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BUSINESS CASES FOR MAJOR PUBLIC INFRASTRUCTURE PROJECTS IN CANADA

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SUMMARY

When governments announce that they are going to spend vast sums of taxpayers' money on a new public infrastructure project, you can be certain they will praise all the terrific new benefits that the project will bring to citizens, making everyone's life easier, safer, greener and better. But this does not tell us whether we are better off as a society, after accounting for the cost of these projects borne by taxpayers today and well into the future. In reality, there is a meaningful risk that a project undertaken without a proper business case could end up making citizens' lives worse. That new commuter train might look sleek and shiny and seem convenient for some, but a close business case analysis of recent transit projects in Canada's three largest cities suggests that in as many as four cases out of 21 projects, the burden of paying for the projects does not justify the public investment.

In a review of thirteen recent public transit projects in the Greater Toronto and Hamilton Area (GTHA), at least three projects had benefits that fell short of the costs. Yet, all three projects went ahead (or have been funded). Only one project showed large net benefits for citizens once all considerations were accounted for. Three projects showed small net benefits – of a size that can be easily offset by a modest cost over-run. The six remaining projects did not have any publicly available business cases.

In the Greater Montreal area, a review of three recent major transit projects turned up no evidence of a publicly available business case for any of them. As a result, Montrealers are in the dark as to how much benefit or value destruction the three projects are responsible for. Things are far more encouraging in Vancouver, however, where three out of the five major transit projects undertaken or funded in recent years were backed by business cases showing a net benefit. Only one project did not show a net benefit and one project did not have a business case.

[†] This paper would never have seen the light of day if the University of Calgary's School of Public Policy had not organized the Paying for Infrastructure Symposium in Toronto on April 6, 2016. Thank you to Jack Mintz for taking the initiative to organize the Symposium and to Metrolinx senior management for suggesting me as a speaker. Thank you also to Geneviève Charette for research assistance and to Lucy Scuderi for research, editorial and administrative support.

Of course, business cases only make projections about net benefits. Rarely, if ever, do governments undertake an ex post review to determine whether their estimates were correct and if the project has delivered — or destroyed — the value expected. Given that these projects can run into the billions of dollars, tie up immense amounts of government resources, and can cause any number of disruptions to business and families, it is remarkable how little cost-benefit scrutiny is brought to bear on them. Without these ex post business cases, there can be no lessons learned from past projects. There can be no assurance that we can make better investment decisions going forward.

"Tooling through the countryside during Duplessis' watch, you could always tell which riding had voted for the (governing) Union Nationale, and which had sinned. The roads in Union Nationale ridings were paved, the others weren't."
Mordecai Richler, "Redeem Duplessis? C'est Assez!"
National Post, June 12, 1999

"There is too much pork barrel and too little cost-benefit analysis in infrastructure decision-making. Projects should be required to pass cost-benefit tests and proposals like a national infrastructure bank that would insulate a larger portion of decision-making from politics should be seriously considered."
Larry Summers, "The Case for a Proper Programme of Infrastructure Spending," Financial Times, January 16, 2017

1. INTRODUCTION

Infrastructure investment is one of the few policy issues that garners support across the entire political spectrum. It is also a topic of near unanimity among policy analysts and economists who tout the wider impacts of public infrastructure on much-needed productivity growth. However, the contribution of infrastructure investments depends on the quality of investment decisions. At the extreme, "bridges to nowhere" make no contribution to community well-being (other than possibly job-creation stimulus) and at worst, they take away resources and funding from better projects that are either delayed or not pursued at all. This is why public-infrastructure investment decisions are typically supported by business cases that establish why the project in question is beneficial to the community on a net basis (i.e., after accounting for the resources used to build the new asset and to deliver the associated services).

However, not all business cases are created equally. Some business cases do not clearly establish the need being addressed. Some do not examine all the options for addressing the need, thereby ignoring potentially superior alternatives. Some business cases provide only a financial analysis and do not present an economic analysis of the options (i.e., also valuing the positive and negative impacts not captured in financial analysis), without which there can be no justification of an investment decision from a public-interest perspective. Some business cases are more akin to promotional material and do not pass even basic commercial due-diligence tests.

This paper reviews the role of business cases in public-infrastructure investment decisions in Canada.[1] For infrastructure projects in the public domain, this means taking a broad public-interest perspective and, as such, incorporating financial, economic and broader socio-economic and environmental considerations. It asks the question whether Canadian governments are investing limited resources in infrastructure projects that create value for the community at large. It also considers how the practice of developing and using business cases to support decision-making can be improved in order to deliver better outcomes for the communities concerned.

The focus of the paper is primarily on infrastructure assets in public transit in Canada. There are several reasons for this. First, public-transit projects almost always make significant demands on the public purse, both during construction and operation. Second, there is a longstanding empirical practice of relying on business cases to justify the use of public funds in transportation and public

[1] Business cases have a role throughout the planning process, from conception through to appraisal, environmental assessment, procurement and post-implementation evaluation. Each province (and the federal government) has its own planning, project-approval and environmental-assessment processes. The purpose of this paper is not to explain what kind of business-case analysis is required at each stage, if any. The latter is the remit of each jurisdiction, which is responsible for its own detailed guidance documents.

transit in particular, a practice known as "transportation economics." Third, other areas of public-infrastructure investments in Canada, especially outside the transportation sector, are usually evaluated primarily on a commercial basis (energy projects, for example, are usually expected to generate positive financial returns) or they are not evaluated in terms of the overall economic costs and benefits (for example, social infrastructure).[2]

The next section of this paper provides an overview of business cases across the Canadian infrastructure space. Section 3 reviews selected business-case frameworks used by transit-planning organizations such as Metrolinx and TransLink, the transportation authorities for the Greater Toronto and Hamilton Area and Metro Vancouver, respectively, which undertake many business cases each year. Section 4 examines business-case results for over 20 major public-transit projects in Canada's three largest urban areas. These are projects that have been built or are under construction, under procurement or have been funded and as such would have been expected to receive considerable scrutiny by both sponsor and funding governments. Based on our review of these business cases, the last section provides several recommendations, lessons and good industry practices for the sponsor governments, transit agencies and senior-level governments funding the projects.

2. BUSINESS CASES IN PUBLIC INFRASTRUCTURE SPACE

While policy discussions and even investors sometimes talk about infrastructure as a single asset class, in practice, project investment decisions differ significantly across specific asset classes and by type of owner or sponsor, as shown in Figure 1 below. One important distinction is between public and privately owned infrastructure. Public-infrastructure investments usually (but not always) commit funding from taxpayers today and sometimes well into the future, while privately owned infrastructure is usually privately funded (although public sector subsidies are possible).

A second and perhaps more important distinction between asset classes relates to how investment decisions are made in practice. For some assets, like freight rail and energy, investment decisions are made primarily on a commercial basis (i.e., focusing on financial returns).[3] This tends to be the case not only for privately owned infrastructure, but also for provincial Crown corporations (e.g., Ontario Power Generation) or even municipally owned power companies, such as Calgary's Enmax and Edmonton's Epcor utilities. For other assets such as public transit, roads and water systems, the gold standard for investment decisions is an economic cost-benefit test that incorporates consumer-surplus measures related to mobility, health and safety, as well as externalities related to air quality, climate change and ecosystem preservation. It is fair to recognize that there are also asset classes where investment decisions are typically based neither on economic- nor financial-feasibility tests, but are more likely based on political considerations and constrained by the available public funding.[4] These assets invariably include public sector assets such as hospitals and other health, social and recreational infrastructure. In many cases, even other public sector infrastructure investments can be heavily influenced by political considerations that are not necessarily consistent with economic or financial feasibility.

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[2] There is an empirical literature that evaluates the willingness to pay for social and recreational infrastructure services or even basic services such as potable-water supply, which are subject to administered prices rather than market pricing (e.g., see Brox et al., 1996). The results of this literature can be used along with benefit-transfer methods in order to assign economic values to the services under consideration. However, this literature has yet to gain broad acceptance in public-policy and government circles. Also see Johnston et al., 2015 and Champ et al., 2017.

[3] Provincial power companies are also subject to policy decisions that are made primarily for environmental reasons, such as phasing-out coal-fired electricity generation, or feed-in-tariff (FIT) programs for encouraging renewable-energy production.

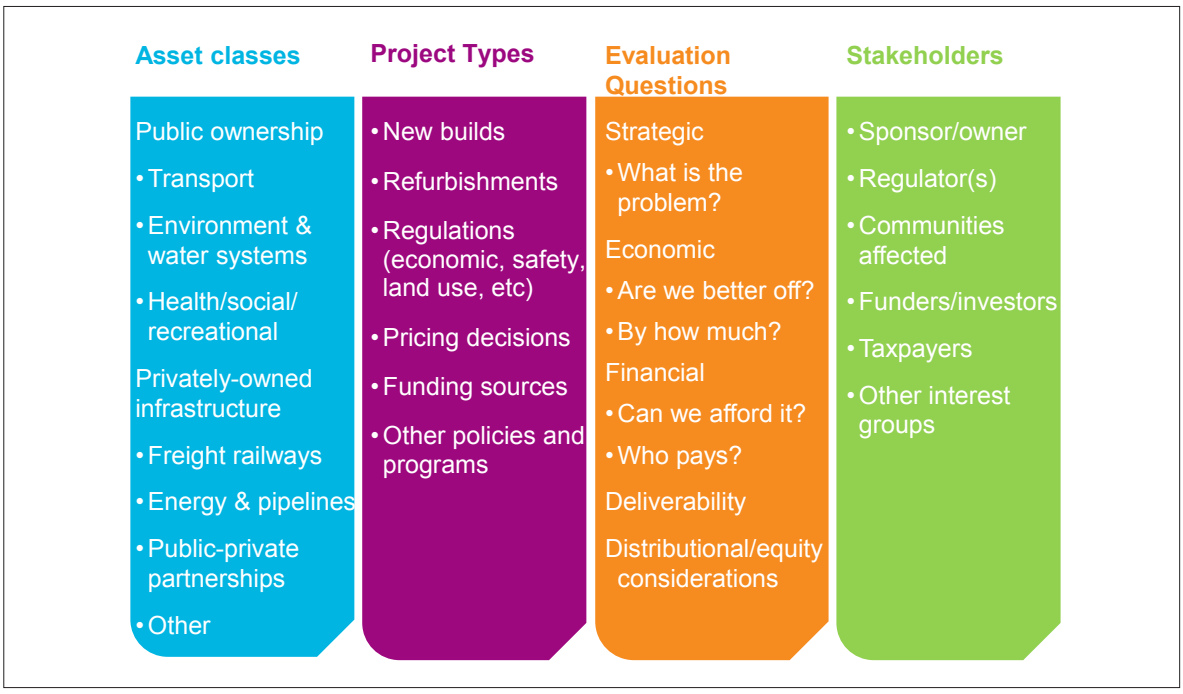
[4] When financial-feasibility studies are carried out in these cases, they are limited to discounted cash-flow analyses that take account of the timing of grants and payments for construction. These are seldom analyzed as income-generating investments.

Business cases also differ by type of project decision and are certainly not limited to new builds or refurbishments. Changes in the pricing, funding and even regulations covering infrastructure services are strong candidates for business cases, especially when the changes are structural in nature and go beyond small, incremental adjustments (for example, transit fare and service-integration reforms). Major changes in funding sources are also excellent candidates for business cases, since some revenue sources — typically tax revenues — entail additional economic costs by imposing distortions on labour markets and/or capital markets, while other sources, such as user fees, can entail positive benefits by moderating overconsumption of certain services (e.g., roadway usage, in the case of tolls) or mitigating other negative externalities.

In practice, infrastructure funding is viewed almost exclusively as a budgeting or financial-feasibility issue, as in "is there enough money to fund the project?" Even when governments consider shifting to new, user-fee-based funding sources, little or no consideration goes into evaluating the economic implications of these decisions.

Business cases involve the justification of a particular infrastructure investment or decision. The overarching evaluation question is: "Does it make sense to commit scarce resources to any one project"?[5] This entails asking (and answering) some follow-up questions, beginning with "what is the problem that needs to be addressed?" and undertaking a strategic analysis of the options available to address the problem. Notice that this question is necessarily economic in nature and goes beyond the financial implications of each option. The economic lens here should be understood to value all impacts that matter to society, including the mobility, safety, environmental impacts and even urban form. It is also applicable to public infrastructure as well as privately owned infrastructure with no public subsidies. After all, some privately owned infrastructure could create negative externalities that offset any private benefits. This is consistent with applied welfare economics practice, which takes an all-encompassing approach to evaluating alternatives, whether in the infrastructure space or elsewhere.

FIGURE 1 BUSINESS CASES IN PUBLIC INFRASTRUCTURE SPACE



[5] The project refers not only to the physical infrastructure, where relevant, but also to the services delivered using that infrastructure.

While the economic lens provides the basis for justifying the choice of one or other alternatives, other questions may impose constraints against choosing the preferred option. For example, the option which is preferred on an economic basis may not be financially feasible for the owner of the asset. One can easily think of many potential infrastructure investments or refurbishments that would be value-creating in an economic sense, but where the infrastructure owners lack capital or even operations funding. In fact, most municipal transit or road projects fit this description. This is usually where senior-level governments step in with grants. However, the question remains that if the economic analysis demonstrates users' willingness to pay for new mobility services (for a transit or highway project), why can't user pricing (fares, tolls, etc.) be used to monetize these apparent benefits? Of course, this does not apply to environmental and other positive externalities, but it does apply to direct user benefits, which typically account for the bulk of identified benefits.

Another potential set of constraints is the deliverability of a particular project option. Deliverability addresses the implementation risks during the planning, design and construction of the project as well as during subsequent operations. It covers the choice of technology for the different components of the asset (e.g., rolling stock, civil infrastructure, signalling and communications systems, etc.); the availability of the designated land or corridor for the purpose at hand; risks related to the environmental-assessment process or other regulations; and the choice of procurement approach (e.g., using traditional design-bid-build or an alternative delivery approach, which transfers more project risks to contractors). It also requires examining the business and governance model to be used for delivering the infrastructure services once the asset is ready for service (e.g., government-service delivery or some form of contracting out of the service delivery to private operators).

Deliverability constraints typically translate into either higher capital or operating costs or delivery-schedule delays, or both. At the limit, some deliverability issues can also entirely undermine a particular project, as in the case of at least one Canadian airport light rail project where the designated right of way was not available because it was under the ownership and control of a freight-rail carrier. This underlines the importance of identifying deliverability risks at an early stage in the planning process.

Understanding the equity and distributional impacts of each project alternative can also be an important issue in business cases. Equity can be defined in a number of different ways. For example, vertical equity examines how the outcomes of the project (both positive and negative) are distributed by income (or wealth) group. The distribution of project outcomes can also be examined on a geographic basis, since the spatial distribution of benefits and costs is an important (and often contentious) part of many infrastructure projects. Also relevant is applying the benefit principle, which tests the extent to which the beneficiaries of the project are those who pay for it (via fares, taxes or other fees). In addition, project outcomes can be examined across racial groups or visible minorities, as is often done for transit and transportation projects in the U.S., where Title VI of the Civil Rights Act of 1964 "prohibits discrimination on the basis of race, color, or national origin in programs receiving Federal assistance."[6]

The stakeholder dimension of business cases is about the project decision-making, accountability and transparency. It is about "who decides" which version of the project to propose: Who should be involved in the decision-making? Who should be informed about the potential outcomes of the different options? And who should have access to the evidence regarding potential outcomes? The reality for most owners and sponsors, typically municipalities, is that it takes years to conceive, develop, champion and execute a major infrastructure project. This is due not only to the need to secure funding from senior governments and undertake environmental-assessment processes, but

[6] See the U.S. Department of Transportation website for a comparison of Title VI and so-called "environmental justice" considerations, both of which are often examined for major infrastructure projects: https://www.fhwa.dot.gov/environment/environmental_justice/equity/.

also due to the need to line up support across the affected community and among key stakeholder groups. In the best of all possible worlds, business cases should help owners/sponsors decide which project alternative delivers the most value for users and the community at large. Secondly, it should also enable the affected community and interest groups to understand the impacts of the different project alternatives. Thirdly, it should enable senior-level governments to make informed funding decisions and to ensure their respective taxpayers are investing in projects that create value, improve regional economic competitiveness and that they meet other social, economic and environmental objectives of the affected communities.

2.1 Key Features of Business Case Evaluations

There are several key features of business-case evaluations. These include (i) the need for a comprehensive, but limited number of well-defined alternatives to address the infrastructure need, (ii) the identification, quantification and valuation of costs and benefits of each alternative, and (iii) the conditions required to ensure consistency of results across different business cases. We discuss each of these below.

(i) Comprehensive, well-defined alternatives

At the heart of any business case is the definition of a clear set of alternative projects for addressing the infrastructure needs in question as well as a reasonable characterization of what happens in the absence of any investment (often called the "do minimum"). The alternatives should be comprehensive in the sense of covering the full range of feasible alternatives, for example both infrastructure-intensive and other relevant alternatives. It should start with a full range of alternatives and illustrate the process for arriving at a shortlist — usually no more than three to five alternatives — in order to facilitate an in-depth analysis of each compared to the do minimum. It is clear from these requirements that arriving at a shortlist of alternatives is likely to be an iterative process. The iteration is necessary not only to identify the full range of alternatives, but also to retain the best or most instructive options, and to exclude those that are clearly inferior. Part of the refinement of alternatives also happens over the natural course of the planning and design of the project, from the time of the initial business case through to the full and final business case.

(ii) Valuing costs and benefits (including wider economic benefits) of each alternative

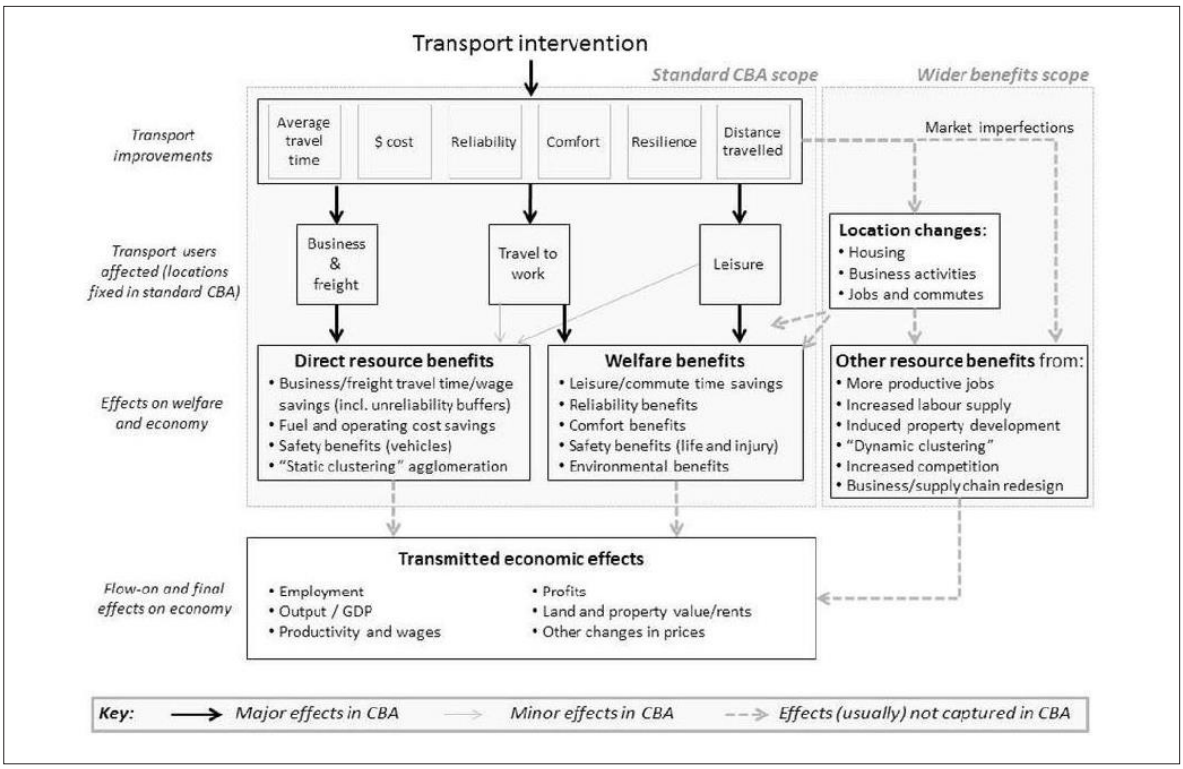
The identification, quantification and valuation of costs and benefits in a common currency is a very powerful tool because it allows for the value of each project alternative to be summarized by a single measure that captures the associated net benefit (or cost) relative to the do minimum. However, this requires that the valuation approach be both comprehensive and consistent across the alternatives. The costs and benefits of the project (or "intervention" as noted in Figure 2 below) refer to opportunity costs and incremental benefits. In other words, these are resource costs or benefits that would not have occurred in the absence of the project. These include financial or out-of-pocket impacts (called "direct resource benefits" below) and welfare impacts, which include the value of time savings, improved safety, and environmental externalities. Notice that the standard CBA approach does not include the "transmitted economic effects" associated with the project. These capture the impact of the project's construction and operations spending on output, jobs and tax revenues using an input-output model. As such, these economic impacts provide a description of the "footprint" of the project, but they cannot be interpreted as "incremental" or as benefits that would be lost to the community if the project did not proceed.[7] In circumstances where there is excess capacity in the local construction and engineering trades, it is possible that the project spending would lead to a net positive increase in output and welfare. However, these tend to be

[7] Economic-impact studies are often undertaken for major infrastructure projects in North America. See AECOM (2012) for a comparison of economic impacts derived from input-output models, macro-economic models and micro-economic/CBA models.

exceptional circumstances and even macro-economic models are often ill suited to evaluating the net output effects of the project spending (e.g., models without price and wage effects associated with the additional spending).

One set of impacts that has not been incorporated in most CBAs in North America is the so-called "wider economic benefits" (see shaded box to the right in Figure 2). These impacts include agglomeration economies, labour-supply impacts, commuters shifting to more productive jobs, and changes in output resulting from lower transportation costs. Agglomeration economies arise when increased concentration of economic activity generates productivity benefits through labour-market pooling, knowledge spillovers, specialization, and the sharing of inputs and outputs. If a project leads to lower commuting costs (time and/or money costs), it can increase labour supply and even lead to the relocation of workers to more productive jobs.

FIGURE 2 WHAT'S IN/OUT OF A TRANSPORTATION COST-BENEFIT ANALYSIS?



Source: International Transport Forum, *Quantifying the Socio-Economic Benefits of Transport*, 2017, p. 12.

To the extent businesses benefit from any of the reduction in transportation costs (e.g., for business trips or shipping costs) in imperfectly competitive markets, a project will enable firms to increase profits by increasing their output. This will generate welfare gains for consumers to the extent that their willingness to pay for the extra output exceeds the cost of producing it.[8] All of these wider economic benefits are at least in part incremental to the standard CBA results. For example, agglomeration economies are positive externalities arising from increased concentration of economic activity associated with any reduction in transportation costs in urban areas. These are not captured in conventional CBAs of time or cost savings resulting from a new project. Nor do CBAs capture the portion of any increase in labour supply and labour income that goes to income taxes and payroll taxes (i.e., the tax wedge). All of these wider economic benefits should be quantified as part of economic evaluations of project alternatives, if there is reason to believe

[8] See Gill et al. (2011) and AECOM (2012) for a discussion of wider economic benefits. Both sources also explain why these are considered legitimately as incremental to the standard CBA results.

that they are significant in empirical terms for the projects and the geography under consideration. Agglomeration economies have been estimated for a few Canadian transit investments, but these have been done using productivity elasticities drawn from U.K. industrial sectors.[9]

(iii) Consistency across business cases

The CBA approach can be a powerful tool for comparing projects, but it requires consistency of methodology and assumptions in order to enable meaningful comparisons across business cases. This means:

- Valuing the same costs and benefits (i.e., if wider economic benefits are estimated in one business case, these should also be included in others).
- Using the same valuation assumptions (e.g., value of time, value of time growth, etc.), unless there is a strong case for different valuation assumptions (e.g., if different cities or identifiable groups of users have a different willingness to pay for time savings or other amenities).
- Making adjustments to the results of one or more business cases to ensure that the two rules above are enforced (e.g., adjusting the time-value assumptions). According the U.K. WebTAG guidance,[10] the adjustments can be done in two stages:
  - (i) calculating an adjusted benefit-cost ratio (BCR) by monetizing some of the quantitative and qualitative impacts for which there is no explicit guidance or which are subject to greater uncertainty; and
  - (ii) taking account of all the other impacts that have not been monetized. If the expected magnitude of these impacts is likely to alter significantly the BCR, this should be reported along with the direction and magnitude of the change.
- Verifying the results of each business case to identify any significant flaws or any areas of uncertainty. CBA results should not be taken at face value. Instead, it is important to conduct basic due diligence on each CBA by checking some of the usual sources for methodological errors, including: demand/revenue forecasts (by asking: are these credible?), especially where these are based on constant annual growth rates over a very long time period; the definition of the do-minimum scenario (asking: is it a reasonable alternative in the absence of any investments?); the main sources of value creation; and the treatment of terminal values.

3. SELECTED BUSINESS-CASE FRAMEWORKS

This section reviews two selected business-case frameworks that have been used extensively to undertake business cases in Ontario and the rest of Canada. The first framework is typically called a multiple-account evaluation (MAE) framework and was used until recently by Metrolinx and TransLink.

[9] See for example AECOM (2013). Agglomeration elasticities by industry have not yet been estimated for Canada or the U.S.

[10] U.K. DfT 2017. Value for Money Assessments. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255126/value-for-money-external.pdf.

FIGURE 3 MULTIPLE-ACCOUNT EVALUATION FRAMEWORK

ACCOUNTS	IMPACTS	PRIVATE/SOCIAL	MONETIZED	INCREMENTAL
Transportation User Account	• Travel-time savings, including in-vehicle time, access times, service frequency and interchange penalties	Mainly private (with some social impacts — congestion, safety, etc.)	Yes	Yes
	• Travel-time reliability, punctuality		Yes	Yes
	• Automobile operating-cost savings		Yes	Yes
	• Safety benefits		Yes	Yes
Financial Account	• Ridership revenues	Private	Yes	(1)
	• Capital and operating costs	Private	Yes	Yes
Environmental Account	• Greenhouse gas emissions	Social	Yes	Yes
	• Local air-quality impacts, including public health impacts	Social	Yes	Yes
	• Noise and vibration impacts	Social	Yes	Yes
	• Water-quality impacts			
Economic Development Account	• Standard economic impacts of project spending (construction and operations phases)	Mainly private with some social impacts	Yes	No
	• Industry, supply-chain effects and spatial distribution of impacts		Yes	No
	• Land-value impacts		Yes	No
	• Wider economic benefits		Yes	Yes
Social Community Account	• Vertical- and horizontal-equity impacts	Social	No	No
	• Intensification, urban form and land-use shaping		No	(2)
	• Health and accessibility			

Notes: (1) If a project generates additional ridership revenues, this is an indication of users' willingness to pay for the services being delivered. (2) The amenities associated with various urban forms (e.g., tree-lined sidewalks) can be monetized using a benefit-transfer approach.

The main feature of this approach is that it supports the examination of a wide range of impacts that are categorized into several accounts, as shown in Figure 3 below. The figure shows the main accounts that are used in the evaluation; the impacts covered in each account; whether these impacts are borne only privately or whether there are also social impacts (i.e., externalities); whether impacts can be monetized; and whether or not the impacts can be considered incremental (i.e., whether or not these can be incorporated into a CBA). The MAE approach is a versatile tool when used appropriately to estimate BCRs and net benefits. It is versatile, because it allows for analysis of a wide range of impacts, not all of which can be quantified and monetized. Even among the impacts that can be quantified and monetized, not all are incremental or additive in a BCR calculation. For example, most of the economic-development impacts cannot be incorporated as benefits into the BCR calculation. This is the case for both standard economic impacts and land-value impacts, both of which cannot be considered incremental in that they would likely have occurred even without the project (but at other locations in the regional economy).

One drawback of this approach is that no guidance is provided on how to calculate the BCRs. In fact, some early business cases based on this approach presented the results on an account-by-account basis, but did not explicitly report the overall BCRs.[11] The appropriate procedure to calculate the BCR is to add all the transportation and environmental impacts, calculated on a present-value basis over the relevant horizon, and divide by the total project costs (capital and operating costs) over the same horizon. It is not appropriate to add the impacts for all other account and/or to weight the accounts in any way.

[11] For example, see MKI (2009).

The second framework, which has been adopted more recently by Metrolinx, is based on the four-case framework used in the U.K. and New Zealand. The framework has not yet been finalized, but the four cases are described as follows based on Metrolinx (2015b):

- The strategic case is intended to develop the shortlist of options that address the problem at hand and ensure the options are consistent with the Regional Transportation Plan and other relevant government objectives.
- The financial case examines the financial impact of each project option on Metrolinx (relative to the base case) and other key stakeholders, such as the transit operator (relative to the base case). It also examines the funding requirements for the projects and the relevant sources of funding.
- The economic case evaluates the economic impact of each project option relative to the base case. The economic case covers all mobility, safety, environmental and other welfare impacts that can be attributed directly to the project. The results are reported in terms of BCRs and/or net economic value creation for the relevant horizon.
- The deliverability case examines whether each option is technically and commercially feasible to build and operate. It examines whether there are significant risks associated with constructability, stakeholder engagement, access to property, operations or other factors that could materially affect costs and/or schedule, or render the option unfeasible.

There does not appear to be an explicit role for a vertical-equity analysis of the options, or for an analysis of the economic-development impact of each option. However, the framework is still a work in progress and these considerations can be incorporated in one or other of the four cases.

4. SELECTED BUSINESS-CASE RESULTS

This section examines selected business-case results for major public-transit projects in Canada's three largest urban areas. Specifically, we identified all public-transit investments of $500 million or more[12] in the Greater Toronto and Hamilton Area (GTHA), Greater Montreal, and Metro Vancouver that met at least one of the following criteria:

- Completed in the last 10 years
- Currently under construction
- Currently in procurement
- Approved and funded

The rationale for this particular focus is that:

- Public transit almost always requires public funding and it can generate substantial externalities in terms of mobility, safety and environmental outcomes.
- All three urban regions have relied on business cases and benefit-cost analyses during this period in order to justify public investments in the transit space.
- By focusing on projects that are already completed, or at least fully funded, we are avoiding a whole host of unfunded projects that may not have been subject to as much scrutiny.

[12] Refers to capital costs expressed in currency of year reported, unless otherwise noted.

This scope also yields a manageable number of projects with a wide range of results that can provide valuable lessons for other jurisdictions across Canada. For the purpose at hand, a business case should meet three minimum conditions:

- It should examine at least one project alternative.
- The project alternative should be compared to a base case or do-minimum scenario (a scenario without the project) that is reasonable and feasible.
- It should include a full comparison of costs and benefits over a time horizon appropriate for the project.

In addition to these three conditions, the sample of transit infrastructure projects was also examined for four other conditions of good governance in business-case planning:

- Business case is available in the public domain, thereby supporting transparency and accountability of decision-making for major public investments.
- Net positive value was created from an ex ante perspective (i.e., before the project is delivered).
- Other alternatives (in addition to the preferred alternative) were explored in the business case, thereby providing some confidence that no superior alternatives were available to address the problem at hand.
- An ex post business-case evaluation (i.e., after the project is in service) was conducted in order to provide valuable lessons for other projects.

4.1 Major Transit Projects in Greater Montreal

The Greater Montreal area has three major transit projects that meet the selection criteria above, as shown in Table 1. The first two are already in service and the third is in procurement. There is no business case in the public domain for any of these projects, although our understanding is that business cases were completed for the first two projects. There is only limited evidence that any alternatives other than the project version implemented were examined as part of the business case or feasibility analysis. Finally, neither of the two projects already in service have had ex post business-case analyses conducted.

TABLE 1 GREATER MONTREAL TRANSIT INVESTMENTS

	Stage	Capex $M	Public CBA	Net Value $M, PV	BCR	Alternatives Analyzed	Ex Post CBA
Subway Extension to Laval	In service (2007)	745	No	(100)	0.71	--	No
Train de l'est (Mascouche)	In service (2014)	730	No		--	Yes(*)	No
Réseau Électrique Métropolitain (REM)	Procurement	6,040	No		--	--	No

(*) Other options examined but not through a CBA.

Notes: All figures expressed in currency of year reported, unless otherwise noted.

CBA: Cost-benefit analysis.

BCR: Benefit-cost ratio.

PV: Present value.

The extension of the Montreal subway to the city of Laval on the North Shore of the island of Montreal was announced by the Quebec government in the run-up to the 1998 provincial election, with a capital cost of $179 million. At the time, the project was not part of the planning priorities of either the provincial department of transportation (i.e., the Ministère des Transports du Quebec (MTQ)) or the Agence métropolitaine de transport (AMT), the regional transit-planning agency

created by the provincial government in 1996.[13] As a result of a review by the auditor general of Quebec, it was reported that a business case was completed in June 2000 showing a BCR of 0.71.[14] This suggests that the project was expected to lead to an economic loss of at least $100 million.[15] However, in retrospect, this result appears to be unduly harsh, because casual observation suggests that the three new subway stations appear to have attracted many new subway riders, even contributing to congestion on the subway's Orange Line. It is not clear to what extent that the subway extension has cannibalized ridership on the AMT's commuter-rail network, which extends to the same part of Laval. However, this project would appear to be a good candidate for an ex post CBA, the results of which could conceivably vindicate the project.

For the Train de l'Est project, a CBA was undertaken, but it is not in the public domain. There is evidence that other alternatives were examined at various times, but not as part of the CBA. One alternative through the city of Laval could have used an existing CP rail corridor and a second alternative could have relied entirely on the existing CN rail corridor and avoided the construction of a new 12-kilometre rail corridor, but it would not have served the towns of Terrebonne and Mascouche.[16]

The REM project had its roots in an agreement between the Quebec government and the Caisse de dépôt et placement du Québec (CDPQ) announced in January 2015.[17] The agreement gave the CDPQ the first right of refusal to assume the full ownership of new public-transit projects. The Quebec government assigned two pre-existing projects to the CDPQ:

- Light rail transit (LRT) service from the South Shore of Montreal to downtown via the new Champlain Bridge.
- LRT service from downtown Montreal to the West Island via the Trudeau airport.

The CDPQ came up with a third project, which incorporates the two above, but is different in several other respects:

- It is a new region-wide light rail network, extending from the Montreal South Shore to the North Shore and to the western extremity of the island.
- It replaces the existing heavy rail commuter network operated by the AMT along the Deux-Montagnes corridor, the highest-ridership corridor, with the proposed light rail network.
- The new LRT route to the airport is no longer direct from downtown Montreal, but instead travels via the existing Deux-Montagnes corridor, which is a longer-distance but higher-ridership route also intended to serve other destinations.

This third, region-wide project is now under procurement. In all likelihood, this project may be more viable in economic terms than the original two projects, and particularly the original airport LRT. However, there is no evidence that other region-wide alternatives were examined, which raises the question of whether or not the new project represents the best alternative for the region in terms of mobility, safety and environmental value. The CDPQ has published some financial

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13 For a summary of the project procurement, see Iacobacci (2008: 28-31).

14 Vérificateur général du Québec (2004: 156).

15 The net loss is based on applying the 0.71 BCR to the project capital cost at the time of the CBA ($345 million). The true net loss should be based on total project costs, including operations, which were a multiple of the $345-million figure, given that actual capital costs turned out to be more than twice as high.

16 See submission by the Accès L'Assomption during the environmental-assessment process: http://www.bape.gouv.qc.ca/sections/mandats/Train_Est/documents/DM27.pdf.

17 Agreement between Gouvernement du Quebec and Caisse de dépôt et de placement du Québec 2015.

information and ridership results for the REM, but it is not possible to assess whether the project creates net economic value for the region and if so, how much.[18]

4.2 Major Transit Projects in Greater Toronto

The GTHA has just over a dozen transit projects that fit the criteria for eligible projects. Only two of these projects are already in service: the Union Pearson Express and the Georgetown South Service Expansion. Five projects are under construction, four are in procurement and two are approved and funded. The first five projects do not have business cases in the public domain. Hence, we do not know if these are creating value for users and the public at large. The eight remaining projects all have business cases, although the evidence regarding value creation is mixed. Moreover, for one project — the Scarborough subway extension — the business-case methodology does not provide any estimate of expected value creation.

TABLE 2 GREATER TORONTO AND HAMILTON AREA TRANSIT INVESTMENTS

	Stage	Capex $M(*)	Public CBA	Net Value $M, PV	BCR	Alternatives Analyzed	Ex Post CBA
Union Pearson Express	In service (2015)	456(**)	No	--	--	No	No
Georgetown South	In service (2015)	1,500	No	--	--	No	No
Union Station Revitalization	Construction	1,393	No	--	--	--	N.A.
Toronto-York Spadina Subway Ext.	Construction	3,184	No	--	--	Partly (RTES 2001)	N.A.
East Rail Maintenance Facility	Construction	859	No	--	--	--	N.A.
Eglinton Crosstown LRT	Construction	3,345	Yes	(673)	0.77	Yes	N.A.
Hurontario LRT	Procurement	1,194	Yes	212	1.24	Yes	N.A.
Finch West LRT	Procurement	443	Yes	(183)	0.75	Yes	N.A.
Hamilton LRT	Procurement	829	Yes	69	1.1	Yes	N.A.
vivaNext York Region BRT	Construction	1,509	Yes	(239)	0.9	Yes	N.A.
GO Regional Express Rail	Procurement	8,547	Yes	23,381	3.3	Yes	N.A.
Scarborough Subway Ext.	Funded	3,159	Yes	No base case		Subway only	N.A.
GO Rail Bowmanville Ext.	Funded	572	Yes	(330)	0.56	No	N.A.

Notes: See Table 1.

(*) Capital costs sourced from CBA, expressed in currency of year reported.

(**) This cost estimate does not include any of the capital costs for the Georgetown South rail-corridor expansion, some of which is used to support the UPX service (AGO, 2012: 210).

The Union Pearson Express (UPX) has a history going back at least to the early 2000s, when the Government of Canada launched a procurement to design, build, finance and operate a dedicated air-rail link service from Toronto's Union Station to Pearson International Airport. This included transferring revenue and demand risk to a private-sector consortium. Not surprisingly, the

[18] CDPQ Infra (2017: 3) notes that "the REM project's rate of return (is expected) to be in the range of 8% to 9%." However, this is a financial rate of return and not the economic rate of return that would be provided by a CBA study. The same source also indicates that the total cost of the REM (i.e. capital and operating) will be between $0.69 and $0.72 per passenger-km as compared to a cost of existing networks of $0.66 per passenger-km – with the latter estimate covering only a part of the capital costs. This appears promising in terms of financial and economic value creation, but it does not address the benefits side of the CBA analysis.

preferred bidder was unable to reach an agreement and secure financing for the revenue-risk project following the global financial crisis of 2008–09 and, as a result, abandoned the project in 2010 (AGO, 2012: 211). The responsibility for the project was assumed by the Province of Ontario and Metrolinx, the provincial transit agency for the GTHA.[19] Metrolinx sought to implement a similar project alternative that had been under discussion with the private concessionaire, which was a premium rail service for airport travellers.[20] Little consideration appears to have been given to other alternatives, such as also serving the commuter market to Pearson airport, which is a major employment hub in the GTHA.

When UPX entered revenue service in 2015, ridership was well below the expected level of 5,000 passengers per day. As a result, the premium fare of $27.50 per trip (or $19 for those with a Presto fare card) — which was practically identical to the $27 fare proposed by the original private concession — was reduced to $12 per trip ($9 with Presto). While no ex ante business case is available publicly, the large fare reduction suggests that users' willingness to pay for the new service was much less than expected and that the commuter market may have been a more important share of overall ridership than expected. An ex post ridership study has been initiated, but neither that study nor an ex post CBA is yet available publicly.

As with UPX, the next four projects in Table 2 do not have public business cases either. This is in part because the planning for these projects started well before the creation in 2006 of Metrolinx, which has had a practice of undertaking and publishing business cases. This appears to be the case for the Union Station Revitalization project and the Georgetown South Expansion. The Toronto-York Spadina Subway Extension was managed directly by the City of Toronto. Again, we could not locate a CBA in the public domain, although there is some evidence that an analysis of alternatives was undertaken (Toronto, 2002). The same holds for the East Rail Maintenance Facility, with Metrolinx completing a feasibility study of alternative locations for such a facility in April 2009.[21]

The next four projects are all new LRT projects with business cases completed under the Metrolinx Multiple Account Evaluation framework. The Eglinton Crosstown LRT is currently under construction and is expected to be in revenue service in 2021. The business case examined four alternatives: three LRT alternatives and one subway alternative. The LRT business-case alternative (Option 3 — "Transit City Concept"), which is closest to the project now under construction, had a benefit-cost ratio of 0.77, which includes an estimate of reliability benefits (lower-bound only) and wider economic benefits.[22] Based on total project costs of $2,928 million, this implies a loss in value to society at large of $673 million on a present-value basis. However, it appears that the project under construction differs slightly from Option 3 (for example, it consists of one fewer station or stop than Option 3), but it is not clear what the impact is on the CBA results.[23]

It is also worthwhile noting that one of the Eglinton Crosstown LRT alternatives in the business case that was not pursued (Option 1 — "Eglinton-Scarborough Crosstown LRT") had a BCR of 1.01, suggesting it could achieve break-even. However, this alternative is redundant in the current context because it would have replaced the aging Scarborough Rapid Transit with an LRT

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19 The air-rail link was included in The Big Move, the Metrolinx regional-transportation plan published in November 2008. It was also subject to an environmental assessment jointly with the Georgetown South Service Expansion (published June 2009).

20 The Metrolinx five-year strategy document (2011) describes "the rail connection between downtown Toronto and Pearson International Airport … (as) a new premium service which does not currently exist in the region."

21 See Town of Whitby (2012: 4).

22 Reliability benefits and wider economic benefits are not typically included in Metrolinx business cases. Without these benefits, the Transit City Concept had a BCR of only 0.37. This raises the issue of the comparability of the Eglinton Crosstown business-case results with other business cases undertaken in the GTHA. However, it should also be recognized that reliability benefits are likely to be more important for this project than for others.

23 See Infrastructure Ontario (2016: 4) for a description of the project under construction.

alternative instead of the Scarborough Subway Extension that is currently being pursued by the City of Toronto. No BRT alternative appears to have been analyzed for the Eglinton Crosstown business case.

The Hurontario LRT project, which is currently under procurement, has been subject to considerable business-case analysis. The project under procurement — which extends from Port Credit at the south end to Steeles Avenue at the north end — has a BCR of 1.24 and delivers $212 million in net value creation, as shown in Steer Davies Gleave (2016a). The latter CBA examined only the alternative now in procurement. A 2014 CBA undertaken as part of the transit-project assessment process (TPAP) also examined just the one alternative, but it included the Main Street segment that was subsequently rejected by Brampton City Council — with the result showing a slightly lower BCR at 1.14. The original 2010 CBA examined three alternatives, including an LRT-only, a BRT-only and a mixed LRT/BRT option. The LRT option had a BCR of 1.5 compared to a BCR of 1.0 for the mixed BRT/LRT option. This suggests that the project underway is the highest-value alternative among those examined. The only caveat is that the BCR for the BRT option in the 2010 study was not reported because "the disbenefits of un-serviced demand have not been included" (Metrolinx, 2010).[24]

The Finch West LRT — which connects the new Finch West subway station on the Toronto-York Subway Extension on the east to Humber College on the west — is also in procurement.[25] An executive summary of the latest CBA undertaken for this project indicates a BCR of 0.75, implying a net loss in value of $183 million in present-value 2012 dollars (Steer Davies Gleave, 2015). However, a sensitivity analysis was done to capture the impact of the project on leisure trips to the Woodbine Racetrack. This showed the project attaining break-even when the impact of current and potential Woodbine visitors is factored into the CBA results.

The Finch West LRT CBA cited above examined only one project alternative — likely because it was the preferred alternative at that stage. Several LRT alternatives were examined as part of an earlier CBA for the entire Sheppard-Finch corridor (Metrolinx, 2009a), but this was a much larger project, the results of which are not easily comparable to the Finch West CBA. Nevertheless, the Sheppard-Finch CBA showed that a continuous LRT connecting Sheppard East to Finch West via Don Mills Road was the highest-performing alternative with a 0.9 BCR. No BRT alternatives were explored.

The Hamilton LRT project was originally proposed as part of the MoveOntario 2020 initiative announced by the Government of Ontario in June 2017 and it was also one of the top 15 projects in The Big Move (Metrolinx, 2008), along with the other GTHA LRT projects discussed above. The Hamilton King-Main CBA study (Metrolinx, 2010) examined three options for a new rapid-transit corridor from McMaster University to Eastgate Square (known as the B-Line): (1) a full BRT service, (2) a full LRT service, and (3) a phased LRT, where the LRT service on the eastern segment of the corridor is postponed to 2030. The CBA study reported that the BRT option had the highest BCR (1.4) and that both LRT options had a BCR of 1.1. However, the full BRT and phased LRT options exhibited similar net value creation ($93 million in present-value terms) as compared

[24] This is unusual, because mode-choice models, which distinguish between BRT and LRT travel modes, usually capture all the generalized costs and benefits associated with each option. Our own calculations using the figures in the 2010 report indicate a BCR of 1.63 for the BRT option (i.e., only marginally higher than the 1.5 BCR for the LRT option), but it is unclear which "disbenefits" were not included.

[25] The executive summary was published on the City of Toronto website. The full business case is not publicly available. Only the older Sheppard-Finch CBA is available on the Metrolinx website.

to only $69 million for the full LRT option.[26] Nevertheless, Hamilton City Council recently voted to proceed with an LRT service along the entire corridor, which appears closest to the full LRT option — the option with the lowest net value creation.[27]

The vivaNext project in York Region is the second phase of an original BRT service that opened between 2005 and 2008 and now consists of articulated buses in mixed traffic. The vivaNext project now underway consists of building segregated bus lanes with signal priority, which would improve run times and service reliability. The CBA report analyzed two options with the same proposed BRT network: Option 1 to be built by 2018 and Option 2 had a portion of the network deferred until 2026. The results for both options suggested that the project does not create any net economic value, with Option 2 exhibiting a slightly higher BCR (0.9) than Option 1 (0.8).[28] The project alternative under construction is Option 2.

The GO Regional Express Rail (RER) initiative dwarfs all other major rapid-transit projects in the GTHA, both in terms of expected project spending and, more importantly, in terms of value creation, as shown in Figure 4 below. GO RER is intended to transform the existing region-wide commuter rail network — currently used mainly for peak period trips to Toronto's central business district — into a more frequent, two-way, all-day service, including providing electrified service in the core sections of the network. The initial business-case analysis examined four scenarios for the intensification of services on the GO rail network (relative to the do-minimum scenario), with the BCR results in a range between 1.6 and 3.1, excluding wider economic benefits (WEBs) and GHG impacts. The scenario currently in procurement is the best-performing scenario with a BCR of 3.1 (or 3.3 with WEB and GHG impacts) and delivers net economic value creation of $24.8 billion (2014 dollars) over a 60-year period. The outstanding performance of this major project is due in large part to the fact that it relies on an existing and arguably underutilized asset — the heavy rail network corridor in the GTHA that was built for the freight railways and has been increasingly used for commuter rail services.[29] According to the initial RER business case, the new off-peak services and more frequent, speedier RER journeys are expected to increase GO ridership by two and a half times between the years 2014 and 2029, while annual operating costs will increase by much less than two and half times (Metrolinx, 2015: iv).

It is worth noting that GO RER is a region-wide project for the GTHA, like the REM for Greater Montreal. However, the REM project is a new light rail network, part of which will replace the existing heavy rail commuter network. The GO RER IBC did not examine a light rail/metro option in its alternatives analysis, although it is unlikely that such a new network would have been as cost-effective as the continued use of the heavy rail network, part of which continues to be used by the freight railways. As for the REM project, the business-case results are not publicly available, nor is it clear if the option of delivering an RER-equivalent project using the heavy rail network for Montreal was examined as an alternative.

The Scarborough Subway Extension (SSE) is intended to replace the aging Line 3 Scarborough, which is a mostly-elevated light rail line with six stops. The SSE is a fully funded $3.3-billion single-stop extension of the Bloor-Danforth subway line from Kennedy Station to a new subway

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[26] This represents an instance where BCRs are misleading in ranking project alternatives, because alternatives 1 and 3 should have a similar ranking given their NPV results.

[27] See the Hamilton LRT project update on the Metrolinx website: http://www.metrolinx.com/en/projectsandprograms/transitexpansionprojects/hamilton_lrt.aspx (accessed June 4, 2017). A previous version of the project would have had the LRT service from McMaster to Queenstown (i.e., three fewer stops than the McMaster-Eastgate Square version).

[28] See Metrolinx (2008a).

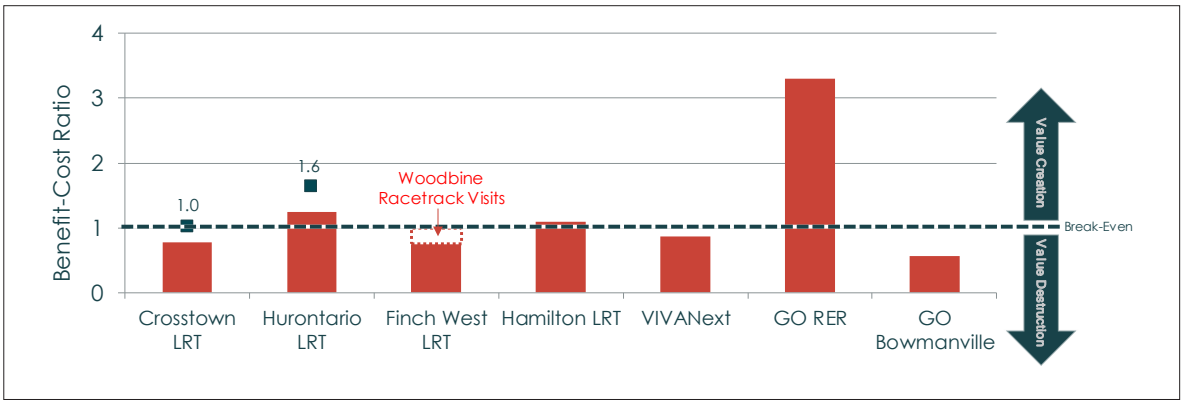
[29] See Metrolinx (2015). This RER IBC does not include the 12 new stations proposed for the GO rail network, which were examined under separate IBCs. See http://www.metrolinx.com/en/docs/pdf/board_agenda/20160628/20160628_BoardMtg_Regional_Express_Rail_EN.pdf.

station at Scarborough Centre 6.2 kilometres away.[30] The SSE IBC examined only subway alternatives and it did not include a base case or do-minimum option. Hence, it is not possible to assess the economic-value creation resulting from the project.

The extension of GO rail service along the Lakeshore East corridor to Bowmanville would provide four peak-period, peak-direction diesel-train services to and from Bowmanville via a new railway bridge crossing Highway 401 just west of the Oshawa GO station. The IBC examined only one option against a base case and found a BCR of 0.56, which implies value destruction in the order of $330 million (in 2015 dollars).[31] The study considered a second possible alignment south of the 401 along the existing CN corridor. This would avoid the construction of the railway bridge, which accounts for most of the capital cost of the project ($400 million), but it would also be further away from the nearby local communities, which are mostly north of Highway 401, including downtown Oshawa, which is designated as a mobility hub. Perhaps for this reason, the second option was not evaluated in the CBA.

Figure 4 below summarizes the CBA results for the GTHA projects currently underway. It shows which ones create or destroy value and those with alternatives that were not pursued but might have delivered greater value.

FIGURE 4 PROJECT VALUE CREATION IN THE GTHA



Note: Dots above the columns indicate projects where the CBAs showed alternatives with greater value.

4.3 Major Transit Projects in Metro Vancouver

Metro Vancouver has five transit projects that fit the criteria for eligible projects. Two of these projects are already in service: the Canada Line and the Millennium Line Evergreen Extension. One project is under construction and two are funded. Only two of the five projects do not have business cases in the public domain. Hence, we do not know if these are creating value for users and the public at large. The three remaining projects all have business cases, with two of those — the Canada Line and the Millennium Line Evergreen Extension — showing significant value creation. However, neither of these projects has been subject to an ex post CBA, which would either confirm the expected value creation or revise the estimate. Moreover, the first phase of the Surrey LRT is expected to destroy value, although this may turn out more positively depending on the option selected for Phase 2.

[30] See City of Toronto and TTC (2016) and City of Toronto (2017).

[31] See Metrolinx (2015a).

TABLE 3 METRO VANCOUVER TRANSIT INVESTMENTS

	Stage	Capex $M	Public CBA	Net Value $M, PV	BCR	Alternatives Analyzed	Ex Post CBA
Canada Line	In service (2010)	1,604	Yes	296	1.25	Yes	No
Millennium Line Evergreen Ext.	In service (2016)	1,400	Yes	197	1.27	Yes	No
Expo Line Upgrade Strategy	Construction	1,092	No	--	--	Yes	N.A.
Surrey LRT	Funded (2016)	2,180	Yes	(510)	0.69	Yes	N.A.
Millennium Line Broadway Extension(*)	Funded (2016)	3,010	Yes	2,257	2.3	Yes	N.A.

Notes: See notes in Table 1.
All figures expressed in currency of year reported, unless otherwise noted.
Capital costs sourced from CBA and expressed in currency of year reported.
(*) Results reported for RRT (i.e., SkyTrain) option.

The Canada Line is the third line built as part of Vancouver's SkyTrain metro system. It connects downtown Vancouver to Richmond, B.C. and to Vancouver International Airport. The Multiple Account Evaluation study examined four options: an exclusive and a shared right-of-way, and either built either by 2010 or by 2021.[32] The exclusive right-of-way option was built and opened for service in 2010. However, the MAE study did not report an economic benefit-cost ratio. Assuming that the user benefits reported for transit and road users represent the total user benefits (i.e., the additional revenue from transit users does not represent an additional willingness to pay for the project), the project option that was built exhibited a BCR of 1.25 and net economic value creation of $295 million in 2001 dollars at a five-per-cent real discount rate.[33] The same exclusive right-of-way option built in 2021 had a BCR of 1.53 and net value creation of $359 million. Notwithstanding the importance of the project for the Vancouver Winter Olympics in 2010, it is unlikely that the Canada Line could have been built a decade later at the capital costs reported in the MAE study. This suggests it may have been the right decision not to postpone the Canada Line to 2021.

The Millennium Line Evergreen Extension to the SkyTrain network was completed and in service in 2016. The CBA examined several alternatives, including LRT and ALRT (i.e., advanced light rail transit, the SkyTrain-type technology). The project alternative implemented (ALRT for the Northwest corridor) had a BCR of 1.27 and entails net value creation of $197 in 2008 dollars.[34] It is also the alternative that delivers the greatest economic value.

The Expo Line Upgrade Strategy is intended to increase the capacity of the first SkyTrain line. Several options were examined, including four-car and five-car options, although no explicit benefit-cost analysis appears to have been undertaken.[35] The project is now underway and consists of the five-car option, which includes the cost of more trains and associated infrastructure upgrades to several stations.

The Surrey LRT project consists of two lines to be delivered in two phases. Phase 1 is an 11-kilometre L-shaped line linking Guildford Town Centre, Surrey City Centre and Newton Town Centre, and Phase 2 is a 17-kilometre line linking Surrey City Centre and Langley Town Centre. The alternatives analysis examined 13 alternatives for the two phases jointly, including BRT, LRT

[32] See IBI Group (2001).

[33] Alternatively, if the net transit revenue from the project represented an additional willingness to pay for the transit services (i.e., those benefits were not captured in the reported user benefits), the BCR would be 1.39 and the value creation would be $457 million in 2001 dollars.

[34] See TransLink (2008: 29).

[35] See SNC Lavalin, Steer Davies Gleave (2010).

and rapid rail transit (i.e., the SkyTrain technology).[36] However, it is not entirely clear which option has been selected for funding and procurement. We know from the City of Surrey website that Phase 1 of the project has been funded and the preferred option is an LRT for both phases.[37] This option is closest to the alternative called "LRT1" in the alternatives study, which has a BCR of 0.69 and would result in an economic loss of $510 million in 2010 dollars discounted at a six-per-cent real interest rate.[38] The top-performing alternative in the IBI Group (2012) study was "RRT1," which consisted of the SkyTrain extension to Langley alone (Phase 2) without any rapid transit service for the L-shaped corridor linking Guildford, Surrey City Centre and Newton — at a BCR of 1.55. The next best option was "RRT1A" at a BCR of 1.45, which is the same as the "RRT1," but it also has a BRT service for the L-shaped corridor mentioned above.

While the "LRT1" alternative is closest in concept to the project that is underway, the business-case results could differ from the 0.69 result for two reasons: (i) the "LRT1" option also includes a BRT segment from Newton to White Rock, which does not appear in the project described on the City of Surrey website, but it is unclear whether or not this component would improve the results; and (ii) Phase 2 could potentially be an extension of the existing SkyTrain service (instead of an LRT), which would improve the business-case results significantly. It is also possible to infer that a BRT alternative for the L-shaped corridor in Phase 1 would have a BCR of 1.15.[39] Hence, this option is shown as the superior alternative to the Surrey LRT project shown in Figure 5 below.

The Millennium Line Broadway Extension project is an extension of the existing SkyTrain Millennium Line from VCC-Clark station through to Arbutus Street, with six underground stations on Broadway and a BRT service from Arbutus through to the University of British Columbia. As for other projects, it is challenging to link the project underway to the alternatives evaluated in the CBA. The CBA screened an initial 200 options, including three technology alternatives (BRT, LRT and RRT, i.e., the SkyTrain technology) and then shortlisted seven final options for analysis.[40] The RRT option — which would entail an extension of the SkyTrain all the way to UBC — was the highest-performing option with a BCR of 2.3 and value creation of $2,257 million in 2010 dollars discounted at a real interest rate of six per cent. However, the project underway is a phased version of the RRT option, with the RRT initially going to Arbutus Street and then to UBC in a future phase. The phased version was not fully evaluated, but the CBA did note that the phased RRT had a BCR of 2.7.[41] However, the results reported in Table 3 above and Figure 5 below are for the full RRT option without phasing.

Figure 5 below summarizes the CBA results for the Metro Vancouver projects that have been recently completed or are currently underway. It shows that most of these have either delivered net positive value (e.g., the Canada Line) or are expected to do so. The one exception is the Surrey LRT, which may not deliver value in its current form, although Phase 2 could restore the overall project to net positive value creation if it is delivered as an extension of the existing SkyTrain service rather than as an LRT. Finally, there is some evidence that the projects underway were not the highest-value alternatives available to decision-makers. This can probably be discounted in the case of the Canada Line, where the alternative referred to the same project delivered 10 years later, but it remains a concern for the Surrey LRT.

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36 See IBI Group (2012).

37 See http://www.surrey.ca/files/LRTMap.pdf.

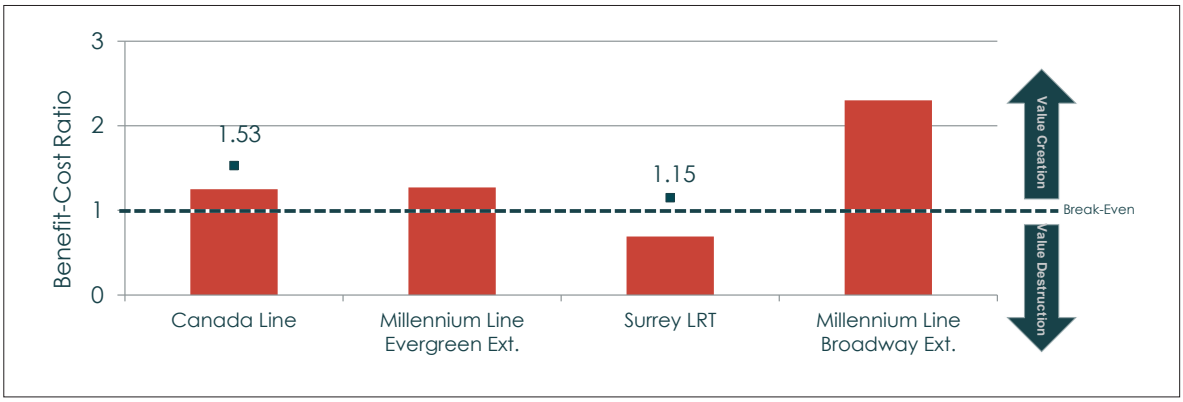
38 But LRT1 also includes a BRT segment from Newton to White Rock, which does not appear in the project described on the City of Surrey website.

39 This can be deduced by taking the difference between "RRT1A" and "RRT1," which amounts to the BRT linking Guildford, Surrey and Newton.

40 See Steer Davies Gleave and SNC Lavalin (2012).

41 Steer Davies Gleave and SNC Lavalin (2012: 146, paragraph 12.26).

FIGURE 5 PROJECT VALUE CREATION IN METRO VANCOUVER



Note: Dots above the columns indicate projects where the CBAs showed alternatives with greater value.

5. BUSINESS CASE RESULTS: RECOMMENDATIONS AND GOOD INDUSTRY PRACTICES

The review of business cases for 21 major public-transit projects across Canada's three largest urban areas provides the basis for a number of recommendations, lessons and good industry practices for the sponsor governments, transit agencies and senior-level governments funding the projects. These recommendations also apply to other asset classes where benefits and costs are easily valued at social prices (i.e., at prices that reflect the users' willingness to pay and benefits or costs to the public at large), including water, environmental and energy assets.

First, business cases should be undertaken for all major projects in order to assess if they provide a net improvement in well-being for users and the public. This applies to projects which require public funding as well as to privately funded projects which may have negative externalities. This also means identifying at least one version of the project under consideration and comparing it to a base case (or do-minimum) scenario that represents a reasonable and realistic view of the world in the absence of the project. It also means analyzing the project option against the base case through the following lenses:

- Strategic — Is the problem at hand well-defined and understood? Does the option address the problem at hand? Are there any other options that can also address the problem and should therefore be subject to evaluation?
- Financial — What will be the financial impact of each project option relative to the base case for the project owner (e.g., the municipality) and possibly for neighbouring municipalities and their operating entities (e.g., transit operators)? Can the sponsoring government afford to invest in the project? What additional funding is required by the sponsor during construction and operations?
- Economic — Is the affected region better or worse off as a result of the project (and by how much)? The economic assessment should cover costs and benefits for users and for the public at large over a sufficiently long time period to capture most of the project lifecycle.
- Deliverability — Is the project option technically and commercially feasible to build and operate? Or are there significant challenges in terms of constructability, stakeholder engagement, access to property, operations or other factors that could materially affect costs and/or schedule, or could even require it to be abandoned?

There are many cases of governments in recent history that have not undertaken such business cases, especially when project funding was already secured. In some cases, governments have explicitly avoided answering the above questions (e.g., when business cases do not have a

reasonable economic case), thereby resulting in a "business case" in name only. The result is that decision-makers are left in the dark as to the true impacts of the projects they are embarking on.

Secondly, business cases should be made publicly available in advance of the point in the delivery of the project where it is no longer possible to change course (or abandon the project) without significant liabilities and sunk costs for the sponsor government. This point is usually the middle to end of the procurement process. Without a publicly available business case that answers the above questions, there can be no transparency and no accountability for the sponsor governments, nor for any senior-level government funders. This leaves plenty of room for special interests to prevail.

Third, projects should be prioritized based on net economic value creation. This is the measure that best captures the broad public interest, including the interest of both users and society at large. In the case of the public-transit projects, user impacts cover changes in travel time and costs for transit and road users, as well as safety impacts. In addition, studies often monetize environmental impacts (e.g., GHG and local air-quality emissions). In some cases, studies also examine the wider economic benefits of projects. Hence, this measure of value is the broadest available to capture various dimensions of the public interest.

Project prioritization should be based on the following decision rules. For any one project, the preferred option should have:

1. A benefit-cost ratio (BCR) greater than 1:1 for the future stream of economic costs and benefits. (Alternatively, the net economic benefits of the project measured in net-present-value terms should be greater than zero). Without this, there can be no confidence that the project is improving public welfare (on a net-of-cost basis), which raises the question as to why the project is being pursued. Even a preferred option with a very low (or break-even) BCR could result in no value creation if there is a cost overrun or if user benefits are overestimated, both of which are common occurrences.

2. The highest net present value (NPV) of economic benefits. (The highest BCR ratio does not always yield the project with the greatest net benefits).[42] In the presence of a budget constraint, the correct decision rule is to choose the option within the budget constraint with the greatest economic NPV.[43]
   Other analysts have suggested a variation on the above decision rules for senior-level governments seeking to maximize the value impact of their funding.[44]

The second decision rule can be more challenging to implement in practice, due to a whole host of reasons ranging from community preferences to more practical issues relating to the deliverability of certain options. However, it is the gold standard for decision-making intended to promote the public good as well as the productivity and competitiveness of the regional economy in question.

Prioritizing investments across different projects is a more challenging proposition. The power of CBAs is that these allow, at least in principle, for a comparison of different projects across different types of assets on a like-for-like basis. This implies that rule 2 above should also apply to choosing which project(s) deliver the greatest benefits. However, in practice, this requires a number of assumptions, notably that:

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[42] For project options of different sizes, it is possible for a project with the highest NPV to have a lower BCR than other projects with a lower NPV. In addition, the calculation of the BCR can be sensitive to the way in which costs are defined. See chapter 4 ("Discounting and Alternative Investment Criteria") of Jenkins, Kuo and Harberger (2011) for a full discussion of the BCR, net present value and other decision rules for the choice of investments.

[43] Note that both decision rules (i.e., highest NPV with or without budget constraints) apply only when options are mutually exclusive.

[44] For example, see Robins (2017: 16) suggesting that the new Canada Infrastructure Bank use a "net benefits-government investment ratio" as a more appropriate decision rule than the overall benefit-cost ratio.

- The CBA studies compared provide a complete representation of the applicable costs and benefits.
- The CBA studies compared are based on accurate assumptions about the unit values of different types of benefits. For example, public transportation projects in any one region are usually based on the same set of valuation assumptions, which are usually set by the regional planning authority.

In practice, the two assumptions are easily verifiable only when dealing with a single asset class (e.g., rapid transit) in one region, like the GTHA. It is much more challenging to compare different types of projects, especially across different regions. Figure 6 below shows the types of travel-time, cost and related benefits that have been evaluated for the seven GTHA rapid transit projects with CBAs reported in the last section. While all the CBAs examine basic categories such as transit and auto travel-time impacts, others incorporate other benefits such as improved reliability, urban realm or agglomeration economies in the CBA results. We also know that most of the underlying valuation and discount assumptions are identical between the studies.[45] While it is possible to compare all CBAs on a like-for-like basis (i.e., covering the same minimum set of impacts), this is not necessarily the correct approach because some types of impacts (like reliability), may be more important for some projects than others. In summary, a prioritization across different projects requires a very careful analysis of the CBA results. However, in this case, it is unlikely that such a reconciliation would alter the main features of the CBA results in Figure 4 (section 4.2), such as the standout performance of GO RER.

FIGURE 6 COMPARISON OF IMPACTS VALUED FOR SELECTED SET OF METROLINX RAPID TRANSIT CBAs

		Eglinton Crosstown	Hurontario LRT(**)	Finch West LRT (***)	Hamilton LRT	VIVANext	GO RER	GO Rail Bowmanville Service Extension
Travel time	Transit	yes	yes	yes	yes	yes	yes	yes
	Auto	yes	yes	yes	yes	yes	yes	
	Reliabiliy	yes			yes	qual	qual	
	Convenience/comfort			qual		qual	qual	
	Crowding relief (other modes)*						qual	
Travel costs	Vehicle operating costs	yes	yes	yes	yes	yes	yes	
	Fares	yes	yes	yes	yes	yes	yes	yes
	Safety (road collisions)	yes	yes	yes	yes	yes	yes	
	Urban realm		yes					
Environment	GHGs	yes	yes	yes	yes	yes	yes	
	CACs						yes	
Wider Economic Benefits	Agglomeration economies	yes					yes	
	Labour supply	yes						
	Imperfect competition	yes						
Economic Development	Economic impacts	yes	yes	yes	yes	yes		
	Land value uplift	yes	yes	yes	yes	yes		
Social/Community	Land use change	qual		qual	qual	qual		
	Health	qual	yes			qual		
	Accessibility	qual						
	Traffic and community Impacts				qual	qual		
Approach		MAE	4-Case	MAE	MAE	MAE	4-Case	4-Case

Notes: (*) Excluding road decongestion benefits;
(**) Based on SDG (2016a)

(***) Based on SDG (2015)

Legend:
- Quantified and included in CBA
- Quantified but not included in CBA
- Assessed qualitatively (qual)
- Not evaluated

The fifth recommendation is that ex post CBA studies should be undertaken for all completed projects once these have had two to three years to ramp up to their steady-state growth. This recommendation applies to all the jurisdictions examined and to all completed projects reviewed in

[45] One exception is that the earlier CBAs, notably VIVA, used a real discount rate of five per cent, while the more recent CBAs used a 3.5-per-cent discount rate.

this report, some of which have clearly not met original expectations regarding ridership and fares (e.g., the Union Pearson Express) and would, on that basis alone, merit an ex post CBA review.[46]

In addition to the above recommendations, we would recommend the following good industry practices:

- CBA studies should not be treated only as an ex post justification of a project option developed through an unrelated planning process. CBAs are a tool that should be used to evaluate alternative project options and where appropriate, illustrate any trade-offs. The development and evaluation of project options should be an iterative process. Following an initial evaluation, option features can be modified to improve project performance; followed by a re-evaluation. All option features should be considered, including but not limited to: (i) service offering, (ii) vehicle technology, (iii) project phasing (iv) end-user pricing and (v) target-market segments.
- CBA studies should be made publicly available at a single location that can be easily found from the main website of the government sponsor or agency.[47] Clearly this suggestion applies to entities such as Metrolinx or TransLink, which have responsibility for or oversight of multiple projects in their respective regions.
- The CBA website above should indicate clearly which project option has been advanced for future analysis or procurement (i.e., the "preferred option") and what changes, if any, have been made to the latest version of the project as compared to the preferred option analyzed in the CBA. It is recognized that a project evolves through various stages of approvals, including environmental assessments, preliminary design and procurement. As a result, it is often unclear how the project options analyzed in the CBA relate to the version of the project that is underway. A brief explanation on the website indicating which CBA option is the preferred option and any significant differences relative to the latest version of project underway would support greater transparency.
- CBA studies should also be updated at appropriate stages in the evolution of the project. For example, an initial CBA would examine a full range of project options, illustrating the process for arriving at a short list of options for analysis. An updated or intermediate CBA would undertake a more in-depth and comprehensive analysis of one or two options. And a final CBA would do an in-depth analysis of the preferred option following completion of the procurement stage. Each of these should be made publicly available on the CBA website.

[46] Ex post assessments are increasingly common in western European countries such as the U.K. and France. See ITF (2015).

[47] By way of example, see links on the Metrolinx website: http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/benefits_case_analyses.aspx.

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