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Urban traffic congestion:  
Alternatives to the private motor  
vehicle from around the world

- 1 Mohamad Razaghi, Rebecca Himsl  
**Editorial**
- 2 Martha Delgado\*  
**Ecobici: Challenging Mexico City's Status Quo Through a Bike Sharing Program**
- 8 Yaron Cohen\*  
**Downtown Vancouver – A Pedestrian Hub**
- 14 Fatih Canitez\*, Umut Alkim Tuncer\*\*  
**Istanbul's BRT System, Metrobus: A quick solution to relieve urban mobility problems?**
- 18 Prof. Matthew W. Daus, Esq.  
**The Increasing Carbon Footprint of Uber in New York City & Beyond**

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Around the world, as urban populations are growing, so too are rates of private car ownership, which in turn leads to complex challenges in the urban governance sphere. With private vehicle ownership rapidly outpacing the growth of our road infrastructures, issues of traffic congestion, road and parking infrastructure maintenance and construction are at the forefront of cities' agendas. These challenges are only compounded by the sustainability concerns associated with the private motor vehicle. In response, many cities are prioritizing other modes of transport in an attempt to reduce the population's reliance on their private cars. In this issue of IGLUS Quarterly, we hear from four experts in different cities around the world and see how their administrations are adapting to this threat.

In the first article, author Yaron Cohen outlines the history of urban development in the Vancouver city center and describes how the city has successfully motivated a pedestrian population through integrated policy and well-thought out zoning. In the second article, Martha Delgado outlines the processes undertaken and the policies that were drafted by the administration in Mexico City to develop the successful bike-sharing scheme "Ecobici". The third article, by Fatih Canitez and Umut Alkim Tuncer, describes the bus rapid transit system that was completed in Istanbul in 2012 and the revitalizing effects that the system has had for the city and its citizens. The fourth article by Matthew Daus takes a different tone and analyzes the impacts that the proliferation of Transportation Network Companies, like Uber, have had on the urban mobility landscape in New York and explains the antithetic effects that such companies can have on sustainable transportation initiatives.

Each of these contributions introduces a different aspect of the mobility framework, and each in very different contexts. As with any infrastructure system, the mobility challenges facing each city are unique, and these cases offer but a snapshot of the many innovative transportation initiatives in place around the world. We invite you to share your experience and join in on the discussion at [www.iglus.org](http://www.iglus.org), and if feel you that there are innovative practices underway in your city-region and you would like to contribute to an upcoming edition of IGLUS Quarterly, we encourage you to contact us at [rebecca.himsl@epfl.ch](mailto:rebecca.himsl@epfl.ch), [mohamad.razaghi@epfl.ch](mailto:mohamad.razaghi@epfl.ch) and [maxime.audouin@epfl.ch](mailto:maxime.audouin@epfl.ch).

Mohamad Razaghi and Rebecca Himsl



# Ecobici: Challenging Mexico City's Status Quo Through a Bike Sharing Program

Martha Delgado\*

**Abstract:** Over the last five years, cyclists in Mexico City have taken to the streets and are now becoming an integral part of the urban landscape. Some have chosen to use “Ecobici”, Mexico City’s bike sharing program, which has proven to be a reliable, successful and efficient urban mobility alternative. But, in order to achieve this, the bike sharing program underwent a sophisticated planning and administration progress. In this paper, we will present the principal challenges faced throughout the creation of the Ecobici system by considering the economic, social and political conditions needed to create a high-quality public policy for a megacity.

## Introduction

At present, more than half of the world’s population lives in cities and over the next two decades this proportion is expected to increase to 66% (Bührmann, 2007). The resultant high concentration of urban residents presents certain advantages and efficiencies, but one of the biggest challenges that cities face around the world is mobility. The majority of densely populated cities around the globe face serious problems in terms of urban traffic congestion and air pollution. The use of private cars has been on the rise everywhere, and the most efficient way to mitigate car saturation and increasing greenhouse gas emissions from transportation is through the implementation of sustainable transport systems. Metros, trains, and Bus Rapid Transit are becoming increasingly popular transportation systems in many cities across the world and have, in some cases, been complemented with bike sharing systems, which help users to make the short travel segments intermodally.

The first shared bicycle systems emerged in the 90’s through initiatives launched in small European cities, universities or by private initiatives. Outdoor advertising companies were charged with the task of expanding and automatizing these systems, and in doing so, providing cities with the solution to one of their main problems (Midgley, 2009). These companies developed technologies that facilitated the spread of automated systems. By 2010, around twenty cities had set-up small bike sharing

programs. Today more than 300 cities worldwide have implemented such systems, some of which consist of more than 50,000 bicycles, as in some Chinese cities. But the creation and operation of these public programs require highly professional processes and efficient management. Many cities have failed to successfully install these systems due to their inability to implement all the necessary stages in the planning, execution or evaluation processes. In this article, we will review the case of Ecobici, in Mexico City, whose implementation stands out as one of the most successful worldwide.

## The idea

In August 2007, the Mayor of Mexico City presented Mexico City’s Green Plan, which was a long-term strategy that aimed to lead the city towards sustainable development. The Green Plan was one of the many actions led by the city’s government to improve air quality, mobility, and promote non-motorized transportation (as well as adequate waste, water, and natural resources management systems).

The required improvements on these matters were, and remained, enormous. Even though cyclist organizations had demanded actions to promote biking as an alternative to urban transportation, the government developed a robust and long-term strategy.

Once the public administration had determined that bicycle mobility would be a priority, it became difficult to decide where to start, how to approach the problem

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and which stakeholders needed to be involved. There were different points of view that needed to be considered. Stakeholders who would be directly affected, or those who would benefit the most, were targeted; these included merchants, neighbors and users of public transport, as well as motorists, legislators and the local authorities. Because of the many competing demands and opinions, it was crucial that, in order to succeed, a single well-thought out strategy needed to be outlined. Of course, it was difficult to design a solid project and to convince the community to get on board, but it was even harder to get support from other political groups.

Many different kinds of projects were proposed, and they all had to be incorporated in a certain way. Civilian biker organizations suggested different infrastructure models and signs- their primary concerns were for their personal safety and to secure bikers' rights out on the streets. Meanwhile, mobility consulting bureaus recommended the creation of 400 kilometers of bicycle lanes arguing that this was the most urgent task. Technical staff from the Secretary for the Environment pushed for the creation of a bicycle mobility strategy, in which they asked for the biggest part of the city budget to be designated to the construction of bikeways. They also proposed a plan that they believed might include all the characteristics needed to increase cycling in the city and turn it into a devoted mode of public transportation.

Each of the projects was meaningful, and investments were necessary for each, but at this point, no one was pushing to install a bike sharing program; that is until the Mayor, Marcelo Ebrard, visited Barcelona and was introduced to SmartBike. Apparently, this system had already been successful in other medium-sized European cities for ten years, but there was little evidence that such a system could be adapted to the world's largest cities, except of course in the case of Barcelona, Paris, and some large Chinese cities.

### The Challenge

The system seemed to be appropriate for Mexico City, and the Secretary for the Environment was appointed to develop the project. Building a system like this in a megacity brought up several important challenges that needed to be resolved. To bring the project to life in one of the largest cities in the world, the local government

executed the following strategy:

- Select an appropriate zone where the urban dynamic needed improvement and the mobility structure exhibited characteristics of one in which pedestrians and vehicles could exist among bicycles. The area also needed to function as a link between the subway and the BRT system.
- Allocate a sufficient budget for the creation of the bike sharing program, that is enough to launch the project. A sustainable financial scheme also needed to be created to permit future expansion.
- Design and create cycling infrastructure that offered comfort and security to the users of the system as well as for the pre-existing urban cyclists.
- Convince the pre-existing cyclists of the benefits of using public bicycles, and ensure the necessary security of pedestrians, cyclists and drivers throughout the introduction of this new type of public way user.
- Convince all citizens of the benefits of the system and placate the concerned non-users. For example, many residents living near the system zones were afraid that it could eventually lead to increased crime rates. Others were against it because it would reduce the available parking spaces.
- Modify the transit regulations to outline the rights and obligations of the users of this new method of urban transportation.
- Establish a mechanism through which cost of usage could be minimized so that every person could have automatic access to the system while at the same time allowing the system to have sufficient control so as to avoid bicycle loss.
- Design a welcoming, attractive and inspiring new form of mobility capable of attracting a broad and diverse range of users.
- Train the transit authorities to not only be more careful around this new user, but to also protect and orientate them.
- Collect enough funds from multi-annual public funds and private resources to guarantee the permanence and expansion of the system.

## Development and results

Ecobici was only a single piece in Mexico City's bicycle mobility strategy and was designed to respond to the city's environmental, social, economic and health crisis. Other programs such as the Sunday's "Move in Bike," night bike festivals, the "Bike to School" program, bike-ways, bicycle parking stations and an advertising campaign also constituted part of the system's larger picture. Each of these actions contributed to a single goal: to create and ensure that all the necessary conditions were in place for the recognition of bicycles as a safe and convenient mode of transport.

Ecobici was the first public bicycle system in Latin America and was inaugurated on February 16th, 2010, with 1215 bikes and 90 stations. By the year 2016, the system had engaged more than 215,000 users, who make an average of 33,000 trips per day, and who have, in total, accomplished more than 37 million trips with Ecobici.

In 2014, the CEMCA (Mexican and Centro American Studies Institute) issued a poll on Ecobici user habits. The following is a summary of their results:

- Although the average user age is 35- the oldest user is 75!
- 87% of the bicycle trips made through Ecobici are combined with another mode of transportation, which makes the system an efficient intermodal option.
- 32% of the users ride primarily in the bicycle lanes, and 62% use the bike lane on la Reforma. In general, the infrastructure built to support Ecobici's users was extremely useful because the riders felt safer using bike lanes.
- 35% of the trips are combined with a walk of more than 10 minutes. This is an important issue because in some megacities citizens use motorized transportation for everything and overlook walking as a transportation option.
- 49% of Ecobici users also have their own bicycles, which highlights the importance of the bicycle as a vector for intermodal connection; 66% of users also have their own automobile, which means that even with a car, users may find the bike more comfortable and convenient.
- 59% of the users did not use biking as a method

of transport before Ecobici existed; this was an important indicator of the program's success since, among its main objectives, it aimed to encourage more people to use bicycles to fulfill their urban transportation needs.

- 82% of the users think Ecobici improved their quality of life. They declared that they now had more time to read, visit their family and exercise.

## Keys to success

Among the hundreds of decisions made in order to realize this project, some were of paramount importance to Ecobici's success:

- Allocate enough time for proper planning. The system's planning period took almost two years and started very early in the administration. This allowed the authorities to focus on developing a good design and then, based on international trends, select a private company with the right qualities to work on the project.
- Step-by-step process. The government chose to implement the program through a "step-by-step" process where, in each phase, a minimum number of bicycles and parking spots were introduced within a given area.
- Select a suitable area. Within the immensity of Mexico City, finding the ideal location was not a simple task, but it was carried out with seriousness. The area where the project was implemented had to fulfill certain prerequisites such as appropriate street conditions to ensure adequate user flow. The area also had to be situated in a place where the Transit Police Department could work (members of which had to be trained and instructed on this new system) and where all urban public transport systems converged to facilitate intermodality.
- Strategically determine the size of the system. If it were too small then we could not have measured the impact of the transformation, and constructing too big a system could have resulted in very costly errors. The evolution of the system is shown in the following table:

| Ecobici Mexico City | Area (Km <sup>2</sup> ) | Stations   | Bicycles    |
|---------------------|-------------------------|------------|-------------|
| Phase I (2010)      | 5.45                    | 90         | 1215        |
| Phase II-III (2012) | 15.85                   | 185        | 2498        |
| Phase IV (2014)     | 13.50                   | 177        | 2389        |
| <b>Total</b>        | <b>34.80</b>            | <b>452</b> | <b>6102</b> |

*Table 1 - Phases of Ecobici 2010 - 2016*

- Sustainable financial model. There are many examples of financing schemes used in similar projects all around the world. Some systems are 100% based on public investment while others rely 100% on private money, many hybridized schemes are also in practice. In our case, the city opted for a hybrid model in which the firm Clear Channel Outdoors (the winner of the international public call) operates the system. An initial budget of 6 million US dollars and permissions for urban outdoors publicity were contributed by the government, creating a hybrid model that proved to be the right mix to ensure a high-quality service while giving the government sufficient flexibility.
- Branding. It was time to baptize the program, and a brand name capable of projecting the real system values was necessary. The job was given to professionals, and no one was disappointed by the results: a new brand was created and with it an entire set of qualities. Ecobici had become a prominent city icon.
- Build a bikeway in la Reforma. Using the principal avenue of the city, which goes from one side of the system area to the other, proved to be an excellent idea. By doing this, the system ensured security and comfort for the users as well as a forward-looking perspective for the system.
- High-quality maintenance. A public bicycle system might be in excellent conditions at the very beginning. But after a while, a certain level of degradation is expected. Each bike is expected to be used at least ten times a day, and so something must be done to ensure their proper upkeep. These technical efforts are crucial when it comes to keeping the system attractive to everyone.
- Stock control. To keep track of all users, it was necessary to ask them for some essential information.

Phone bills or credit card numbers provide primary data that the government uses to secure its bikes- a strategy that turned Ecobici into one of the systems with the lowest theft rates in the world.

- Security as a priority. The biggest challenge was guaranteeing security to citizens in general. A single fatal accident could cause the credibility of the entire system to plummet. To that end, the Departments of Transit and Communications had to be very well prepared, and without a collaboration with the Public Security Department, the Ecobici project would never have become one of the safest bike sharing programs in the world, never mind one of the firsts to pay the users' medical expenses.
- Client services. The system does much more than simply install bicycle stalls in the streets. One of the necessary tools behind its success was its customer service, which works by providing close attention at all times and a full 24/7-client attention. Managing bicycle maintenance, station saturation and accidents are all tasks that require immediate attention from system administrators. The efficient and fast solutions issued by customer service representatives, as well as the cordial attention paid to the users, are key aspects embodied by the system to maintain the loyalty of its users and ensure rapid growth.

### The Future

Once a public project such as Ecobici succeeds there are two things that are needed to maintain the prestige: first, a good level of service must be sustained, and second, it is essential that it is continuously growing. It is also important that investments and promotional campaigns are managed at a very high level.

Once a public project such as Ecobici succeeds there are two things that are needed to maintain the prestige: first, a good level of service must be sustained, and second, it is essential that it is continuously growing. It is also important that investments and promotional campaigns are managed at a very high level.

It is odd that, after so much success in Mexico City, only two cities in the country (Guadalajara and Toluca) have tried to replicate this system. In Guadalajara, the system was properly implemented, but it proved difficult to expand due to a lack of funding from the State

Government. In Toluca, the system was developed without considering lessons learned in other Mexican cities, and it is now at risk of disappearance due to a lack of implementation skills among the local team. Another factor that contributed to these outcomes is that local governments have shorter administration periods than Mexico City (just 3 years), and thus it becomes more difficult to develop thorough plans and implement such projects. Additionally, local governments in Mexico frequently lack technical resources and budgets for this kind of project. Nevertheless, some of them could benefit from reorganizing their priorities and introducing this excellent solution for the urban mobility.

In the case of Ecobici, it is important to understand that this is just the beginning of an innovative program. The first four phases only marked the preparations of a real mobility revolution. The massive use of bicycles and other forms of non-motorized transports, along with the recovery of the public spaces and the transformation of more efficient and sustainable public transport must be encouraged. Only then, can Ecobici become more than just a great initiative, but a critical piece of Mexico City's mobility puzzle.

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# Downtown Vancouver – A Pedestrian Hub

Yaron Cohen\*

**Abstract:** The case of the downtown core of the city of Vancouver provides us with interesting insights on how an integrated policy that includes mixed-use neighborhoods and transportation planning can turn certain urban zones into pedestrian hubs where car-dependency is decreasing, as well as challenges to keep those areas economically affordable.

## 1. Introduction

Cities, in their nature, tend to have a very different geographic structure and population distribution across different regions around the world in a way that affects the transportation choices of their residents. While European cities tend to be more dense and compact in their nature, North-American cities tend to have bigger suburban areas and lower population density on average (Demographia, 2015). In accordance with the lower population density in most North-American cities, together with cultural factors (the “American Dream” of car-ownership), private cars are a more common transportation mode in North America, while European cities see a bigger number of cyclists and public transit riders, though car-ridership still remains relatively high even in some major European cities (Bendix, 2015; Cohen, Namazu, & Pajouhesh, 2014).

Past studies in the field reveal that integrated policy that includes both transportation planning and land-use, in a way that densify certain areas over a certain threshold can reduce car-dependency in cities (P. Newman, 1996; Peter Newman, 2006). One of the best examples in North America can be found in the heart of the city of Vancouver, which is part of the third largest metropolitan area in Canada. In the downtown core of Vancouver, a growing number of residents walk to reach their destination, irrespective of other options available to them. This case study will explore the strategy taken by the City of Vancouver to enable this result and the possible challenges that the city might face in attempting to continue increasing the number of pedestrians.

## Metro Vancouver – The urban region

The greater Vancouver metropolitan area (also known as Metro Vancouver) is considered the third biggest metropolitan area in Canada after Toronto and Montreal, and it had a population of 2,313,328 as of 2011 (Statistics Canada, 2012a). In this agglomeration of urban areas, the city of Vancouver had a population of 603,500. Due to its mild climate in comparison to other parts of Canada, and the city’s good reputation as the most liveable city in North America, the metropolitan area is projected to attract additional 1,000,000 residents by 2040, a situation that can put pressure on the existing infrastructure if not properly planned (“2011 Population Density and the Metro 2040 Growth Model,” 2014; Slattery, 2015). The region’s main economic activities are trade (through the Port of Vancouver which is Canada’s gateway to Asia), Tourism, and the film industry.

The public transit modes offered to the Metro Vancouver’s residents are quite diverse. Translink is the operator of most public transit services in Metro Vancouver, and that includes buses, the Skytrain (the oldest and one of the longest automated driverless light rapid transit systems in the world.), the SeaBus (a ferry), and the West Coast Express which is a commuter rail service operating in peak hours between Vancouver and a few of its suburbs. In addition, a robust system of roads and bike lanes exists, and the city is working on expanding those bike lanes, and improving the walkability of streets. In order to do so, the City of Vancouver created the 2040 Transportation Plan (City of Vancouver, 2012). It is a long-term plan that overlaps the Greenest City 2020 Action plans in certain areas, and takes the triple bottom-line

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approach of improving the economy, the society, and the environment in the city, and lists a few main goals (City of Vancouver, 2015b):

To make the majority of trips (two-thirds) on either foot, bike, or public transit, by 2040, in a way that promotes a healthy and active lifestyle.

Reducing the distance driven in order to reduce GHG emissions 33% from the 2007 level by 2020, and to improve air quality in the city to levels that will make Vancouver's air the cleanest of any major city in the world.

Zero traffic-related fatalities by increasing safety with special attention to the most vulnerable groups, such as children, senior, and those with mobility problems.

## 2. Analysis of the case

This section will analyze a few measures that have been taken by local infrastructure managers in the Metro Vancouver area to reduce the road traffic. First of all, it's important to mention that as of 2014, 50% of the trips originating in the city of Vancouver were by either public transit, walking, or cycling. The table below summarizes the past and current trends in regards to transportation mode share in Vancouver.

| Year | Walking, Cycling, Public Transit - Altogether | Motor Vehicle |
|------|-----------------------------------------------|---------------|
| 2008 | 40%                                           | 60%           |
| 2011 | 44%                                           | 56%           |
| 2014 | 50%                                           | 50%           |

Table 1- Transportation Mode Share in Vancouver (City of Vancouver, 2015b)

Moreover, it is important to look at each alternative transportation mode independently to better understand which mode contributed most significantly to the reduction in motor vehicle use. The figure below is showing us that walking contributed the most out of all alternative modes to the reduction in motor vehicle use for trips originating in the city.

While the share of biking remained steady on a range of 3-5% and use of transit went down from 23% to 18%, walking went up significantly between 2008 and 2014, from 15% to 26% of all trips originating in the city. Therefore, this case study will focus mainly on walking

| MODE SHARE IN VANCOUVER |                              |      |                                        |      |
|-------------------------|------------------------------|------|----------------------------------------|------|
|                         | Source: TransLink Trip Diary |      | Source: City of Vancouver Panel Survey |      |
|                         | 2008                         | 2011 | 2013                                   | 2014 |
| TRANSIT                 | 22%                          | 23%  | 18%                                    | 18%  |
| WALK                    | 15%                          | 17%  | 26%                                    | 26%  |
| BIKE                    | 3%                           | 5%   | 4%                                     | 5%   |
| TOTAL                   | 40%                          | 44%  | 48%                                    | 50%  |

as means of transport in Vancouver, and what steps were taken by the City of Vancouver in the past few years in order to get more people to walk to work or to run errands instead of driving.

### Walking is on the rise in the city's dense areas

The city of Vancouver sees walking as a top priority out of all transportation modes, followed by cycling, public transit, taxi/car share, and private vehicles (City of Vancouver, 2010). As a result, the city declared that whenever a new road is designed or an existing one is altered, opportunities for including walking and cycling will be reviewed wherever possible, since some streets are limited in terms of space. The 2013 pedestrian volume and opinion survey conducted by the City of Vancouver reveals a few trends in regards to walking in the city (City of Vancouver, 2015a):

The busiest streets for pedestrians were all around the main streets of the downtown core (e.g. Granville, Georgia, Pender, Howe, Robson, and Burrard) next to three Skytrain stations: Vancouver City-Centre (The Canada Line), Granville and Burrard (The Expo Line and the Millennium line).

Busy street blocks outside the downtown core were mostly ones where either rapid bus line stations were located (The 99 B-line) or Skytrain stations (e.g. Commercial Drive station, Broadway-City Hall).

59% of pedestrians surveyed in the downtown core walked the entire distance, while the remaining 41% used another mode of transport, such as transit, to complete their trip.

51% of pedestrians surveyed in neighborhood centers

outside the downtown peninsula completed their entire trip on foot.

It seems as though a majority of people in dense areas are walking extensively, and in order to understand how this situation evolved, it is important to understand the physical structure and density of certain parts of Vancouver.

Vancouver is considered the most densely populated Canadian municipality (Statistics Canada, 2012b). However, there are still differences in density levels among different parts of the city. As of 2011, the population density for the entire city was 5249 people per square km, but the downtown peninsula, where most trips are taken by foot, had a much higher population density of 17,138 people per square km (Vancity Buzz, 2012). The area's population almost doubled itself within a decade from 27,988 people in 2001 to 54,690 people in 2011, adding 26,702 people in that period. Another area that was repurposed for a more densely populated neighborhood is the Renfrew-Collingwood area that grew from 44,946 people in 2001 to 50,495 people in 2011 thanks to a change in land-use policy, and the proximity of the area to the Joyce-Collingwood Skytrain station. Such population density creates ideal conditions for people to run errands walking, and to even walk to work, especially given the mild range of temperatures throughout the year in the area, and the active/outdoor culture of the West Coast. In order to allow these conditions that increased the walkability of certain parts of the city, the City of Vancouver took a few steps. The next section will expand about these steps.

### **How did the city of Vancouver increase walkability**

Looking at the macro level, the City of Vancouver tried to provide an integrated mix of accessibility (mixed-use areas, giving access to all sorts of needs within walking distance) and mobility (using population density to support transit and connectivity to the larger region). Using a common North American method to direct and guide land use called zoning, the city determines what kind of developments are allowed, not allowed, and encouraged in each zone of the city (City of Vancouver, 2012; Tumlin, 2012). Mixed-use zones allow for people to live, work, and play at the same area, and walk or cycle to their destination. This is achieved by creating "complete communities", where people can find shops, schools, and other services provided within walking distance based on

a balanced planning of commercial, institutional, and residential buildings. Vancouver's downtown core, and other neighborhood centers were designed around this idea, and the population density in these areas support other means of rapid public transit such as the Skytrain, and buses. The city's guidelines to keep supporting the population growth while reducing the use of private cars mention the prioritization of dense mixed-use areas that are served by frequent, high-capacity transit (City of Vancouver, 2015b).

Looking at the micro level, the City of Vancouver implemented a few elements of street design to increase walkability (City of Vancouver, 2012, 2015b):

Providing generous space for sidewalks, allowing for safe and pleasant walk, while taking advantage of the relatively fine-grain street grid throughout most of the city.

Making the streets as accessible as possible for people with walking disabilities, making sure the sidewalks are unobstructed, and that there are ramps in most major pedestrian crosses. This way, the streets become inclusive and accessible to everyone.

Creating streets that are visually interesting, by designing buildings that support a people-friendly environment to maintain visual interest for people walking or biking.

The VIVA program that creates vibrant pedestrian spaces, by temporarily closing streets for all sort of activities such as leisure, and arts.

### **3. Challenges for the future**

Even though the strategy taken by the city of Vancouver has been a success so far and there is an increasing number of pedestrians in the city, it is important to mention a major possible challenge that might make it difficult to keep the numbers of people walking as high as it is, and maybe even increase it more. As seen before, the highest number of pedestrians is concentrated mainly in the downtown core. One of the main challenges mentioned in the Transportation Plan 2040 is the high cost of living in Vancouver that can be offset by living in mixed-neighborhoods where car is not a must-have (City of Vancouver, 2010). However, the downtown area, is becoming unaffordable to live due to foreign investments that increase the price of real-estate properties and the rent making Vancouver one of North America's most expensive cities, and even areas that were



considered affordable in the past, such as the East-End of downtown, are gentrifying (Lupick, 2014; Van Loon, 2015). The high cost of living drives young professionals who might want to save the costs of owning a vehicle by living downtown outside Vancouver (to suburban areas where they need to drive or even to other cities), and attracts wealthier and more established populations that sometimes buy properties in the area to use them as temporary vacation houses and not as a primary residence (Vancouver Sun, 2016). The city will have to plan for affordable housing in mixed-use areas, inside and outside the downtown core, in order to ensure that young professionals and young families can still afford to live, work, and have vibrant community life in walkable areas (Angus Reid Institute, 2015; Mason, 2016).

### **Conclusion**

Vancouver has become a major global population center that successfully implemented a strategy to integrate land use and transportation planning to reduce its residents' auto-dependency. By proper zoning that allowed the creation of mixed-use areas and complete communities, people could have access to most of their everyday needs without having to drive anywhere, and the densification of certain areas allowed further expansion of the public transit network to allow better mobility between different parts of the region. However, further planning will have to be done in order understand how to integrate affordable housing in certain parts of the city to ensure the continuity of community life in them in a way that will motivate people to drive less, and use alternative modes of transportation, including walking.

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# Istanbul's BRT System, Metrobus: A quick solution to relieve urban mobility problems?

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**Abstract:** This article aims to analyze Istanbul's bus rapid transit (BRT) system, known as Metrobus in terms of its benefits and deficiencies. We introduce the main challenges faced during construction and operational phases and discuss whether Metrobus successfully alleviated the mobility problems in Istanbul.

## 1. Istanbul's Mobility Landscape

Urban mobility and traffic congestion problems come first among Istanbul's most important urban problems. In a study that measures traffic congestion levels around the world, Istanbul is cited as the third most congested city after Mexico City and Bangkok with a level of 50% (Tom Tom's Traffic Index, 2016). Therefore, it is understandable that most people in Istanbul say that the most important urban problem in the city is traffic congestion traffic. People spend, on average, 50 minutes for a single one-way trip, costing 13 TL, nearly equivalent to 4.2 USD (Istanbul Transportation and Traffic Survey, 2014). However, this situation is not unique to Istanbul and, with the urbanization trend, cities around the world are experiencing similar things in this regard.

Even if Istanbul has a robust and sound public transport infrastructure, rapidly rising car ownership and usage largely offset the positive impacts. With a population of nearly 16 million people, every day 1017 new vehicles roll out onto the streets of the city (TRT Haber, 2015). Main public transport modes include a 149.5 km rail network comprised of metro, light rail, tramway, funicular and cable car systems, 6007 public buses partly operated by private operators and partly by the public bus company IETT and waterborne modes like ferries and sea buses. Paratransit modes like shuttles, minibuses and shared taxis try to fill the gaps between these regular public transport services (IETT, 2016).

Istanbul is comprised of European and Asian parts which are separated by the Bosphorus Strait; these two

sides are connected by three bridges and an underwater rail tunnel called Marmaray. As there is a natural partition between two heavily populated centers and options to cross over to each side are limited, heavy vehicle traffic bottlenecks form, especially during peak times when people try to cross the bridges on the Bosphorus in their private cars. Other main roads are also congested during most parts of the day, particularly during commuting times. As public transport supply is not enough to comfortably cover the demand, people tend to opt to use their personal vehicles, which in turn increases traffic congestion more and more, leading to a vicious traffic cycle.

## 2. Construction of Metrobus

According to the Institute for Transportation & Development Policy (ITDP), a Bus Rapid Transit (BRT) system is defined as a 'high-quality bus-based transit system that delivers fast, comfortable, and cost effective services at metro-level capacities through the provision of dedicated lanes, with busways and stations aligned to the center of the road, off-board fare collection, and fast and frequent operations' [ITDP, 2016]. Istanbul's bus rapid transit system, Metrobus, was constructed to provide a seamless public transport corridor on one of the most congested roads in Istanbul and across the Bosphorus Bridge. The construction was completed in 4 phases; each one expanded the existing system. The phase lengths and construction periods can be seen in the Figure 1. Istanbul's Metrobus infrastructure was constructed by reserving two lanes from the heavily congested highway, providing a totally dedicated right of way for Metrobus vehicles. The idea behind Metrobus was to alleviate the severe traffic

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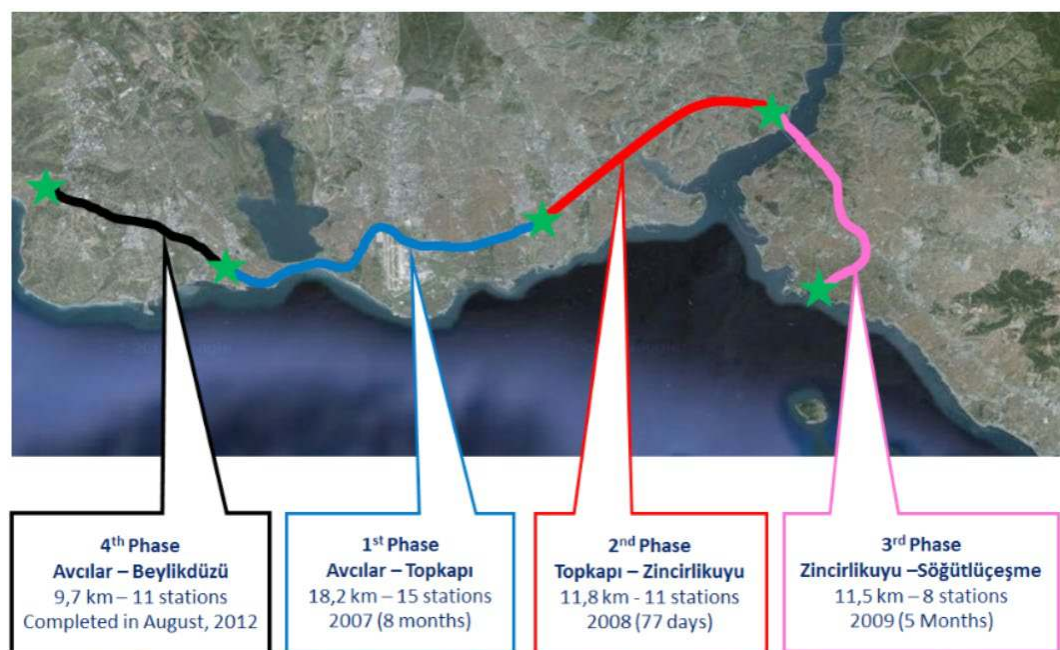


Figure 1: Construction phases of Metrobus

congestion by providing a quick and cheap solution, which is emphasized by the periods of construction listed in Figure 1. As can be seen, phases were completed within several months and the investment cost were nearly one tenth of what was required to build the underground metro at 6 million USD per kilometer (Babalik-Sutcliffe, E. & Cengiz, E. C., 2015).

Another objective for this system was to increase social inclusion through greater accessibility to the Metrobus system. A distance-based pricing system, based on the number of stations one travels, also provided a fairer pricing scheme.

The total length of the Metrobus network is 52 km with 44 stations. There are 8 different routes on the network, each with different terminal stations. The commercial speed is around 35 km/h. When compared to 10-15 km/h average speed on the road by private vehicles- this high speed provides a very fast travel option. The headway during peak hours is nearly 15-20 seconds and non-peak hours: 45-60 seconds. This high frequency makes Metrobus a highly preferred mode among the people. However, this creates a heavy demand burden on the system, which reduces comfort levels, particularly during peak times.

### 3. Benefits

Although there are many benefits of the Metrobus in terms of economic, environmental and social aspects, the reduction in travel times can be regarded as the greatest among them. To be more concrete, before the introduction of Metrobus, the average journey from one end of the Metrobus line to the other lasted nearly 3 hours. This is not just because of congested traffic conditions, but also due to transfer times between different bus and

minibus lines. After the introduction of the Metrobus, it now takes only 83 minutes from one end to the other. The main reason behind the gradual increase in the number of users has been this travel time gain, which is extremely important in Istanbul's traffic conditions.

With more than 850,000 passengers per day, Metrobus covers its operational costs with only revenue from fares, whereas regular bus services need government support to cover their costs. In addition to the low investment costs compared to other public transport modes, Metrobus can be regarded as a financially viable and sustainable model. With high operational revenues and a low investment cost, the payback period is quite short, making BRT systems an attractive mobility option for cities seeking a cost-effective solution.

On the other hand, with the introduction of Metrobus, some bus and minibus services were either reduced or removed completely the corridor. Some private car users also changed their travel mode to Metrobus. This not only reduced the traffic but also reduced average fuel consumption, which led to a reduction in CO<sub>2</sub> and other harmful gases. In total, 623 tons of less CO<sub>2</sub> is emitted to the atmosphere annually. 242 tons of fuel is also saved with a reduced number

of buses, minibuses and private vehicles in operation (Alpkökin, Black, İyınam & Kesten, 2013). Even if it is far from solving the emission problems caused by transportation, Metrobus still represents a remarkable contribution to the environment.

Integration with other transport modes also provides accessibility and social inclusion. Metrobus is integrated with metro, tramway, bus services, minibuses and Marmaray. Since the Metrobus corridor is the main axis connecting the two sides of Istanbul, suburban areas are also connected with the Metrobus route by feeder bus or minibus services, providing a high degree of accessibility, which was not possible before Metrobus.

Metrobus also runs 7 days a week and 24 hours a day with varying degrees of headway and frequency. Non-stop night time services have since also increased the social vitality of Istanbul's city life during night time. Students, teachers, people aged more than 60 and disabled people can use Metrobus at a discounted rate that is nearly half the total price, which also increases the social mobility of certain groups. The stations, platforms and vehicles have also been specially designed for disabled people creating an opportunity to increase the socially disadvantaged groups' accessibility to urban life.

#### 4. Challenges

Metrobus in İstanbul is the first BRT service in Turkey, and this caused some problems on the passengers' side as they were not used to this kind of mobility. Users had to learn the payment procedure and how to use the stations. They were also forced to make transfers between modes in order to reach their final destinations.

Metrobus has also brought with it new challenges, not just for users, but also for the service provider. To begin with, during the construction phase, it was a legislative challenge to obtain permission from the Highway and Road Authority for the two lanes on the E-5 highway. After that, for some parts of the road, enlargement activities were carried out, sometimes jeopardizing the traffic safety by reducing lane width. Even if the construction period did not last too long compared to other Metrobus projects in other cities in the world, traffic flow was still affected during construction and lane enlargement.

Bus and minibus operators were also affected by this new transport mode. It was sometimes quite hard to persuade them to shift their routes so that they did not operate on the Metrobus route but instead started providing a feeder service for Metrobus. As Metrobus ridership increased throughout the years, these operators were eventually compensated for their initial loss of revenue. Finding a common ground among the operators is quite important to increase their involvement, which is an indispensable part of the process. In this reorientation process, it is important not to make radical changes, but to gradually shift the routes in order to provide a smoother transition.

As Metrobus continued to grow in terms of ridership figures every year, a comfort problem arose from the natural capacity limit of Metrobus. In order to refrain from bus bunching in front of the platforms, it became important to impose some frequency or headway limits between consecutive Metrobus vehicles. Otherwise the travel time, which is the most important benefit of a Metrobus service, could increase as the riders were forced to wait at the stations. Especially at certain central stations during peak times, there can be extremely heavy passenger loading on stations. IETT tried to diminish this problem by reorienting the route layout so that there would be less passenger loading at these crowded stations. Currently, this capacity problem, which results in reduced comfort levels, is the most pressing issue that IETT faces. Alternative rail routes along this corridor are being considered as a way to decrease the high demand for Metrobus. Moreover, buses with a greater capacity are also being considered. Such physical constraints can be experienced all around the world as road space and carrying capacity are universal indicators. So, it is crucial to go over projected demand growth in depth before commencing a BRT project.

As Metrobus has become one of the main modes of transport for many people living in Istanbul, any disruption during service can affect thousands of people. As there are not so many overtaking spaces along the corridor, buses can immediately bunch up, and this can create transfer. It is even normal that such disruptions find a place on the news and social media, which can sometimes negatively affect the service provider's image. Therefore, it is crucial to provide a seamless service for the people, and this can only be ensured by

steady service levels and a good integration with other modes of transport.

### Conclusion

Bus Rapid Transit systems are gaining recognition around the world as they are among the most effective solutions for providing high-quality urban mobility at a comparably low cost. BRT systems provide a seamless network of public transit corridors, underscoring the priority of public transit solutions over private modes of transport. Istanbul's Metrobus case presents many opportunities to understand the benefits and challenges of BRT systems. As every city has its unique urban transport landscape, it is quite important to understand the mobility dynamics before deciding to implement a BRT system. In conclusion, Istanbul's BRT experience is a good example of how BRT systems can bring about new solutions as well as challenges to the urban mobility landscape. As we understand, quick solutions may sometimes lack long-term vision and at the end passenger comfort and seamlessness of the public transport experience can be compromised. On a broader level, it can be argued that each urban system taken into service affects the existing balance between services; so, it is important to ensure preliminary studies are as extensive as possible before starting a similar project.

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# The Increasing Carbon Footprint of Uber in New York City & Beyond

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**Abstract:** The unmanaged proliferation of personal motor vehicles introduced by Uber has impacted the environment and increased traffic congestion in New York City and beyond. Uber's business model relies on an ever-increasing volume of vehicles and "surge pricing" economic incentives implemented during hours of peak demand, when traffic in urban centers is at its worst. Uber's increasing carbon footprint is on a "collision course" with decades of sustainable transportation planning and policy. There is, however, still time to manage growth through regulation, policy planning, deploying the concepts of price control, curb space usage, shared mobility and incentives for clean-air vehicles.

## 1. Transportation Planning and Policy Challenges

Over the last few decades, cities have been working hard to minimize and deter Personal Motor Vehicle ("PMV") usage, while increasing reliance on mass public transportation modes. With the rise of Transportation Network Companies ("TNCs"), there is considerable concern that these efforts will be reversed with a deleterious effect on congestion and the environment.

PMVs produce greenhouse gases such as carbon dioxide, nitrous oxide and methane, contributing to climate change and global warming. Environmental statistics demonstrate that 28% of greenhouse gas emissions in the United States are generated by transportation, 34% of which are generated by passenger automobiles (Traveling Via Public Transportation in North America 2016). In the United States, vehicles are responsible for 27% of hydrocarbon emissions, 51% of carbon monoxide (CO) emissions, 20% of nitrogen oxide (NOx) emissions and 18% of carbon dioxide (CO<sub>2</sub>) emissions (National League of Cities 2016). PMVs affect air quality by releasing pollutants into the environment that cause negative health effects, especially for individuals with allergies or respiratory conditions, with research suggesting that certain pollutants are carcinogenic (Royal Automobile Club of Victoria 2016).

Congestion is another major effect of the increase in the amount of PMVs on the road, especially as the design capacities of our roads have been exceeded. Although highway funding in the United States increased by 100% in the last 25 years, congestion has increased

by 300% (Traveling Via Public Transportation in North America 2016), causing many negative effects, including extra travel time that may decrease productivity (Economics Online 2016). Congestion also increases business costs, as an increase in the amount of time a PMV is on the road leads to higher payments towards fuel and vehicle repairs. Even worse, emergency services, such as ambulances, police cars and fire engines, provide their services to those in need with increasing difficulty (Economics Online 2016).

## 2. Impact of TNC Growth On Transportation Networks and the Environment

While cities are attempting to decrease the use of PMVs, TNCs have grown at a near exponential rate, adding a significant amount of automobiles on the streets of already congested cities. In New York City ("NYC"), the number of for-hire vehicles ("FHVs") has grown significantly over the past four years, with this number rising to over 84,000 in December 2016 (NYC Open Data 2016).

Uber grew from zero drivers in 2012 to 160,000 actively partnered drivers (defined as drivers that have completed more than four trips per month) by the end of 2014 in the United States alone (Hall & Krueger 2015). In July 2015, Uber claimed that only 1,900 vehicles were active between 7 a.m. and 7 p.m. in the Central Business District ("CBD") of NYC. It is estimated that these additional 1,900 vehicles have resulted in a 7.7% decrease in CBD travel speeds (Miller 2015). To put

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this into perspective, each additional mile driven by an Uber vehicle in the CBD in Manhattan adds an extra 10 minutes to all other vehicles on the road at the same time (Komanoff 2015). Despite Uber possibly being a contributor to increased Manhattan congestion, Uber keeps expanding its fleet: Uber had more than 35,000 affiliated vehicles in NYC as of February 2016 (Hawkins 2016a); this number has now increased to over 44,000 (NYC Taxi and Limousine Commission 2016).

In the past, municipalities considering the introduction of new taxi medallions to their respective markets would conduct environmental impact studies. It is puzzling that the City of New York did not conduct a similar study before allowing TNCs open entry into the NYC market, especially considering that “fleet size reduction measures” have been shown to decrease carbon emissions and that transportation emissions increased by 0.2% from 2013 to 2014 alone (Pasion, Amar, & Zhou 2016).

This unregulated vehicle growth may have a detrimental impact on the environment. Carbon emissions may increase as vehicles spend more time in traffic, idling or crawling, and undergoing numerous acceleration and deceleration events (Zhang, Batterman, & Dion 2011). The number of active vehicles on the streets and the growth of vehicles for the sole purpose of providing for-hire transportation, which will inherently require longer than average vehicle miles, have been a concern for policymakers who seek to improve air quality, reduce pollution, and combat global climate change.

The lack of sufficient data to correctly measure the impact of the expansion rate of Uber and other TNCs in many cities has exacerbated the problem. These companies do not provide data to substantiate the claims they make about their success in reducing the number of vehicles on the roads.

Although it is difficult to accurately determine the impact of these new vehicles on NYC’s environment and their direct contribution to carbon emissions without app companies’ data, it is possible to make reasonable assumptions by utilizing various primary and secondary data sources.

The following formula can be used to calculate the CO<sub>2</sub> emission of Uber vehicles in NYC per day:

$$\text{Pounds of CO}_2 \text{ per Day} = ((\text{Miles Traveled} * \text{Number of Trips}) / \text{Average Miles per Gallon}) * \text{CO}_2 \text{ per Gallon}$$

- In order to determine average distances, one can use data from a report issued by SherpaShare that estimated the average Uber trip length in the top U.S. cities is between 4.4 and 8.9 miles (SherpaShare 2016). The average Uber trip that will be used in this article is 6.6 miles.
- Based on NYC Taxi and Limousine Commission (“TLC”) T-PEP data, Uber drivers conduct an average of 44 trips per week. For the purpose of this article, it is estimated that Uber drivers perform an average of 6.2 trips per day.
- Upon reviewing the Uber vehicle fleet in NYC and taking a sample from 407 approved vehicles, the average miles per gallon fuel usage (“AMPG”) can be calculated. The current NYC TLC rule permits any vehicle that passes inspection to be part of the FHV fleet (City of New York 2016). However, Uber only accepts vehicles that are 2006 model year or newer to be part of its fleet (Uber 2016). A cautious approach was developed to derive AMPG cognizant of the fact that there are multiple vehicle types with different models and fuel consumption capacity. To account for any disparity, MPG reports of the sampled vehicles were utilized as reported on their marketing packages and, most vehicles were assumed to be new, with maximum capacity to efficiently utilize fuel as advertised. Based on the sample of vehicles studied and their MPG fuel usage advertised when operated, it is estimated that the AMPG utilization of Uber vehicles in NYC is 18.7 per vehicle.
- Finally, according to the U.S. Energy Information Administration, about 19.64 pounds of carbon dioxide are produced from burning a gallon of gasoline that does not contain ethanol (U.S. Energy Information Administration 2014).
- Therefore, following the above formula, it is estimated that an Uber vehicle potentially produces 42.97 pounds of CO<sub>2</sub> per day in NYC alone.

As discussed above, there are currently over 84,000 FHV’s in NYC, with a majority of them operated by

Uber. The cumulative impact of Uber and other app-based companies' growth in NYC's environment is estimated to generate daily emissions of 3,610,063 pounds of CO<sub>2</sub> in the atmosphere. If the same moderate estimate of 42.97 pounds of CO<sub>2</sub> emissions per vehicle per day is applied to Uber's more than one million vehicles worldwide, the increased carbon footprint could be as much as 42,970,000 pounds of CO<sub>2</sub> emissions per vehicle per day produced by Uber's vehicles across the globe.

There have been various reports purporting to demonstrate that the proliferation of TNCs does not have any negative impact on the environment. A closer analysis of these reports, however, reveals that an ever-increasing TNC carbon footprint remains a highly likely scenario. A study by McKinsey and Company determined that TNCs did not increase congestion in NYC (Hawkins 2016b). However, some have questioned the research model used for this study and critics have noted that the \$2 million report did not include links to spreadsheets, nor additional data for the public (Fitzsimmons 2016; Miller 2015). A report by the Transportation Research Board makes no conclusive determinations about the environmental impact of TNCs, but does hint at TNCs' causal connection to congestion, and also concedes the likelihood of "increases in vehicle-miles traveled ("VMT"), congestion and GHG emissions" (Transportation Research Board 2016).

While the number of TNC trips is significantly increasing and, in turn, reducing taxicab market share, society at large is taking a step in the wrong environmental direction by substituting many trips that would have occurred in government mandated alternative fuel taxicabs for typically less environmentally-sustainable personal vehicles.

### **3. Uber's Use of "Surge Pricing" — An Incentive for "Peak Hour" Congestion?**

"Surge pricing," or, as Uber describes it, "dynamic pricing," is the notorious TNC economic model that raises fares based on demand at a given time (Gurley 2014). As Uber admits, the entire idea behind surge pricing is to increase the supply of drivers to match demand. Bill Gurley (2014), a Board Director at Uber, explained that surge pricing was created as a model in 2012, when Uber noticed in Boston there was a gap in the supply of drivers at 1:00 a.m. resulting in unfulfilled requests. Uber then conducted an experiment to see what would happen if the company increased prices for that time.

The experiment concluded that surge pricing increased the on-the-road supply of drivers by 70-80%. Thus, by Uber's own admission, the surge/dynamic pricing model is designed specifically to increase the number of drivers. By increasing the number of vehicles on the road by such large percentages, especially in highly congested CBDs, the results will invariably be increased travel times and emissions coupled with diminished air quality.

### **4. Policy Recommendations to Manage TNC Growth**

Cities are rapidly growing in population, a trend that is expected to continue, resulting in an ever-increasing population density and demand on transportation needs. The unchecked growth of TNCs will only cause more environmental problems, as an increase in demand will lead to an increase in traffic congestion. In order to avoid a "collision course" between increasing urban populations and the growth of TNCs, city regulators and traffic managers must have a policy planning agenda that focuses on shared mobility solutions, and which provides incentives and disincentives for the continued growth of TNCs that is not consistent with sustainable transportation goals (The United Nations 2014).

Limiting or managing the growth of the number of TNCs would help reduce traffic congestion. TNC growth could be capped, or it could be monitored and managed with incentives for vehicles and services that promote environmental sustainability, to mitigate emissions and congestion. Localities could tap into data and manage the number of vehicles by limiting growth of traditional point-to-point TNC service, while allowing for the addition of clean air vehicles. Road, traffic planning, and mobility management should be factored into the incentive plan, which can include dedicated airport areas and stands, and dedicated lanes used exclusively for those services that assist in overall public policy goals. A variety of different methods could be employed, including: requiring that TNCs utilize a certain number of vehicles committed to equitable and sustainable growth measures, or be subject to a limitation on growth that would only be allowed following Environmental Impact Studies that are completed by independent and objective consulting firms authorized and hired by the government (or the government itself), but paid for by TNCs. These could include enhanced emission standards enacted by Congress for obtaining and maintaining TNCs, to be enforced at a local level through withholding State and Local federal transportation funds unless

such congestion management policies are enacted.

The policy emphasis should be on promoting shared rides and micro-transit, zero emissions or clean air vehicles, with all modes working together to move people in a sustainable and efficient manner. To reduce the roaming factor, fees could be charged for staging or standing areas for clean air TNCs. Also, minimum and maximum working hours for TNC drivers may reduce the pool of drivers and promote safety and environmental goals. True ride-sharing services such as Lyftline or Uberpool, which replicated the NYC service known as Via, with economical multi-passenger trips, should be encouraged. One idea would be for regulators to allow accountable and transparent “surge pricing” at severe off-peak hours, but to ban such demand pricing during peak hours, and allow or only permit shared services by TNCs during rush hours.

In terms of planning these changes, transit planning agencies, airports, business improvement districts, incumbent for-hire and taxi industries, TNCs and others must all be at the table working together, with government taking the lead. Most importantly, the incumbent taxicab, limousine, livery and for-hire industries, including commuter vans or shuttle/jitney services should be treated equally on the same playing field, or arguably with less stringent regulations than TNCs given their alarming expansion, increased safety risks and lack of internal sustainable policy goals.

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IGLUS Quarterly, is an online quarterly publication dedicated to the analysis of **Governance, Innovation and Performance** in Cities and is edited at École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. IGLUS Quarterly aims to facilitate knowledge and experience sharing among scholars and practitioners who are interested in the improvement of urban system's performance in terms of the service efficiency, sustainability and resilience.

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