

Sustainable Transportation

Strategy February 2018



Final Report

Business Case Framework

Region of Peel Sustainable Transportation Strategy



Prepared for Region of Peel
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1 Introduction

1.1 About Business Cases

What is a “business case”? It is a logical, coherent collection of quantitative and qualitative evidence that explains how an action contributes to an organization’s objectives.

What is a business case used for? It is used to assess or compare alternative actions and to select a preferred action, thereby enabling an informed decision about whether to proceed with an investment. Once an investment is complete, a “business case review” can be used to evaluate its value and performance.

To illustrate the information that business cases (or business case reviews) generate, the figure below presents some of the findings of a recent evaluation by Metrolinx of the Smart Commute workplace program.

EXAMPLE: BUSINESS CASE REVIEW OF GTHA SMART COMMUTE WORKPLACE TDM PROGRAM (METROLINX, 2015)	
KEY FINDINGS FOR 2013-2014	
Benefit-cost ratio	2:1 to 11:1, with a “most likely” ratio of 6:1
Increase in active transportation	About 9 million person-kilometres, leading to \$21 million in health benefits
Decrease in single-occupant vehicle (SOV) use	About 40 million vehicle-kilometres, leading to \$34 million in benefits
Annual costs and funding sources	\$3.1 million: 44% from Metrolinx, 39% from municipalities, 18% from employers/other
Congestion reduction	Increases the efficiency of the road network by allowing Metrolinx to fight congestion in areas that have low-quality transit services
Knowledge building	Collects commuting data and other information that Metrolinx can use to develop transportation projects and programs
Policy alignment	Aligns with The Big Move (the GTHA Regional Transportation Plan) and Provincial growth policies encouraging TDM and sustainable travel

1.2 Why develop a Business Case Framework for the Region of Peel’s STS?

As the Region of Peel plans, builds and operates its transportation system, it wants to make the best of use of available resources and maximize the outcomes that it values most. A business case framework for the STS will allow the Region of Peel to clearly demonstrate the multi-sectoral benefits of proposed infrastructure and services to elected officials, staff, partner institutions, businesses and residents.

The business case framework for the STS will necessarily be broader than a specific business case developed for a single project or program. It will identify:

- The scope, dimension and relative importance of issues that could be relevant to a sustainable transportation business case
- Representative measures and indicators that explain those issues
- Possible sources of information to specify measures and indicators

Within the STS itself, the business case framework will be used to demonstrate the benefits of proposed increases in the use of walking, cycling, transit, carpooling and telework by 2041 (i.e. future mode share targets). Other possible uses within the STS are:

- Clarifying key messages to attract stakeholder engagement and buy-in
- Comparing alternative solutions
- Explaining the need for and benefits of partnerships
- Designing a performance measurement program

1.3 Key Inputs

This document summarizes some of the information that will feed into the STS business case framework, including:

- A review of Region of Peel policy documents
- A review of experience elsewhere related to business cases for sustainable transportation plans, policies, programs and projects
- Input gathered from Region of Peel staff, partners and stakeholders at a half-day workshop on November 17, 2016

1.4 Proposed Indicators

This Business Case Framework identifies a broad range of indicators, organized by theme and outcome.

THEMES AND OUTCOMES		
<u>Transportation system performance</u> <ul style="list-style-type: none"> • Travel demand • Travel choice • Access to destinations • Speed and delay • Capacity • Efficiency • Safety • Universal access • Connectivity • Reliability • User awareness and satisfaction 	<u>Public health and safety</u> <ul style="list-style-type: none"> • Clean air • Physical activity • Injury and death from collisions • Mental health • Independent travel by children • Personal security <u>Environment</u> <ul style="list-style-type: none"> • Greenhouse gas emissions from transportation • Land consumption • Greening 	<u>Economy</u> <ul style="list-style-type: none"> • Vitality and growth • Land use density • Land value • Access to labour • Retail vibrancy • Cost of congestion • Affordability of travel • Commuter satisfaction <u>Economic costing</u> <ul style="list-style-type: none"> • Unit travel costs by mode • Benefit-cost analysis

As part of the STS, key indicators to measure the outcomes of the STS policies, programs and projects are included in the following table. Where possible, these indicators will be qualified at a high level to compare the anticipated outcomes of the STS projects, programs and policies with existing conditions and a “Business as Usual” scenario for 2041.

TRANSPORTATION SYSTEM PERFORMANCE	
Travel Demand	
Mode shares (walking, cycling, transit, vehicle passenger, vehicle driver, telework)	Peak period or daily, for the Region, municipalities or traffic zones
Person trips	Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver, telework). Can be reported per-capita, daily or annual
Person-kilometres travelled	Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver). Can be reported per-capita, daily or annual
Vehicle occupancy ratio	Calculated as person-km travelled (PKT) /vehicle-km travelled (VKT). Peak period, 24-hour or annual
Travel Choice	
Residential accessibility to cycling network	Proportion of households within 1 km of a cycling facility (trail, bike lane, cycle track) Observed or modelled
Employment accessibility to cycling network	Proportion of jobs within 1 km of a cycling facility (trail, bike lane, cycle track) Observed or modelled
Transit access to employment opportunities from home	Calculated as the number of jobs per resident accessible by transit within 45 minutes; useful for comparing transit access to employment among different communities
User Awareness and Satisfaction	
Awareness and satisfaction of travel options among Region of Peel residents	Observed: Survey of residents (e.g. by telephone)
PUBLIC HEALTH AND SAFETY	
Clean Air	
Emission of criteria air contaminants (CAC) pollutants (PM2.5, PM10, NOx) from motor vehicles	Calculated based on VKT and PKT and emission rates per kilometre. Absolute value could be normalized per capita. Also proxy for actual health impacts
Injury and Death from Collisions	
Cost of Injuries and deaths from collisions by victims' mode of transport	Economic costs can be determined using average rates per injury and death based on VKT.
ENVIRONMENT	
Emission of Greenhouse Gases	
Greenhouse gas emissions from transportation	Estimated based on VKT and PKT, vehicle fuel consumption rates and standard GHG conversion factors. Absolute value could be normalized per capita.

ECONOMY	
Vitality and Growth	
Sustainable mode use in key nodes	Estimate of sustainable mode shares and change in employment areas. Higher sustainable mode usage maintains road capacity for trucks and other vehicles
Access to Labour	
Transit access to potential workers from workplace	Calculated as the number of potential workers per job accessible by transit within 45 minutes; useful for comparing transit access to labour force among different communities
Cost of Congestion	
Cost of delay to individuals	Estimates of delay hours and cost/hour for personal travel by motor vehicles and transit
Affordability of Travel	
Cost of personal transportation	Total private vehicle ownership, operating and parking costs, plus transit, taxi and ride-hailing fares. Could be normalized per capita.

2 The Region of Peel's Interests

2.1 Imagine Peel: Strategic Plan 2015-2035

Imagine Peel, the Region of Peel's Strategic Plan for 2015-2035, contains a number of elements related to sustainable mobility, as summarized in the following table.

FOCUS AREAS IN <i>IMAGINE PEEL</i> : STRATEGIC PLAN 2015-2035	STRATEGIC PLAN'S SHORT-TERM AND LONG-TERM OUTCOMES LINKED TO SUSTAINABLE MOBILITY	
	In 4 years (2019)	In 20 years (2035)
LIVING: People's lives are improved in their time of need		I will have: <ul style="list-style-type: none"> • access to employment opportunities of my choice • access to services that meet my needs at all stages of life
THRIVING: Communities are integrated, safe and complete	We will: <ul style="list-style-type: none"> • adapt to and mitigate the effects of climate change • improve goods movement • promote healthy and age-friendly built environments 	We will live in a community: <ul style="list-style-type: none"> • that is environmentally friendly • that promotes mobility, walkability and various modes of transportation • that promotes economic sustainability and future investments in Peel. • where the built environment promotes healthy living.
LEADING: Government is future-oriented and accountable	We will: <ul style="list-style-type: none"> • attract and retain top talent 	I trust that: <ul style="list-style-type: none"> • sustainability and long-term benefits to future generations are considered • the Region of Peel is a model and progressive employer

2.2 Official Plan (October 2014 Consolidation)

Official Plan Section 5.9 (The Transportation System in Peel) presents objectives and policies related to many aspects of transportation. Many of the objectives relate to sustainable transportation, and are summarized below:

Section 5.9.1 – General Objectives

- To achieve the safe, convenient and efficient movement of people and goods in the Region and support the same within the Greater Toronto and Hamilton Area in cooperation with area municipalities, the Province, the Federal government and the private sector.
- To develop and promote a sustainable, safe, efficient, effective and integrated multi-modal transportation system.
- To support the provision of improved transportation mobility and choice to all residents, employees and visitors.

- To promote and encourage the increased use of public transit and other sustainable modes of transportation.
- To optimize the use of the Region's transportation infrastructure and services.
- To maximize the capacity of the transportation system by focusing on moving people and goods rather than on moving vehicles.
- To minimize adverse environmental and human health impacts caused by transportation and support transportation alternatives that foster improved health and well-being in the Region.
- To support a transportation system that enhances economic vitality and growth in the Region.
- To ensure that practices and performance measures are in place to maintain a safe and efficient Regional transportation network.
- To support the integration of transportation planning, transportation investment and land use planning.

Section 5.9.4 – Major Road Network

- To work with the area municipalities and the Province to provide, maintain and operate a Major Road Network to facilitate the safe, efficient and reliable movement of people and goods.

Section 5.9.5 – The Inter and Intra-Regional Transit Network

- To support and encourage a higher use of public transit and an increase in transit modal share within the region.
- To support and encourage the development of an economically feasible, effective, efficient, sustainable and safe inter- and intra-regional transit network and encourage connectivity and coordination between transit services.
- To encourage the provision of improved transit service to Toronto–Lester B. Pearson International Airport and the surrounding employment area.
- To support and encourage transit-supportive development densities and patterns, particularly along rapid transit corridors and at designated nodes such as transit terminals, urban growth centres, GO stations and mobility hubs.

Section 5.9.6 – Airports

- To optimize the economic potential of Toronto–Lester B. Pearson International Airport and the Brampton Flying Club airport to the Region of Peel and the GTHA, having regard for:
 - a) Existing and future industry, business and employment opportunities; and
 - b) The interests of existing and future residents.

Section 5.9.7 – Goods Movement

- To facilitate the development of a safe and efficient goods movement network within Peel and between Peel and adjacent municipalities that supports the regional economy and that minimizes impact to the environment.
 - To optimize the use of existing goods movement infrastructure and capacity.
- Section

5.9.8 – Environmental Impact

- To improve air quality and reduce the greenhouse gas emissions produced by vehicles using Peel's transportation system.
- To promote a transportation system that encourages energy conservation

Section 5.9.9 – Transportation Demand Management

- To reduce auto dependency by promoting sustainable modes of transportation.
- To provide a range of transportation services to meet the diverse needs of the population.
- To maximize the capacity of the transportation system to move both people and goods.

Section 5.9.10 – Active Transportation

- To increase the share of trips made using active transportation.
- To encourage and support the development of a safe, attractive, accessible and integrated network of bicycle and pedestrian facilities that enhances the quality of life, and promotes the improved health, of Peel residents.

Section 5.9.11 – Accessible Transportation

- To provide accessible and affordable transportation services for persons with disabilities.

The Official Plan also calls for a performance measurement program that has not been developed yet (check). However, an earlier report on the Region's 1996-2006 Official Plan Monitoring Program is available, and reported on progress using the following indicators related to sustainable transportation:

- Number and duration of smog advisories for the Region of Peel
- Modal split (auto driver, auto passenger, transit, walk, school bus, cycle)
- 12-hour truck trips crossing Peel Region cordon
- Low-floor buses as a proportion of total buses in local transit systems

2.3 Long Range Transportation Plan (LRTP, 2012 update)

The LRTP contains an "opportunity statement" that calls for the Region of Peel to pursue transportation solutions that will:

- Support and conform to the Provincial Policy Statement, the Provincial Growth Plan (Places to Grow), the Greenbelt Plan, and the Niagara Escarpment Plan
- Support policies in the Regional Official Plan
- Support planned growth in Peel
- Protect the natural and agricultural resources of Peel
- Minimize the negative impacts of transportation on the natural environment
- Maintain the Region's economic competitiveness by facilitating goods movement in Peel

- Provide an integrated transportation network that supports the urban structure of Peel and provides access to a diverse range of land uses and activities in the Region
- Meet the transportation needs of the elderly and those with disabilities
- Encourage sustainable modes of transportation such as transit, carpooling, cycling and walking
- Provide a connected and balanced transportation network that supports all modes of travel and improves travel efficiency

The LRTP also contains a detailed performance measurement framework, based on seven key performance objectives that are each supported by potential performance measures. This framework is reproduced below.

LRTP Performance Objectives and their Measures (2012 LRTP, Table 5.2)

PERFORMANCE OBJECTIVE	POTENTIAL PERFORMANCE MEASURES	SOURCES OF DATA
1. Move people and goods efficiently through Peel	Average commute time	Travel Time Study
	Vehicle kilometres travelled on Regional roads	Region of Peel
	Levels of service of Regional roads	Travel Time Study, Region of Peel
	Morning peak-period auto occupancy	Cordon Count Program
	Average vehicle speed	Travel Time Study
	Degree of road congestion (volume/capacity)	Region of Peel, Region of Peel and area municipalities' traffic counts (AADTs, turning movement counts), MTO AADTs
2. Ensure transportation safety	Number of injuries/fatalities on Regional roads	Region of Peel
	Number of cyclist and pedestrian collisions	Region of Peel
3. Meet the mobility needs of the elderly and persons with disabilities	Specialized transit ridership	Region of Peel
	Percentage of low-floor buses in local transit fleets	Area Municipalities
4. Encourage alternative modes of transportation	Annual transit ridership	Area Municipalities, GO Transit
	per cent of trips made by walking/cycling/transit	TTS, Cordon Count Program
	Kilometres of bike lanes/multi-purpose trails	Region of Peel
	Kilometres of sidewalks on Regional roads	Region of Peel
	Kilometres of transit lanes on Regional roads	Area Municipalities
	Kilometres reduced by Smart Commute Initiative	Smart Commute Annual Report
5. Provide an integrated transportation network	Number of employers within a 400 m (5 min.) walking distance of a bus stop	Region of Peel, Area Municipalities
	Number of residents within a 400 m (5 min.) walking distance of a bus stop	Region of Peel, Area Municipalities
	Travel time from residential areas to employment areas	Region of Peel, Area Municipalities
6. Support sustainable economic development	Number of trucks crossing Peel boundaries	Cordon Count Program
	Level of goods movement activity in Peel, i.e. origin-destination of truck trips in Peel (trips within Peel, trips destined to Peel, trips originating in Peel, trips through Peel)	MTO, University of Toronto Shipper Survey
7. Reduce air emissions from transportation sources	Greenhouse gas emissions from passenger travel (kilograms per capita)	Region of Peel
	NOx emissions from passenger travel (kilograms per capita)	Region of Peel

2.4 Improving Health by Design

The landmark 2014 report Improving Health by Design in the Greater Toronto-Hamilton Area (authored by several GTHA Medical Officers of Health including Peel Region's Dr. David Mowat) quantified several health and non-health benefits of better community design and transportation systems:

HEALTH BENEFITS	NON-HEALTH BENEFITS
<p>Quantitative</p> <p>Annual premature deaths prevented due to physical activity</p> <ul style="list-style-type: none"> Annual premature deaths prevented due to traffic-related air pollution Annual new diagnoses of diabetes prevented due to physical activity Annual hospitalizations prevented due to air pollution <p>Qualitative</p> <ul style="list-style-type: none"> More transportation options for all More support for an aging population Improved mental health and social connectivity Fewer injuries 	<p>Quantitative</p> <ul style="list-style-type: none"> Reduced congestion (i.e. faster average commute trip time) Annual economic cost of congestion Increase in annual GHG emissions from transportation Reduction in upfront and annual operating costs for municipal infrastructure <p>Qualitative</p> <ul style="list-style-type: none"> Protection of natural space, heritage sites and farmland

2.5 Summary of Interests

Following is a compilation of the transportation-related outcomes that are identified in the Region of Peel's policy and planning documents. To the extent that is practical, the business case framework should enable an assessment of whether a given initiative or scenario is aligned with these outcomes.

Social

- Access to employment
- Access to services
 - All stages of life
- Choice of services to meet diverse needs
- Auto dependency
- Mobility (i.e. ease of movement)
 - Travel times/speeds/delay
 - Population-wide/persons with disabilities/elderly
- Health impacts
 - Injury and death (motor vehicle users, vulnerable road users)
 - Physical activity (diabetes, premature death)
 - Air pollution (hospitalizations, premature deaths)
 - Mental health/social connectivity

Environment

- Environmental impacts
- Air emissions/quality
- Energy conservation
- Climate change emissions/mitigation
- Climate change adaptation
- Protection of natural spaces and farmland

Economy

- Goods movement
 - Safety
 - Efficiency (including of existing infrastructure and capacity)
 - Supports economy
 - Minimizes environmental impacts
- Promote investment
- Costs of congestion
- Vitality and growth
- Transit access to airport and surrounding employment area
- Economic potential of airports

Built Environment

- Support for Provincial Policy Statement, Growth Plan, Greenbelt Plan
- Integration of land use planning with transportation planning and investment
- Support transit-supportive densities and patterns
- Healthy
- Age-friendly

Peel Region as a Leader

- Attract top talent
- Be a model employer

Overarching transportation system characteristics

- Safety
- Efficiency
- Effectiveness
- Reliability
- Integration
- Capacity (for moving people and goods, rather than vehicles)
- Sustainability

- Convenience
- Attractiveness
- Cleanliness (NOx, GHG)
- Balance
- Connectivity
- Proximity (between transit and homes/jobs)
- Accessibility (including transit)
- Affordability for users
- Affordability for government (life-cycle, capital, operating)
- Increase demand for sustainable modes
- Transit connections within Peel and with other regions
- Coordination between transit services

3 Approaches in Other Jurisdictions

3.1 Metrolinx: Business Case Analysis

Metrolinx defines business case analysis (BCA) as “a tool that decision-makers use to ensure major transportation infrastructure investment is consistent with the goals and objectives of The Big Move.” Metrolinx uses BCA early in the project planning process, and subsequently as projects evolve. BCAs examine different options by applying several major considerations:

- Transportation user benefits compared to the financial impact
- Value for tax-payer dollars
- Environmental, economic and social benefits of alternatives
- A project’s impacts on communities
- Alignment with the current policy objectives.

Metrolinx views BCA not as a tool to replace conventional decision making, but rather as a point of reference for decision-makers that offers an informed view of alternative actions. Completed business cases assess the following areas of interest:

STRATEGIC CASE
Does the initiative support higher-level goals, policies or principles?
<ul style="list-style-type: none"> • Examines the alignment of proposed programs, investments or interventions with Metrolinx strategic plans and goals • Involves the presentation of transportation planning information, including traffic forecasts, related travel patterns, drivers and interdependencies
FINANCIAL CASE
Can the initiative’s direct costs be successfully financed?
<ul style="list-style-type: none"> • Examines the lifecycle costs and revenues of proposed investments or interventions
ECONOMIC CASE
Do the initiative’s benefits outweigh its costs, in economic terms?
<p>Generally includes a benefit-cost ratio</p> <ul style="list-style-type: none"> • Examines the economic impacts of proposed investments or interventions: <ul style="list-style-type: none"> – Transportation user benefits (journey time impacts, road congestion impacts, safety/crash reductions, operating cost savings, active transportation health impacts, etc.) – Environmental impacts (changes in emissions levels, vibration, etc.) – Social and community impacts (the distribution of benefits among populations, severance/isolation impacts, etc.) – Wider economic benefits (agglomeration/productivity impacts, etc.) – Public funding impacts (property tax revenues, etc.)
DELIVERABILITY AND MANAGEMENT CASE
Can the initiative be delivered and operated successfully?
<ul style="list-style-type: none"> • Examines the impacts of proposed investments or interventions on operations; the delivery of the proposal; potential risks; procurement and related commercial or management issues

3.2 U.S. Environmental Protection Agency: Guide to Sustainable Transportation Performance Measures (2011)

3.2.1 Overview

This document describes 12 representative (i.e. not comprehensive) performance measures that can be used in transportation planning, decision-making, programming, monitoring and evaluation. The measures address environmental, economic and social sustainability. The guidebook presents possible metrics for each measure, identifies analytical methods and data sources, and illustrates applications. The measures, along with some possible metrics where clarity is helpful, are:

<p>Transit accessibility</p> <ul style="list-style-type: none"> Distance to transit stops, destinations accessible by transit <p>Cycling and walking mode share</p> <p>Vehicle-miles travelled per capita</p> <p>Carbon emissions per capita from transportation</p> <p>Mixed land uses</p> <ul style="list-style-type: none"> Typically captured through an arithmetic index function <p>Transportation affordability</p> <ul style="list-style-type: none"> Annual cost of transportation as a proportion of income <p>Distribution of benefits by income group</p> <ul style="list-style-type: none"> Access to employment by income group Access to other destinations by income group Transit availability by income group 	<p>Land consumption</p> <ul style="list-style-type: none"> Area of sensitive lands consumed by new transportation infrastructure Paved area for roads (i.e. lane-km) and parking lots <p>Cyclist and pedestrian activity and safety</p> <ul style="list-style-type: none"> Bicycles/pedestrians per day (link-based) Crashes involving cyclists/pedestrians per 1,000 residents <p>Cyclist and pedestrian level of service</p> <p>Average vehicle occupancy</p> <ul style="list-style-type: none"> Average number of occupants per motorized vehicle on a link or network <p>Transit productivity</p> <ul style="list-style-type: none"> Transit boardings per revenue-hour or revenue-km Annual transit boardings per route-km Passenger-km per revenue-km (i.e. average load)
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Example: Long-range plan performance monitoring

The guidebook gives one example of “report card” factors and measures used to track a region’s progress towards its long-term transportation goals (see figure, below).

Example: Performance measures for long-range regional transportation plan
(Mid-America Regional Council, Kansas City Region)

Goal	Factor	Measure
Accessibility	Level of Transit Service	<ul style="list-style-type: none"> ▶ Revenue service hours ▶ Ridership
	Environmental Justice	<ul style="list-style-type: none"> ▶ Percent of transportation investments in environmental justice tracts
Economic Vitality	Transportation Costs	<ul style="list-style-type: none"> ▶ Combined transportation and housing costs as a percentage of median income
Climate Change/ Energy Use	Vehicle Miles Traveled /CO ₂	<ul style="list-style-type: none"> ▶ Systemwide daily VMT/CO₂ emissions
	Vehicle Occupancy	<ul style="list-style-type: none"> ▶ Vehicle occupancy rate
Environment	MetroGreen Network	<ul style="list-style-type: none"> ▶ Percent/miles of MetroGreen Network Completed
Place Making	Multi-modal Options	<ul style="list-style-type: none"> ▶ Modal balance (mode share)
Public Health	Ozone	<ul style="list-style-type: none"> ▶ Ozone levels
	Physical Health	<ul style="list-style-type: none"> ▶ Obesity rate
Safety and Security	Crash Fatality and Injury Rate	<ul style="list-style-type: none"> ▶ Annual crash fatalities and disabling injuries
System Condition	Bridge & Pavement Condition	<ul style="list-style-type: none"> ▶ Pavement condition ▶ Bridge condition
System Performance	Level of Service	<ul style="list-style-type: none"> ▶ Observed speed vs. posted speed on Congestion Management System network
	Congestion	<ul style="list-style-type: none"> ▶ Percent of Congestion Management System network congested
	Travel Time	<ul style="list-style-type: none"> ▶ Average commute time
	On-Time Performance	<ul style="list-style-type: none"> ▶ On-time performance of transit system

Example: Project assessment for inclusion in a long-range plan

The guidebook presents two groups of measures used by the Metropolitan Transportation Commission as part of a long-range planning exercise (see figures, below):

- Quantitative measures used to evaluate about 60 major projects
- Qualitative criteria used to assess 21 groups of projects of different types (representing a total of 700 projects) as strongly supportive of, supportive of, or neutral toward, the plan's major goals

Example: Quantitative project evaluation measures for a long range regional transportation plan

(Metropolitan Transportation Commission, San Francisco Bay Area)

Measures	Plan Performance Objective
Benefit-Cost Ratio (monetized), reflecting: <ul style="list-style-type: none"> ▶ Recurrent delay (vehicle hours) ▶ Non-recurrent delay (vehicle hours) ▶ Transit travel time ¹ ▶ Particulate matter emissions (PM2.5 and PM10) ▶ Carbon dioxide emissions ▶ Fatal and injury collisions ▶ Direct user costs (vehicle operating and, in some cases, auto ownership costs) ▶ Public and private cost savings from performing on-time maintenance ² 	Reduce Congestion, Reduce Emissions, Reduce Collisions and Fatalities
Reduction in VMT and cost per VMT reduced	Reduce Vehicle Miles Driven
Reduction in CO₂ emissions and cost per ton reduced	Reduce Emissions
Cost per low-income household served by transit (trial measure) ³	Improve Affordability

Notes: 1) For HOV and HOT projects only; 2) For maintenance programs only; 3) For transit projects only.

Example: Qualitative project-level assessment criteria for a long range regional transportation plan

(Metropolitan Transportation Commission, San Francisco Bay Area)

Plan Goals	Criteria for Determining Support
Maintenance	Advances maintenance of the existing transportation system
Congestion Relief (Reliability and Efficient Freight Travel) ¹	<ul style="list-style-type: none"> Improves freight mobility Improves transit mobility, effectiveness, or efficiency Improves local mobility or circulation Completes a critical transportation gap (geographic or temporal) Institutes or enables a new user-based pricing program Implements technology-based operations or traveler information Improves roadway safety
Emissions Reduction	<ul style="list-style-type: none"> Provides an alternative to driving alone Improves transit mobility, effectiveness, or efficiency Marketing, education and incentive programs that encourage mode shift away from driving alone or during peaks
Focused Growth	<ul style="list-style-type: none"> Located within a proposed or planned priority development area Connects two priority development areas
Access and Safety (non-motorized) ²	<ul style="list-style-type: none"> Provides a transit alternative to driving on a future priced facility Provides an alternative to driving alone Improves access for youth, elderly, and disabled persons Improves safety for pedestrians and cyclists Reduces transportation or housing costs for low-income households

Notes: 1) Includes roadway safety; 2) Includes affordability for low-income households and non-motorized safety.

Example: Program prioritization

The document gives one example of a scorecard that applies nine factors as metrics to compare different programs for future funding (see figure). Example: Program rating scorecard (Southwestern Pennsylvania Commission)

Factors	Weight	Score	Weighted Score	Best Possible Score
		1=low 2=med 3=high		
1. Consistency with 2035 Long Range Plan Vision and Policies that Impact Air Quality	10			30
2. CMP Congested Corridor Rating	10			30
3. Deliverability / Project Readiness	10			30
4. Raise Public Awareness of Transportation Demand Management Options	7			21
5. Grouped Projects	5			15
6. Safety Improvements	7			21
7. Sustainable Development Benefits	5			15
8. Projects that bring Non-Traditional Funding to TIP	5			15
9. Non-Federal Funding Share	5			15

3.3 Transportation Research Board Sustainable Transportation Indicators Subcommittee: Sustainable Transportation Indicators (2008)

This paper outlined a recommended program to define a standard set of indicators for sustainable transportation planning. The authors' goal was to address both direct and indirect impacts in a way that can guide short-term decisions to support longer-term goals.

The paper suggests that sustainable transportation indicators should:

- Be comprehensive, balanced, understandable and useful
- Reflect impacts of concern (e.g. smog days) rather than intermediary effects (e.g. tons of pollutants)
- Be quantified using data that is be feasible to collect
- Support disaggregation (e.g. geographic or demographic) where useful
- Apply normalized reference units (e.g. per year, per dollar, per kilometre, per capita) to aid comparisons
- Be accompanied by quantitative targets or at least the direction of desired changes

The paper includes the following list of possible indicators. Indicator with an "A" rating are suggested for application in virtually all situations, those with a "B" rating are proposed where relevant or feasible, and those with a "C" rating are proposed when needed to address specific community needs. The main categories of indicator are:

- Travel activity
- Air pollution emissions

- Noise pollution
- Traffic risk
- Economic productivity
- Overall accessibility
- Land use impacts
- Equity
- Transport policy and planning

Possible sustainable transportation indicators(TRB Sustainable Transportation Indicators Subcommittee)

Category	Subcategory	Indicator	Disaggregation	Rating
Travel Activity	Vehicles	Motor vehicle ownership	By type of vehicle, owner demographics, location	A
	Mobility	Motor vehicle travel	Trip type, traveler type, travel conditions	A
	Mode split	Portion of trips by auto, public transit, and non-motorized modes	Trip type, traveler type, travel conditions	A
Air Pollution Emissions	Emissions	Total vehicle emissions	Type of emission, mode, location	A
	Air pollution exposure	Number of days of exposure per year	Demographic groups affected	A
	Climate change	Climate change emissions (CO ₂ , CH ₄)	Mode	A
	Embodied emissions	Emissions from vehicle and facility construction	Type of emission and mode	A
Noise Pollution	Traffic noise	People exposed to traffic noise above 55 LAeq,T	Demographic group, location, transport mode	B
	Aircraft noise	People exposed to aircraft noise above 57 LAeq,T	Demographic group, location, transport mode	B
Traffic risk	Crash Casualties	Crash deaths and injuries	Mode, road, type and cause of collision.	A
	Crashes	Police-reported crashes	Mode, road, type and cause of collision.	A
	Crash costs	Traffic crash economic costs	Mode, road, type and cause of collision.	B
Economic Productivity	Transport costs	Consumer expenditures on transport	Mode, user type, location	A
	Commute costs (time and money)	Access to employment	Mode, user type, location	A
	Transport reliability	Per capita congestion costs	Mode, location	B
	Infrastructure costs	Expenditures on roads, public transit, parking, ports, etc.	Mode, location	A
	Shipping costs	Freight transport efficiency	Mode, geographic area	B

Category	Subcategory	Indicator	Disaggregation	Rating
Overall Accessibility	Mobility options	Quality of walking, cycling, public transit, driving, taxi, etc.	Trip purpose, location, user	A
	Land use accessibility	Quality of land use accessibility	Trip purpose, location, user	B
	Mobility substitutes	Internet access and delivery service quality	Trip purpose, location, user	B
Land Use Impacts	Sprawl	Per capita impervious surface area	By location and type of development	B
	Transport land consumption	Land devoted to transport facilities	By mode	B
	Ecological and cultural degradation	Habitat and cultural sites degraded by transportation facilities	Type of habitat and resource, location	B
Equity	Affordability – Transport	Portion of household budgets needed to provide adequate transport.	Demographics, especially disadvantaged groups	A
	Affordability – Housing	Affordable housing accessibility	By demographic group, especially low income and disabled groups	C
	Basic accessibility	Quality of accessibility for people with disabilities	By geographic area, mode, type of disability	B
Transport Policy and Planning	Pricing efficiency	Cost-based pricing	By mode, type of cost (road, parking, etc.)	B
	Strategic planning	Degree to which individual planning decisions support strategic goals	By mode, agency.	B
	Planning efficiency	Comprehensive and neutral planning	By mode, agency.	C
	User satisfaction	User survey results.	By group (disabled, children, low income...)	B

3.4 GPI Atlantic: GPI Transportation Accounts – Sustainable Transportation in Nova Scotia (2006)

This document identified indicators useful for assessing the long-term sustainability of transportation systems, based on the goals of preventing harm and providing benefits to people and their natural world. The document presents four categories of objectives (transport activity, economic, social and environmental), 17 individual objectives, and 20 component indicators.

Example: Sustainable transportation objectives and indicators (GPI Atlantic)

Objective	Indicator
Transport Activity	
1. Decrease economically excessive motor vehicle transport, and increase use of more sustainable modes	1. Motorized movement of people: <ul style="list-style-type: none"> - Vehicle-km - Passenger-km - Passenger-km per capita - Comparison of trends: passenger-km and GDP 2. Motorized movement of freight <ul style="list-style-type: none"> - Tonne-km - Tonne-km per capita - Comparison of trends: tonne-km and GDP 3. Passenger automobiles per capita
Environment	
2. Decrease energy consumption	4. Transport-related energy consumption <ul style="list-style-type: none"> - Total and per capita energy consumption devoted to transportation - Percentage of primary energy consumption dedicated to transportation - Share of energy consumption by mode and fuel
3. Increased fossil fuel energy efficiency	5. Energy intensity of cars and trucks <ul style="list-style-type: none"> - Energy consumption per vehicle-km
4. Decrease greenhouse gas (GHG) emissions	6. Transport-related GHG emissions by mode and per capita
5. Decrease emissions of air pollutants	7. Total transport emissions of air pollutants by mode and per capita
6. Decrease pollution emissions per unit of travel	8. Emissions intensity of cars and trucks <ul style="list-style-type: none"> - Emissions per vehicle-km
7. Decrease water pollution	9. Polluting discharges by mode <ul style="list-style-type: none"> - Oil spills - Road salt usage - Well contamination
8. Increase recycling and re-use of transportation components	10. Number of tires recycled
9. Decrease space taken by transport facilities	11. Number of derelict cars recycled
	12. Land Use <ul style="list-style-type: none"> - Space taken by transport facilities by mode - Total length of paved roads - Urban density
Social	
10. Increase access to basic services	13. Access to basic services <ul style="list-style-type: none"> - Average commuting distance - Percentage of children who walk to school - Percentage of commuters who walk, bicycle, or use public transit
11. Increase access to public transportation	14. Access to public transit <ul style="list-style-type: none"> - Percentage of population who live within 500m of transit station
12. Increase access to the Internet	15. Percentage of population with home internet <ul style="list-style-type: none"> - Percentage of population who work at home
13. Decrease transport injuries and fatalities	16. Transport injuries and fatalities by mode
14. Increase non-motorized transportation	17. Non-motorized travel: quality and quantity of walking and cycling conditions <ul style="list-style-type: none"> - Kilometres of bike paths and sidewalks
Economic	
15. Increase percentage of net government spending on public transportation	18. Investments in public transport <ul style="list-style-type: none"> - Percentage of net government ground transportation expenditures spent on public transportation
16. Increase proportion of household transportation spending devoted to public transit	19. Percentage of household transportation spending devoted to public transit
17. Decrease cost of household transportation expenditure in lowest income quintile	20. Expenditure on personal mobility <ul style="list-style-type: none"> - Percentage of household expenditures dedicated to transportation for those in lowest income quintile

3.5 U.S. Federal Highway Administration: Guidebook for Developing Pedestrian and Bicycle Performance Measures (2016)

This guidebook provides a comprehensive framework for active transportation planning, decision-making and monitoring. It addresses the “universe of possibility” and includes a toolbox of performance measures applicable for a variety of contexts and purposes, with the intention of helping governments at all levels to develop customized performance measurement strategies.

Recognizing that transportation is not an end in itself, the document is organized around seven higher-level community goals that are supported by transportation:

- Connectivity – access to opportunities, reliability, cost-effectiveness, speed
- Economic – job impacts, retail impacts
- Environment – air quality, water quality, noise, habitats, climate
- Equity – options for non-car-owning households, accessibility
- Livability – transportation choice, revitalization, community character
- Health – physical activity, safety, air quality, access to health-related opportunities, equity
- Safety – crashes, injuries, deaths

The active transportation measures proposed in the guidebook all support (directly or indirectly) at least one of the community goals. The measures themselves are grouped into six categories:

- Accessibility – access for people with disabilities to programs, services, and activities
- Compliance – conforms to a requirement (e.g. statute or regulation)
- Demand – the amount of existing and potential future walking and bicycling activity
- Reliability – the degree of certainty and predictability in travel times on the transportation system
- Mobility – the ability to travel or move from place to place
- Infrastructure – streets, signals, bridges, transit, bike facilities, shared use paths, sidewalks

The following chart illustrates the strength (low or high) of the connection between each group of active transportation measures and the community goals.

Example: Connection between active transportation measures and community goals
(U.S. FHWA)

COMMUNITY GOALS CATEGORIES	TRANSPORTATION MEASURES CATEGORIES					
	ACCESSIBILITY	COMPLIANCE	DEMAND	INFRASTRUCTURE	MOBILITY	RELIABILITY
CONNECTIVITY	High	Low		High	High	Low
ECONOMY	High			Low	High	High
ENVIRONMENT	High		High		Low	Low
EQUITY	High	Low	Low	High	High	Low
HEALTH	High	Low	High	High	Low	Low
LIVABILITY	High	Low	Low	High	Low	High
SAFETY	High	High	High	High	High	Low

The following chart illustrates the specific suggested active transportation performance measures and their connections to the various community goals. For each of the 30 measures, the guidebook discusses its applicability to various purposes (benchmarking, scenario evaluation, alternatives comparison, project prioritization, standard compliance), land use contexts (e.g. rural, suburban, urban), geographies (local, regional, state), data needs and sources, and sample applications.

Example: Active transportation measures and their support for community goals
(U.S. FHWA)

PERFORMANCE MEASURES	GOALS						
	CONNECTIVITY	ECONOMIC	ENVIRONMENT	EQUITY	HEALTH	LIVABILITY	SAFETY
Access to Community Destinations	X	X	X	X	X	X	X
Access to Jobs	X	X		X			
Adherence to Accessibility Laws	X	X		X	X	X	X
Adherence to Traffic Laws					X		X
Average Travel Time	X	X		X		X	X
Average Trip Length	X	X		X		X	X
Connectivity Index	X	X		X		X	X
Crashes				X	X	X	X
Crossing Opportunities	X			X	X	X	X
Delay				X		X	X
Density of Destinations	X	X		X	X	X	X
Facility Maintenance	X			X		X	X
Job Creation		X					
Land Consumption		X	X			X	
Land Value		X					

PERFORMANCE MEASURES	GOALS						
	CONNECTIVITY	ECONOMIC	ENVIRONMENT	EQUITY	HEALTH	LIVABILITY	SAFETY
Level of Service				X		X	X
Miles of Pedestrian/Bicycle Facilities	X			X	X	X	X
Mode Split			X	X	X	X	
Network Completeness	X	X	X	X	X	X	X
Pedestrian Space		X		X		X	X
Person Throughput		X		X			
Physical Activity and Health				X	X	X	
Population Served by Walk/Bike/Transit	X			X	X	X	X
Retail Impacts		X					
Route Directness	X	X	X	X		X	X
Street Trees			X		X	X	X
Transportation-Disadvantaged Population Served	X			X			
User Perceptions					X	X	X
Vehicle Miles Traveled (VMT) Impacts			X		X	X	X
Volume			X		X		X

3.6 AARP/Smart Growth America: Evaluating Complete Streets Projects – A Guide for Practitioners (2015)

This document provides a broad framework for target setting and monitoring of complete streets projects (which are broadly supportive of sustainable transportation principles and objectives). The following bullets identify the seven major goals considered and the measures recommended for each goal that are most relevant to Peel's STS. The document also suggests specific metrics that could be used to quantify each measure, although these are not repeated here.

<p>Access</p> <ul style="list-style-type: none"> • Auto trips • Bicycle trips • Community connections (proportion of population within reach of facility) • Transit trips and service quality • Walk trips • Freight movement • Presence of cycling facilities • Presence of transit facilities • Presence of walking facilities • Transit reliability • Transportation connections (closing gaps, last mile) • Trip consistency (travel time reliability and delay) <p>Economy</p> <ul style="list-style-type: none"> • Access to opportunities • Land value • Parking utilization • Retail vibrancy <p>Environment</p> <ul style="list-style-type: none"> • Air quality • Energy efficiency • Providing/preserving habitat for native species • Stormwater runoff • Vegetation 	<p>Place</p> <ul style="list-style-type: none"> • Quality of automobile trips (LOS) • Quality of bicycling environment (MMLOS, design) • Quality of pedestrian environment (MMLOS, design) • Quality of transit environment (MMLOS, amenities) • Satisfaction • Seating (presence, quality) • Shade (proportion of area) <p>Safety</p> <ul style="list-style-type: none"> • Adequate lighting • Compliance with speed limit • Crashes • Fatalities and serious injuries • Personal security <p>Equity</p> <ul style="list-style-type: none"> • <i>Integrated into measures for goals related to access, economy, environment, place and safety</i> • <i>Considers the distribution of benefits under other objectives for disadvantaged communities</i> <p>Public health</p> <ul style="list-style-type: none"> • <i>Integrated into measures for goals related to access, economy, environment, place and safety</i> • <i>Considers access to physical activity and active transportation, incidence of death and injury, and exposure to pollutants</i>
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3.7 City of Ottawa: Cost of Travel Model (2011 Update)

The City of Ottawa's Cost of Travel Model was originally developed in 1995, and was last updated in 2011. It integrates extensive datasets and produces various costs per person-kilometre of travel by auto, transit, cycling and walking, for both peak and off-peak travel in urban areas, for suburban/rural travel, and for total daily travel. The model identifies operating costs, infrastructure costs, time/delay costs, and environmental/social costs. The latter group of costs largely constitutes externalities.

The model outputs allow rapid computation of how private, public and social costs would differ for different travel activity scenarios (i.e. different distributions of personal travel among various modes).

Unit travel costs by component – Weighted average (total daily travel) Ottawa Cost of Travel Mode, 2011

Travel Cost Component	Cost per person-km			
	Auto	Transit	Bicycle	Pedestrian
Operating costs				
<i>Operating costs</i>				
Fixed (ownership) vehicle costs	\$0.313	\$0.133	\$0.045	\$0.000
Variable (operating) vehicle costs	\$0.112	\$0.401	\$0.074	\$0.167
Parking	\$0.094	\$0.000	\$0.004	\$0.000
Total operating costs	\$0.519	\$0.534	\$0.122	\$0.167
Non-operating costs				
<i>Infrastructure costs</i>				
Road construction	\$0.032	\$0.007	\$0.004	\$0.000
Road maintenance	\$0.030	\$0.028	\$0.000	\$0.000
Roadway land value	\$0.033	\$0.007	\$0.004	\$0.000
Enforcement/protection services	\$0.007	\$0.000	\$0.000	\$0.000
Subtotal	\$0.102	\$0.041	\$0.009	\$0.001
<i>Time/delay costs</i>				
Personal time	\$0.321	\$0.721	\$0.467	\$2.292
Commercial delays	\$0.011	\$0.002	\$0.001	\$0.000
Subtotal	\$0.332	\$0.723	\$0.469	\$2.292
<i>Environmental/social costs</i>				
Unaccounted accidents	\$0.014	\$0.000	\$0.027	\$0.035
Air pollution	\$0.049	\$0.010	\$0.000	\$0.000
Noise pollution	\$0.010	\$0.003	\$0.000	\$0.000
Water pollution	\$0.013	\$0.001	\$0.000	\$0.000
Subtotal	\$0.085	\$0.015	\$0.027	\$0.035
Total non-operating costs	\$0.519	\$0.779	\$0.504	\$2.328
Total travel costs				
TOTAL COSTS	\$1.038	\$1.313	\$0.627	\$2.495

3.8 New Zealand Transport Agency: Costs and Benefits of Modal Transport Solutions (2009)

This report by GHD Pty Ltd for the New Zealand Transport Agency included estimates of unit costs for passenger travel by different modes in urban areas. The report addresses the costs of providing public transit (vehicle-kilometre basis), the benefits and costs to travellers (person-kilometre basis), and community impacts (person-kilometre basis).

Public transit operating costs (GHD Pty Ltd)

2009 NZ\$/vehicle km	Running costs			Vehicle purchase/lease	Total costs
	Fuel/energy	Staff	Insurance and registration		
Bus	0.37	0.95	0.26	0.84	2.42
Light rail	0.28	0.95	0.26	3.34	4.84
Heavy rail	0.66	0.74	0.52	3.14	5.06

Source: White, P (2008, p60); Kenworthy, J (2003, table 4); ESAA (2009); public transport operators' websites; GHD internal estimates of insurance costs, various procurement notices for estimates of vehicle purchase costs and lifetime distances

Traveller costs and benefits (GHD Pty Ltd)

Costs/ passenger km (2009 NZ\$)	Costs paid each trip			Annual costs		Cost of time			Cost of risks			Other impacts	Total
	Fare	Fuel	Park- ing	Vehicle purchase/ lease/ service	Insur- ance/ regist- ration	Travel time (in vehicle)	Wait time	Access time	Health	Acci- dent risk	Crime risk	Descriptions	Quantifiabl e costs only
Walk	0	0	0	0	0	3.62	0	0	-1.1	0.49	CC	Exposure to weather/contact with community	3.01
Bicycle	0	0	0	0.19	0	1.14	0	0.07	-0.54	0.33	C	Exposure to weather/pleasure from cycling	1.19
Bus	0.34	0	0	0	0	0.94	0.17	0.09	0	0.01	C	Traffic congestion experienced/exposure to weather	1.55
Light rail	0.34	0	0	0	0	0.91	0.11	0.09	0	0.01	C	Crowded carriages/exposure to weather	1.46
Heavy rail	0.25	0	0	0	0	0.59	0.11	0.15	0	0.01	C	Crowded stations/carriages	1.11
Taxi	2.55	0	0	0	0	0.68	0.04	0.04	0	0.06	c	Benefit for disabled/elderly	3.37
Private car	0	0.18	0.67	0.42	0.09	0.68	0.05	0.07	0	0.06	c	Traffic congestion experienced/separation from crowds	2.22

Source: Public transport operators' websites; NZ Household Travel Survey (1997/8); NZAA (2009); private parking operators' websites; VTPI (2009, table 5.3.7-1); GHD estimates and assumptions

Note: Health impacts for walk and bicycle are negative costs because each kilometre of use tends to reduce public health costs, ie they are a benefit to the traveller.

Community costs and benefits (GHD Pty Ltd)

Cost/vehicle km (2009 \$NZ)	Accidents	Noise	Air pollution	Greenhouse gases	Severance	Health impacts*	Upstream/ downstream impacts	Place making	Total (quantifiabl e costs only)
Walk	0.003	0	0	0	0	-1.054	0.002	BBB	-1.049
Bicycle	0.003	0	0	0	0	-0.527	0.005	B	-0.519
Bus	0.316	0.022	0.237	0.109	0.017	0	0.157	-	0.858
Light rail	0.158	0.034	0.066	0.067	0.034	0	0.188	B	0.547
Heavy rail	0.158	0.068	0.131	0.1	0.101	0	0.204	B	0.762
Car	0.066	0.007	0.023	0.019	0.005	0	0.03	C **	0.15

Source: Austroads (2008, table 3.1); MoT et al (2005, tables B12.4, B12.5); NZTA (2009a, pp3-18); VTPI (2009, chs 5.3, 5.10); GHD assumptions

*Health impacts for walk and bicycle are negative costs because each kilometre of use tends to reduce public health costs, ie they are a benefit.

** While car traffic may make streetscapes unpleasant and impose a cost rather than confer a benefit in place making, widespread availability of car travel may provide community benefits such as opportunities for children and adults to access and participate in a wider range of sporting and cultural activities.

3.9 New Zealand Transport Agency: Economic Evaluation Manual (2016)

This very detailed guide outlines processes and tools for conducting economic benefit-cost analyses of all types of possible transport projects.

TDM Activities

Benefits to be considered in the economic efficiency evaluation of TDM activities are:

- VOC savings
- Travel time cost savings
- Trip reliability
- Generated traffic
- Spillover effects
- Walking and cycling costs
- Crash cost savings
- Health benefits
- Transport service user benefits
- Parking user cost savings
- Other user benefits
- Carbon dioxide reduction
- Other monetized and non-monetized environmental impacts
- Community livability improvements
- Increased consumer travel options
- Adjustment for public transport fares
- Disbenefits during implementation/construction
- Land use benefits
- National strategic factors

Benefits to businesses are considered to be economic transfers and are excluded from benefit-cost analyses, but may be included in the larger strategic case made for a TDM activity.

Transit Activities

Costs of transit activities to be considered include:

- Funding assistance from government
- Road maintenance, renewal and construction cost savings
- Construction costs, including property, for any additional infrastructure required
- Maintenance costs not already included in service contracts.

Benefits of transit activities include:

- Transport service user benefits
- Road traffic reduction benefits (VOC savings, travel time cost savings, CO2 reduction and crash cost savings)
- Disbenefits during implementation/construction
- Other monetized and non-monetized impacts

- National strategic factors

Other benefits that could be considered include impacts on equity, business profitability, and property values.

Walking and Cycling Activities

The guide specifies that evaluation of walking and cycling activities should be done at the package level (i.e. infrastructure combined with bike parking, wayfinding, maps, education, promotion, marketing, and integration with transit) due to the importance of synergies that may not be apparent when examining individual components.

The benefits of new walking and cycling facilities include:

- User benefits (time savings and crash reduction)
- Non-monetized effects
- National strategic factors
- Equity impacts

Education, Promotion and Marketing Activities

The benefits to be considered for these activities include:

- Benefits to people who change their travel behaviour
- Benefits to remaining road users (road traffic reduction and safety)
- Health
- Other monetized impacts including environmental effects

Benefits arising from road construction, operation and maintenance cost savings are assumed to be negligible for the number of private vehicle trips and/or vehicle-kilometres that are likely to be removed by education, promotion and marketing activities.

4 Stakeholder Workshop

4.1 Overview

Objectives. A workshop of key stakeholders was held on November 17, 2016 to help guide the development of the STS business case framework. The objectives of the workshop were:

- To build stakeholder understanding of sustainable transportation and the STS.
- To identify how transportation influences key stakeholder outcomes.
- To identify indicators and data sources related to key stakeholder outcomes.

The workshop also addressed other aspects of STS development, namely opportunities for program or project partnerships between stakeholders and Region of Peel's Transportation Division.

Participants. The workshop's 57 participants represented many different organizations (see Appendix A), and their varied experience and professional perspectives did much to enrich and enhance the event. For several discussions, participants were divided into breakout groups based on the following interest areas:

Non-transportation groups

- Public health
- Human services
- Environmental management
- Economic development
- Land use planning and policy (two groups)
- Transportation groups
- Transportation services (i.e. active transportation, public transit, TDM)
- Transportation planning (two groups)

Agenda. The half-day event ran from 9:00 a.m. to 1:00 p.m. at the Brampton Masonic Centre at 955 Clark Boulevard in Brampton. The major agenda items and speakers are listed below:

- Welcoming remarks (Brian Hollingworth, IBI Group; Dr. Eileen De Villa, Medical Officer of Health, Region of Peel; Gary Kocialek, Director of Transportation, Region of Peel)
- Sustainable Transportation Strategy overview (Arthur Lo, Sustainable Transportation, Region of Peel)
- Business case overview (Geoff Noxon, Noxon Associates)
- Breakout group discussion A: Finding the links
- Breakout group discussion B: Measuring the outcomes
- Breakout group discussion C: Working together
- Interactive plenary discussion: Connecting the dots
- Next steps

Focus questions. Breakout group discussions A and B allowed small groups to answer the following focus questions related to the business case framework from the perspective of participants' interests, responsibilities and activities.

Breakout group discussion A: Finding the links

Question 1:

- Non-transportation groups – What desired outcomes of your work (e.g. goals or objectives) are affected by transportation systems or activities? Effects may be positive or negative.
- Transportation groups – What do you consider to be the non-transportation impacts or outcomes of your work? Effects may be positive or negative.

Question 2:

- What is the chain of cause-and-effect leading from transportation systems or activities to each outcome in Question 1? Begin with the most important outcome, and work in order of decreasing importance.

Breakout group discussion B: Measuring the outcomes

Question 3:

- What metrics or indicators do you use to measure progress toward (or away from) the outcomes in Question 1? What additional metrics or indicators would you like to use? Be as specific as possible.

Question 4:

- What data sources, measurement tools or processes help you quantify the metrics or indicators in Question 3? What gaps exist? Be as specific as possible.

4.2 Key Findings: Connections and Metrics

Appendix B presents a detailed summary of notes taken during breakout group discussion A (Finding the links) and discussion B (Measuring the outcomes). The following table presents a synthesis of this input:

- The two leftmost columns aggregate the key non-transportation outcomes and objectives suggested by breakout groups.
- The two rightmost columns summarize the quality (i.e. breadth of scope, depth of detail) of the metrics, indicators, data sources, measurement tools and processes that participants indicated were available to describe the key outcomes both broadly (i.e. community-wide) and at a more focused level (i.e. more narrowly considering the effects of transportation systems and activities).

Several principal observations result from a review of this table:

- Workshop participants have an interest in a very broad range of outcomes that are influenced by transportation systems and activities in the Region of Peel. These have been grouped into the themes of public health, quality of life, environment, economy, and land use.
- Two of the themes (public health and environment) are generally well addressed at both broad (community-wide) and focused (effects of transportation) levels.
- Two themes (economy and land use) are moderately well addressed at a broad level, but poorly addressed at a focused level.

- One theme (quality of life) is poorly addressed at both broad and focused levels.

As noted at the bottom of the table, poor quality of metric ratings (i.e. none or low) do not imply that supporting data sources and measurement tools or processes are non-existent—rather, that they were not identified by workshop participants. Additional work is required to examine whether such sources do in fact exist, or whether they could be created.

A final observation is that while transportation data themselves (i.e. metrics of transportation system performance and use) are quite robust, the analytical links (e.g. models, factors and other heuristics) that can help “translate” transportation data into metrics describing outcomes of interest appear to be very weak.

Discussion summary of Questions 1 through 4: Outcomes of interest & available metrics			
Themes	Outcomes of interest	Quality of identified metrics — None □ Low ◆ High	
		Community-wide (all influences)	Effects of transportation only
Public health	Respiratory disease	◆	□
	Chronic diseases (e.g. diabetes, cardiac, cancer)	◆	□
	Mental health	◆	—
	Injury and death from collisions	◆	◆
Quality of life	Productive use of time	—	—
	Lifestyle/mobility choice	□	◆
	Affordability of travel for individuals	—	—
	Independence of children	—	—
	Independence of seniors	—	—
	Employment choice & access	—	—
	Access to greenspace	□	□
	Access to services	—	—
	Social equity	□	—
Environment	Greenhouse gas emissions	◆	□
	Protection of greenspace/agricultural land	◆	□
	Watershed health/water footprint	◆	□
Economy	General prosperity/growth	□	—
	Employment growth in key nodes	◆	—
	Efficient goods movement	—	—
	Growth/quality of labour force	◆	—
	Employer access to labour force	—	—
	Commuter satisfaction	□	□
	Public costs of transportation system	—	—
Land use	Complete, compact communities	◆	—
	Quality of public realm	—	—
	Accommodation of growth & intensification	◆	—
	Land value	□	—

Note: Ratings (i.e. none, low, high) reflect metrics identified at the workshop, rather than all metrics that may exist.

5 Recommendations: Business Case Framework

This chapter recommends guiding principles and major elements of the sustainable transportation business case framework.

5.1 Major Elements

The business case framework should support the development of the four key elements discussed in the following paragraphs.

Benefits case. The benefits case is the most important element of the STS business case framework. It would be an “outward-looking” analysis using both qualitative and quantitative measures to assess an initiative’s impacts on society, the economy and the environment. Impacts may affect individuals or society as a whole, and may require an equity analysis of how they are distributed. Possible measures are discussed in the following subsection, and could lead to quantitative summary indicators such as benefit-cost ratios or return on investment (ROI) rates.

Fiscal case. The fiscal case would be a quantitative analysis of the initiative’s expected direct costs and revenues to the Region of Peel using a life-cycle lens, including opportunities for leveraged funding.

Strategic case. The strategic case would be an “inward-looking” analysis using qualitative measures to summarize how an initiative aligns with and support higher-level organizational goals, policies and plans, including:

- Growth Plan for the Greater Golden Horseshoe (Province of Ontario)
- GTHA Regional Transportation Plan (Metrolinx)
- Strategic Plan 2015-2035 (Region of Peel) – short-term and long-term outcomes
- Official Plan (Region of Peel) – objectives and policies
- Long Range Transportation Plan (Region of Peel) – vision, goals and policies

Implementation case. For use in planning the delivery of individual projects, the implementation case would be an analysis of key opportunities and challenges related to the initiative’s delivery. It would use qualitative measures to address factors such as:

- Operational risks and impacts
- Acceptability to public, political and other stakeholders
- Means of delivery including governance, program bundling and procurement
- Commercial or other management issues to be addressed

5.2 Guiding Principles

The following principles should inform the development of the overall business case framework, as well as the creation of individual business cases using selected elements of the overall framework.

Comprehensiveness. The framework should represent multisectoral interests and outcomes.

Alignment. The framework should reflect goals and policies of the Region and senior levels of government.

Meaning. The framework should support consideration of real-world outcomes that have clear linkages to the Region's sustainable transportation initiatives, and that have a clearly desirable direction of change.

Scalability. The framework should be applicable to sustainable transportation initiatives at both a local scale (e.g. neighbourhood, corridor, street or intersection) and a municipal or regional scale.

Utility. The framework should support both planning (e.g. setting long-term mode shift targets, or comparing alternative corridors for a new cycling route) and performance measurement (e.g. assessing observed changes in mode shares, or evaluating a cycling safety campaign).

Practicality. The framework should apply indicators that can be both forecasted (for planning) and observed (for performance measurement), which can be normalized to enable comparisons, and for which data collection is feasible.

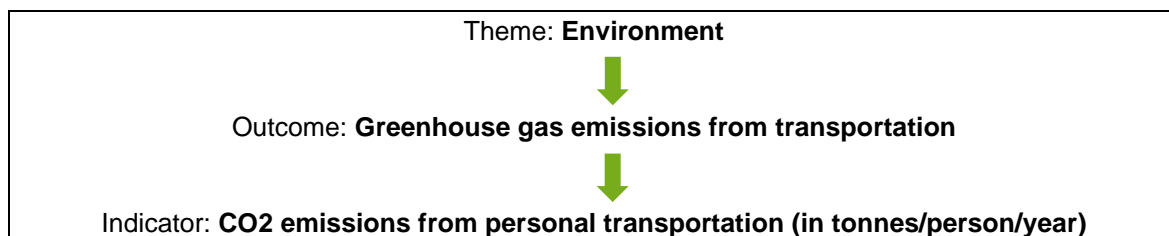
Multimodality. The framework should allow business case to be developed for projects that focus on public transit, active transportation, carpooling, telework and/or TDM initiatives.

6 Recommendations: Benefits Case Themes, Outcomes and Indicators

This section recommends a structure for the benefits case (i.e. one of the four major elements of the business case framework, as presented in Section 5.1) for sustainable transportation initiatives in the Region of Peel, based on:

- The STS objectives discussed in Chapter 1
- The Region of Peel's interests discussed in Chapter 2
- The business case approaches in other jurisdictions discussed in Chapter 3
- The stakeholder workshop input summarized in Chapter 4

The recommended structure of the benefits case includes themes (i.e. major issues), outcomes (i.e. major parameters of those issues) and indicators (i.e. attributes of those parameters to be forecasted or observed). To illustrate this structure, one example "branch" of the benefits case could include:



The five themes are transportation system performance, public health and safety, environment, economy and economic costing. The table below summarizes the outcomes contained within each theme (note that outcomes within the "quality of life" theme identified in Section 4.2 have been merged with transportation system performance, public health and safety, and economy; outcomes within the "land use" theme identified in Section 4.2 have been merged with economy). The guiding principles of comprehensiveness, alignment and meaning (as discussed in Section 5.2) are satisfied by the use of multiple outcomes for each theme; similarly, the guiding principles of scalability, utility, practicality and multimodality are generally satisfied by the use of multiple indicators for each outcome.

THEMES AND OUTCOMES		
Transportation system performance <ul style="list-style-type: none"> • Travel demand • Travel choice • Access to destinations • Speed and delay • Capacity • Efficiency • Safety • Universal access • Connectivity • Reliability • User awareness and satisfaction 	Public health and safety <ul style="list-style-type: none"> • Clean air • Physical activity • Injury and death from collisions • Mental health • Independent travel by children • Personal security Environment <ul style="list-style-type: none"> • Greenhouse gas emissions from transportation • Land consumption • Greening 	Economy <ul style="list-style-type: none"> • Vitality and growth • Land use density • Land value • Access to labour • Retail vibrancy • Cost of congestion • Affordability of travel • Commuter satisfaction Economic costing <ul style="list-style-type: none"> • Unit travel costs by mode • Benefit-cost analysis

Sections 6.1 through 6.5 recommend possible indicators for consideration to describe each theme and outcome. For each indicator, the possible scale(s) of application is suggested, as is the typical derivation of data to express the indicator, as well as any other explanatory notes. For scale, the following definitions are suggested:

- Facility/corridor
- Transit station
- Destination (e.g. school, retail)
- Employment area/TMA (e.g. business park, Smart Commute service area)
- Neighbourhood (e.g. Secondary Plan area, subdivision)
- Municipality (i.e. one area municipality, or a major portion thereof)
- Region (i.e. Region of Peel, or a major portion thereof)

6.1 Theme: Transportation System Performance

This section recommends possible benefits case indicators that express the following outcomes related to transportation system performance:

- Travel demand
- Travel choice
- Access to destinations
- Speed and delay
- Capacity
- Efficiency
- Safety
- Universal access
- Connectivity
- Reliability
- User awareness and satisfaction

Some of these outcomes adhere to the key principle of “meaning” as described in Section 5.2, while others are useful to provide context and explanation to support the benefits case by tracing broad travel patterns or aspects of system performance over time.

An equity analysis may be performed for many of these indicators by examining the distribution of pertinent costs and benefits among demographic groups according to income, gender, age, race or other parameter.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Travel Demand			
Mode shares (walking, cycling, transit, vehicle passenger, vehicle driver, telework)	<ul style="list-style-type: none"> • Facility/corridor • Destination • Neighbourhood • Municipality • Region 	Observed: Field counts, TTS or other travel survey (e.g. workplace survey)	Peak period or daily
Person trips: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver, telework)	<ul style="list-style-type: none"> • Destination • Neighbourhood • Municipality • Region 	Observed: Field counts, TTS or other travel survey. Or modelled: travel demand model	Total and per-capita, daily or annual
Person-kilometres travelled: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	<ul style="list-style-type: none"> • Destination • Neighbourhood • Municipality • Region 	Observed: TTS or other travel survey. Or modelled: travel demand model	Total and per-capita, daily or annual
Outcome: Travel Choice			
Motor vehicle ownership/capita	<ul style="list-style-type: none"> • Neighbourhood • Municipality • Region 	Observed: Provincial data or TTS	Reduction in vehicle ownership/capita indicates greater reliance on non-driving options
Proportion of households within walking distance of bus stop with service every 30 minutes or better	<ul style="list-style-type: none"> • Municipality • Region 	Observed or modelled: Spatial analysis	
Proportion of households within walking distance of quality transit service (10-minute frequency or better)	<ul style="list-style-type: none"> • Municipality • Region 	Observed or modelled: Spatial analysis	
Proportion of households in urbanized areas with immediate access to a sidewalk	<ul style="list-style-type: none"> • Municipality • Region 	Observed or modelled: Spatial analysis	Exclude rural areas
Proportion of households within 1 km of a cycling facility (trail, bike lane, cycle track)	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed or modelled: Spatial analysis	
Proportion of jobs within 1 km of a cycling facility (trail, bike lane, cycle track)	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed or modelled: Spatial analysis	
Outcome: Access to Destinations			
Transit access to employment opportunities from home	<ul style="list-style-type: none"> • Municipality • Region 	Observed or modelled: Spatial analysis	Calculated as the number of jobs per resident accessible by transit within 45 minutes; useful for comparing transit access to employment among different communities
Access to greenspace	<ul style="list-style-type: none"> • Municipality • Region 	Observed: Spatial analysis	
Average trip lengths (distance)	<ul style="list-style-type: none"> • Municipality • Region 	Observed: TTS	Lower lengths indicate greater

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
			access. With mode shares, enables estimation of motor vehicle operating cost reductions
Average trip duration (time)	<ul style="list-style-type: none"> • Municipality • Region 	Observed: TTS	Shorter durations indicate greater access
Outcome: Speed and Delay			
Delay to individuals	<ul style="list-style-type: none"> • Facility/corridor • Region 	Observed or modelled: Delay encountered by motor vehicle and transit passengers	
Average speed as a % of posted speed on arterial roads (weighted by link volume, peak hour)	<ul style="list-style-type: none"> • Municipality • Region 	Observed or modelled: Travel time surveys or travel demand model	
Average transit speed (total revenue veh-km/revenue veh-hr)	<ul style="list-style-type: none"> • Municipality • Region 	Observed: Transit system operating statistics or travel time surveys	Can measure impact of transit priority measures
Outcome: Capacity			
People-moving capacity: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	<ul style="list-style-type: none"> • Facility/corridor 	Modelled: Based on ROW allocation and geometry, average vehicle occupancies, operational characteristics	
Outcome: Efficiency			
Transportation facility efficiency (utilization of infrastructure)	<ul style="list-style-type: none"> • Facility/corridor • Destination • Neighbourhood • Municipality • Region 	Observed: Based on field counts, surveys and GIS inventory	Calculated as transportation facility area per capita or per person-trip
Vehicle occupancy ratio	<ul style="list-style-type: none"> • Facility/corridor • Destination • Neighbourhood • Municipality • Region 	Observed: TTS or other travel survey. Or modelled: travel demand model (calculated as person-km/vehicle-km travelled)	Calculated as person-km/vehicle-km travelled. Peak period, 24-hour or annual
Transit boarding efficiency	<ul style="list-style-type: none"> • Route/corridor • Municipality • Region 	Observed: Transit system data	Calculated as boardings per bus-hour or bus-kilometre. Daily or annual
Outcome: Safety			
Collisions: Total or by mode (involving pedestrians, cyclists, buses, light-duty vehicles, heavy trucks)	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed: Collision data, or Modelled: Based on exposure and average collision rates by facility type	Daily, monthly or annual
Outcome: Universal Access			
% of traffic signals with accessible push buttons and audible signals	<ul style="list-style-type: none"> • Municipality • Region 	Observed: Facility inventories	
% of bus stops with accessible shelters and seating	<ul style="list-style-type: none"> • Municipality • Region 	Observed: Facility inventories	
Outcome: Connectivity			

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Multimodal trips	<ul style="list-style-type: none"> Transit station Destination Municipality Region 	Observed: Walk-transit, bike-transit, kiss-and-ride, park-and-ride, park-and-bike	Daily or annual
Outcome: Reliability			
Transit on-time performance	<ul style="list-style-type: none"> Route/corridor Municipality Region 	Observed: Transit system data	Calculated as % of transit arrivals within acceptable on-time window. Peak period, daily, monthly, annual
Outcome: User Awareness and Satisfaction			
Awareness of travel options among Region of Peel residents	<ul style="list-style-type: none"> Neighbourhood Municipality Region 	Observed: Survey of residents (e.g. by telephone)	
Satisfaction with transportation options among Region of Peel residents	<ul style="list-style-type: none"> Neighbourhood Municipality Region 	Observed: Survey of residents (e.g. by telephone)	

6.2 Theme: Public Health and Safety

This section recommends possible benefits case indicators that express the following outcomes related to public health and safety:

- Clean air
- Physical activity
- Injury and death from collisions
- Mental health
- Independent travel by children
- Personal security

An equity analysis may be performed for many of these indicators by examining the distribution of pertinent costs and benefits among demographic groups according to income, gender, age, race or other parameter.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Clean Air			
Hospital admissions related to poor air quality	<ul style="list-style-type: none"> Region 	Observed: Hospital admission records	
Emission of criteria air pollutants (PM2.5, PM10, NOx) from motor vehicles	<ul style="list-style-type: none"> Facility/corridor Neighbourhood Municipality Region 	Modelled: Transportation demand model with emission factors	Absolute value could be normalized per capita. Proxy for actual health impacts, which are unlikely to be significant at less than a regional level
Annual air quality events (smog alerts)	<ul style="list-style-type: none"> Region 	Observed: Provincial data	Proxy for actual health impacts

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Physical Activity			
Deaths from all causes related to a given level of cycling and walking activity	<ul style="list-style-type: none"> • Municipality • Region 	Modelled: Using WHO's Health Economic Assessment Tool (HEAT) for walking and cycling	Allows scenario comparison to determine impact of changes in walking and cycling activity. Does not address illness impacts other than death; does not estimate air pollution impacts. Estimates economic costs related to deaths.
Incidence of overweight and obesity	<ul style="list-style-type: none"> • Municipality • Region 	Percentage of population considered obese, based on annual or periodic surveys	Active transportation contributes to reduced obesity, but is only one factor
Incidence of type II diabetes	<ul style="list-style-type: none"> • Municipality • Region 	Modelled: Using the Diabetes Population Risk Tool based on physical activity levels	Allows comparison of scenarios to track changes over time, or to model contrasts. Economic costs can be determined using estimated annual cost of care per person
Outcome: Injury and Death from Collisions			
Injuries and deaths from collisions	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed: Collision reports	Allows segmentation by victims' mode of transport. Economic costs can be determined using average rates per injury and death.
Outcome: Independent Travel by Children			
% of children (kindergarten to grade 12) who walk or cycle to school	<ul style="list-style-type: none"> • Destination (school) • Neighbourhood • Municipality • Region 	Observed: School-based or household surveys	

6.3 Theme: Environment

This section recommends possible benefits case indicators that express the following outcomes related to the environment:

- Greenhouse gas emissions from transportation
- Land consumption
- Greening

An equity analysis may be performed for some of these indicators by examining the distribution of pertinent costs and benefits among demographic groups according to income, gender, age, race or other parameter.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Emission of Greenhouse Gases			
Greenhouse gas emissions from transportation	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed: Community GHG inventory; fuel sales data. Or modelled: transportation demand models.	Absolute value could be normalized per capita.
Outcome: Land Consumption			
Area of paved surface	<ul style="list-style-type: none"> • Neighbourhood • Municipality • Region 	Observed: Municipal GIS inventory and/or aerial data	Includes paved land in rights-of-way and/or off-street parking areas. Absolute value could be normalized per capita. Proxy for water quality impact via runoff, and for habitat degradation via greenspace consumption.
Outcome: Greening			
Street trees	<ul style="list-style-type: none"> • Facility/corridor • Neighbourhood • Municipality • Region 	Observed: Municipal GIS inventory and/or aerial data	Absolute value could be normalized per capita.

6.4 Theme: Economy

This section recommends benefits case indicators that express the following outcomes related to the economy:

- Vitality and growth
- Land use density
- Land value
- Access to labour
- Retail vibrancy
- Cost of congestion
- Affordability of travel
- Commuter satisfaction

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Vitality and Growth			
Sustainable mode use in key nodes	<ul style="list-style-type: none"> • Employment area/TMA • Municipality • Region 	Observed: Survey of workplaces, TTS	Higher sustainable mode usage maintains road capacity for trucks and other vehicles

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Land Use Density			
Population and employment density per hectare	<ul style="list-style-type: none"> Corridor Destination Neighbourhood Municipality Region 	Observed: Municipal databases, employment surveys, census	Of particular interest in transit-oriented development zones, and added density in infill vs greenfield sites.
Outcome: Land Value			
Average home cost	<ul style="list-style-type: none"> Corridor Destination Neighbourhood 	Observed: Home sales data before/after transportation initiative	Price change in subject area can be compared to concurrent change in Municipality/region
Average commercial land cost	<ul style="list-style-type: none"> Corridor Destination Neighbourhood 	Observed: Commercial land sales data before/after transportation initiative	Price change in subject area can be compared to concurrent change in Municipality/region
Outcome: Access to Labour			
Transit access to potential workers from workplace	<ul style="list-style-type: none"> Municipality Region 	Observed or modelled: Spatial analysis	Calculated as the number of potential workers per job accessible by transit within 45 minutes; useful for comparing transit access to labour force among different communities
Outcome: Retail Vibrancy			
Change in spending patterns	<ul style="list-style-type: none"> Destination (retail) Facility/corridor Neighbourhood 	Observed: Survey of retailers before/after transportation initiative	
Retail occupancy	<ul style="list-style-type: none"> Destination (retail) Facility/corridor 	Observed: Survey of retail vacancies before/after transportation initiative	Municipalities to collect this information.
Outcome: Cost of Congestion			
Cost of delay to individuals	<ul style="list-style-type: none"> Facility/corridor Region 	Modelled: Estimates of delay hours and cost/hour for personal travel by motor vehicles and transit	
Costs of delay to goods and services	<ul style="list-style-type: none"> Facility/corridor Region 	Modelled: Estimates of delay hours and cost/hour for trucks and other commercial vehicles	
Outcome: Affordability of Travel			
Cost of personal transportation	<ul style="list-style-type: none"> Region 	Modelled: Total private vehicle ownership, operating and parking costs, plus transit, taxi and ride-hailing fares	Could be normalized per capita.
Proportion of average household income spent on transportation	<ul style="list-style-type: none"> Municipality Region 	Observed: Statistics Canada surveys	
Outcome: Commuter Satisfaction			

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Satisfaction with commutes by Region of Peel residents or workers	<ul style="list-style-type: none"> • Destination • Employment area/TMA • Region 	Observed: Survey of residents (e.g. by telephone) or employees (e.g. by Smart Commute)	

6.5 Theme: Economic Costing

This section recommends two different approaches to economic costing, each having its own advantages and disadvantages.

Unit travel costs by mode

Section 3.7 discussed the 2011 update to the City of Ottawa's Cost of Travel Model, which is based on extensive research into individual, government and social costs and benefits of each person-km travelled by auto, transit, cycling and walking. This approach allows rapid quantification of the economic costs and benefits of mode shifts, such as the shifts that will be proposed as targets for STS, where:

Incremental annual cost or benefit, mode A (\$)	=	(Total person-trips by all modes)
	x	(Incremental mode share, mode a)
	x	(Average trip length, mode a, km/trip)
	x	(Unit travel cost, mode a, \$/person-km)

For example, in a hypothetical scenario where 1% of 500 million annual person-trips are shifted from automobile (average trip length = 10 km) to cycling (average trip length = 4 km), the Cost of Travel Model would yield the following:

Incremental annual cost or benefit, auto (\$)	=	500 million trips
	x	- 1% change in auto mode share
	x	10 km/trip
	x	\$1.038/person-km
Incremental annual cost or benefit, cycling (\$)	=	\$51.9 million benefit
	=	500 million trips
	x	+ 1% change in cycling mode share
	x	4 km/trip
	x	\$0.627/person-km
	=	\$12.5 million cost
Net incremental annual benefit	=	\$51.9 million – \$12.5million
	=	\$39.4 million

NB: This benefit includes operating, infrastructure, time/delay and environmental/social costs.

Note that excluding personal time/delay costs would dramatically increase the net benefits of mode shift from auto to other modes (particularly walking). This approach may be justified, as opinions about the value of time borne by individuals can vary greatly.

The monetary values applied by the City of Ottawa need to be updated from 2011 to 2017 dollars, which is straightforward. They also need to be adjusted to reflect Region of Peel conditions, which are different than Ottawa's; however, even in the absence of such updating the unit costs may be reasonably transferable, given that the populations of Ottawa (about 970,000) and Peel (about 1.45 million) are roughly similar, and that both municipalities include urban, suburban and rural areas.

6.5.2 Benefit-cost analysis

The guidance provided by Metrolinx for business case development is comprehensive and detailed, and could be adopted by the Region of Peel for large individual projects (the application for which the guidance is intended). The Metrolinx approach is designed to yield both a benefit-cost ratio and a net present value for a given investment. However, its utility may be more limited for general scenario analysis (e.g. broad mode shifts) or for smaller initiatives (e.g. neighbourhood TDM programs) that do not involve large capital investments.

Appendix C identifies some economic values recommended in the Metrolinx business case documentation that could also be applied to business cases for initiatives in Peel Region.

7 Sample Applications of Benefits Case Indicators

This chapter presents three example sets of indicators that could be applied in creating the benefits case for sustainable mobility initiatives at three scales:

- Section 7.1 presents indicators for the pre-implementation business case preparation of a project
- Section 7.2 presents indicators for the post-implementation business case review of a program
- Section 7.3 presents indicators for the pre-implementation business case preparation of a policy

7.1 Project Example: Minor Arterial “Road Diet” with Cycle Track Installation

The following indicators could be applied in preparing a pre-implementation benefits case for the proposed conversion of a four-lane arterial road to a two-lane arterial road with a dual centre left-turn lane and one-way cycle tracks in the boulevards. The benefits case would depend on having a projection of the effectiveness of such a project in shifting travel behaviours, based on prior experiences, and on the development of a traffic simulation model that enables a comparison of “before” and “after” operating conditions in the corridor.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Transportation System Performance			
Outcome: Travel choice			
Proportion of households within 1 km of a dedicated cycling facility (trail, bike lane, cycle track)	• Facility/corridor	Modelled: Spatial analysis	Change
Outcome: Speed and Delay			
Delay to individuals	• Facility/corridor	Modelled: Delay encountered by motor vehicle and transit passengers	Annual change
Outcome: Capacity			
People-moving capacity: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	• Facility/corridor	Modelled: Based on ROW allocation and geometry, average vehicle occupancies, operational characteristics	Change
Outcome: Efficiency			
Transportation facility efficiency	• Facility/corridor	Modelled: Based on estimated shift in behaviour	Calculated as transportation facility area/daily person-trip
Outcome: Safety			
Collisions: Total or by mode (involving pedestrians, cyclists, buses, light-duty vehicles, heavy trucks)	• Facility/corridor	Modelled: Based on exposure and average collision rates by facility type	Annual change
Public Health and Safety			
Outcome: Clean air			
Emissions of criteria air pollutants (PM2.5, PM10, NOx)	• Facility/corridor	Modelled: Estimated using motor vehicle volumes, fleet characteristics and driving conditions	Annual change. A proxy for actual health impacts, which are unlikely to be

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
			significant at less than a regional level
Environment			
Outcome: Greenhouse Gas Emissions from Transportation			
Greenhouse gas emissions from transportation	• Facility/corridor	Modelled: based on transportation simulation model	Annual change
Economy			
Outcome: Cost of Congestion			
Cost of delay to individuals	• Facility/corridor	Modelled: Estimates of delay hours and cost/hour for personal travel by motor vehicles and transit	Annual change
Costs of delay to goods and services	• Facility/corridor	Modelled: Estimates of delay hours and cost/hour for trucks and other commercial vehicles	Annual change

7.2 Program Example: Neighbourhood-Based Individualized Marketing Campaign

The following indicators could be applied in a post-implementation benefits case review of an individualized marketing program delivered to a neighbourhood of several thousand homes. Once estimated, these benefits could be applied to the development of future pre-implementation benefits cases for similar projects.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Transportation system performance			
Outcome: Travel Demand			
Mode shares (walking, cycling, transit, vehicle passenger, vehicle driver)	• Neighbourhood	Observed: Household survey	Peak period or daily change
Person trips: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	• Neighbourhood	Observed: Household survey	Daily or annual change, by mode
Person-kilometres travelled: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	• Neighbourhood	Observed: Household survey	Daily or annual change, by mode
Outcome: User Awareness and Satisfaction			
Awareness of travel options among Region of Peel residents	• Neighbourhood	Observed: Household survey	Change
Satisfaction with transportation options among Region of Peel residents	• Neighbourhood	Observed: Household survey	Change
Public Health and Safety			
Outcome: Clean Air			
Emission of criteria air pollutants (PM2.5, PM10, NOx)	• Neighbourhood	Modelled: Estimated using emission factors applied to observed changes in travel behaviour	Annual change. Proxy for actual health impacts, which are unlikely to be significant at less than a regional level

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Outcome: Independent Travel by Children			
% of children (kindergarten to grade 12) who walk or cycle to school	• Neighbourhood	Observed: Household survey	Change
Environment			
Outcome: Greenhouse Gas Emissions from Transportation			
Greenhouse gas emissions from transportation	• Neighbourhood	Modelled: GHG factors applied to observed changes in travel behaviour	Annual change
Economy			
Outcome: Retail Vibrancy			
Change in spending patterns	• Destination (neighbourhood retail)	Observed: Survey of retailers before/after transportation initiative	% change
Economic Costing			
Individual and social costs and benefits	• Municipality	Estimated: Application of unit travel costs by mode to observed changes in travel behaviour	Annual

7.3 Policy Example: Reduced Parking Allowances for a Greenfield Employment Hub

The following indicators could be applied in preparing a pre-implementation benefits case for a proposed zoning by-law amendment to significantly reduce the maximum parking supply rates for employment land uses within a major greenfield development hub. The benefits case would depend on having a projection of the resulting change in parking supply at a horizon year, and a projection of the shifts in travel behaviour that would result.

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
Transportation System Performance			
Outcome: Travel Demand			
Mode shares (walking, cycling, transit, vehicle passenger, vehicle driver)	• Employment area	Modelled: Travel demand model	Peak period or daily change
Person trips: Total and by mode (walking, cycling, transit, vehicle passenger, vehicle driver)	• Employment area	Modelled: Travel demand model	Daily or annual change
Outcome: Efficiency			
Vehicle occupancy ratio	• Employment area	Modelled: Travel demand model	Peak period or daily change. Calculated as person-km/vehicle-km travelled
Outcome: Safety			
Collisions: Total or by mode (involving pedestrians, cyclists, buses, light-duty vehicles, heavy trucks)	• Municipality	Modelled: Based on change in exposure due to mode shift	Annual change
Public Health and Safety			
Outcome: Clean Air			
Emission of criteria air pollutants (PM2.5, PM10, NOx)	• Municipality	Modelled: Estimated using motor vehicle volumes, fleet	Proxy for actual health impacts, which are unlikely to be significant

OUTCOMES AND INDICATORS	SCALE	TYPICAL DERIVATION	NOTES
		characteristics and driving conditions	at less than a regional level
Environment			
Outcome: Greenhouse Gas Emissions from Transportation			
Greenhouse gas emissions from transportation	• Municipality	Modelled: Travel demand model	Annual change
Outcome: Land Consumption			
Area of paved surface	• Employment area	Estimated: Based on estimated parking capacity reduction	Proxy for water quality impact via runoff, and for habitat degradation via greenspace consumption.
Economy			
Outcome: Vitality and Growth			
Sustainable mode use in key nodes	• Employment area	Modelled: Travel demand model	Change in mode shares; higher sustainable mode usage maintains road capacity for trucks and other vehicles
Outcome: Land use Density			
Employment density per hectare	• Employment area	Estimated: Based on estimated increase in building density due to reduced parking	Change
Economic Costing			
Individual and social costs and benefits	• Municipality	Estimated: Application of unit travel costs by mode to estimated mode shift	Annual change

Appendix A

Workshop Participants

NAME		ORGANIZATION	SECTION
Breakout Group: Public Health			
Olha	Dobush	Region of Peel	Public Health - Chronic Disease & Injury Prevention
Sharanjeet	Kaur	Region of Peel	Public Health - Chronic Disease & Injury Prevention
Sandra	Fitzpatrick	Region of Peel	Public Health - Chronic Disease & Injury Prevention
Natalie	Lapos	Region of Peel	Public Health - Built Environment
Louise	Aubin	Region of Peel	Public Health - Environmental Health
Lorenzo	Mele	Region of Peel	Public Health
Breakout Group: Human Services			
Sandra	Solonik	Region of Peel	Human Services - Community Partnerships
Leroy	Briggs	Region of Peel	Human Services - Employment Development Specialist
Augustina	Nagberi-Asseez	Region of Peel	Peel Poverty Reduction Strategy
Cherry	Skerrit	Region of Peel	Human Services – Community Development
Ilona	Vartolas	Region of Peel	Human Services - Community Access
Breakout Group: Environmental Management			
Michael	Gusche	City of Mississauga	Parks and Recreation
Gayle	Soo Chan	Credit Valley Conservation Authority	Director, Watershed Knowledge
Alex	Dumesle	TRCA	Senior Manager, Partners in Project Green
Deanna	Cheriton	TRCA	Supervisor, Greenspace Conservation
Cinzia	Ferracane	Region of Peel	Climate Change and Energy Management
Mark	Pajot	Region of Peel	Climate Change Strategy
Breakout Group: Economic Development			
Jeffrey	Baines	City of Brampton	Economic Development
Joanne	Pattison	Region of Peel	Corporate Strategy Office
Prabh	Banga	GTAA	Strategy Development & Corporate Sustainability
Ben	Roberts	Town of Caledon	Economic Development & Tourism
Breakout Groups: Land Use Planning and Policy (2)			
John	Hardcastle	Region of Peel	Development Services
Sharleen	Bayovo	City of Mississauga	Citywide Planning (Official Plan)
Angela	Dietrich	City of Mississauga	Citywide Planning (Official Plan)
Arvin	Prasad	Region of Peel	Integrated Planning
Alka	Johri	Region of Peel	Planning and Policy
Lori-Ann	Thomsen	Region of Peel	Capital Acquisitions – Real Estate
Adrian	Smith	Region of Peel	Integrated Planning - Policy Development
Breakout Group: Transportation Services			
Ben	Gomberg	City of Mississauga	Cycling Office
Nelson	Cadete	City of Brampton	Transportation - Active Transportation
Becky	Upfold	Metrolinx	Manager, Smart Commute, Planning and Policy
Glenn	Gumulka	Smart Commute	PM - Mississauga, Pearson, Brampton-Caledon
Dominic	Ho	MiWay	Transit Planner
Chris	Lafleur	Brampton Transit	Transit Planner
Erica	Warsh	City of Mississauga	TDM Coordinator
Breakout Groups: Transportation Planning (2)			
Henrik	Zbogar	City of Brampton	Transportation Planning
Joe	Avsec	Region of Peel	Traffic & Sustainable Transportation
Steve	Ganesh	Region of Peel	Strategist, Transportation
Sabbir	Saiyed	Region of Peel	Transportation Systems Planning

NAME		ORGANIZATION	SECTION
Eric	Chan	Region of Peel	Transportation System Planning
Elizabeth	Bang	Region of Peel	Transportation Systems Planning
Sandy	Lovisotto	Region of Peel	Road Design and Construction
Numair	Bari	GTAA	Groundside Systems Transportation Planner
Dean	McMillian	Town of Caledon	Transportation
Project Team / Workshop Facilitators / Guest Speakers			
Eileen	De Villa	Region of Peel	Medical Officer of Health
Gary	Kocialek	Region of Peel	Director of Transportation
Wayne	Chan	Region of Peel	Sustainable Transportation
Judy	Yack	Region of Peel	Sustainable Transportation
Brandon	Quigley	Region of Peel	Sustainable Transportation
Arthur	Lo	Region of Peel	Sustainable Transportation
Erica	Duque	Region of Peel	Sustainable Transportation
Lisa	Ma	Region of Peel	Sustainable Transportation
Brian	Hollingworth	IBI Group	
Kathryn	Grond	IBI Group	
Trevor	Jenkins	IBI Group	
Zibby	Petch	IBI Group	
Geoff	Noxon	Noxon Associates	

Appendix B

Detailed Workshop Notes

This appendix summarizes the results of the two breakout group discussions (A and B) that related to the business case framework. For each breakout group, the highlights of each discussion (as presented by each breakout group facilitator to participants in the plenary discussion) are given first, followed by supplemental notes that were recorded on flipcharts during the discussions.

Breakout group discussion A: Finding the links

Question 1:

- *Non-transportation groups*—What desired outcomes of your work (e.g. goals or objectives) are affected by transportation systems or activities? Effects may be positive or negative.
- *Transportation groups*—What do you consider to be the non-transportation impacts or outcomes of your work? Effects may be positive or negative.

Question 2:

- What is the chain of cause-and-effect leading from transportation systems or activities to each outcome in Question 1? Begin with the most important outcome, and work in order of decreasing importance.

Group	PUBLIC HEALTH
Highlights	<ul style="list-style-type: none"> • More AT facilities & compact/mixed land uses → increased physical activity & access to healthy food → chronic disease reduction • Compact land use, better public realm & transportation options that support transportation availability/affordability/accessibility → improved mental health, wellness & social connectivity
Other notes	<ul style="list-style-type: none"> • Reduced auto use → drop in % of income spent on transportation, lower opportunity costs for money spent on mobility • Reduced emissions → reduced respiratory and cardiovascular illness • Safety measures for accident prevention → declining rate of injuries and death • Better public transportation → increased housing prices • Lack of snow removal, tree maintenance etc. → reduced use of active transportation

Group	HUMAN SERVICES
Highlights	<ul style="list-style-type: none"> • Better, more direct transit routes & safe AT routes → increased access to services, food, recreation, employment → better quality of life: productive/family time, health, productivity, decreased isolation
Other notes	<ul style="list-style-type: none"> • Higher cost of transit passes, bicycles (ownership & maintenance) → reduced affordability • Isolated locations for social housing → lack of transit & pedestrian access for residents • Better design of public spaces → safe access for children • Signage/wayfinding, parking for mobility devices → better mobility for seniors • Better access to employment → increased employability → increases in retention, work-life balance, job choice (i.e. difficult to be employed in Caledon without a car) • Extended transit service hours → access to off-peak shift work

Group	ENVIRONMENTAL MANAGEMENT
Highlights	<ul style="list-style-type: none"> Convert truck fleets → reduce emissions → reduced climate change impacts More AT → demand to build trails → protect & connect to green spaces Reduce road width at high risk locations → control flooding → reduce water footprint
Other notes	<ul style="list-style-type: none"> Engaging the public in recreational activities → people more comfortable outside, with confidence to explore further → connectivity to the natural environment and greenspace Low impact development in high flood risk areas → healthier watersheds Sustainable procurement of goods and services, conversion to low-carbon fleets → reduced waste and emissions

Group	ECONOMIC DEVELOPMENT
Highlights	<ul style="list-style-type: none"> Variety of transportation options → affordable non-car travel options → attract employees to key nodes (airport, Bramalea GO, Bramalea City Centre) Shifting demand to sustainable modes → maintaining road capacity for trucks and other vehicles Transit (esp. Caledon) and AT options → employee safety & access to jobs
Other notes	<ul style="list-style-type: none"> Providing affordable & more sustainable mode options → attracting employees to airport business zone (especially since not all employees can afford cars) Better walking and cycling routes → safety for employees Better first and last mile to employment from transit hubs → attract more employment to key hubs Adding dedicated AT lanes rather than taking space away for them → preserve needed capacity

Group	LAND USE PLANNING AND POLICY [A]
Highlights	<ul style="list-style-type: none"> Walkable communities with strong public realms → affordability, ages, land uses → mixed-use, complete communities Safe/attractive multimodal options, reduced car reliance, more permeable surfaces → health (personal & environmental) Reduce auto ownership to save money for lower-income households → affordability
Other notes	<ul style="list-style-type: none"> More active transportation → improves goods movement & reduces GHG emissions More transit → combat perception that buses are for low-income customers Initiatives that enable aging in place & working from home → health benefits (reduced stress, more personal time, reduced obesity and improved bone density) Universal design for infrastructure → better public realm and walkability

Group	LAND USE PLANNING AND POLICY [B]
Highlights	<ul style="list-style-type: none"> Active, multimodal transportation → more density → protect environmental and agricultural land (GHG emissions and land consumption) Fewer roads → less need for private property acquisition for ROW → maximize land for development & support private landowners Active modes and multimodal options → less driving → population & employment growth
Other notes	<ul style="list-style-type: none"> Pedestrian friendly environments → walkability → compact development forms Age-friendly, complete communities → live-work balance

Group	TRANSPORTATION SERVICES
Highlights	<ul style="list-style-type: none"> • AT infrastructure/activity, telework programs → good health (mental/stress & physical/obesity) • Better travel choices, personal time on transit → attract/retain professionals • SOV reductions → Reduced GHG emissions, better air quality
Other notes	<ul style="list-style-type: none"> • Other benefits to sustainable transportation: • More social interaction • Affordability of living in Peel • Better quality of life • More personal time • Lifestyle flexibility • Reduced public costs • Positive impacts on economy • Mobility for seniors

Group	TRANSPORTATION PLANNING [A]
Highlights	<ul style="list-style-type: none"> • Harmonized cost of transportation system, design complete streets → freedom and choice for residents • Telework, reduced parking standards, employer sponsored transit passes → mobile workforce with access to jobs • Comfortable, safe facilities, education, outreach, higher order transit to enable land use change → changing societal/cultural values
Other notes	<ul style="list-style-type: none"> • Sidewalk connectivity in employment areas, increased transit frequency and carpool parking → mobile workforce with access to jobs • Bikeshare/carshare, alternative forms of transit (transit taxi, Uber, etc.), active travel to school → more freedom and choice for residents Access to and cost of goods • Other benefits to sustainable transportation: • Supporting growth and intensification • Access to services • Better air quality • Decreased stress

Group	TRANSPORTATION PLANNING [B]
Highlights	<ul style="list-style-type: none"> • Active transportation → better air quality (SOx, NOx, PM) & reduced GHG emissions • Better design → more safety and vibrancy → healthier communities • Better transit service → congestion reduction → economic prosperity & equity
Other notes	<ul style="list-style-type: none"> • Consider fiscal responsibility for municipal budgets in planning/delivery of transportation infrastructure → smarter investments → economic prosperity • Reduced impact of congestion on companies that rely on mobility for goods and people → economic prosperity • Better transit and active modes → more affordable mobility for more people → better social equity • More balanced/efficient transportation networks → better land use → greater livability • Better access → higher land prices → pressure to reduce parking supply → mode shift (a virtuous circle)

Breakout group discussion B: Measuring the outcomes

Question 3:

- What metrics or indicators do you use to measure progress toward (or away from) the outcomes in Question 1? What additional metrics or indicators would you like to use? *Be as specific as possible.*

Question 4:

- What data sources, measurement tools or processes help you quantify the metrics or indicators in Question 3? What gaps exist? *Be as specific as possible.*

Group	PUBLIC HEALTH
Highlights	<ul style="list-style-type: none"> Mental health and wellness: rapid risk factor surveillance systems, Canadian Community Health Survey, Ontario Student Drug Survey Chronic Diseases: diabetes, Ministry of Health 2014 report methodology for rates of chronic disease, WHO's Health Economic Assessment Tool, Canadian Health Measures Survey, Air Quality Benefits Assessment, AQBAT (note: moving away from BMI as a health indicator)
Other notes	<ul style="list-style-type: none"> Peel-specific quality of life indicators Census data Health Canada measures impact of air pollution and calculates cost in terms of hospital visits, mortality, health care costs, quality of life

Group	HUMAN SERVICES
Highlights	<ul style="list-style-type: none"> Canadian Index of Well-being: vitality, democratic engagement, education, environment, health, etc. Peel/Halton Workforce Development Group: labour market info, education level, new employees Food bank usage Neighbourhood financial index Neighbourhood information tool Suggested new tool: Livability index – provide radius of access map with community information (health, housing, jobs, recreation) to help decisions that reduce access distances and provide travel options for those trips
Other notes	<ul style="list-style-type: none"> Ontario Works – caseload, number of recipients Maps of food bank usage Collect knowledge from community development workers

Group	ENVIRONMENTAL MANAGEMENT
Highlights	<ul style="list-style-type: none"> • Greenhouse gases & air quality: community GHG inventory, extreme heat events, estimate from vehicle-km travelled (VKT) • Water quality: contaminant measurements, base flow, % impervious surfaces, flood events, stormwater outflow • Natural environment: biological inventory, Living City reports (habitats, amount of vegetation, change in species at risk, invasive species, interior forest amounts/connectivity) • Greenspace access: user trail counts, surveys • Greenspace protection: density, developed land use • Vulnerability assessments
Other notes	<ul style="list-style-type: none"> • Corporate and community GHG inventory, GHG reductions per capita for benchmarking, air contaminants, lifecycle analysis • Water quality and quantity: contaminants, base flow and outflow (stormwater treatments), impermeable surfaces % • Biological inventory every 10 years (living city reports): change in species at risk, interior forest quantity and connectivity, habitats, amount of vegetation, invasive species • Health impacts: asthma, extreme heat, productivity, road construction • People engagement, counters, surveys • Social benefits: reduce unemployment • Urban heat island effect

Group	ECONOMIC DEVELOPMENT
Highlights	<ul style="list-style-type: none"> • Economic attraction: new square footage of industrial/commercial land uses built, employee density/hectare, employee travel surveys (commute satisfaction/mode) • Needs: knowledge of business registration data of all new businesses in a municipality to enable proactive planning for transportation needs • Challenge: surveying enough employers (especially small/medium sizes) to get a good sense of travel habits
Other notes	<ul style="list-style-type: none"> • n/a

Group	LAND USE PLANNING AND POLICY [A]
Highlights	<ul style="list-style-type: none"> • Density: local surveys (employment, pop, Cdn Community Health Wellbeing index), Census, development apps & planning monitoring • Health: Healthy Development Checklist, Canadian Community Belonging Index • Environment/mixed uses: Development apps, GHG emissions, Canadian Census place of residence/place of work and Transportation Tomorrow Survey origin-destination data • Gaps: need to not overanalyze data, need to manage how much is actually associated with transportation, economic sustainability diagnostic tools
Other notes	<ul style="list-style-type: none"> • Annual land use consumption • Rate of households that spend 30% or more on housing • Rate of part-time workers • Location/access to services, distances of travel and GHG emissions • Need: Clear definition of economic sustainability • Need: Clear link of health outcomes from transportation improvement

Group	LAND USE PLANNING AND POLICY [B]
Highlights	<ul style="list-style-type: none"> • Environmental features on watershed basis: Census of Agriculture from Conservation Authority • Inventory of land acquisition: land taken for different types of uses from developments
Other notes	<ul style="list-style-type: none"> • GIS • Peel Employment Survey • Census • Designated greenfield property • Density data: population and employment per hectare

Group	TRANSPORTATION SERVICES
Highlights	<ul style="list-style-type: none"> • Transit ridership: boarding/alighting counts, Presto card, cordon counts, customer service surveys • Carpool use: carpool counter (in-vehicle) • AT usage: turning counts, cordon counts, pedestrian/bike count stations, Transportation Tomorrow Survey • Quality of cycling infrastructure • Mode share: Transportation Tomorrow Survey • Wishlist: pedestrian/transit accessibility rating, access parameters (impacts of providing shorter blocks), carsharing & ride-hailing data (Uber, Zipcar), bikeshare data, mobility tool tracking data
Other notes	<ul style="list-style-type: none"> • n/a

Group	TRANSPORTATION PLANNING [A]
Highlights	<ul style="list-style-type: none"> • Access to jobs/mobility of workforce: employment density, travel time (Waze), multimodal levels of service (MMLOS), employer parking utilization, workforce age/work from home • Freedom/choice: mode shares, bike rack use, % transit system available under common system, person-capacity of roads, % of roads with sidewalks, access to transit (ref. Metrolinx tool) • Changing cultural/societal values: % new licensed drivers (from MTO, insurers), car ownership rates, before/after mode choice of new immigrants
Other notes	<ul style="list-style-type: none"> • Access to jobs/mobility of workforce: from employee surveys and Smart Commute

Group	TRANSPORTATION PLANNING [B]
Highlights	<ul style="list-style-type: none"> • Collision history: rates and numbers, costs • Walkability: Walkscore, pedestrian level of service • Mode share: TTS, passenger surveys • Infrastructure: kms • Rates of chronic disease • Land value uplift from transit investment: activity rates, vacancy rates • Transit ridership
Other notes	<ul style="list-style-type: none"> • Land prices: reflect value/attractiveness of a place, in part due to transportation conditions • Activity rate (population/employment), vacancy rates, business requests, community events, employee attractiveness, regional access vs local access • Safety: number vs. rate of collisions (before and after interventions, over time), costs of damage to property, injuries, fatalities, cost of healthcare, cost of improvements: • Measure of performance: link LOS to costs & benefits

Group	TRANSPORTATION PLANNING [B]
Highlights	<p><i>Question 5</i></p> <ul style="list-style-type: none"> • Plan regional transit network around airport: last mile issues and many barriers in area, which is an anchor hub with 300,000 jobs and over a million daily trips • Regional active transportation connections: especially cross-boundary, work with agencies (Hydro, conservation groups), 407 Transitway, consistent facility design and wayfinding, Bike highways, 400 route, identification system for major bike routes • Growth management: connect land use and transportation services <p><i>Question 6</i></p> <ul style="list-style-type: none"> • Partner with economic development: to attract/encourage businesses that fit • Integrate demand modelling and data sharing
Other notes	<ul style="list-style-type: none"> • Continue to foster existing partnership between public health and strategic planning (e.g. Peel participation in new TAC national guidelines for cycling/walking infrastructure) • Add outcome metrics for injury prevention & add other modes – carpooling, transit • Smart Freight Sectors programs: focus interventions to improve air quality and manage congestion hotspots • Marketing and awareness: community-based program “Getting the message out on sustainable transportation”, e.g. cinema ads • Work more closely with developers • Better align budget and transportation with land use, and connect to development charges

Appendix C

Economic Values for Metrolinx BCA

COST INDICATOR	VALUE	REFERENCE
Base year for costs	2016	
Value of time	\$16.71	Metrolinx, 2015
Cost of driving per km	\$0.63	Metrolinx, 2015
Peak period cost of congestion per VKT (for Region of Peel)	\$0.22	Metrolinx, 2015
Cost of auto collision externalities per VKT	\$0.08	Metrolinx, 2015
Cost of CAC's per auto VKT	\$0.002	Metrolinx, 2015
Average cost of CO ₂ per auto VKT	\$0.035	Metrolinx, 2015
Health benefits of walking per VKT	\$2.96	Metrolinx, 2015
Health benefits of cycling per VKT	\$1.48	Metrolinx, 2015

