Investments in Active Transportation

Volume 1

THE PROBLEM OF URBAN CONGESTION IN CANADA

The recent CAA study *Grinding to a Halt: Evaluating Canada's Worst Bottlenecks* took a new perspective on a problem that Canadians know all too well: urban congestion is a growing strain on our economy and well-being. Canada's worst traffic bottlenecks are almost as bad as bottlenecks in Chicago, Los Angeles and New York. Bottlenecks affect Canadians in every major urban area, increasing commute times by as much as 50%.

This CAA briefing on investments in active transportation is one in a series that explore potential solutions to the problem of urban congestion in Canada. These briefings delve into solutions not only to highway congestion, but also to congestion on urban streets. Taken together the solutions explored in these briefings represent a toolkit to address this problem. The objective is to inform policy makers and the public about options to reduce congestion and key considerations for when and where a particular solution might be the right fit.

Active transportation refers to non-motorized modes of transportation, most notably walking and biking. Under the right conditions, policies and projects benefiting active transportation can be a useful tool in reducing traffic congestion, particularly in the highly congested central parts of Canadian cities. The potential to alleviate urban highway congestion with active transportation is likely a longer term and more limited opportunity.

While the benefits of investing in active transportation can take many forms – such as urban livability and beautification of the public realm – this briefing focuses specifically on commuters (rather than recreational users) and on the transportation system. Although there are some steps that could be taken to enhance walking (mentioned incidentally through the briefing), most of the focus is on cycling, which with its faster speed offers greater potential for congestion reduction.

This briefing explores two types of active transportation solution: bicycle infrastructure (such as bike lanes and cycle tracks – also known as segregated bike lanes) and bike share systems, which can serve as practical and healthy solutions to the problem of urban congestion in Canada.

The examples provided in this briefing are illustrative of the full range of ways in which active transportation solutions can be implemented. European and Asian cities have made active transportation a core part of their identity, with transformational investments in bike infrastructure (even "bike highways"), supportive policies and education, and even full integration of active transportation into public transit systems. In other places, the focus has been on localized smart, targeted investments. As with other modes, the private sector is not waiting around. Innovative programs like Drop Bike, funded by venture capital, are already starting to shake up Canadian cities.

This briefing explores two types of active transportation solution: bicycle infrastructure (such as bike lanes and cycle tracks – also known as segregated bike lanes) and bike share systems, which can serve as practical and healthy solutions to the problem of urban congestion in Canada

50%

Bottlenecks affect Canadians in every major urban area, increasing commute times by as much as 50%

PROBLEM: CONGESTION ON URBAN STREETS

POTENTIAL SOLUTION: BIKE LANES AND CYCLE TRACKS

How does it work & what are the benefits? Bike lanes and cycle tracks have greater capacity than vehicle lanes with single-occupancy cars. Bicycle facilities also handle crowding more resiliently than vehicle lanes.

Examples: Cycle tracks in New York City have been found to reduce injuries, while traffic speeds remained steady. Large German cities have invested in a full suite of solutions, including bike lanes, supporting facilities and cuclist and driver education. This has helped

CONSIDERATIONS:

- **Most successful where biking has a speed, reliability and/or cost advantage over other modes (autos, transit)**
- **Less successful where they reduce road capacity without attracting significant bike traffic**
- **Biggest benefit is improved public health and safety - potentially in the billions of dollars for a large shift to cycling**
- **Important to ensure a well-connected and planned network of bike lanes and cycle tracks if full benefits are to be achieved**
- **Weather - and topography-dependant - should not be considered in isolation of other modes**
- **Electric bikes can increase capacity but also reduce public health benefit**

INNOVATIVE IDEA:

Higher-order "bicycle highways" designed for speed, reliability and safety have been show to be successful in Chine, Germany and Denmark.

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POTENTIAL SOLUTION: BIKE SHARE

How does it work & what are the benefits? Bike share systems provide flexible short-term use of bicycles within defined geographic zones to members or paying customers. These systems are growing rapidly: in the US alone, bike share trips have increased by more than 12-fold in the past five years. Bike share currently exists in five Canadian cities.

Examples: SoBi Hamilton is an example of bike share implemented in

CONSIDERATIONS:

- **Similar benefits in terms of public health as with bicycle facilities**
- **Additional benefits include flexibility, and being able to provide last-mile connectivity to homes and businesses from transit stations**
- **Challenge can be unbalanced demand - trips clustering in particular locations at particular times. Can result in needing to reposition bicycle, an added cost**
- **May not reduce congestion much if trips displace transit, walking, or private bike trips, rather than auto trips - whether this happens depends on city and context**
- **The business model is relatively new. Large Canadian bike share systems have had financial and perational challenges before being transferred to new owners. However, customer usage of thes systems does continue to increase.**

INNOVATIVE IDEA:

Hangzhou Public Bicycle is the largest bike share system in the world, and operates in a fully integrated manner with the public transit network. "Dockless" bike share systems (such as Dropbike in Canada) are financed with venture capital, and require no public subsidy.

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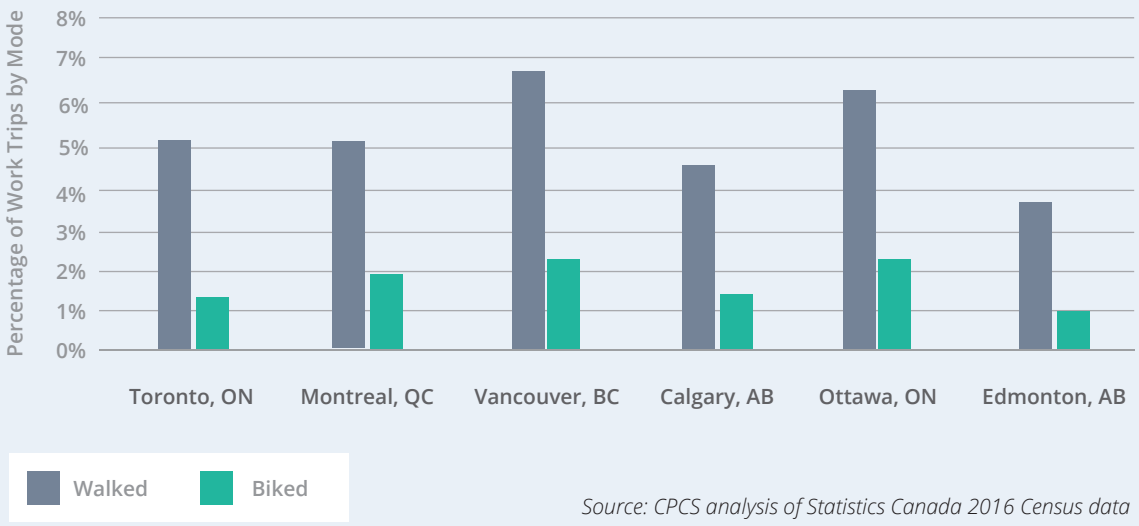
ACTIVE TRANSPORTATION IN
CANADIAN COMMUTING PATTERNS

Across Canada to get to work 1.1 million people use active transportation – 6.9% of commuters (5.5% walked, 1.4% cycled).[1] The share of commuters using active transportation ranges from under 4% (Abbotsford, BC and Oshawa, ON) to 17% (Victoria, BC). Active transportation commuting shares for major metropolitan areas of over one million people are shown in Figure 1 (range from 9% for Vancouver to 5% for Edmonton).

Figure 1: Active Transportation Commuting Mode Shares in Major Canadian Metropolitan Areas



Source: CPCS analysis of Statistics Canada 2016 Census data

Although the share of commuters cycling to work hovers around 1-2% for major cities, this figure is significantly higher for the dense urban cores of many of these cities. For example, there are 45 census tracts in Montréal, 29 in Toronto, and 10 in Vancouver in which more than 10% of working residents commute by bicycle (each census tract generally has between 2,500 and 8,000 residents).[2]

Some occupations lend themselves to walking and cycling better than others – as shown in Figure 2. The share of commuters using active transportation ranges from a high of 13% for Art, Culture, Recreation and Sport occupations to as low as 2% for Trades and Transport occupations.

Another important dimension is duration of commute – particularly for walking. Walking as a mode of commuting is mostly only competitive for short distances. Nationally, 57% of people who walked to work commuted less than 15 minutes and 89% had a commuting duration of under half an hour. Assuming a typical walking speed of 5 km/h, walking is not a competitive option for people whose commute to work is much longer than 2.5 km.

[1] All Canadian journey to work data are from 2016 Census (Statistics Canada), except census tract-level data

[2] Census tract-level data were not publicly available for 2016 at the time of writing; 2011 data used

In contrast, the average commuting duration for cycling was 21 minutes, which for a typical cycling speed of 15 km/h corresponds to 5 km. Fully 26% of commuters cycling to work had a commuting duration of 30 minutes or longer. These statistics imply that targeting cycling, more than walking, offers greater potential for increasing the share of Canadian commuters who use active transportation.

Figure 2: Active Transportation Mode Share by Occupation and Duration of Commute

NATIONAL OCCUPATIONAL CLASSIFICATION	1-15	15-29	30-44	45-59	60+	TOTAL
MANAGEMENT	13%	6 %	3 %	1 %	1 %	6%
BUSINESS, FINANCE, ADMINISTRATION	11%	7 %	3 %	1 %	1 %	6%
NATURAL AND APPLIED SCIENCES	13%	9 %	4 %	2 %	1 %	7%
HEALTH	10%	6 %	3 %	2 %	1 %	6%
EDUCATION, LAW, SOCIAL, GOVERNMENT	14%	9 %	5 %	3 %	1 %	9%
ART, CULTURE, RECREATION, SPORT	21%	14%	9 %	4 %	2 %	13%
SALES AND SERVICE	16%	10%	5 %	3 %	2 %	10%
TRADES AND TRANSPORT	6%	2%	1 %	1 %	0%	2%
NATURAL RESOURCES, AGRICULTURE	12%	3%	2 %	1 %	1 %	5%
MANUFACTURING, UTILITIES	7%	3%	2%	1%	1%	4%
ALL OCCUPATIONS	**13**%	**7**%	**4**%	**2**%	**1**%	**7**%

Source: CPCS analysis of Statistics Canada 2016 Census data. All of Canada.

BICYCLE INFRASTRUCTURE

Bicycle infrastructure comes in several basic forms:

- **Cycle tracks (segregated bike lanes)** are dedicated bicycle lanes physically separated from vehicle traffic by curbs, bollards, or other dividers. Cycle tracks can be one- or bidirectional and offer the greatest protection for cyclists from motor vehicles.
- **Bike lanes** are dedicated lanes demarcated by painting or striping, typically adjacent to the right curb lane of a roadway but not physically separated from vehicle traffic.
- **Multi-use trails** are off-street paths that are commonly located adjacent to major roads or within parks. Typically bidirectional, these paths are often shared with pedestrians and other non-motorized uses, and may be equally or more targeted to recreational cyclists as to commuters.

Figure 3: Examples of Bicycle Infrastructure in Canada

Bidirectional Cycle Track in Montreal

Bike Lane in Toronto

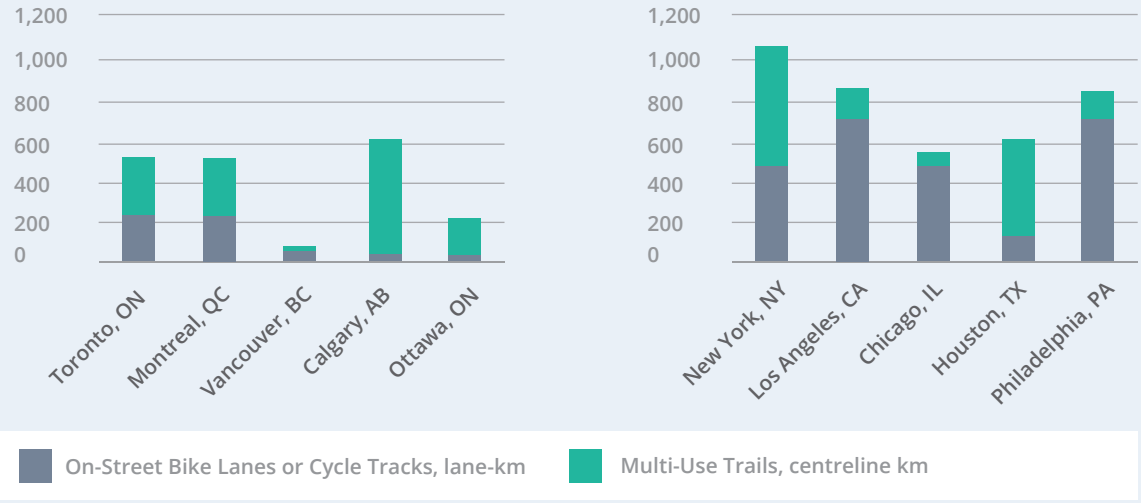
Photo Sources: NACTO (left), Wikimedia (right)

Figure 4 shows the existing scope of bicycle infrastructure in major Canadian Cities, as of 2015. The largest US cities, many of which have been heavily investing in bicycle infrastructure, are also shown for comparison.

Bicycle lanes and cycle tracks can reduce congestion by incenting drivers to switch to cycling and thereby reducing the number of vehicles on the road. The effective capacity of dedicated bike lanes or cycle tracks is on the order of 1,600 bicycles per hour per lane with signalized intersections and higher without.[3] This capacity is higher than what is attainable on arterial roads (in terms of vehicles per hour per lane), and significantly higher than what is attainable in highly congested stop-and-go conditions. Thus, bicycle lanes and cycle tracks can be more efficient at transporting people than private vehicles with a vehicle occupancy of one or two. In addition, bicycle lanes and cycle tracks handle crowding more resiliently than vehicle lanes, the effective capacity of which can be reduced substantially as a result of bottlenecks, turning vehicles, and parked cars, among other impediments.

[3] *Zhou (2015) – referencing sources from the US (Highway Capacity Manual), Europe and China*

Figure 4: Bicycle Infrastructure in Major Canadian and US Cities



Sources: Vijayakumar (2015) for Canadian Cities (p.3), Alliance for Biking & Walking (2014) for US cities (2011-12 data) (p. 156)

The congestion relief benefits of bike infrastructure are highest in dense, urban areas where commutes tend to be shorter and where the high cost of parking and pervasive stop-and-go congestion on roadways make driving and public transit less attractive to commuters. However, bicycle infrastructure can also be a worthwhile investment in suburban areas, especially where implemented in such a way that it does not reduce road capacity (e.g. multi-use paths adjacent to roadways, bike lanes on collector roads).

Whether bike volumes on bike lanes or cycle tracks reach capacity, there can be considerable benefits to building this infrastructure in the domain of health and safety. Biking and walking are among the most practical and effective ways to improve physical fitness and health. The economic burden of physical inactivity or excess weight in Canada was estimated to be $34.1 billion in 2013.[4] As a reference point, one study of 11 Midwestern US metropolitan areas found that shifting 50% of short (under 4 km one-way) car trips to bicycle would result in mortality declines of 1,295 deaths per year due to improved air quality and increased physical activity. For that study area of 31.3 million people, the value of these savings would exceed $10 billion annually.[5]

Separating bicycles from cars and trucks has significant safety benefits, although careful attention to design – especially at intersections – is important. Studies of Montréal, Toronto and Vancouver have found that bike lanes and cycle tracks reduce the risk of serious bicycle accidents by 14% to 31% compared to mixed traffic, while mixed-use paths offer a safety improvement of 9% to 16% compared to biking on sidewalks.[6,7] In addition, there is a well-documented "safety in numbers" benefit to cycling in metropolitan areas: as the amount of kilometres of walking or cycling per person doubles, the injury rate per kilometre walked or cycled declines by 34%.[8] One of the reasons behind this phenomenon is that as drivers' familiarity with pedestrians and cyclists increases, drivers become better at anticipating their movements.

The costs of constructing bike lanes is on the order of $70,000 per kilometre (higher for cycle tracks), while the cost of constructing multiuse paths is on the order of $200,000 per kilometre.[9]

[4] *Krueger (2015)*
[5] *Grabow (2012). $8.7 billion USD converted to CAD using 2017 exchange rates.*
[6] *Teschke (2012)*
[7] *Lusk (2011)*
[8] *Jacobsen (2003)*
[9] *Bushell et al (2013)*

EXAMPLES

Cycle Tracks in New York City: Lessons from a Dense North American City

New York City is an example of a large city that has been investing in bike lanes and cycle tracks. In 2014, the New York City Department of Transportation (NYC DOT) undertook a detailed study of how their cycle tracks had impacted safety, mobility and economic vitality. The study assessed 12 projects on six avenues in Manhattan, on which the cycle tracks were at least three years old. NYC DOT found that pedestrian injuries were down by 22% and cyclist injuries showed a minor decrease, even as bicycle volumes increased dramatically. The study also found that vehicle travel speeds in the central business district were largely unchanged and that stores on streets with cycle tracks saw an increase in retail sales.[10]

Cycling Investments in German Cities: Beyond Infrastructure

Cities in Germany including Munich, Berlin and Hamburg have significantly reduced the share of trips made by automobiles over the past 20 years despite high rates of car ownership and high incomes. For example, between 2002 and 2011, the share of trips made by automobile in Munich has decreased from 41% to 33% and the share by bicycle has increased from 10% to 17%. These gains have been achieved through the implementation of a comprehensive package of policies supportive of active transportation, including investments in bike lanes, bike share, bike parking, traffic calming, widened sidewalks, and promotional events and education (including cycling training as part of traffic education). Academic studies attribute the success of these programs to their coordinated implementation, including multimodal coordination.[11] Bicycle-supportive policies in Germany have been applied not just in large cities, but also widely in small- and medium-sized cities. For example, a "bike station" adjacent to the main train station in the city of Münster (population 300,000) offers secure, indoor parking for 3,300 bikes in addition to bicycle sales, repair and washing services.[12]

Bicycle Highways: A Paradigm Shift

Bicycle highways refer to higher-order bike infrastructure designed to provide superior speed, safety, and directness. Bicycle highways are generally conceived of as fully separated bicycle lanes designed for reduced conflicts with other road users, including cross-movements, whether grade-separated or at-grade. The specific applications vary with some notable examples described below.

One of the most ambitious applications of a bike highway is in the Chinese city of Xiamen. The 7.6-kilometre Xiamen Bicycle Skyway is an elevated bicycle route that runs parallel to (and partly underneath) an elevated bus rapid transit line in the city's downtown area. The 4.8-metre wide skyway opened in 2017 and features eleven entry and exit points.[13]

Germany has recently opened the first 11 kilometres of a planned 100-km bike highway (also termed a "bike autobahn") from Hamm to Duisburg in the Rhine-Ruhr region, the country's most populated urban

[10] *NYC DOT (2014)*
[11] *Buehler (2016)*
[12] *Pucher and Buehler (2008)*
[13] *Gibson (2017)*

area. The dedicated thoroughfare runs along an abandoned rail line parallel to a major highway and will connect cities, suburbs, farmland, and four major universities.[14]

Copenhagen, Denmark is rolling out an expansive "Supercykelstier" (Bicycle Super Highway) network, currently comprising eight routes covering over 100 km (with five routes completed in 2017 and more planned for 2018). This network is not generally grade-separated but features upgrades such as innovative sensor-based lighting and "green wave" technology that times traffic lights to match average bicycling speeds for smooth, uninterrupted peak bike flow. [15, 16]

Figure 5: Bicycle Highways

"Cycle Snake" in Copenhagen

Bike Skyway in Xiamen

Photo Sources: NACTO (left), Wikimedia (right)

London's "cycle superhighway" network consists of six routes. One of the challenges is that specific improvements are controlled by individual boroughs, which manage 95% of London's roads.[17] Thus, the actual implementation of this system varies from wide segregated lanes along the Thames River embankment to pavement markings in shared road lanes (not reflective of a true bicycle highway).

Technical Feasibility, Limitations and Trends

At a city-wide level, the full benefit of bicycle infrastructure may not be realized if the bike network as a whole is discontinuous. A dense bike network supports greater usage than a more geographically sparse network of the same total mileage. Additionally, gaps and discontinuities along individual corridors have an outsized negative impact on use. One study of 74 US cities found that bike network density, connectivity, fragmentation and directness all have a significant impact on a city's bicycle commuting rate.[18]

Neighbourhood factors also affect the attractiveness of biking. Beyond the quantity and quality of available bicycle infrastructure, other significant factors affecting neighbourhood "bikeability" include street connectivity, topography, and land use.[19] In other words, cycling levels are likely to be lower in neighbourhoods with circuitous street networks, variable elevation, and low population and employment density.

Biking is also weather-dependent. Both precipitation and temperature significantly impact cycling levels[20] (some climate-dependent effects can be offset by the availability of trip-end facilities such as showers,

[14] *Schwägerl (2016)*
[15] *Copenhagenize Design Company (2017)*
[16] *Urban Land Institute (2016)*
[17] *Laker (2014)*
[18] *Schoner (2014)*
[19] *Winters (2013)*
[20] *Winters (2007)*

which have been shown to be a significant determinant of cycling levels).[21] In addition, although cycling corridors can move more people than roadways congested with single occupancy vehicles, they may not be more efficient than high-capacity transit. For these reasons, active transportation does not necessarily fully replace other modes and should not be considered in isolation of other multimodal transportation solutions.

Electric bicycles ("e-bikes") can increase the capacity of bike infrastructure.[22] However, e-bike usage does not provide the public health benefits of active transportation, diminishing the business case for these investments. It is also not clear whether safety benefits are reduced as a result of e-bikes sharing infrastructure with regular bicycles.

As with any transportation investments, it is difficult to generalize about the benefits and costs of bicycle infrastructure, as these are highly site-specific and dependent on a variety of factors. Done wrong, bike lanes can reduce road capacity without attracting significant bike traffic. Key factors for consideration are highlighted in Figure 6. For any application, there are likely to be some factors supportive of cycling and other factors less supportive. Whether the business case overall is positive depends on the total net benefits for a specific corridor, taking into account all factors.

Figure 6: Summary of Key Factors Affecting Business Case for Specific Bike Lanes

FACTOR	CONDITIONS MORE SUPPORTIVE OF CYCLING
ORIGIN-DESTINATION COMMUTING PATTERNS	• High "latent demand" - potential to serve a lot of trips • Trip distances competitive for cycling (e.g. 1-1.75 km)
COMPETITIVENESS OF OTHER MODES OF TRANSPORT (DRIVING, TRANSIT)	• Other modes slower, less reliable or more costly than biking
AVAILABILITY OF ALTERNATE ROUTES	• Area is underserved in terms of parallel bike corridors
CONTEXTUAL FACTORS	• Corridor is flat and direct • Weather is supportive • Snow and ice control measures • Community engagement and public buy-in • Awareness and education regarding rules of the road and interaction between modes (e.g. cars and bikes)
OPPORTUNITY COST OF BICYCLE INFRASTRUCTURE	• Bike lanes do not reduce road capacity • Bike lanes replace highly-congested lane of traffic

Source: CPCS

[21] *Buehler (2012)*
[22] *Zhou (2015)*

BIKE
SHARE SYSTEMS

Bicycle sharing systems are services that provide short-term use of bicycles within defined geographic zones to members or paying customers. These systems have gained popularity worldwide as an urban solution to mobility challenges, including in some of the world's largest cities (e.g. Vélib in Paris, France has 20,000 bikes and Santander Cycles in London, UK has 13,600). Existing publically supported bike share systems in Canada are listed in Figure 7.

Figure 7: Existing Bike Share Systems in Canada

CITY	SYSTEM	FLEET SIZE
MONTREAL, QC	BIXI Montreal	6,250
TORONTO, ON	Bike Share Toronto	2,750
VANCOUVER, BC	Mobi	1,200
HAMILTON, ON	SoBi Hamilton	825
OTTAWA, ON	VeloGo	300

Photo Sources: NACTO (left), Wikimedia (right)

Although a relatively new phenomenon, bike share systems are growing at a rapid rate. For example, across the United States, the number of total trips taken by bike share increased from just 2.3 million in 2011 to 28 million in 2016, a more than 12-fold increase in just five years. The 28 million trips in 2016 corresponds approximately to the annual ridership of the entire Amtrak (intercity rail) system.[23]

Bike share systems are run under a variety of business models. Costs are typically covered through some combination of membership/user fees, public subsidies, and corporate sponsorship (often in exchange for branding or advertising). One study of North American bike share systems found that sponsorship accounts for on average 42% of operating revenue. The same study also appraised the cost of expansion as $55,000 per new kiosk (hub), $4,000 per new dock, and $7,250 per bicycle.[24]

Bike share systems complement investments in bicycle infrastructure such as bike lanes and cycle tracks, and thus the benefits described above related to congestion relief and public health apply similarly to bike share systems.

[23] *NACTO (2016)*

[24] *Mineta Transportation Institute (2014) Converted from USD to CAD at 2017 exchange rates*

EXAMPLES

Social Bicycles Hamilton: A Medium-Sized Canadian City

Social Bicycles Hamilton (SoBi Hamilton), which started operations in 2015, is an example of a bike share system in a moderately-sized Canadian city. Membership costs $4 per hour, $15 per month, or $85 annually (the latter two with 60 minutes of free usage per day). A "Power User" plan targeted to commuters costs $125 annually with 90 free minutes per day. There are also discounts for university students and low-income residents and the option to pay by the minute. One interesting feature is the ability to lock to a regular bike rack for a $1 convenience fee (because the technology is in the bike rather than the dock, the bike comes equipped with a "U-bar" lock that can be attached both to designated docks and regular bike rings). SoBi Hamilton uses "smart bike" technology that allows them to collect route data for trips (as distinct from many other systems which can only track origins and destinations). SoBi is self-sufficient for operating costs and relies on public support for capital costs (having received $1.6 million through a Metrolinx Quick Wins program to fund the purchase of bikes and station infrastructure).[25]

Figure 8: Sobi Hamilton Bicycle

Figure 9: Hangzhou Public Bicycle – Manned Station for Greater Efficiency

Photo Sources: Wikimedia (left), USE Today (right)

Hangzhou Public Bicycle: A Prime Example of Multimodal Coordination

Hangzhou Public Bicycle in Hangzhou, China, is considered to be the largest bike share system in the world. Launched in 2008, the system has grown to over 84,000 bicycles as of May 2016. In Hangzhou, the bike share system is operated by the Hangzhou Public Transport Corporation and is fully integrated with public transit – bike use is free for the first 90 minutes after payment for a bus ride. By providing last-mile connectivity on both ends of transit commutes, the bike share system helps to reduce gridlock on the city's roads. According to local polls, 78% of car owner respondents used the bike share system for trips previously taken by autos. Another feature of this system is that it operates manned service stations in dense urban locations where high demand for docks would be an issue.[26]

[25] *Sobi Hamilton website: hamilton.socialbicycles.com*

[26] *Energy Smart Communities Initiative (2016)*

TECHNICAL FEASIBILITY, LIMITATION AND TRENDS

Compared to privately owned bicycles, bike share systems have several notable benefits as well as drawbacks, as listed in Figure 10.

Figure 10: Benefits and Drawbacks of Bike Share Compared to Private Bicycles

CITY	SYSTEM	FLEET SIZE
COST	• Ability to eliminate the costs of purchasing and maintaining a bicycle and the space needs for storing a bicycle • Marginal cost of usage is low or zero (e.g. free under 30 minutes) • Reduces the risk of bicycle theft or vandalism	• Can be more expensive than purchasing a bicycle, over several years • Can be expensive for trips longer than the free window • Can require a public subsidy to operate
CONVENIENCE	• More flexible – can be used for one-way trips, e.g. where a return trip is not planned or where the weather is anticipated to change • Can be used on the "spur of the moment" • Easy access with smartphone apps • Can be combined with public transit to provide "last-mile" connectivity from transit stations	• May be less comfortable than private bikes ("one size fits all" bikes) • Docking stations may not be conveniently located for all trips • Limited to a concentrated geographic area • Docking stations have limited capacity and can fill up or be empty, exacerbated by geographic imbalances in trip patterns

Bike share systems are relatively new and business models are evolving rapidly. One of the issues with bike share is that it typically requires a public subsidy. Bike share systems also have to hit a "critical density" to achieve a high level of utilization. Finding the right business model has not always been a smooth process. Toronto's bike share system, launched as Bixi in 2011, struggled financially and was transferred to the city-owned Toronto Parking Authority in 2013. However, as the system has densified it is now hitting new highs in ridership.[27] Similarly, the company owning Bixi Montréal filed for bankruptcy in 2013, selling its assets to the City of Montréal. Despite a small increase in the number of bikes, Bixi Montréal's ridership has risen from 1.1 million to 4.1 million between 2009 and 2016, while membership has increased from around 11,000 to nearly 40,000 in that same span.[28] This shows that while the operations of large Canadian bike share systems have not been immediate successes, these systems have been far from a failure in terms of customer usage.

One very recent innovative phenomenon is the development of "dockless" bike share systems that operate privately, typically funded by venture capital rather than government initiatives. One example is Dropbike, which has launched in 2017 in Toronto, Kingston, ON and Westmount, QC. These systems place the "smart" technology in the bike itself – the bike is unlocked with a smartphone Quick Response (QR) code and can be left free-standing within designated zones – eliminating the problem of docks filling up. Similar systems have launched in 2017 in cities like Seattle, Washington DC, the Bay Area, and London (UK), and have existed for many years in cities in China.

[27] *Rider (2017)*
[28] *Symon (2017). Also, Riga (2016)*

One of the traditional issues with bike share systems is that demand is often unbalanced, with, for example, many people travelling to the central business district or popular recreational destinations at the same time. As a consequence, docks in these locations fill up quickly, and docks near residential areas go empty. Similar issues apply to trips to and from major transportation hubs, as well as areas with large elevation differences (users may bike downhill and take other modes of transportation back). This can result in the bike share agency having to manually reposition bikes by truck throughout the day, an added expense (averaging about $8,000 per month in a study of US cities).[29]

The extent to which bike share rides displace auto trips as opposed to transit, walking or private bicycle trips depends on the city. One user survey-based study of five North American cities (including Toronto and Montréal), found that bike share reduced driving in all five cities, and mostly reduced rail and bus commuting (with some exceptions). In Toronto and Montréal the effect was muted, as a large proportion of bike share users were not owners of vehicles and therefore not switching from driving. However, in Salt Lake City and Minneapolis a majority of users reported driving less frequently.[30] Bike share systems are not always year-round solutions: in Montréal the bike share system shuts down for the winter season.

One of the greatest potentials for bike share, in terms of reducing traffic congestion, is by providing "last-mile" connectivity to and from public transit stations (including commuter rail), thereby encouraging drivers of very long trips to shift away from driving. A challenge is the imbalance in demand issue described above. Another important challenge is having docks not only at the station but in convenient locations close enough to commuters' destinations.

[29] Mineta Transportation Institute (2014). Converted from USD to CAD at 2017 exchange rates.

[30] Mineta Transportation Institute (2014)

CONCLUSION

Not all commuters can switch to cycling, particularly those who must travel long distances, who are physically less mobile, or whose job requires use of a vehicle. Nonetheless, active transportation can be an important part of a congestion solutions toolkit. Active transportation solutions can range from infrastructure investments to educational policies, to more transformative investments such as bicycle superhighways and public transit integration.

Bicycle infrastructure typically requires public investment, although the magnitude of funds involved remains quite small compared to public expenditures on other modes. For example, recently the City of Toronto doubled its annual budget for cycling infrastructure to $16 million,[31] and the Province of Ontario announced an additional $25.6 million. For reference, the Toronto Transit Commission's annual operating budget is $2.0 billion ($688 million net of revenues),[33] and its planned capital budget is $9.4 billion over 10 years.[34] Cycling investments can be a relatively low-cost solution that, properly targeted, can reduce congestion and increase health and safety for the residents of Canadian cities.

[31] Toronto Centre for Active Transportation (2016)

[32] Spurr, Ben (2017). Toronto Star. "Province to give Toronto $25.6 million for bicycle infrastructure."

[33] City of Toronto (2017)

[34] Toronto Transit Commission (2016)

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