Business Case for the Millennium Line Extension to UBC

Evaluating the Strategic, Economic, and Financial Case Through A Multiple-Accounts Cost-Benefit Analysis

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Extending the Millennium Line to the UBC campus (Figure 1.) will provide numerous benefits to the Vancouver community: **time savings of up to 21 minutes**[1] for users travelling along the entire extension, **improved access to jobs for 75 census tracts**, upzoning and land value capture opportunities around stations, greenhouse gas emissions reductions, and equity improvements.

Although the cost is expected to be high (the comparable Broadway Extension cost $2.9 billion[2] for a similar length, other cost estimates equate to ~ **$4.8 billion**[3]), other modes would struggle to handle the demand of the corridor and an extension of the Millennium Line would provide transit capacity for sustained growth while improving the commute of tens of thousands of daily riders.

Strategic Case

The Millennium Line extension is estimated to serve an average of 130,000 daily passengers by 2050 [1], with an estimated **84,698 daily passengers** in Year 1. Many of these riders (56k) are expected to be current users of the transit system, particularly from the bus routes serving Commercial-Broadway, the **third-busiest SkyTrain station in 2024**[4], but analysis shows that 28k daily riders are expected to be additions to the system. If the line opened today, its estimated opening day ridership would already account for nearly a quarter of the total 2024 ridership for both the Expo and Millennium lines, and nearly 18% of the total SkyTrain ridership[4].

New 2016 Link stations at University of Washington and Capitol Hill in Seattle **overperformed expectations** and grew by 705% and 850% between 2016 and 2017, amassing ridership higher than all but one station[5]. This is relevant to Vancouver because UBC has a similar captive ridership base and constrained bus corridor, meaning rail investment is likely to produce similarly disproportionate ridership gains. The York University station in Toronto was so successful (27,500 daily boardings after one year of operation) that Metrolinx closed the York University GO station in 2021 due to a decline in GO boardings[6].
This supports the expectation that serving a large university dramatically shifts ridership patterns and reduces pressure on parallel bus corridors, just as the Broadway–UBC corridor would.



Figure 1. Proposed Millennium Line UBC extension

Resident support for the project is high, a TransLink survey showed that 92% of survey respondents support the project [7]. Translink predicts that riders between UBC and Commercial-Broadway are expected to save 20 minutes on their daily commute[1], with lesser but still significant time savings for those who do not travel along the full route. An extension of the Millennium Line to UBC campus would satisfy several goals outlined in the Vancouver Plan, namely creating convenient transit, supporting economic strength, addressing the spatial mismatch between jobs and housing, and combating underutilized neighbourhoods[8].

Economic Case

The largest benefit could be achieved through travel time savings. Analysis of travel times between Arbutus and UBC show savings of 21 minutes when a 10 minute transfer penalty is included, a conservative estimate based on the transfer penalty literature[9]. For this analysis, 21 minute savings are only fully realized for 50% of riders while 25% of riders are assumed to experience a 10.5 minute reduction and the final 25% are assumed to experience a 5.25 minute reduction. Travel time savings are estimated to provide $2.5B in benefit to the region after discounting.

Financial Case

This analysis predicts that the extension's largest financial

return would come from fare revenue, which is expected to bring in **$546M** over 30 years based on demand predictions from TransLink. Further, the extension would be expected to have a farebox recovery ratio of 0.85 in the first year of operation, nearly covering operation expenses.

Since detailed rezoning and land value capture (LVC) forecasts for the Broadway–UBC corridor are not available, this analysis applies TransLink's own conservative estimate that LVC mechanisms could generate approximately $25 million annually region-wide[10]. We assign the full region-wide estimate to this line rather than a proportional share because the Millennium Line extension would be one of the region's largest transit-induced rezoning catalysts and the line would be constructed through employment areas in need of densification. This is seen globally, more than half of Hong Kong's transit revenue comes from development along stations[11]. Examples from the UK have seen the Northumberland line raise 37% of its capital cost and the Elizabeth Line is expected to raise at least £4.2 billion from land value capture strategies by 2041[12]. A North American example shows that **Tax Increment Financing (TIF)** districts in Chicago generated over **$1B** in annual revenue since 2023[13]. While the TIF program is a city-wide revenue stream and faces its own issues with benefiting neighbourhoods that need assistance, it is substantially more than the predicted $25M in LVC for the entire Vancouver Region. These examples illustrate that LVC for rail is not theoretical; and while results are not easily transferrable, Western cities have successfully applied this method at scale to pay for transit.

Based on the cost and benefit assumptions used in this analysis, the extension does not generate a positive internal rate of return (-1%), and would rely on sustained public operating and capital funding. In order to be financially sustainable, the Millennium Line extension would need an annual subsidy of at least $3.1 million, peaking in the first year at $28 million.

Assuming the same investment proportions as the Broadway Subway Extension, Vancouver would need $4.64 billion in capital funding from the federal and provincial governments, plus approximately $299 million in operating subsidies over 30 years. UBC has pledged to contribute to the construction of the line, but exact contributions remain uncertain. Assuming a 4% discount rate, the net present value for the project sits at -$2.68 billion. TransLink would require operating subsidies averaging $0.24 per boarding over the first 30 years of the project. This figure is low compared to the approximately $4.70 per boarding in non-fare revenue (taxation, government transfers, and other income) that TransLink required systemwide in 2024[14].

When converted to monetary values for comparison and discounted for future money, the benefits of a Millennium Line extension cover 53.2% of the 30-year costs of the project (Figure 2). Societal benefits can potentially capture 44% of the 30-year costs while financial returns (LVC, fare revenue) can capture 17%. Although substantial, these quantified economic benefits do not exceed the 30-year financial costs of the project, resulting in a negative net present value. This is typical for major rapid transit investments in Canada, where strategic and societal benefits justify public funding despite financial shortfalls. A 2012 study of the Eglinton Crosstown Line in Toronto estimated that the most financially productive option would only recover ~52% of the capital investment[15].

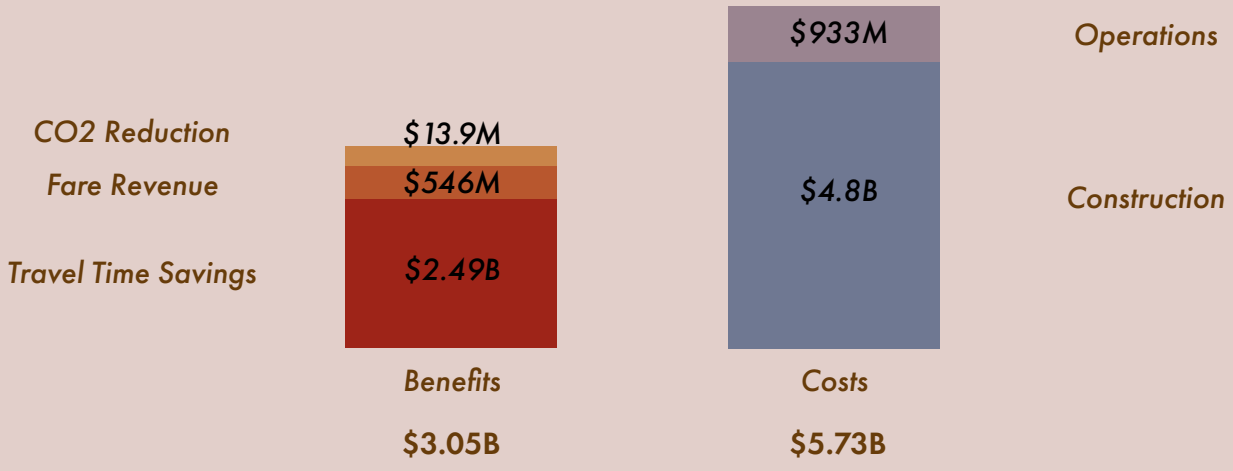


Figure 2. *Total discounted costs and benefits associated with the Millennium Line extension over 30 years*

Multiple Accounts Cost Benefit Analysis

For this analysis, greater emphasis is placed on customer service and social accounts, consistent with Vancouver's stated objectives around accessibility, housing affordability, and equity. Financial, economic development, and environmental considerations follow. Overall, the project generates substantial societal benefits but does not fully recover its capital or operating costs.

Financial Account: When converted to monetary values, the benefits of the extension cover 53.2% of its 30-year costs (Figure 2), with societal benefits (time savings and emissions reduction) covering 44%. On the funding side, fare revenue and land value capture could recover about 17% of costs. Capital cost impacts and ongoing operating costs weigh heavily against the project. However, two financial indicators are moderately positive: the required subsidy per boarding is lower than TransLink's current systemwide subsidy, and strong long-term demand slightly offsets annual deficits. Despite these modest positives, the overall financial case remains negative.

Economic Development Account: Economic impacts score consistently positive. The extension supports elements like employment growth, business development, infill, university reach, and regional economic productivity. By connecting UBC, which is one of the region's largest employers and research hubs, the project strengthens the reach of the university, housing options for researchers and students, and ability for research partnerships. Land value capture around stations leads to sustained revenue streams for local governments. Overall, economic development scores moderately to strongly positive.

Customer Service Account: The customer service account scores highest because the extension addresses the region's most overcrowded bus corridor and improves reliability for more than 50,000 daily riders (2024) that are assumed to shift from the B99, R4, 49, and 25 bus lines. Accessibility gains are substantial, with 75 census tracts seeing improved access to jobs and education within 60 minutes (Figure 3). Multimodal integration with the existing SkyTrain network and the future Broadway extension further strengthens systemwide connectivity.

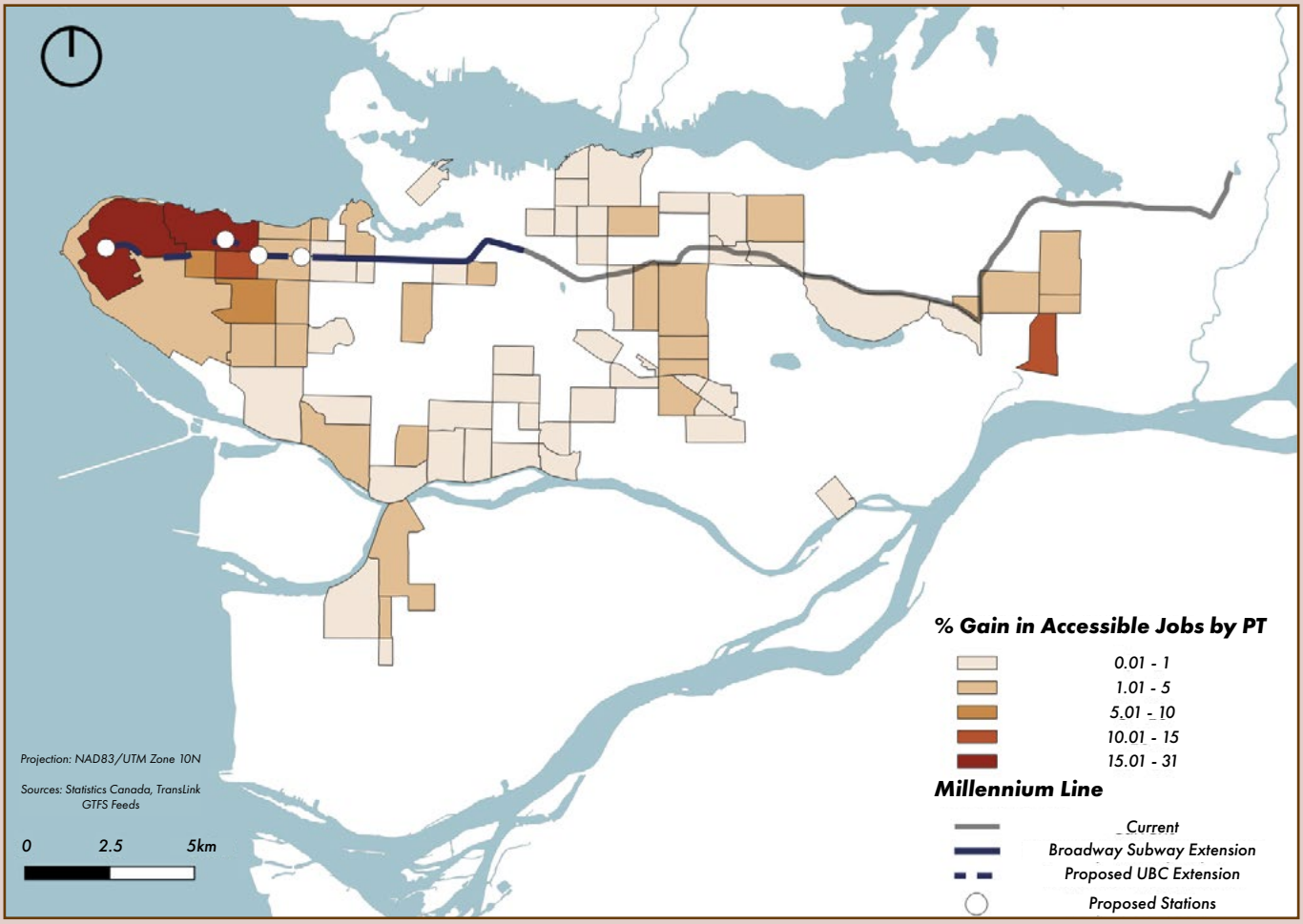


Figure 3. Accessibility gains to jobs by public transit with a 60 minute travel time

Moderate travel-time impacts for shorter trip riders (10–20 min savings) provide widespread benefits. Overall, this category is strongly positive.

Social Account: Social impacts are mixed. Some residents will be negatively impacted by the noise and vibrations of a new rail line, however the line serves many students and low income riders which creates a strong overall score for vulnerable populations. Concerns exist about the potential for fragmentation and gentrification but these can be mitigated through strong place-based planning approaches and inclusionary zoning policies. The net score is slightly negative but that could change with successful mitigation strategies.

Environmental Account: Environmental outcomes are mildly positive, evidenced by the $13.9M in social benefit from emissions reduction. Mode shift from private vehicles to SkyTrain results in lower carbon emissions and reduced regional pollution. However, construction-related impacts such as vibration, noise, and local ecosystem disruption along the corridor produce small negative effects. Over the long term, operational emissions are low and consistent with regional climate goals. This account scores overall slightly positive but not transformative.

Conclusion

The Millennium Line extension's projected costs are significantly more than its projected benefits. Despite the costs, the societal benefits (time savings, emissions reduction) have potential to recoup 44%, while financial returns (fare revenue, land value capture) have the potential to recoup 17% of the 30-year costs. An accessibility analysis shows that the UBC link would be an invaluable addition to the city's network and would allow university students and staff to access a wider range of housing choices, be better equipped to participate in the city's economy, and have a wider range of research opportunities. A multiple accounts analysis suggests that the project would perform particularly strongly in customer service and economic development, moderately in environmental impacts, unevenly in social impacts, and poorly in financial impacts. This is typical for Canadian rapid-transit projects that rarely produce positive financial returns but provide societal, accessibility, and productivity benefits.

The City of Vancouver should place particular emphasis on continued use of land value capture as a tool for realizing property value gains around new rapid transit stations. The Millennium Line extension aligns with Vancouver's long term plans; it sensibly adds to the existing transit network, significantly increases accessibility around the line, allows for neighbourhood intensification, and creates a reliable connection to the city's largest university.

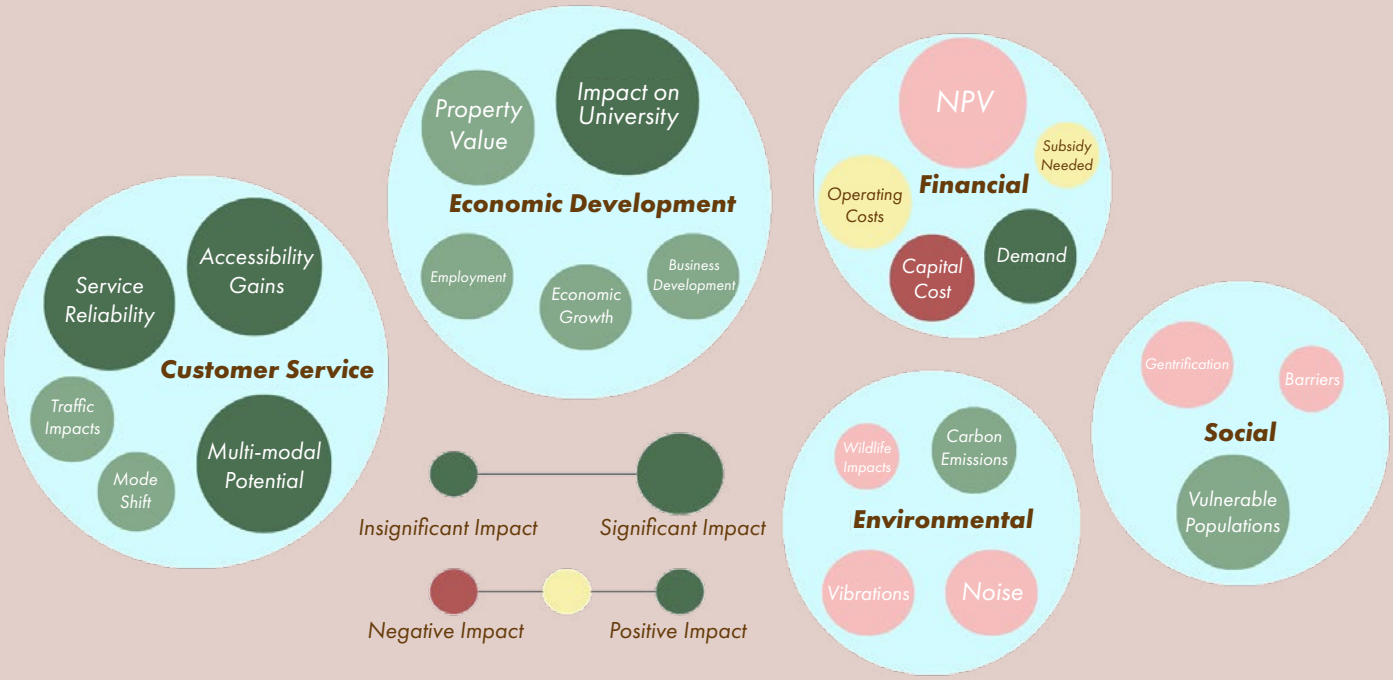


Figure 4. Visualization of multiple account cost benefit analysis

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Appendix

General Assumptions

All costs and benefits are expressed in constant 2024 dollars and discounted at a real rate of 4% over a 30-year appraisal period, beginning with an assumed opening year of 2035. No inflation or real escalation was applied to fares, operating costs, or the value of time. The appraisal compares a base case, in which the Broadway Subway operates to Arbutus and the 99 B-Line continues to UBC, with the project case, in which the Millennium Line is extended to UBC. Only differences between the two cases are counted.

Ridership

Total ridership was based on TransLink's projection of 130,000 daily riders on the UBC extension by 2050[1]. With opening in 2035, 2050 is year 16 of operations. Year-1 ridership was calculated backwards from this target, assuming a five-year ramp-up period with 6.8% annual growth (years 2–6), which reflects the time new rapid transit lines typically take to reach mature ridership, followed by 1% annual growth consistent with long-run regional population growth. This produces 84,698 daily riders in year 1.

Riders were divided into existing and new transit users. Existing riders are those already travelling in the corridor by bus in the base case. They were estimated from 2024 boardings on the 99 B-Line (10,624,000), plus an assumed 25% of riders on the R4, 49, and 25, which also serve UBC and whose riders may shift to SkyTrain[16]. These figures were grown at 1% annually to 2035, giving approximately 56,300 existing daily riders in year 1 of the project that would be estimated to switch to the new line. New riders were calculated as total ridership minus existing bus ridership: approximately 28,400 in year 1, rising to 64,598 by 2050. The 25% share for the R4, 49, and 25 is a conservative assumption. A higher share would increase existing riders and reduce new ones.

Annualization

Daily ridership was converted to annual ridership using mode-specific annualization factors derived from TransLink's 2024 average daily boardings by day of week[17]. Saturday and Sunday/holiday boardings were expressed as a share of average weekday boardings and applied to 52 Saturdays and 53 Sundays/holidays, with 260 weekdays counted at full weekday ridership. For SkyTrain, Saturday and Sunday/holiday ridership equalled approximately 73% and 58% of weekday ridership, producing a factor of 329. This was applied to TransLink's 130,000-rider projection, which was treated as an average weekday figure. The same method applied to systemwide bus boardings (67% and 56%) produced a factor of 325, which was used to convert annual route boardings into average weekday riders. Because the 99 B-Line primarily serves weekday university and commuter trips, its weekend ridership is likely below the bus system average, so existing weekday ridership should be read as a lower bound.

Fare Revenue

Average fare per boarding ($1.65) was calculated indirectly because TransLink reports fares per journey. The ratio of boardings to journeys was used to find the average number of boardings per journey, and the average fare per journey was divided by this ratio[18]. Because existing riders already pay fares in the base case, only new riders generate incremental fare revenue. This totals $15.4 million in year 1 and approximately $546 million over 30 years.

Operating Costs

Rail operating costs were estimated from the additional service required to operate the extension rather than from ridership, since rail operating costs scale primarily with the service provided. Scheduled service hours for the extension were calculated from the custom GTFS feed developed for the accessibility analysis, built in Croquis, giving approximately 176.6 service hours per weekday, 112.6 per Saturday, and 102.8 per Sunday/holiday. These were annualized using 260 weekdays, 52 Saturdays, and 53 Sundays/holidays, for approximately 57,219 annual service hours. Service hours were valued at $281 per hour, based on TransLink's reported cost of operating SkyTrain service in 2024[19]. This produces annual rail operating costs of approximately $16.1 million. Because TransLink's rate is reported per car-hour while the GTFS service hours are train-hours[20], this was multiplied by four cars per train, giving approximately $64.4 million annually, but may underestimate costs when considering new Mark V trains. Service levels were held constant over the appraisal period; if frequencies increase as ridership grows toward 130,000 daily riders, operating costs would be higher. Because part of SkyTrain's operating cost, such as guideway and station maintenance, is fixed rather than proportional to service hours, applying a systemwide average rate is an approximation.

Following the extension's opening, 99 B-Line service between Arbutus and UBC was assumed to be discontinued. Annual bus service hours on this segment were estimated from TransLink's 99 B-Line timetable (effective September 7, 2026) [21]. Because Arbutus is not a scheduled timepoint, run time between Arbutus and UBC was estimated for each trip as half the scheduled time

between Broadway–City Hall and Alma at 10th Avenue, plus the scheduled time between Alma and UBC Exchange. Across 230 weekday, 145 Saturday, and approximately 101 Sunday/holiday trips in each direction, this produced approximately 53,800 annual in-service hours. A 10% allowance for layover and deadheading was added, giving 59,180 hours. These hours were valued at $177 per service hour, calculated by dividing TransLink's 2024 Bus Operations expenditure ($1,015.5 million) by 2024 service hours for conventional bus, Community Shuttle, and West Vancouver services (5,728,000)[22]. This gives annual bus savings of approximately $10.5 million, which were subtracted from rail operating costs to produce net operating costs. Service on the R4, 49, and 25 was assumed to continue unchanged.

Travel Time Savings

Because the base case includes the Broadway Subway to Arbutus, travel time savings were measured between Arbutus and UBC only. Estimated transit travel time between Arbutus and UBC falls from 26 minutes by bus to 15 minutes by SkyTrain, a saving of 11 minutes (r5r travel-time matrix). A pure transfer penalty of 10 equivalent in-vehicle minutes was added to reflect the elimination of the transfer between the Broadway Subway and bus service at Arbutus. This is conservative relative to Garcia-Martinez et al. (2018), who estimate the pure transfer penalty at 15.2–17.7 equivalent in-vehicle minutes, excluding walking and waiting time[23]. This produces a maximum saving of 21 minutes.

Because no data on trip lengths along the extension were available, 50% of riders were assumed to receive the full 21-minute saving, 25% half (10.5 minutes), and 25% a quarter (5.25 minutes), for an average of approximately 14.4 minutes. Following the standard rule of half, existing riders receive the full saving and new riders half, since new riders' benefits range from near zero to the full saving.

The value of travel time was set at 50% of the median hourly wage for full-year, full-time workers in the Greater Vancouver Regional District. Median 2020 employment income from the 2021 Census ($66,500) was converted to an hourly wage assuming 2,000 working hours per year and adjusted to 2024 dollars using the Bank of Canada inflation calculator, giving a value of $19.67 per hour. Because 2020 incomes may be affected by pandemic-related changes in the full-time workforce, this value was held constant in real terms over the appraisal period. Travel time savings total approximately $2.5 billion over 30 years.

Environmental Benefits

TransLink estimates that the extension would remove 3,000 car trips during peak periods[1]. Using TransLink's average trip length of 9.3 km[24] and an emissions factor of 206 g CO_2/km[25], this avoids approximately 5.7 tonnes of CO_2 per day, or approximately 1,890 tonnes per year using the SkyTrain annualization factor. Emissions reductions were valued using Environment and Climate Change Canada's social cost of carbon (2% near-term Ramsey discount rate), applying the value for each calendar year from 2035 ($317/tonne) to 2064 ($457/tonne)[26]. These values are in 2021 dollars and were converted to 2024 dollars (13.46%) using the Bank of Canada inflation calculator. Environmental benefits total approximately $14 million over 30 years.

This estimate does not account for the gradual electrification of the vehicle fleet, which would reduce the emissions avoided in later years. It also excludes emissions avoided from the reduced 99 B-Line service, which would increase them. Vehicle operating cost savings for drivers who switch to transit were not added, as these benefits are captured through the rule of half applied to new riders' time savings.

Land Value Capture

TransLink's estimate that land value capture mechanisms could generate approximately $25 million annually region-wide was assigned in full to the extension[27]. It was treated as a funding source that reduces the required subsidy, not as an economic benefit, because land value increases near stations largely reflect the same accessibility and travel time benefits already counted.

Capital Costs and Financing

Construction costs were assumed to be $4.8 billion, based on a 2019 TransLink estimate adjusted to 2024 dollars[3]. Consistent with the Broadway Subway Project's funding structure[28], the federal government was assumed to contribute $1.46 billion (30.3%) and the provincial government $3.18 billion (66.2%). The remaining $163 million was assumed to be financed through a 30-year fixed-payment loan at 8%, giving annual debt service of approximately $14.5 million. No cost overruns or optimism bias were applied to the capital cost.

Subsidy and Cost Recovery

The annual operating subsidy was calculated as net operating costs plus debt service, minus new-rider fare revenue and land value capture. This gives approximately $28 million in year 1, falling to approximately $3 million in year 30, and approximately $299 million over the appraisal period, or $0.24 per boarding. The year-1 cost recovery ratio, defined as fare revenue from all riders divided by net operating costs plus debt service, is 0.67. The year-1 farebox recovery ratio, defined as fare revenue from all riders divided by net operating costs, is 0.85.

Net Present Value

The net present value was calculated using the $4.8 billion capital cost in year 0 and annual benefits (travel time savings, environmental benefits, and new-rider fare revenue) minus net operating costs, discounted at 4%. The resulting NPV is −$2.68 billion.

Accessibility Analysis

To evaluate the accessibility impacts of the extension, a travel-time matrix was generated using the r5r package in R for all census tracts in the Vancouver CMA. This matrix was joined with 2016 census tract employment data to calculate the number of jobs reachable within 60 minutes by public transit. Because the standard TransLink GTFS feed does not yet include the Broadway Subway or the proposed UBC extension, custom GTFS feeds were created for both scenarios. The Broadway Subway feed was used to estimate base-case accessibility, and a second feed including the UBC extension was used for the project case. Travel times were estimated using multimodal (walk–bus–rail) paths under peak-period assumptions.