STREETCARS FOR BRITISH COLUMBIA

prepared by Kathryn Mandell for MLA Sam Sullivan
In 2014, all levels of government in Canada face the time-sensitive challenge of modernizing critical infrastructure. A series of concerns inform this objective. The most important of these is Climate Change. Climate change has already had social, economic and environmental impacts in British Columbia, giving rise to the pine beetle epidemic and an increase in the frequency of floods and forest fires. Energy prices are increasing while our population is growing, and fast: between 2014 and 2036 the Province will swell from 4.7 to 6 million. It is also growing older: those 65 years and up will constitute a quarter of the Canadian population in the same time frame; a proportionate doubling. If we do not move soon towards a carbon-neutral, accessible and less car dependent future, we will look forward to a high dependence on expensive non-renewable fuel, increased urban sprawl, and an isolated population of senior citizens. The decisions that are made to accommodate demographic growth and change will form the foundations for resilient cities of the future - or they won’t. Alternative transportation technologies put to use around the world offer strategies to respond to the needs of residents in the present, in the 21st century, and beyond.

Greenhouse gas (GHG) free public transit is fundamental to building this future. Transportation is the top-most producer of emissions in the province. Initiatives to tackle climate change often target the transportation choices of individuals, with the recommendation that commuters choose public transit. The success of this method is limited by the quality and convenience of existing public transit systems. Sustainable transportation can be used to enable cultural and economic activities in ways that are both convenient and environmentally sound, supporting improvements to the quality of life for all citizens and the economic productivity of the province. This report seeks to support existing provincial objectives that address climate change and demographic growth by explaining the possible benefits of installing GHG-zero and low-energy modern tram technology in our province, and projects how it might be deployed over the next five decades to solve these social and environmental issues.

Included in the body of this report are case-studies of Vancouver and Surrey. This focus is consistent with demographic projections for 2014-2036, which concentrate 75% of BC’s population growth in the Lower Mainland. The data compiled is also intended to reach beyond these cities, to support an ecologically responsive approach to the land-use and transportation planning of neighbourhoods situated across the Fraser Valley and in other urbanized parts of the Province.

Provincial Support
Climate Action for the 21st Century (2009)
Climate Action Plan (2008)
http://www.energypplan.gov.bc.ca/

Vancouver Region - Regional Support
Regional Growth Strategy (2011)
http://www.metrovancouver.org/planning/development/strategy/pages/default.aspx

Municipal Support
Transportation 2040 (2012)
Vancouver - Greenest City Action Plan (2012)
Surrey - Sustainability Charter (2008)

Dozens of cities in North America grew up around the streetcar: Seattle, Los Angeles, Minneapolis, Edmonton and Vancouver are classic streetcar cities. Forty percent of city-dwellers in Canada and the United States are residents of what were once streetcar districts. The streetcar helped to determine the layout of central cities. As light rail track was laid, development followed its armature. This new technology made it convenient to live at a distance four times further away from work and school than was previously possible. Neighbourhoods of detached homes became a viable option for a diverse population of tenants and homebuyers.

The rise of the car and the aggressive commercial practices of companies seeking to sell diesel buses contributed to the failure of privately owned streetcar companies by the 1950s. Almost all were burned to prevent their sale to other cities, because the technology would have competed with buses for market share. Unfortunately, at this time the dire consequences of complete car dependence were not well understood. Despite being forced into early retirement, the streetcar has left a permanent imprint that shapes the most connected, low-carbon neighbourhoods we know. Brooklyn, NY and Vancouver, BC are legacies of the streetcar era.
Recognized in many places as a new and revived best practice in public transportation, a streetcar revival is taking place in cities across the globe.

500 light rail and streetcar modern tram systems are in operation across the world.

70 North American cities currently have modern tram projects at the proposal, planning or development stage. While our social, environmental and economic concerns overlap, so far British Columbia has not joined this trend. International data of can assist us in addressing a pressing need for transit capacity increases in BC, and for better connected, low-impact, more sustainable urban communities. An investigation into the applicability of light, GHG free, and inexpensive modern tram systems in British Columbia is thus merited.

Below we present the key findings in our effort to arrange current information about comparable streetcar modern tramway, streetcar, and light rail systems from both North America and other parts of the world, either recently built or under construction.

Light rail projects that include intensive and expensive elements such as elevated guideways and bored tunnels, have been excluded, as this distorts the basic and most common costs of street level systems.

The streetcar had a formative role in the development and growth of cities in Canada and the United States. This history continues to play out in the layouts of central cities, in the gridiron pattern of the streets.

The urban pattern of the streetcar city is characterized by:

- Connections to destinations along multiple pathways, distributing traffic
- Easy navigation
- Many commercial corridors, approximately 800 m apart
- Mixed land uses
- Low travel times between home and work
- A convenient, walkable urban form that supports active transportation
- Enables neighbourhoods to function as complete communities connected with the greater region.

This form is particularly visible in Vancouver, Victoria (above) and Nanaimo.

The gridiron street pattern is a sustainable alternative to the "hub-and-spoke" model of city design. Hub-and-spoke is a hallmark of North American car-oriented planning. This model locates distant points of dense activity as destinations and then links them via single, high-capacity, radial transit lines and highways. The regional design that is effected by hub-and-spoke allowed for the economic development of the suburbs during the immediate post WWII era. This solution ceases to be effective in the long-term however. City design that facilitates long distance movement between points encourages lengthy commutes that rack up high emissions levels and concentrate commuters at highly loaded main intersections, creating congestion. Phoenix, AZ, and Los Angeles, CA are examples of this kind of development.

The modern tram integrates effectively into the streetcar city grid pattern. It catalyzes the preservation and growth of vital, walkable, low GHG neighbourhoods, where people can conveniently interact in the public realm and meet their daily commercial needs at services within a five minute walking distance.
Technology Described: Streetcar Modern Tram

Carbon-zero: Produce zero on-street emissions. Regenerative braking technology stores energy for reuse. Externals of public transit are key to sustainable planning and often overlooked. Streetcars or modern trams have low environmental impacts at all stages of the vehicle life-cycle: Alstom, Siemens, and Bombardier, making ~95% recyclable trams.

Affordable: Low cost per passenger mile over system lifecycle. Built to have lower, maintenance, life-cycle operating and amortized total costs than equivalent bus systems, with zero emissions.

Accessible: Low floor designs enable easier access and have a faster rate of passenger on and off loading.

Lightweight: Less expensive, narrower and less intrusive in ordinary streets than heavier LRT (light rail transit) vehicles, with lower maintenance than heavier technology over a system lifecycle.


Flexible: Modular design is easily adjustable to meet changing ridership demands. Separated from or integrated with traffic depending on conditions.

Expanding on Flexibility: Capacity Increases After Initial Construction

It is easier and more cost-effective to increase the capacity of surface-running tram systems than to increase the capacity of elevated or tunnelled systems in the vast majority of cases. To increase the frequency of service, additional rolling stock can be commissioned. These vehicles can also be used to extend existing vehicles in the fleet. Major increases in capacity may or may not require lengthened platforms and changes to electrical delivery systems. Extending platform lengths in streets often requires the simple installation of a raised curb to existing street located platforms. Choosing lightweight, street-level transportation reduces or eliminates the need to relocate subsurface utilities. Concerns about road interference can be resolved by running tracks down the center lane of arterials.

A number of cities have chosen to build for immediate capacity needs and to anticipate the extension of trams and platforms.

Ottawa: The Confederation Line platforms will be 120 m in phase one, with a planned extension to 150 m.

Calgary: Upgrading all LRT platforms to accommodate 4-car trams.

Dublin: Extended Luas trams from 30 m to 40 m in 2008.

Completing a capacity increase on Vancouver’s Canada Line will require that all underground stations be dug up and extended, extended, at costs exceeding $100 million.

Tram Manufacturers

These internationally acclaimed tram manufacturers and their tram series stood out for their particular relevance to BC.

Alstom Citadis

Based in France and headquartered in the United States, Alstom manufactures light rail vehicles and infrastructure to generate renewable power. Alstom accepts contracts to operate and maintain tram systems. The company produced the Citadis Spirit for North American cities.

Siemens

Manufactures 18-72 m trams, which at the high end represent some of the longest trams in the world, 700 passenger vehicles, or 21,000 ppdph.

Bombardier

Manufactures low floor light rail vehicles designed for cities, including the high-capacity Flexity Freedom which can be configured to carry 30,000 ppdph. Can be run with or without overhead wiring.

TramPower

UK company produces lightweight, affordable, 16-38 m trams. Manufactures LR55 tracks, fitted with concrete slab to embed rails. Slab reduces utility works and expense.

CityClass Tram
<table>
<thead>
<tr>
<th>City</th>
<th>Cost Per km $ CAD 2013</th>
<th>Opening Year</th>
<th>Length (km)</th>
<th>Average Speed</th>
<th>Stops Per km</th>
<th>Average Minimum Headways (mins)</th>
<th>Minimum Headways (mins)</th>
<th>Vehicle Capacity in Multiple Consists</th>
<th>Average Operational Capacity</th>
<th>Maximum Operational Capacity (pphhp)</th>
<th>Line</th>
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<td>35</td>
<td>50</td>
<td>1.8</td>
<td>5</td>
<td>273</td>
<td>219</td>
<td>426</td>
<td>4,380</td>
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<td>2</td>
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<td>31</td>
<td>19</td>
<td>1.7</td>
<td>5</td>
<td>475</td>
<td>303</td>
<td>606</td>
<td>7,650</td>
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<td>Dublin, Ireland</td>
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<td>38</td>
<td>1.3</td>
<td>5</td>
<td>356</td>
<td>394</td>
<td>0</td>
<td>5,376</td>
<td>Lusis Red and Green Lines</td>
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<td>13</td>
<td>18</td>
<td>2.2</td>
<td>3</td>
<td>374</td>
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<td>374</td>
<td>9,400</td>
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<td>2011</td>
<td>15.3</td>
<td>1.6</td>
<td>2</td>
<td>2</td>
<td>250</td>
<td>500</td>
<td>15,000</td>
<td>15,000</td>
<td>Line 1 – Başkır – Kabataş</td>
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<td>35</td>
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<td>420</td>
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<td>Downtown tram – Kaiserstrasse</td>
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<td>16</td>
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<td>15</td>
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<td>Sugarhouse Streetcar</td>
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<td>868</td>
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<td>19.2</td>
<td>80</td>
<td>1.2</td>
<td>3</td>
<td>200</td>
<td>600</td>
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**Cost Comparison of Modern Streetcar Systems at the Proposal, Planning or Construction Stage**

<table>
<thead>
<tr>
<th>City</th>
<th>Year</th>
<th>Length (km)</th>
<th>Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore, USA</td>
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<tr>
<td>Cincinnati, USA</td>
<td>2015</td>
<td>5.8</td>
<td>Cincinnati Streetcar</td>
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<td>Kansas, USA</td>
<td>2015</td>
<td>3.2</td>
<td>Downtown Streetcar</td>
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<tr>
<td>Ottawa, Canada</td>
<td>2018</td>
<td>12.5</td>
<td>Confederation Line</td>
</tr>
<tr>
<td>St. Louis, USA</td>
<td>2015</td>
<td>3.5</td>
<td>Trolley Loop</td>
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<tr>
<td>Waterloo, Canada</td>
<td>2017</td>
<td>19</td>
<td>IGN Line</td>
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<tr>
<td>Vancouver, Canada</td>
<td>2017</td>
<td>13.5</td>
<td>Broadway LRT</td>
</tr>
</tbody>
</table>
Barcelona, Spain - Trambaix and Trambesòs
- Alstom Citadis
- 450,000 residents live within 500 m of the tram.
- Trams can be run in double sets.
- Headways can be decreased to 2.5 minutes.
- 10,000 people per direction per hour (ppdph) could be supported by the tram although ridership levels do not yet necessitate this configuration.
- Urban integration was a key focus in planning.
- Extensive tram network, to provide city-wide connectivity.
- Operated by a joint venture of companies, comprising TramMet.

Calgary - LRT
- Siemens S200 high-floor LRV
- At very low cost, a heavier and higher capacity style of light rail system.
- Up to 30,000 passengers per direction per hour.
- 4 tram vehicles can be linked to reach these astonishing capacities, far in excess of capacities of our own SkyTrain.
- Current demand is satisfied at 20,000 per hour.
- Ridership increased by 120% between 1996 and 2006.

Casablanca, Morocco - Tramway
- Alstom Citadis trams - custom built, 65m
- 605 passengers per vehicle
- 7,600 ppdph
- 140,000 passengers per day are expected in 2014.
- 250,000 daily ridership capacity
- 75% priority rate at intersections
- Operated as a P3: Casa Tram, headed jointly by French transit RATP.
- Project generated 3,000 jobs.
- Built to address congestion.

Casablanca demonstrates the significant capacity of streetcar modern trams. The line was built to "help bring environmental, social and financial sustainability to Morocco's cosmopolitan capital."

Dublin, Ireland - Luas Green Line
- Alstom Citadis 402, 40m-long. Has operated different Citadis vehicles, changed in response to ridership.
- Luas operates without government subsidy.
- Recorded years of surplus, followed by years of deficit as a result of the global financial crisis. The system at large is expected to return to break-even by 2015 and currently funds the deficit from previous surpluses.
- 2005-2013, ridership grew by 40%.
- 50% of residents in close proximity to the line chose to take Luas if their destination fell close to a platform.

Grenoble, France - Line A
- Alstom Citadis 402
- 7,480 ppdph

Istanbul, Turkey - T1 Line
- Alstom Citadis X04
- Peak capacity of 15,000 PPDPH.
- 320,000 daily ridership

One of the highest capacity low-floor light rail systems in the world. Yet, it employs one of the world’s least expensive basic rail platforms, manufactured in France.

Karlsruhe, Germany, see next page.

Murcia, Spain - Tram Line 1
- Alstom Citadis 302
- 2011-2015, directly responsible for a 4755 tonne reduction of CO2 emissions -- equal to the amount produced by 5 million private vehicles.
Karlsruhe, Germany - Tramway
Renowned for seamlessly bridging commuter train technology with that of a light tram suitable for more dense urban settings.
• Siemens Niederflurwagen GT8-70D / N, 39 m detachable vehicles can be doubly articulated to carry 420 passengers; additionally use Vossloh rolling stock.
• Expanded network from 50 to 500 km in two decades.
• 1 minute headways.
• Dramatic development and ridership outcomes.
• Transfer-free travel is key – on Karlsruhe-Bretten line, ridership grew 6x after transfers were eliminated.
• Financed by German Municipal Financing Act (GVFG) and local and regional authorities.

Mode Share in the City of Karlsruhe (%)
Source: TTK, The Tram-Train of Karlsruhe, 2004

47% of city commuters choose public transit. Source: TVV KA Modelle 2004.

Ottawa, Canada - Confederation Line
• Alstom Citadis Spirit
• Double-articulated, up to 600 passengers.
• 25,000 ppdph.
• Funded jointly by the federal and provincial governments and will be allocated a portion of the city’s gas tax receipts from both levels.

Paris, France - T3 Tram Line
• Alstom Citadis 402.
• 10,000 ppdph.
• 120,000 recorded peak daily passengers, but has the capacity to support a larger crush load of 235,000 people per day.

The T3 line is built to foster place-making, through its appeal to pedestrian travel and the resulting activity on the streets.

The T3 through the high-income residential census tracts, and does so elegantly, on a grassy boulevard, fit from above at night.

Portland, USA - Portland Streetcar
• 1st modern tramway constructed in North America,
• This original streetcar system was built and equipped for less than 20 million per mile, with very little disruption to streets or intersections traversed.

Tram and economic development
With the goal of linking high-quality transit investments to increased development, the system is an ongoing success.

2008, $3.5 billion (USD) of development had taken place within two blocks of the modern streetcar routes.

1997-2005, 55% of development within one block of the rails, from the same area’s share of development before the streetcar route was identified, of 19%.

Catalyzing sustainable neighbourhood transformations
River District/Pearl District, previously a brownfield, into a fruitful neighbourhood. Grocery stores, office blocks, restaurants, storefronts, galleries and banks have opened.

South Waterfront development, scheduled for completion in 2015 and only viable after the city promised to extend streetcars to the site, will provide 5,000 new residences and 10,000 jobs, as well as major greenway projects and educational facilities.

Blitz Weinhard Brewery was rebuilt as a mixed-use complex the area of five city blocks.

The City of Portland considers streetcars crucial to the actualization of their development goals:
1. Promote investment in the City centre
2. Provide housing options for a population of diverse income levels.
3. Support urban amenities

A development report (http://www.portlandstreetcar.org/pdf/development_200804_report.pdf) prepared jointly by the Office of Transportation stresses the importance of broadly increasing access to areas that might otherwise go unseen by visitors and new residents in order to meet development objectives.

They plan to extend the streetcar network to a cover a distance of more than 115 km.

To support the transit system, the Portland-Milwaukie Light Rail Bridge will be accessible exclusively to pedestrians, cyclists and public transit vehicles. The bridge is scheduled to open early 2015.
Surrey will grow in population from 509,000 to 785,000 in 2014.

Surrey has taken the position that surface rail is the only way to effectively serve this large city into the century, and will add to the environmental quality of districts served. A regional modern tram system is planned for two principle arms of transit, to be complimented by a dense network of buses.

An application for funding has been submitted to the Canada Building Fund.

Tram was chosen to guide density and attract investment. It will be matched with neighbourhood-specific zoning plans to support neighbourhoods based on their unique needs.

2,000 riders are passed by bus rapid transit (BRT) along Fraser Highway and King George Boulevard, similar to the number passed on Vancouver’s Broadway Corridor. The alternative, increasing the capacity of roadways, is not a viable long-term option.

City of Surrey’s Vision for Rapid Transi
https://www.youtube.com/watch?v=U3K98dL7Ic#t=38

Rapid Transit Now
http://www.surrey.ca/city-services/10797.aspx

Light Rail Transit: Shaping the Future of Surrey
http://udi.bc.ca/sites/default/files/events/udi/presentations/UDI%20Breakfast%20Regional%20Rapid%20%20Transit.pdf
Vancouver will grow in population from 540,000 to 740,000 in 2041. The City of Vancouver aims to make Vancouver the world’s most sustainable city by 2020. At this time 50% of all trips are to be made taking sustainable transportation modes. By 2040, two thirds of all trips are to be sustainable. Reaching 2040 mode share targets means planning to triple the percentage of commuters who take public transit from 2011 numbers.

Vancouver has a legacy of bold urban planning that is directly influenced by civic action. This history has given the city its form. The layout of Vancouver is distinguished from most North American cities by the absence of freeways, and as a result, the arterial streetcar grid along which the city was first developed has been retained. In light of the 21st century challenges of climate change and demographic growth, it is time to renew this urban planning legacy and support its successes with innovative plans for the transportation system.

Street-running modern tram is appropriate for application in the city of Vancouver, where it will support the grid street system. As the framework from which to work, the rectilinear grid has many advantages (see page 3). The relationship between land-use, walking and transportation that is supported by the rectilinear grid will allow the accommodation of demographic growth to have many positive impacts on quality of life, at the same time as the environmental footprint of the city is decreased. Embedded in the grid, this carbon-zero transportation system actualizes multiple principles of sustainable urban design: increased viability of walking and public transit as a mode share choice; the location of jobs in proximity to residences; a diversity of housing types; place-making; a network of neighbourhoods linked by public transit; and increased access to green space.

Sustainable mode share choice. Walking and taking public transit are most often chosen when services, employment, and access to public transit platforms are located within a five-minute walk. In Vancouver, most residents can satisfy their daily commercial needs on streetcar arterials. However, only 19% of Vancouver residents live within 1 km of rapid transit, compared to 37% in Montreal and 34% in Toronto. With its low cost, a streetcar or modern tram system can be used to bring rapid transportation within a five-minute walk of the homes of 80% of the population. Streetcar/modern tram has flexible capacity, to accommodate current and future ridership levels.

Comfort and aesthetics are key to the provision of public transit to “choice riders” and the elderly. The level boarding, spacious interiors and contemporary design of the tram make it suitable to the goals of increased modal choice.

Locating jobs close to residences. The interconnected street design can accommodate a doubling of people and jobs. Adding jobs and population across the grid will enhance the land-use composition of individual neighbourhoods and increase the proximity of residential buildings to commercial land-uses. Population growth generates the locally-based workforce for a growing number and diversity of businesses, who will be able to walk or take transit to work. Businesses will benefit from on-street transit along the arterial grid, as store fronts are made equally accessible to passersby.

A diversity of housing types. Density is currently distributed unevenly in Vancouver: 50 percent of the city’s land area is covered by low-density single family homes, while some neighbourhoods have an optimal density (of 75 to 150 people per hectare). The transit-oriented development model that streetcar/modern tram underpins encourages gradual and even densification across the grid. Tram systems have been shown to capitalize on the development potential of commercial corridors in every neighbourhood.

Individual households consume significantly less transport-related energy if they are in a more dense urban formation. The single-family home is popular in Vancouver — the neighbourhood feeling that it engenders can be retained sustainably with the addition of row-houses, the sub-division of houses into multiple units, and the reduction of vehicle kilometres travelled. Low-rise, medium-density apartment buildings have optimal emissions levels and maintain the character of existing residential neighbourhoods.

Support the place-making that gives each neighbourhood its distinct character. Street-running modern tram is a human-scale choice for transportation infrastructure. Keeping the commute at street-level enhances the role of the public realm as the location of activity and interaction. This increases the potential for place-making, as residents foster the distinct character of their neighbourhoods.
Connect neighbourhoods across the grid. Streetcar or modern tram will make it possible to navigate the city easily via public transit, as direct routes provide the most efficient connections between destinations. Level boarding and a view of the street allow commuters to trip-chain smoothly.

Increase access to green space. On-street transit complements a green urban network. Train right-of-ways can be planted with trees and additional vegetation for rainwater absorption and CO2 sequestration, reducing the heat island effect, providing opportunities to create riparian pathways for pedestrians, and improving access to parks for recreation.

Possible System Route

Vancouver’s existing streetcar grid is marked by more frequently travelled arterials every half mile (0.8 km).

The downtown line could be extended south, east and west: along the arterial grid up Arbutus and out to UBC.

The Arbutus corridor, long considered for this purpose, could include a track bed up to 41st Ave; the line could reconnect the city along 41st Avenue, Victoria or Commercial Drive, and travel via Hastings to downtown.

Downtown Streetcar: Confirming A Commitment to a Sustainable Urban Form

- Connect the downtown by linking the distant but cardinal landmarks of Vancouver: Stanley Park, Granville Island, Yaletown and Coal Harbour to the transit hub at Main St. and Terminal.
- Complete the integration of sustainable transit in the downtown core.

Proposed multiple times in Vancouver’s recent history.

VIA Study (1998) - VIA found that cost of construction and operation will be recovered from fares paid by tourists alone. 50% commuters as well, serving the West End and Chinatown, as well as False Creek North and South as they are built up.

(1999) City of Vancouver approved plan for a Downtown Streetcar.

City of Vancouver Report (2005) - Recommended phase one from Granville Island to Waterfront Station.


Existing supports for Vancouver Streetcar

Streetcar and modern tram is supported through the preservation of right-of-ways. This has been completed in False Creek, on Pacific Boulevard and 1st Avenue. The Arbutus Corridor has long been set aside with surface light rail in mind.
As a form of transportation, modern trams are uniquely suited to the challenges of a sustainable world. They are carbon zero, comfortable, and cost-effective. As we consider strategies to mitigate harmful GHGs while creating a more convenient way of life, elegant and affordable modern trams, with net zero carbon emissions, offer a way to reach that goal.

Support BC Targets for the 21st Century

**Mode Share:** Placing many currently under-served residents within walking distance from public transit, to move us closer to mode share targets that differ from region to region. Automobile users accept railbound transit over tires. We can educate our transit decisions with the precedent of cities like Portland and Karlsruhe which represent the “best case scenario” of planning that supports walking and public transit, just as BC seeks to do.

**Congestion:** Minimize congestion in our cities to stop the deleterious impacts on air quality and environmental systems, and to reduce economic inefficiencies as well as the personal time and energy wasted by commuters every day.

**Ageing In Place:** The availability of accessible, integrated urban transit will support a quickly aging population into the later years of life.

**Economy:** The shift to sustainable streetcar modern tram has cascading economic impacts. This starts with the money saved by choosing energy-efficient, low-cost technology.

On-street, light rail public transit and the form it supports has been proven to motivate profitable investment in real estate, in an urban form that is resilient and sustainable for a low carbon future. Investment takes place along streetcar routes, extending dense commercial and residential development. This sustainable technology can facilitate the access and commuter contact that is needed for commercial enterprises to thrive.

**Addressing capacity**

The findings above constitute evidence that modern tram systems can support capacity that significantly exceeds the ridership levels of existing high speed transit lines in BC.

**Passengers per direction per hour:**

- 1,000 ppdph circulator trams, to 20,000 ppdph multiply articulated tramways appropriate for dense urban settings.

With the capacity to operate at different speeds and to add additional passenger compartments, the specific design of light rail systems can be determined based on contextual needs. Streetcar modern tram technology meets the mobility needs of many of BC’s urban centres.

**CONCLUSIONS**

Housing policies must be in place at provincial and municipal levels in order to guide development at the scale of the neighbourhood and prevent displacement.