

About the Model

What is it: The Cost of Commute Calculator provides a multimodal comparison of the expanded costs of transportation impacts in the Metro Vancouver Region. These include both personal costs, and costs to society.
Trips: This analysis pertains to utilitarian trips only (i.e. non recreational trips).
Time Period: This analysis pertains to travel taking place during the Peak Period on weekdays.* The Peak Period is defined by TransLink as a morning peak (between 6AM and 9AM), and an afternoon peak (between 3PM and 6PM).
Currency: All costs are expressed in 2015 Canadian Dollars (\$ CAD 2015)

Units

Unit	Description
Cost per Passenger-Kilometer (\$/p-km)	Represents the average cost of moving one passenger one kilometer in the Metro Vancouver Region.

Cost Structure

Cost Component	Description
Internal (Personal)	Components of the total costs of an activity that are borne by the user in normal market transactions. These may include the cost of a vehicle, price of fuel, transit fares, or travel time.
External (Societal)	Components of the total costs of an activity that are not redeemed by the user/consumer of an activity or service. These are offloaded onto society and are ultimately redeemed through collective payment/taxation. These may include pollution or infrastructure costs.

Modal Characteristics

Mode	Description
Passenger Vehicle	“Passenger Vehicle” in these calculations represents a conflation of various personal (i.e. non commercial or service) automobile models. These include sedans, passenger trucks, vans, SUV’s and Jeeps. These do not include electric/hybrid vehicles, compact cars, or motorcycles. Average peak period speeds were determined to be 29 km/hr including all time spent idling. Average peak period vehicle occupancies in the Metro Region were determined to be 1.2.
Transit Bus	Transit buses refer to all bus models operated by Translink in the Metro Vancouver Region. These include diesel powered buses,

	electric trolley buses, hybrid buses, and compressed natural gas buses, each of various size and capacity. The physical and operating characteristics of different bus models affect both internal and external cost components. Average peak period speeds were determined to be 12 km/hr. Average peak period bus occupancies vary by route and were determined on the basis of the 2013 Translink Bus System Performance Review.*
Cycling	These calculations assume all bicycles to be newly purchased road/hybrid models. Average operating speeds were determined to be 12.5 km/hr.
Walking	Refers to pedestrian travel at an average operating speed of 3.5 km/hr.

Cost Components and Classifications

Component	Description	Classification
Emissions	The cost of airborne pollutants emitted from motorized modes. These calculations consider the economic and health effects of CO, NOx, PM2.5, PM10, SOx, VOC's, and Ozone (O3).	External
Climate Change	The cost of climate change effects resulting from CO ₂ emissions from motorized modes.	External
Infrastructure	The cost of building and maintaining roadway infrastructure dedicated to motorized modes. Components include: Street cleaning, boulevard grade & trimming, catch basins/drainage, minor repairs, major road maintenance, bridges programs, street lighting, traffic signals, road markings, road signs, surface repairs, and capital costs.	External
Noise Pollution	The cost of noise emissions resulting from motorized travel. These costs include amenity costs (ie. the localized depression of rents or property values associated with proximity to high grade noise), productivity costs, and health costs.	External
Congestion	The costs of roadway congestion imparted on other road users. These include travel time, operating costs, fuel costs, reliability costs, pollution and climate change, accidents, noise and decreased productivity added in excess of already present costs.	External
Accidents (External)	The cost of accidents specific to modes (i.e. the monetization of the risk of causing personal injury or death). Costs include minor injuries, major injuries,	External

	and fatalities attributed to medical expenses, pain & suffering and loss of life.	
Operating Costs (External)	The cost of operating the TransLink bus system as detailed in the Bus System Performance Review. TransLink has determined average cost per service hour as \$98 and \$61 for conventional buses and Minibuses respectively.	External
Operating Charges	The monetary benefit of operating/utilizing a particular mode. These may be derived from taxes, tolls, fares, or other charges. Operating charges depend on mode.*	External
Healthcare Savings	The savings to the healthcare system resulting from partaking in active transportation.	External
Productivity Gains	The savings derived from increased workplace productivity (ex. fewer sick days) resulting from partaking in active transportation.	External
Travel Time	The cost of travel time while utilizing a particular mode. Travel time costs are adjusted for bus operating conditions pulled from the Bus System Performance Review.†	Internal
Extended Life Benefits	The benefit to the individual derived from prolonged life and averted deaths resulting from active transportation.	Internal
Operating Costs (Internal)	The internal cost of owning and/or operating and utilizing a particular mode. Operating costs depend on mode.	Internal
Accidents (Internal)	The personal risk of injury or death resulting from utilizing a particular mode. Costs include minor injuries, major injuries, and fatalities attributed to medical expenses, pain & suffering and loss of life.	Internal

Special Notes

‡ Certain transit routes are not operational during the Peak Period or on weekdays. These are: 242, C19 (weekend only) and the N6, N8, N9, N10, N16, N17, N19, N20, N22, N24, N35 (nighttime only).

+ Average peak period bus occupancies vary by route and were determined on the basis of the 2013 TransLink Bus System Performance Review. “Peak Period” values were determined as a weighted average of peak occupancy rates during the morning and afternoon peaks (6-9AM & 3-6PM). As data was unavailable, the following routes use an assumed peak period occupancy of seven (7): 609, C10, C11, C12, C19, C3, C4. This peak period occupancy was determined using the average of the remaining “C” routes. For those routes operating outside the regular model time frame (see above): “N” routes used average occupancies during weekday nights, and weekend routes used peak period occupancies on weekends.

◆ The cost of travel takes into account operating conditions, commonly expressed using Level of Service (LOS). LOS rates for transit bus users were based upon average peak capacity as determined using the TransLink Bus System Performance Review. These produced scores from A to F. Passenger vehicle levels of service were set at LOS D during the peak period.

× Operating charges depend on mode:

Passenger Vehicles	Bicycles	Transit Buses
PST on Vehicle Finance	PST on Chain Replacement	Transit bus charges are the portion of total transit revenues derived from transit bus farebox payments.
PST on License and Registration	PST on Brake Pad Replacement	
PST on Maintenance and Repair	PST on Drivetrain Replacement	
PST on Tire Costs	PST on Rim Replacement	
Dedicated Motor Fuel Tax (to TransLink)	PST on Inner Tube Replacement	
Dedicated Motor Fuel Tax (to CTFA)	PST on General Tune-ups	
Provincial Motor Fuel Tax (general revenue)	PST on Depreciation	
Carbon Tax	PST on Bike Boots, Bike Jacket	
Federal Air Conditioner Tax	PST on Panniers	
BC Tire Tax	PST on Helmet, Lights	

° Operating costs depend on mode:

Passenger Vehicles	Bicycles	Transit Buses
Vehicle Finance	Chain Replacement	Transit bus costs are equivalent to user farebox payments. Although other
License and Registration	Brake Pad Replacement	
Maintenance and Repair	Drivetrain Replacement	

Tire Costs	Rim Replacement	structures are available (e.g. monthly passes, seniors rates), for the purposes of this analysis, average user payments were set equal to a single adult fare of \$2.75.
Fuel	Inner Tube Replacement	
Insurance	General Tune-ups	
Depreciation	Depreciation	
	Bike Boots, Bike Jacket	
	Panniers	
	Helmet, Lights	
		Transit bus users also incur wait time costs, which were determined on the basis of average headways for each route.

Assumptions

Accidents:

While the international standard for recording injuries has six categories, ICBC uses only three (minor injuries, major injuries, and fatalities).

Data for fatalities was taken from the VPD because it is more detailed, with information on who was at fault etc., and this is the data used by the province.

Fatality data only covers the City of Vancouver. Our assumption is that the rate is similar throughout Metro Vancouver. This is likely conservative, as fatality rates are likely higher in more automobile-oriented parts of the region.

Accident costs are different for different bus routes, although there is a constant accident cost per bus kilometer travelled (BKT). We assume the more kilometers a bus travels, the more likely it is to be in an accident.

Climate Change:

Buses with a zero per cent climate change impact are the electric trolley buses, operating mostly in downtown Vancouver.

Infrastructure:

Data from Europe was used for this estimate as the factors measured in Canada and the United States do not go back far enough.

Operating Costs:

The cost of cycling equipment was calculated from a survey of bike shops. All possible pieces of equipment were included to simulate the most conservative (ie. expensive) case of a brand new cyclist who buys all new equipment off the shelf.

Insurance and maintenance costs for personal vehicles are based on the aggregate average mileage in Metro Vancouver. This is a similar methodology as that used by Canadian Automobile Association.

Travel Time:

Travel time costs are calculated on the basis of the value of travel time (VTT). The VTT is an index which calibrated the value of travel time. These calculations are a derivation based off the average regional wage, standardized by the BC Provincial Government. The VTT may vary according to mode or operating condition to reflect circumstances such as level of service/bus capacity (ie. user comfort). For example, buses such as the 99 B-Line that generally carry considerably more people than other buses and are therefore more uncomfortable, are prescribed a higher VTT.

Wait Time:

Wait time is based on the average headway of buses divided by two. With long headways, the wait time was capped at eight minutes, with the assumption that on infrequent routes people would check the schedule and attempt to arrive just before the bus. Wait times were also assumed to follow a normal distribution.

This model does not include pass-ups, but does have that possibility. If data for the percentage of pass-ups were included, then headways could simply be doubled for that fraction of buses.

Charges:

The standard fare was assumed to be a single-zone \$2.75, which is a high estimate because many people buy monthly passes or concession tickets.

Extended Life Benefits:

Calculations are based off the World Health Organization's HEAT tool.

Health Care Savings:

Calculations are based on a provincial government study of healthcare and morbidity costs associated with physical inactivity.

Productivity Gains:

Productivity Gains are from the same study as above, but differentiated by the entity paying the cost changes, as there is a softer cost that comes with inactivity, like sick days, paid indirectly by businesses.

Not Included:

Costs and benefits that were unavailable for this analysis, but significant enough to warrant future investigation include: specific infrastructure costs for buses (i.e. bus shelters, signs, benches etc.), infrastructure costs for cycling and walking, parking costs, roadway land value costs, transportation diversity costs, land use impacts, water pollution and hydrologic impacts/costs and waste disposal costs and/or life cycle costs.

A capital cost that is relatively small but could be significant is the overhead electrical cables to run the trolley buses. Data was not available.