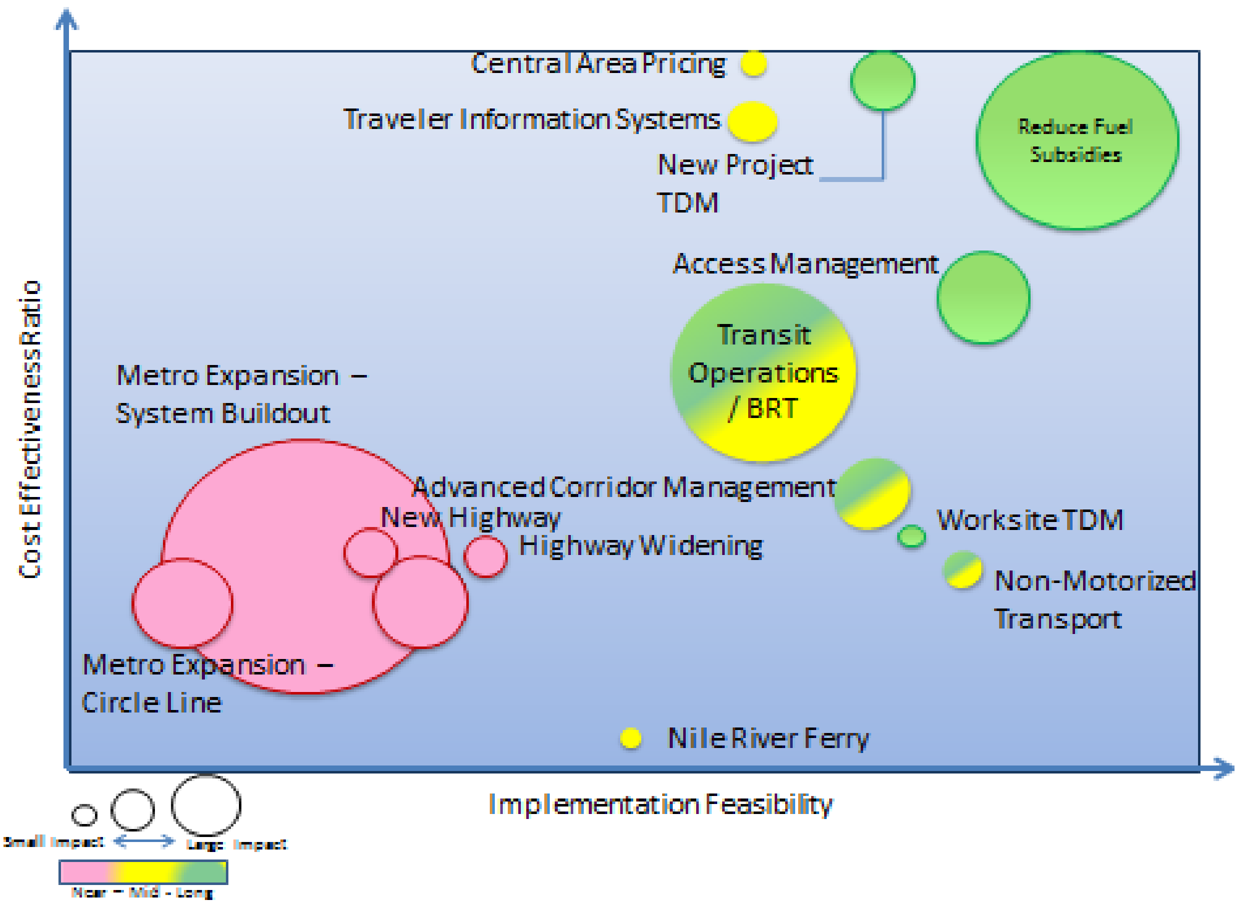
Policy Measure Packages	Description	Location	Reduction in Congestion Costs (Percent)	Institutional Feasibility	Local Acceptance	Capital Implementation Cost (Billions LE)	Cost-Effectiveness Ratio	Timeframe
New Highway	New highway construction	Tested on new ring road (Figure 8.1)	2.9%	●	◑	3.18	◑ 10	Long
Road Widening	Added lanes to existing roads	Tested by adding one lane to existing ring road (Figure 8.1)	1.4%	●	◕	1.30	◑ 9	Long
Metro – Circle Line	Circle Metro Line	See Figure 8.2	13.6%	●	●	16.16	◔ 6	Long
Metro – Radial Line	Planned Lines 4, 5, and 6 (results reflect each line independently)	See Figure 8.2	9.6%	●	●	13.57	◔ 5	Long
Metro – Combined System	Circle Metro Line + Planned Lines 4, 5, and 6 (combined)	See Figure 8.2	37.6%	●	●	56.88	◔ 7	Long
Nile River Ferry	Ferry route from CBD to the north	See Figure 8.2	0,4%	◕	●	1.78	◔ 0.2	Mid
Transit Operations/BRT	Several BRT lines plus transit operational improvements to support BRT and other bus service.	See Figure 8.2. Transit operations applied across major corridors.	23.1%	◑	●	5.94	◑ 35	Near/Mid
NMT	Bicycle facilities; Pedestrian facilities; Active travel campaign	Other Routes	2.3%	◕	◕	0.95	◑ 22	Near/Mid
Worksite TDM	Carpool/ridesharing info Alternative work options	Major Corridors	0.7%	◑	◑	0.30	◑ 24	Near
New Project TDM	Development mitigation Permitting enforcement	Regionwide	5.5%	◔	◑	0.03	● 1,819	Near
Advanced Corridor Management	Incident management, traffic signal coordination/interconnection, adaptive control, real-time information, variable speed limits, etc., along major corridors	Major Corridors	4.9%	◑	●	1.47	◑ 32	Mid
Traveler Information Systems	511, highway advisory radio, variable message signs, web-based traveler information, real-time transit arrival information, trip planning software, etc.	Regionwide	1.6%	◑	◕	0.01	● 1,123	Mid
Reduced Fuel Subsidies	50% increase in fuel price to consumers	Regionwide	17.5%	◕	◑	No implementation cost and revenue positive	N/A	Near
Central Area Pricing	Pricing of most congested central area applied to congested/daytime times, with revenue reinvested in transit	Cairo CBD	0.7%	◔	◔	Low implementation cost and revenue positive	● 2,695	Mid
Access Management	Median closures, turn restrictions, access/egress to major buildings such as government buildings, etc.	Major Corridors	8.5%	◕	◕	0.73	◕ 112	Near/Mid
Education	Media campaign; Driver education and training programs; Active travel	Regionwide	N/A	◕	●	Low	● High	Near

Policy Measure Packages	Description	Location	Reduction in Congestion Costs (Percent)	Institutional Feasibility	Local Acceptance	Capital Implementation Cost (Billions LE)	Cost-Effectiveness Ratio	Timeframe
Management and Reg.	Traffic police reform; Regulation of paratransit; Vehicle safety inspection; Regional oversight of the transport sector; Land use planning; Development permitting and traffic mitigation	Regionwide	Impacts most regionwide policy measures	◑	◕	Low	● High	Near
Enforcement	Enforcement of traffic laws; Driver licensing and violations; Requirements for developments	Regionwide	N/A	◑	◕	Low	● High	Near

Figure ES.16 compares the policy options to each other and displays several dimensions of each policy package:

- The magnitude of the impact on direct and indirect congestion costs is indicated by the size of the circle;
- The likely phasing is shown by color: green is near (1 to 5 years), yellow is mid (5 to 10 years), and red is long (more than 10 years);
- The height of the circle along the vertical axis denotes the cost-effectiveness, (measured as the impacts divided by capital implementation costs), so that the higher the circle, the more cost-effective is the measure; and
- The distance along the horizontal axis denotes the feasibility of implementing the policy measure, so that the further along the horizontal axis the higher the feasibility of the measure getting implemented.

Figure ES. 16 Comparing Policy Options



From the combination of these dimensions emerges the relative priority of the policy package. The larger the policy package and the closer to the upper right side of the graph it is, the better it is for quick and effective implementation. For example, the policy option to *gradually* reduce the fuel subsidy can be implemented relatively quickly– with the exception of potential political difficulties – and has a large impact on reducing congestion costs, and it is a very cost effective way to address traffic congestion. By contrast, building new metro lines take a long time to implement, are relatively difficult to implement (because of managing the disruptions that will occur due to the construction works), are not as cost-effective as reducing the fuel subsidy given the high requirements for capital costs, but they have a very large impact on reducing traffic congestion. Traffic management solutions (access management, non-motorised transport, corridor management), are measures that emerge as high priority and potential "quick wins.". Improving transit operations also performs well in the analysis.

Recommendations

While Cairo congestion has a large number of complex problems, there are four categories of actions that can yield significant results in tackling congestion if properly implemented.

1. Start with Traffic Management Solutions – Implement Corridor Management Schemes.

This recommendation includes measures aimed at maximizing the utilization of the available road space in Cairo. Corridor management schemes involve the selection of pilot roads and corridors and implementing actions to improve traffic flow: introducing traffic signals at intersections, removing or regulating U-Turns, improving pedestrian access on sidewalks and crossings, providing and enforcing stops for buses and minivans, and introducing on-street parking where possible. The study has already identified some corridors suffering high congestion, which can be considered for pilot improvements such as the May 15th bridge, Al Mokatam Street and El Malek Faisal Street. In addition, the study has already identified the type and location for each traffic influencing event along surveyed streets and corridors, therefore facilitating implementation (see technical report), although additional detailed technical studies would be required for implementation.

2. Somebody has to be in charge, not everybody - Strengthen the Capacity and Authority of the Greater Cairo Transport Regulatory Authority.

The recent creation of the GCTRA was a move in the right direction. Tackling congestion, especially in a complex environment such as in Cairo, involves too many stakeholders. While coordination is important, it is not enough to drive policies and interventions. In order to ensure that proper and effective actions are undertaken, one agency should take the overall responsibility. It has to be endowed with sufficient *capacity, resources, and authority*. Most importantly, it needs strong political backing from the highest levels in order to overcome the various challenges associated with its desired role in managing traffic in Cairo.

3. There is Price for Using the Rare Public Space, Which Needs to be Shared – Introduce Traffic Related Charges.

Revising pricing has multiple advantages:

i) It is an effective demand management instrument as it rationalizes travel;

ii) It generates much needed resources to improve traffic in sustainable manner; and

iii) Very importantly, it creates an understanding and culture that road space is not free and has to be shared or paid for its usage (such as through parking charges).

Therefore, the following actions are recommended:

- Start with introducing on-street parking charges (this could be operated by the private sector). Experience around the World suggests this is the traffic related charge that is most accepted by the public. It also creates an important behavioral change and understanding that there is a cost for using public space and that it needs to be shared. On-street parking charges can be the first action part of a broader parking policy that will see an increase of parking requirements for new commercial and residential centers, and the possible development of parking structures in Cairo.

- Implement gradual removal of gasoline and fuel subsidy. This money should be re-invested in improving traffic, notably in mass transit. If communicated effectively to the public that savings from reduced subsidies are used to improve traffic, there will be broader acceptance and support.
- Review the tariff structure of all transport modes to improve bus and microbus quality of service and to organize their operations. This is a challenging task to implement, requiring political will and consultations with private operators. However it requires little cost and if tackled properly could significantly reduce congestion. The Cairo Governorate and the Greater Cairo Transport Regulatory Authority should *at best* try and regulate the competition on routes and *at least* organize the stopping areas for buses and microbuses. This action will require the use of both enforcement as well as financial incentives (cash subsidy to operators instead of fuel, microbus scarping scheme such as implemented for taxis…).

4. Invest, Invest, Invest, but not in Urban Roads! – Expand Your Mass Transit Network.

Figures 3 and 4 make it very clear that there is little public transport in Cairo, despite being highly demanded. While all previous actions are very important, and will yield high results in the short to medium term, a city of the size of Cairo just can't properly function without a reliable mass transit network. Building more roads[2] and bridges will simply not solve the problem: Los Angeles tried building roads only, so did Houston and Riyadh, and now they are all building public transport. Expanding the metro is one of the options (completing lines 3, 4…), but is not the only one, and there are also other cost effective systems as such as BRT (possibly on the ring road?) and trams (the upgrading the Heliopolis Tram). The better integration of transit systems (bus and metro for example), such as through single fare ticketing, will also improve transport services.

Fiscal constraints might be an impediment for investments, however action 2 above is meant to generate some important resources for mass transit investments (especially from subsidy removal). Private sector participation could contribute to some of the costs (such as operations and rolling stock for trams and BRT). After all, and as the numbers in this study demonstrate, there are very large economic benefits from reducing congestion in Cairo, justifying several investments. It should be noted however that sine the economic benefits in this study are rather of order of magnitude, any proposed project or investment has to undergo a proper and detailed economic and cost/benefit analysis.

[2] With the exception of the ring road which would contribute in alleviating congestion