POLICY SERIES

No. 241 / MARCH 2024

BUILDING 21ST CENTURY TRANSIT SYSTEMS FOR CANADIAN CITIES

BY RANDAL O'TOOLE

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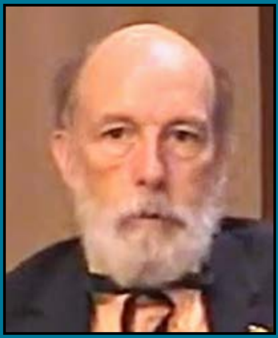

RANDAL O'TOOLE

Randal O'Toole (born 1952) is an American public policy analyst. The majority of O'Toole's work has focused on public lands, land-use regulation, and transportation, particularly light rail. He frequently criticized proposals for passenger rail systems.

He had been associated with the Cato Institute as an adjunct scholar since 1995 and a senior fellow from 2007–2021. O'Toole was the McCluskey Visiting Fellowship for Conservation at Yale University in 1998, and has served as a visiting scholar at the University of California, Berkeley (1999) and Utah State University (2000). O'Toole studied economics at the University of Oregon. O'Toole's private consultancy is known as the Thoreau Institute.

He has campaigned against smart growth policies and light rail systems in several U.S. states as well as in Winnipeg, Manitoba, and Ottawa, Ontario. His 2001 book, *The Vanishing Automobile and Other Urban Myths,* was written as a detailed critique of these styles of planning. He continues to advocate for free market solutions to urban planning and design in his writing and teaching.

O'Toole has written four books; *The Best-Laid Plans* argues that long-range comprehensive government planning necessarily relies on fads and fails to account for current and future public desires and needs. *Gridlock* looks at the history of transportation in America and argues that the future is in autonomous personal vehicles, not rail transit or high-speed rail. *American Nightmare* examines the history of housing in America and argues that zoning and, more recently, growth-management planning represents efforts by the middle- and upper-classes to separate themselves from the working class. *Romance of the Rails* looks at the history of urban and intercity rail transit in the United States to show why they once worked but no longer work today.

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Policy Series No. 241 • Date of First Issue: March 2024.

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ISSN 1491-78

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EXECUTIVE SUMMARY

In the 1950s, nearly everyone in the transit industry, including executives in both private companies and public agencies, agreed that rail transit was obsolete and most streetcar and other rail lines should be replaced with buses. The only exceptions were rapid transit lines that operated above or below street level, allowing them to move masses of people without contributing to congestion. But even these lines made sense only where they already existed; while a few cities, including Toronto, built new rapid transit systems, many were expensive and failed to reverse the steady growth of automotive travel.

Despite this one-time consensus, eight Canadian cities have recently built or are building rail transit lines, and most of them are planning even more. These lines have been expensive, often suffered major cost overruns, and the transportation they provided was no better than could have been done with buses at a far lower cost. While some did increase ridership, in many if not most cases bus ridership was already increasing before the rail lines opened. If the funds required to build one rail transit line had instead been spent on improving bus transit throughout an urban area, it would have done much more for transportation and transit riders.

A close look at these rail projects reveals that they are premised on an archaic view of cities and transportation technologies. Rail transit made sense in 1910, when most urban jobs were in downtowns, residential densities were high, auto ownership rates were low, and buses were still primitive. All those conditions changed in the next two decades: Henry Ford's development of moving assembly lines in 1913 led most jobs to move out of downtowns and many residents to buy cars and move to low-density suburbs. Meanwhile, buses that were less expensive than rail transit to both buy and operate, per seat-kilometer, were first produced in 1927.

Today, downtowns are only one of many economic centers in a typical 21st-century urban area, and not always the most important one. Modern urban areas need transit systems that can serve people traveling throughout the regions, not just to downtowns. Moreover, economic centers grow and shrink over time, requiring transportation systems that are flexible and nimble. Rail transit cannot do this job as it takes too long and costs too much to open new lines. Instead, transit agencies should rely on buses.

INTRODUCTION

At one time, more than 50 Canadian cities had streetcar lines. By 1960, all of them were gone except in the Toronto area, which also had opened its first subway line in 1954. During the 1960s, Montreal and Toronto both built subway lines. Then, in 1978, Edmonton became the first North American city to open a post-World War II light-rail system. Calgary followed in 1981. Vancouver opened its SkyTrain in 1985. Ottawa opened its first light-rail line in 2001 and Waterloo began operating a light rail in 2019. Montreal opened a light-rail line in July 2023 and Toronto is building one to supplement its subway and streetcar lines. Most of these cities are planning expansions of their systems and Hamilton and other cities are planning or building lines of their own.

This rail transit renaissance is applauded by people who call themselves progressive, yet in fact it is regressive in almost every sense of the word. There are two fundamental flaws in the logic behind rail transit. First, rail proponents have failed to understand how cities have evolved in the last century. Second, they have failed to realize that newer technologies, namely buses, can carry more people to more places at higher speeds at a far lower cost than railcars.

DEFINITIONS AND DATA

Streetcars are electrically powered vehicles that usually operate in streets but sometimes operate in their own rights of way. Historically, streetcars came in many sizes but were typically 12 to 15 meters long, contained 50 to 60 seats, and had room for 50 or so standees. Many so-called modern streetcars are 20 meters long but with only around 30 seats and room for around 100 standees.

Light rail is essentially a variant of streetcars. Like streetcars, light-rail cars are electrically powered vehicles that sometimes operate in streets and sometimes in their own rights of way. Light-rail cars tend to be longer than regular streetcars, with most being between 20 and 29 meters. Like so-called modern streetcars but unlike most historic streetcars, light-rail cars tend to be "articulated," that is, supported by three sets of wheels and hinged so the cars can bend around sharp corners. One variation of light rail, which the U.S. Federal Transit Administration calls *hybrid rail,* is rail cars that are powered by Diesel motors instead of electric lines but sometimes operate on light-rail schedules, meaning frequent service throughout much of the day.

Other than vehicle length, the only real technological difference between light rail and other streetcars is that light-rail cars have couplers and can be operated together in trains of two, three, or four cars. Couplers are hardly a new invention, and the first true light-rail line—with articulated cars that could be coupled together—began operating in 1939 across the San Francisco-Oakland Bay Bridge.

Because most light-rail systems operate in streets for at least part of their route, the length of trains is dictated by the length of city blocks. Portland has 60-meter city blocks so can only run trains of two 29-meter-long cars. Salt Lake City has 120-meter city blocks so can run four 29-meter-long cars. Most other U.S. cities have 90-meter blocks so can run three-car trains.

Edmonton can run up to five-car trains, but its cars are shorter, 20 to 25 meters long. Most light-rail cars in Calgary are around 25 meters long and it runs four-car trains on at least one of its lines.

Heavy rail, also known as rapid transit, metros, and either subways or elevateds, always operates in its own exclusive right-of-way. This allows for trains that are much longer than light-rail trains, with the length of trains limited only by the length of platforms built to load and unload passengers. Washington DC's Metro can run trains of eight 23-meter-long cars; San Francisco BART can run trains of 10 such cars. Most New York City subway platforms are long enough to handle seven- to nine-car trains of 23-meter cars, though some trains may have more cars because some subway cars are as short as 16 meters.

Automated guideways are grade separated, like heavy rail, and are fully automated, meaning no driver. They tend to operate shorter trains than most heavy-rail lines. The Vancouver SkyTrain runs four- to six-car trains, but the cars are only about 12 meters long. The SkyTrain and most other automated guideways combine the high-cost disadvantage of heavy rail with the low-capacity disadvantage of light rail.

Commuter rail usually uses existing rail lines that are shared with freight trains or lines that were once used by freight trains. Toronto's GO trains use cars that are 26 meters long that hold 136 to 162 seats with room for at least 200 more standees. Trains can be 10 cars long or more.

Other kinds of rail transit include monorails, personal rapid transit, and inclined planes, none of which are operating in or proposed for Canada.

Bus transit can be divided into *local buses, commuter buses,* and *rapid buses,* also known as bus rapid transit. Local buses tend to stop around three to five times per kilometer. Rapid buses, which are sometimes described as buses running on light-rail schedules, typically stop only once per 1 to 1.5 kilometers. Commuter buses, sometimes called express buses, make the fewest stops of all, often running non-stop for many kilometers while possibly making a few stops near their origins and a few near their destinations.

Data: Public agencies in the United States publish huge amounts of data about their systems; those in Canada not so much. Data for U.S. transit systems include ridership, operating costs, capital costs, fares, miles and hours of service, and energy consumption for every transit agency and mode of transit operated by those agencies. Most of these data go back to 1982, though capital costs go back only to 1992 and fares to 2002. By comparison, Canadian transit agencies barely publish ridership data, much less cost data, and most agencies have amnesia about any data from much before 2000.

Since 1960, the U.S. Census Bureau has kept track of how people get to work, including whether they take bus transit, streetcars, subways or elevateds, or commuter rail. Statistics Canada has journey-to-work data going back only to 1996 and it counts all transit together, with no breakdowns between bus or rail transit. This report will rely on Canadian data as much as possible but will use U.S. examples where Canadian data are not available.

AN ARCHAIC VIEW OF CITIES

An image search for the word "city" invariably returns dozens of photographs of clusters of skyscrapers that are presumably surrounded by low-rise residential development. The implicit assumption is that cities are *monocentric,* meaning most people work downtown and need to commute to downtown from outer and suburban residential areas.

This has become so indelibly associated in our minds with "city" that some people question whether an agglomeration of several million people is a "real city" if it doesn't have a central cluster of skyscrapers.[1] Proponents of rail transit implicitly have this notion of city in their minds as most rail transit lines connect residential areas with the central clusters of skyscrapers.

Yet the reality is that, in the 5,000-or-so-year history of cities, humans only built cities like this for about 50 years. Before the early 1800s, cities may have had central government centers or central religious centers, but they didn't have central business districts as we know them today.

The consolidation of businesses into central districts began with the development of the factory system and in particular steam-powered factories. The earliest factories were powered by water and had to locate near a source of waterpower. The development of steam power allowed factories in the early 1800s to locate wherever their owners wanted, and in most cases that meant at the nexus of transportation lines that could deliver raw materials to the factories and take away finished products. This led to the first central business districts or downtowns, a term that was rarely used before the 1840s.[2]

By 1880, most urban jobs were in factories and most factories were in downtowns. But downtowns became especially concentrated after 1891, when an electrical engineer named Frank Sprague developed the first high-speed electrical elevator that allowed the construction of very tall buildings. A few buildings between seven and ten stories tall had been built in the mid-1880s, including the eight-story (plus clock tower) New York Life Insurance Building that opened in Montreal in 1888. But until Sprague's invention the elevators providing access to upper floors were too slow to be useful for buildings taller than 10 stories. Canada's first building taller than ten stories wasn't built until 1904.[3]

Another electrical engineer, Charles Van Depoele, developed a workable electric streetcar system that allowed Windsor to install the first electric streetcar in Canada in 1886. Two years later, Frank Sprague had improved on Van Depoele's design and installed a system in Richmond, Virginia that was widely imitated. By 1905, every U.S. city of more than 15,000 people had installed streetcar lines based on Sprague's design. In 1911, Regina became the last Canadian city of more than 15,000 people to install a streetcar line. In 1892, Sprague developed the first electric rapid transit system, the basis for subways and elevateds in cities such as New York, Montreal, and Toronto.

Sprague's inventions made possible the monocentric city of our imagination. In large cities such as New York and Chicago, rapid transit carried skilled workers and middle-class employees to downtown jobs. In small- to medium-sized cities, including 50 cities in Canada, streetcars carried people from "streetcar suburbs," which tended to be single-family homes and duplexes on small lots, to downtown jobs. Many unskilled workers weren't paid enough to regularly ride the streetcar or rapid-transit lines and they lived in high-density tenements, which were often mid-rise (3-6 stories) housing located within walking distance of jobs on the edges of the downtown areas.

The undoing of the monocentric city began in 1913 when Henry Ford started making automobiles on a moving assembly line. This had three major effects. First, the line was so productive that Ford and later users of moving assembly lines doubled the pay of unskilled workers, enabling them to move out of tenements and into single-family homes.

Second, Ford cut the price of his Model Ts in half, causing the share of U.S. families who owned autos to rise from under 5 percent in 1913 to more than 55 percent by 1926.[4] In that same year, Canada had about 2.1 million households and well over 700,000 private passenger cars, so as many as one out of every three Canadian households had an automobile.[5]

The third effect of the moving assembly line was that it caused factories to move out of downtowns. Moving assembly lines required far more land than older style factories. One Ford factory alone was bigger than any downtown in Canada.[6] As more industries adopted moving assembly lines, factories moved to the suburbs.

Increasing auto ownership enabled more families to move to the suburbs as well. This led major retailers to build stores and shopping centers outside of downtown. For example, in 1931 a downtown Portland retailer named Fred Meyer opened a suburban shopping center that sold food, clothing, hardware, variety, pharmacy, and other goods. By 1950 he had stores scattered throughout the Portland area and his superstore concept was imitated in many places, particularly by a company called Walmart.[7] As retailers decentralized, downtowns became mainly office and entertainment centers, and even then they had to compete with offices and entertainment venues in the suburbs.

As a result, the monocentric city was being replaced by a *polycentric urban area* as early as the 1920s. The Depression and World War II slowed any changes, but by 1950 the largest urban areas had dozens of major job centers of which downtown was only one, and not always the largest. Cities that rapidly grew after 1950, such as Phoenix and San Antonio, often had hardly any downtowns to speak of at all.

Another transition took place after World War II: the growth of the service economy. As of 1911, only a third of jobs in Canada were in the service sector. By 1987, it was two-thirds.[8] Where suburban factory jobs were at least concentrated in various job centers, service jobs could be scattered across an urban area. This led to what I call the *nanocentric urban area,* one that has many "centers" of a few jobs each.

Rail transit worked well in monocentric cities. Bus transit works much better in polycentric urban areas as new job centers open and close all the time and the cost of building rail lines to each new job center is expensive and pointless if, by the time the rail line is built, the job center is no longer important. Neither bus nor rail transit do very well for nanocentric urban areas. This means that cities that build rail transit are privileging those few residents who still work downtown at everyone else's expense.

Unfortunately, even most bus transit systems are designed to serve travelers to and from downtowns but not travelers to other destinations. Building rail transit lines that are mostly focused on downtown only makes this problem worse.

In 2016, for example, about 45 percent of workers in downtown Calgary took transit to work.[9] About 98,000 of Calgary's 684,000 workers worked downtown.[10] About 98,500 Calgary workers commuted by transit, of which 44,000 worked downtown.[11] That left 54,500 out of the remaining 586,000 non-downtown workers, or 9.3 percent, commuting by transit. Rather than redesign its transit system to serve workers in the entire region, Calgary transit has spent hundreds of millions of dollars building a light-rail system that mainly serves the shrinking share of commuters who work downtown.

AN ARCHAIC VIEW OF TRANSIT TECHNOLOGIES

With its streamlined or semi-streamlined appearance and quiet electric motors, rail transit can look like the transportation of the future. In fact, it is the transportation of the distant past. It was surpassed in 1927 by a form of transit called the omnibus, or bus for short. In Latin, *omnibus* means "for all," which is appropriate because buses can move more people to more places at higher speeds for far lower costs than any form of rail transit.

Early buses were basically truck frames with passenger bodies built on top. In 1921, a family of four brothers named Fageol built the first buses from the ground up. They had lower centers of gravity making them less likely to tip over, so the Fageol's called them safety buses.[12] These buses cost less to buy than streetcars and didn't require streetcar infrastructure, so construction of new streetcar lines practically halted as transit companies and agencies bought buses when they wanted to extend service into new areas. However, with the engine located under a long hood in front and most cities limiting bus lengths to about 35 feet, the safety buses could only seat a couple of dozen passengers while streetcars typically sat 60, so the buses cost more to operate, per seat-kilometer, than streetcars. This kept existing streetcar lines in business for a few more years.

In 1927, two of the Fageol brothers designed a new bus that had two engines under the rear-most seats. This "Twin Coach," as they called their bus and their company, eliminated the need for a long hood in front and allowed the Fageols to build buses with 40 seats without exceeding length limits. This reduced bus operating costs per seat-kilometer to less than streetcars.[13] Within 10 years, half of the U.S. cities and 30 percent of Canadian cities with streetcars completely converted their streetcar lines to buses.[14]

Some people have blamed the replacement of streetcars with buses on a conspiracy involving General Motors, but this is a gross misreading of history. General Motors did buy some streetcar companies after 1937 and it was convicted of an antitrust violation and forced to sell those companies in 1948. Its goal, however, was not to convert streetcars to buses but to capture market share from Twin Coach as transit companies were converting their streetcars to buses. General Motors never controlled more than a tiny fraction of transit companies in the United States and none in Canada, yet all but a handful of transit companies and agencies in both countries ended up replacing their streetcars with buses.[15]

Like any infrastructure, rail lines eventually wear out. After the introduction of the Twin Coach bus, it was only a matter of time before the infrastructure for any particular streetcar line wore out, and when it did the most efficient thing for the owners to do was to replace it with buses.

"The motor coach and the private automobile have made streetcar operations obsolete in the United States," explained a Portland transit executive in 1955. "It is not economically possible [for streetcars] to compete with this newer and better type of transportation."[16] This was an industry consensus, and most of the few streetcar lines that survived much longer than that either had their own exclusive rights of way that the transit companies would lose if they tore up the rails or went through long tunnels that would be unsafe for petroleum-powered vehicles.

Rapid transit made economic sense longer than streetcars. Its higher capacities could move more people into crowded downtowns without clogging up surface streets. Even so, after careful consideration the Chicago Transit Authority replaced six rapid transit lines along with all its streetcars with buses between 1948 and 1954.[17]

While keeping some existing rapid transit lines may have made sense, building new ones was more questionable. Baltimore and Miami both built heavy-rail lines in the 1980s that failed to move significant numbers of people and even Atlanta's 84-kilometer system is questionable. Miami's heavy-rail line, for example moved just 1,550 weekday riders per kilometer in 2019, while Baltimore's moved under 1,000. Atlanta's was better at 2,500, but still marginal considering high construction costs.[18] For comparison, Toronto and Montreal subways moved about 20,000 weekday riders per kilometer and New York City subways moved more than 17,000 people per kilometer. Poor performance in Atlanta, Baltimore, and Miami is largely because they did not have job-heavy downtowns like Toronto and Montreal.

Rail transit has four major disadvantages when compared with buses: capacity, flexibility, speed, and cost.

CAPACITY

A single railcar can hold far more people than a bus, so transit agencies often call light rail and even streetcars *high-capacity transit.* This is misleading, however: each car may have a high capacity, but the capacity of a rail line to move people is often much lower than buses. This is because rail lines can safely move only 20 (for light rail) to 30 (for heavy rail) trains per hour, while bus lanes can move hundreds of buses per hour.

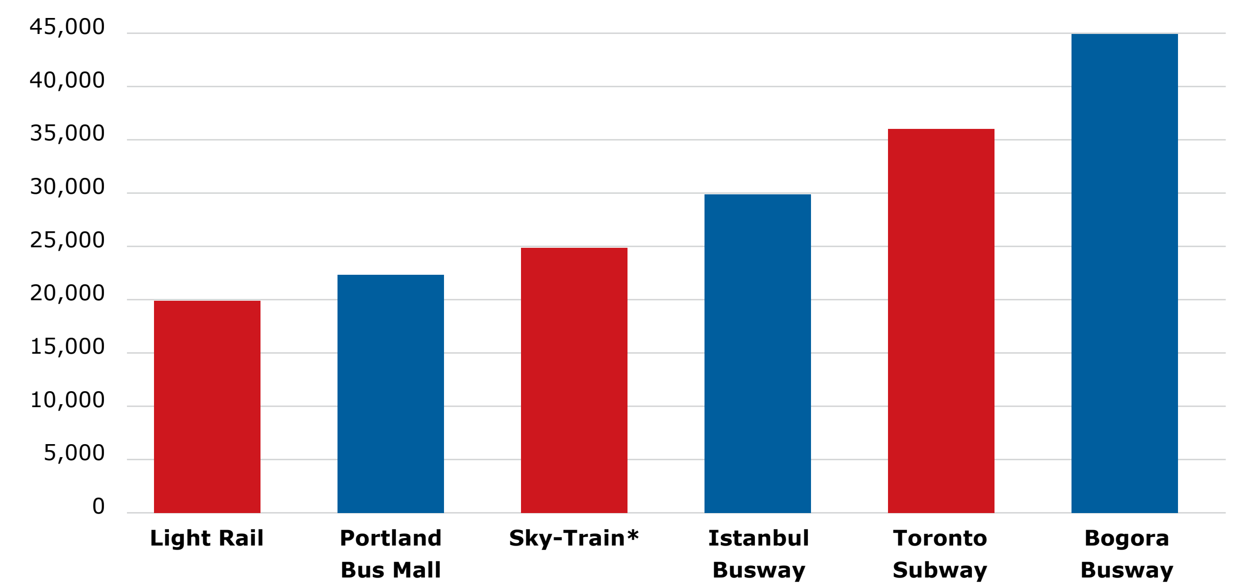
Light rail's low capacities are indicated by the name, which doesn't refer to weight—light-rail cars weigh more than heavy-rail cars—but to capacity. According to the American Public Transit Association's *Glossary of Transit Terminology,* light rail is "an electric railway with a 'light volume' traffic capacity."[19] Ironically, when low-capacity rail systems like these become overcrowded, the overcrowding is celebrated as a sign of their success, when in fact it represents the failure of transportation planners to design a transit system that can handle the demand.

Calgary's highest-capacity light-rail cars are rated to hold 247 people and can be operated in four-car trains. At 20 trains per hour, that's a potential capacity of 19,760 people per hour in each direction. Edmonton has some five-car trains but the capacity of each car is lower at 190 passengers, allowing for 19,000 people per hour. Ottawa's light-rail capacity is much lower.[20] So-called modern streetcar capacities are even lower, and they are typically capable of moving only about 2,600 people per hour.

Subway and elevated capacities are usually higher. New York City's subway can move more than 40,000 people per hour in each direction. Toronto's subway had a capacity of 28,000 people per hour in 2015, but new trains and better train controls were expected to increase that capacity to 36,000 by 2021.[21]

Figure 1

Transit Capacities in People per Hour



For every rail line in Canada (shown in red), it is possible to find a busway (shown in blue) that has a higher capacity at a much lower cost. Capacities are shown in people per hour past a point in one direction. * SkyTrain capacity is shown for the Expo and Millenium lines; the capacity of the Canada line is only 15,000 people per hour.

In-between light rail and heavy rail is Vancouver's SkyTrain, which like heavy rail is separated from other traffic but like light rail has capacity limits due to short trains. The Expo and Millenium SkyTrain lines are estimated to have a potential capacity of 25,000 people per hour, but due to short platforms the Canada line will be unable to move more than 15,000 people per hour, which has led one writer to call it a "poorly designed, under-built toy train."[22]

An appropriately designed bus route can handle any capacity in this range at a much lower cost. A single bus stop can serve slightly more than one bus every 90 seconds or 41.5 buses per hour. In a high-use transit corridor known as the Portland bus mall, Portland staggered bus stops on ordinary city streets so that four stops were located every two blocks. This allowed the corridor to be served by 166 buses per hour.[23] Standard 40-foot buses can carry about 60 passengers while some articulated 60-foot buses can carry as many as 132 passengers. This means the potential capacity of such a corridor using articulated buses is nearly 22,000 people per hour.

Dedicated busways on major highways can move even more people. Istanbul has a busway in the median strip of a freeway that moves well over 250 buses per hour. The busway, which uses no more land than a light-rail line, has a rated capacity of 30,000 people per hour and often moves well over 20,000 people per hour.[24] Bogota, Columbia has achieved even higher capacities with busways that have two lanes in each direction, allowing express buses to pass buses that are stopped at stations. Rated at 45,000 people per hour, Bogota officials believe this could be increased to 60,000 people per hour with optimized signals and grade-separated intersections.[25]

In short, within the space of a single lane buses can move more people than any light-rail line and there are no rail lines in North America whose capacities cannot be exceeded by an appropriately designed bus corridor. Moreover, buses are scalable, meaning that buses can serve a wide range of demand with little variation in capital or operating costs per seat-kilometer, allowing transit agencies to tailor the bus service to meet the demand. In contrast, rail lines are extremely costly at low levels of ridership and are expensive to modify once ridership reaches a line’s capacity.

FLEXIBILITY

The biggest advantage of buses is that they are far more flexible than rail. Not counting local streets, major metropolitan areas typically have thousands of kilometers of arterial and collector roads. Buses can use any of these streets at any time.

This makes it possible to temporarily reroute buses in case of an accident, breakdown, or other emergency. Rail systems have few to no passing tracks, so if one train breaks down, every train on that line can end up being delayed. If a bus breaks down or a street is blocked for some other reason, other buses can easily pass or take a different route.

Existing street networks also make it easy to permanently reroute buses in response to changing transportation patterns. The opening of a new economic or residential center, the reduction in importance of an existing economic center, or a major change in work habits such as that caused by the recent pandemic can all produce new transportation patterns. Agencies can change bus routes overnight, while new rail lines take years to plan and build, by which time transportation patterns may have changed again.

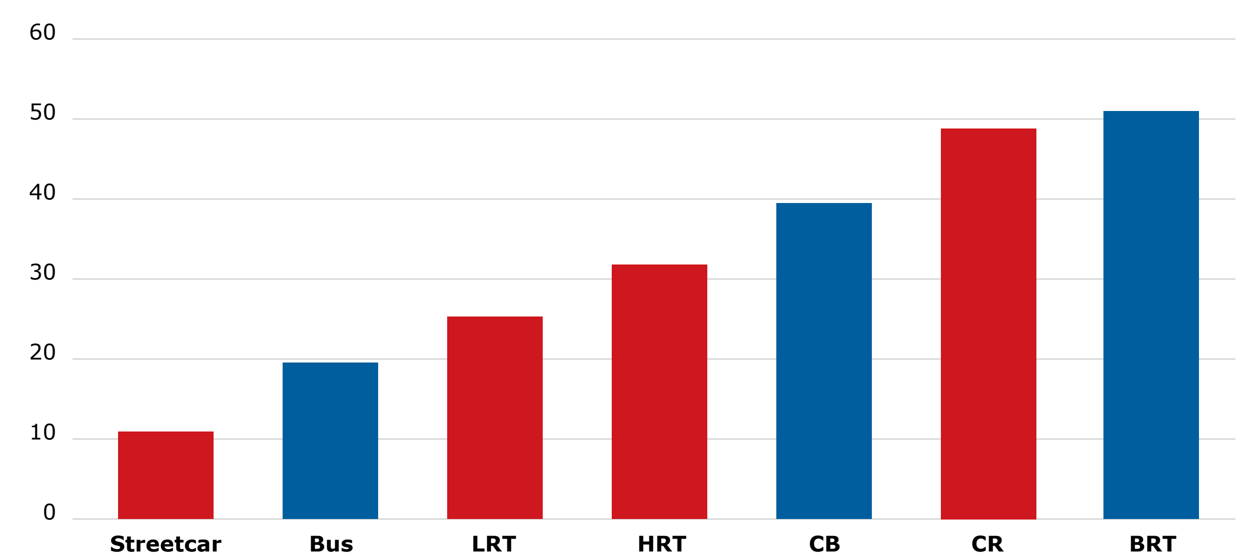
SPEED

Rail lines are touted as having higher speeds than buses, but a major reason for that is that most rail lines are built to have fewer stops per kilometer than conventional buses. Rapid buses (which stop about as frequently as light rail) and express buses (which stop less frequently than almost any rail lines) can easily be time-competitive with rail lines.

The American Public Transportation Association says that conventional bus lines in the United States average about 19 kilometers per hour, while light rail averages 25 kph and heavy rail averages 32 kph. However, commuter buses average 39 kph.[26] More than 20 commuter bus systems in the U.S. run buses averaging more than 60 kph.[27]

Figure 2

Transit Speeds in Kilometers per Hour



For every rail line (red), there is a bus line that is faster. Numbers shown are U.S. national averages published by the American Public Transportation Association except for BRT. The association doesn't publish a number for BRT so the number shown is for the Denver-Boulder BRT line, which admittedly is faster than most BRT lines.

In-between conventional and commuter buses are rapid buses. Denver has a rapid bus running 45 kilometers between downtown Denver and downtown Boulder that uses a high-occupancy/toll lane (a lane that low-occupancy vehicles are allowed to use provided they pay a toll that varies so that the lane never becomes congested) for most of the route. The "express service" on this route makes five intermediate stops and averages 69 kph, but it only operates a few times a day. The all-day service, operating four times per hour, makes nine intermediate stops and averages 51 kph.[28]

A single freeway lane can move close to 2,000 cars per hour. A standard bus has been estimated to be equivalent to three cars, which means a lane can move about 667 buses per hour. If demand warranted, a lane could move well over 100 buses per hour and still leave room for hundreds of automobiles per hour, so exclusive bus lanes aren't needed unless transit demand gets high enough to need several hundred buses per hour.

COST

Bus capital costs are obviously lower than those of rail because buses usually don't require special infrastructure. But even the vehicles themselves are less expensive. Buses themselves typically cost around $500,000, while light-rail cars cost around $3 million to $4 million. While rail vehicles last longer and have room for more people, buses still cost less per seat per year.

Except in corridors with the highest transit demand, buses require very little dedicated infrastructure. Even where dedicated bus lanes are needed, the cost need not be high. Istanbul's Metrobus cost around $12 million per kilometer.[29] Bogota's busway system cost less than $20 million per kilometer.[30] By comparison, light rail typically costs more than $60 million a kilometer and Vancouver's recent SkyTrain lines cost between $200 million and $500 million a kilometer.[31]

Rail advocates sometimes claim that rail's higher capital cost will be made up for by lower operating costs, but this is rarely true. In the United States, bus and light-rail operating costs per seat-kilometer were both 30¢ in 2021. Heavy rail was a little less at 26¢, but that small difference won't cover much in the way of capital costs.[32]

If there were any savings in rail operating costs, those savings are offset by the cost of interest and the long-term costs of major maintenance and capital replacement of rail infrastructure. Interest costs are growing more significant with the rise of interest rates. Transit agencies rarely have to borrow money to buy buses, but typically borrow hundreds of millions of dollars to build rail transit. Vancouver's TransLink, for example, is nearly $4 billion in debt and spends as much as 14 percent of its entire operating budget on interest on that debt.[33]

Rail advocates often neglect to consider long-term maintenance and capital replacement costs, sometimes even saying that, once built, a rail line lasts forever. In fact, the U.S. Federal Transit Administration estimates that structures, trackwork, and signals have a useful life of about 30 years, after which they should be replaced or the system faces significantly increased maintenance costs and risk of accidents.[34] In 2021, U.S. transit agencies spent an average of 6¢ per seat-kilometer for bus capital replacement but 9¢ per seat-kilometer for light rail and 17¢ per seat-kilometer for heavy rail.[35] Note that the difference between bus and heavy-rail capital replacement costs is much greater than the savings in heavy-rail operating costs.

While the exact numbers may vary for Canada's rail lines, the point is that the long-term costs of rail are much higher, when all costs are counted, than for buses. A 2009 comparison of transportation costs, including both operating costs and amortized capital costs, found that Vancouver's SkyTrain cost more than $1.62 per passenger-kilometer, compared with $1.02 for light rail, 93¢ for Diesel buses, 65¢ for a light truck, and about 50¢ for a Toyota Prius.[36]

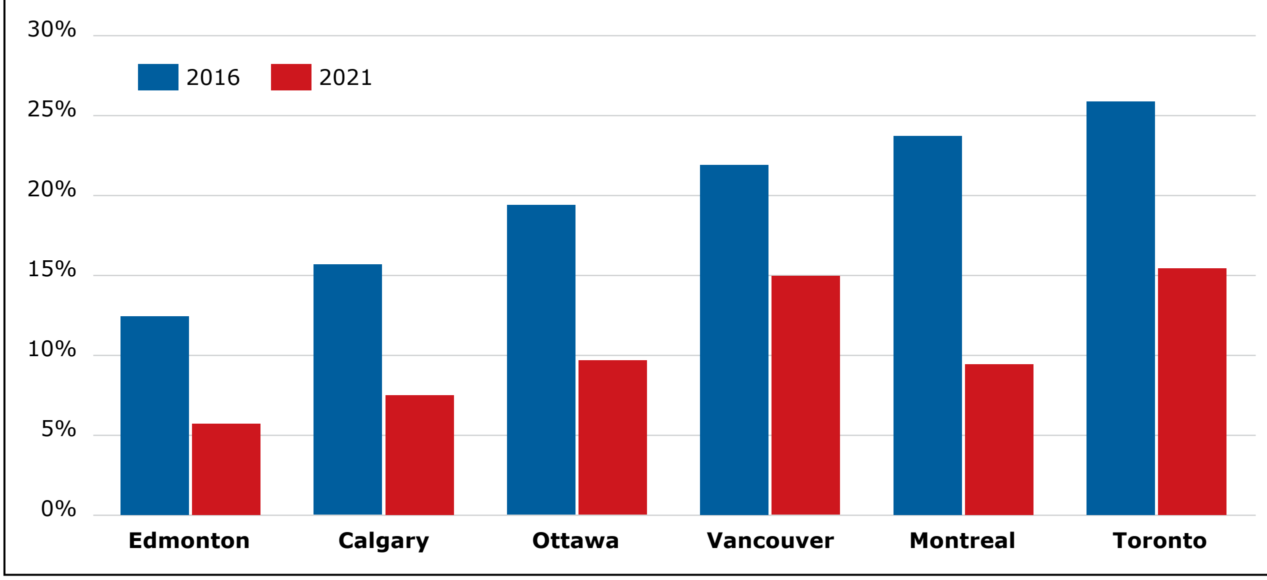
In short, buses are superior to rail in almost every way, which explains why the transit industry voluntarily converted almost all Canadian and U.S. streetcar lines and some rapid transit lines to buses between 1927 and 1975. The main advantage rails have over buses is that they cost more, and that extra cost earns profits for rail contractors, engineering and design firms, and railcar manufacturers. These companies in turn spend money on lobbying and make contributions to political campaigns aimed at obscuring the fact that rail transit costs more and does less than buses.

THE PANDEMIC REDUCED THE DEMAND FOR TRANSIT

The COVID-19 pandemic resulted in large numbers of people working at home and, even though the pandemic is largely over, many of those people continue to work at home. The 2021 census found 2.8 million fewer Canadians commuting to work than in 2016.

Figure 3

Share of Workers Commuting by Transit



Transit carried a far smaller share of workers to work after the pandemic than before, as documented by the Canadian 2016 and 2021 censuses. While some of the people working at home in 2021 may end up returning to a workplace, many probably will do so only two to three days a week and continue to work at home the other days.

This change has had an outsized effect on transit commuting. While automobile commuting declined by 13 percent, the number of transit commuters fell by half.[37] As shown in figure 3, the share of workers commuting by transit declined dramatically in major Canadian urban areas.[38]

Transit was most heavily impacted by the pandemic for several reasons. First, as noted above, a large percentage of transit commuters worked downtown, and downtown office workers were among the most likely to begin working at home during the pandemic. Second, the pandemic has made people wary of crowded places, including transit vehicles, where they might be most likely to catch infectious diseases. Third, the reduction in auto commuting has reduced congestion, and some people who rode transit to avoid congestion switched back to driving to work. This partially offset the decline in auto commuters due to people working at home.

Transit agencies naturally hope that these effects will be only temporary. However, Canadian transit ridership has so far recovered to only about 80 percent of pre-pandemic levels and there is some evidence that it will not rise much higher.

When measured as a percentage of 2019 ridership, ridership in most Canadian urban areas appears to be leveling off somewhat short of the 2019 numbers. Edmonton is the worst, with transit carrying only 61.3 percent as many riders in March of 2023 as the same month in 2019, growing slightly to 64.9 percent in September. Ridership on the Montreal subway was 68.6 percent of pre-pandemic numbers in June, growing to 75.1 percent in September. Toronto transit did a little better, growing from 68.6 percent of pre-pandemic numbers in March 2023 to 81.0 percent in September. Ottawa ridership reached 81.6 percent of pre-pandemic levels in March but grew to only 83.8 percent in September. Similarly, ridership in Vancouver reached 86.8 percent of March 2019, but increased to only 88.9 percent by September 2023. Calgary transit is doing best, as ridership grew from 85.1 percent of 2019 in March 2023 to 96.6 percent in September.[39]

Transit agencies responded to lower ridership by seeking more federal and provincial funding to make up for the lost revenues due to lower ridership.[40] Ironically, when ridership increases, agencies demand more funding to support the losses from the increased number of riders while, when it decreases, agencies demand more funding to support the losses from the drop in revenues.

Even if ridership returns to a significant percentage of pre-pandemic levels, it appears that the migration of jobs out of downtowns is more permanent. A University of Toronto database has found that, as of July 2023, downtowns in Calgary, Edmonton, Ottawa, and Vancouver have recovered to 80 to 85 percent of pre-pandemic economic activity, but Toronto is only 70 percent and Montreal is 67 percent.[41]

Employers may succeed in persuading some employees to return to workplaces, but many will do so on a “hybrid” basis, meaning they will still work at home two, three, or even four days a week. Many employers may decide that paying for expensive downtown office space is unnecessary if many employees are coming in only part time. The long-term loss of downtown jobs makes downtown-centric transit systems even less effective than before the pandemic.

From 2013 to 2021, suburban office vacancy rates were higher than downtown vacancy rates. That was reversed in 2022 and the gap between downtown and suburban vacancy rates is growing.[42] Since offices are typically leased for years at a time, there is a lag time between people making workplace decisions and changes in vacancy rates, but the trend is clearly towards the suburbs rather than downtowns. The difference between downtown and suburban vacancy rates was particularly high in Calgary, Edmonton, Vancouver, and Waterloo, all regions planning more rail transit lines.

Also due to this lag time, downtown vacancies will continue to rise even as some people return to work. Nationwide, the downtown vacancy rate was 18.9 percent in the second quarter of 2023 and was rising everywhere but Calgary and Halifax. Despite falling slightly, Calgary’s was still the highest in the nation at 31.5 percent. Edmonton, Winnipeg, London, and Waterloo were all also above average.[43]

Toronto office vacancies are at their highest in nearly 30 years and experts expect them to rise still further over the next several years.[44] Downtown Calgary vacancy rates were already high before the pandemic, reached nearly 30 percent in late 2021, but have since improved to a mere 27 percent—still the highest in the nation—in 2023.[45] Vacancy rates are highest in the downtown areas: downtown Hamilton has been called a "wasteland" while "the rest of the city fares better."[46] Downtown Vancouver is faring better, but vacancy rates rose from just 2 percent in 2019 to more than 12 percent in mid-2023 and are not expected to recover anytime soon.[47]

Downtown offices may eventually fill up, but the proportion of total jobs that are downtown will continue to decline. This will make downtown-centric transit even more obsolete than it was before the pandemic. This makes it even more imperative that transit agencies begin the belated task of redesigning their route maps to better serve economic centers throughout their urban areas rather than focus on downtowns. Yet none of the transit agencies in major Canadian urban areas seem interested in doing that; nor are any seriously considering cancelling plans to build more rail transit.

RAIL TRANSIT COST OVERRUNS ARE NOW ROUTINE

Rail transit costs have massively grown since Edmonton and Calgary first pioneered light-rail transit in the late 1970s and early 1980s. Edmonton's first light-rail line cost $10.5 million per kilometer (about $45 million in today's dollars); its latest line is costing $169 million per kilometer.[48] Calgary's first light-rail lines cost $18 million a kilometer (less than $40 million in today's money), but now the city is constructing a line that is expected to cost at least $120 million a kilometer.[49] Vancouver's original SkyTrain cost about $40 million a kilometer (about $96 million in today's money), but the most recent extension cost $131 million per kilometer and the next line is expected to cost $500 million per kilometer.[50]

Not only are construction costs high, they are often much higher than the original projections as cost overruns have increasingly become the norm for Canadian rail projects.

- Calgary's West Line was originally projected to cost $700 million but by 2012 ended up costing $1.5 billion;[51]
- In 2015, Montreal started construction on a light-rail line to its airport that was expected to cost $5 billion but actually cost $7 billion;[52]
- Calgary's Green Line was originally projected to cost $4.5 billion and is now expected to cost more than $5.5 billion;[53]
- Edmonton's 14-kilometer Valley Line West light rail was originally supposed to cost $1.8 billion and now is expected to cost $2.7 billion;[54]
- Toronto's Eglinton light-rail line was originally projected to cost $4.6 billion.[55] When the contracts were let in 2015, capital costs had risen to $5.3 billion.[56] Since then, total costs have risen by $2.7 billion, most of which is for construction;[57]
- Toronto's 15-kilometrer Ontario subway line was once projected cost $10.9 billion but now is expected to cost well over $17 billion;[58]
- Hamilton's initial light-rail line was originally projected to cost $1.0 billion—current projections are $2.8 billion;[59]
- The cost of the second stage of Ottawa's light-rail line was originally projected to be under $2.0 billion and now is expected to cost $4.7 billion.[60]

Megaprojects expert Bent Flyvbjerg says there are two reasons for such cost overruns: *optimism bias* and *strategic misrepresentation.* Optimism bias is when planners unconsciously make optimistic assumptions about costs, ridership, and other important numbers. Strategic misrepresentation is when planners consciously make optimistic assumptions in order to make projects more politically acceptable.[61]

As US Department of Transportation analyst Don Pickrell observed, "the systematic tendency to over-estimate ridership and to under-estimate capital and operating costs introduces a distinct bias toward the selection of capital-intensive transit improvements such as rail lines."[62] Once politicians have bought into projects, then projections can become more realistic and politicians are unlikely to reverse themselves, especially if a lot of money has already been spent on planning, right-of-way acquisition, or other costs.

Flyvbjerg argues that planners should use *reference class forecasting,* which means that if a particular type of project tends to have 50 percent cost overruns, then all cost estimates for that kind of project should be increased by 50 percent.[63] Cost overruns for the above list of rail transit projects, for example, averaged between 55 and 60 percent overruns.

There are several reasons why this is not likely to help. First, if planners are indeed engaged in strategic misrepresentation, they will just make estimates that are that much lower. Second, many people are simply unable to comprehend large numbers, so many inclined to favor rail transit wouldn't care if a project was estimated to cost $750 million or $1.5 billion. Finally, for politicians, the cost is the benefit: a higher-cost project simply means more political favors that can be turned into campaign contributions.

Rising construction costs have led numerous people to ask why transit construction costs so much.[64] One answer is that rail lines must be built to higher precision standards than roads and each rail project must be carefully engineered while roads are basically a commodity that can be built with little sophisticated engineering, other than for bridges and tunnels.

The real answer for why transit line construction is so expensive, however, *is because it can be.* Knowing that politicians are attracted to higher-cost projects, transit agencies have no incentive to keep costs low and in fact have an incentive to choose the high-cost solution to any transit problem.

In response to public criticism of costs, some transit agencies have tried building transit lines with public-private partnerships. Under this model, which became popular for new road and bridge construction in Europe, a public agency defines a project and then lets a private company build and operate it. Unfortunately, there is a significant difference between public-private partnerships for roads and those for transit.

Most highway public-private partnerships allow the private partner to toll the road for 30 or more years and repay the cost of construction out of tolls. This is called the *demand-risk* model because the private partner takes the risk that demand might not be sufficient to repay the costs. The public takes no risk at all since they get the road whether the private partner profits or not.

Transit public-private partnerships are so different that it seems deceptive to use the same name. Under these partnerships, the private partner builds the project and operates and maintains it for, usually, 30 years. But no one expects the fare revenues to cover the construction costs, so the public agency guarantees an annual payment for those 30 years. This is called an *availability-payment* model, and in this system, all of the risk is absorbed by the public. When costs prove higher than projected, as recently happened in a Maryland light-rail project, the private partners often withdraw from the contract.[65]

The availability-payment model is attractive to many government agencies because it allows them to hide debt.[66] Most public agencies have debt limits either legally or to maintain their credit ratings. Since the private partner is the one borrowing the funds to build the project, expecting that those funds will be repaid out of the annual availability payments, the public agency often doesn't declare the debt. For example, in 2004 Denver-area voters approved a sales tax increase to build several rail projects but imposed a firm debt limit on the regional transit district. When overruns nearly doubled project costs, the transit district used public-private partnerships to pay for some of the biggest projects, as the private partner borrowings didn't count against the public agency's debt limit.

In a demand-risk partnership, the private partner has an incentive to keep costs low while maintaining high construction standards because they are required to maintain the project in good condition for the life of the contract. In an availability-payment partnership, neither the public nor the private partners have similar incentives, allowing costs to balloon and threatening the quality of construction.

RAIL TRANSIT IS SOCIALLY UNJUST

Subsidies to transit are often promoted as socially just because many transit riders have low incomes and presumably cannot afford to own automobiles. In fact, these subsidies are socially unjust as most low-income people do own automobiles and most of the subsidies come from regressive taxes that force a majority of low-income people to disproportionately pay for transit systems they aren't using.

Most Canadian transit agencies rely heavily on property taxes to subsidize their systems. Even renters effectively pay property taxes since the rents they pay must cover their landlord's taxes. Property taxes are highly regressive, both because low-income people pay a larger share of their incomes on housing and because tax authorities are more likely to over-assess home values in low-income neighborhoods.

United States census data indicate that low-income families spend 40 percent of their incomes on housing while higher-income families spend only 30 percent.[67] Less-detailed data are available for Canada, but Statistics Canada says that 72 percent of low-income families spend more than 30 percent of their incomes on housing compared with just 20 percent of families in Canada as a whole.[68]

Although low-income families may spend a higher percentage of their incomes on housing, property taxes might not be regressive if the homes they live in are worth substantially less than the homes of higher-income people. However, a study from the University of Chicago found that homes in low-income neighborhoods face tax assessments that are, as a proportion of actual value, "twice as high as that faced by homes in the top decile." The reason is that assessors typical base their assessments on the size and other external features of the homes and so miss the lower quality of construction and poor maintenance that is typical in low-income neighborhoods. "As a result," the study concluded, "the property tax disproportionately burdens owners of less valuable homes."[69]

Other taxes used to support transit are also often regressive. For example, Vancouver's TransLink receives about as much tax revenue from fuel taxes as it does from property taxes. Low-income families drive less than high-income families, but they spend a larger share of their incomes on driving. U.S. data indicate that, in 2014, families in the lower third of income classes spent almost 16 percent of their incomes on driving compared with just 8 percent for families in the upper third.[70] While these data are not available for Canada, the results are likely to be similar.

U.S. residents own about 890 motor vehicles per thousand people compared with 770 for Canadians.[71] Surveys indicate that almost 85 percent of Canadian adults own at least one car compared with 92 percent of U.S. households.[72] This suggests that a greater share of Canadian low-income households may lack autos than those of the U.S., but not too much greater.

Most low-income people are acutely aware that automobiles give them access to far more economic opportunities than transit. Studies published by the University of Minnesota Accessibility Observatory show that typical residents of the 50 largest urban areas in the United States can reach almost twice as many jobs in a 20-minute auto drive as in a 60-minute transit ride, and more than 11 times as many jobs in an auto drive of any number of minutes (up to 60) as in a transit ride in the same number of minutes. Even in the most transit-intensive urban area, New York, auto users can reach far more jobs than transit riders.[73] People concerned about social equity should focus on reducing Canada's fuel taxes to the amount needed to build and maintain Canadian roads rather than increasing regressive subsidies to transit.

Transit advocates often try to make transit appear inexpensive compared with driving by calculating driving costs assuming that everyone buys a new car, pays full financing charges for it, and after paying it off in five or six years, immediately trades it in on another new car. Some people may do this, but the average car on the road in the United States is 13.6 years old, meaning the average car lasts more than 25 years.[74] The average age of Canadian cars is a little lower, probably due to harsher climate.[75] At either average, anyone who trades in their car after six years misses most of the car's lifespan. This makes for a robust used-car market that benefits low-income people. In other words, the assumption that people drive only new cars greatly exaggerates the cost of driving.

RAIL TRANSIT IS BAD FOR THE ENVIRONMENT

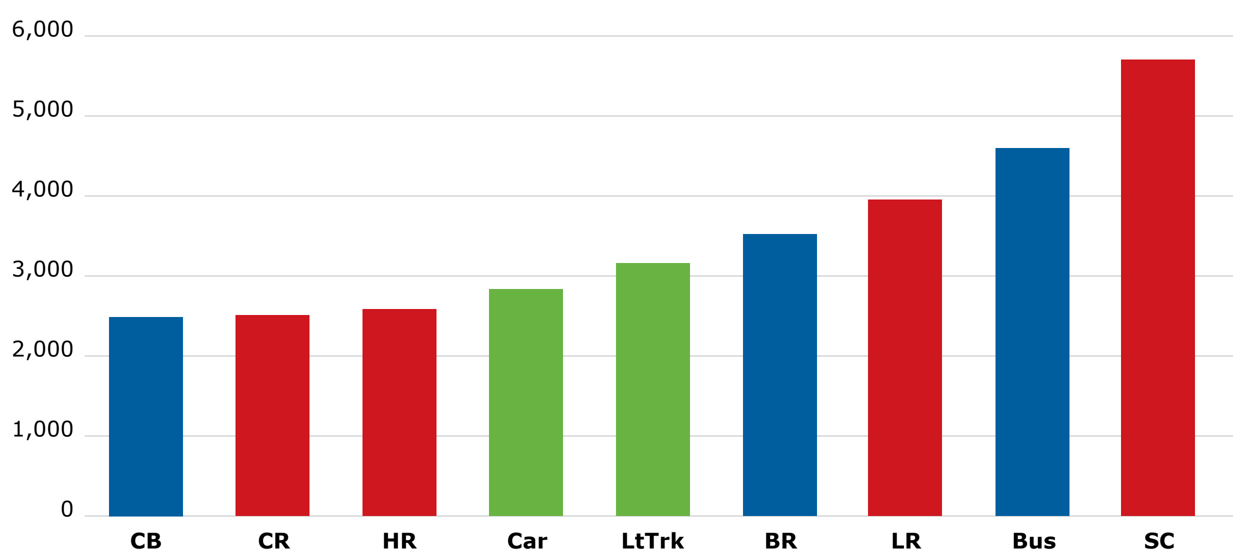
One argument for rail transit is that it saves energy and reduces greenhouse gas emissions. In reality, given similar load factors, buses use less energy than trains. In 2019, buses in the United States used 663 British thermal units (BTUs) per seat-kilometer, while heavy rail used 715, light rail 771, and streetcars 1,174. Commuter buses also produced slightly fewer greenhouse gases per seat-kilometer than commuter trains.[76]

Energy consumption per passenger-mile depends heavily on occupancy rates. In 2019, buses, light rail, and streetcars all used significantly more energy per passenger-mile in the U.S. than cars and light trucks. Commuter buses, commuter rail, and heavy rail did better mainly due to high occupancy rates in the New York urban area, which is the dominant provider of such services.[77]

Canadian occupancy rates may differ from those of the U.S. but the relative ratios of one mode to another probably remain about the same. For example, Canadian transit occupancies may be higher, but automobile occupancies may also be higher. Census data indicate that Canadians are more likely to carpool to work than U.S. residents.[78] If this carries over to other automobile trips, then Canadian auto occupancies will be

Figure 4

BTUs per Passenger-mile



Average British thermal units per passenger-mile for U.S. transit modes (shown in red and blue) and automobiles (shown in green) in 2019. CB=commuter bus; CR=commuter rail; HR=heavy rail; LtTrk=pickups, SUVs, and vans; BR=rapid bus; LR=light rail; Bus=conventional bus; and SC=streetcar. Transit data are calculated from the 2019 National Transit Database, energy consumption and service spreadsheets; car and light truck data are from the Transportation Energy Databook, 40th edition, table 2-14. Numbers for Canada will vary if occupancy rates of transit and automobiles are significantly different.

significantly higher and therefore automobile energy consumption per passenger-mile will be lower than in the U.S.

Greenhouse gas emissions from petroleum-powered vehicles are almost exactly proportional to BTUs. Electrically powered transit may directly emit fewer greenhouse gases than petroleum-powered transit, but most of the electricity in Alberta comes from burning fossil fuels, so the real emissions per passenger-kilometer or seat-kilometer for light rail may be as great as for buses. Calgary Transit claims its light-rail trains are "wind powered," but any wind power the agency buys is power that isn't available for others in the province, so it is most appropriate to use the mix of energy generated in Alberta, not one source, when calculating the impacts of electrical use on the environment.

Most of the electricity in British Columbia, Ontario, and Quebec comes from hydropower, so trains in those provinces are cleaner. However, it is more cost-effective to reduce greenhouse gas emissions by electrifying buses or automobiles than by building expensive rail lines, especially since rail construction itself results in the emission of millions of grams of greenhouse gases per kilometer.

PROPERTY VALUES AND ECONOMIC DEVELOPMENT

One more argument for rail transit is that it supposedly promotes economic development and enhances property values. The economic development myth started in Portland, Oregon.

In 1996, ten years after Portland opened its first light-rail line and rezoned all of the stations areas along the line for redevelopment, city planners ruefully reported to the Portland city council that “we have not seen any of the kind of development—of a mid-rise, higher-density, mixed- use, mixed-income type—that we would’ve liked to have seen” on the light-rail route.[79]

“We are in the hottest real estate market in the country,” city commissioner Charles Hales noted, yet city planning maps revealed that “most of those sites [along the light-rail line] are still vacant.”[80] Hales persuaded the city council to begin subsidizing such developments. Portland subsidies included property tax waivers, below-market land sales to developers, installation of infrastructure that developers would normally have to pay for themselves, and direct grants to developers. This led to many new developments but given the subsidies those developments would have taken place without the light-rail line.

Many Canadian cities are following Portland’s example. Instead of promoting economic development, construction of Calgary’s light-rail line led to a deterioration of the neighborhood known as East Village. That deterioration was reversed only when the city began heavily subsidizing new infrastructure, including raising the entire area above the flood plain.[81]

Using a tax tool known as tax-increment financing, Portland has surrounded its light-rail corridors with urban renewal districts and provided well over a billion dollars in subsidies to new projects along its light-rail lines.[82] Calgary and Edmonton are using the same tool, locally known as community revitalization levies.[83] These levies look like “free money” because they come from property taxes on the new development, but any new development consumes urban services that would normally be paid for out of those property taxes. Since the taxes are going to subsidize the development, other property taxpayers in the city must either pay higher taxes or accept a lower level of urban services in order to fund the services used by the new developments.

British Columbia is spending hundreds of millions of dollars buying land along the SkyTrain and making it available to developers for high-density developments.[84] Planners hope that people living in these apartments will be more likely to ride transit, but such developments must be subsidized because Canadians overwhelmingly prefer to live in single-family homes.[85] It would be more effective to design a transit system that matches the way Canadians want to live than to try to force Canadians to live a lifestyle that fits obsolete transit systems.

Moreover, the evidence that such developments increase transit ridership is weak. A literature review of the effects of density on driving by University of California, Irvine economist David Brownstone found that studies that make such claims fail to account for self-selection bias; that is, people who want to drive less may tend to locate in an area near transit. After adjusting for self-selection bias, Brownstone found that the effect of density on driving and transit was “too small to be useful” in saving energy or reducing greenhouse gas emissions.[86]

While it is far from clear that rail transit by itself, without the support of additional subsidies, generates economic development, several studies have found that rail transit increases property values near transit stations.[87] This is likely only true in areas where transit ridership is already high. A study of the Waterloo light-rail line found only a “small impact” on property values due to “very low rates of transit use in Kitchener-Waterloo.”[88]

Even where rail transit has boosted property values, the result is a zero-sum game for an urban area as a whole. In other words, such an increase in property values is balanced by a decrease or a less-than-average increase in other parts of the urban area.

A study of high-speed rail—another rail program that supposedly generates economic development—in Japan found that, for every community that benefitted from having a high-speed rail line, other communities not on high-speed rail lines have suffered.[89] Certainly, Japan’s overall economic growth, which has been slow or stagnant since 1990, has not benefitted from building more rail lines.

In the same way, rail transit leads to insignificant increases in the total value of property or the total amount of property tax revenues in the urban area as a whole, namely because rail transit carries such a small amount of passenger travel, and virtually no freight, in the urban area. Some people or businesses may decide to locate near a rail station within an urban area, but few people or businesses decide to move to an urban area because it has rail transit.

RAIL TRANSIT IS NOT RESILIENT

One of the lessons of the COVID pandemic is that societies need to be resilient, meaning that institutions should allow people to easily adapt to social, economic, or physical shocks such as natural disasters, depressions, and pandemics. Rail transit is far less resilient than buses because it takes so long to plan and build and is so inflexible and expensive.

Brookings Institution scholar Clifford Winston tells the story of the Capital Center, a popular venue outside of Washington DC used for professional basketball and hockey, rock and roll concerts, and other entertainment. The Washington Metropolitan Area Transportation Authority decided it would be worthwhile building a rail line to serve the Capital Center. After many years of planning and construction, the new rail line and station opened in 2005—three years after the Capital Center had closed down.[90] Any system that takes more than a decade to plan and implement is not going to be resilient because no one knows, when planning begins, what a city's needs will be more than a decade in the future.

Rather than adopt more flexible systems, transit agencies end up trying to prop up downtowns and to change people's lifestyles by subsidizing construction of high-density housing projects in downtowns or near rail transit stations. It would be much better if transit agencies redesigned their systems to meet the needs of 21st century cities rather than to try to rebuild those cities using 19th century patterns.

There are several reasons why large numbers of people may need to evacuate cities, whether due to natural disasters such as wildfire or earthquakes or to terrorist attacks such as 9/11. Buses will work far better at moving large numbers of people than rails, partly because of their higher inherent capacities but also partly because it rail systems are more vulnerable to being crippled if a single section is put out of commission.

Another way that rail transit makes cities less resilient is that rail construction usually requires transit agencies to go heavily into debt, which can exacerbate the effects of revenue declines from recessions or other causes. The investors holding the debt will expect regular payments even if tax and/or fare revenues fall. If revenues fall by 25 percent, a bus system may need to reduce its service by 25 percent, but if 20 percent of revenues are dedicated to debt service, a 25 percent cut in revenues would require a 32 percent cut in service. San Jose's transit system suffered that problem in the 2001 dot-com bust and transit ridership there has never recovered.[91]

Buses cost less and can move more people to more destinations than rail transit. But if that isn't enough of a reason to prefer buses over rail, the need to make Canadian cities as resilient as possible should tip the balance in favor of using bus transit, usually on shared infrastructure, rather than building expensive infrastructure dedicated exclusively to rail transit.

RAIL TRANSIT HAS QUESTIONABLE RIDERSHIP BENEFITS

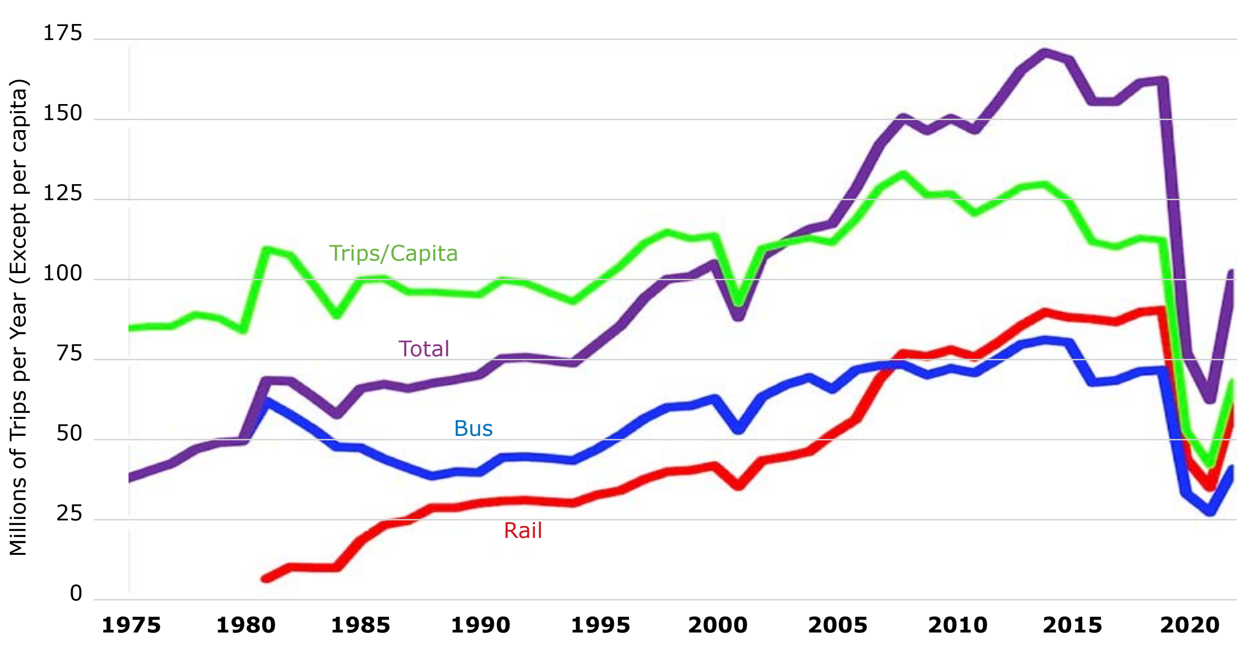
Some rail transit advocates claim that rails are superior to roads because many people will ride a train when they won't ride a bus. There is little evidence that this is true.

In fact, construction of new rail lines has actually hurt transit ridership in several U.S. cities, including Baltimore, Houston, Los Angeles, Norfolk, San Jose, and St. Louis, where transit systems carried fewer riders in 2019 than they did before they began building rail transit. This is because agencies lost more bus riders than they gained rail riders when they cut bus service to pay for rail cost overruns. For example, for every rider attracted to new light-rail lines built by Los Angeles Metro between 2007 and 2019, Metro lost almost seven bus riders.[92]

Canadian transit agencies have so far minimized this hazard. Calgary transit ridership in 2019, for example, was 3.3 times as great as in 1980, before the city opened its first light-rail line.[93] Much of this growth, however, was due to population growth, as the region had 2.4 times as many residents in 2019 as in 1980.[94]

Figure 5

Calgary Transit Ridership



Calgary transit ridership grew after the opening of the city's first light-rail line, but not any faster than it was growing before the rail line opened. It appears that trips per capita, which peaked in 2008 then declined by nearly 15 percent in 2019, is more a record of the fortunes of downtown Calgary than the benefits of light-rail transit. Source: Calgary Transit; trips per capita calculated using census population data for the Calgary Census Metropolitan Area, with numbers interpolated for the years between the censuses.

Bus ridership was already growing rapidly before the city opened its first light-rail line. Bus riders increased by 65 percent and bus trips per capita grew from about 86 to 100 trips per year between 1975 and 1981. By 1988, however, bus ridership fell back to 1975 levels and per capita bus ridership fell to 56 trips per year. This may have been partly due to a recession but was more likely due to cuts in bus service as during the same years light-rail ridership grew by more than 180 percent.

Despite early declines in bus ridership, Calgary's total transit ridership continued to grow through 2014. However, where bus ridership had been growing by 10.5 percent per year in the six years before the light-rail line opened, transit's growth rate immediately declined after the light rail opened and averaged just 2.8 percent through 2014. This suggests that Calgary transit was increasingly providing quality service only to people who happened to live in the light-rail corridor and work downtown while neglecting travelers in the rest of the city.[95]

As one local critic noted in 2022, Calgary's "absurd... downtown-centric system leaves many in the cold."[96] All of Calgary's light-rail lines go downtown and Calgary operates 268 bus routes, the majority of which either go downtown or go to a station of a light-rail line going downtown. This makes it easy for people to get downtown but requires that people going from other parts of the region to other economic centers take long journeys if they take transit.

Due to declining oil prices, the number of jobs in downtown Calgary dropped after 2014.[97] This pushed ridership down. Between 2014 and 2019 total ridership fell by 5 percent and annual per capita ridership fell from 131 trips to 114 trips.

Ottawa also saw ridership increase after it opened its light-rail line in 2001. As with Calgary, however, Ottawa's bus ridership was already growing, having increased by 31 percent between 1996 and 2001. While transit ridership continued to grow after 2001, per capita ridership stagnated after 2002 and declined after 2012. In 2002, transit carried about 115 trips per Ottawa resident, but by 2017 this had fallen below 100 rides per resident and even fewer in 2019.[98]

Waterloo opened its light-rail line in July 2019, just eight months before the pandemic began affecting ridership. However, total bus plus rail ridership in January 2020 was significantly lower than bus ridership alone had been in January 2019. Total ridership in February 2020 was higher than in 2019, so it will be difficult to know in the future whether ridership would have improved if there were no pandemic.[99]

Ridership data from before 1995 for other Canadian transit systems are not available. However, data for Toronto, which has Canada's most intensive transit network, indicate that per-capita transit ridership was higher in 1995 than for any year since. Despite opening a new subway line in 2002 and extensively reconstructing the city's streetcar system, per capita ridership fell from 158 trips per year in 1995 to 143 trips per year in 2017. Per capita ridership appears to have recovered in 2019, but some of the published ridership numbers for that year are questionable.[100]

Studies have shown that transit ridership is sensitive to frequencies, speeds, fuel prices, and parking costs.[101] No study has ever shown that ridership is sensitive to whether the wheels under the transit vehicles are steel or rubber. When transit agencies introduce new rail transit lines, they always operate them more frequently and with fewer stops (meaning higher average speeds) than the bus lines they replaced. When rail transit leads to ridership growth, that growth is responding to the increased frequencies and average speeds. There is no reason why buses cannot provide the same or greater frequencies and speeds for far less cost.

CITY-BY-CITY REVIEW OF TRANSIT PROJECTS

Calgary

In the six years prior to opening its first light-rail line in 1981, Calgary transit ridership grew at 10.5 percent per year. Growth rates immediately fell after the light rail began operating, averaging just 2.8 percent between 1981 and 2014. Calgary opened the West light-rail line in 2012, but ridership peaked in 2014 and fell over the next five years.[102]

The city's 1981 line cost $18 million per kilometer, which is about $56 million per kilometer in today's money. The 8.2-kilometer West Line opened at a cost of $183 million per kilometer, which is about $238 million today.[103] The Green Line's first stage is expected to cost at least $5.5 billion for 18 kilometers or $275 million per kilometer.[104] Thus, construction costs have nearly quintupled.

In short, Calgary is spending increasing amounts of money on light rail but ridership growth has not justified this expenditure. This is partly due to the downtown-centric nature of Calgary's transit system. For example, the ridership decline after 2014 resulted from the decline in downtown jobs when oil prices fell.

As of 2016, Calgary's downtown-centric system carried 45 percent of downtown employees to their jobs, but less than 10 percent of workers in the rest of the region. Since only about 14 percent of Calgary jobs were in downtown Calgary in 2016, the transit system poorly serves 86 percent of workers in the region.

Edmonton

Edmonton's first light-rail line cost $9.4 million per kilometer when it opened in 1978, or about $40 million per kilometer in today's money.[105] The Valley Line West, which is now under construction, is expected to cost $2.7 billion for 27 kilometers, or $100 million per kilometer.

Like Calgary, Edmonton's transit system has a strong downtown orientation. About 60,000 jobs were located in downtown before the pandemic.[106] That's only about 9 percent of the more than 650,000 jobs in the Edmonton census metropolitan area. Edmonton's smaller number of downtown jobs is why only 11 percent of Edmonton-area workers commuted to work by transit in 2016, compared with 14 percent in Calgary.[107]

Hamilton

In 2014, Hamilton proposed to build a 14-kilometer light-rail line whose cost was initially projected to be $1.0 billion ($1.26 billion in today's dollars). Costs quickly rose to $2.85 billion and due to that increase the province froze any further spending on the project in 2018.[108] However, the project was revived in 2021 by which time the projected cost had increased to $3.4 billion or $283 million per kilometer.[109]

Hamilton had begun planning the project in 2007 and hopes to complete it in 2024, which means it is taking at least 17 years to put a light-rail line into operation.[110] Documents make it clear that the city chose light-rail technology because it made the classic mistake of confusing the higher capacity of light-rail vehicles, relative to buses, with a higher capacity *route,* when a bus route would actually have higher capacities than a light-rail line.[111]

Kitchener

If rail transit has a questionable value in cities such as Calgary and Vancouver, it is simply a joke in Kitchener or, more properly, the Kitchener-Waterloo-Cambridge metropolitan area. With fewer than 600,000 people in 2021, Kitchener is the smallest urban area in North American to build a light-rail line. Light rail is always inferior to buses, but the characteristics that would make rail transit seem feasible, such as a large downtown, dense residential areas, or high pre-existing transit ridership, are completely absent in Kitchener.

In 2016, less than 8 percent of workers in the region commuted by transit compared with more than 20 percent of Montreal, Toronto, and Vancouver. Population densities in Montreal, Toronto, and Vancouver metropolitan areas are two to three times as great as in Kitchener-Waterloo, meaning far fewer people are within walking distance of a rail station. There is really very little about this region that would make any reputable transportation analyst believe that rail transit would make sense.

Despite this, Grand Rivers Transit, which serves the Kitchener region, opened a 19-kilometer light-rail line in 2019 at a cost of $868 million, for an average of $46 million per mile ($53 million in today's money).[112] Based on projected population growth, planners claimed that the alternative to building light rail was to build 500 lane-miles of highway at a cost of $1.5 billion.[113] Yet a mile of light rail carries fewer people per day than a single lane-mile of highway, so this calculation must have been either in error or a figment of someone's imagination.

Although the region's population and job densities make it unsuited to any kind of rail transit, one of the justifications for building rail was that the region's leaders were determined to make it denser by "growing up not out."[114] Apparently, officials somehow fear that Ontario, Canada's third-largest province, is somehow running out of land due to urban sprawl. In fact, the 2021 census found that all of the province's metropolitan areas and agglomerations of more than 10,000 people contain 90 percent of provincial residents but occupy only 6 percent of the land.[115]

The other reason given for increasing population densities was that people living in higher density areas supposedly emit less greenhouse gases because they don't have to drive as far to get to various destinations. In fact, data published by the U.S. Department of Energy shows that people living in denser areas do drive less, but because the areas they live in are more congested, they end up using more fuel and emitting more greenhouse gases per capita than people living in lower density areas.[116]

Grand River Transit opened its light-rail line just eight months before the pandemic began affecting ridership. Although planners had projected the light rail would carry 25,000 riders a day when it opened, ridership (after a brief free-fare period ended) was only around 15,000 a day before the pandemic.[117] That's even less impressive considering buses in the corridor were carrying more than that before the light-rail opened.[118] Total transit ridership was in January 2020 was only 71 percent of what it had been in January 2019. However, total ridership in February 2020 was 6 percent higher than in 2019. It will be difficult to know in the future whether ridership would have improved if there were no pandemic.[119]

Despite high costs and low ridership, Grand River Transit wants to build a second light-rail line from Kitchener to Cambridge. This 17.5-kilometer route was projected to cost $1.5 billion in 2021, but that cost has risen to $4.5 billion, or $257 million per kilometer.[120]

Montreal

The first phase of Montreal's planned 67-kilometer light-rail system, called the Réseau express métropolitain or REM, opened in the summer of 2023. Originally expected to cost $5.5 billion, the current projected cost is $7.95 billion or $119 million per mile.[121] Some people argue that this is a "bargain" because it is costing less than other rail lines, but most early light-rail lines cost under $50 million a mile in today's dollars.[122]

Ottawa

The nation's capital opened its first rail line, known as the Trillium Line, in 2001. Because it used existing railroad track and Diesel-powered railcars rather than overhead wires, it cost only $21 million ($34 million in today's dollars). Later lines, however, cost much more.

The city's first "real" (that is, electric-powered) light-rail line opened in September 2019. The 12.5-kilometer route cost $2.1 billion or $168 million per kilometer. A 44-kilometer extension of this line was supposed to cost $3.4 billion but is now expected to cost $4.66 billion or $106 million per kilometer.[123]

In the six months between the opening of this line and the beginning of the pandemic lock-downs, Ottawa's overall transit ridership grew by 4.2 percent. However, most of this wasn't due to the light rail. During those six months of 2019-2020, Ottawa transit carried an average of 540,000 more riders per month than in the same six months of 2018-2019, but the light rail carried less than 43,000 more riders.[124] Thus, the $2.1 billion light-rail line produced a mere 0.3 percent increase in total ridership.

Toronto

Canada's largest city opened its first subway line in 1954. The 7.4-kilometer line took four-and-a-half years to build and cost $50.5 million ($564 million in today's money), which works out to $6.8 million per kilometer ($76 million today).[125] At that price, it would be hard to argue with the construction of a line capable of moving 28,000 people per hour in each direction (later increased to 36,000). Since then, several additions have been made to the line bringing the total subway system to 70 kilometers.

The city currently has three more lines under construction that are a lot more questionable. First is a 19-kilometer light-rail project called the Eglington line. When planned in 2007, the Eglington line was projected to cost $4.6 billion ($6.5 billion in today's money), but its cost has exploded to $12.5 billion, or well over $650 million a kilometer, partly because Mayor Rob Ford insisted that—even though it is light rail—most of the line be underground. Construction began in 2011 but due to various delays totaling at least three years the completion date is unknown.[126]

Second is another light-rail line called Finch West. Unlike the Eglington line, this 11-kilometer line will be at street level, yet it is still expected to cost $2.5 billion or $227 million per kilometer. That may sound inexpensive compared with $650 million, but even after adjusting for inflation earlier light-rail lines cost only $50 million a mile.

The third is a subway line called the Ontario line. In 2019, this 16-kilometer line was projected to cost $10.9 billion ($12.7 billion in today's dollars), but in just three years that cost estimate increased to as much as $19 billion.[127] That means it will cost more than $1 billion per kilometer, making it by far the most expensive rail transit line in Canada and one of the most expensive in the world. Despite its high cost, the city is planning shorter platforms and shorter trains so it may not have the same capacity as Toronto's other subway lines. Even if it does, there is no justification for spending $1 billion per kilometer on a transit line.

Vancouver

Vancouver's first SkyTrain, the 28.9-kilometer Expo line, was opened in three stages between 1986 and 1994 at a cost of $1.18 billion or an average cost of $41 million per kilometer (about $93 million per kilometer in today's dollars). The 20.5-kilometer Millennium line opened in 2002 and cost $1.167 billion or $89 million a kilometer in today's dollars. The 19.2-kilometer Canada line, which opened in 2009, cost $2.0 billion for an average cost of $104 million per kilometer or $144 million in today's dollars.[128]

As previously noted in this report, the Expo and Millennium lines are considered "medium-capacity transit" because they can move about 25,000 people per hour in each direction, which is more than light rail (about 20,000 people per hour in

Calgary and Edmonton) but less than Toronto's subway, which can move 36,000 people per hour. However, the Canada line is truly low-capacity transit as it can move only 15,000 people per hour, which means that its higher cost made it an exceptionally poor investment.

Planned additions to the SkyTrain system will be even more expensive. A 5.7-kilometer subway extension of the Millennium Line is currently under construction for opening in 2026. It is expected to cost $2.83 billion or nearly $500 million per mile.[129] Despite spending the extra money to put this line underground, there would be no point in making train platforms longer than the rest of the Millenium line (which would increase their capacity) because trains on the rest of the line are limited by existing platform lengths.

TransLink also proposes to build a line from Surrey to Langley. This 16-kilometer route is currently expected to cost nearly $4 billion or $250 million per mile.[130] This is a billion dollars more than the cost estimate made just five years before.[131]

Common Themes

The experiences of many of these cities have several things in common. The first rail transit lines built in a city typically are low in cost, and sometimes (such as Ottawa's Trillium Line and Toronto's original subway line) are quite affordable, but later lines have cost much more. Those later expensive lines often start with low projected costs that, after the line is approved, balloon to gargantuan levels. Most of these lines are taking well over a decade to plan and build. Finally, ridership on the lines for which data are available is often disappointing.

In most cases, there doesn't appear to have been any serious effort by the transit agencies and cities proposing these projects to consider alternative technologies, such as buses or busways, that would cost less and could move more people. Even when costs rise to eye-popping levels, the main question for transit agencies appears to be not whether to build bloated projects but where they will get the money to build them.

Agencies add to confusion with terms like "high-capacity transit" when light-rail and even some heavy-rail projects have relatively low capacities, and "rapid transit" even though the speed of rail systems, particularly light rail, is not all that rapid. Agencies and transit advocates appear to believe they are entitled to dig as deep as they want into taxpayer pockets and such considerations as cost-effectiveness, flexibility, and serving people who aren't going to or from major downtowns are completely ignored.

A PROPOSAL FOR A 21ST CENTURY TRANSIT SYSTEM

Rail transit made sense when most jobs were downtown, automobile ownership rates were low, and bus technologies were still primitive. None of these prerequisites have been true for at least 75 years, making rail transit an obsolete technology whose proposals are based on archaic views of how cities work. While everyone ends up having to support subsidies to rail transit, the main beneficiaries, other than the contractors who build them, are those who live along the narrow rail corridors and work downtown, a group that was decreasing in prominence before the pandemic and more rapidly declined since then.

If transit is to be relevant to more people, transit agencies need to reinvent themselves to meet the needs of 21st century urban areas. Such a reinvented transit system should be polycentric, serving all major economic centers as well as current systems serve downtowns. These economic centers should be served with fast, frequent service using the latest, most flexible technology available, namely buses. Finally, the system should be legible, meaning it should be easy for people see the best way to use transit to get from any point in the urban area to any other point.

One way to design this system would be to run non-stop buses between 10 or more transit centers, each of which have local buses radiating away from them. Primary transit centers would offer frequent (at least five times an hour during peak hours) non-stop bus service to every other primary transit center. Secondary transit centers would offer frequent non-stop bus service to one or two of the nearest primary transit centers. Local bus routes radiating from each primary and secondary transit center would provide complete coverage of the region.

All the major economic centers in a region should become primary or secondary transit centers. Depending on the location of economic centers, enough additional transit centers should be designated to provide good geographic coverage. Most economic centers are located near freeway or expressway exits, so the transit centers themselves should be next to such freeway exits or the intersections of two major highway. That way the non-stop buses can essentially operate at freeway speeds over most of their routes.

If necessary to minimize congestion, new lanes could be added to these freeways and used as high-occupancy/toll lanes. These lanes would be open for any high-occupancy vehicles at no charge and for low-occupancy vehicles that pay a toll that varies by the amount of traffic to ensure that the lanes never get congested. The construction of such lanes would, in most cases, cost far less per kilometer than light-rail lines and the cost could be shared by all users of the lanes.

Calgary's freeway network, for example, includes highways 1, 1A, 2, 2A, 8, and 201. This network can be used to provide fast bus service between major economic centers in the region. Major economic centers include downtown, the airport, the

University of Calgary, Chinook Center, and Seton. The downtown transit center might be located around 4th or 5th and MacLeod Trail but other transit centers should be located as close to freeways as possible. The Seton center, for example, could be located at the junction of 2 and south 201. Other primary transit centers could be located at the junctions of 1 and 52nd or 68th streets NE, and 8 and 52nd Street SE. Secondary transit centers might include the junctions of 2 and 8 and of 1A and 201.

The map in figure 6 shows 10 primary transit centers and 6 secondary centers connected by 50 non-stop routes. An average of 12 local routes radiating away from each center totals to 192 such local routes. This brings the route total to 242, which is 26 fewer routes than Calgary's current total of 268 routes.

To minimize the number of transfers people would have to make, each bus could operate several routes in a single journey. A bus could start in south Seton, operate in local service to the Seton primary transit center at the junction of 2 and 201, then go non-stop to the University of Calgary, then travel non-stop to the secondary transit center at the junction of 1A and 201, and finally operate in local service in Rocky Ridge.

With this system, travelers could go from one corner of an urban area to another at speeds approaching that of automobiles. Many of the non-stop buses would go at freeway speeds over most of their routes. While local buses would still average less than 20 kilometers per hour, the average speed of the entire transit system would be well over 30 kilometers per hour. This would make transit far more attractive and useful to many people.

While running five non-stop buses per hour between all primary transit centers would rack up a lot of vehicle-kilometers of travel, most of them would be at high speeds so the total number of vehicle-hours of travel would be the same or less than the current system. Since many costs, including driver pay, are more proportional to vehicle-hours than vehicle-kilometers, this system could be implemented at approximately the same annual operating budget as the city is now spending. Capital costs, however, would be far lower than that of expanding the light-rail system.

Calgary's existing light-rail system could continue to operate but to increase average speeds its focus might be changed to serve only primary and secondary transit centers along its route, making few or no stops in between. As rail lines wear out, Calgary and other cities should replace them with buses rather than spend the hundreds of millions of dollars required to rehabilitate rail infrastructure.

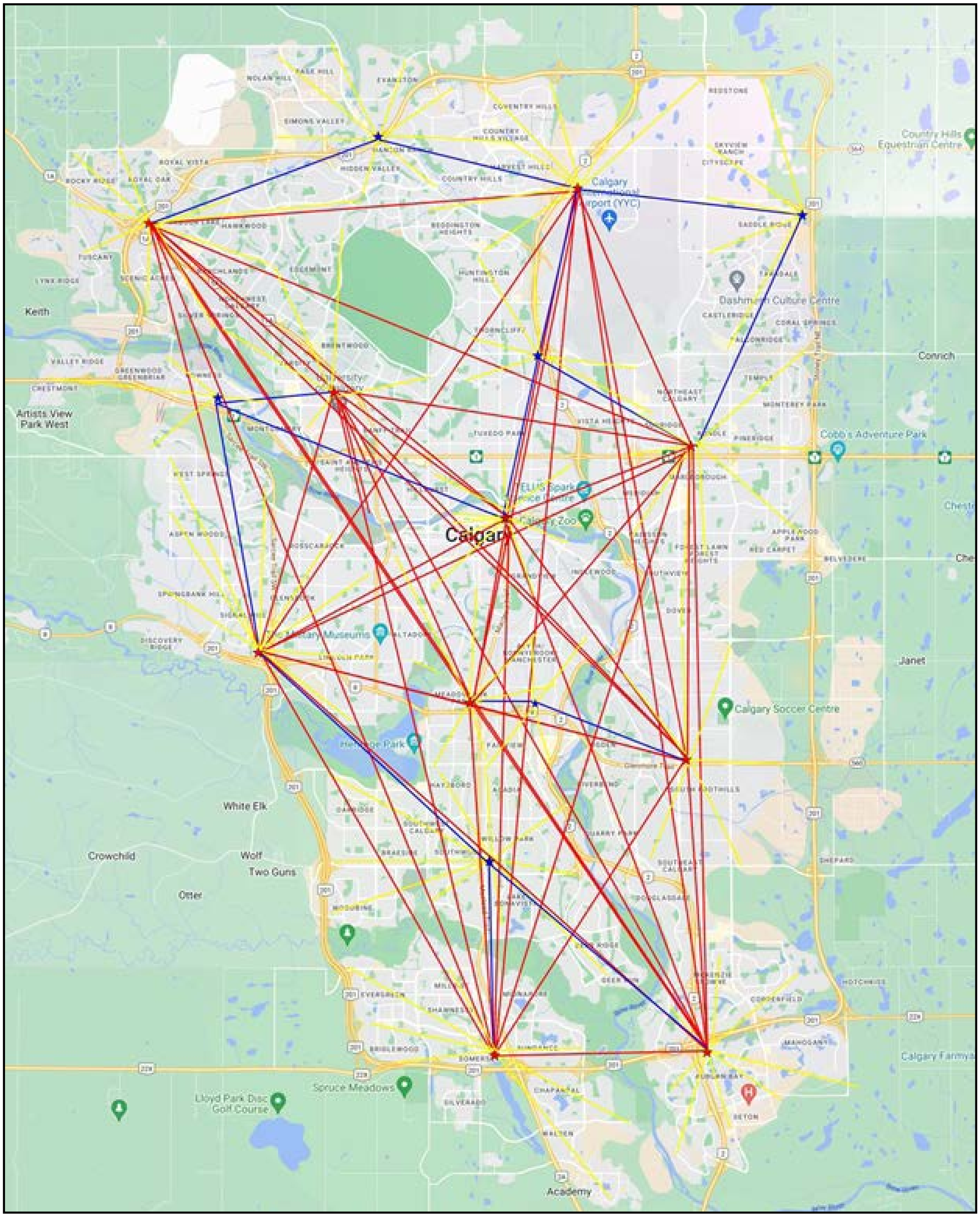


Fig. 6. Proposed route structure for a 21st century transit system for Calgary. Ten red stars are primary transit centers with non-stop routes to every other primary center designated by red lines. Five blue stars are secondary centers with non-stop routes to two or three other centers designated by blue lines. Yellow lines are local buses radiating away from every center. Lines represent approximate origins and destinations only and not exact routes. Without increasing Calgary Transit's current operating budget, it should be possible to add more local routes than are shown on this map thus ensuring complete coverage of the region.

CONCLUSIONS

The fact that so many cities are spending so much money on projects that have so little benefits is an indication that Canada's transit industry has gotten out of control. Rather than being responsive to transit riders or to taxpayers, it is more oriented towards producing contractor profits at everyone else's expense. The people who make the decisions to build these projects are failing to ask critical questions, such as whether the costs can be justified by the benefits or if the same benefits could be produced at far lower costs using a different technology, namely buses.

Canadian cities don't need more obsolete and expensive transit projects that rely on 19th-century technologies. What they need are transit systems that work in decentralized 21st-century urban areas. Such transit systems require the use of nimble, flexible buses, not rail. While the proposal presented above is only a rough draft that may be far from perfect, it demonstrates one way in which Canadian transit agencies could make the services they provide more useful to more people than the systems they operate today.

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