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# Car Sharing: A Feasibility Study in Hong Kong



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## **Abstract**

In an effort to reduce traffic congestion and air pollution caused by private vehicles, this project, in collaboration with Friends of the Earth Hong Kong, aimed to determine the feasibility of expanding car sharing in Hong Kong. We used a transportation survey of car owners and non-owners, archival traffic pattern research, and an environmental and societal impact analysis to identify recommendations regarding transportation policies that could increase the use of car sharing in Hong Kong.

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Interviews:

- Jeanie Lau, Business Development of ECrent in Hong Kong,
- Dr. Hung Wing-Tat, Professor of Civil Engineering at The Hong Kong Polytechnic University,
- Andrew Pickford, Director of Infrastructure and Transport Advisory Services for MVA,
- Crystal Pang, Operations Manager at Uber,

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## **Authorship**

**Andrew Belz** - Andrew contributed to writing the abstract, executive summary, introduction, the sections of the background concerning the current state of transportation in Hong Kong and legal consequences and considerations of car sharing, a large portion of the methodology, results and analysis concerning the public's opinion of car sharing services from the perspective of those who do not own a car and social responses to increased car sharing, and the conclusions and recommendations. He also compiled the references, wrote the description of Friends of the Earth Hong Kong in Appendix A, assisted in formulating the questionnaires in Appendix B and the interview protocols in Appendix C, transcribed interview notes in Appendix F, and contributed to the calculations found in Appendix G. Andrew edited many sections of the report for content, style, and grammar.

**Emma Healey** - Emma contributed to writing the executive summary and introduction, the background regarding the history of car sharing and the environmental benefits as a result of it, a large portion of the methodology, the results and analysis regarding analysis of the survey data from the public, traffic conditions on major roads, and creation of the framework for calculating potential emission reduction, and the conclusions and recommendations. She also assisted in the writing of the questionnaires and interview protocols as well as creation of the equations and calculations in Appendix G. She compiled all of the survey data from which she created all graphs. In addition, Emma played a large role in the editing of the entire report as well as formatting and creating the table of contents, table of tables, and table of figures.

**Kyle Hudgins-** Kyle contributed to the writing of the abstract, executive summary, introduction, and background with a large portion written about the different types of car sharing and created clear and definable car sharing type names, and the conclusions and recommendations. He assisted in the writing of the methodology, and results and analysis chapters. Additionally, he assisted in the writing and distribution of the questionnaires through online survey response software in Appendix B, assisted in the writing of the interview protocols in Appendix C, enhanced the archival traffic map images for better comprehension of traffic conditions, and formatted the North American car sharing impacts chart in Appendix H. Kyle edited many sections of the report for any errors in grammar, organization, clarity, or consistency.

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## **Executive Summary**

Hong Kong is one of the most densely populated cities in the world. Of 7.24 million people living there, approximately 90% use public transportation, which contributes to one of the most widely used and well-run public transportation systems in the world. Despite this, almost half a million people own and use a private car, which the roads cannot effectively cope with. The Hong Kong government has put in place monetary penalties to deter individuals from owning cars. However, the number of private cars has been increasing annually, causing worsening traffic congestion and air pollution problems in Hong Kong.

Encouraging car sharing, which includes using a personal vehicle to drive passengers and carpooling with complete strangers, has been identified as a potential solution to help reduce the number of private cars on the roads, and as a consequence, the levels of air pollution in the city. It is unclear how the public will receive car sharing and how helpful it may be in alleviating traffic congestion and air pollution problems. The goal of this project was to provide our partnering agency, Friends of the Earth Hong Kong, with recommendations regarding the feasibility of expanding car sharing services in Hong Kong. To achieve this goal we established three objectives:

- Determine the receptivity of car sharing services among Hong Kong residents and tourists;
- Identify where and when car sharing services would be most beneficial to Hong Kong;
- Determine the likely effects of increased car sharing on traffic congestion, air quality, and society.

We administered a survey, conducted interviews, and performed archival research to gather data about car sharing in Hong Kong.

We found that people who had used car sharing had more positive views of car sharing than those who had not, and women were much more likely to think it is unsafe than men. Only half the car owners surveyed use their vehicle every day, and most car owners were open to the idea of carpooling.

We also found that the central Cross Harbour Tunnel was significantly more congested but contained a smaller percentage of private vehicles than the other cross-harbour tunnels. We also selected three major roads that have a lot of congestion to see how car sharing might help; two had a relatively high percentages of cars on them, while the third carried a lower percentage of cars and a higher percentage of buses. Roads used predominantly by cars were much more congested because cars are less space efficient than buses. We determined that the three tunnels and the three roads would benefit from car sharing.

The reduction in emissions from using car sharing can be determined quantitatively using a framework developed with our calculations in conjunction with a carbon emissions calculator. This framework could be used in future studies of vehicular emissions.

Based on the analysis of our results we have provided Friends of the Earth Hong Kong with recommendations regarding the feasibility of implementing car sharing in Hong Kong on a larger scale.

**Pass new laws to confirm the legality of car sharing services.** The explicit legalization of car sharing services, along with creating clear definitions for various types of car sharing services, would allow for effective regulation.

**Encourage car sharing services.** The government and car sharing companies should create initiatives to get people to try car sharing. Creating a framework for community-based car

sharing through an app or online posting board could establish more community based car sharing.

**Improve Safety in Car Sharing.** Increased awareness about driver background checks would lead to an increase in consumer confidence in car hailing services' safety. Clearly defined insurance policies should be provided by car hailing services to ensure the rider is properly covered if in an accident. Carpooling could greatly benefit from a rating system of drivers and riders in order to make carpooling safer for both parties.

**Establish new policies.** Congestion Tolls should be implemented in highly trafficked roads and tunnels to reduce the levels of road congestion by increasing prices during heavy traffic. Tolls prices for the three cross-harbour tunnels should be evaluated.

**Further Research.** The framework we created can be used to determine environmental benefits from an increased use of car sharing services. A more comprehensive survey of private vehicle owners in Hong Kong could provide an accurate number of drivers willing to switch to car sharing services. Other methods of reducing traffic congestion should be explored to work in conjunction with car sharing to benefit Hong Kong.

# 1. Introduction

Transportation is a vital part of daily life for activities such as commuting to work, transporting goods, and obtaining personal necessities. As a region expands, the development and implementation of new transportation methods are needed to reduce congestion caused by increasing numbers of vehicles. Private vehicle usage is one of the leading causes of traffic congestion and environmental problems in a city (Batterman & Zhang, 2013). A large number of vehicles on limited road space causes slower transportation speeds and engine idling. By reducing the number of vehicles populating the roadways, the decrease in traffic congestion and air pollution would have a positive effect on a region's inhabitants, especially in a city as congested as Hong Kong (Abu-Lebdeh, 2015).

With over 7.24 million people living in Hong Kong, the population density is greater than 6,600 people per square kilometer (Hong Kong Information Services Department, 2015). Of this population, there is continued ownership and usage of private vehicles that cannot be efficiently supported by the current infrastructure (Cullinane, 2002). A reduction in Hong Kong's heavy traffic congestion would decrease travel times as well as street level pollution (Tam et al, 2014). However, because of a limited capacity to expand roads and a continuing increase in private car usage, Hong Kong is struggling to find a solution to traffic congestion and air pollution (Hong Kong Transport Advisory Committee, 2014).

Hong Kong has a well-established and efficient public transportation system consisting of trains, trams, taxis, buses, and ferries (Hong Kong Transport Department, 2015). Government organizations in Hong Kong have established monetary penalties to deter car ownership (Hong Kong Transportation Advisory Committee, 2014). A relatively new approach that has the potential to reduce traffic congestion and pollution is a series of web based platforms that

facilitates car hailing, carpooling, or private car rentals. This approach, known as car sharing, has been received in varied ways by the global public (Aragon, Humbaraci, & Papotta, 2011; Stefansdotter, Danielsson, Nielsen, & Sunesen, 2015).

Car sharing has been available in Hong Kong in various capacities for the past few years (Sharp, 2013). Individuals use car sharing for trips that require destinations inconvenient to access via public transport, but it is not a primary mode of transportation (University of California, Berkeley Transportation Research Center, 2014). Our partner, Friends of the Earth Hong Kong does not know if car sharing will, in fact, alleviate traffic congestion and thus reduce air pollution.

The goal of this project was to determine the feasibility of expanding various car sharing methods in Hong Kong as a way to alleviate traffic congestion and reduce air pollution. Because there is a lack of research about the use of car sharing services as an alternative to owning a car and its potential to reduce traffic congestion and air pollution, our field and archival research focused on gathering of this data. We achieved our goal by completing the following objectives:

- Determine the overall receptivity of car sharing services among Hong Kong residents and tourists;
- Identify where and when car sharing services would be most beneficial to Hong Kong;
- Determine the likely effects of increased car sharing on traffic congestion, air quality, and society.

To meet these objectives, we used information gathered from surveys, interviews, and archival research. The research we completed in Hong Kong provided our project partner, Friends of the Earth Hong Kong, with an informed recommendation regarding the desirability of car sharing as well as other methods of reducing traffic and air pollution in Hong Kong.



## **2. Background**

Urban areas frequently struggle with air pollution and traffic congestion caused by excessive use of private cars. A new transportation initiative, car sharing, may be a solution to alleviating this problem (Sharp, 2015; Stefansdotter, Danielsson, Nielsen, & Sunesen, 2015). Throughout the world, car sharing has been met with varied responses from public and legal viewpoints. In Hong Kong, there is a remarkably effective and extensive transportation network with a very high usage rate. Despite this, Hong Kong is still plagued by traffic congestion and street-level air pollution (Hong Kong Transport Advisory Committee, 2014). In this chapter, we will discuss problems facing transportation in urban areas, the history and current social and political climate surrounding car sharing, implementation of car sharing on a global scale, and the current state of transportation available in Hong Kong.

### **2.1 Transportation and Urban Problems**

Transportation in urban areas can be a challenge because of the high population density coupled with limited space (Guo, 2015; Cullinane, 2003). Two significant problems plaguing urban areas are air pollution and traffic congestion which will be discussed further in the following sections. Both of these problems decrease the quality of life for inhabitants of urban areas (Correia, 2013; Schrank, Lomax & Eisele, 2015).

#### **2.1.1 Air Pollution**

Air pollution in urban environments has been a problem since the Industrial Revolution in the mid-1800s (Seinfeld & Pandis, 1998). This problem have become worse as cities have grown higher and sprawled out. One of the main causes of increased air pollution in urban areas

is the presence of motor vehicles. The amount of pollution caused by vehicles varies based on the age and condition of the vehicles as well as the infrastructure of the city (Echevarria, Johnstone, Mejias, & Porras, 2000). Locations with winding roads or chronic traffic problems have higher amounts of air pollution due to vehicle idling (Mraihi, 2014). The layout of cities can cause the wind to speed up and slow down erratically, which increases the pollution concentration because it cannot be pushed out (Santamouris, 2001). Such a large concentration of air pollution is very damaging to the health of the city's inhabitants. According to a 2013 study in the United States, a decrease of  $10 \mu\text{g}/\text{m}^3$  of PM<sub>2.5</sub> (particulate matter up to 2.5 micrometers in size) seemed to be correlated with a 0.35-year increase in mean life expectancy (Correia, 2013). Areas with heavy air pollution, such as Beijing, China, have levels of particulate matter which can reach  $500 \mu\text{g}/\text{m}^3$  of PM<sub>2.5</sub> (Gardner, 2015). This amount of pollution has been reported to cause a decrease in life expectancy of almost 6 years compared to less polluted areas.

### **2.1.2 Traffic Congestion**

As the number of people commuting to work grows, transportation systems must support the increased demand. According to the 2014 Urban Mobility report, there was a 400,000 person increase in the workforce in the United States between 2012 and 2013 (Schrank, Lomax & Eisele, 2015). Due to this increase, Americans traveling in urban areas spent an additional 6.8 billion hours commuting and, as a result, had to purchase an additional 3.1 billion gallons of fuel. This congestion resulted in an additional \$153 billion in expenditures on fuel and vehicle maintenance due to the increase in travel times.

Traffic congestion is a major problem for urban areas. Beijing, for example, has such extreme traffic congestion that the average speeds on expressways occasionally drop below 10

kilometers per hour (Sun, Zheng, & Wang, 2014; Guo, 2015). A rapidly growing number of privately owned vehicles coupled with a decrease in the percentage of commuters who take public transportation has made Beijing one of the most congested and polluted areas in the world.

## **2.2 Car sharing**

Some believe car sharing is a way to alleviate congestion caused by private vehicle use and reduce the environmental impacts of vehicular transportation (Stefansdotter, Danielsson, Nielsen, & Sunesen, 2015). The phrase “car sharing” itself can have several meanings which can range from broad to specific. In this report, we will be using the phrase “car sharing” as a blanket term to cover all forms of transportation in which a private vehicle, owned by an individual or a company, is used by another individual. Car sharing, in general, attracts people who occasionally need alternative transportation when public transportation is either not viable or not preferred (University of California, Berkeley Transportation Research Center, 2014). Many of these car sharing services have similar core concepts such as unit pricing that includes insurance, and sometimes fuel (Fei, Lin, Quan & Tian, 2011). However, the way a vehicle is shared is what differentiates specific car sharing services. The types of car sharing we will cover in this chapter are car hailing, carpooling, and short-term car rentals.

### **2.2.1 The History of Car sharing**

The history of car sharing began in 1948 with the operation of a small cooperative car club known as Sefage in Zurich, Switzerland (Shaheen & Cohen, 2007). This initiative was created mainly for individuals who could not afford to purchase a private vehicle. Structured

short-term car rental services became more prominent in Europe in the early 1990s with services such as Statt in Germany, and Green Wheels in the Netherlands (Aragon, Humbaraci, & Papotto, 2011). Car clubs eventually came to the United States in 2000 by way of Zipcar in Boston, Massachusetts (Silva & Gameng, 2014).

### **2.2.2 Car Hailing**

Car hailing is a form of car sharing in which a passenger determines a destination and is driven there for a fee. The destination may or may not be determined before the passenger enters the vehicle. Some methods allow for the passenger to hail their ride in advance via a web-based service, whereas others are street hailed as needed. Car hailing allows the passenger to be driven from one location to another without needing to have the car returned or docked at the original location. Examples of these services include but are not limited to Uber, Lyft, and traditional taxis. Some car hailing services allow users to request a particular type of vehicle, such as black cars or sport utility vehicles. These services are popular throughout the world, especially in cities where there are large tourist populations, as well as individuals seeking rides at all hours (Pullen, 2014). This type of service is for passengers who do not wish to drive a car themselves.

### **2.2.3 Carpooling**

Carpooling is another method of car sharing where an individual who plans to drive from one location to another picks up one or more additional passengers (MASS.gov, 2014). This method is both economical and environmentally conscious because the driver and passengers can share the cost of fuel and parking while reducing the number of cars causing air pollution and congestion. This method of car sharing is popular in Washington, D.C. because highways around

the city contain lanes that can only be used by vehicles with three or more passengers (Wilson, 2013). Drivers pick up passengers who need a ride, similar to hitchhiking, enabling the driver and passengers to use special lanes to reduce commute time. An estimated 13% of commuters in the Washington, D.C. area use this form of transportation.

#### **2.2.4 Short-Term Car Rental**

Short-term car rental is when a person borrows a vehicle to drive for a small duration of time (Ducharme, Lam, Otuyelu, & Tombarelli, 2011). This service may be done through a car club or a peer-to-peer platform. A car club is a short-term car rental of a vehicle provided and owned by a company. Peer-to-peer car rental uses cars owned by private citizens instead of a company's fleet of vehicles (Carshare.hk, 2014). This does not include car rental companies that loan cars for longer durations of time, such as Avis, Budget, or Hertz.

Car clubs include registering as a member, which may or may not require an application fee, as well as yearly fees to maintain membership on top of the usage fees (Ducharme, Lam, Otuyelu, & Tombarelli, 2011). The member pays a unit rate that could be based on factors such as time of use and distance traveled. The member is responsible for picking up and returning the vehicle to its designated parking spot while in possession of the vehicle. An example of a car club is Zipcar, which began in Boston, Massachusetts, in 1999 (Silva & Gameng, 2014). Zipcar has proved popular with college students and people who occasionally need to use a car for a short trip. Many users have praised Zipcar for its convenience (Kirsner, 2010).

Peer-to-peer car rental is done through postings on platforms such as Carshare.hk or ECrent (Carshare.hk, 2014). Private citizens can list their vehicles to be rented for a certain fee, and individuals can request usage of the car. These rentals are facilitated through these

platforms; however, since private vehicles are being used instead of company cars, no additional vehicles need to be procured, maintained, or stored for this method of car rental.

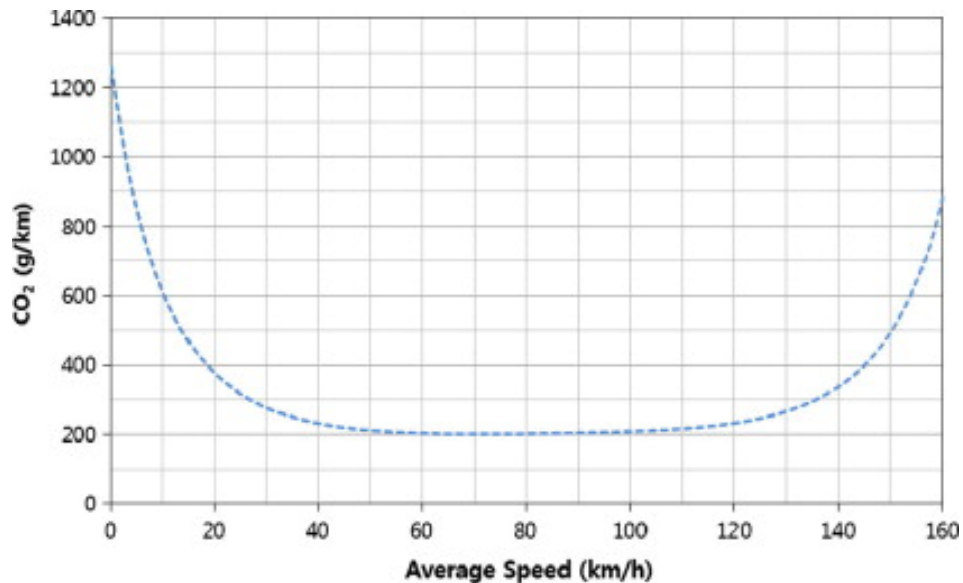
## **2.3 International Implementation of Car Sharing**

Car sharing companies have been entering major cities around the world. They provide convenience to the public and tourists and may be able to provide environmental benefits (Shaheen, Mallery, & Kingsley, 2012; Waxman, 2014). As these companies have been established, they have been seen as competition to other forms of public transportation, especially taxis (Zoroya & Waters, 2015). There have also been legal concerns regarding the insurance of the drivers, background checks, and taking away business from taxis (Farrell, 2012; Rhodan, 2014). Car sharing has received varied reactions from the public and from legal perspectives across the world.

### **2.3.1 Environmental Benefits**

Car sharing companies have been developing around the world and their impact on traffic congestion and air pollution has already been studied (An & Gu, 2014; Shaheen, Mallery, & Kingsley, 2012). According to a study in Orange County, California, the speed of a vehicle is directly correlated to the vehicle's carbon dioxide (CO<sub>2</sub>) emissions (Chung, Cho, & Choi, 2013). As indicated in Figure 2.1, when cars are moving slower or are stopped, they emit exponentially greater amounts of CO<sub>2</sub> than when traveling at faster speeds. This indicates that congestion is a major contributor to air pollution. When people begin using car sharing services, the amount they use their own vehicles tends to decrease (Shaheen, Mallery, & Kingsley, 2012). For various car sharing companies throughout the United States and Canada, it has been shown that there is an

average of a 40% reduction in vehicle miles traveled for those who enrolled in a car sharing program. With fewer vehicle miles traveled, there are fewer cars on the road, less traffic, and therefore, less pollution.



**Figure 2.1: Vehicular emissions compared to average speed (Chung, Cho, & Choi, 2013)**

### 2.3.2 Public Reactions

Travel habits tend to change after enrolling in car sharing programs. According to studies of various car sharing programs, 25-70% of car sharing users avoided future car purchases, depending on their location (Shaheen, Mallery, & Kingsley, 2012). Approximately 25-30% of the participants who owned cars ended up selling them, decreasing the number of cars on the road even more. In general, the response from the public has been positive in terms of convenience, satisfaction, and expansion of transportation options (Waxman, 2014; CBC News, 2015; Rogers, 2015). However, there are still some issues with the implementation of car

sharing. In China, many people see cars as a symbol of social status, so they would not choose to share a car if they could afford to own one (An & Gu, 2014).

Car sharing has had problems expanding in certain areas due to legislative ignorance about car sharing as a “potential sustainable transport solution” (An & Gu, 2014, p27). Some legislation concerning the explicit legalization of car sharing services stems from public reactions to proposed restrictions (Chen, 2012). In reaction to a proposed Washington, D.C. legislative amendment that required prices for services such as Uber to be at least five times that of traditional taxis, Uber customers signed petitions and urged legislators to pass a different amendment allowing Uber to operate without price restrictions; this amendment passed.

### **2.3.3 Response from Competitors**

The car sharing industry has not gone without competition from other car hailing services. Uber, which is “the dominant ridesharing service,” has three major car hailing competitors globally: Lyft, Curb, and Sidecar (Johnson, 2014). By-products of competition in the industry ranged from a previous employee stealing company secrets to accusations of ordering fake rides on a competitor’s app (Luckerson, 2014). This competition has even led to the termination of Sidecar’s operations on December 31, 2015 (Kia, 2016).

There has also been an influx of protests around the world from the taxi industry (Zoroya & Waters, 2015). Violent protests involving taxi drivers have occurred in both France and Germany. Established cab companies claim that car hailing services like Uber dodge regulations ensuring safety and uniform fares. Taxi drivers are concerned about a loss of customers and revenue (Scott & Plass, 2014). These concerns have not gone without notice, as a Berlin court has upheld a ban on Uber for using unlicensed cab drivers (Copley, 2015).



A protest was recently held in Albany, New York, by New York City cab drivers outside of Governor Andrew Cuomo's office after he sided against a proposed cap on the growth of Uber in the city (Harshbarger, 2015). The alliance of cab drivers in the city is concerned about the possible loosening of restrictions on car hailing services like Uber. They are also concerned about the disappearance of yellow cabs in New York as a result of Uber's growth in the city. The New York City taxi industry is, however, fighting back with a new taxi hailing app called Arro.

#### **2.3.4 Legal Consequences and Considerations**

Car sharing services have come under legal scrutiny (Farrell, 2012; Rhodan, 2014). Many areas have or had laws and regulations that are not definite regarding the legality of car sharing services. The legal climate in many areas continue to evolve regarding views on car sharing.

In response to public reaction to car sharing services, some jurisdictions have explicitly banned certain car sharing services, particularly services that use an online platform to set up rides, such as Uber (Reuters, 2015; Eddy, 2015). One such jurisdiction is Germany, where a March 2015 ruling instituted a nationwide ban on Uber's UberPOP car hailing service. It was found that drivers were not sufficiently licensed and that the company did not hold the proper insurance. In response to this, Germany's branch of Uber replaced UberPOP with a new car hailing service, UberX, which requires drivers to hold special licenses that allow commercial passenger transportation (Geiger, 2015). Additionally, drivers must return to a company location after each trip; this is a requirement to be classified as a legal chauffeur service. Uber claims that UberX is compatible with German laws.

Some government-level responses have been aimed at the creation of new laws explicitly permitting and regulating car hailing services. The California Legislature Assembly Bill No.

2293 (2014) addresses ambiguities of how services such as Uber and Lyft are objectively different from traditional taxi services. This bill created the term transportation network company (TNC) whose journeys must be prearranged via a digital platform, such as a smartphone application. Creating a narrow definition allows for an exact set of rules to regulate car sharing services separately from traditional taxi services (Los Angeles Times, 2014).

California Legislature Assembly Bill No. 2293 (2014) created regulations and procedures about who may operate TNCs as well as safety, insurance, and training requirements for these companies.

Other legal hurdles come from the classification of car hailing service drivers, particularly if drivers are employees of the service that they drive for or are independent contractors (Bosch, 2015; Levine, 2015). The distinction between employee and contractor is of great importance because in some jurisdictions, car hailing companies would be required to pay taxes for and provide benefits to employees, but not for independent contractors (Nusca, 2015). Additional regulations, such as minimum wages and overtime pay, may apply to employees but not to independent contractors (Scheiber, 2015). In the United States, some states have distinguished car hailing service drivers to be employees of the service provider, while other states have defined these same drivers as independent contractors (Levine, 2015; Farrell, 2014; Nusca, 2015). A potential remedy for problems stemming from defining the driver as either an employee or independent contractor is creating a new class of worker, called an “independent worker” (Isaac & Singer, 2015; Scheiber, 2015; Harris & Krueger, 2015).

Legal challenges remain despite laws passed with the intention of allowing and regulating car sharing services. Because many laws and lawsuits concerning car sharing services have been fairly recent developments, their larger effects and significance may not be known for some time

(Nusca, 2015). Some of these developments are ongoing, such as appeals that remain pending, with outcomes that could affect the future of car sharing services (Isaac & Singer, 2015).

## **2.4 Current State of Transportation in Hong Kong**

Hong Kong is serviced by an excellent public transportation system consisting of trains, buses, ferries, escalators, and taxis. Each day, people in Hong Kong take about 12.5 million journeys using public transportation (Hong Kong Information Services Department, 2015). It has the highest rate of public transportation usage in the world in terms of percentage of journeys taken by public transportation annually (Cervero & Murakami, 2008). The public transportation system in Hong Kong makes a profit, which is very uncommon for other places in the world. The following sections will introduce the public transportation modes that operate within Hong Kong. Not included are transportation modes to locations outside of the Hong Kong Special Administrative Region, as well as escalators and ferries which are not primary modes of transportation for a majority of users.

### **2.4.1 Trains**

Railways in Hong Kong are operated by the MTR Corporation Limited (2014), or MTRCL. The Hong Kong government sold some of its shares in the MTRCL in 2000, expanding the ownership of the MTRCL to include private investors. Rail journeys account for 41% of all public transportation journeys (Hong Kong Transport Department, 2015). The Mass Transit Railway (MTR) system operates nine electric MTR lines that service 87 stations throughout Hong Kong, with a total route length of 177.4 kilometers. Each day, the MTR carries over 4.5 million passengers. The MTR (2013) has an excellent on-time performance record, with 99.9%

of journeys arriving on-time. Trams, operated by Hong Kong Tramways Limited (2015), are another part of Hong Kong's rail system. Electric trams, 165 in total, run on seven lines that cover 18 kilometers of track. Ridership of the tram is about 184,000 journeys per day (Hong Kong Transport Department, 2015).

#### **2.4.2 Buses**

The bus system in Hong Kong consists of franchised buses, non-franchised buses, and public light buses (Hong Kong Information Services Department, 2015). Five private bus companies operate the franchised buses. Combined, the private bus companies own over 5,500 buses that cover over 600 routes, serving more than 3.5 million passengers per day. Private companies operate more than 7,000 non-franchised buses, which are used to supplement normal bus routes during peak hours, as well as in areas where there is not enough demand to have a regularly scheduled franchise bus (Hong Kong Transport Department, 2015). Public light buses, also known as minibuses, carry sixteen or fewer passengers. Green minibuses run on fixed scheduled routes with fixed fares while red minibuses are free to operate anywhere and can set their own fares.

#### **2.4.3 Taxis**

Over 18,000 taxis serve Hong Kong's territory (Hong Kong Transport Department, 2015). There are three types of taxi, each restricted to a certain geographic areas. There are 15,250 "Urban taxis", which are colored red and operate in Kowloon, Hong Kong Island, and the New Territories, with a few exceptions. There are 2,838 "New Territories taxis" which are green and restricted to the New Territories. The 50 "Lantau taxis" are colored blue and operate on

Lantau Island and around Chep Lap Kok Airport. As of 2003, all taxis in Hong Kong run on liquefied petroleum gas, or LPG (Leung, 2011). Previously, Hong Kong taxis ran on diesel fuel; the government initiated the move to LPG because LPG emissions are less harmful than diesel emissions.

Taxi fares are regulated by the government and are determined based on distance traveled, time waiting in traffic, tolls, and the number of pieces of baggage (Hong Kong Transport Department, 2015). All taxis must have a license to operate; since 1998, the number of taxi licenses has been fixed at 18,138 licenses (Wong, 2015). Because of this, the price to obtain a taxi license is over \$7 million HKD. Taxi drivers often rent a vehicle from a taxi license holder; they are considered individual operators and not employees of the taxi owner (Tsang & Leung, 2015).

Some view the taxi services of Hong Kong to be too monopolistic since more than 90% are owned and managed by the same four companies (Wong, 2015). A lack of competition, combined with the government-regulated fares, has made some believe the taxi drivers do not feel the need to provide quality service. In recent years, complaints against taxi services have risen (Lee, 2015). Common complaints include rude drivers, overcharging, and taking a longer route than necessary. Users of taxi and car sharing services have indicated that they overwhelmingly prefer Uber specifically due to better customer service and convenience (Griffiths, 2015).

#### **2.4.4 Private Cars**

As of June 2015, there were about 500,000 private cars registered in Hong Kong, accounting for 71% of road vehicles (Hong Kong Information Services Department, 2015).

Comparatively, there are about 113,000 goods delivery vehicles, about 20,000 franchised, non-franchised, and light buses, and about 6,000 government vehicles. Purchasing, registering, and operating a private car in Hong Kong is very expensive. Taxation on a new car can exceed 100% of the price of the car. Because of this, the rate of car ownership in Hong Kong is much less than other cities of comparable size, population, and wealth (Fisher, 2012). Studies in Hong Kong suggest that once a car is acquired, dependence on the car increases quickly, regardless of the effectiveness of the public transportation system (Cullinane & Cullinane, 2003).

#### **2.4.5 Traffic Congestion**

Despite the relatively low rates of private vehicle ownership, traffic congestion is a serious problem in Hong Kong (Hong Kong Transport Advisory Committee, 2014). Rates of private vehicle ownership continue to grow, with an increase of about 4.5% per year. Hong Kong's roads will not be able to effectively cope with the increase in vehicles in the future, even with increased road construction. Compared to buses, private vehicles are much less space efficient. They account for 16% of road passengers and 40% to 70% of traffic on major roads during peak hours; buses and minibuses account for 71% of road passengers while taking up only 5% to 25% of road traffic.

#### **2.4.6 Attempts to Alleviate Congestion**

Efforts made in the past to curb private vehicle ownership rates and congestion included increases in taxes and fees, and congestion charges, where drivers pay a toll to enter certain areas at particularly busy times (Hong Kong Transportation Advisory Committee, 2014). In a similar fashion, Hong Kong has previously offered tax incentives for environmentally-friendly private

petrol vehicles. Offered from April 2007 to March 2015, the program was terminated because the government judged emission control technologies in petrol vehicles to be sufficiently advanced to the point where the possibility of further emission reduction is limited (Hong Kong Environmental Protection Department, 2015). However, these tax incentives may have actually hindered efforts to reduce private vehicle ownership (Hong Kong Transportation Advisory Committee, 2014). Many of the recommendations with the intent of curbing the growth of private vehicle ownership have focused on increasing the cost of owning and operating a vehicle. Efforts to reduce the environmental impact of private vehicles may reduce street-level pollution, but this does not contribute to reductions in congestion.

## **2.5 Introduction to Car Sharing in Hong Kong**

Although car sharing is relatively new to Hong Kong, car club startups like Carshare.hk are starting to take off (Sharp, 2015). Carshare.hk (2014) is a car rental service that rents out cars owned by private citizens. Customers rent these cars when not in use by the owner. This eliminates the need for cars to be procured for the specific intent of car sharing while also eliminating the need for specified car bays as the cars can be returned to the car owner's parking space.

Web-based carpooling had its start in Hong Kong with the launch of Carpool King (2015) in 2007. Carpool King allows better utilization of a driver's car space by setting up points along a driver's normal route in order to pick up one or multiple passengers. The passenger and driver can negotiate compensation before the trip, or no compensation at all, similar to hitchhiking. Similar services operating in Hong Kong, such as CarpoolWorld (2015), allow compensation in the form of splitting costs, sharing coffee, music, food, or taking turns driving.

Online based car hailing arrived in Hong Kong when Uber (2015) launched its low-cost car hailing option UberX on December 3rd, 2015. This joins Uber's existing service of UberBlack, a black car service. This new service allows private citizens to use cars they already own to transport riders for a fee. By utilizing privately owned cars and contracting owners of the cars, Uber is able to offer 20% lower rates compared to UberBlack.

Car hailing services in Hong Kong have not been without controversy (Chan, 2015). Some taxi drivers see car hailing services such as Uber as a threat to their jobs. Concerns over the licensing and regulation of Uber drivers and vehicles have also contributed to negative publicity (Boxwell, 2015). In August 2015, seven Uber drivers were arrested for illegally transporting passengers for reward (Pomfret, 2015). Police stated that the Uber drivers did not have the necessary permits and insurance, while an Uber spokesperson stated that the drivers were qualified. On the same day, police searched an Uber office in Hong Kong and confiscated computers and documents, in addition to arresting seven Uber staffers. On Friday, January 22, 2016, two of the drivers were brought to court and found guilty of "using a car for hire without a permit and driving that vehicle without the specific third-party insurance required" (Ngo, 2016, para. 5).

Some of the controversies surrounding car sharing services stem from the lack of clear regulations (Wong, 2015). There are many interpretations about the legality of car sharing services in Hong Kong; some individuals, such as taxi drivers and certain government officials, view services such as Uber to be explicitly illegal, while others view the law as ambiguous towards these services (Pomfret, 2015; Wong, 2015; Soo, 2015). Taxi drivers throughout Hong Kong have even held protests against car hailing apps (Soo & Feng, 2015).



Contrary to some negative opinions of car sharing in Hong Kong, many view car sharing services as a smart business move that improves the quality of Hong Kong's transportation options (South China Morning Post, 2015). Increased competition from car sharing services such as Uber have the potential to increase the quality and efficiency of existing transportation; for example, the Hong Kong Taxi Trade Council, which represents over half of Hong Kong's taxi drivers, has launched an app as an alternative way to hail a taxi (Chan, 2015).

## **2.6 Summary**

Hong Kong has an excellent public transportation system, with very high rates of usage and reliability. However, despite the relatively low rates of private vehicle ownership, traffic congestion and air pollution are at problematic levels. Studies have shown that high levels of air pollution are correlated with adverse health effects, and traffic congestion leads to reduced quality of life. Private vehicle ownership rates continue to rise and Hong Kong's roads cannot effectively support an increase in the number of vehicles.

Car sharing is a method of transportation that has been implemented in various locations around the world where an individual utilizes a car owned by a different entity. These services are relatively new to Hong Kong and have seen both support and backlash from members of the public and the government. Increasing the availability and knowledge of car sharing may be an approach to reduce traffic congestion and air pollution in Hong Kong, but there is currently no data on the what public thinks about this new method of transportation or what areas may benefit from an increased use of car sharing. The methods we used to answer these questions are discussed in the next chapter.

### **3. Methodology**

The goal of this project was to provide Friends of the Earth Hong Kong with recommendations regarding the feasibility of expanding car sharing services in Hong Kong as a way to reduce traffic congestion and lower air pollution levels. Our objectives to achieve this goal were to determine the overall receptivity among Hong Kong residents and tourists of car sharing services, to identify where and when car sharing services would be most beneficial to Hong Kong, and to determine the likely effects of increased car sharing on traffic congestion, air quality, and society. In this chapter we describe the methods we used to achieve our objectives and goal.

#### **3.1 Determining the receptivity to car sharing**

Car sharing services are relatively new to Hong Kong and have been controversial since their inception. Public opinion towards car sharing services is likely to be a significant driving force in determining their success. To gain insight on people's opinions, we held interviews with experts and conducted a survey with the general public.

Friends of the Earth Hong Kong provided interview contacts with the car sharing service providers Erent and Uber. These interviews allowed our team to gain valuable information on the business aspects of car sharing services, as well as the challenges that these companies are facing. Interview protocols can be found in Appendix C.

We also looked at Who's Driving You (2016), a database of news sources documenting current events involving car sharing services. We used this database to evaluate how these events may affect public opinion.

In order to determine the Hong Kong public's opinions about car sharing, we carried out a survey with locals outside of public areas (see Appendix B for the survey questionnaire). The questionnaire asked about the opinions of current and potential car sharing users. The first five questions of both the car owner and non-car owner questionnaires were identical demographic questions, asking for gender, age, occupation, monthly income, and where the respondent lives. These questions were included to determine if there were any significant correlations between demographics and receptivity to car sharing. In the questionnaire specifically for non-car owners, Questions 6, 7, and 8 were specific to car sharing. Our goal for the survey was a sample of 200 participants. We developed the questionnaire in both English and Chinese and created a paper and online version to maximize accessibility. We insured the anonymity of all respondents and indicated this before a respondent started the questionnaire.

We created a university collection page and a general public collection page for the online version. They were identical surveys but were kept separate in order to determine the origin of the data. The university version was sent to a professor at The Hong Kong Polytechnic University to be distributed among his students and we posted the survey to a Facebook page of university students created for the purpose of car sharing. In addition, we contacted Student Unions and faculty group email addresses at University of Hong Kong, City University, Chinese University, and The Hong Kong Polytechnic University and provided the link to the survey to distribute throughout the university. The general online survey was posted to a Facebook group of car sharing individuals from Tai Po and some of Friends of the Earth Hong Kong's contacts. These surveys were active from Friday, January 22<sup>nd</sup> to Sunday, February 21<sup>st</sup>.

The paper questionnaire was administered over three days, in five different locations. The first round of surveys was conducted near the Central MTR station and University of Hong Kong

on Monday, January 25<sup>th</sup> between 10:00 AM and 1:00 PM. We surveyed using a convenience sampling approach in order to maximize the number of responses, so the sample of responses are not necessarily an accurate representation of Hong Kong's overall population. When surveying in Central, we were able to gain the most responses by interviewing those waiting for a bus. Students at the University of Hong Kong were approached while sitting on benches near a snack bar. Many of them had free time, so they were able to complete our survey. The second round of survey data was collected in Kowloon Park in Tsim Sha Tsui and then at City University on Tuesday, January 26<sup>th</sup> between 11:00 AM and 2:30 PM. Collecting responses in the park allowed us to get a larger range of demographics. When collecting data at City University, we approached people sitting at tables in a common area on the campus. The third round of surveying was administered at Chinese University of Hong Kong on Monday, February 1<sup>st</sup> between 11:30 AM and 1:45 PM. We approached students in a cafeteria to have them fill out the questionnaire.

### **3.2 Identifying locations and times car sharing would be most beneficial**

Demand for car sharing services may differ based on geographic location and time of day. Factors such as transportation availability, traffic congestion, and toll prices may affect the demand for car sharing services.

To determine where and when car sharing services would be most beneficial in Hong Kong, we reviewed records that provided data on things such as traffic congestion in relation to location and time, and the ratio of private vehicles to other types of vehicles at particular locations (Hong Kong Transport Department, 2014, 2015, 2016; Hong Kong Transport Advisory Committee, 2014). Examples of records we used included historical traffic trends and maps of

roads and public transportation routes. Triangulating multiple forms of relevant data gave us a holistic overview of problem areas. Traffic data was collected from Google's crowdsourced traffic analyzer tool, which showed what locations had heavy traffic during different times of day (Google Traffic, 2016). Data from the Transport Department of Hong Kong was also analyzed to find transportation trends at the three tunnels that cross Victoria Harbour as well as on other major roadways. These maps and documents were used to determine the potential reduction in traffic congestion if there was a reduction in private car usage.

In addition to exploring ways car sharing would reduce air pollution and traffic congestion, we learned about other methods that may deter people from driving private vehicles. We interviewed Andrew Pickford at MVA which is a transportation research and consulting firm. His work focuses on the reduction of air pollution and improved efficiency of travel, so he was able to share his opinions about our research objectives.

### **3.3 Determining Likely Environmental and Social Responses of Increased Car Sharing**

An increase in car sharing would reduce the number of private vehicles on the road in Hong Kong, thus reducing the air pollution caused by private cars. To determine the likely environmental effects of increased car sharing, we created a framework that could be used to find the actual reduction in carbon emissions. To collect the data that this framework would use, we performed archival research on the average daily travel distances, number of cars by engine size, and fuel economies by engine size of cars in Hong Kong. We also identified a carbon emissions calculator created by an environmental organization, Carbon Footprint Ltd (2015), which would enable an annual amount of vehicle carbon emissions to be calculated using fuel economy and annual distance traveled. By calculating emissions data from vehicles alone instead of using the

national emissions average per person in Hong Kong, we were able to obtain results that more accurately reflect air pollution from cars. This is because the national emissions average per person would include carbon emissions data from public transportation, electricity, heat, and all other activities instead of solely the carbon emissions from private cars. The data we gathered from car owners was used in conjunction with previous studies of car owners who have used car sharing to determine the number of cars that would be removed from the road due to an increase in car sharing.

In addition to creating a framework that can be used to determine carbon emission reductions with increased car sharing, we determined likely social responses to increased car sharing from the public and private sector. We examined our survey data, specifically comparing responses from those who have used car sharing services to those who have not. We also used results from our interviews with Dr. Hung Wing-Tat, an expert on transportation systems and a professor of Civil Engineering at The Hong Kong Polytechnic University, and Andrew Pickford at MVA to determine how society might react to increased car sharing and changed transportation policies in general.

### **3.4 Summary**

We used all of our methods to gather information about the complex and controversial topic of car sharing in Hong Kong and how its expansion might impact the city. Our survey, interviews, and archival research supplied us with data that helped us meet our objectives. In our next chapter, we present the results of our research.

## **4.0 Results and Analysis**

In this chapter, we analyze the feasibility of car sharing in Hong Kong to reach our ultimate goal of providing recommendations to Friends of the Earth Hong Kong. We used the data collected to determine the public's receptivity to car sharing, locations and times where car sharing would be most beneficial, and the likely effects of increased car sharing.

### **4.1 The public's receptivity to car sharing**

Our car sharing opinion survey's responses totaled 205, with 17 of the respondents owning a car and 188 not owning a car. We found that individuals aged 18-24 were more willing to respond to our survey than older people. When we requested responses from an older demographic in Lan Kwai Fong and Kowloon Park, most of them were unwilling to answer our survey. This realization led us to carry out most of our surveying on university campuses, so a large portion of our responses came from college-aged individuals. Since the survey disproportionately takes into account the opinions of students aged 18-24, the data cannot be considered to be representative of Hong Kong's population as a whole. To gauge the disparity of results from 18-24 year olds and 25 and older, we analyzed the responses about the legality, convenience, affordability, and safety of car sharing from the two age groups (see Appendix E1). This analysis shows that although there are some differences, the responses did not differ enough to greatly alter our interpretation of the results. A complete table of survey responses can be found in Appendix D.

### 4.1.1 Non-Car Owners

Receptivity to the aspects of legality, convenience, safety, and affordability of car sharing was generally positive, but there was also a large number of respondents who were neutral or unsure (see Appendix E2). In order to find useful trends in our data, we divided up the survey responses into those who had previously used car sharing and those who had not (see Appendix E3). Survey response data indicated that the 63 non-car owners who had used car sharing services in the past were likely to have positive opinions about car sharing (see Figure 4.1a). By comparison, the 125 non-car owners surveyed who had never used car sharing tended to have

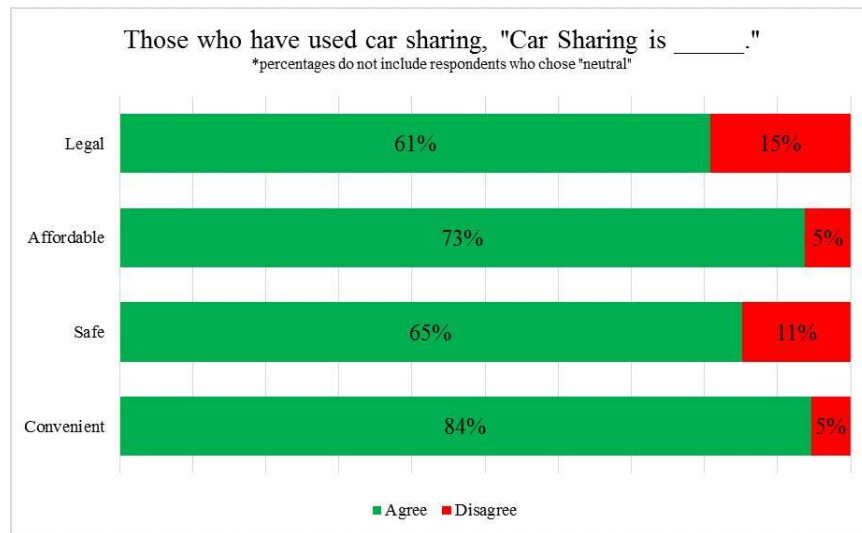


Figure 4.1a: Those who have used car sharing

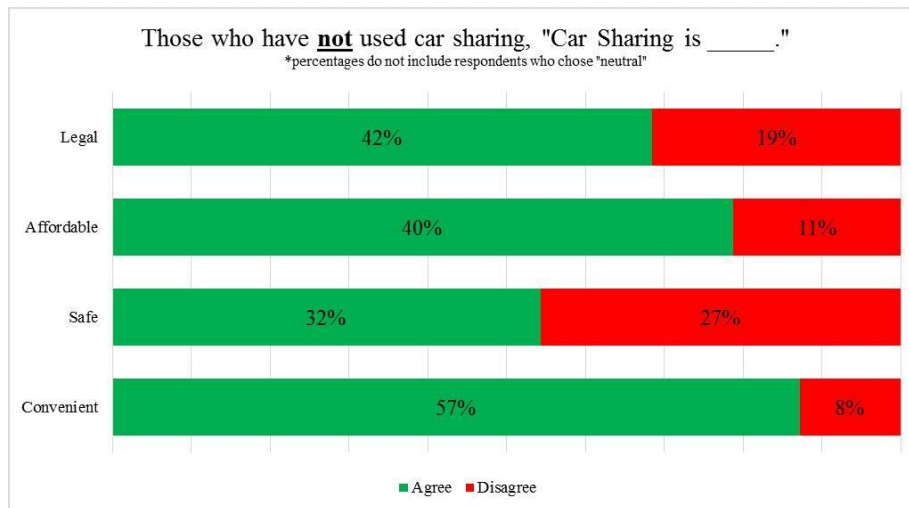
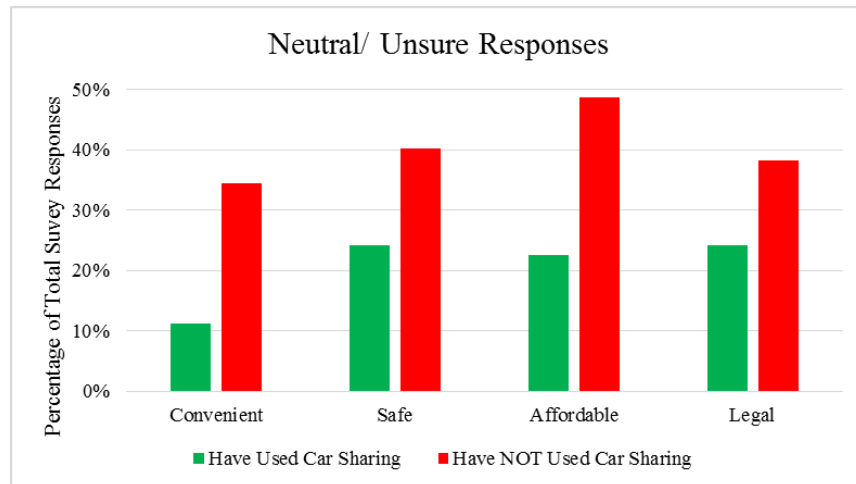


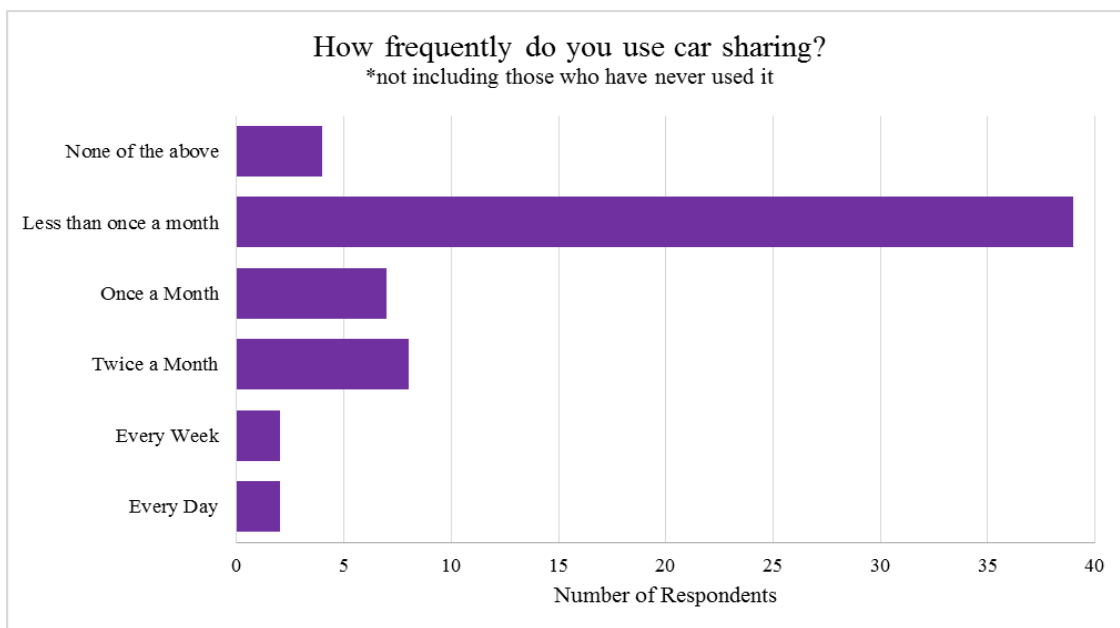
Figure 4.1b: Those who have not used car sharing





**Figure 4.2: Neutral/ Unsure Responses**

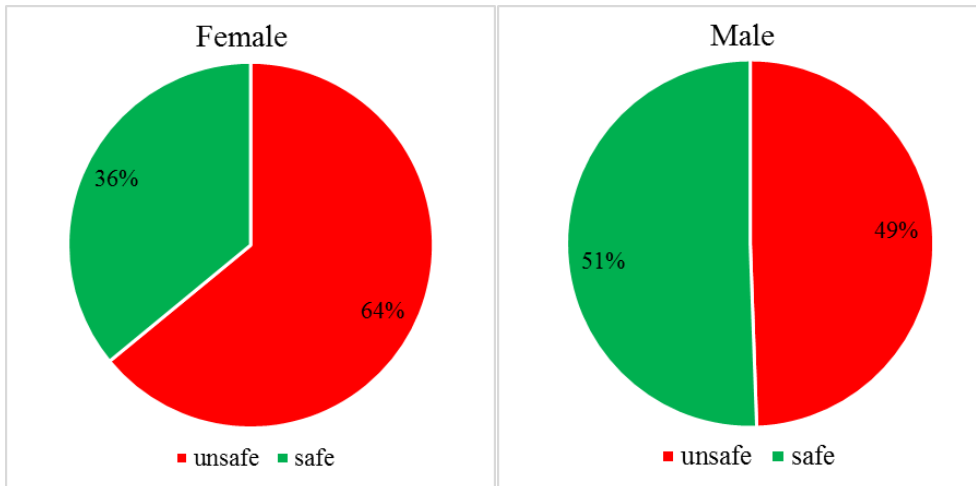
more negative or neutral opinions about car sharing (see Figure 4.1b). Negative or unsure opinions of car sharing may deter individuals from trying the services, but once the service has been used, the uncertainties seem to be alleviated. Similarly, respondents who had used car sharing services were more likely to have a definitive opinion of car sharing, as evidenced by the lower percentage of respondents who answered neutral or unsure (see Figure 4.2). Although those who had used car sharing before tended to have more positive viewpoints on car sharing, many of them had not used car sharing very frequently.



**Figure 4.3: How frequently do you use car sharing?**

Most respondents who indicated that they had used car sharing services before used it less than once a month, as seen in Figure 4.3. This would indicate that after a single use of car sharing, individuals had begun to develop positive views towards car sharing. The car hailing company Uber has used this trend in their marketing. They hold promotions in locations not easily accessible by current public transportation, such as Sha Tin in the New Territories (see Appendix C). Individuals were given the opportunity to try Uber services free of charge. Following this promotion, those who may not have wanted to use car sharing in the past continued to hail Uber rides even after the conclusion of the promotion. This suggests that the neutral feelings from those who had previously not used car sharing became positive after trying the service, and rates of car sharing usage increased after being exposed to it a single time.

Comparing the responses of the 96 females and the 91 males surveyed who did not own a car, there was a general consensus about the legality, affordability, and convenience of car sharing (see Appendix E4). However, as Figures 4.4a and 4.4b indicate, females were more likely than males to be unsure of the safety of car sharing. A little over a third of females agreed that car sharing was safe, compared to over half of males who believed it to be safe. This may be because females are aware that they are more likely to be targeted for assault by car sharing drivers. Since July 2013, approximately 94% of reported sexual harassment or assault incidents involving car sharing drivers have been directed towards women (Who's Driving You, 2016).

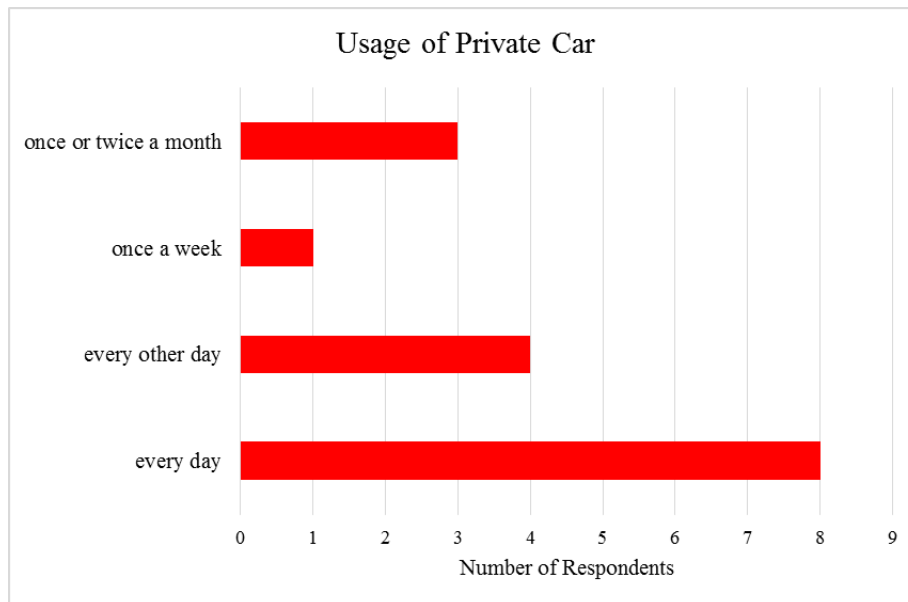


**Figure 4.4a: Female Respondents**

**Figure 4.4b: Male Respondents**

### 4.1.2 Car Owners

Respondents who owned cars cited flexibility as the main reason for owning a private car (see Appendix E5). As seen in Figure 4.5, we found that half of the car owners used their cars every day, while a fourth used their car every other day. According to Andrew Pickford of MVA,



**Figure 4.5: Use of Private Car**

even when car owners use their cars daily, a large majority of the time the car is parked. He gave the example that if a car owner drives 30 minutes to work and 30 minutes home, the car is only

used about 5% of the time. Some individuals surveyed indicated that they used their private car as little as twice a month, which means their vehicles would be used even less than 5% of the time. This is where services like Carshare.hk or ECrent would be useful because during the 95% of the time in which the car is not in use, other individuals could rent the car. However, we noticed that most of the respondents surveyed were not comfortable renting out their cars to others, so people would need to be encouraged to do so. Most were willing to carpool and they recognized the environmental and potential monetary benefits of sharing their cars with other riders (see Appendix E6).

We interviewed Ms. Jeanie Lau, Business Development Manager at ECrent, about the “sharing economy”, in which personal items are rented rather than purchased, and its impact on car sharing. Ms. Lau explained to us that ECrent acts as an online posting board where its users can pay a small fee to post products available to rent, including privately owned vehicles. ECrent’s rapid growth since its founding in 2013 indicates a positive reception and demand for the sharing economy among the public. We were informed that the car renting portion of ECrent is one of their most widely used individual categories of products. Ms. Lau told us about a time her supervisor Thomas Chan, Chairman of ECrent, listed his car for rent and received multiple responses within hours of the original listing, indicating a potentially high demand for community-based car rentals. For notes on the interview, see Appendix C.


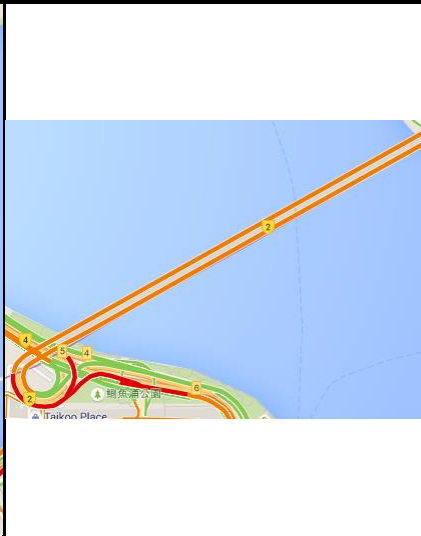


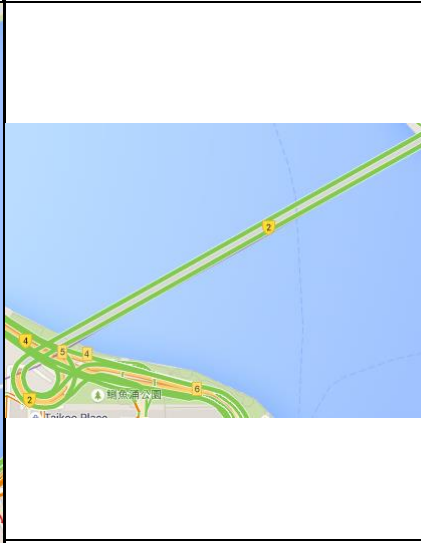
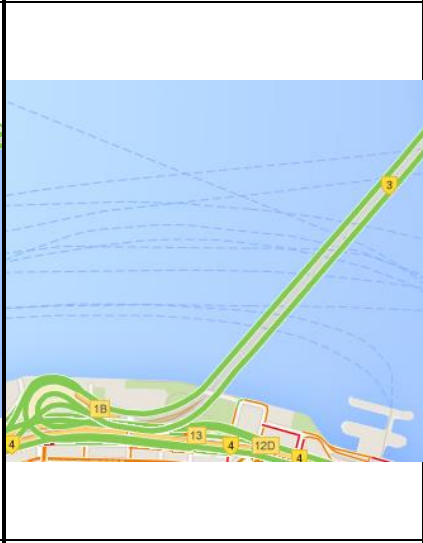

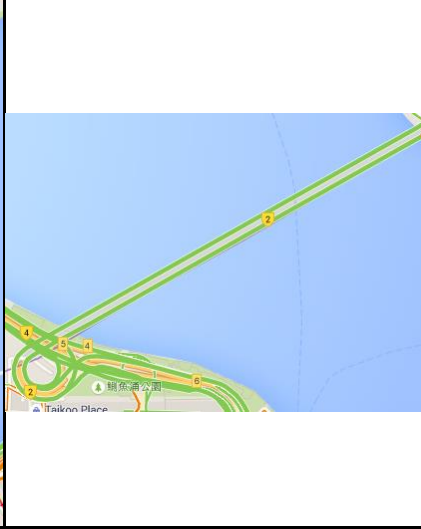
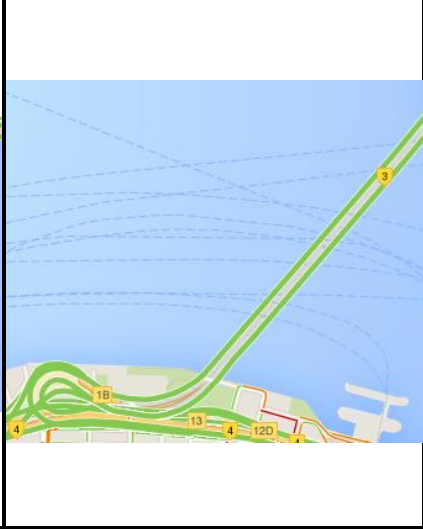
#### **4.2 Locations and times car sharing would be most beneficial**

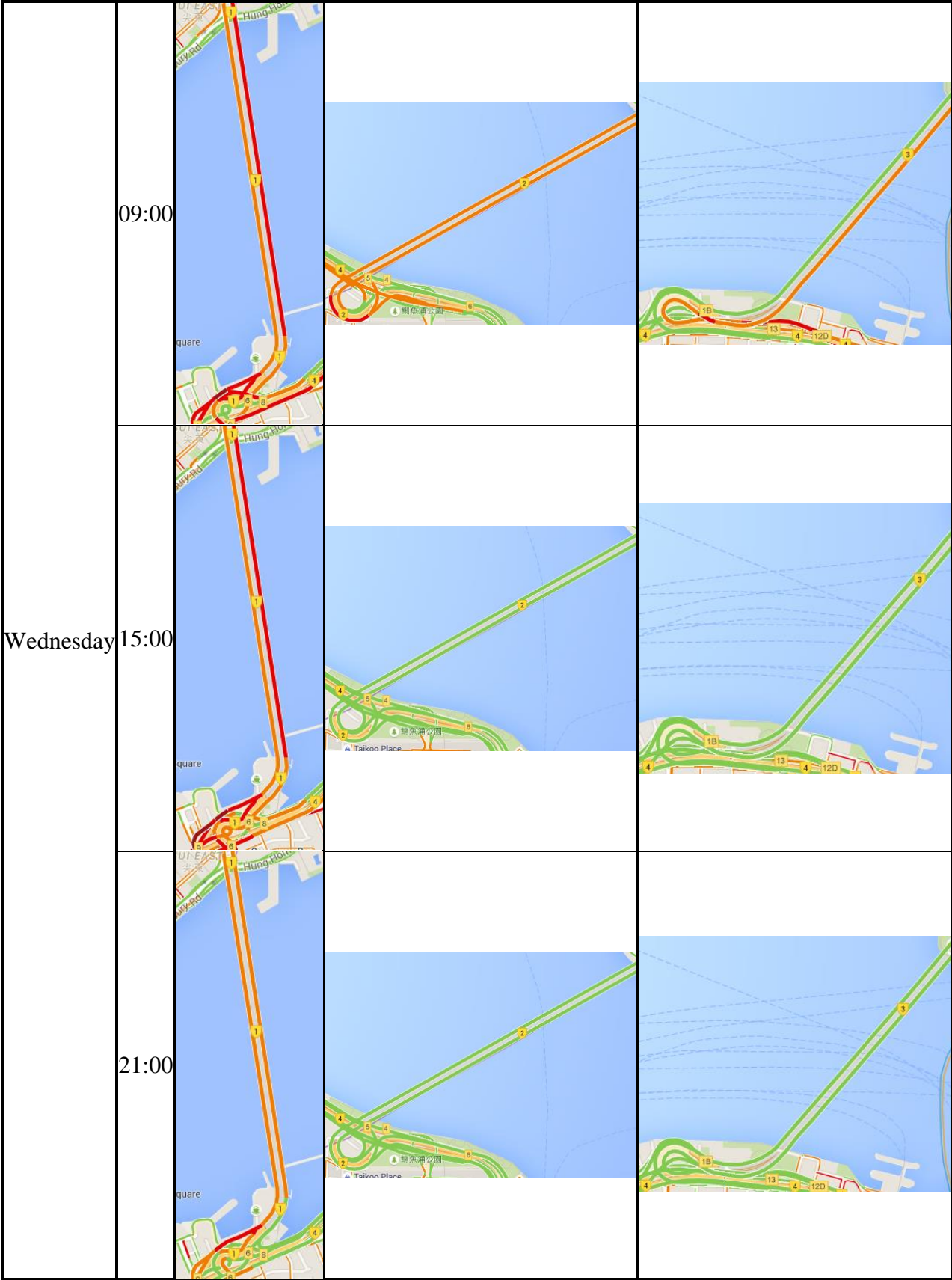
To determine times and locations where car sharing services could be most beneficial for alleviating traffic congestion, we analyzed traffic congestion levels, toll prices, and types of vehicles in major tunnels and on heavily used roads. These metrics were found using archival

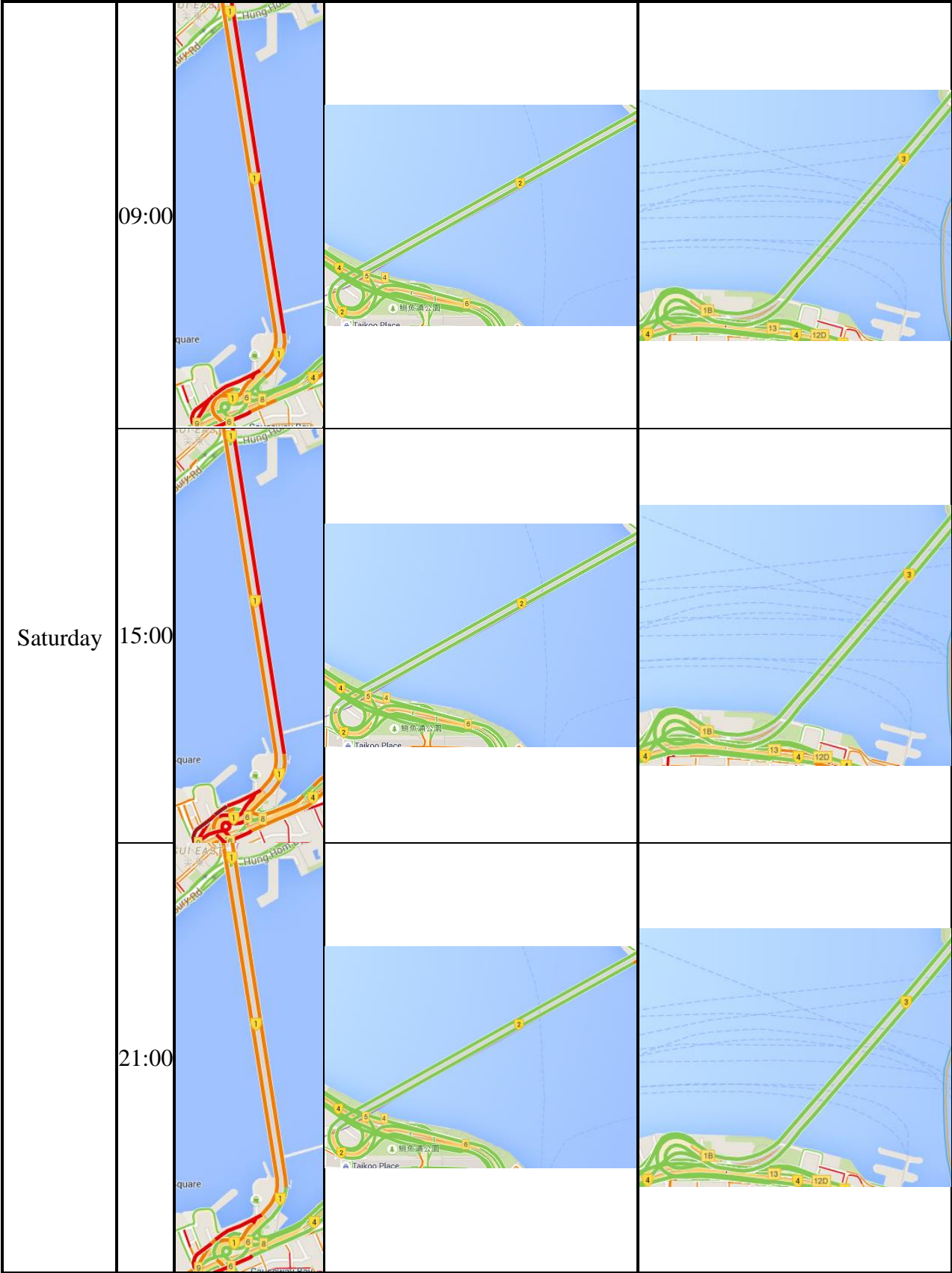
research, including crowdsourced traffic data from Google (2016) as well as published traffic data from the Hong Kong Transport Department (2014, 2015, 2016), the Hong Kong Transport Advisory Committee (2013), and Electrical and Mechanical Services Department (2014). The tunnels we analyzed were the Western Harbour Crossing, Cross Harbour Tunnel, and Eastern Harbour Crossing, and the roads we analyzed were Connaught Road Central on Hong Kong Island, and Princess Margaret Road and Nathan Road in Kowloon. We believe these locations are most prone to air pollution due to the frequent reduction in speed of vehicles on these roads, which causes exponentially greater emissions (see Figure 2.1).

#### **4.2.1 Tunnels**

As a result of our archival research, we found three of the most widely used roads in Hong Kong are the three main tunnels connecting Hong Kong Island and Kowloon (Hong Kong Transport Department, 2015). We analyzed these tunnels from crowdsourced data provided by Google Traffic to determine how significant the congestion was in these areas. From this data, we learned that these roads can be very congested, especially at peak times of day. The data in Figure 4.6 shows the traffic in each tunnel on Monday, Wednesday, and Saturday at 09:00, 15:00, and 21:00. These hours and days were chosen to show the beginning of the week, the middle of the week, and the weekend, during rush hour, mid-day, and night time to give a wide range of data.

| Day    | Time  | Cross Harbour Tunnel                                                                | Eastern Harbour Crossing                                                             | Western Harbour Crossing                                                              |
|--------|-------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Monday | 09:00 |    |    |    |
|        | 15:00 |   |   |   |
|        | 21:00 |  |  |  |





**Figure 4.6: Crowdsourced Traffic Data for Tunnels, Google Traffic (2016)**



The traffic data provided is color-coded, where green represents free-flowing traffic, orange means there are some slowdowns, red represents heavy traffic, and dark red means the flow of vehicles is stopped. As shown in Figure 4.6, the Eastern Harbour Crossing and the Western Harbour Crossing are both fairly congested during the morning commute but remain relatively clear for the rest of the work day, as well as on weekends (Google Traffic, 2016). The Cross Harbour Tunnel, however, is congested at all times and on all days for which we obtained data.

Heavily congested areas may benefit from car sharing if the congestion is caused by private vehicles. To determine the sources of this traffic, we analyzed traffic data from the Transport Department that indicated the number of each vehicle type using the tunnels throughout the year (Hong Kong Transport Department, 2015). Table 4.1 shows the total number of private cars compared to the total number of vehicles to determine the percentage of private cars using each tunnel.

**Table 4.1: Vehicular Flow Through Cross Harbour Tunnels, (Hong Kong Transport Department, 2015)**

| <u>Annual Total Number of Vehicles</u> |                      |                          |                          |
|----------------------------------------|----------------------|--------------------------|--------------------------|
| <b>Tunnel</b>                          | Cross Harbour Tunnel | Eastern Harbour Crossing | Western Harbour Crossing |
| <b>Number of Private Cars</b>          | 16,409,196           | 14,592,003               | 11,112,576               |
| <b>Total Number of Vehicles</b>        | 42,044,261           | 26,657,699               | 23,006,349               |
| <b>Percentage of Private Cars</b>      | 39.03%               | 54.74%                   | 48.30%                   |

Even though the Cross Harbour Tunnel has significantly more congestion, with many millions more vehicles annually, only 39% of the vehicles traveling through it are private cars,

compared to 55% and 48% in the Eastern and Western Harbour Crossings, respectively (Hong Kong Transport Department, 2015). This disparity is most likely due to the significantly higher toll prices in the privately owned Eastern and Western Harbour Crossings than in the government owned Cross Harbour Tunnel (Hong Kong Transport Department, 2016). As shown in Table 4.2, the toll for private cars is 25% higher in the Eastern Harbour Crossing and 200% higher in the Western Harbour Crossing than in the Cross Harbour Tunnel. These increases are minimal compared to single and double-decked buses, which have a 400% and a 1000% higher rate in the

**Table 4.2: Toll Prices for Select Vehicles in Cross-Harbour Tunnels (Hong Kong Transport Department, 2016)**

| <b>Vehicle Type</b> | <b>Cross Harbour Tunnel</b> | <b>Eastern Harbour Crossing</b> | <b>Western Harbour Crossing</b> |
|---------------------|-----------------------------|---------------------------------|---------------------------------|
| Private Cars        | \$20                        | \$25                            | \$60                            |
| Taxis               | \$10                        | \$25                            | \$55                            |
| Light Buses         | \$10                        | \$38                            | \$70                            |
| Single-Decked Buses | \$10                        | \$50                            | \$110                           |
| Double-Decked Buses | \$15                        | \$75                            | \$155                           |

Eastern and Western Harbour Crossings, respectively. Light buses have relatively lower toll prices in those two tunnels compared to larger buses, but they are still paying very high tolls.

Andrew Pickford indicated that since the Eastern and Western Harbour Crossings are privately owned, their commercial objectives encourage higher tolls in order to turn a profit (See Appendix C).

For the private cars that use the tunnels, the majority of them are not at full occupancy. According to the Annual Traffic Census from the Hong Kong Traffic Department (2014), the average occupancy is 1.3 persons per vehicle at peak travel times and 1.5 persons per vehicle

during the rest of the day (see Appendix F). This means that during times of high congestion, for every four private cars, only one of them would have two persons riding in it, and the rest would contain only the driver. With so many private car owners traveling alone, there is a high potential for traffic reduction if several individuals drove together in the same car.

After analyzing the traffic patterns, percentages of private vehicles using tunnels, toll prices, and average occupancy of private cars, we determined that the Western Harbour Crossing and the Eastern Harbour Crossing would both benefit from car sharing during commuting hours. Although the percentage of private vehicles compared to other types of vehicles is much lower, the number of private vehicles using the Cross Harbour Tunnel is much greater than in the other two tunnels. Because of this, car sharing would not eliminate as much congestion as in the other tunnels, but the Cross Harbour Tunnel would still benefit from car sharing at all times of day. The Eastern Harbour Crossing is congested in both directions so commuters from both Hong Kong Island and Kowloon would benefit from car sharing. The Western Harbour Crossing is only congested going from Kowloon to Hong Kong Island, so car sharing would be most beneficial coming from the Kowloon side. In addition to reducing traffic congestion, those using car sharing in the Western and Eastern Harbour Crossings would also benefit by splitting the toll fares with other occupants of the car.

#### **4.2.2 Major Roads**

The three roads that we selected for analysis were Connaught Road Central, Princess Margaret Road, and Nathan Road; these roads had a large range of types of vehicles using them (Transport Advisory Committee, 2014). Table 4.3 shows the type of traffic that each road carries during the morning rush hour. These statistics were the result of a study conducted by the Hong

Kong Transport Advisory Committee (2014). Private cars and taxis are similarly space-inefficient, so they are grouped together for this analysis. Connaught Road Central and Princess Margaret Road both had relatively high percentages of cars and taxis traveling on them; this is

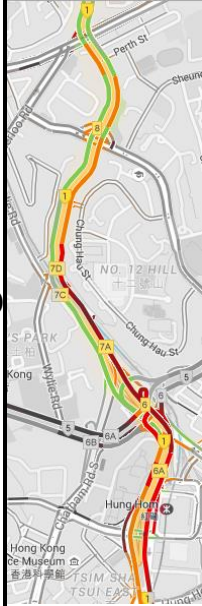


**Table 4.3: Vehicle Mix on 20 Major Roads During the Morning Peak (Transport Advisory Committee, 2014)**

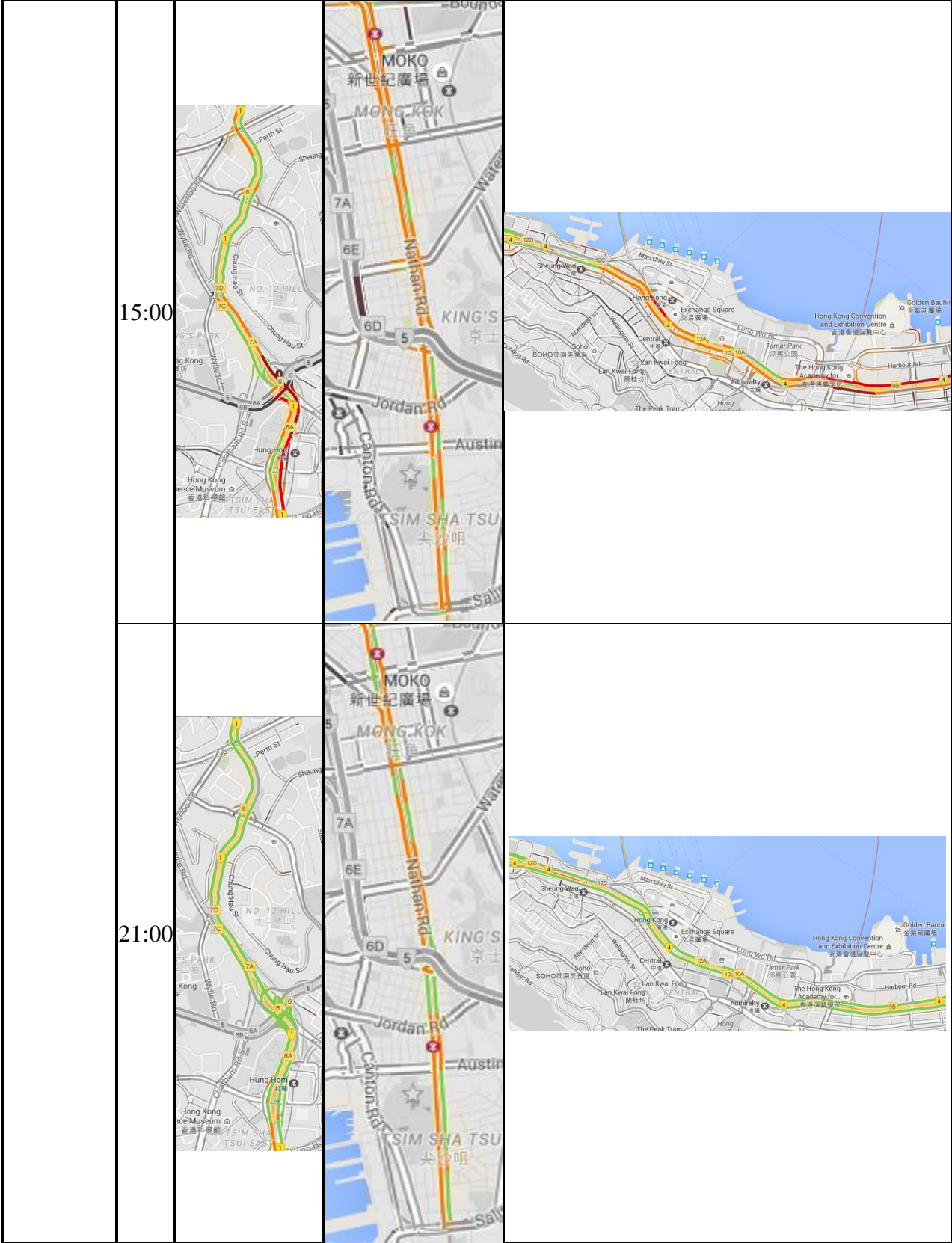
| <b>Road</b>                   | <b>Private Car &amp; Taxi</b> | <b>Bus and Light Bus</b> |
|-------------------------------|-------------------------------|--------------------------|
| <b>Connaught Road Central</b> | 67%                           | 25%                      |
| <b>Princess Margaret Road</b> | 77%                           | 7%                       |
| <b>Nathan Road</b>            | 40%                           | 42%                      |

especially true with Princess Margaret Road. Nathan Road, on the other hand, carried a relatively low percentage of cars and taxis and a relatively high percentage of buses. From looking at the vehicle percentages of these main roads in Table 4.3 and the traffic data in Figure 4.7, we concluded that roads with less space efficient vehicles, like cars and taxis, had much heavier traffic than roads with space efficient buses. Table 4.3 shows vehicle percentages during the morning commute, which when compared to 09:00 in Figure 4.7, shows that roads with higher percentages of cars had much more congestion during this time. The times and days analyzed were chosen following the same criteria for the tunnels as mentioned in Section 4.2.1. We used Google’s crowdsourced traffic information to obtain color-coded diagrams of each road during each time period (Google Traffic, 2016). These diagrams can be found in Figure 4.7.

The two roads that contained a high percentage of car traffic, Connaught Road Central and Princess Margaret Road, had on average much worse traffic congestion during the three time periods that we analyzed. Conversely, Nathan Road, with a much smaller percentage of cars and a higher percentage of buses, maintained a relatively low level of congestion and never reach the

extremes present on the other two roads. The extremes of congestion on Connaught Road Central and Princess Margaret Road compared to Nathan Road could be because cars are much less space efficient compared to buses as indicated in Section 2.4.5. For private car journeys on the former two roads, car sharing could increase the average number of occupants per car, thus increasing space efficiency, resulting in less traffic congestion. Although private cars are not the most space efficient choice for transportation, car sharing is beneficial to those set on using a private car in lieu of public transportation.

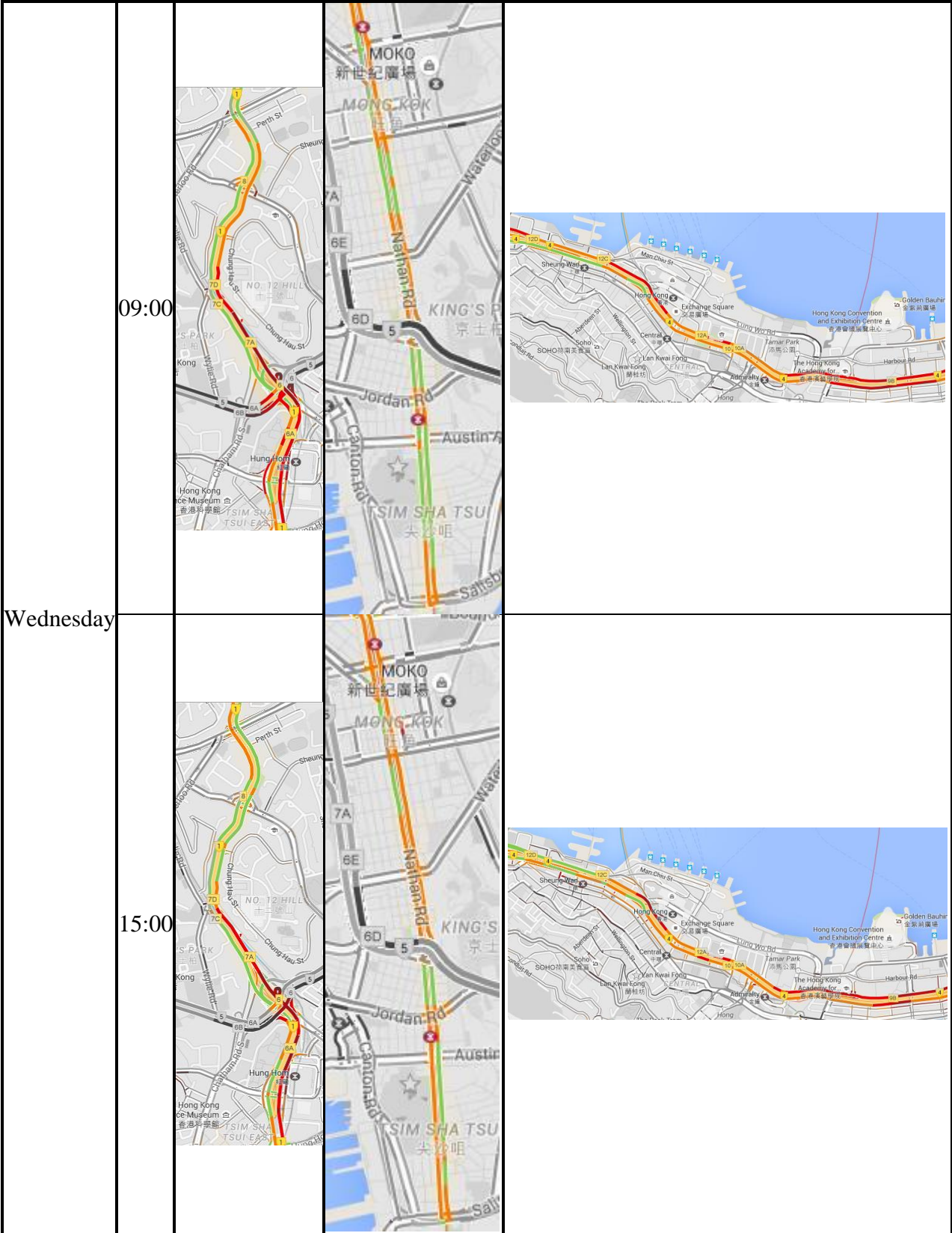
| Day    | Time  | Princess Margaret Road                                                            | Nathan Road                                                                        | Connaught Road                                                                     |
|--------|-------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Monday | 09:00 |  |  |  |



15:00

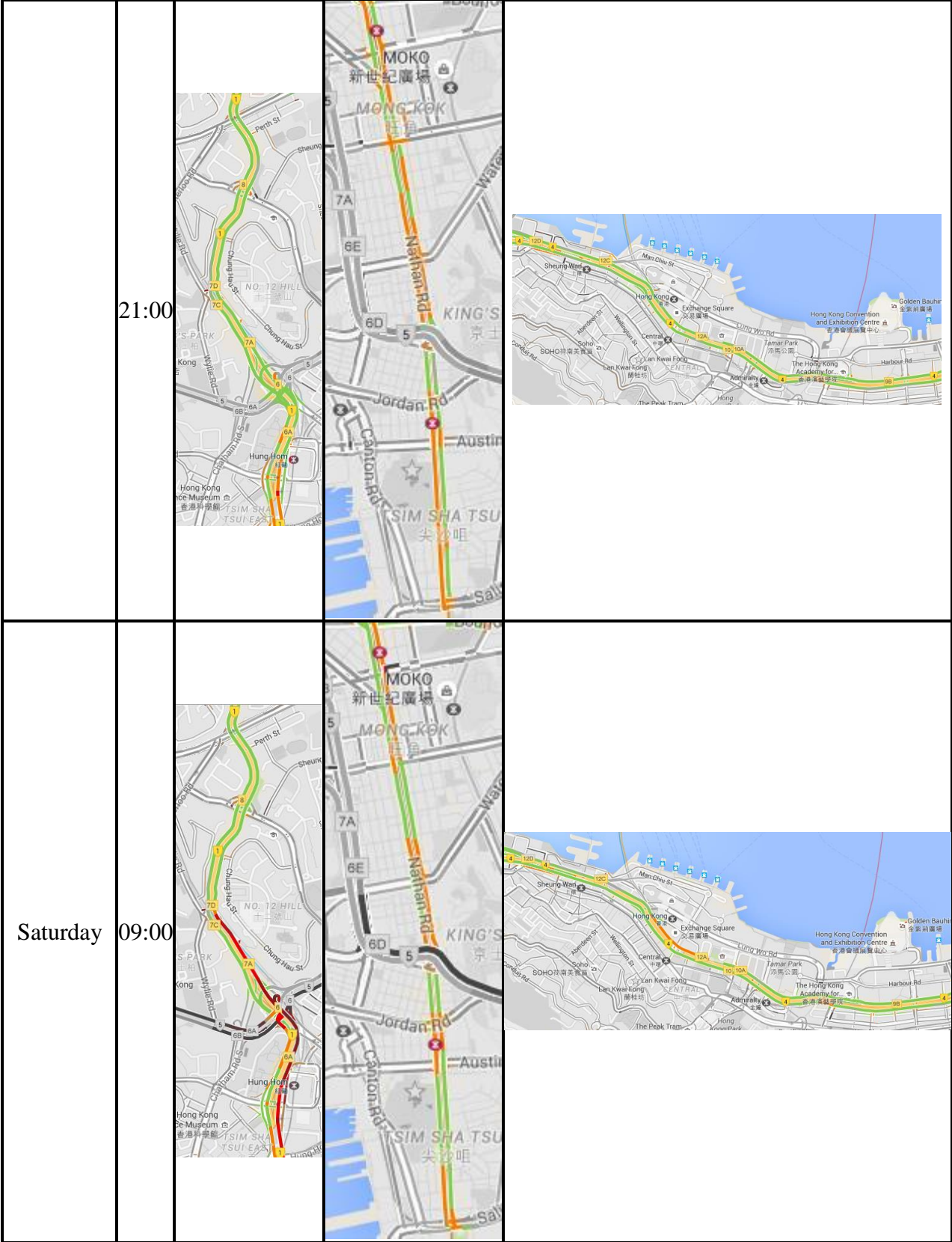
21:00

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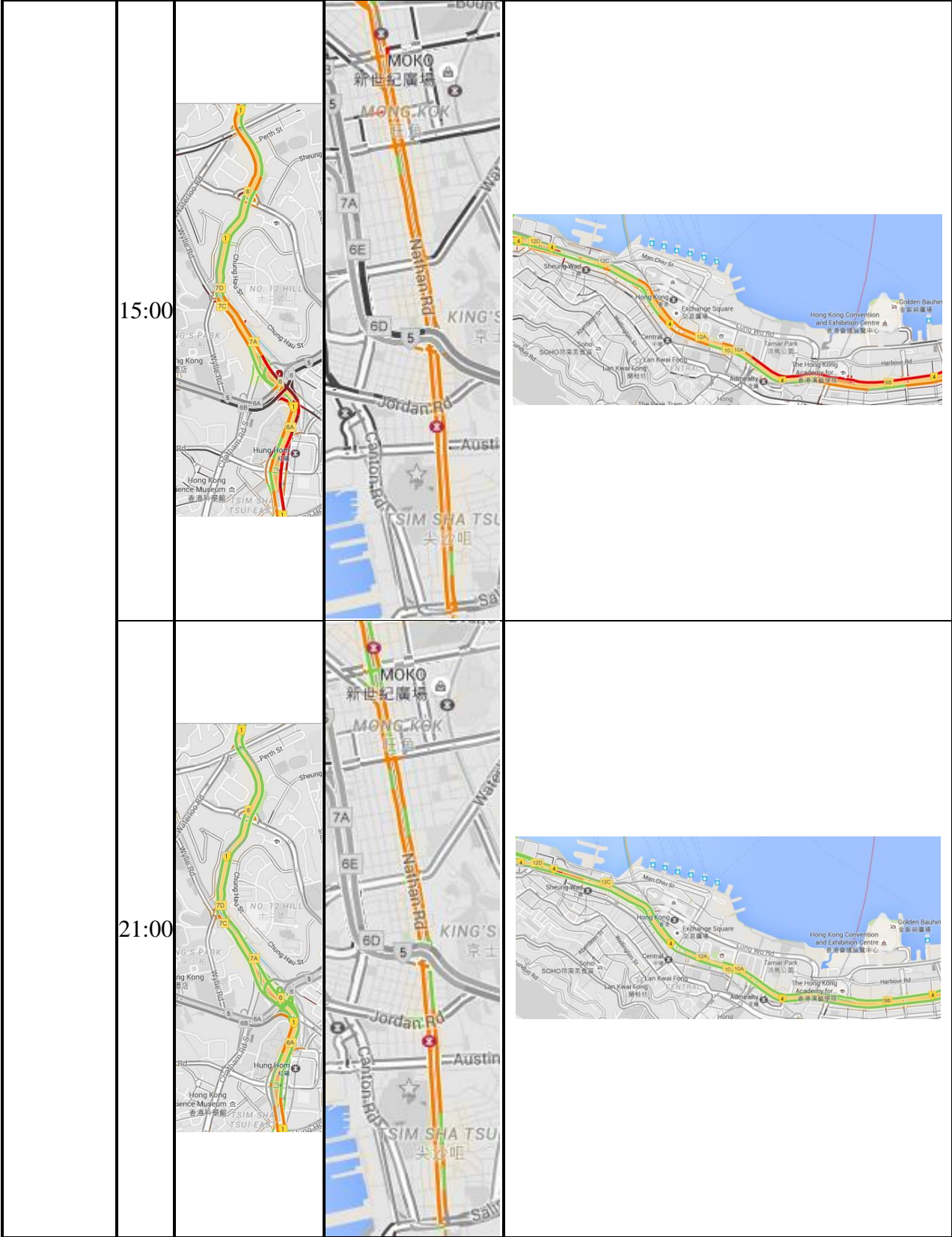


Figure 4.7: Crowdsourced Traffic Data of Major Roads (Google Traffic, 2016)

### **4.3 Likely Effects of Increased Car Sharing**

Increasing car sharing could reduce traffic congestion and emissions due to fewer cars being driven. The reduction in emissions can be determined quantitatively using a series of calculations based off of a framework developed through our research. Additionally, there could be social reactions in terms of public and legal responses resulting from an increase in car sharing.

#### **4.3.1 Quantitative Calculation of Emission Reduction**

To determine the environmental effects of increased car sharing, we created a framework to calculate the emission reduction from a reduction in private cars on the roads. We gathered data to analyze the fuel economy of the current private cars on the roads of Hong Kong to determine the potential benefits of a reduction in the number of private cars on the roads (Electrical and Mechanical Services Department, 2014). This is based on the assumption that when there is a reduction in the total number of private vehicles being driven, there is a reduction in carbon emissions created by private cars. Table 4.4 shows the number of registered private vehicles divided into groups by engine size (Hong Kong Transport Department, 2014). Each size has a particular average fuel economy, shown in Table 4.5, which we used to create a weighted average of fuel economy.

The weighted average calculations can be found in Appendix G. The data included the average kilometers traveled per day, which was multiplied by 365 days to determine the average annual kilometers traveled per private vehicle in Hong Kong. The weighted average of fuel economies and the annual kilometers traveled were used in a carbon footprint analyzer to develop an average annual volume of carbon dioxide produced by an average car (Carbon

Footprint Calculator, 2016). The emission data provided by this calculator was multiplied by the total number of registered private vehicles to determine the total carbon emission from private vehicles in Hong Kong to be 2,605,822 metric tons of CO<sub>2</sub> annually.

**Table 4.4: Number of Registered Vehicles per Engine Size (Hong Kong Transport Department, 2014)**

| Engine Size (cubic centimeters) | Number of Registered Vehicles |
|---------------------------------|-------------------------------|
| ≤ 1000                          | 5301                          |
| 1000-1500                       | 119,540                       |
| 1500-2500                       | 271,109                       |
| 2500-3500                       | 108,801                       |
| 3500-4500                       | 17,589                        |
| > 4500                          | 19,411                        |

**Table 4.5: Average Fuel Economy by Engine Size (Electrical and Mechanical Services Department, 2014)**

| Engine Size (cubic centimeters) | Average Fuel Economy (Liter/100 km) |
|---------------------------------|-------------------------------------|
| ≤ 1000                          | 8.1                                 |
| 1000-1500                       | 9.0                                 |
| 1500-2500                       | 11.5                                |
| 2500-3500                       | 14.0                                |
| 3500-4500                       | 16.3                                |
| > 4500                          | 17.3                                |

#### **4.3.1.1 Emission Reduction due to Car Sharing**

The framework developed to determine a quantitative value of emission reduction could be applied to studies of car sharing. An example of this is a study conducted in the United States and Canada (Shaheen & Cohen, 2007). This study surveyed those who used car sharing and determined that 25% of those individuals would no longer use their private vehicle. With a large enough sample size of car owners, the percentage of car owners who actively use car sharing could be determined, and using that information a 25% reduction could be used to determine the number of cars no longer on the road (see Appendix G).

Our sample is not large enough to gain an accurate amount of data about car owners. For the framework developed to be used, 59,000 car owners would need to be surveyed in order to have a 99% confidence level and a confidence interval of 0.5 (Raosoft, 2016). If 20% of car owners were to use car sharing, that would include 108,350 private cars in Hong Kong and a theoretical reduction of 27,087 fewer private cars on the road. This is a 5% reduction of vehicles, which equals an annual reduction of 130,288 metric tons of carbon dioxide (see Appendix G for complete calculation). The ability to have a convenient, short-term car rental could discourage people from owning their own cars, making people less reliant on driving, therefore reducing traffic congestion.

If data from 59,000 car owners were used, the confidence level would be high enough that data could be extrapolated to include the entire population of car owners. By using the theoretical reduction of vehicles as a result of car sharing, a theoretical reduction of carbon emissions could be calculated. These calculations are a rough estimate to show the potential environmental benefits from having fewer private cars emitting carbon dioxide into the air.

### **4.3.2 Social Responses to Increased Car Sharing**

In other areas outside of Hong Kong, public and private sectors have responded to an increase in car sharing by various means, including changing opinions about car sharing and modifying laws to further expand or restrict car sharing. Similar responses would happen in Hong Kong if car sharing were to increase.

With Dr. Hung Wing-Tat, a civil engineering professor and expert on transportation policy at The Hong Kong Polytechnic University we discussed initiatives that the Hong Kong government has used with the intention of reducing traffic congestion and pollution as well as social reactions to transportation policy. Notes on our interview with Professor Hung can be found in Appendix C.

Professor Hung had many insights about government policies regarding transportation and traffic reduction. If the Hong Kong government were to implement transportation policy changes to deter private vehicle use, there is the potential for negative reactions from the public. For example, when a toll increase was proposed for the Cross Harbour Tunnel, the backlash from car owners was so great that the government was forced to table any further discussions. With car owners having such a strong influence over the government, new policies to encourage car sharing may have similar results. According to Professor Hung, these negative reactions could stem from the Hong Kong Government's failure to sufficiently explain and advertise the positive effects of new transportation policies; the public may not understand or even know of the benefits. He also explained that the government did not clearly indicate what any increase in toll revenue would be used for.

The idea of car sharing has many definitions and is not directly included in the laws of Hong Kong under the name of "car sharing" or anything similar due to the time period when the

existing laws were written in 2012. As interpreted by Professor Hung, if money is exchanged, the law states car sharing to be illegal. This holds true even if there is a private agreement among neighbors to help offset the cost of fuel and tolls, despite the fact that the driver may not provide the service for monetary gain. Community-based carpooling where no money is exchanged can avoid the legal issues over accepting passengers for reward, but this relies on people being altruistic. For companies such as ECrent that provide community-based car rentals, the company can avoid being directly involved in the transaction, as a private vehicle is simply provided by an individual to another individual; an individual car owner does not drive a passenger anywhere. In addition, when car hailing companies such as Uber have faced legal bans by a region, they adapt their platform. As indicated in Section 2.3.4, when UberPop was banned in Germany, the company changed some of the logistics and came back with UberX. This shows that the company is willing to make concessions to work with the local government.

As shown in Section 4.1, exposure to car sharing tends to result in greater receptivity to car sharing, with more positive opinions expressed about the four aspects of car sharing that our survey gauged. With increased car sharing, more and more people would be exposed to it, and opinions towards car sharing would likely improve. Some users of car sharing have even indicated that they prefer using services like Uber instead of taking a taxi, as referenced in Section 2.4.3. These users may be willing to defend car sharing services, similar to individuals in Washington D.C. (Section 2.3.2), to prevent a decrease in accessibility to car sharing.

#### **4.4 Summary**

We surveyed 205 people to gauge the public's perception of car sharing. This included a car owner and non-car owner survey in order to gather perspectives from both groups. A

majority of both car owners and non-car owners surveyed had a positive view of car sharing in general. We also analyzed the levels of traffic congestion in three main tunnels that cross Victoria Harbour and three major roads in Hong Kong. We found that tunnel systems would benefit from increased car sharing, with the Cross Harbour Tunnel benefiting the most due to lowered congestion. The roads we examined with a higher relative percentage of private cars and taxis had a greater level of congestion compared to a road that had a greater percentage of buses. We identified likely outcomes of car sharing in terms of possible environmental effects and social responses. In the next chapter, we provide recommendations for the continued success of car sharing in Hong Kong.



## **5. Conclusions and Recommendations**

Based on the research we have conducted, we have come up with specific recommendations that address car sharing in Hong Kong. We formulated these recommendations using conclusions drawn from our survey, interviews, and archival research. The intent of these recommendations is to ensure the long-term success of car sharing services in Hong Kong with a focus on reducing traffic congestion and air pollution.

### **5.1 Pass new laws to confirm legality of car sharing services**

We recommend that the Hong Kong Government update laws to reflect the current state of transportation needs and wants of Hong Kong's population. Many people who have used car sharing view it as a safe, convenient, and affordable mode of transportation, as seen in our survey. The explicit legalization of car sharing services would allow for effective regulation of a transportation method that has the potential to reduce traffic congestion and air pollution, along with expanding the transportation options for Hong Kong's residents. Clear and narrow definitions for various types of car sharing services should be included in order to allow each type to be independently regulated; this way, proper regulations based on the specifics of each method could be determined to maximize safety and efficiency and prevent any legal overlap. A new law legalizing car sharing services would not restrict transportation options but rather open up new ones. We conclude that an explicit legalization of car sharing services would increase the use and acceptance of car sharing and ultimately benefit the public.

## 5.2 Encourage car sharing

In order to make car sharing more widely used, the Hong Kong Government, car sharing companies, and other non-government organizations would need to:

- Establish initiatives to get people to try car sharing,
- Create a framework for community-based car sharing,
- Ensure that the public knows the benefits of car sharing.

Our research indicates that individuals who have used car sharing in the past have more positive opinions about car sharing than those who have not used it. To encourage individuals to become new users of car sharing, car sharing companies, the government, and non-governmental organizations should use initiatives to get them to try it. Car sharing companies could provide free or discounted services for first-time users, exposing them to these services, which will in turn engender positive opinions about car sharing and increase the future use of this practice. Initiatives of this type have done this in the past with much success.

A framework that enables easy and effective use of these services should be created for community based car sharing services like carpooling and private vehicle rentals. Housing estates are ideal locations for this type of framework because it is a shared origin or destination for its inhabitants. We recommend that housing estates set up a system of carpooling that would allow for members of that facility to car share. Criteria used to match up passengers should include the destination, needed time of departure and arrival, and number of seats in a vehicle. For example, private car owners living in the same housing estate who commute to similar destinations on work days could be matched up. This would be particularly useful for private car journeys that traverse high-traffic areas, such as the tunnels that cross Victoria Harbour. Additionally, housing estates should set up a system where residents who do not own a private

vehicle can rent their neighbor's private vehicle when it is not in use. Community-based car sharing frameworks should include a code of conduct to ensure that all parties understand the expectations.

We also recommend that employers, as well as building operators, organize carpool groups for their employees' morning and evening commutes.

A campaign from the government, car sharing companies, and organizations such as Friends of the Earth should be created to highlight the benefits of car sharing. To be most effective, the campaign should mention the environmental, social, and economic benefits. These include the potential to reduce traffic congestion and air pollution, the potential for business connections and socializing, and the ability to split fuel costs, tolls, and parking fees. This could be done through a series of posters near high volume private vehicle areas, such as parking garages. These posters would address the struggles of owning a car, such as parking fees and finding a parking space, and encourage car sharing as a way to address those frustrations.

### **5.3 Improve Safety in Car Sharing**

Many survey respondents indicated concerns over the safety of car sharing. Increased awareness about driver background checks would lead to an increased consumer confidence in the safety of car hailing services. Commercial car hailing services use a system of accountability for both drivers and passengers to ensure safe practices. Community-based carpooling could greatly benefit from a similar system in order to make carpooling more available and efficient for the public. It could also allow for a rating system to be placed on drivers and riders to ensure the safety of both parties. Campaigns for community-based car sharing should include safety tips for both drivers and passengers, and urge drivers to confirm that car sharing will not affect their

insurance status or coverage. Increasing safety for both the driver and the passenger will make people more comfortable with car sharing and therefore more likely to use it.

#### **5.4 Establish new policies**

The Hong Kong Government needs to enact new policies to further reduce the severe traffic and air pollution. These policies would be combined with a car sharing initiative to maximize the benefits.

Congestion tolls should be implemented on high traffic roads to reduce the levels of road congestion. This would charge vehicles more money during times of heavy traffic to deter people from driving in the congested areas. An increase in the existing tolls for private cars could also be implemented to deter drivers from using the tunnels. Such an increase in the Cross Harbour Tunnel would further serve to more evenly distribute traffic to the Eastern and Western Harbour Crossings. An increased toll could be divided amongst occupants of a private vehicle, specifically a carpooling vehicle, which would ease the higher cost.

In the past, public response to new transportation policies have been negative, likely because the public does not understand or is unaware of the potential benefits of the new policies. If the government were to enact any new transportation policies, especially those that could increase the cost of driving, it should be sure to fully explain the intention and positive effects of the new policy.

#### **5.5 Further Research**

Due to our own limitations, further research should be conducted to continue assessing car sharing as a transportation option in Hong Kong. Future researchers can use the emissions

calculation framework we created to determine environmental benefits from an increased use of car sharing services. A more comprehensive survey of private vehicle owners in Hong Kong could provide an accurate number of drivers willing to switch to car sharing services. A study on changes to transportation policy should be conducted, as our study did not gauge public reactions to possible policy changes. The opinions of other stakeholders in Hong Kong's transportation system, such as taxi operators and tunnel owners, should be determined in order to make policies that prevent future animosity and work best for Hong Kong's public.

Another cause of traffic congestion and air pollution that should be investigated is commercial traffic caused by trucks. Much of our research has been focused on maximizing efficiency of human transport. Although public transportation would be the most environmentally friendly option, car sharing is a first step in reducing traffic congestion and air pollution caused by private vehicles. A next step in exploring traffic reduction would be to promote sharing economy and efficiency of commercial traffic.

Although increased car sharing could reduce traffic congestion and air pollution, these would still remain major problems in Hong Kong. The government and non-government organizations should explore other methods of reducing traffic congestion to work in conjunction with car sharing in order to benefit Hong Kong.

## References

- Abu-Lebdeh, G. (2015). A108 Transport Systems and Public Health: The Case of Traffic Congestion and Signal Control. *Journal of Transport & Health*, 2(2), S61-S61.
- An, H., & Gu, L. (2014). Main Success Factors for Developing Car-sharing in China. *Department of Mechanical Engineering Blekinge Institute of Technology*. Retrieved from <http://www.diva-portal.org/smash/get/diva2:813320/FULLTEXT01.pdf>
- Aragon, L. M., Humbaraci, A., & Papotto, J. M. (2011). *Feasibility Study of Car-Sharing Service in Hangzhou, China* (Major Qualifying Project No. E-project-081211-112615). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: <http://www.wpi.edu/Pubs/E-project/Available/E-project-081211-112615/>
- As Hong Kong makes plans for a premium taxi service, the Uber model would be worth following. (2015, November 6). *South China Morning Post*. Retrieved from <http://www.scmp.com/comment/insight-opinion/article/1876068/hong-kong-makes-plans-premium-taxi-service-uber-model-would>
- Carbon Footprint Ltd. (2016). *Carbon Footprint Calculator*. Retrieved from <http://www.carbonfootprint.com/calculator.aspx>
- Carpool King. (2015). *FAQ*. Retrieved from <http://www.carpoolking.com/hk/en-gb/faq.jsp?platform=classic>
- Carpooling and Ride Share Options in Massachusetts. (2014, October 22). *Mass.Gov Blog*. Retrieved December 10, 2015, from <https://blog.mass.gov/blog/transportation-2/carpooling-and-ride-share-options-in-massachusetts-2/>
- CarpoolWorld. (2015). *Carpool Hong Kong*. Retrieved from

[http://www.carpoolworld.com/carpool.html?to=HONG\\_KONG&wc=HKG,HK&lat=22.2447000&lon=114.1888580](http://www.carpoolworld.com/carpool.html?to=HONG_KONG&wc=HKG,HK&lat=22.2447000&lon=114.1888580)

Carshare.hk. (2014). *How it Works*. Retrieved from

<http://www.carshare.hk/how-it-works>

Cervero, R. & Murakami, J. (2008). *Rail and Property Development in Hong Kong:*

*Experiences, Impacts, and Extensions*. Retrieved from

[https://www.lincolnst.edu/pubs/dl/1388\\_706\\_Cervero%20Murakami%20Final.pdf](https://www.lincolnst.edu/pubs/dl/1388_706_Cervero%20Murakami%20Final.pdf)

Chen, B. (2012, July 10). Uber, Maker of Summon-a-Car App, Wins in Washington. *The New*

*York Times*. Retrieved from [http://bits.blogs.nytimes.com/2012/07/10/uber-vs-](http://bits.blogs.nytimes.com/2012/07/10/uber-vs-washington-dc/)

[washington-dc/](http://bits.blogs.nytimes.com/2012/07/10/uber-vs-washington-dc/)

Chung, Y., Cho, H., & Choi, K. (2013). Impacts of freeway accidents on CO2 emissions: A case

study for Orange County, California, US. *Transportation Research Part D: Transport*

*and Environment*, 24, 120-126. Retrieved from

<http://www.sciencedirect.com/science/article/pii/S1361920913000928>

Copley, C. (2015, April 16). Berlin court upholds ban on Uber ride-share service. *Reuters*.

Retrieved from [http://www.reuters.com/article/us-uber-germany-](http://www.reuters.com/article/us-uber-germany-idUSKBN0N71WN20150416#m3ltgEpsWXXK10bvE.97)

[idUSKBN0N71WN20150416#m3ltgEpsWXXK10bvE.97](http://www.reuters.com/article/us-uber-germany-idUSKBN0N71WN20150416#m3ltgEpsWXXK10bvE.97)

Correia, A., Pope, C., Dockery, D., Wang, Y., Ezzati, M., & Dominici, F. (2013). Effect of Air

Pollution Control on Life Expectancy in the United States. *Epidemiology*, 23-31.

Cullinane, S. (2002). The relationship between car ownership and public transport provision: a

case study of Hong Kong. *Transport Policy*, 9, 29-39. Retrieved from

<http://www.sciencedirect.com/science/article/pii/S0967070X01000282>

- Cullinane, S. (2003). Hong Kong's low car dependence: lessons and prospects. *Journal of Transport Geography*, 11, 25-35. Retrieved from <http://faculty.fiu.edu/~revellk/pad3800/Cullinane.pdf>
- Cullinane, S. & Cullinane, K. (2003). Car dependence in a public transport dominated city: evidence from Hong Kong. *Transportation Research Part D: Transport and Environment*, 8, 129-138. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1361920902000378>
- Ducharme, K., Lam, C., Otuyelu, A., & Tombarelli R. (2011). *Promoting Car Clubs in* (Interactive Qualifying Project No. E-project-042811-075011). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: <http://www.wpi.edu/Pubs/E-project/Available/E-project-042811-075011/>
- Echeverria, J, Johnstone, N., Mejias, R., & Porras, I. *The environmental effects of tax differentiation by vehicle characteristics: results from Costa Rica*. Available from [https://books.google.com.hk/books?id=p1DPQSJBLcwC&pg=PA8&lpg=PA8&dq=vehicle+age+vs+emissions&source=bl&ots=-9YD0QON0m&sig=kThj9Ix8lgd2RoPCAGgjXa1vu2Q&hl=en&sa=X&ved=0ahUKEwj5h\\_bkhc7KAhWHt44KHx41DyEQ6AEILjAJ#v=onepage&q&f=false](https://books.google.com.hk/books?id=p1DPQSJBLcwC&pg=PA8&lpg=PA8&dq=vehicle+age+vs+emissions&source=bl&ots=-9YD0QON0m&sig=kThj9Ix8lgd2RoPCAGgjXa1vu2Q&hl=en&sa=X&ved=0ahUKEwj5h_bkhc7KAhWHt44KHx41DyEQ6AEILjAJ#v=onepage&q&f=false)
- ECrent. (2014). *Sharing Economy*. Retrieved from <http://www.hk.ecrent.com/sharingeconomy/>
- Eddy, M. (2015, March 18). An Uber Service Is Banned in Germany Again. *The New York Times*. Retrieved from <http://www.nytimes.com/2015/03/19/technology/germany-frankfurt-uber-ruling-taxi.html>
- Electrical and Mechanical Services Department. (2014). *Energy Utilization Index*. Retrieved from [http://ecib.emsd.gov.hk/en/indicator\\_trp.htm](http://ecib.emsd.gov.hk/en/indicator_trp.htm)



- Farrell, M. (2012, August 17). State reverses ban on Uber car service ordering app. *The Boston Globe*. Retrieved from <http://www.boston.com/businessupdates/2012/08/15/state-reverses-ban-uber-car-service-ordering-app/Iv1leadnS3ViIvyqzx8LYiP/story.html>
- Farrell, M. (2014, June 26). New lawsuit claims Uber exploits its drivers. *The Boston Globe*. Retrieved from <https://www.bostonglobe.com/business/2014/06/26/uber-hit-with-class-action-lawsuit/JFITJLMuBoXuEmMU3elTAI/story.html>
- Fisher, Max. (2012, August 14). It's Official: Western Europeans Have More Cars Per Person Than Americans. *The Atlantic*.
- Friends of the Earth Hong Kong. (2015). *Mission & Vision*. Retrieved from [http://www.foe.org.hk/e/content/cat\\_page.asp?cat\\_id=35#.VmNe4fkrKM9](http://www.foe.org.hk/e/content/cat_page.asp?cat_id=35#.VmNe4fkrKM9)
- Friends of the Earth Hong Kong. (2015). *Board and Structure*. Retrieved from [http://www.foe.org.hk/e/content/cat\\_page.asp?cat\\_id=37#.VmNe3fkrKM8](http://www.foe.org.hk/e/content/cat_page.asp?cat_id=37#.VmNe3fkrKM8)
- Gardner, D. (2015, January 20). Beijing's smog is increasingly toxic for China's politicians. *The Guardian*. Retrieved from <http://www.theguardian.com/environment/2015/jan/20/beijings-smog-increasingly-toxic-chinas-politicians>
- Geiger, F. (2015, May 19). Uber Launches Licensed Driver Service in Germany. *Wall Street Journal*. Retrieved from <http://blogs.wsj.com/digits/2015/05/19/uber-launches-licensed-driver-service-in-germany/>
- German court places nationwide ban on UberPOP. (2015, March 18). *Fortune*. Retrieved from <http://fortune.com/2015/03/18/german-court-ban-uber/>
- GovHK: Hong Kong – the Facts. (2015, August 1). Retrieved November 26, 2015, from <http://www.gov.hk/en/about/abouthk/facts.htm>

- Griffiths, J. (2015, September 16). Hongkongers overwhelmingly prefer Uber over taxis in wake of government crackdown: survey. *South China Morning Post*. Retrieved from <http://www.scmp.com/tech/start-ups/article/1858774/hongkongers-overwhelmingly-prefer-uber-over-taxis-wake-government>
- Guo, O. (2015, November 11). A City Choking on Cars Hopes Commuters Will Return to Two Wheels. *The New York Times*. Retrieved from [http://www.nytimes.com/2015/11/12/world/asia/a-city-choking-on-cars-hopes-commuters-will-return-to-two-wheels.html?\\_r=0](http://www.nytimes.com/2015/11/12/world/asia/a-city-choking-on-cars-hopes-commuters-will-return-to-two-wheels.html?_r=0)
- Harris, S. & Krueger, A. (2015, December 8). A proposal for modernizing labor laws for 21<sup>st</sup> century work: The “independent worker”. *The Hamilton Project* Retrieved from <http://www.brookings.edu/research/papers/2015/12/09-modernizing-labor-laws-for-the-independent-worker-krueger-harris>
- Harshbarger, R. (2015, September 16). Cabbies protest Uber at Gov. Cuomo's office. *AmNEWYORK*. Retrieved from <http://www.amny.com/transit/nyc-s-yellow-cab-drivers-protest-uber-at-gov-andrew-cuomo-s-office-1.10853089>
- Hong Kong Environmental Protection Department. (2015, April 1). *Tax Incentives for Environmentally-friendly Petrol Private Cars*. Retrieved from [http://www.epd.gov.hk/epd/english/environmentinhk/air/prob\\_solutions/environment\\_friendly\\_private\\_cars.html](http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/environment_friendly_private_cars.html)
- Hong Kong Information Services Department. (2015). *Hong Kong: The Facts (Transport)*. Retrieved from <http://www.gov.hk/en/about/abouthk/factsheets/docs/transport.pdf>

Hong Kong taxi licenses hit record high of almost US\$1m. (2013, August 7). *South China Morning Post*. Retrieved from <http://www.scmp.com/business/money/markets-investing/article/1294823/hong-kong-taxi-licences-hit-record-high-almost-us1m>

Hong Kong Tramways, Limited. (2015). *About Hong Kong Tramways*. Retrieved from <https://www.hktramways.com/en/about-hong-kong-tramways/>

Hong Kong Transport Advisory Committee. (2014). *Report on Study of Road Traffic Congestion in Hong Kong*. Retrieved from [http://www.thb.gov.hk/eng/boards/transport/land/Full\\_Eng\\_C\\_cover.pdf](http://www.thb.gov.hk/eng/boards/transport/land/Full_Eng_C_cover.pdf)

Hong Kong Transport Department. (2015). *The Annual Traffic Census – 2014*. Retrieved from [http://www.td.gov.hk/filemanager/en/content\\_4726/annual%20traffic%20census%202014.pdf](http://www.td.gov.hk/filemanager/en/content_4726/annual%20traffic%20census%202014.pdf)

Hong Kong Transport Department. (2015). *Guidelines for Importation and Registration of Motor Vehicle*. Retrieved from [http://www.td.gov.hk/en/public\\_services/licences\\_and\\_permits/vehicle\\_first\\_registration/guidelines\\_for\\_importation\\_and\\_registration\\_of\\_mot/](http://www.td.gov.hk/en/public_services/licences_and_permits/vehicle_first_registration/guidelines_for_importation_and_registration_of_mot/)

Hong Kong Transport Department. (2015). *Monthly Traffic and Transport Digest – December 2014*. Retrieved from [http://www.td.gov.hk/filemanager/en/content\\_4672/1412.pdf](http://www.td.gov.hk/filemanager/en/content_4672/1412.pdf)

Hong Kong Transport Department. (2015). *Registration and Licensing of Vehicles by Class of Vehicles*. Retrieved from [http://www.td.gov.hk/filemanager/en/content\\_281/table41a.pdf](http://www.td.gov.hk/filemanager/en/content_281/table41a.pdf)

Hong Kong Transport Department. (2015). *Vehicle License Fees & Charges*. Retrieved from [http://www.td.gov.hk/en/public\\_services/fees\\_and\\_charges/](http://www.td.gov.hk/en/public_services/fees_and_charges/)

Hong Kong Transport Department. (2016). *Toll Rates of Road Tunnels and Lantau Link*. Retrieved from

[http://www.td.gov.hk/en/transport\\_in\\_hong\\_kong/tunnels\\_and\\_bridges/toll\\_rates\\_of\\_road\\_tunnels\\_and\\_lantau\\_link/index.html](http://www.td.gov.hk/en/transport_in_hong_kong/tunnels_and_bridges/toll_rates_of_road_tunnels_and_lantau_link/index.html)

Isaac, M. & Singer, N. (2015, June 17). California Says Uber Driver Is Employee, Not a Contractor. *The New York Times*. Retrieved from

<http://www.nytimes.com/2015/06/18/business/uber-contests-california-labor-ruling-that-says-drivers-should-be-employees.html>

Johnson, D. (2014, November 21). See Where Uber Faces the Biggest Competition. *Time*.

Retrieved December 9, 2015, from <http://time.com/3598873/uber-alternatives/>

Kia, K. (2016, January 19). GM Buy's Sidecar's Assets as It Preps New Transportation Services.

*Fortune*. Retrieved from <http://fortune.com/2016/01/19/gm-sidecar-acquisition/>

Kirsner, S. (2010, June 1). A little Zipcar history, as company files for initial public offering.

Retrieved from

[http://www.boston.com/business/technology/innoeco/2010/06/a\\_little\\_zipcar\\_history\\_as\\_com.html](http://www.boston.com/business/technology/innoeco/2010/06/a_little_zipcar_history_as_com.html)

Lee, D. (2015). Uber 'success story' removed from Hong Kong government investment agency

website after police raid car-hailing app. *South China Morning Post*. Retrieved from

<http://www.scmp.com/news/hong-kong/economy/article/1848836/uber-success-story-removed-hong-kong-government-investment>

Leung, V. (2011). Slow diffusion of LPG vehicles in China – Lessons from Shanghai,

Guangzhou and Hong Kong. *Energy Policy*, 6, 3720-3731. Retrieved from

<http://www.sciencedirect.com/science/article/pii/S0301421511002783>

- Levine, D. (2015, September 1). Uber drivers granted class action status in lawsuit over employment. *Reuters*. Retrieved from <http://www.reuters.com/article/us-uber-tech-drivers-lawsuit-idUSKCN0R14O920150901#5ffjrWiBykGuDseu.97>
- Luckerson, V. (2014, November 6). Lyft Sues Uber Exec For Allegedly Stealing Company Secrets. *Time*. Retrieved from <http://time.com/3561353/lyft-uber-lawsuit-travis-vanderzanden/>
- Mraihi, R., Harizi, R., Mraihi, T., & Bouzidi, M. (2014). Urban air pollution and urban daily mobility in large Tunisia's cities. *Renewable and Sustainable Energy Reviews*, 315-320
- MTR. (2014). *Corporate Profile*. Retrieved from [http://www.mtr.com.hk/en/corporate/overview/profile\\_index.tml](http://www.mtr.com.hk/en/corporate/overview/profile_index.tml)
- Ngo, J. (2016, January 22). Uber court cases see two men fined and banned from driving for a year. *South China Morning Post*. Retrieved from <http://www.scmp.com/news/hong-kong/law-crime/article/1903807/uber-court-cases-see-two-men-fined-and-banned-driving-year>
- Nusca, A. (2015, September 10). Uber loses another legal round in the employee vs. contractor debate. *Fortune*. Retrieved from <http://fortune.com/2015/09/10/uber-california-employee/>
- Poll finds Toronto residents supportive of Uber, but think taxis are safer. (2015, August 21). *CBC News*. Retrieved from <http://www.cbc.ca/news/canada/toronto/poll-finds-toronto-residents-support-uber-but-think-taxis-are-safer-1.3198737>
- Pomfret, J. (2015, August 12). Police search Uber offices in Hong Kong and arrest five drivers. *Reuters*. Retrieved from <http://www.reuters.com/article/us-uber-hongkong-idUSKCN0QG1L920150812#GOqV1hlWTurKbw2h.97>

- Raosoft, Inc. (2004). *Sample Size Calculator*. Retrieved from <http://www.raosoft.com/samplesize.html>
- Rogers, B. (2015). The Social Cost of Uber. *University of Chicago Law Review*, 82, 85-102.
- Santamouris, M. (2001). *Energy and climate in the urban built environment*. London: James X James.
- Scheiber, N. (2015, December 10). A Middle Ground Between Contract Worker and Employee. *The New York Times*. Retrieved from <http://www.nytimes.com/2015/12/11/business/a-middle-ground-between-contract-worker-and-employee.html?mabReward=A7&moduleDetail=recommendations-0&action=click&contentCollection=Technology&region=Footer&module=WhatsNext&version=WhatsNext&contentID=WhatsNext&src=recg&pgtype=article>
- Schrank, D., Lomax, T., & Eisele, B. (2015). 2014 Urban Mobility Report powered by INRIX Traffic Data.
- Scott, M. & Plass, S. (2014, September 16). German Court Lifts Ban on Uber Ride Service. *The New York Times*. Retrieved from <http://www.nytimes.com/2014/09/17/business/international/uber-ban-in-germany-is-lifted-by-court.html>
- Seinfeld, J., & Pandis, S. (1998). The Atmosphere: History and Evolution of the Earth's Atmosphere. In *Atmospheric chemistry and physics from air pollution to climate change* (p. 2). New York, New York: Wiley.
- Shaheen, S., & Cohen, A. (2007). Growth in Worldwide Carsharing: An International Comparison. *Transportation Research Record: Journal of the Transportation Research Board*, 81-89.

- Shaheen, S., Mallery, M., & Kingsley, K. (2012). Personal vehicle sharing services in North America. *Research in Transportation Business & Management*, 3, 71-81. Retrieved from <http://www.sciencedirect.com/science/article/pii/S2210539512000065>
- Sharp, M. (2013, April 26). Car-sharing start-up wins investment. *South China Morning Post*. Retrieved from <http://www.scmp.com/lifestyle/motoring/article/1222940/car-sharing-start-wins-investment>
- Sharp, M. (2015, April 15). Hong Kong car-sharing start-up goes from strength to strength. *South China Morning Post*. Retrieved from <http://www.scmp.com/lifestyle/motoring/article/1766926/hong-kong-car-sharing-start-goes-strength-strength>
- Silva, H. & Gameng, M. (2014). 10 Things You Didn't Know About Zipcar (Okay, More Than 10). Retrieved from <http://www.zipcar.com/ziptopia/inside-zipcar/history-of-zipcar-infographic>
- Soo, Z. (2015, August 14). Hongkongers rally to Uber's cause as nearly 50,000 sign petition in favour of continued service after arrests. *South China Morning Post*. Retrieved from <http://www.scmp.com/tech/enterprises/article/1849493/hongkongers-rally-ubers-cause-nearly-50000-sign-petition-favour>
- Soo, Z. & Feng, C. (2015, August 17). More than 100 Hong Kong taxi drivers protest against Uber and other car-hailing apps. *South China Morning Post*. Retrieved from <http://www.scmp.com/tech/start-ups/article/1833345/more-100-hong-kong-taxi-drivers-protest-against-uber-and-other-car?page=all>
- Stefansdotter, A., Danielsson, C., Nielsen, C. K., & Sunesen, E. R. (2015). *Economic benefits of peer-to peer transport services*. Retrieved from

<http://www.copenhageneconomics.com/dyn/resources/Publication/publicationPDF/0/320/1441009386/economics-benefits-of-peer-to-peer-transport-services.pdf>

Sun, C., Zheng, S. & Wang, R. (2014). Restricting driving for better traffic and clearer skies: did it work in Beijing? *Transport Policy*, 32, 34-41.

Transportation network companies: insurance coverage, Cal. Assemb. B. 2293 (2013-2014), Chapter 389 (Cal. Stat. 2014).

Tsang, E. & Leung, C. (2015, October 31). 'Our business is tough enough': Plan to launch premium taxi service in Hong Kong raises hackles. *South China Morning Post*. Retrieved from <http://www.scmp.com/news/hong-kong/economy/article/1874322/premium-hong-kong-taxi-service-proposed-shake-trade?page=all>

Uber. (2015). *Uber - Hong Kong*. Retrieved from <http://www.uber.com/cities/hong-kong>

University of California Berkeley Transportation Sustainability Research Center. (2014). *Carsharing*. Retrieved from <http://tsrc.berkeley.edu/carsharing>

Waxman, S. (2014, May 23). Uber vs. taxis. *The Boston Globe*. Retrieved from <https://www.bostonglobe.com/opinion/2014/05/23/podium-uber/qDzgxr7of6vBP805aGNohN/story.html>

Web, Rob. (2007). *Hong Kong Traffic*. [Image], Retrieved from [https://www.flickr.com/photos/rob\\_web/451033160/](https://www.flickr.com/photos/rob_web/451033160/)

Who's Driving You? (2016). *Reported List of Incidents Involving Uber and Lyft*. Retrieved 1 March, 2016 from <http://www.whosdrivingyou.org/rideshare-incidents>

Wilson, M. (2013, January 30). Life in the fast lane: In the D.C. area, carpooling 'slugs' ride fast and free. *Grist*. Retrieved from <http://grist.org/cities/ridesharing-it-isnt-just-for-the-techy-share-y-set/>



- Wong, M. (2015, October 15). Government exploring feasibility of premium taxi service to solve Uber problem. *Harbour Times*. Retrieved from  
<<http://harbourtimes.com/2015/10/14/government-exploring-feasibility-of-premium-taxi-service-secretary-for-transport-and-housing/>>
- Wong, R. (2015, September 1). The unhappy states of Hong Kong's taxi service. *South China Morning Post*. Retrieved from  
<http://www.scmp.com/business/markets/article/1854341/unhappy-state-hong-kongs-taxi-service>
- World Wide Fund for Nature Hong Kong. (2015). *What We Do*. Retrieved from  
<http://www.wwf.org.hk/en/whatwedo/>
- Zhang, K., & Batterman, S. (2013). Air pollution and health risks due to vehicle traffic. *Science of The Total Environment*, 450-451, 307-316.
- Zoroya, G., & Waters, A. (2015, July 7). Uber under assault around the world as taxi drivers fight back. *USA Today*. Retrieved from  
<http://www.usatoday.com/story/news/world/2015/07/07/uber-protests-global-germany-france-taxi/29500747/>

## **Appendix A: Partner Description- Friends of the Earth Hong Kong**

Friends of the Earth Hong Kong (2015), referred to as FoE, is a donation-funded organization that promotes environmentally-friendly policies and lifestyles. It was established in 1983 as a charitable organization. Their mission is found in an acronym of their name:

**F**ocuses on protecting our local and regional environment

**O**ffers equitable solutions to help create environmentally sustainable public policies,  
business practices and community lifestyles

**E**ngages government, business, and community to act responsibly

FoE is controlled by a Board of Governors, which include members such as a Chairperson, Vice-Chairperson, Treasurer, Secretary, and other members. The Board of Governors, along with a Chief Executive Officer and an Executive Committee, oversee the various sub-structures. These sub-structures focus on specific areas, such as energy research, outreach to schools, and policy advocacy, as well as administrative functions. Friends of the Earth Hong Kong has over 12,000 members. Corporations and organizations can partner with FoE; FoE currently has 51 of these “Earth Partners” (Friends of the Earth Hong Kong, 2015).

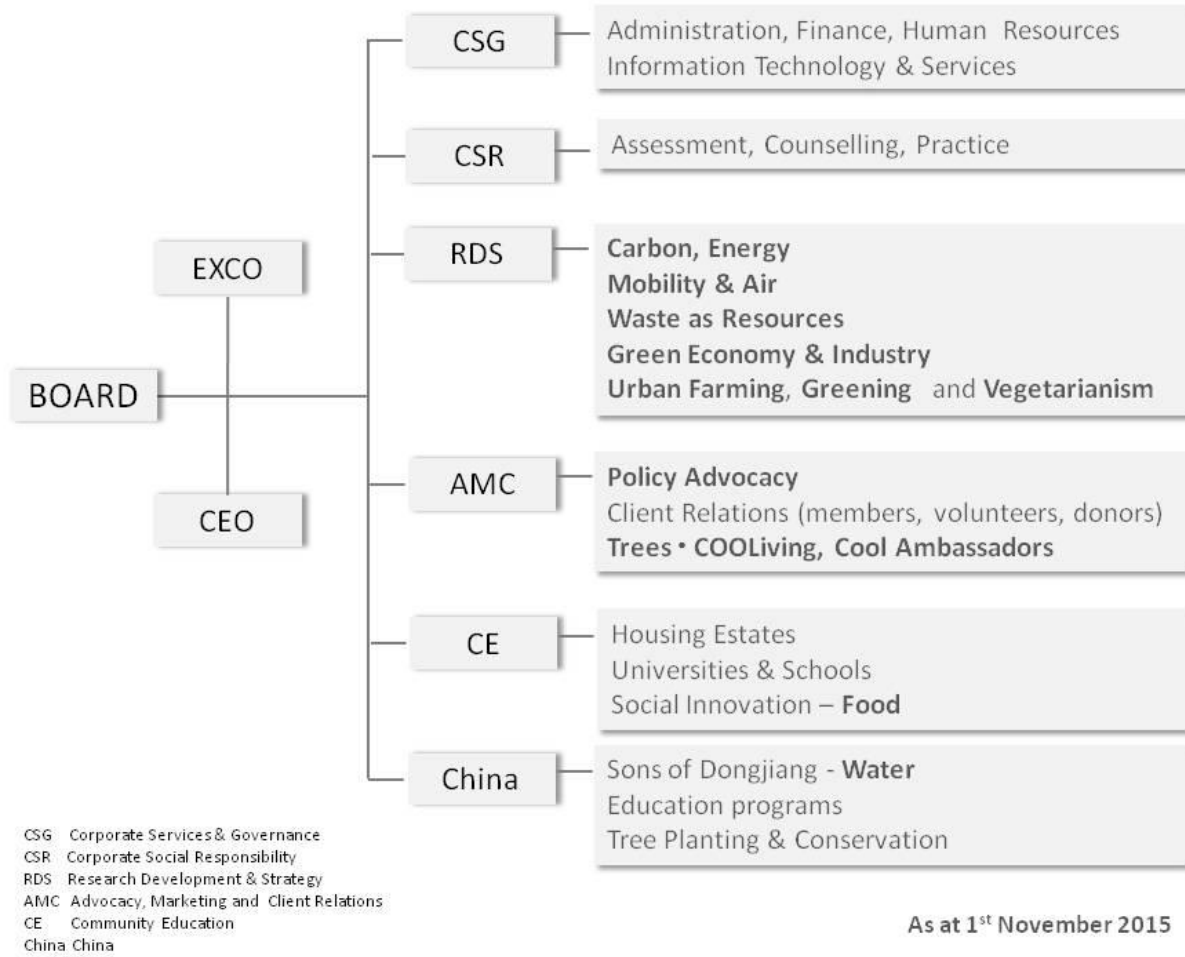


Figure A-1: Board and Structure of Friends of the Earth Hong Kong (Source: Friends of the Earth Hong Kong, 2015)

Table A-1: Board of Governors of Friends of the Earth Hong Kong (Friends of the Earth Hong Kong, 2015)

| <b>Position</b>    | <b>Member</b>           |
|--------------------|-------------------------|
| Chairperson        | Dr. Vivian Wong         |
| Vice-Chairperson   | Ms. Karen Barretto      |
| Honorary Treasurer | KAM TAM Suk Han         |
| Honorary Secretary | WONG Mee Chun, JP       |
| Members            | Professor Carlos Lo     |
|                    | FONG Siu Mei, May       |
|                    | Mr. George Coombs       |
|                    | Dr. YEUNG Kee Sin       |
|                    | WONG Man Tai            |
|                    | WONG Hok Leung          |
|                    | YU Sum Tak              |
|                    | Professor YIU Chung Yim |
|                    | Ms. Lisa Yu             |
|                    | Ms. Linda Chan          |

Friends of the Earth Hong Kong (2015) aims to solve environmental problems through advocacy. They provide recommendations to the government on policies that are environmentally sustainable. They also attempt to influence the public by spreading information, with various campaigns aimed at persuading the public to be more environmentally friendly. Their campaigns focus on air pollution, energy use and climate change, waste, and water usage.

One of the campaigns aimed at reducing air pollution is “Take a Brake”, which began in 2010 (Friends of the Earth Hong Kong 2015). This campaign is sponsored by Standard Chartered Bank in Hong Kong and encourages people to drive less and adopt green habits when driving is

needed. FoE is also working with corporations to incorporate green driving habits in their fleet vehicles. Other air pollution campaigns inform people about emissions caused by idling cars, ships, and additional planes as a result of airport expansion.

FoE's initiatives on Energy and Climate, and Waste focus on ways an individual can make changes in their daily lives to be more environmentally conscious (Friends of the Earth Hong Kong). They encourage turning off lights, purchasing less food to avoid waste, recycling old clothes and making prudent purchases, and raising awareness about proper disposal of electronic waste. There is also a larger scale focus with these initiatives that discourage the use of incinerators to remove garbage and advise the government to implement light pollution restrictions.

The water initiatives put forth by Friends of the Earth Hong Kong (2015) are primarily related the nature and vegetation. They have set forth projects to help villagers in the Dongjiang Headstream who have been forced into poverty due to water conservation policies in their region. Water initiatives also focus on planting trees which remove carbon dioxide from the atmosphere, benefitting the environment.

Friends of the Earth Hong Kong (2015) is unique as an organization in Hong Kong that conducts research and advocates for the environment to both the government and to the public. Other organizations research environmental problems in Hong Kong and provide advocacy, but they are typically limited to a certain subject area. For example, the World Wide Fund for Nature (WWF) (2015) conducts research about environmental issues in Hong Kong, but with the focus of animal habitat conservation and environmental research and education in a more general sense.

## Appendix B: Survey Questionnaires

### 1: Non-Car Owners

#### Statement of Anonymity

#### 個人資料保密聲明

No personally identifiable information will be disclosed to the public. Your participation is not required but greatly appreciated in helping us further our research. If you have any questions, please contact us at [friendsoftheearth@wpi.edu](mailto:friendsoftheearth@wpi.edu)

Sincerely,

本次問卷調查所收集的個人資料將不會對公眾公開。這次調查是自願性參與，您的參與將會為這次問卷調查帶來重要資訊。如有任何問題或疑問，請透過電郵發送至

[friendsoftheearth@wpi.edu](mailto:friendsoftheearth@wpi.edu) 聯絡我們。

謝謝。

Andrew Belz

Emma Healey

Kyle Hudgins

#### **A transportation study conducted by Worcester Polytechnic Institute and Friends of the Earth Hong Kong**

**此研究為Worcester Polytechnic Institute (伍斯特理工學院)與香港地球之友合作項目。**

#### Introduction 調查介紹

We have designed this survey to collect information about transportation habits and public perceptions of various transportation methods.

這份問卷調查將會收集關於公眾使用交通工具的習慣及公眾對於不同交通工具的看法。

#### Definitions

Car sharing: Forms of transportation in which a private vehicle is being shared with a person who does not own the car. 共享汽車：將私人座駕提供給他人租用，或用作提供乘車服務。

Carpooling: Driving one or more passengers in a private vehicle. 共乘汽車：駕駛私人座駕時同時用作提供義載或順風車服務。

1. What is your gender? 您的性別是？

- Male 男
- Female 女
- Prefer not to answer 不予作答

2. What is your age? 您的年齡層為？

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+
- Prefer not to answer 不予作答

3. What is your occupation? 您的職業種類為？

- o Admin & HR 行政/人力資源
- o Accounting/ Banking / Finance 會計/銀行/金融
- o Building & Construction 樓宇/建築
- o Education 教育
- o Engineering 工程
- o Information Technology (IT) 資訊科技
- o Insurance 保險
- o Management 管理
- o Marketing / Public Relations 市場營銷
- o Merchandising & Purchasing 採購
- o Professional Services 專業類別
- o Public / Civil 社會服務
- o Sales, CS & Business Development 零售及客戶服務
- o Transportation & Logistics 交通運輸/物流
- o Other\_\_\_\_\_ 其他

4. What is your monthly income? 您的收入為？

- < \$10,000
- \$10,001 - \$20,000
- \$20,001 - \$30,000
- \$30,001 - \$40,000
- > \$40,001
- I prefer not to answer 不予作答

5. Where do you live? 您居住的區域是?

- New Territories 新界
- Hong Kong Island 香港
- Kowloon 九龍
- I prefer not to answer 不予作答

6. Have you ever used a car sharing service such as Uber or other carpooling groups? 您曾經使用過共享汽車服務如Uber或共乘汽車服務如義載、順風車、或俗稱「泥鯁的」服務嗎?

- Yes 有
- No 沒有

7. How frequently do you use car sharing? 您經常使用共享汽車服務嗎?

- Less than once a month 每月少於一次
- Once a month 每月一次
- Twice a month 每月兩次
- Every week 每星期一次
- Every day 每天一次
- None of the above 以上沒有合適選擇
- I have never used it 從沒使用過此類服務

8. Please rank your opinion on each statement about car sharing on a scale from 1-5

Car sharing is \_\_\_\_\_: 你對共享汽車服務的感覺，請給以下選項評分:

|                  |   |   |   |   |   |                 |
|------------------|---|---|---|---|---|-----------------|
| 不方便 Inconvenient | 1 | 2 | 3 | 4 | 5 | Convenient 方便   |
| 不安全 Unsafe       | 1 | 2 | 3 | 4 | 5 | Safe 安全         |
| 價錢貴 Unaffordable | 1 | 2 | 3 | 4 | 5 | Affordable 價錢合理 |
| 非法 Illegal       | 1 | 2 | 3 | 4 | 5 | Legal 合法        |



## 2: Car Owners

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1. What is your gender? 您的性別是?
  - Male 男
  - Female 女
  - Prefer not to answer 不予作答
2. What is your age? 您的年齡層為?
  - 18-24
  - 25-34
  - 35-44
  - 45-54
  - 55-64
  - 65+
  - Prefer not to answer 不予作答
3. What is your occupation? 您的職業種類為?
  - o Admin & HR 行政/人力資源
  - o Accounting/ Banking / Finance 會計/銀行/金融
  - o Building & Construction 樓宇/建築
  - o Education 教育
  - o Engineering 工程
  - o Information Technology (IT) 資訊科技
  - o Insurance 保險
  - o Management 管理
  - o Marketing / Public Relations 市場營銷
  - o Merchandising & Purchasing 採購
  - o Professional Services 專業類別
  - o Public / Civil 社會服務
  - o Sales, CS & Business Development 零售及客戶服務
  - o Transportation & Logistics 交通運輸/物流
  - o Other\_\_\_\_\_ 其他
4. What is your monthly income? 您的收入為?
  - < \$10,000
  - \$10,001 - \$20,000
  - \$20,001 - \$30,000
  - \$30,001 - \$40,000
  - > \$40,001
  - I prefer not to answer 不予作答

5. Where do you live? 您居住的區域是？

- New Territories新界
- Hong Kong Island香港
- Kowloon九龍
- I prefer not to answer不予作答

6. How often do you use your car? 您經常駕駛您的私人座駕嗎？

- o Everyday 每天
- o Every other day 每隔一天
- o Once a week 每星期一次
- o Once or twice a month 每月一至兩次

7. Why do you drive over taking public transportation? Check all that apply. 為什麼選擇駕駛而不選擇乘搭公共交通工具？可選多項

- Less expensive 所需費用少
- Flexibility 有彈性
- I enjoy driving 喜歡駕駛
- Safer 較為安全
- I do not like public transportation不喜歡公共交通
- Other其他

8. What are your thoughts about renting out your personal car for use by others? Check all that apply. 您對租出私人座駕供他人駕駛的感覺，可選多項。

- I can make money可以賺取利潤
- It is good for the environment有助改善環境問題
- I always need my car 需要經常駕駛
- I don't want people in my car不願意讓陌生人駕駛
- I would never do this 決不會租出私人座駕
- Unsure 不肯定

9. What are your thoughts about driving your personal car with a stranger as a passenger? Check all that apply. 您對將私人座駕用作提供義載或順風車服務的看法，可選多項。

- I can make money 可以賺取利潤
- It is good for the environment有助改善環境問題
- Socializing 可作社交用途

- Inconvenient 不方便
- Unsafe 不安全
- I don't want people in my car 不願意承載陌生人
- I would never do this 決不會提供義載或順風車
- Unsure 不肯定

## **Appendix C: Interview Protocols and Notes**

### **1: ECrent (Jeanie Lau)**

This interview will be loosely structured. We may ask additional questions or request clarification based off of the responses of the interviewees, and some questions may be individually tailored to the interviewees. This interview will be on-record and, if willing, your name will be included in our final report. If not, we will do our best to keep responses anonymous.

Introduction: We are three students from Worcester Polytechnic Institute, a university in the United States. We are working with Friends of the Earth Hong Kong to determine the feasibility of car sharing in Hong Kong.

**Interview Notes:** Friday, January 15, 2016

Please tell us about your company.

- ECrent's goal: reduce waste by enabling peer-to-peer sharing
- covers many categories of products/services
- internet platform
- ECrent sees themselves as a tool, not a negotiator
- main markets: Hong Kong, China, Taiwan
- rapid growth in other parts of the world

What is the rental process (including for private vehicles)?

- anyone can post belongings or services on the site
- ECrent does not charge commission for a transaction but charges a posting fee
- \$6 USD to post; campaign to reduce posting price to \$3 USD
- renter directly contacts and negotiates with the poster
- renter does not pay any fee to ECrent

What is the utilization rate of cars posted on ECrent?

- depends on the type of car and location

- after a few cars were posted on the website, the owner quickly received inquiries
- repeat customers: depends on the renter/owner relationship

What do people use the rented cars for?

- depends on the type of car
- specialty cars for weddings, moving vans, etc.
- partners with Gogo Van

How did ECrent make itself known?

- online marketing
- social media
- attend events to do outreach and make ECrent more known
- collaboration with other organizations

Why do people post? How do you convince people to post?

- marketing, flyers, events, speeches
- have not yet attended car-related events
- word of mouth spreads knowledge of ECrent's services

What are potential challenges and problems that ECrent faces?

- issues with customers: ECrent is not a middleman
- does not handle the transaction themselves; this is done between the two parties
- avoids arguments between the owner and the renter

Does ECrent have any legality issues?

- ECrent not affected by some laws that may affect other car sharing services, such as Uber
- avoids legal grey area by simply acting as a posting site
- separates the service/product from the company
- Drivers for hire on site:
  - no real concern over whether or not people working with ECrent are ECrent employees; they are not

What is the public reaction to ECrent?

- no formal research thus far
- but feedback is good; people are satisfied

What are the demographics of ECrent's customers?

- ages 30-45
- not students
- customers typically more established in terms of money

What competition has ECrent has?

- so far, little competition because ECrent has such a diverse range of products
- most competitors focus only on one sector or in one geographic location

Has ECrent done any research into traffic reduction?

- ECrent believes that their car rental service can reduce traffic congestion and emissions, because their core value is to be sustainable
- use of existing resources prevents overproduction; at the same time this reduces the number of vehicles on the road
- have not yet conducted research into this

## **2: Professor Wing-Tat Hung**

This interview will be loosely structured. We may ask additional questions or request clarification based off of the responses of the interviewee, and some questions may be individually tailored to the interviewee. This interview will be on-record and, if willing, your name will be included in our final report. If not, we will keep your comments anonymous.

Introduction: We are three students from Worcester Polytechnic Institute, a university in the United States. We are working with Friends of the Earth Hong Kong to determine the feasibility of car sharing in Hong Kong.

**Interview Notes:** Tuesday, January 19, 2016

Please explain some of your research.

- Environment-related transport studies
- Emission measurement
  - air pollution
  - measure noise pollution using tire noise measurement instrument
- Road safety
  - Road infrastructure
  - Traffic management
  - Human behavior (drivers and pedestrians)
- Transportation policy
  - Safety policy

How do some other cities deal with traffic congestion?

- in many cities: build more roads to reduce congestion
  - attractive policy: creates jobs, more transport options
  - HK cannot do this effectively because congestion is so great and cannot build more roads in the main city areas

What policies has Hong Kong implemented to reduce traffic?

- 3rd round of electronic road pricing guidelines recently released



- rationale: charging for road use will reduce traffic congestion
- people strongly object to additional costs
- Professor Hung: road pricing is unavoidable
  - cannot build more roads because of limited space
  - must suppress demand (cars) because supply (road space) cannot increase
  - this method is fair because it targets those who contribute to congestion and does not penalize those who do not cause traffic congestion (example: private cars on Lantau Island and other rural areas)
  - should not increase ownership costs, only charge people who still insist on driving into high congestion areas
  - other methods (first registration tax, ownership rights auction) are not completely fair for certain groups (people with disabilities who require a personal vehicle, people who live in rural areas)
- Government did not do a good job selling this idea to the public
  - public does not perceive the benefits of increases in costs
  - public response focuses on the increase in cost instead of the decrease in congestion
  - Government does not clearly state what it will do with money collected from road tolls; public does not see how their increased costs are helping the public

How does the public respond to price increases (in general)?

- minor MTR fare increase → very negative response from the public
  - MTR not completely owned and operated by a private company
  - some feel that it is monopoly
- supporting price increases is politically unpopular

Are there cultural factors that drive people to own a private vehicle?

- there is no inherent cultural desire to own a private vehicle
- most have no need to own a car
- but for those who do, either they need one or it is a status symbol

What are your views on concerns over the legality of car sharing?

- “car sharing is always a solution” to traffic congestion
- no money transaction → avoid many legal problems
  - only taxis and hire cars can accept passengers for rewards
- community-based solutions avoid legal problems
  - app-enabled solutions would be easy to use
  - success depends on people being altruistic
  - example: people in a housing estate can have their own car sharing network

### **3: MVA (Andrew Pickford)**

This interview will be loosely structured. We may ask additional questions or request clarification based off of the responses of the interviewee, and some questions may be individually tailored to the interviewee. This interview will be on-record and, if willing, your name will be included in our final report. If not, we will keep your comments anonymous.

Introduction: We are three students from Worcester Polytechnic Institute, a university in the United States. We are working with Friends of the Earth Hong Kong to determine the feasibility of car sharing in Hong Kong.

**Interview Notes:** Friday, February 12, 2016

Please explain what MVA does.

- simulation of transportation networks to find gaps
- intermodal transport integration through use of big data
- transportation capacity alignment
- Growth-responsive transport
- transport that responds in real-time to demand, such as Uber and taxis
- growth of new companies such as Uber because of convenience

What are some transport policies that other cities have implemented?

- Mobility to Service Example: Helsinki, Finland
- employers pay employees to use public transport in lieu of private vehicles
- rationale: private cars are only used 5% of the time
- employers contract with transport companies to bring employees from home to work
- employee buses
- aim to make transport to and from work as seamless as possible

What are some methods to reduce car ownership in Hong Kong?

- ownership cost (such as First Registration Tax) and usage cost (such as cost of fuel and maintenance)

- Electronic Road Pricing
  - time-based road charges; charges increase when congestion increases
  - encourages spreading traffic load more evenly in terms of time

What are your thoughts on transport policy in Hong Kong?

- bundling of policies → public unsure
- traffic congestion and air pollution are different
  - electric cars still contribute to traffic congestion
- policies need to focus either on lowering emissions or reducing traffic congestion
  - policies have a primary and secondary effect
- difficult to please everyone
  - electric vehicle owners may feel targeted by traffic congestion policies
  - example from Milan: congestion charge implemented, many drivers complained → 85% of vehicles exempted from congestion charges
- the most effective transport policies depends on the local condition
- Parking Enforcement
  - low enforcement results in reduction in road space and reduction in traffic capacity
- Tolls
  - demand regulation is not the primary intention of tolls

What are some policies that MVA has done research into?

- Low Emissions Zones in three areas: Mong Kok, Causeway Bay, Central
- Government has an agreement with bus companies to reduce number of buses in certain times of the day
- this policy is not very well known

Has MVA done any research into the Cross Harbour Tunnels?

- MVA counts vehicles for Cross-Harbour Tunnel; provides consultation
- a company acquired by MVA did a study on the center tunnel in 2013-2014

- result: wait to make tunnel policy changes until after concessionary fare scheme ends in 2016
- center tunnel is owned and operated by the government
- Eastern and Western Tunnels owned and operated by private companies
  - tunnel prices based on commercial objectives
  - some jurisdictions (example: South Africa) allow tunnel operators to set prices, but specify the maximum queue length

Has MVA dealt with any issues over legality of new transportation policies?

- MVA wanted carpark operators to display number of parking spaces available on electronic signs
- did not work in Hong Kong because parking operators are under no legal obligation to provide this information, and they are not voluntarily giving this information
- however, government can require that carparks must publish number of parking spaces available in order to have license renewed

#### **4: Uber (Crystal Pang)**

This interview will be loosely structured. We may ask additional questions or request clarification based off of the responses of the interviewees, and some questions may be individually tailored to the interviewees. This interview will be on-record and, if willing, your name will be included in our final report. If not, we will do our best to keep responses anonymous.

Introduction: We are three students from Worcester Polytechnic Institute, a university in the United States. We are working with Friends of the Earth Hong Kong to determine the feasibility of car sharing in Hong Kong.

**Interview Notes:** Wednesday, February 17, 2016

Please tell us about the history of Uber in Hong Kong

- June 2014
  - Late introduction compared to other Asian cities
  - Fast induction due to many ex-Pats using it
    - Introduction to locals after induction

How did Uber make itself known in Hong Kong?

- Online Marketing
- “Give-Get Promotions”
  - Current users would give a promotion to a new user and get one themselves
    - Word of mouth promotion

What successes has Uber had in Hong Kong?

- Very popular
  - Seen as upscale and trendy (Uber Black)
- View of the users
  - convenient
  - represents a new type of lifestyle
  - embracing the sharing economy

What challenges has Uber overcome?

- Archaic laws, unrepresentative of this new method of transportation
  - Goal: bridge the gap with lawmakers
    - Determine how Uber fits into the current framework
    - Listen to riders and drivers for any changes that may be needed
  - Currently facing legal proceedings
    - No comment on the status of these

What are the demographics of Uber's users?

- At the point of inception in Hong Kong
  - Mostly tourists for the first 12 months
- Currently
  - Marketing and education has increased the number of locals using Uber
  - Higher percentage of locals than tourists now use Uber
- Neighborhood Campaigns
  - Sha Tin, located in the New territories
    - Very densely populated by minimal Uber traffic
    - No MTR station
    - Uber Promotion
      - One free ride of up to \$200 to and from Shatin
      - Has increased in use from locals in this area

What do people use Uber for?

- Peak Hours
  - Morning and evening commute
  - Weekends
- Most popular destinations (2015)
  - International Finance Centre
  - International Commerce Centre
  - Time Square Hong Kong

What are some reasons drivers choose to drive for Uber?

- Data is gather by Uber from surveys of the drivers
- At the point of inception in Hong Kong
  - Full time drivers for Uber Black
  - Main source of income for these people
- Currently
  - Part-time drivers during specific times (mornings, weekends, etc.)
    - Make extra money
    - Some use it as a method of networking for their other careers

What are the concerns over the legality of Uber in Hong Kong?

- The biggest concern of Uber is the ride is safe
- The company has a global insurance policy
  - They communicated an open letter to their drivers explaining the policy
  - Covers up to \$5 million in damages
  - Confirmed coverage in Hong Kong

How does Uber ensure safety?

- Background check process for drivers
  - Daily collection of data from courts to identify new criminal records
  - Archival collection of open records of criminal history by name of driver
    - If any results turn up, they contact the driver for confirmation
  - Daily checks of ratings from passengers
    - If any downward trends in ratings or negative comments are noticed, they driver will be monitored and potentially terminated
  - Online safety tests are required to become a driver
    - Hong Kong license points may be checked if deemed necessary by Uber
- Not a perfect system but safer than taxis
  - Taxis have no background checks

Has Uber taken any initiative in terms of reducing environmental impact?



- Promotion of sharing economy
- Encourage people to communicate online to share and Uber to work
  - Uber in Hong Kong is too premature for the UberPool system from the United States
    - Need to finish working out legal issues before facilitating carpool via Uber
- Many electric cars present in the fleet of Uber vehicles
  - Purchasing an electric vehicle is encouraged by Uber
- Optimization of drivers
  - Drivers have multi-dispatch trips
    - When a driver is within a certain radius of the drop off point, if a new passenger is hailing a ride in that radius, the original driver will pick them up instead of returning to the dispatch center and sending a new driver

Has Uber conducted any research into the potential to reduce traffic congestion and air pollution?

- No formal studies have been conducted by Uber about the potential to reduce traffic
- They do participate in green initiatives in hopes of helping the environment

What are Uber's plans for the future?

- New Uber category launched on Thursday, February 18, 2016
  - Uber Assist
    - Service for individuals with mobility issues
    - Working with the Blind Union, Silence, and rehabilitation institutions
    - Drivers are trained to assist in the transportation of those who are mobility challenged
    - Current resources for those with mobility challenges are very limited
    - Created with the idea that “there are all kinds of riders”
- Uber usage for the elderly
  - No current plans in Hong Kong due to the premature nature of the company
    - Currently partnering with caregivers who may assist in the use of Uber for the elderly

## Appendix D: Survey Responses

### 1: Non-Car Owner

|    | Location | Gender | Age   | Occupation | Income                 | Region          | Use | Frequency              | Convenient | Safe | Affordable | Legal |
|----|----------|--------|-------|------------|------------------------|-----------------|-----|------------------------|------------|------|------------|-------|
| 1  | HKU      | female | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 3          | 2    | 2          | 4     |
| 2  | HKU      | female | 18-24 | student    | I prefer not to answer | HK Island       | no  | never                  | 5          | 4    | 4          | 4     |
| 3  | HKU      | female | 25-34 | education  | 10001-20000            | HK Island       | no  | never                  | 3          | 3    | 3          | 3     |
| 4  | HKU      | female | 18-24 | student    | <10000                 | New Territories | no  | never                  | 5          | 4    | 5          | 4     |
| 5  | HKU      | male   | 18-24 | student    | <10000                 | New Territories | no  | never                  | 3          | 3    | 4          | 5     |
| 6  | HKU      | male   | 18-24 | student    | <10000                 | HK Island       | yes | less than once a month | 4          | 3    | 3          | 5     |
| 7  | HKU      | ---    | 18-24 | student    | <10000                 | HK Island       | yes | less than once a month | 5          | 5    | 4          | 5     |
| 8  | HKU      | male   | 18-24 | student    | <10000                 | New Territories | no  | never                  | 4          | 4    | 4          | 4     |
| 9  | HKU      | male   | 18-24 | student    | <10000                 | HK Island       | yes | once a month           | 5          | 4    | 5          | 4     |
| 10 | HKU      | female | 18-24 | student    | <10000                 | Kowloon         | yes | less than once a month | 3          | 3    | 4          | 2     |
| 11 | HKU      | male   | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 3          | 3    | 3          | 3     |
| 12 | HKU      | female | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 3          | 3    | 4          | 3     |
| 13 | HKU      | male   | 18-24 | student    | I prefer not to answer | HK Island       | no  | never                  | 4          | 2    | 3          | 2     |
| 14 | HKU      | male   | 18-24 | student    | I prefer not to answer | HK Island       | no  | never                  | 3          | 3    | 3          | 2     |
| 15 | HKU      | male   | 18-24 | student    | I prefer not to answer | HK Island       | no  | never                  | 4          | 3    | 4          | 3     |
| 16 | HKU      | female | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 3          | 2    | 3          | 4     |
| 17 | HKU      | female | 25-34 | media      | 20001-30000            | Kowloon         | no  | never                  | 3          | 3    | 4          | 3     |
| 18 | HKU      | male   | 45-54 | other      | 30001-40000            | Kowloon         | yes | twice a month          | 5          | 4    | 4          | 5     |
| 19 | HKU      | male   | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 4          | 3    | 4          | 2     |
| 20 | HKU      | male   | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 4          | 4    | 4          | 2     |
| 21 | HKU      | male   | 18-24 | student    | <10000                 | New Territories | yes | less than once a month | 4          | 4    | 3          | 5     |
| 22 | HKU      | male   | 18-24 | student    | <10000                 | New Territories | yes | every day              | 5          | 4    | 5          | 5     |
| 23 | HKU      | female | 18-24 | student    | I prefer not to answer | New Territories | no  | never                  | 4          | 3    | 3          | 3     |
| 24 | HKU      | female | 18-24 | student    | <10000                 | HK Island       | no  | never                  | 3          | 4    | 3          | 5     |
| 25 | HKU      | female | 18-24 | student    | <10000                 | Kowloon         | no  | never                  | 3          | 3    | 3          | 3     |
| 26 | LKF      | female | 45-54 | other      | 10001-20000            | HK Island       | no  | never                  | 4          | -    | -          | -     |

|    |                 |        |       |                                     |                        |                 |     |                        |   |   |   |   |
|----|-----------------|--------|-------|-------------------------------------|------------------------|-----------------|-----|------------------------|---|---|---|---|
| 27 | LKF             | male   | 45-54 | transportation and logistics        | 20001-30000            | Kowloon         | no  | never                  | 5 | 4 | 5 | 5 |
| 28 | LKF             | female | 35-44 | FDH                                 | <10000                 | Kowloon         | no  | never                  | 5 | - | - | - |
| 29 | LKF             | female | 45-54 | FDH                                 | <10000                 | HK Island       | yes | less than once a month | 5 | 5 | 5 | 5 |
| 30 | Kowloon Park    | female | 18-24 | student                             | I prefer not to answer | HK Island       | no  | never                  | 3 | 3 | 3 | 3 |
| 31 | Kowloon Park    | female | 18-24 | student                             | 10001-20000            | HK Island       | yes | once a month           | 2 | 3 | 5 | 4 |
| 32 | Kowloon Park    | female | 18-24 | student                             | <10000                 | -               | yes | once a month           | 4 | 5 | 4 | 5 |
| 33 | Kowloon Park    | male   | 35-44 | other                               | <10000                 | Kowloon         | no  | never                  | 4 | 4 | 4 | 5 |
| 34 | Kowloon Park    | male   | 65+   | engineering                         | >40000                 | -               | no  | never                  | 5 | 5 | 4 | 5 |
| 35 | Kowloon Park    | female | 35-44 | sales, cs, and business development | I prefer not to answer | -               | no  | never                  | 4 | 4 | 4 | 4 |
| 36 | Kowloon Park    | female | 18-24 | student                             | I prefer not to answer | New Territories | no  | never                  | 1 | 1 | 2 | 1 |
| 37 | Kowloon Park    | male   | 45-54 | engineering                         | 20001-30000            | -               | no  | never                  | 1 | 1 | 1 | 2 |
| 38 | Kowloon Park    | female | 18-24 | other                               | I prefer not to answer | New Territories | no  | never                  | 3 | 4 | 4 | 3 |
| 39 | Kowloon Park    | female | 25-34 | education                           | 10001-20000            | HK Island       | yes | less than once a month | 3 | 5 | 4 | 1 |
| 40 | Kowloon Park    | male   | 45-54 | accounting/banking/finance          | 10001-20000            | Kowloon         | no  | never                  | 3 | 2 | 3 | 3 |
| 41 | Kowloon Park    | male   | 55-64 | retired                             | 10001-20000            | HK Island       | no  | never                  | 4 | 2 | 3 | 2 |
| 42 | Kowloon Park    | male   | 18-24 | student                             | I prefer not to answer | New Territories | yes | twice a month          | 5 | 3 | 3 | 3 |
| 43 | Kowloon Park    | male   | 45-54 | professional services               | >40000                 | Kowloon         | no  | never                  | 2 | 2 | 2 | 2 |
| 44 | Kowloon Park    | male   | 25-34 | merchandising and purchasing        | >40000                 | HK Island       | yes | twice a month          | 4 | 3 | 3 | 4 |
| 45 | Kowloon Park    | male   | 35-44 | education                           | <10000                 | -               | yes | twice a month          | 4 | 5 | 4 | 5 |
| 46 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | yes | none of the above      | 1 | - | - | - |
| 47 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 5 |
| 48 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 5 | 5 | 5 | 5 |
| 49 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 4 | 3 | 4 | 4 |
| 50 | Kowloon Park    | female | 18-24 | student                             | <10000                 | HK Island       | yes | less than once a month | 4 | 3 | 3 | 4 |
| 51 | Kowloon Park    | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 2 | 3 |
| 52 | City University | male   | 18-24 | student                             | <10000                 | HK Island       | no  | never                  | 3 | 4 | 2 | 2 |
| 53 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | - | - | - | - |
| 54 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | yes | twice a month          | 4 | 4 | 3 | 3 |
| 55 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 3 | 3 | 3 | 4 |
| 56 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 3 | 4 | 4 | 4 |

|    |                 |        |       |                                     |                        |                 |     |                        |   |   |   |   |
|----|-----------------|--------|-------|-------------------------------------|------------------------|-----------------|-----|------------------------|---|---|---|---|
| 57 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 5 | 3 | 3 | 4 |
| 58 | City University | female | 18-24 | student                             | <10000                 | New Territories | yes | less than once a month | 4 | 3 | 3 | 4 |
| 59 | City University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 4 | 3 |
| 60 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 4 | 4 | 3 | 3 |
| 61 | City University | male   | 18-24 | Accounting, banking, finance        | 10001-20000            | Kowloon         | yes | less than once a month | 5 | 2 | 4 | 3 |
| 62 | City University | male   | 18-24 | student                             | I prefer not to answer | New Territories | no  | never                  | 5 | 3 | 3 | 2 |
| 63 | City University | male   | 18-24 | transportation and logistics        | I prefer not to answer | New Territories | yes | less than once a month | 4 | 3 | 4 | 4 |
| 64 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | yes | less than once a month | 5 | 4 | 5 | 3 |
| 65 | Kowloon Park    | female | 25-34 | sales, cs, and business development | 10001-20000            | Kowloon         | no  | never                  | - | - | - | 2 |
| 66 | Kowloon Park    | male   | 35-44 | engineering                         | 10001-20000            | New Territories | no  | never                  | 3 | 3 | 3 | 3 |
| 67 | Kowloon Park    | female | 25-34 | building and construction           | 20001-30000            | Kowloon         | no  | never                  | 4 | 3 | 3 | 5 |
| 68 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 3 | 3 | 2 | 4 |
| 69 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 3 | 3 | 3 | 4 |
| 70 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 5 | 4 | 5 | 3 |
| 71 | City University | female | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 4 | 3 | 4 | 3 |
| 72 | City University | female | 18-24 | student                             | <10000                 | New Territories | yes | less than once a month | 4 | 4 | 4 | 4 |
| 73 | City University | female | 18-24 | student                             | <10000                 | HK Island       | no  | never                  | 3 | 3 | 3 | 4 |
| 74 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | yes | twice a month          | 4 | 5 | 3 | 3 |
| 75 | City University | male   | 18-24 | engineering                         | I prefer not to answer | HK Island       | no  | never                  | 5 | 4 | 1 | 5 |
| 76 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 2 | 4 | 3 | 3 |
| 77 | City University | male   | 18-24 | student                             | I prefer not to answer | New Territories | no  | never                  | 5 | 5 | 3 | 5 |
| 78 | City University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 5 | 3 | 3 | 2 |
| 79 | City University | female | 18-24 | student                             | <10000                 | HK Island       | no  | never                  | 3 | 3 | 3 | 3 |
| 80 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 3 | 3 | 4 |
| 81 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 3 | 5 | 4 | 1 |
| 82 | City University | female | 18-24 | student                             | I prefer not to answer | HK Island       | no  | never                  | 4 | 3 | 4 | 3 |
| 83 | City University | male   | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 4 | 4 | 5 | 3 |
| 84 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 2 | 2 | 4 | 3 |
| 85 | City University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 3 | 2 | 3 | 3 |

|     |                    |        |       |                       |                        |                 |     |                        |   |   |   |   |
|-----|--------------------|--------|-------|-----------------------|------------------------|-----------------|-----|------------------------|---|---|---|---|
| 86  | City University    | female | 18-24 | student               | <10000                 | New Territories | yes | less than once a month | 4 | 4 | 5 | 3 |
| 87  | Chinese University | female | 18-24 | student               | <10000                 | HK Island       | no  | never                  | 3 | 2 | 5 | 4 |
| 88  | Chinese University | female | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 2 | 4 | 3 |
| 89  | Chinese University | female | 18-24 | public/civil          | <10000                 | New Territories | yes | less than once a month | 4 | 4 | 5 | 2 |
| 90  | Chinese University | female | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 1 |
| 91  | Chinese University | male   | 25-34 | other                 | 10001-20000            | New Territories | yes | less than once a month | 5 | 5 | 5 | 5 |
| 92  | Chinese University | male   | 25-34 | other                 | I prefer not to answer | New Territories | yes | less than once a month | 5 | 5 | 4 | 4 |
| 93  | Chinese University | male   | 25-34 | student               | <10000                 | New Territories | no  | never                  | 2 | 2 | 3 | 4 |
| 94  | Chinese University | male   | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 2 | 4 | 2 |
| 95  | Chinese University | male   | 18-24 | professional services | <10000                 | New Territories | no  | never                  | 4 | 4 | 3 | 3 |
| 96  | Chinese University | female | 18-24 | student               | <10000                 | New Territories | no  | never                  | - | - | - | - |
| 97  | Chinese University | male   | 18-24 | student               | <10000                 | Kowloon         | yes | less than once a month | 2 | 2 | 4 | 3 |
| 98  | Chinese University | male   | 18-24 | student               | I prefer not to answer | New Territories | yes | once a month           | 4 | 3 | 4 | 2 |
| 99  | Chinese University | female | 18-24 | student               | <10000                 | New Territories | yes | less than once a month | 5 | 4 | 2 | 3 |
| 100 | Chinese University | female | 18-24 | student               | <10000                 | Kowloon         | no  | never                  | 3 | 3 | 4 | 3 |
| 101 | Chinese University | male   | 18-24 | student               | I prefer not to answer | Kowloon         | no  | never                  | 5 | 5 | 5 | 5 |
| 102 | Chinese University | male   | 18-24 | student               | <10000                 | HK Island       | yes | every week             | 4 | 4 | 5 | 5 |
| 103 | Chinese University | female | 18-24 | student               | <10000                 | New Territories | no  | never                  | 3 | 2 | 4 | 4 |
| 104 | Chinese University | female | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 3 |
| 105 | Chinese University | male   | 18-24 | education             | 10001-20000            | New Territories | no  | never                  | 4 | 3 | 2 | 4 |
| 106 | Chinese University | male   | 18-24 | professional services | I prefer not to answer | HK Island       | no  | never                  | 4 | 4 | 5 | 3 |
| 107 | Chinese University | male   | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 4 | 4 | 4 |
| 108 | Chinese University | female | 18-24 | student               | <10000                 | HK Island       | yes | less than once a month | 5 | 5 | 4 | 4 |
| 109 | Chinese University | male   | 18-24 | student               | <10000                 | Kowloon         | no  | never                  | 4 | 4 | 3 | 3 |
| 110 | Chinese University | male   | 18-24 | student               | <10000                 | Kowloon         | no  | never                  | 4 | 2 | 3 | 4 |
| 111 | Chinese University | male   | 18-24 | student               | <10000                 | Kowloon         | no  | never                  | 4 | 2 | 3 | 3 |
| 112 | Chinese University | male   | 18-24 | student               | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 2 |
| 113 | Chinese University | female | 18-24 | student               | <10000                 | HK Island       | no  | never                  | 4 | 2 | 2 | 3 |

|     |                    |        |       |                                     |                        |                 |     |                        |   |   |   |   |
|-----|--------------------|--------|-------|-------------------------------------|------------------------|-----------------|-----|------------------------|---|---|---|---|
| 114 | Chinese University | male   | 18-24 | professional services               | I prefer not to answer | New Territories | no  | never                  | 3 | 3 | 3 | 4 |
| 115 | Chinese University | male   | 18-24 | student                             | I prefer not to answer | New Territories | no  | never                  | 3 | 3 | 3 | 3 |
| 116 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 4 | 3 |
| 117 | Chinese University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 2 | 2 | 3 | 4 |
| 118 | Chinese University | male   | 18-24 | student                             | <10000                 | New Territories | yes | -                      | 4 | 4 | 5 | 4 |
| 119 | Chinese University | male   | 18-24 | student                             | I prefer not to answer | HK Island       | no  | never                  | 4 | 5 | 5 | 3 |
| 120 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 3 |
| 121 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 2 | 3 | 2 | 4 |
| 122 | Chinese University | female | 35-44 | sales, cs, and business development | 10001-20000            | Kowloon         | no  | never                  | - | - | 3 | - |
| 123 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 3 | 4 | 4 |
| 124 | Chinese University | female | 35-44 | sales, cs, and business development | 20001-30000            | Kowloon         | no  | never                  | - | - | 3 | - |
| 125 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 3 | 3 | 4 | 4 |
| 126 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | yes | less than once a month | 5 | 5 | 5 | 5 |
| 127 | Chinese University | male   | 18-24 | student                             | <10000                 | New Territories | yes | every day              | 3 | 2 | 4 | 2 |
| 128 | Chinese University | male   | 18-24 | student                             | <10000                 | Kowloon         | no  | never                  | 4 | 3 | 4 | 3 |
| 129 | Chinese University | male   | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 3 | 3 | 4 |
| 130 | Chinese University | female | 18-24 | student                             | <10000                 | Kowloon         | yes | less than once a month | 5 | 4 | 4 | 4 |
| 131 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 3 | 4 | 4 |
| 132 | Chinese University | female | 18-24 | student                             | I prefer not to answer | New Territories | no  | never                  | 4 | 2 | 3 | 4 |
| 133 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | yes | less than once a month | 5 | 3 | 4 | 4 |
| 134 | Chinese University | female | 18-24 | public/civil                        | <10000                 | Kowloon         | yes | less than once a month | 4 | 4 | 4 | 5 |
| 135 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | yes | less than once a month | 5 | 5 | 5 | 5 |
| 136 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 4 |
| 137 | Chinese University | female | 25-34 | student                             | I prefer not to answer | Kowloon         | yes | none of the above      | 3 | 2 | 3 | 3 |
| 138 | Chinese University | female | 18-24 | student                             | <10000                 | HK Island       | yes | twice a month          | 4 | 5 | 4 | 5 |
| 139 | Chinese University | female | 18-24 | student                             | <10000                 | New Territories | no  | never                  | 5 | 3 | 5 | 4 |
| 140 | Chinese University | male   | 25-34 | student                             | <10000                 | Kowloon         | no  | never                  | 3 | 4 | 3 | 3 |

|     |                    |        |       |                           |                        |                 |     |                        |   |   |   |   |
|-----|--------------------|--------|-------|---------------------------|------------------------|-----------------|-----|------------------------|---|---|---|---|
| 141 | Chinese University | female | 18-24 | student                   | <10000                 | New Territories | yes | less than once a month | 3 | 2 | 3 | 3 |
| 142 | Chinese University | female | 25-34 | student                   | <10000                 | Kowloon         | no  | never                  | 3 | 4 | 5 | 2 |
| 143 | Chinese University | male   | 18-24 | student                   | <10000                 | HK Island       | no  | never                  | 5 | 5 | 3 | 5 |
| 144 | Chinese University | female | 18-24 | student                   | <10000                 | HK Island       | yes | less than once a month | 4 | 2 | 3 | 3 |
| 145 | Chinese University | male   | 18-24 | student                   | <10000                 | Kowloon         | no  | never                  | 3 | 3 | 3 | 3 |
| 146 | Chinese University | female | 18-24 | building and construction | <10000                 | New Territories | yes | less than once a month | 4 | 4 | 4 | 3 |
| 147 | Chinese University | male   | 25-34 | information technology    | 10001-20000            | Kowloon         | no  | never                  | 3 | 3 | 3 | 3 |
| 148 | Chinese University | male   | 18-24 | student                   | <10000                 | New Territories | yes | less than once a month | 5 | 4 | 5 | 5 |
| 149 | Chinese University | male   | 18-24 | student                   | <10000                 | Kowloon         | yes | less than once a month | 5 | 5 | 5 | 3 |
| 150 | Chinese University | male   | 18-24 | student                   | <10000                 | New Territories | no  | never                  | 4 | 2 | 3 | 2 |
| 151 | Chinese University | female | 18-24 | student                   | <10000                 | HK Island       | yes | less than once a month | 4 | 3 | 4 | 4 |
| 152 | Chinese University | female | 18-24 | student                   | <10000                 | Kowloon         | no  | never                  | 4 | 3 | 3 | 4 |
| 153 | Chinese University | female | 18-24 | student                   | I prefer not to answer | New Territories | no  | never                  | 4 | 3 | 3 | 3 |
| 154 | Online: University | female | 25-34 | education                 | >40000                 | New Territories | no  | never                  | 3 | 2 | 3 | 1 |
| 155 | Online: FoE        | female | 25-34 | education                 | 10001-20000            | New Territories | yes | every week             | 5 | 4 | 5 | 4 |
| 156 | Online: University | male   | 25-34 | engineering               | 20001-30000            | New Territories | no  | never                  | 5 | 4 | 4 | 2 |
| 157 | Online: University | female | 18-24 | engineering               | 10001-20000            | Kowloon         | no  | never                  | 4 | 3 | 3 | 2 |
| 158 | Online: FoE        | female | 25-34 | public/civil              | 10001-20000            | New Territories | no  | never                  | 3 | 3 | 2 | 3 |
| 159 | Online: FoE        | female | 25-34 | education                 | 30001-40000            | HK Island       | no  | never                  | 3 | 4 | 3 | 3 |
| 160 | Online: University | male   | 18-24 | engineering               | 20001-30000            | Kowloon         | no  | never                  | 5 | 3 | 5 | 2 |
| 161 | Online: University | female | 18-24 | engineering               | 10001-20000            | New Territories | no  | never                  | 3 | 3 | 2 | 3 |
| 162 | Online: University | male   | 18-24 | building and construction | 10001-20000            | New Territories | no  | never                  | 2 | 2 | 3 | 3 |
| 163 | Online: FoE        | female | 18-24 | other                     | 10001-20000            | HK Island       | yes | less than once a month | 4 | 3 | 1 | 2 |
| 164 | Online: University | male   | 25-34 | building and construction | 30001-40000            | Kowloon         | yes | less than once a month | 5 | 3 | 4 | 1 |
| 165 | Online: University | male   | 25-34 | building and construction | 20001-30000            | New Territories | yes | less than once a month | 3 | 4 | 3 | 2 |
| 166 | Online: FoE        | female | 25-34 | professional services     | >40000                 | HK Island       | yes | less than once a month | 4 | 4 | 4 | 2 |
| 167 | Online: FoE        | female | 25-34 | public/civil              | 30001-40000            | HK Island       | no  | never                  | 2 | 3 | 3 | 5 |
| 168 | Online: FoE        | female | 35-44 | other                     | I prefer not to answer | New Territories | yes | less than once a month | 3 | 3 | 3 | 3 |

|     |                       |        |       |                                   |                              |                    |     |                              |   |   |   |   |
|-----|-----------------------|--------|-------|-----------------------------------|------------------------------|--------------------|-----|------------------------------|---|---|---|---|
| 169 | Online:<br>FoE        | male   | 65+   | transportation<br>and logistics   | <10000                       | New<br>Territories | yes | less than<br>once a<br>month | 5 | 5 | 5 | 5 |
| 170 | Online:<br>University | female | 18-24 | student                           | <10000                       | HK Island          | no  | never                        | 3 | 5 | 5 | 5 |
| 171 | Online:<br>University | female | 18-24 | education                         | <10000                       | New<br>Territories | yes | less than<br>once a<br>month | 4 | 4 | 3 | 4 |
| 172 | Online:<br>FoE        | male   | 18-24 | other                             | 10001-<br>20000              | New<br>Territories | no  | never                        | 5 | 5 | 5 | 5 |
| 173 | Online:<br>FoE        | female | 25-34 | marketing/<br>public<br>relations | I prefer<br>not to<br>answer | Kowloon            | yes | none of<br>the above         | 4 | 3 | 5 | 4 |
| 174 | Online:<br>FoE        | female | 45-54 | other                             | 10001-<br>20000              | New<br>Territories | yes | none of<br>the above         | 4 | 5 | 5 | 5 |
| 175 | Online:<br>FoE        | female | 18-24 | accounting/ba<br>nking/finance    | 10001-<br>20000              | New<br>Territories | yes | once a<br>month              | 5 | 5 | 5 | 5 |
| 176 | Online:<br>University | female | 25-34 | admin/hr                          | 10001-<br>20000              | Kowloon            | yes | once a<br>month              | 5 | 5 | 5 | 5 |
| 177 | Online:<br>FoE        | female | 35-44 | other                             | >40000                       | HK Island          | no  | never                        | 4 | 3 | 3 | 3 |
| 178 | Online:<br>FoE        | male   | 35-44 | information<br>technology         | 20001-<br>30000              | New<br>Territories | no  | never                        | 4 | 4 | 3 | 3 |
| 179 | Online:<br>FoE        | male   | 35-44 | insurance                         | 10001-<br>20000              | New<br>Territories | no  | never                        | 4 | 4 | 3 | 4 |
| 180 | Online:<br>FoE        | female | 35-44 | engineering                       | >40000                       | HK Island          | no  | never                        | 3 | 3 | 4 | 5 |
| 181 | Online:<br>FoE        | male   | 45-54 | marketing/<br>public<br>relations | I prefer<br>not to<br>answer | New<br>Territories | yes | once a<br>month              | 5 | 5 | 5 | 5 |
| 182 | Online:<br>FoE        | male   | 25-34 | information<br>technology         | >40000                       | New<br>Territories | yes | twice a<br>month             | 5 | 5 | 5 | 5 |
| 183 | Online:<br>University | male   | 18-24 | student                           | <10000                       | Kowloon            | no  | never                        | - | - | - | - |
| 184 | Online:<br>FoE        | female | 45-54 | transportation<br>and logistics   | >40000                       | New<br>Territories | no  | never                        | 5 | 5 | 5 | 5 |
| 185 | Online:<br>FoE        | male   | 25-34 | marketing/<br>public<br>relations | 20000-<br>30000              | HK Island          | yes | less than<br>once a<br>month | 4 | 2 | 1 | 3 |
| 186 | Online:<br>FoE        | female | 45-54 | other                             | >40000                       | Kowloon            | no  | never                        | 3 | 4 | 4 | 4 |
| 187 | Online:<br>FoE        | male   | 25-34 | education                         | 30000-<br>40000              | HK Island          | yes | less than<br>once a<br>month | 4 | 4 | 4 | 5 |
| 188 | Online:<br>FoE        | male   | 35-44 | other                             | 10000-<br>20000              | New<br>Territories | no  | never                        | 3 | 4 | 4 | 2 |



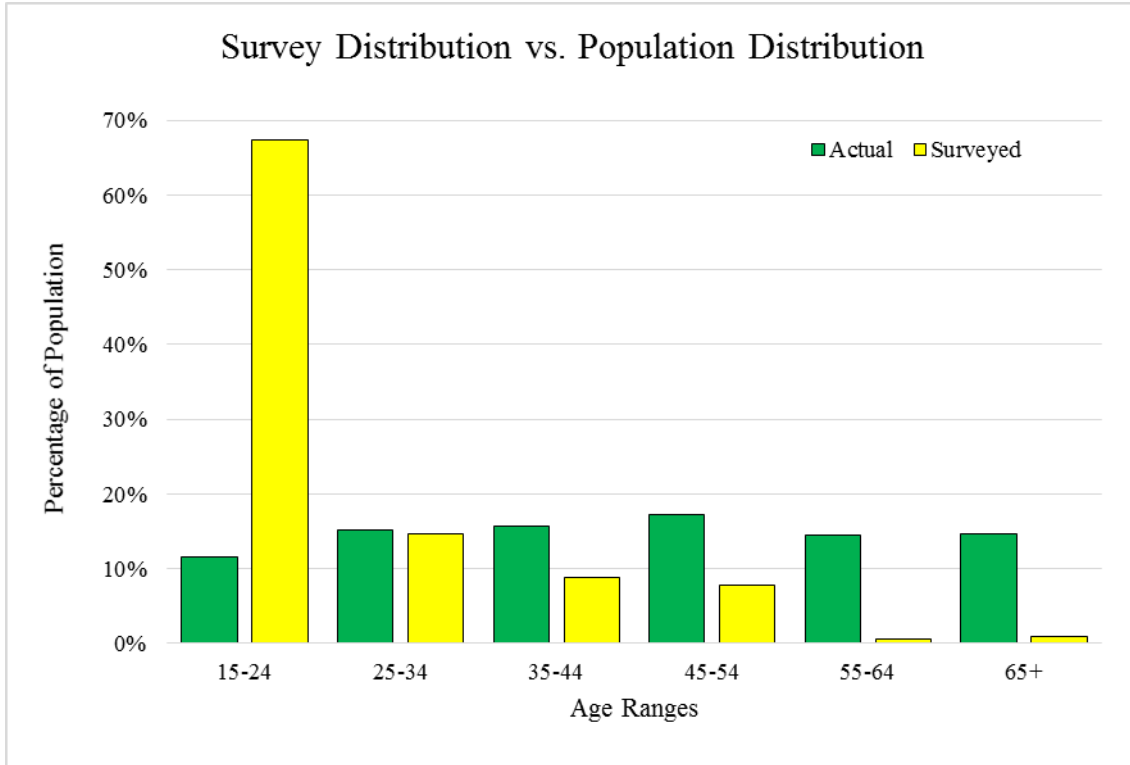
## 2: Car Owner

| 9                                              | 8                                           | 7                                      | 6                                           | 5                                             | 4                                           | 3                                                                 | 2                                          | 1                                 | Number                                  |
|------------------------------------------------|---------------------------------------------|----------------------------------------|---------------------------------------------|-----------------------------------------------|---------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|-----------------------------------|-----------------------------------------|
| Online: FoE<br>female<br>25-34<br>public/civil | Online: FoE<br>male<br>25-34<br>management  | Online: FoE<br>male<br>45-54<br>other  | Online: FoE<br>male<br>35-44<br>engineering | Online:<br>male<br>45-54<br>education         | City<br>male<br>18-24<br>accounting/finance | Kowloon<br>female<br>35-44<br>sales, cs, and business development | Kowloon<br>female<br>45-54<br>admin and hr | HKU<br>male<br>18-24<br>student   | Location<br>Gender<br>Age<br>Occupation |
| 10001-20000<br>New Territories<br>once a week  | 30001-40000<br>New Territories<br>every day | 40000+<br>New Territories<br>every day | 20001-30000<br>New Territories<br>every day | >400000<br>HK Island<br>once or twice a month | 10001-20000<br>New Territories<br>every day | <10000<br>-<br>every day                                          | <10000<br>-<br>every day                   | -<br>HK Island<br>every other day | Income<br>Region<br>Use of Car          |
| x                                              | x<br>x                                      | x                                      | x                                           | x                                             | x                                           | x                                                                 | x                                          | x                                 |                                         |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   | Question 7                              |
| x                                              |                                             |                                        | x                                           | x                                             | x                                           |                                                                   |                                            |                                   |                                         |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   | Question 8                              |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   |                                         |
| x                                              | x<br>x                                      | x<br>x                                 | x                                           |                                               |                                             |                                                                   | x                                          | x                                 |                                         |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   | Question 9                              |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   |                                         |
|                                                |                                             |                                        |                                             |                                               |                                             |                                                                   |                                            |                                   |                                         |

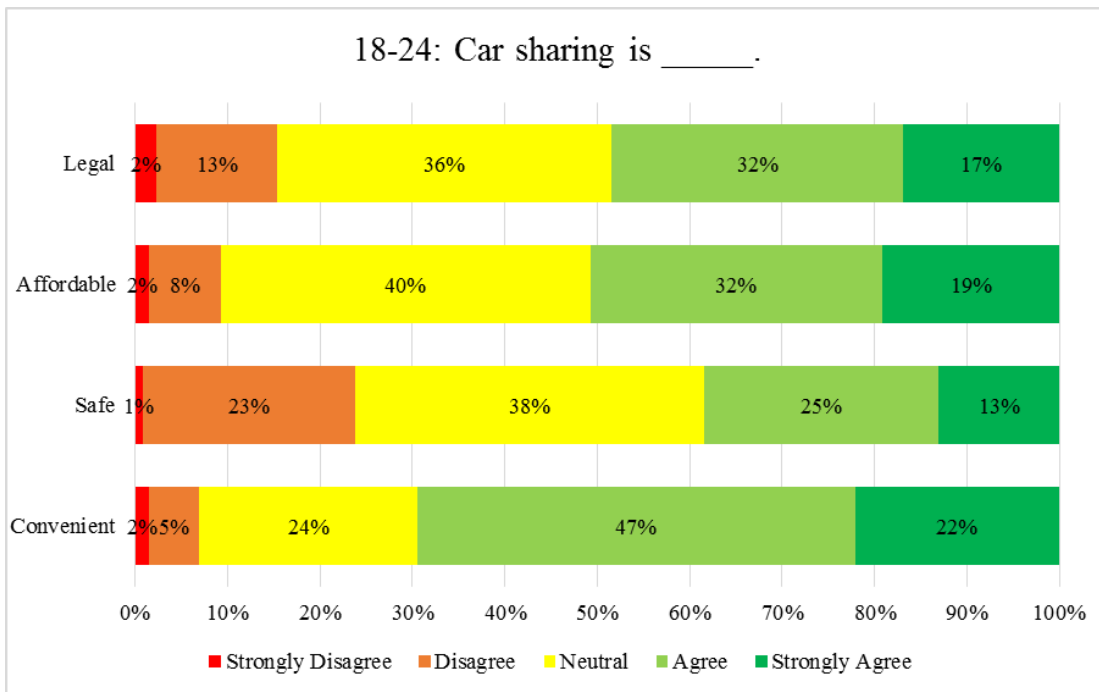
| 17                                                                | 16                                                         | 15                                          | 14                                                           | 13                                                       | 12                                                        | 11                                                 | 10                                                            |
|-------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------|
| Online: FoE<br>male<br>35-44<br>Marketing/<br>public<br>relations | Online: FoE<br>female<br>18-24<br>professional<br>services | Online: FoE<br>female<br>35-44<br>education | Online: FoE<br>male<br>18-24<br>building and<br>construction | Online: FoE<br>female<br>45-54<br>education              | Online: FoE<br>male<br>35-44<br>information<br>technology | Online: FoE<br>male<br>45-54<br>engineering        | Online: FoE<br>male<br>25-34<br>other                         |
| >40000<br>New<br>Territories<br>once or twice<br>a week           | 10001-20000<br>New<br>Territories<br>every other<br>day    | 40000+<br>New<br>Territories<br>every day   | 10001-20000<br>New<br>Territories<br>every day               | I prefer not<br>New<br>Territories<br>every other<br>day | 40000+<br>New<br>Territories<br>-                         | 40000+<br>New<br>Territories<br>every other<br>day | 30001-40000<br>New<br>Territories<br>once or twice<br>a month |
| X                                                                 | X                                                          | X                                           | X                                                            | X                                                        |                                                           | X                                                  | X                                                             |
| X                                                                 |                                                            |                                             |                                                              |                                                          |                                                           |                                                    |                                                               |
|                                                                   |                                                            | X                                           | X                                                            |                                                          |                                                           |                                                    |                                                               |
|                                                                   | X                                                          | X                                           | X                                                            | X                                                        | X                                                         |                                                    |                                                               |
|                                                                   |                                                            | X                                           | X                                                            | X                                                        |                                                           | X                                                  |                                                               |
| X                                                                 |                                                            |                                             |                                                              | X                                                        |                                                           |                                                    |                                                               |
| X                                                                 |                                                            |                                             |                                                              |                                                          |                                                           |                                                    |                                                               |
|                                                                   | X                                                          |                                             | X                                                            | X                                                        | X                                                         | X                                                  | X                                                             |
|                                                                   | X                                                          |                                             |                                                              |                                                          |                                                           |                                                    |                                                               |
| X                                                                 |                                                            | X                                           |                                                              | X                                                        |                                                           |                                                    |                                                               |

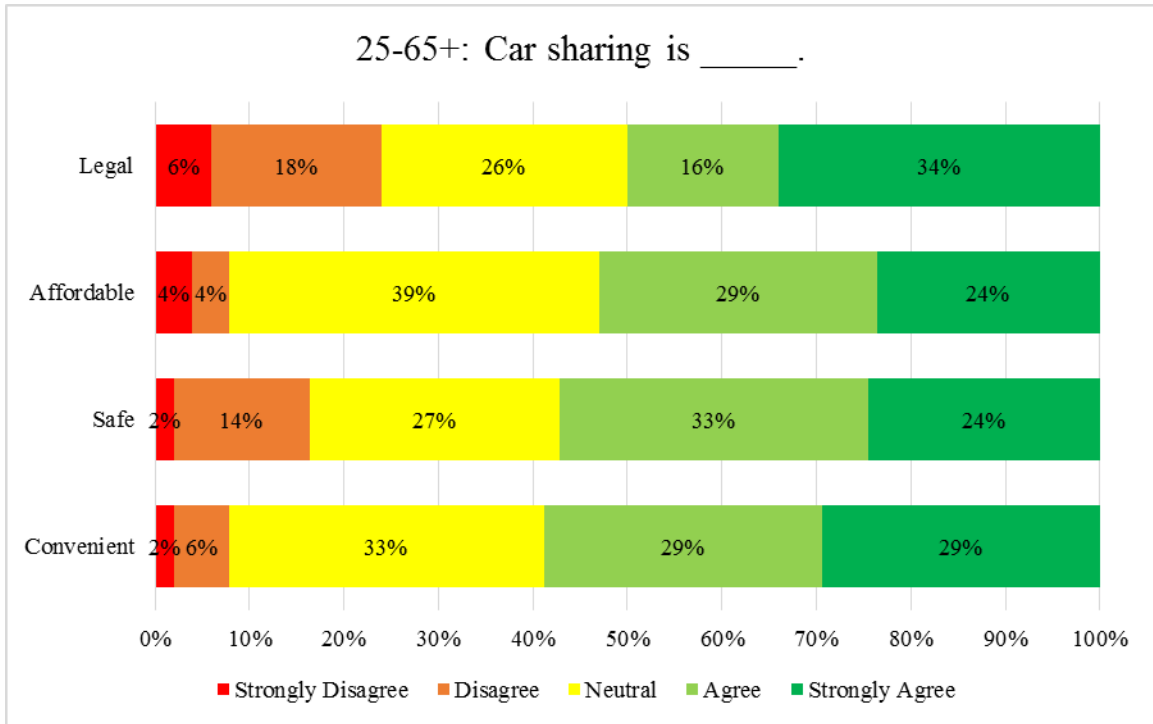
# Appendix E: Graphs

## 1: Age Distributions

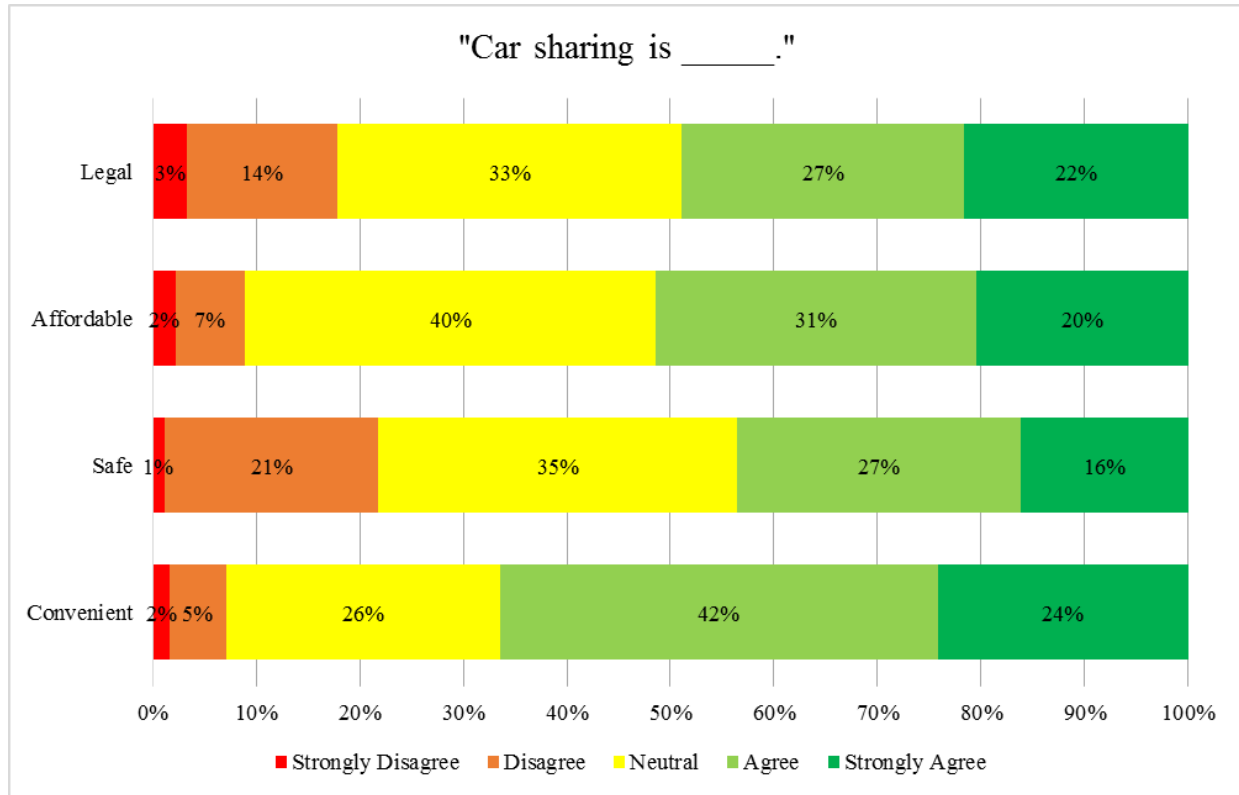


\*Note: population data contains ages 15-65+ whereas surveys were only taken from 18-65+

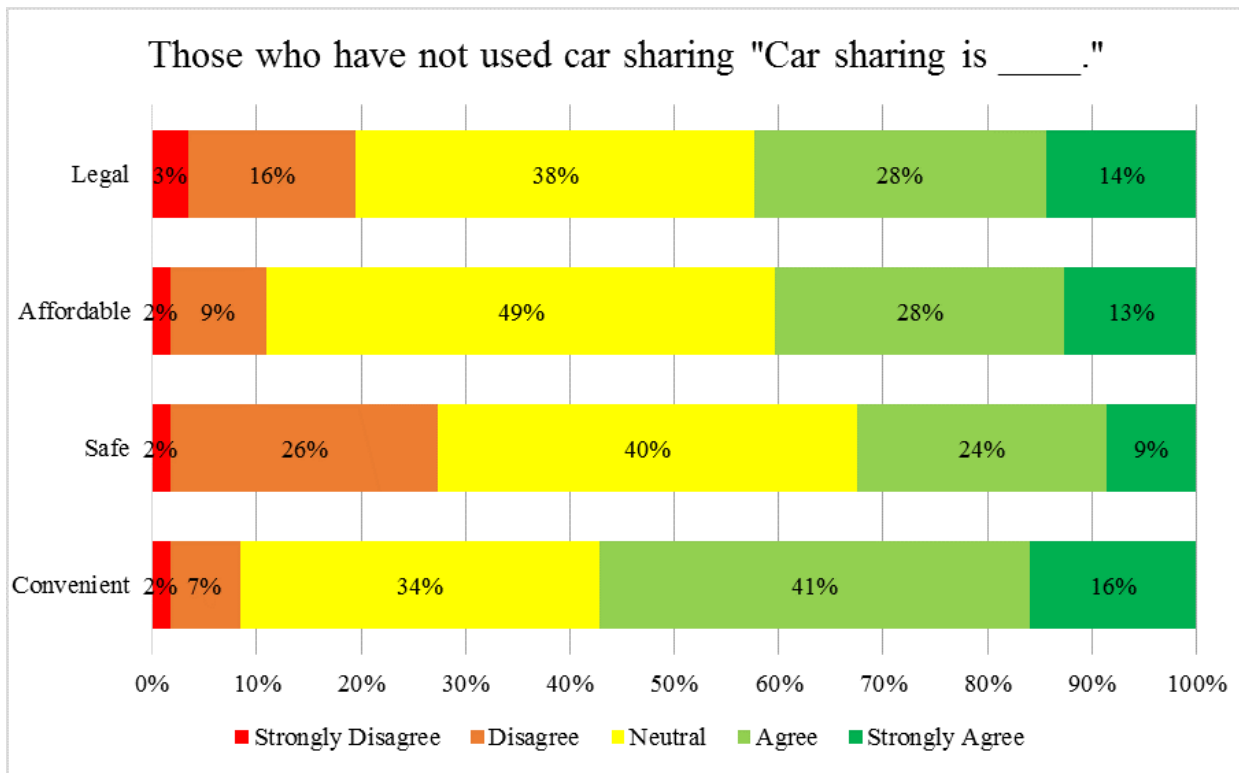
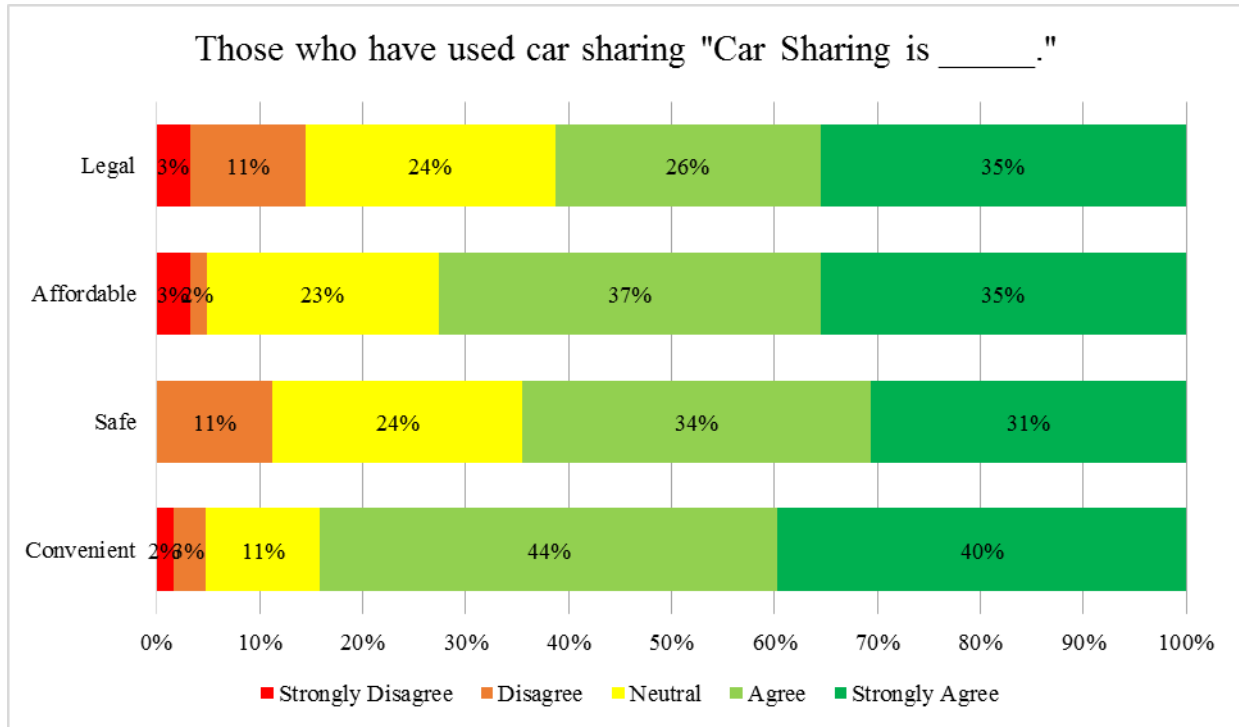




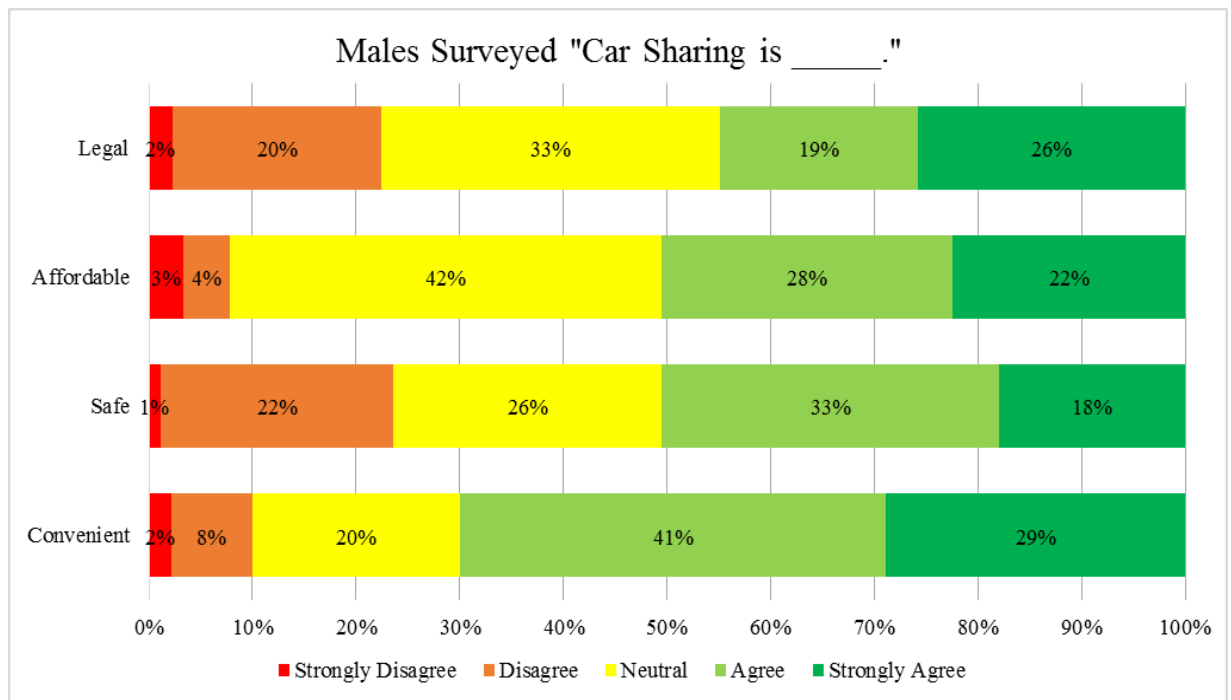
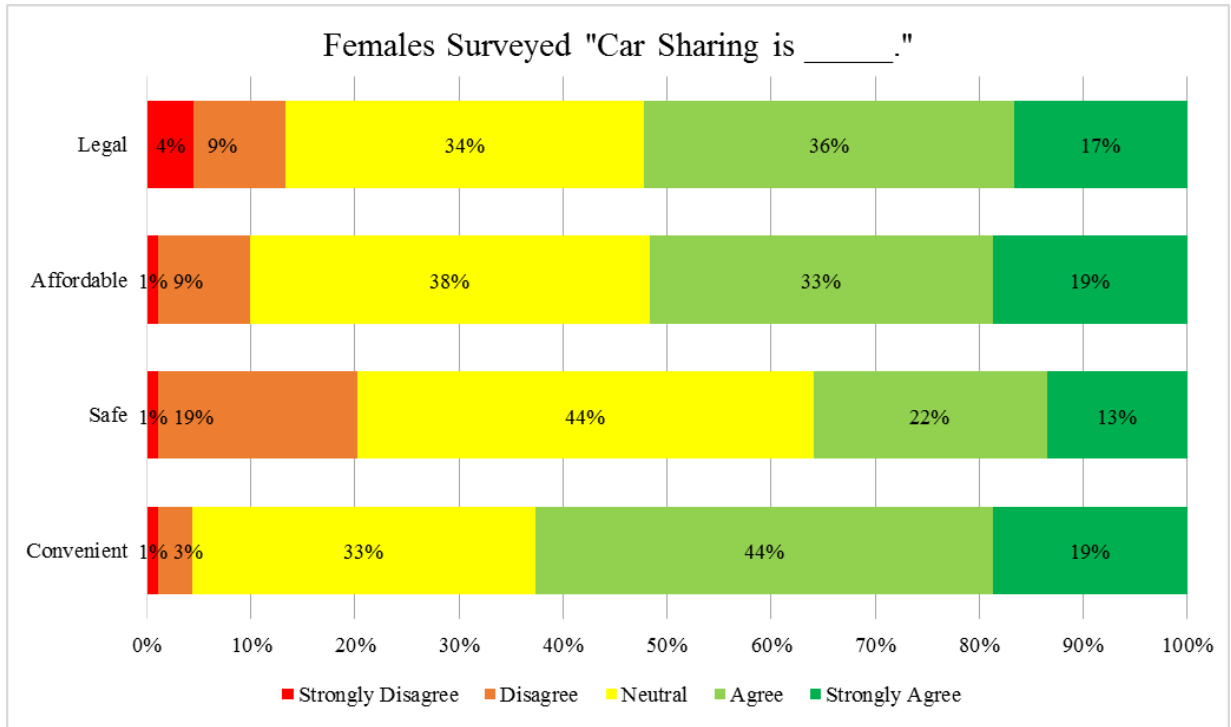
## 2: All Non-car Owner Responses



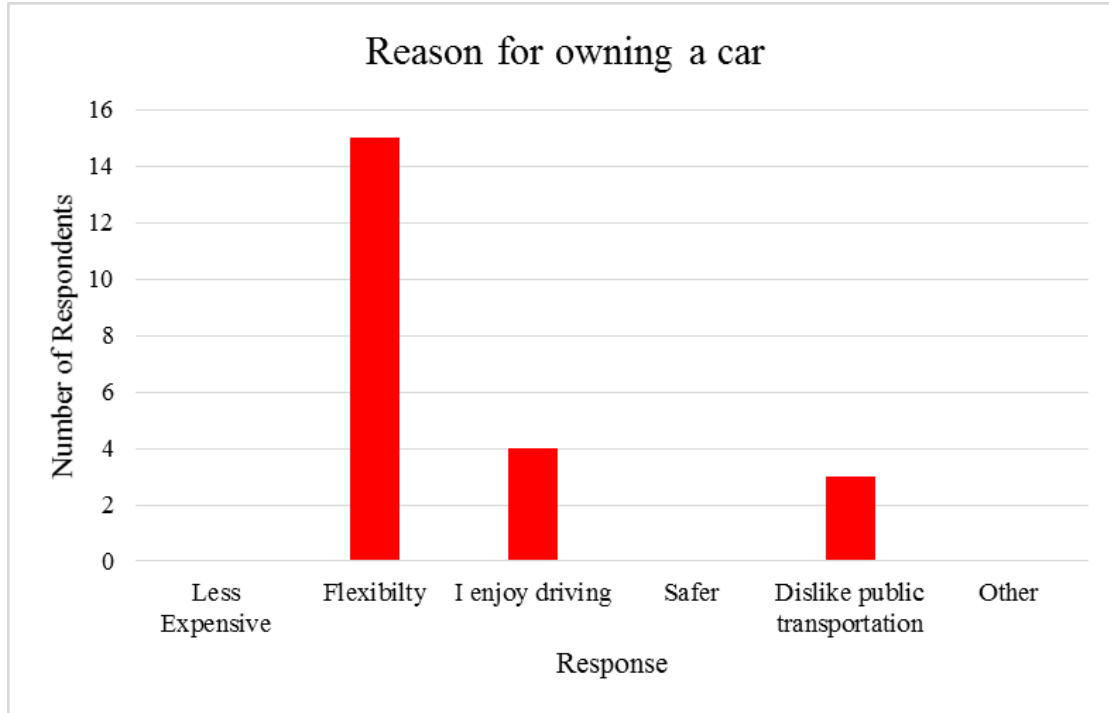
### 3: "Car Sharing is..." Based on Previous Usage



#### 4: "Car Sharing is..." Based on Gender

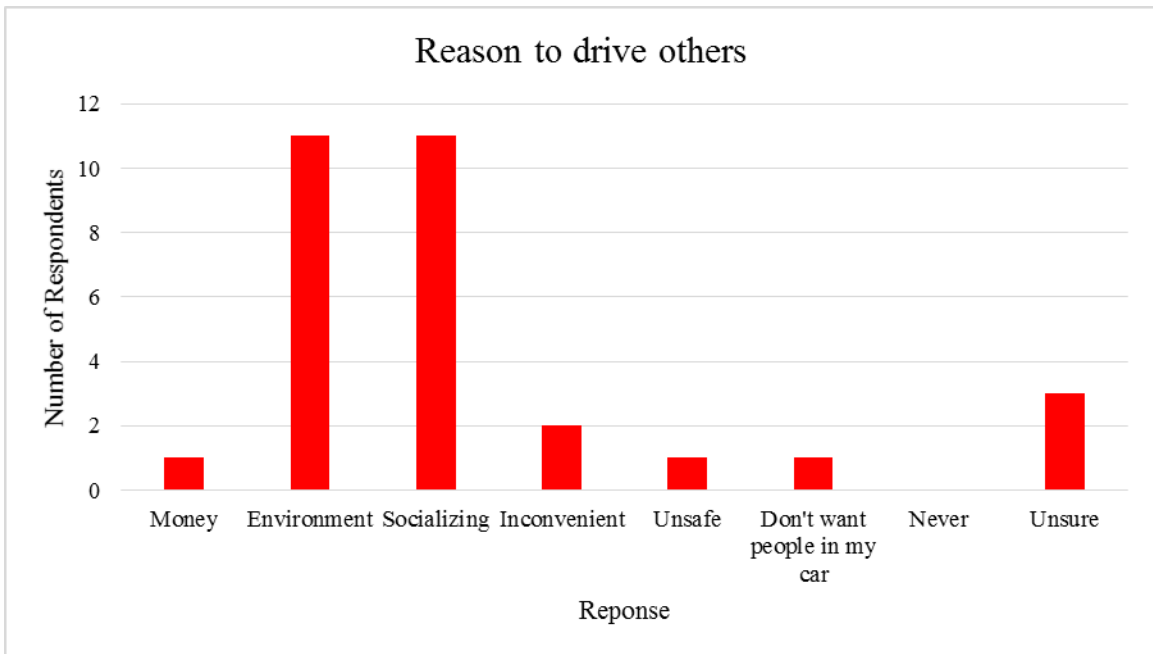
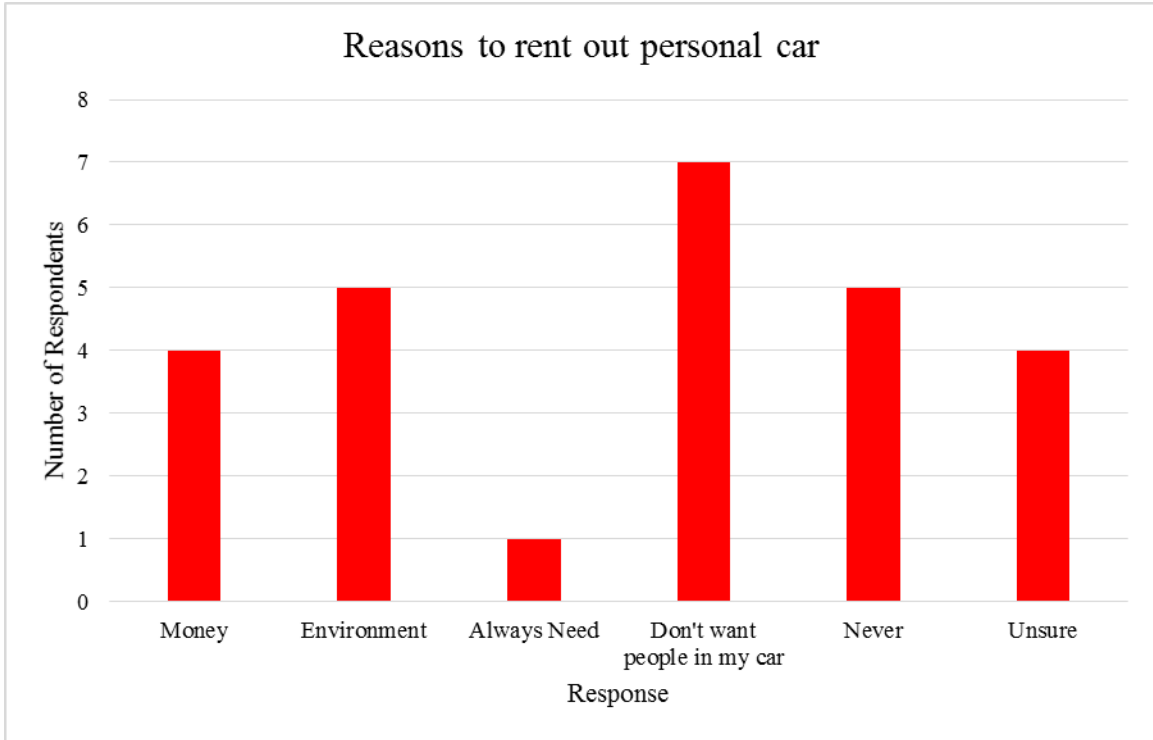


## 5: Reasons for Owning a Car





## 6: Car Owners Opinions of Car Sharing



## Appendix F: Tunnel Vehicle Occupancy

| Time      |     | Class of vehicle |             |      |            |      |            |            |             |         |      |
|-----------|-----|------------------|-------------|------|------------|------|------------|------------|-------------|---------|------|
|           |     | Motor Cycle      | Private Car | Taxi | Private LB | PLB  | Goods veh. |            | Non-Fr. Bus | Fr. Bus |      |
|           |     |                  |             |      |            |      | Light      | Med./Heavy |             | SD      | DD   |
| 0700-0800 | Pro | 4.6              | 41.8        | 22.5 | 1.9        | 2.3  | 13.2       | 3.5        | 4.5         | 0.1     | 5.5  |
|           | Ocp | 1.1              | 1.4         | 2.1  | 7.3        | 15.9 | 1.5        | 1.3        | 20.5        | 21.1    | 63.1 |
| 0800-0900 | Pro | 3.6              | 52.5        | 14.0 | 0.4        | 1.9  | 14.5       | 3.2        | 4.3         | 0.1     | 5.6  |
|           | Ocp | 1.1              | 1.3         | 2.3  | 5.5        | 15.6 | 1.7        | 1.5        | 29.5        | 32.0    | 74.3 |
| 0900-1000 | Pro | 2.5              | 46.6        | 17.2 | 0.3        | 1.1  | 20.0       | 4.3        | 3.0         | 0.1     | 4.9  |
|           | Ocp | 1.1              | 1.3         | 2.3  | 2.4        | 15.2 | 1.7        | 1.5        | 14.8        | 21.7    | 41.8 |
| 1000-1100 | Pro | 2.6              | 39.9        | 20.5 | 0.5        | 0.8  | 24.4       | 4.9        | 1.8         | 0.1     | 4.6  |
|           | Ocp | 1.1              | 1.4         | 2.1  | 2.3        | 14.1 | 1.6        | 1.4        | 9.8         | 15.3    | 31.6 |
| 1100-1200 | Pro | 1.6              | 40.7        | 20.5 | 0.5        | 0.7  | 24.5       | 5.4        | 1.8         | 0.1     | 4.1  |
|           | Ocp | 1.1              | 1.4         | 2.1  | 2.0        | 15.4 | 1.5        | 1.4        | 16.4        | 16.1    | 32.3 |
| 1200-1300 | Pro | 3.0              | 45.4        | 19.0 | 1.0        | 0.7  | 20.6       | 3.6        | 2.9         | 0.1     | 3.8  |
|           | Ocp | 1.0              | 1.5         | 2.2  | 5.1        | 13.6 | 1.6        | 1.4        | 16.9        | 15.5    | 32.6 |
| 1300-1400 | Pro | 1.8              | 40.8        | 17.8 | 0.8        | 0.7  | 25.9       | 5.3        | 2.7         | 0.1     | 4.0  |
|           | Ocp | 1.0              | 1.5         | 2.3  | 2.7        | 14.1 | 1.5        | 1.4        | 18.2        | 22.2    | 36.7 |
| 1400-1500 | Pro | 2.7              | 42.6        | 20.1 | 0.9        | 0.5  | 21.9       | 4.8        | 2.6         | 0.1     | 3.7  |
|           | Ocp | 1.0              | 1.5         | 2.4  | 3.0        | 13.9 | 1.6        | 1.5        | 12.6        | 18.6    | 33.8 |
| 1500-1600 | Pro | 2.3              | 43.5        | 18.5 | 0.9        | 0.6  | 23.4       | 4.7        | 2.0         | 0.1     | 4.1  |
|           | Ocp | 1.1              | 1.5         | 2.4  | 5.8        | 13.6 | 1.5        | 1.4        | 18.8        | 14.2    | 32.4 |
| 1600-1700 | Pro | 3.4              | 46.0        | 17.0 | 0.9        | 0.6  | 21.3       | 3.6        | 3.0         | 0.1     | 4.1  |
|           | Ocp | 1.1              | 1.5         | 2.3  | 3.2        | 11.7 | 1.6        | 1.4        | 10.0        | 22.8    | 36.2 |
| 1700-1800 | Pro | 4.9              | 50.6        | 15.6 | 0.8        | 1.2  | 16.2       | 2.8        | 3.0         | 0.1     | 4.9  |
|           | Ocp | 1.1              | 1.4         | 2.5  | 2.9        | 15.0 | 1.6        | 1.4        | 12.5        | 26.5    | 48.7 |
| 1800-1900 | Pro | 4.7              | 58.6        | 15.7 | 0.4        | 1.5  | 9.9        | 1.2        | 3.3         | 0.1     | 4.6  |
|           | Ocp | 1.1              | 1.5         | 2.4  | 6.7        | 16.4 | 1.6        | 1.3        | 27.4        | 26.8    | 71.2 |
| 1900-2000 | Pro | 3.1              | 62.4        | 17.4 | 0.1        | 1.7  | 6.2        | 0.9        | 3.2         | 0.1     | 4.9  |
|           | Ocp | 1.1              | 1.4         | 2.5  | 2.1        | 14.8 | 1.5        | 1.4        | 16.9        | 25.0    | 59.3 |
| 2000-2100 | Pro | 2.5              | 54.3        | 26.6 | 0.1        | 1.8  | 5.2        | 1.1        | 2.7         | 0.1     | 5.6  |
|           | Ocp | 1.1              | 1.5         | 2.4  | 2.0        | 13.4 | 1.7        | 1.5        | 14.8        | 28.9    | 40.4 |
| 2100-2200 | Pro | 3.0              | 47.3        | 34.1 | 0.1        | 2.3  | 4.7        | 1.2        | 1.7         | 0.1     | 5.4  |
|           | Ocp | 1.1              | 1.5         | 2.4  | 1.5        | 12.6 | 1.5        | 1.2        | 16.0        | 19.0    | 42.4 |
| 2200-2300 | Pro | 2.5              | 48.1        | 36.3 | 0.1        | 2.2  | 3.4        | 0.8        | 1.5         | 0.1     | 5.0  |
|           | Ocp | 1.2              | 1.5         | 2.4  | 1.0        | 12.8 | 1.6        | 1.6        | 16.5        | 22.0    | 46.5 |
| 16 hours  | Pro | 3.1              | 47.8        | 20.1 | 0.6        | 1.3  | 16.3       | 3.3        | 2.8         | 0.1     | 4.7  |
|           | Ocp | 1.1              | 1.4         | 2.3  | 4.4        | 14.5 | 1.6        | 1.4        | 18.2        | 21.4    | 47.3 |

### Legend

**Pro.** Proportion of vehicles in % (Sum may not add up to 100% due to figure rounding)

**Ocp.** Average occupancy of vehicles

Source: Hong Kong Transport Department (2015)

## Appendix G: Calculations

The fuel economy weighted average can be found using the formula:

$$w = \sum_{i=1}^n (v_i \div V) \times a_i$$

$n$  = Number of engine size classes (in this case,  $n = 6$ )

$v_i$  = Number of vehicles in a particular engine size class

$V$  = Total number of vehicles (in this case,  $V = 541751$ )

$a_i$  = Average fuel economy for vehicles in a particular engine size class (Liters/100 km)

$w$  = fuel economy weighted average (Liters/100 km)

$$w = [(v_1 \div V) \times a_1] + [(v_2 \div V) \times a_2] + [(v_3 \div V) \times a_3] + [(v_4 \div V) \times a_4] \\ + [(v_5 \div V) \times a_5] + [(v_6 \div V) \times a_6]$$

$$w = [(5301 \div 541751) \times 8.1] + [(119540 \div 541751) \times 9] + [(271109 \div 541751) \times 11.5] \\ + [(108801 \div 541751) \times 14] + [(17589 \div 541751) \times 16.3] + [(17586 \\ \div 541751) \times 17.3]$$

$$w = 11.7808 \text{ Liters/100 km}$$

$$\text{Average mileage per car} = \left(51 \frac{\text{km}}{\text{day}}\right) \times \left(365 \frac{\text{day}}{\text{year}}\right) = 18,615 \frac{\text{km}}{\text{year}}$$

Using the calculations above, the total carbon footprint per car, obtained from the carbon footprint calculator, is 4.81 metric tons of carbon dioxide per car per year. The equation below then shows the annual metric tons of CO<sub>2</sub> from all private cars

$$\left(4.81 \frac{\text{metric tons}}{\text{one car}}\right) \times (541,751 \text{ total cars}) = 2,605,822 \text{ metric tons of carbon dioxide}$$

#### Example from 4.3.1.1

The theoretical number of private car owners using car sharing:

$$(541,751 \text{ total cars}) \times 20\% = 108,350 \text{ cars}$$

Assuming 25% of car sharing users would give up their car:

$$(108,350 \text{ cars}) \times 25\% = 27,087 \text{ cars}$$

Assuming a theoretical reduction of 27,087 private vehicles, then the annual reduction in carbon emissions would be:

$$\begin{aligned} &(27,087 \text{ cars}) \times (4.81 \text{ metric tons } CO_2 \text{ per car per year}) \\ &= 130,288 \text{ metric tons } CO_2 \text{ per year} \end{aligned}$$

## Appendix H: US/ Canada Study of Car Sharing

**Table 1**  
North American carsharing impacts.

| North American studies (year) | Location                | Sample size | Participants selling owned vehicle (%) | Participants avoiding vehicle purchase (%) | # of privately-owned vehicles removed per carsharing vehicle | Change in average VMT/VKT (%)      |
|-------------------------------|-------------------------|-------------|----------------------------------------|--------------------------------------------|--------------------------------------------------------------|------------------------------------|
| Martin and Shaheen (2010)     | North America           | N/A         | 25                                     | 25                                         | 9-13                                                         | N/A                                |
| Econsult (2010)               | Philadelphia, PA        | 300         | 25                                     | 7                                          | 15.3                                                         | N/A                                |
| Cervero et al. (2007)         | San Francisco, CA       | N/A         | 24.2                                   | N/A                                        | N/A                                                          | -33                                |
| Cervero et al. (2007)         | San Francisco, CA       | N/A         | N/A                                    | N/A                                        | N/A                                                          | -67 <sup>c</sup> /24 <sup>d</sup>  |
| Dallaire et al. 2007          | Quebec Province, Canada | N/A         | 24                                     | 53                                         | 4.6                                                          | N/A                                |
| Price et al. (2006)           | Arlington, VA           | 369         | 29 <sup>a</sup>                        | 71 <sup>b</sup>                            | N/A                                                          | -43                                |
| Zipcar (2006)                 | United States           | N/A         | 32                                     | 39                                         | 20                                                           | -79.8                              |
| Millard-Ball et al. (2005)    | North America           | 1340        | 55.2 <sup>a</sup>                      | 70.5 <sup>b</sup>                          | 14.9                                                         | -37                                |
| Lane (2005)                   | Philadelphia, PA        | 502         | 24.5                                   | 29.1                                       | 10.8 <sup>e</sup>                                            | -42                                |
| Price and Hamilton (2005)     | Arlington, VA           | 403         | 25                                     | 68                                         | N/A                                                          | -40                                |
| Cervero and Tsai (2004)       | San Francisco, CA       | 516         | 29.1                                   | 67.5                                       | 6.8                                                          | -47 <sup>c</sup> /-73 <sup>d</sup> |
| Autoshare (2003)              | Toronto, Canada         | N/A         | 15                                     | 25                                         | 6-8                                                          | N/A                                |
| Katzev (2003)                 | Portland, OR            | 64          | 26                                     | 53                                         | N/A                                                          | N/A                                |
| Cervero et al. (2002)         | San Francisco, CA       | 404         | 2.5                                    | 60                                         | N/A                                                          | -3 <sup>c</sup> /-58 <sup>d</sup>  |
| Jensen (2001)                 | Quebec Province, Canada | N/A         | 21-29                                  | 55-61                                      | 9.1                                                          | N/A                                |
| Cooper et al. (2000)          | Portland, OR            | N/A         | 23                                     | 25                                         | N/A                                                          | -7.6                               |
| Katzev (1999)                 | Portland, OR            | 110         | 26                                     | 53                                         | N/A                                                          | N/A                                |
| Walb and Loudon (1986)        | San Francisco, CA       | N/A         | 15.4                                   | 43.1                                       | N/A                                                          | N/A                                |

Note: N/A denotes data not provided.

<sup>a</sup> Percentage that strongly agreed or agreed that they were able to sell one or more cars due to carsharing.

<sup>b</sup> Percentage that strongly agreed or agreed that they were able to postpone buying a car due to carsharing.

<sup>c</sup> Reflects existing members' reduction in VMT/VKT.

<sup>d</sup> Reflects only trial members' reduction in VMT/VKT.

<sup>e</sup> Reflects vehicles removed by members who gave up a car.