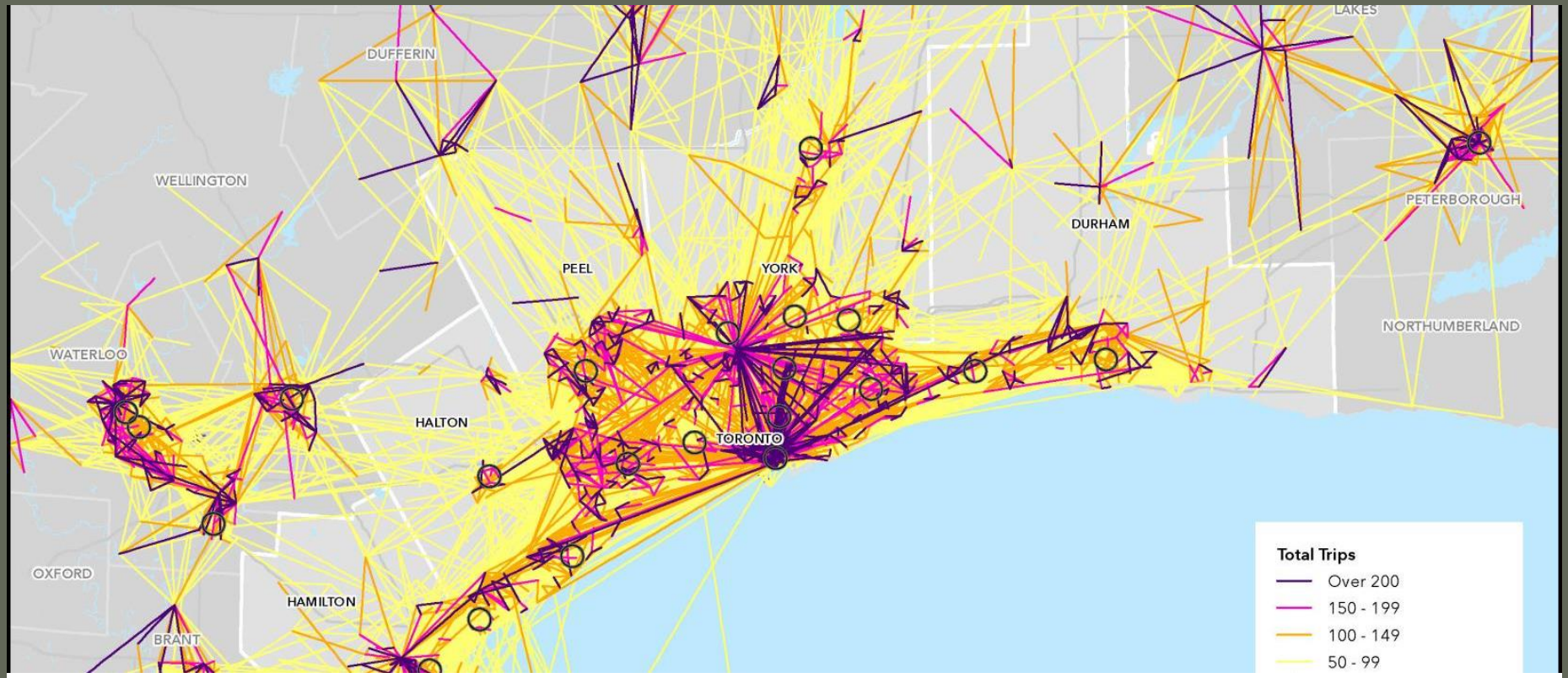

Transport Economics and Appraisal

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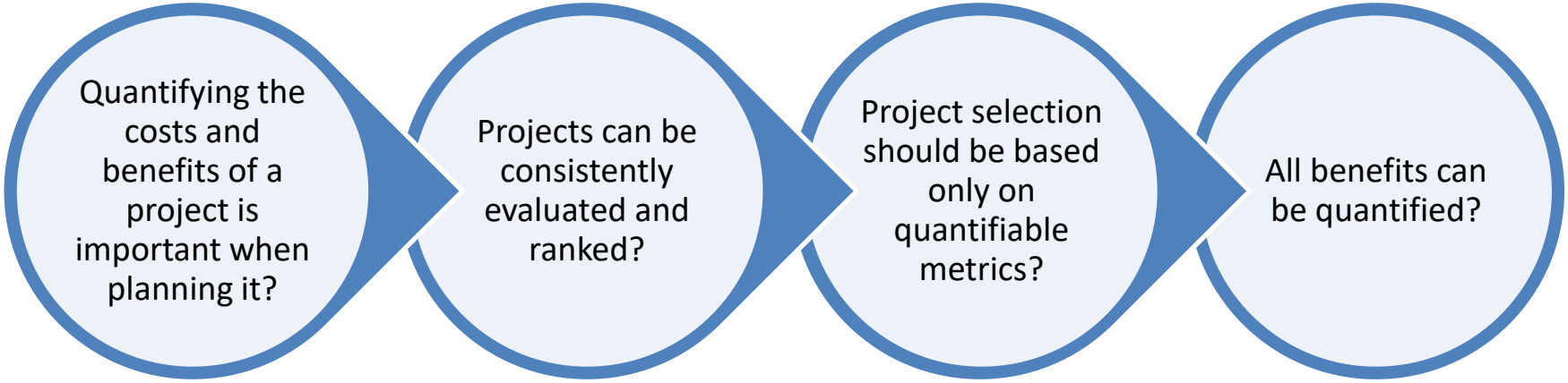
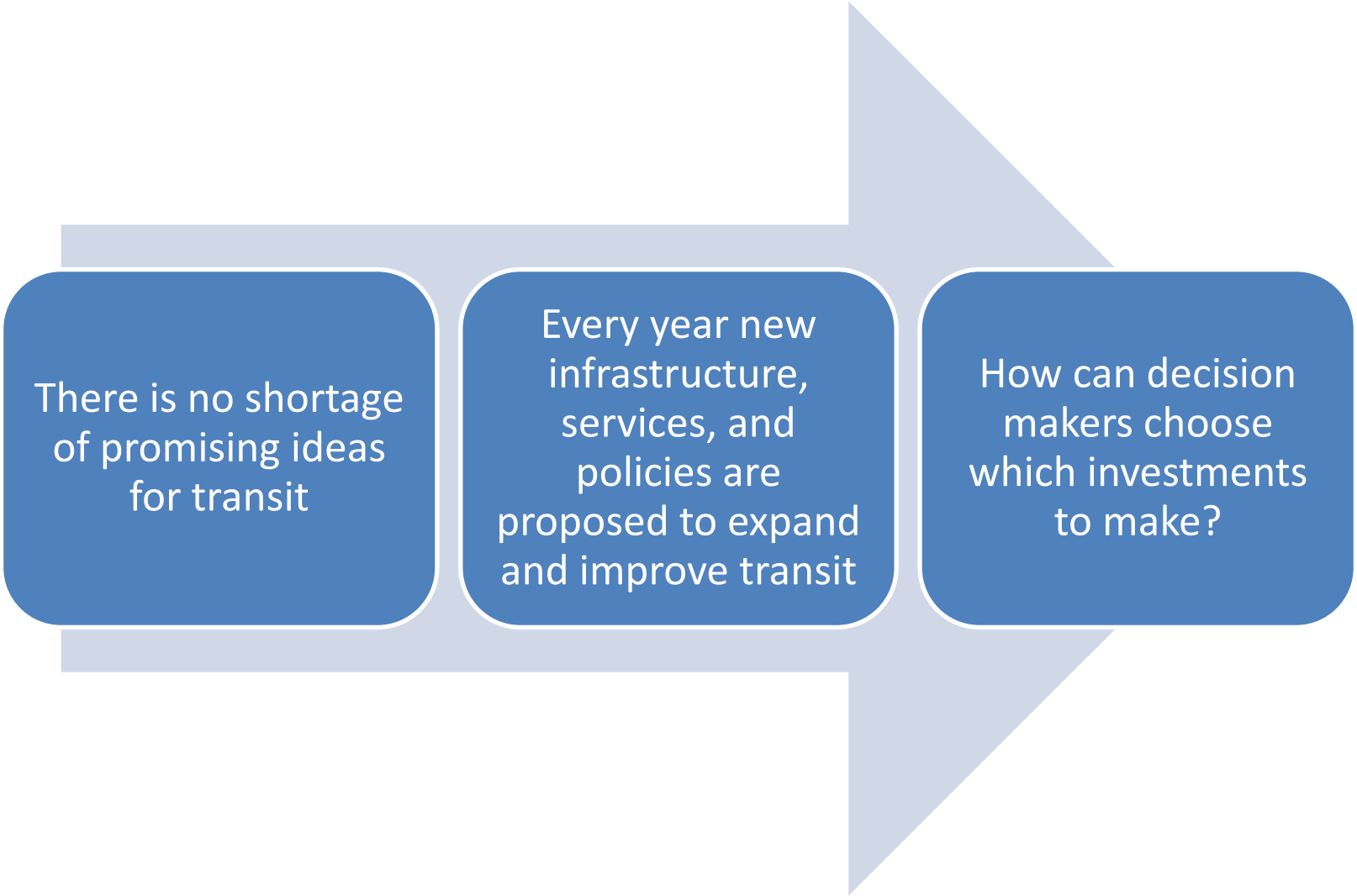
INTRODUCTION

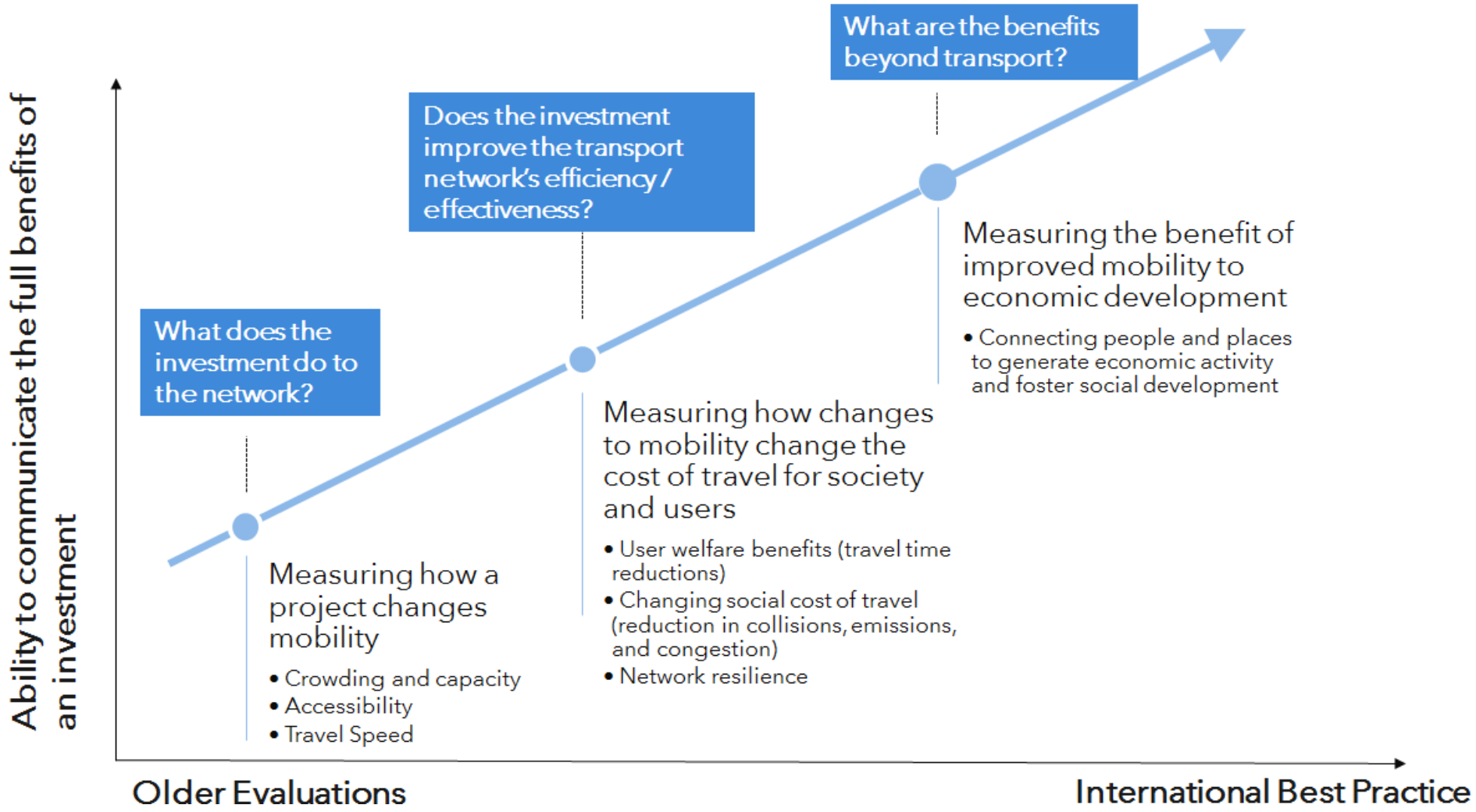
Questions for you



The need for appraisal



Evolving to meet new demands



BUSINESS CASES AS A TOOL FOR APPRAISAL

Business cases

- Comprehensive collection of evidence and analysis that sets out the rationale for why an investment should be implemented to solve a problem or address an opportunity
- Provide evidence to decision-makers, stakeholders, and the public as a crucial part of transparent and evidence-based decisions
- Used throughout any proposed investment's lifecycle, including planning, delivery, and performance monitoring

Four cases of appraisal

Strategic Case

How does the investment achieve strategic goals and objectives?

- Determines the value of addressing a problem or opportunity based on regional development goals, plans, and policies
- Options are evaluated against objectives that tell a clear narrative of how the investment can address the problem or opportunity
- Establishes 'why' an investment should be pursued from a strategic lens

Economic Case

What is the investment's overall value to society?

- Assesses the economic costs and benefits of the proposal to individuals and society as a whole, and spans the entire period covered by the investment
- Uses standard economic analysis to detail benefits and costs in economic terms
- Establishes 'what the benefit to society' is in economic terms

Financial Case

What are the financial implications of delivering the investment?

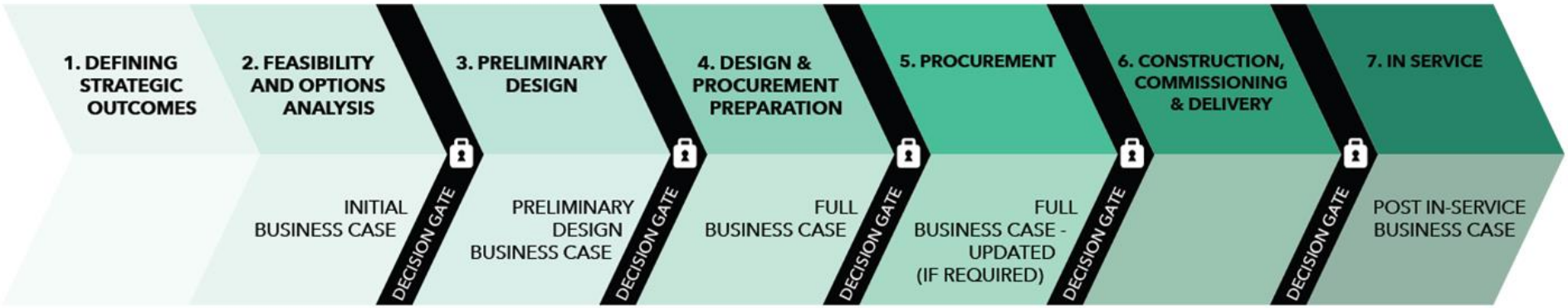
- Assesses the overall financial impact of the proposal, its funding arrangements and technical accounting issues and financial value for money
- Focuses on capital, operating, and revenue impacts directly related to the investment and indirectly resulting from the investment
- Establishes 'how much the investment will cost' in financial terms

Deliverability and Operations Case

What risks and requirements must be considered for delivering and operating the investment?

- Provides evidence on the overall viability of one or more options for addressing the problem/opportunity
- May consider procurement strategies, deliverability risks, operating plans and risks, or organizational risks
- Establishes 'what is required to deliver and operate' the investment

Used throughout the project lifecycle



Identifies problem statement and defines benefits that the project needs to deliver.

Evaluates options and determines a preferred option. Typical point at which funding for planning and preliminary design is secured.

Refines preferred option, further clarifying scope and cost. Typical point at which funding for procurement and construction is secured.

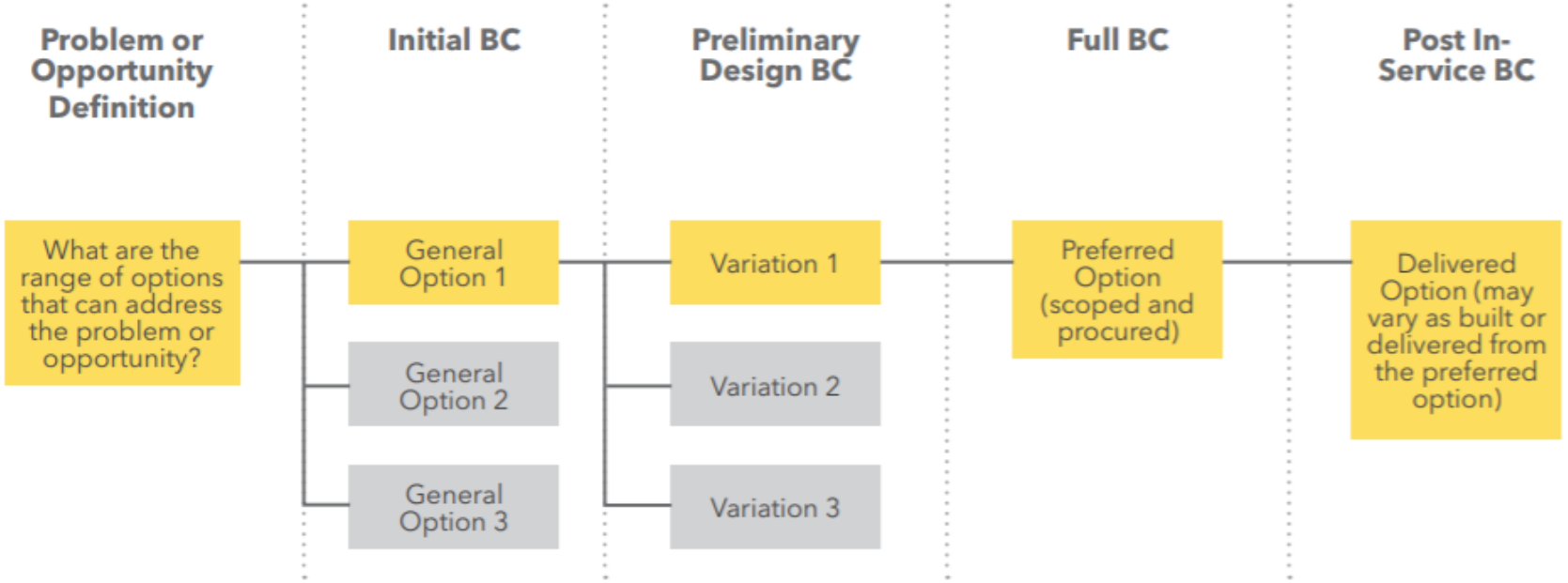
Develops project framework, designs and requirements used as the basis for procurement.

Procures the project.

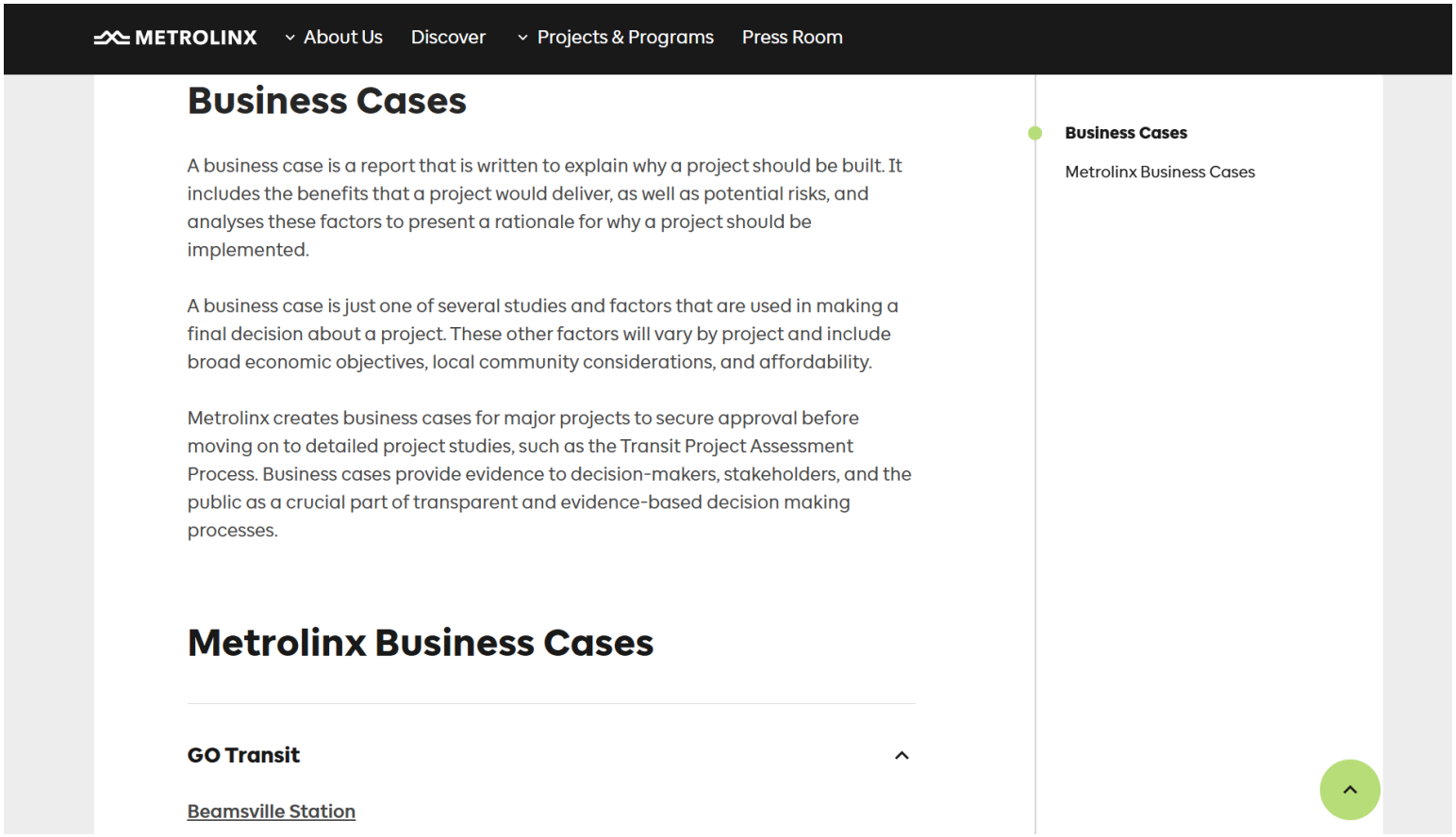
Delivers and commissions the project.

After the asset is in service, monitors the benefits and costs to identify opportunities for enhancements and lessons learned.

Options over the Business case lifecycle



Examples of business cases



Metrolinx publishes many of its business cases at https://www.metrolinx.com/en/about-us/doing-business-with-metrolinx/business-cases

CONCEPTS

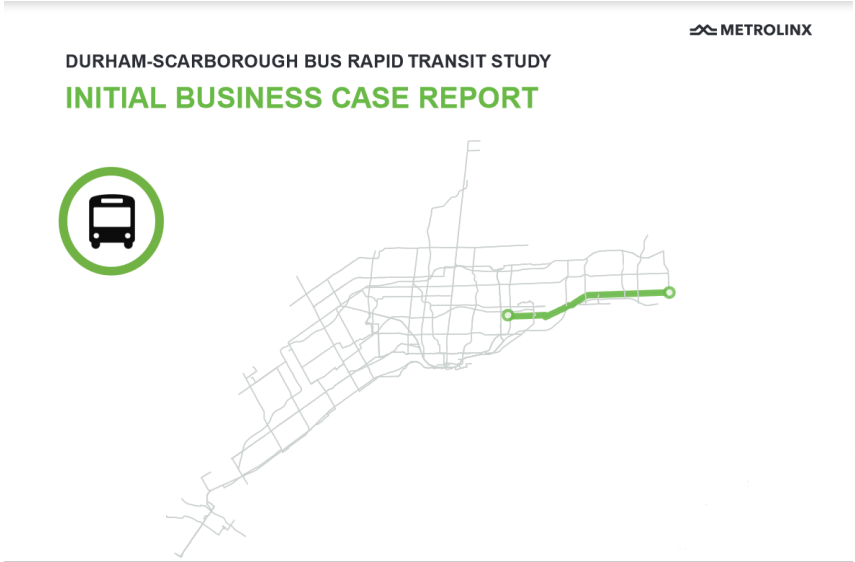
Problem or opportunity statement

- A concise summary of the case for change being considered
- Should be 'investment agnostic'

Problem/Opportunity Driver	Description
Transport Network (Internal Drivers)	• The transport network is defined as the components that make up the network, and the resulting traveller behaviour. • It includes: the state or condition of infrastructure, technology, and services, and how customers use the network. • Analysis is conducted with a consideration of existing and future conditions.
Drivers External to the Transport Network (External Drivers)	• External drivers are defined as the factors that influence or direct travel behaviour and transport infrastructure/technology. • They include stakeholder input, government policies, and economic activity, land use, and demographics.

Problem statement example

The Highway 2 BRT corridor is a crucial transportation corridor connecting people through the Region of Durham and Scarborough. The corridor has varied traffic, land use conditions and constraints. With rapid growth in the past decade and an expectation for this growth to continue into the future, demand for travel along the corridor will continue to increase and a higher capacity form of transit will be needed to link communities and employment on both sides of the Toronto-Durham boundary.



Business As Usual

The baseline against which options are compared where the investment has not occurred and existing business practices, committed plans and general trends continue into the future

Funded and committed major changes to the transport network

Minor changes to the network based on changes to transport demand in future years

Land use, population, and employment assumptions that are consistent with official plans/policies.

Options

Poor Options Analysis

- A business case examining new locomotive procurement contains only one option for analysis: Purchase 10 new locomotives
- No examination of purchasing different types of locomotives (used, refurbished) nor the case for not purchasing

Sound Options Analysis

- 2018 Durham-Scarborough Bus Rapid Transit IBC examined differing technologies and routes to deliver the project
- Option 1: Center Median bus lanes along the identified corridor
- Option 2: Curbside bus lanes
- Option 3: Hybrid alternative applying elements of options 1 and 2

Base vs Real vs Nominal

The Business Case uses 3 types of costs:

Base costs, which are an estimate of the cost of the investment if the entire system was procured today, are used to scope the concepts.

Economic costs, which are used to understand the economic value of the investment to society in the Economic Case.

Financial costs, which are used to understand the financial cash flow impacts of the investment in the Financial Case.

Base costs

The expected cost to provide an investment including capital and operating costs.

Economic costs (real costs)

Investments require capital and operating costs to be paid throughout the project lifecycle. Economic costs reflect the real price of these costs based on the year they are incurred and a social discount rate.

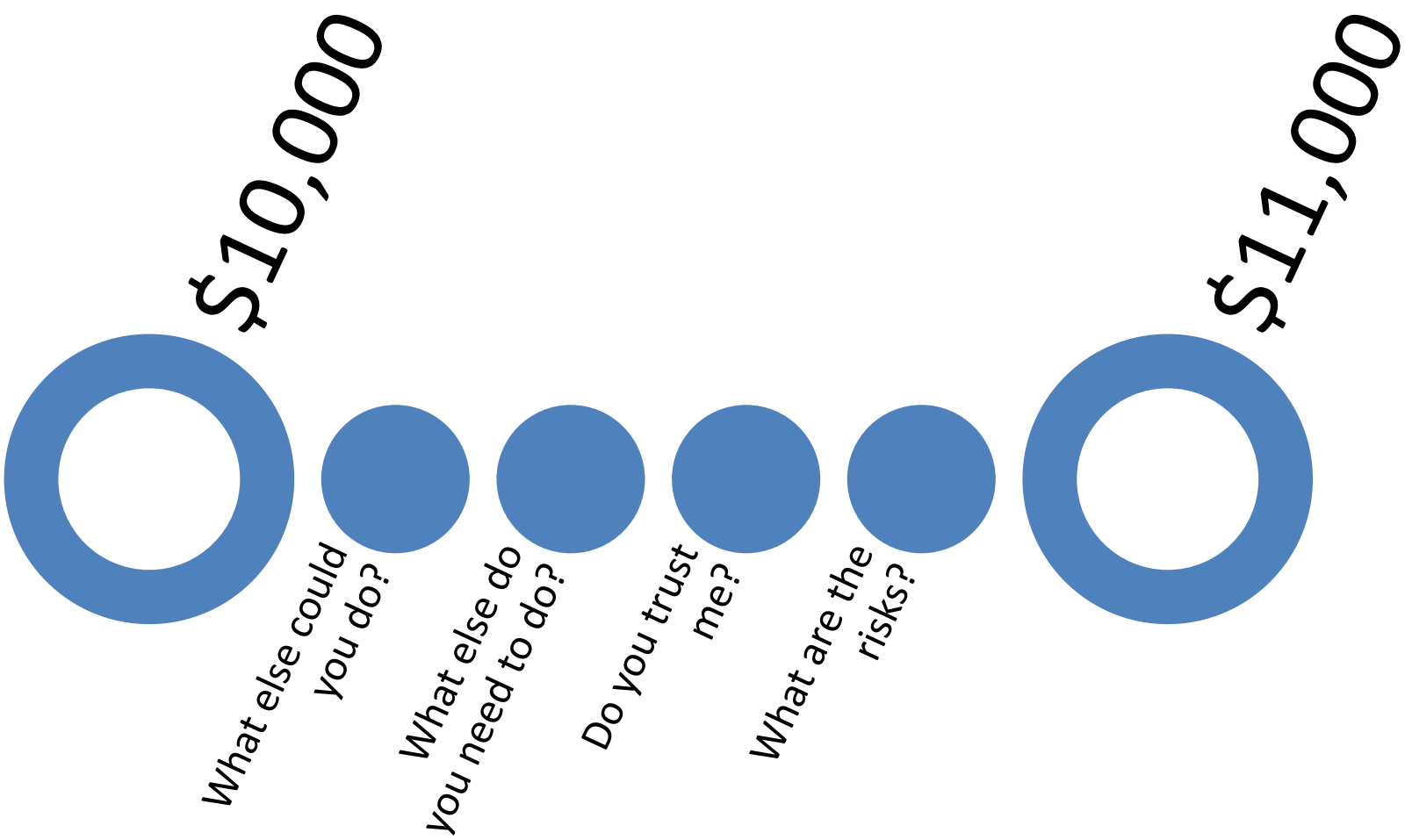
The social discount rate reflects a general 'time preference' for value – value today is seen as more valuable than value in the future so over time costs and benefits are discounted.

Financial costs (nominal costs)

Investments require capital and operating costs to be paid throughout the project lifecycle. Financial costs reflect the actual price in the year they are required.

Because the purchasing power of money generally declines over time, cost estimates need to be adjusted throughout the lifecycle to reflect the increase in money required to procure them compared to if they were produced in the base year.

Discounting: Money now is better than money later



Discounting

- Discounting is a process to convert benefits and costs that occur in future years into present value

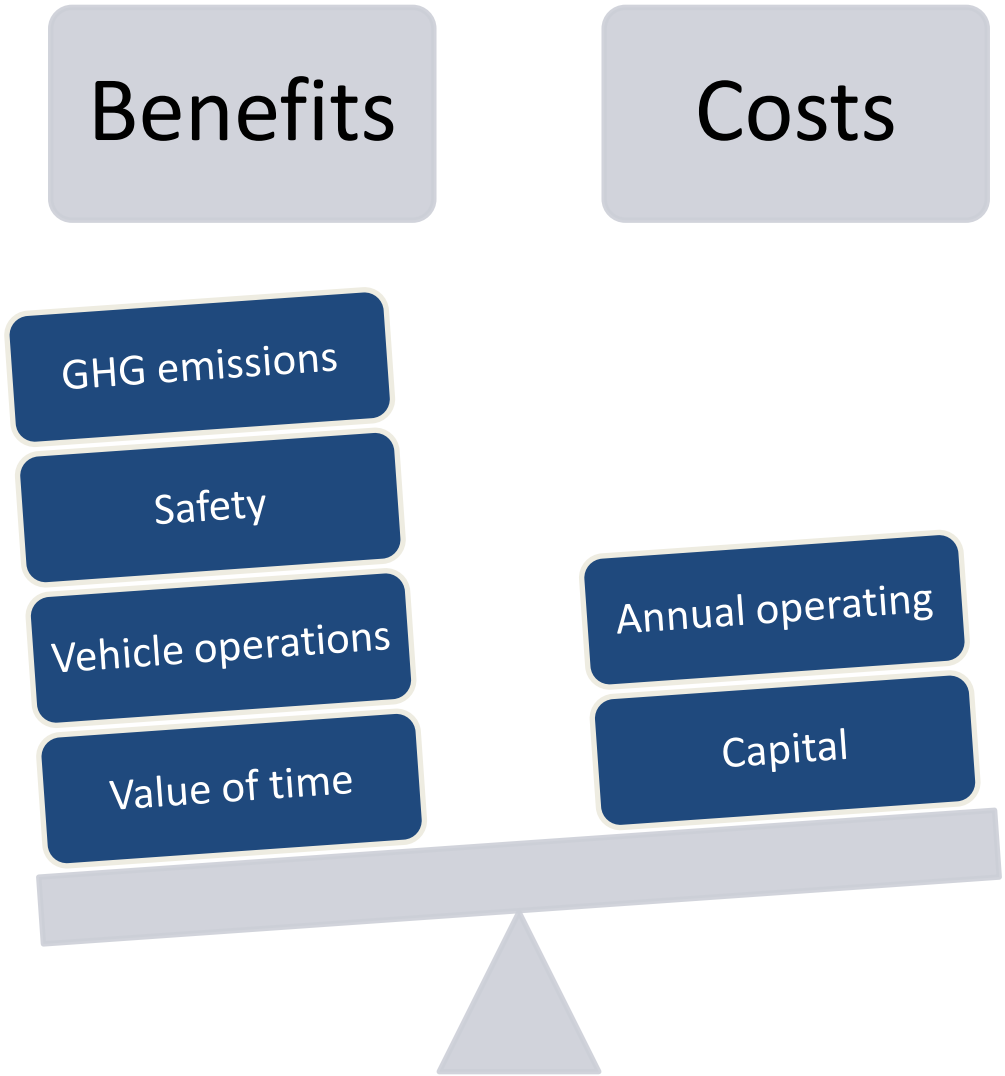
$$PV = \sum_{y=0}^{n} B_y \Big/ \prod_{i=base}^{y} (1 + r_i)$$

`PV`: The Present Value `B`: The Benefit or Cost (C) Under Analysis
`r`: Social Discount Rate

Or, use the `NPV` function in Excel

ECONOMIC ANALYSIS

Weighing costs and benefits



How do we monetize benefits?

Economic impacts quantified and monetized in economic appraisal can be any scarce and valued resource:

- Personal time, health, safety, comfort, and environmental elements such as clean air
- We can determine the value that people place on marginal changes in these valued resources
- For example, how much extra you might be willing to pay for a more comfortable seat on the train, or the financial savings that you would demand before you would accept a home location close to the tracks

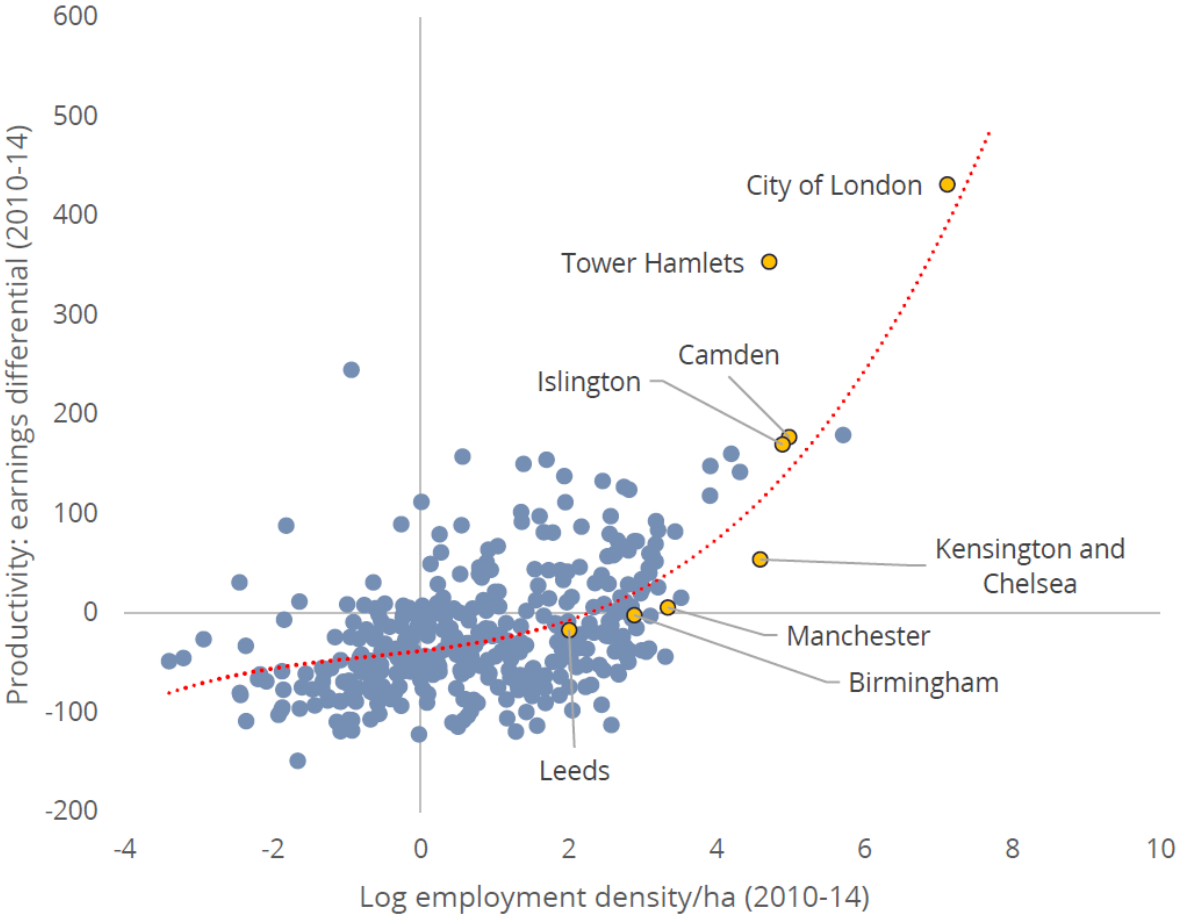
User Impacts (Generalized Costs)

- The cost of taking a transit trip as perceived by travelers
- Each mode or service in the region has a cost composed of perceived travel times and direct user costs (fares or tolls), which determine if an individual will travel
- Transport investments can change demand by changing the generalized cost of transport – either by providing a new service or modifying an existing one
- When the generalized cost 'paid' by travelers decreases beyond what they were willing to pay, they benefit
- If the generalized cost increases, users receive a disbenefit

Social Impacts

- Each transport service has a social cost to society based on the impacts it creates
- Common transport social costs include collisions resulting in property loss, injury, or death; emissions resulting in health impacts; and climate change
- Investments may change the overall social costs of the transport system by reducing the overall social cost of travel in the region

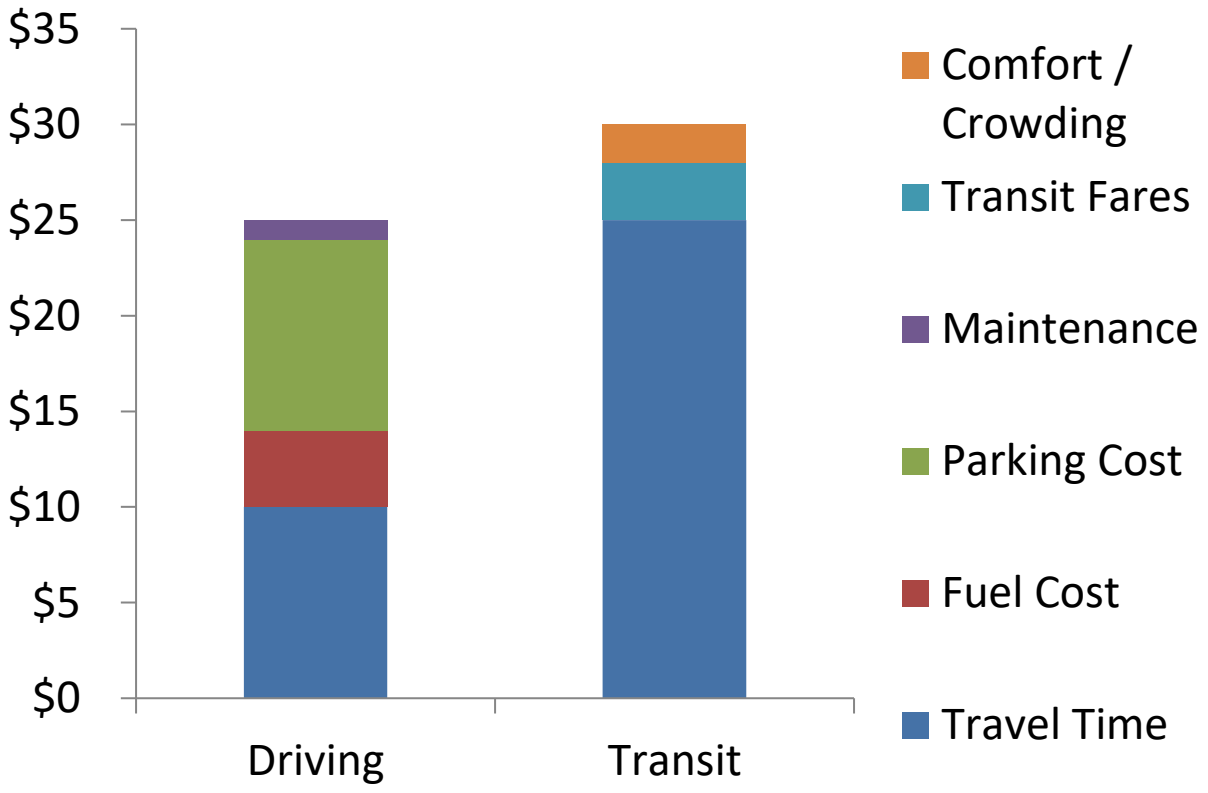
Wider Economic Impacts



Productivity (Agglomeration and Clustering)
Imperfect Competition
Labour Markets

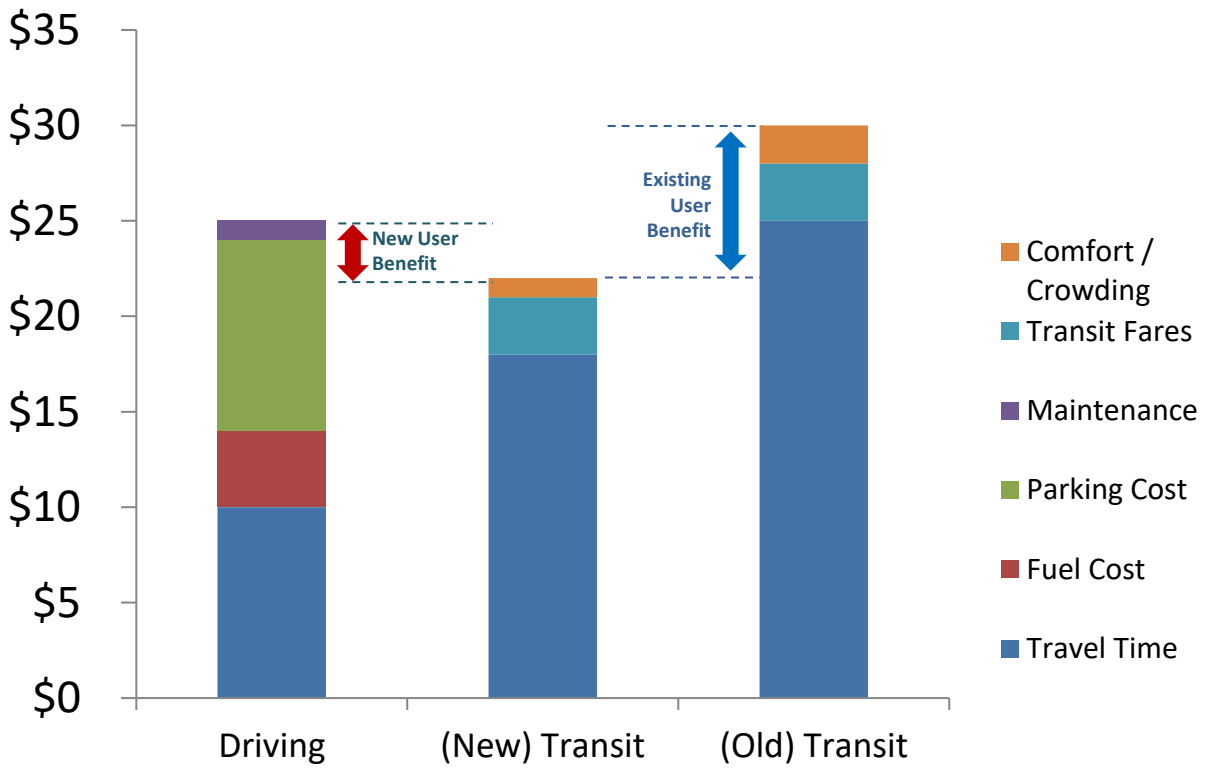
Calculating User Benefits (Generalized Journey Cost)

- In this example, a user would choose to drive, as the "generalized journey cost" of all the factors that go into their decision results in a trip by car being $5 more valuable.
- All the user's perceived factors are considered in the equation
- Factors not considered include unperceived user benefits (vehicle depreciation) and externalities (pollution)



Calculating User Benefits (Generalized Journey Cost)

- In this example, a new transit line was built that reduced travel time and improved comfort
- The user would now choose transit over driving
- The user's benefit would be the difference between the driving option and the New Transit option
- This change in generalized journey cost is often reported as travel time savings



Benefit Cost Ratio

The Benefit Cost Ratio (BCR) is calculated by dividing the present value of the total benefit by the present value of the total cost

$$BCR = \frac{PVB}{PVC}$$

PVB : Present Value of Benefits – The real, discounted value of the stream of benefits

PVC : Present Value of Costs – The real, discounted value of the stream of costs

Net Present Value

The Net Present Value (NPV) is the total present value of all future benefits minus the total present value of all future costs:

$$NPV = PVB - PVC$$

The NPV is complementary to the BCR. It communicates value for money in an alternative way by showing overall the net benefit from the project in absolute terms

Economic Case vs. Financial Case

Both present information in dollar terms, but reflect different ways to understand investment impact

The **Economic Case** considers society-wide impacts and the resource costs to deliver an investment

Impacts such as reducing user travel time, air pollution, or car accidents are monetized as benefits

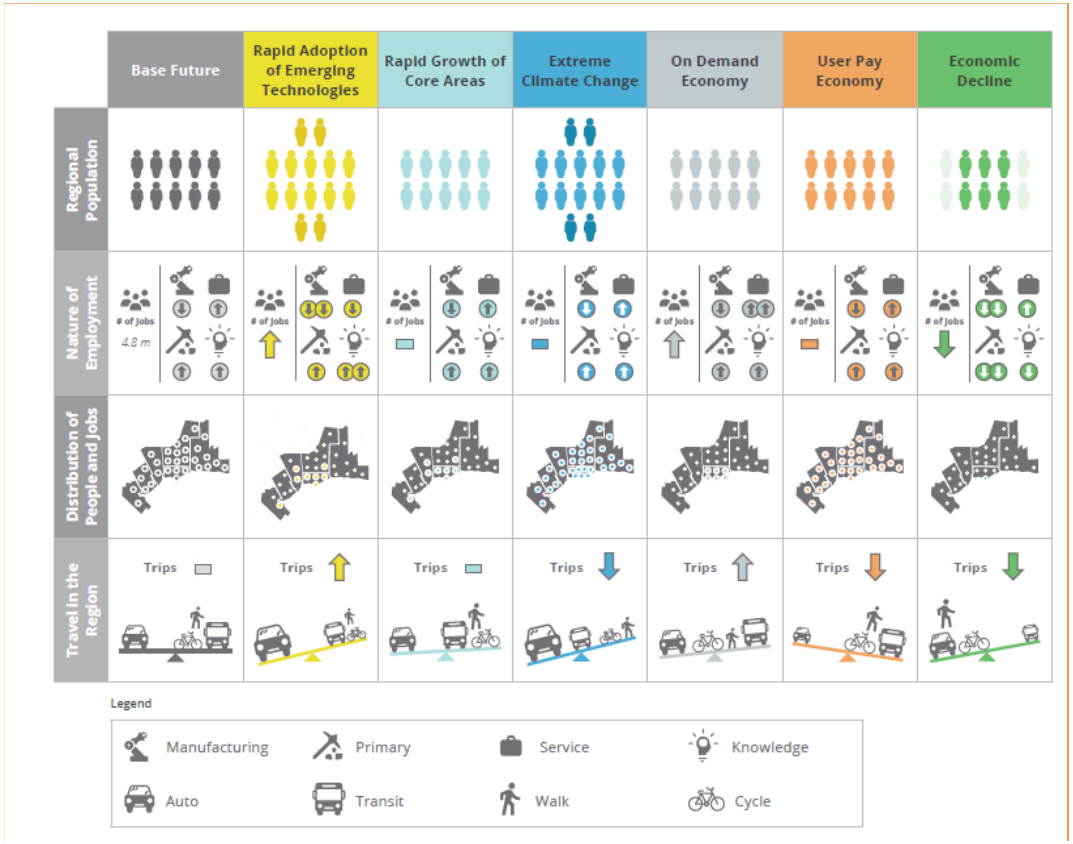
The **Financial Case** focuses on the financial resources required to implement the investment and the cash flow impact for the agency responsible for the investment

Key features of economic vs. financial appraisal framework

Key Features	Economic Evaluation	Financial Evaluation
Unit of Account	Resource cost	Market/financial cost
Prices	Real, constant year dollars, inflation excluded	Nominal, year of expenditure dollars, inflation included
User Benefits (e.g., travel time savings, comfort)	Included, valued using perceived costs	Excluded
Service provider impacts (e.g., construction, O&M)	Included, valued using resource costs	Included, valued using market/financial costs
Externalities (e.g., GHG emissions, safety)	Included, valued using resource costs	Excluded
Appraisal Period	Typically 60 years	Typically 60 years
Discounting	Uses social discount rate	Uses financial discount rate
Point of View	Society's point of view (Users of all modes, service providers, Gov't)	Metrolinx/Government of Ontario's point of view

Testing multiple futures provides resilient evidence

- Scenario planning explores potential futures under incomplete – or imperfect – information
- Uncertainty can be mapped across scenarios with correlated sensitivities

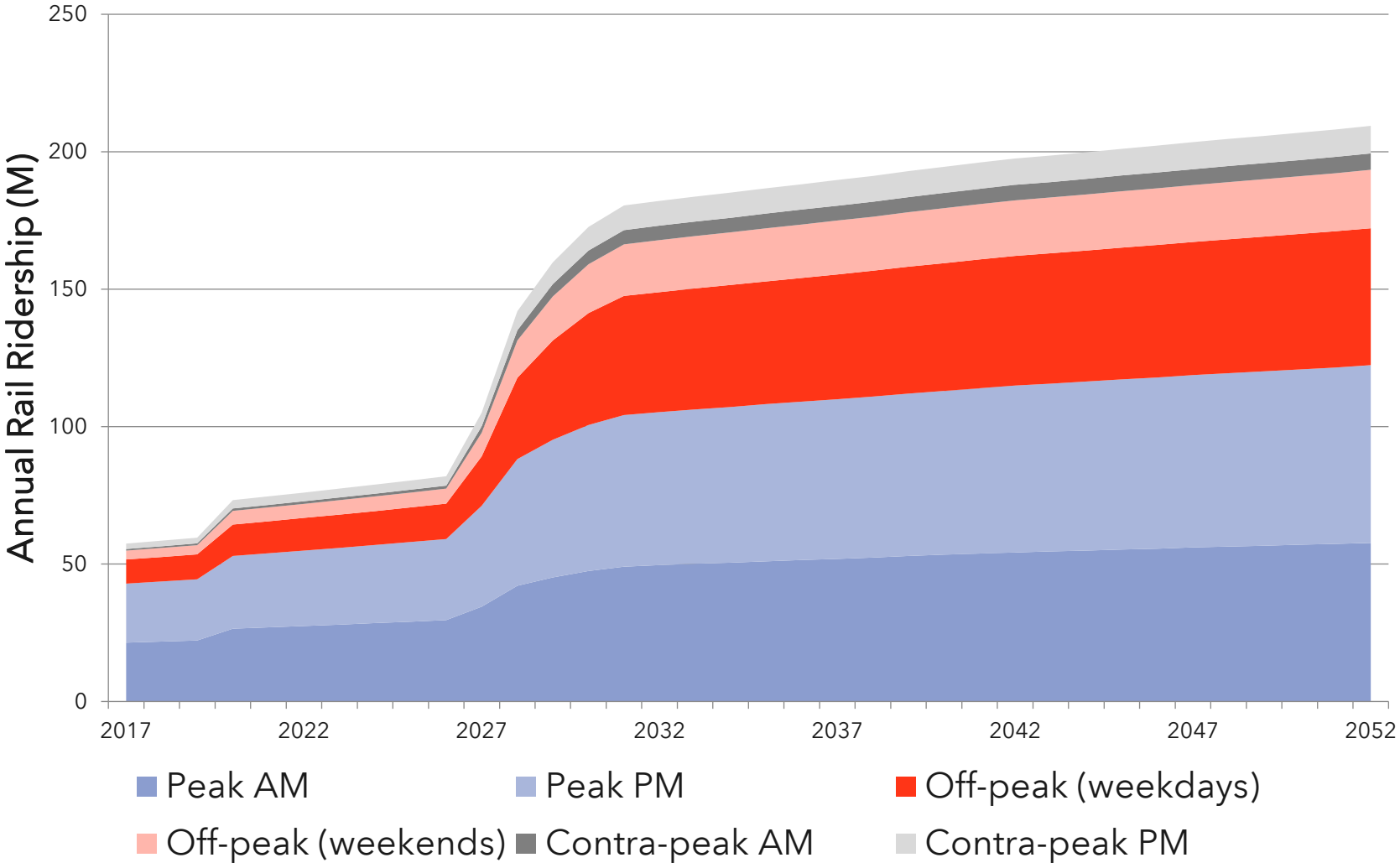


Scenarios from the 2041 Regional Transportation Plan

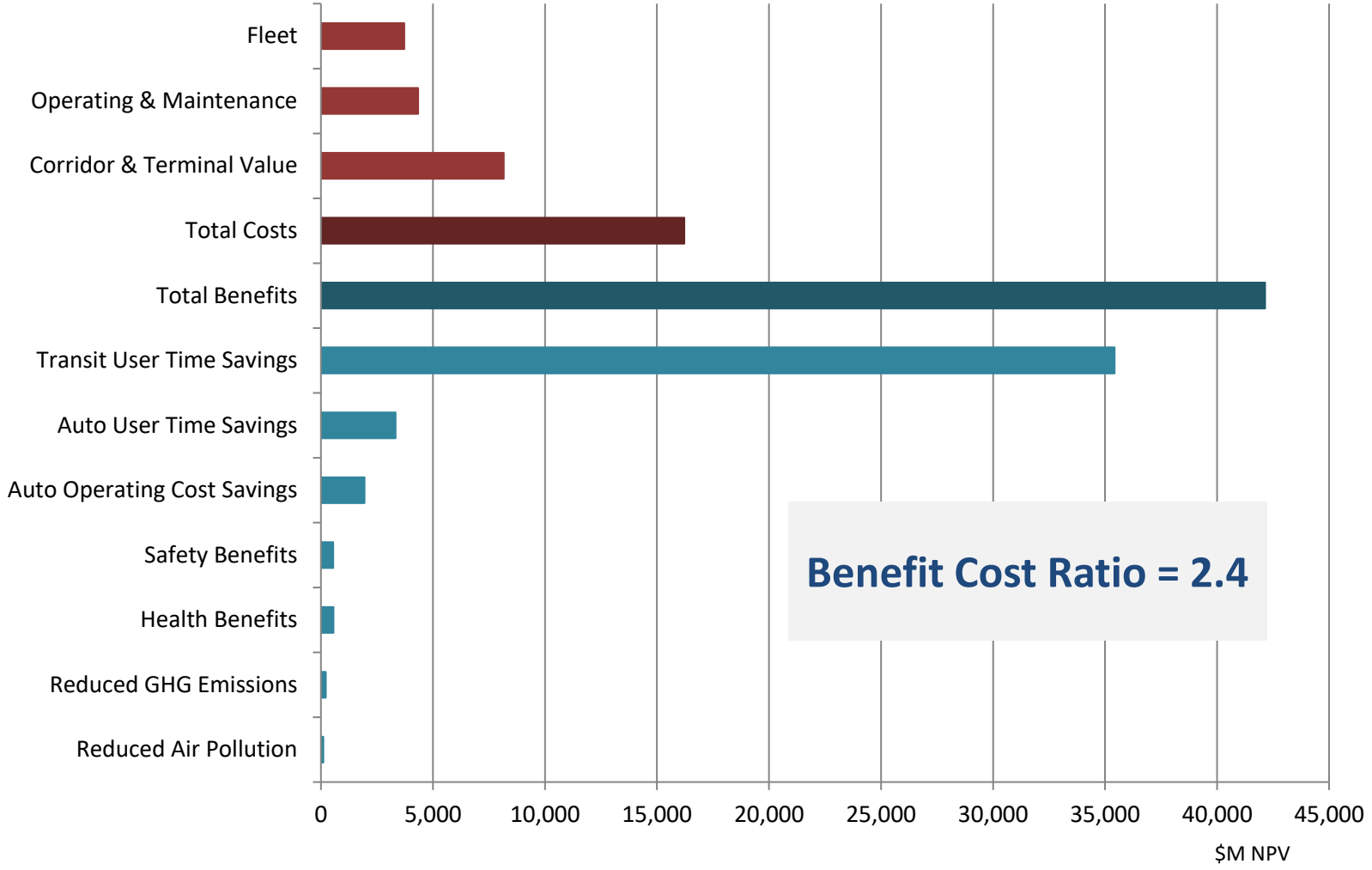
GO EXPANSION

Project overview

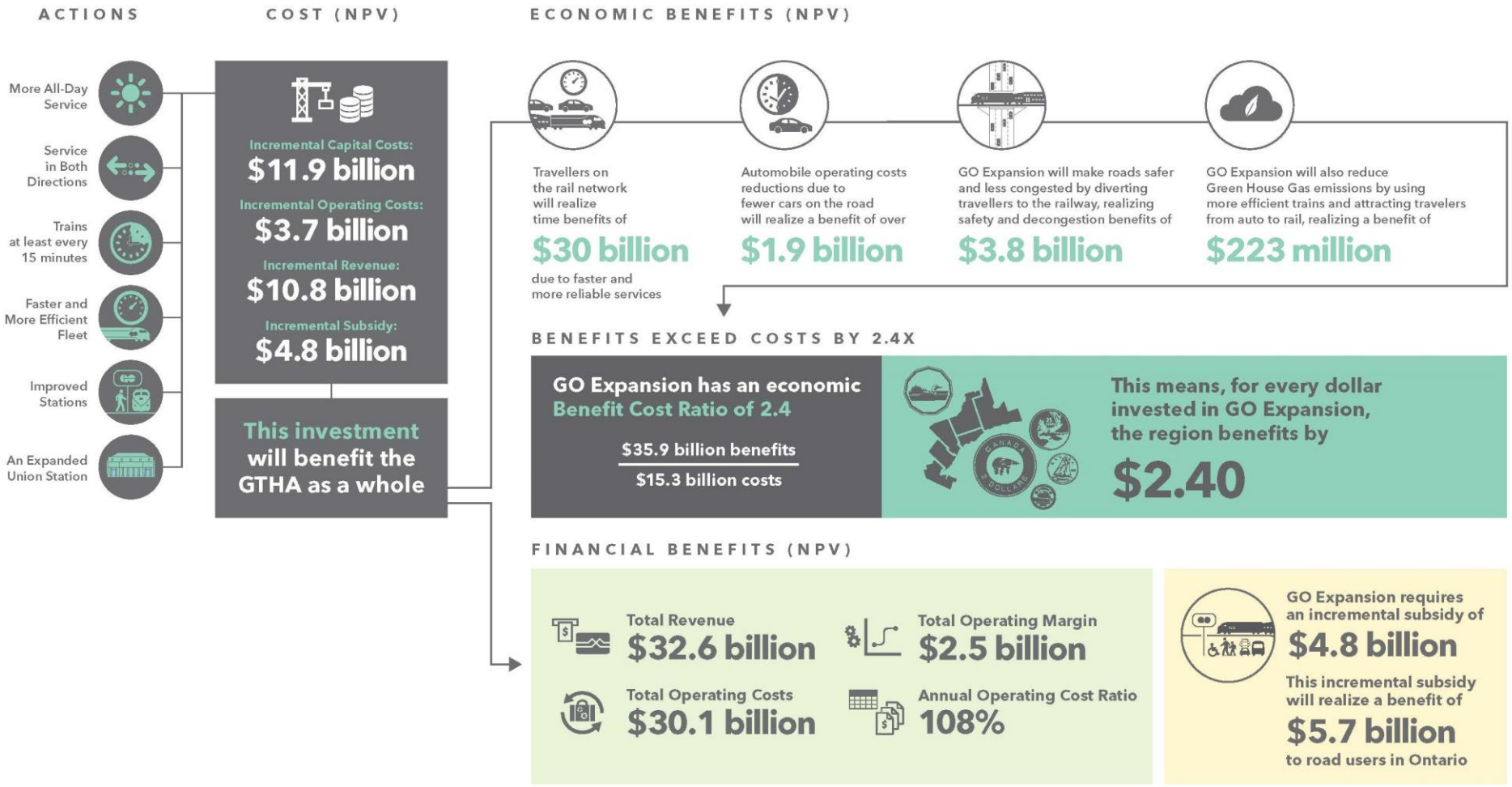
Ridership


Annual Rail Ridership (M)
250
200
150
100
50
0
2017
2022
2027
2032
2037
2042
2047
2052
Peak AM
Peak PM
Off-peak (weekdays)
Off-peak (weekends)
Contra-peak AM
Contra-peak PM

Economic analysis



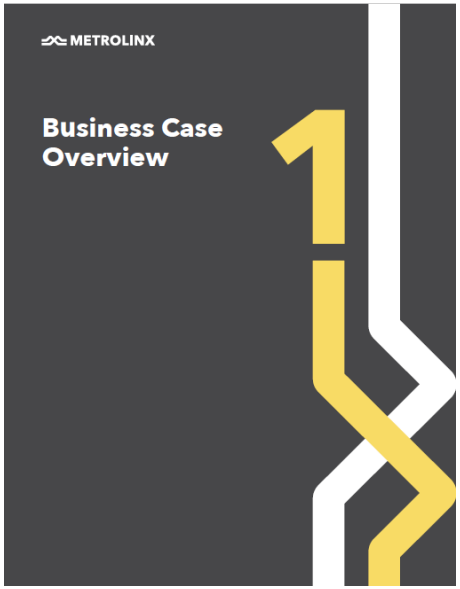
Business case summary

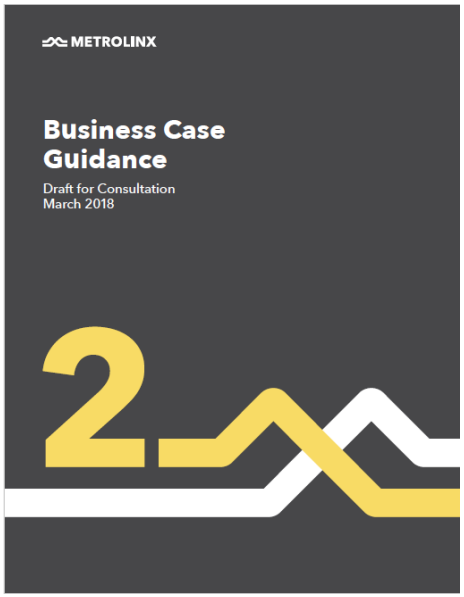


RESOURCE

Metrolinx Business Case Guidance

Metrolinx has released two documents that describe the purpose of business cases and how to develop consistent and comparable business cases for a range of potential investments.

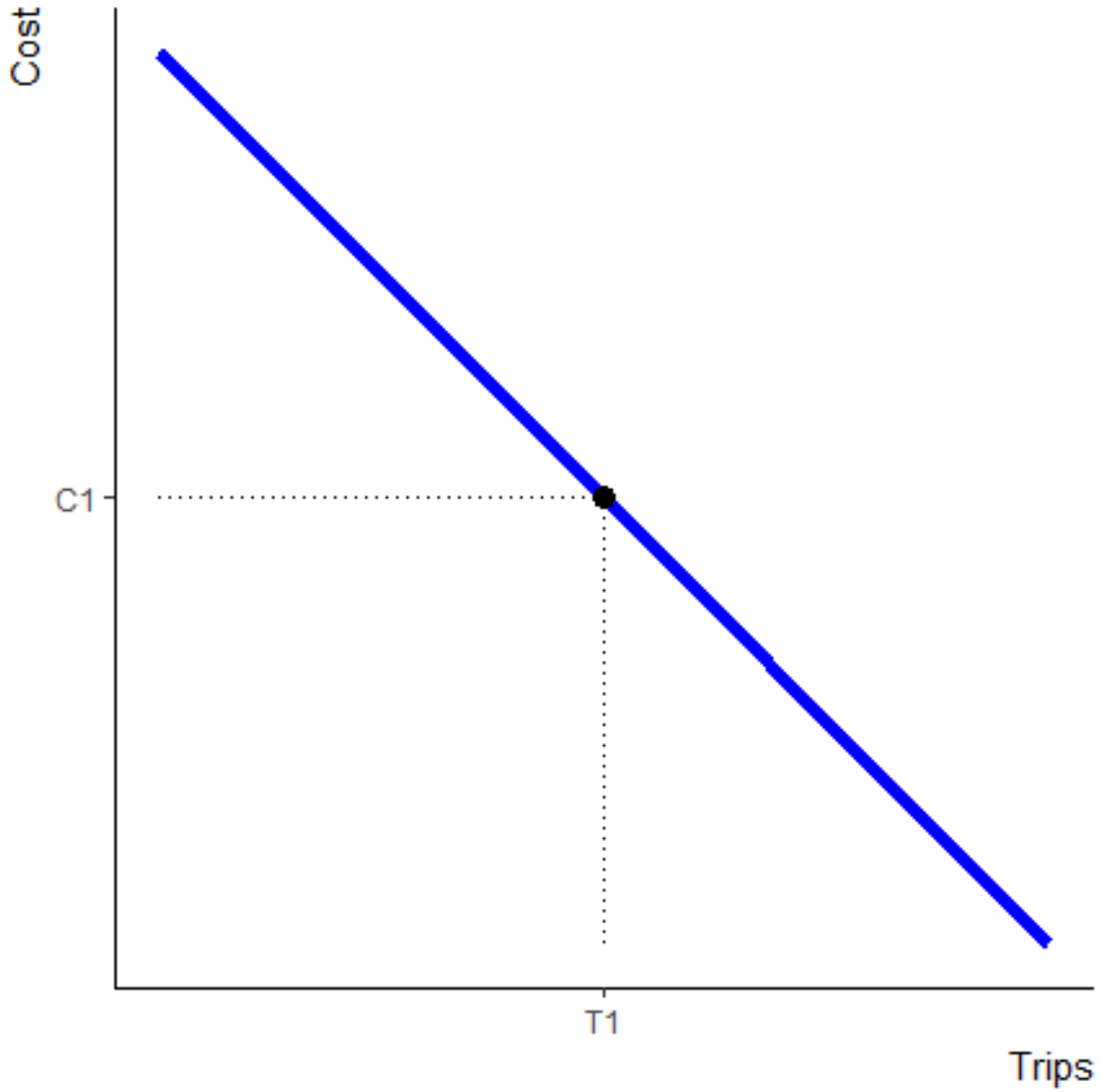




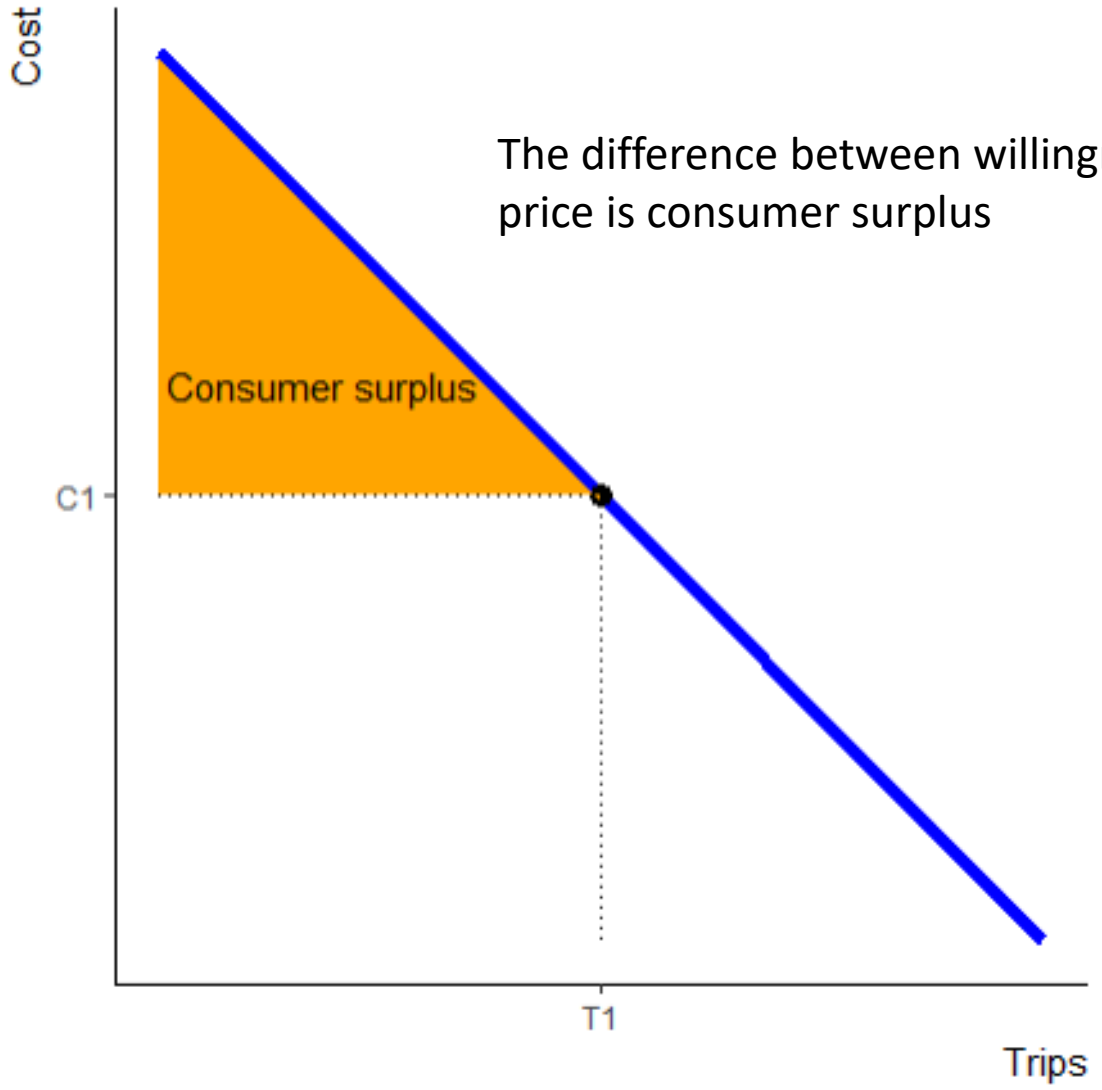
- **Guidance 1: Business Case Overview** provides a concise summary of the overall business case approach used by Metrolinx to help stakeholders, decision-makers, and the public interpret business cases.
- **Guidance 2: Business Case Guidance** provides detailed information on how to lead business case development This document also lays out the analytical methods and parameters to develop business case content.

APPENDIX

Consumer surplus

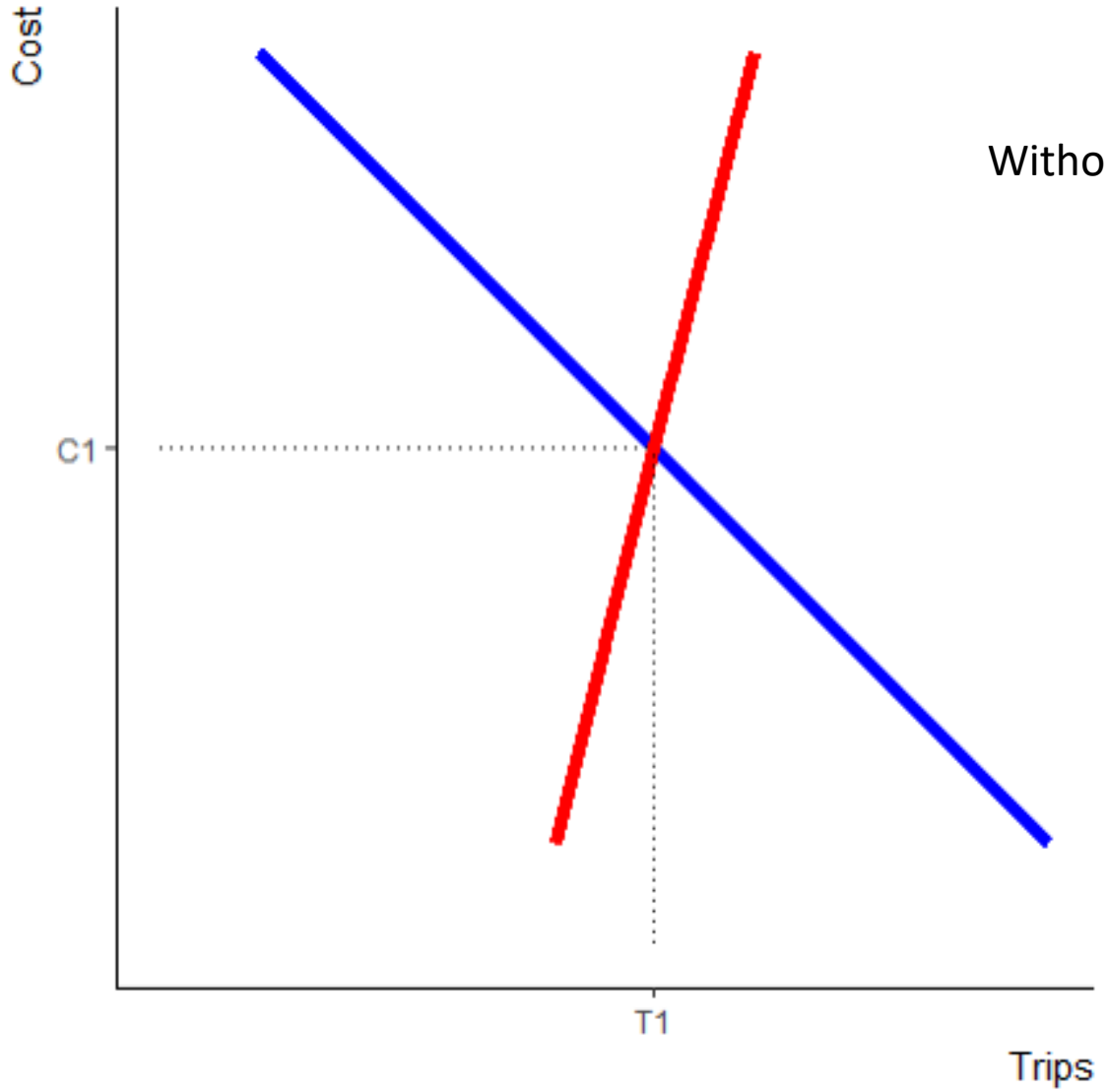


Consumer surplus



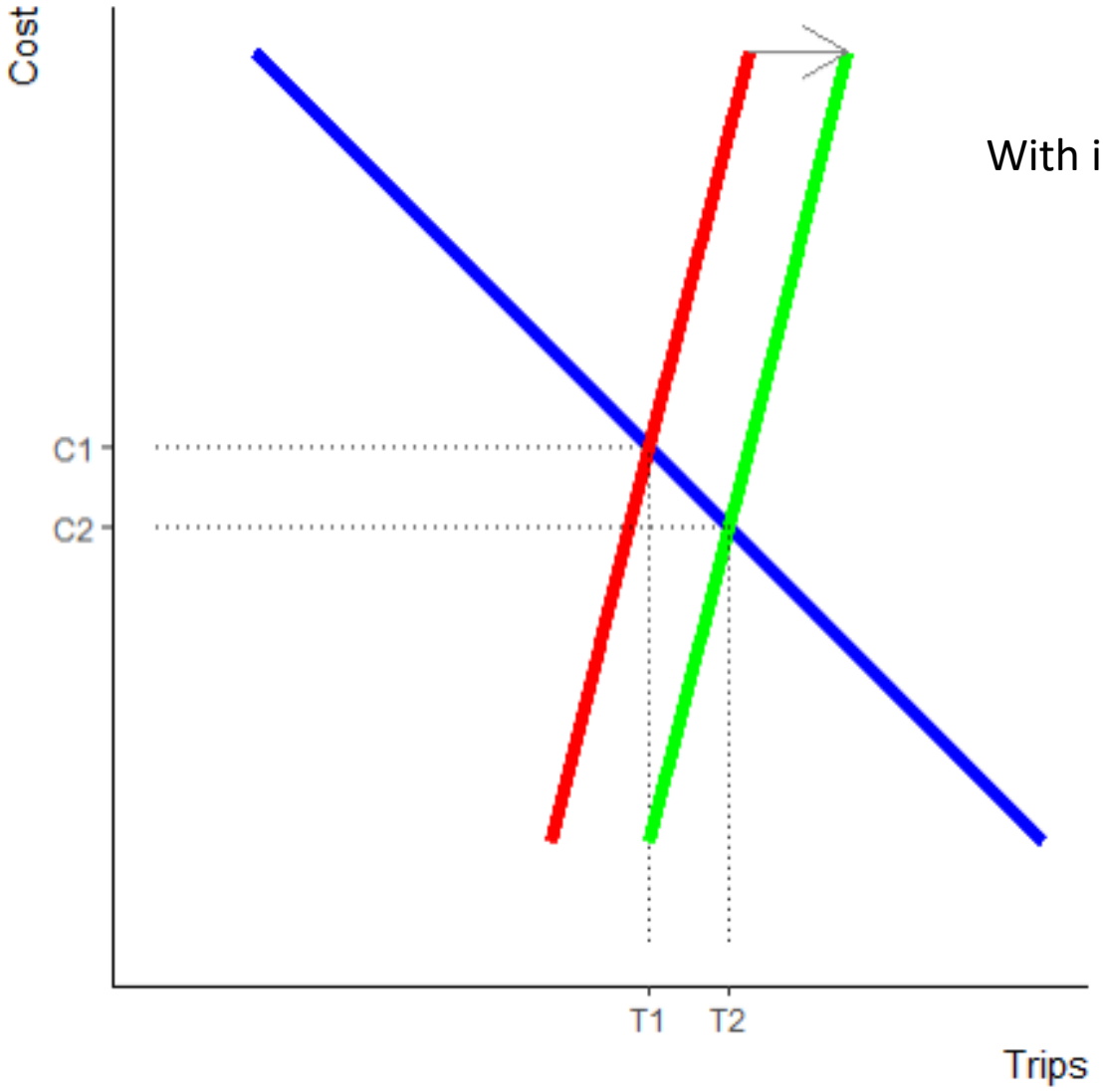
The difference between willingness to pay and price is consumer surplus

Benefits calculation



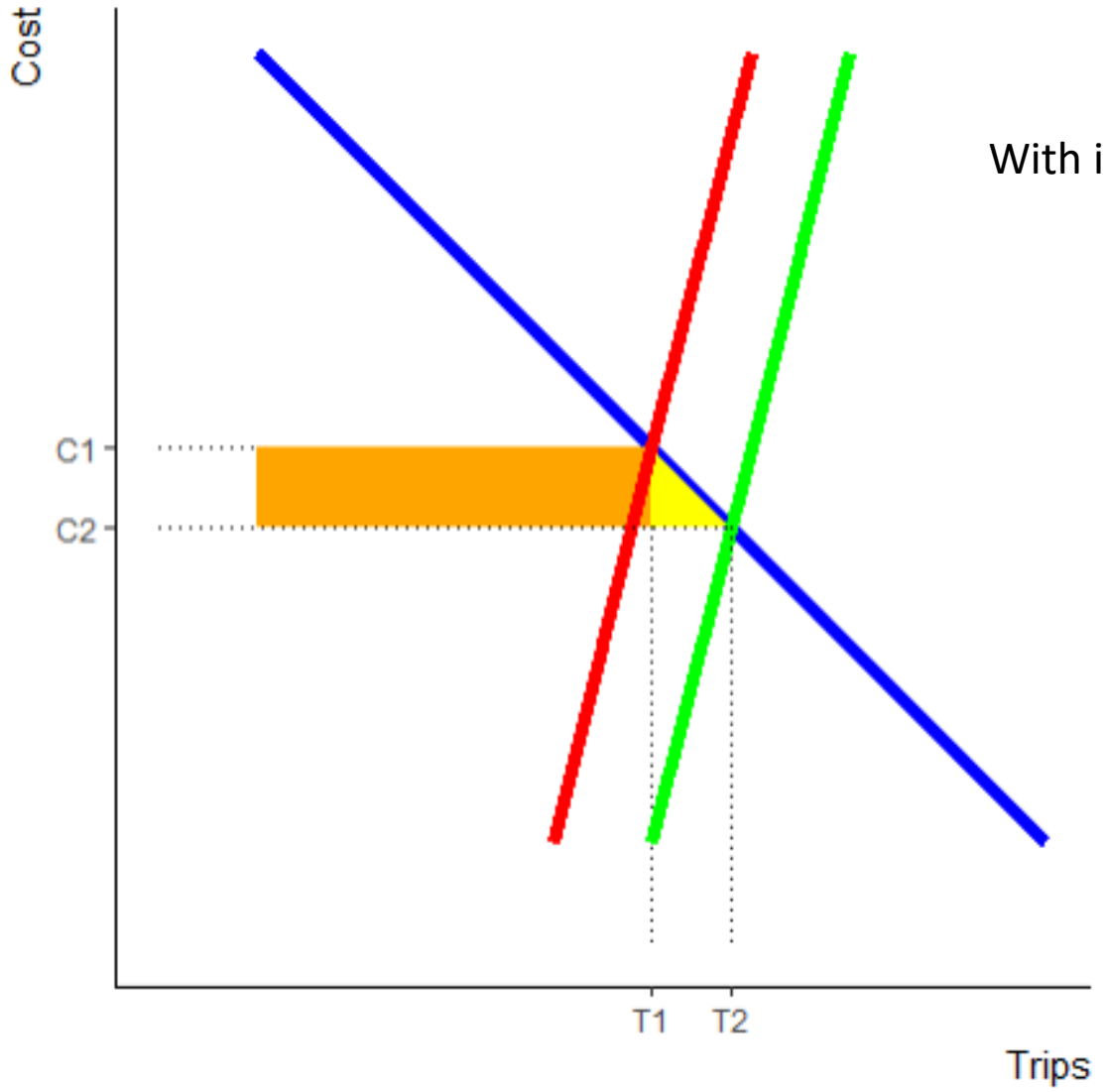
Without investment

Benefits calculation



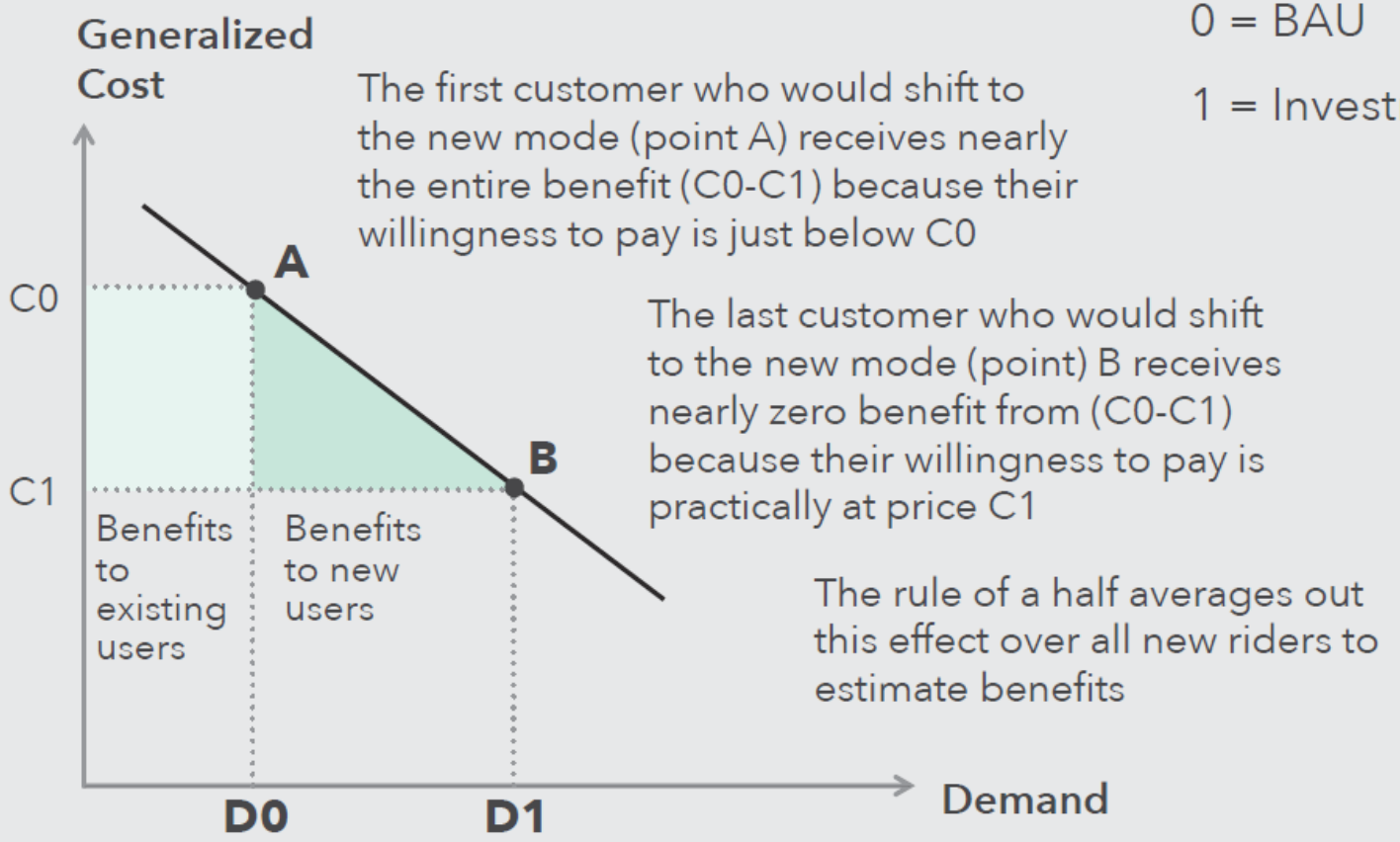
With investment

Benefits calculation



With investment

Rule of a half



0 = BAU

1 = Investment Case

The first customer who would shift to the new mode (point A) receives nearly the entire benefit (C0-C1) because their willingness to pay is just below C0

The last customer who would shift to the new mode (point) B receives nearly zero benefit from (C0-C1) because their willingness to pay is practically at price C1

The rule of a half averages out this effect over all new riders to estimate benefits

Modelling 101

WHAT IS TRANSPORTATION DEMAND MODELLING?

Utilizing computer models to estimate travel behavior and travel demand for a specific future time frame, based on strictly defined assumptions and inputs

Why?
1. Trip Generation

You decide to ***make a trip.***

Determines the frequency of origins or destinations of trips by trip purpose, as a function of land use and household demographics, and other socio-economic factors.

Where?
2. Trip Distribution

You decide ***where to go.***

Matches tripmakers' origins and destinations to develop a "trip table", a matrix that displays the number of trips going from each origin to each destination.

How?
3. Mode Split

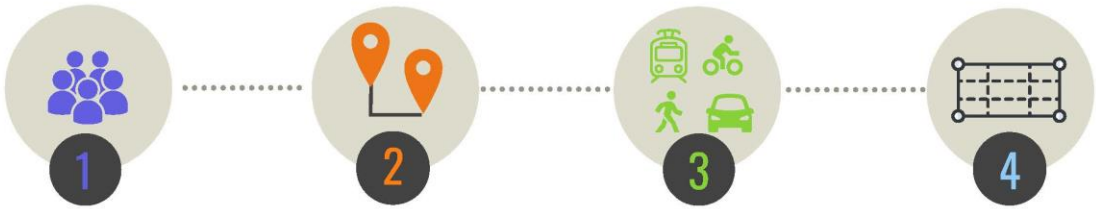
You ***pick your mode.***

Estimates the proportion of trips between each origin and destination that use a particular transportation mode.

How?
4. Trip Assignment

You ***pick your route.***

Allocates trips between an origin and destination by a particular mode to specific routes.



Transport Economics & Appraisal