



# MOVING TOWARDS IDEAL MEASURES OF SUSTAINABLE TRANSPORT

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in the session entitled  
"New Ideas in Sustainable Transportation Indicators"  
(Part 4 of the Sustainable Transportation Symposium)  
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## Purposes of the Sustainable Transportation Performance Indicators (STPI) project

- To implement CST's **founding Action Plan** and respond to a letter from the Ministers of Environment and Transport.
- To **provide an initial set of indicators of progress** or otherwise towards sustainable transportation (ST) in Canada, rooted in the definition of an ST system developed by CST.
- To **flesh out the definition of CST** and allow determination of whether or not progress is being made towards EST.
- To **help provide for continuous improvement** of the STPI, both through additions and improvements to the data set on which they are based and through refinements and additions to the indicators.



## The Centre's definition (and that of the EU)

A **sustainable transportation system** is one that:

- **Allows the basic access needs of individuals to be met safely** and in a manner consistent with human and ecosystem health, and with equity within and between generations.
- Is affordable, operates efficiently, offers choice of transport mode, and **supports a vibrant economy**.
- Limits emissions and waste within the planet's ability to absorb them, **minimizes consumption of non-renewable resources**, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise.



## Initial plan

Operationalize CST's definition by (i) deconstructing it into 18 elements:

**Environmental domain:** (1) limits emissions, (2) limits waste, (3) minimizes consumption of non-renewable resources, (4) limits consumption of renewable resources to the sustainable yield level, (5) reuses and recycles components, (6) minimizes use of land, (7) minimizes production of noise;

**Societal domain:** (8) meets access needs of individuals, (9) meets access needs of society, (10) access needs are met safely, (11) access needs are met consistent with human health, (12) access needs are met consistent with ecosystem health, (13) access needs are met with equity within this generation, (14) access needs are met with equity across generations;

**Economic domain:** (15) is affordable, (16) operates efficiently, (17) offers choice of transport mode, and (18) supports a vibrant economy.

(ii) quantifying each element as a target, and

(iii) fashioning for each target one or more indicators that represented movement towards or away from the target.



## Initial plan abandoned

Because setting targets is too intellectually and politically challenging.

Because, even if targets could be set, there would be huge data challenges in fashioning appropriate indicators.

Nevertheless, this was a **Good Idea**.

**Environmental domain:** (1) limits emissions, (2) limits waste, (3) minimizes consumption of non-renewable resources, (4) limits consumption of renewable resources to the sustainable yield level, (5) reuses and recycles components, (6) minimizes use of land, (7) minimizes production of noise;

**Societal domain:** (8) meets access needs of individuals, (9) meets access needs of society, (10) access needs are met safely, (11) access needs are met consistent with human health, (12) access needs are met consistent with ecosystem health, (13) access needs are met with equity within this generation, (14) access needs are met with equity across generations;

**Economic domain:** (15) is affordable, (16) operates efficiently, (17) offers choice of transport mode, and (18) supports a vibrant economy.



## Next plan

Develop three types of indicator:

**A single composite indicator** that expresses the extent of progress towards or away from sustainable transportation

**Descriptive indicators**, 5-10 in total, that reflect the components of the single indicator and represent the *effects* of transportation

**Explanatory indicators**, 10-30 in total, that reflect *contributory factors* that could help explain the effects of transportation.

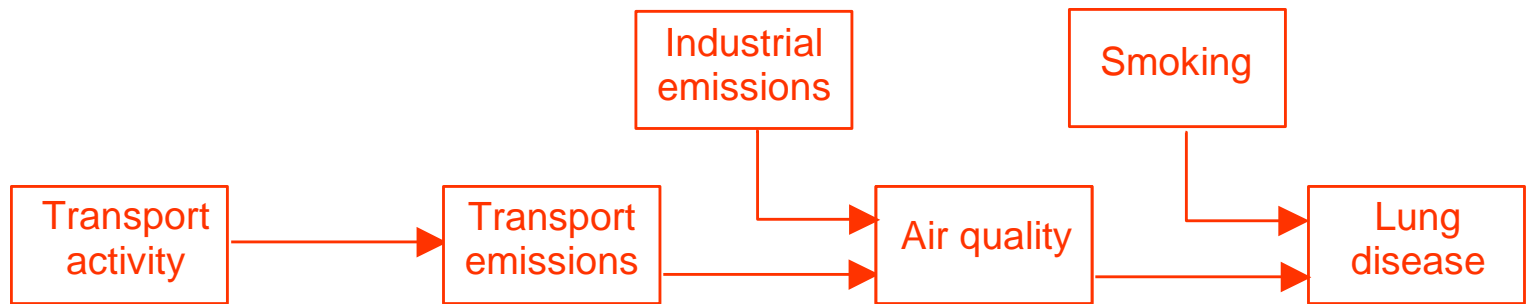
**Environmental domain:** (1) limits emissions, (2) limits waste, (3) minimizes consumption of non-renewable resources, (4) limits consumption of renewable resources to the sustainable yield level, (5) reuses and recycles components, (6) minimizes use of land, (7) minimizes production of noise;

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**Economic domain:** (15) is affordable, (16) operates efficiently, (17) offers choice of transport mode, and (18) supports a vibrant economy.

## This plan too was abandoned

Because we do not know enough about the effects of transportation.



We know something about transport activity and transport emissions.

But we do not know how much transport contributes to poor air quality.

Or how much poor air quality contributes to disease.

## New plan: Use the TERM topics and questions

| TERM topics and <i>questions</i>  | STPI topics and <i>questions</i>   |
|---|--|
| 1. Environmental consequences of transport<br><i>Is the environmental performance of the transport sector improving?</i>  | 1. Environmental and health consequences of transport<br><i>Is the performance of the transport sector improving in respect of its adverse impacts on environment and health?</i>          |
| 2. Transport demand and intensity<br><i>Are we getting better at managing transport demand and at improving the modal split?</i>  | 2. Transport activity<br><i>Is transport activity changing in directions consistent with positive answers to the other questions?</i>  |
| 3. Spatial planning and accessibility<br><i>Are spatial planning and transport planning becoming better coordinated so as to match transport demand to the need for access?</i>                         | 3. Land use, urban form and accessibility<br><i>Are land use, urban form, and transportation systems changing so as to reduce transportation effort?</i>                                   |
| 4. Supply of transport infrastructure and services<br><i>Are we optimizing the use of existing transport infrastructure capacity and moving towards a better balanced inter-modal transport system?</i> | 4. Supply of transport infrastructure and services<br><i>Are we increasing the efficiency of use of current infrastructure and changing the infrastructure supply in sustainable ways?</i> |



## Topics and questions continued

| TERM topics and <i>questions</i>   | STPI topics and <i>questions</i>   |
|--|--|
| <p>4. Supply of transport infrastructure and services</p> <p><i>Are we optimizing the use of existing transport infrastructure capacity and moving towards a better balanced inter-modal transport system?</i></p> | <p>4. Supply of transport infrastructure and services</p> <p><i>Are we increasing the efficiency of use of current infrastructure and changing the infrastructure supply in sustainable ways?</i></p>                          |
| <p>5. Transport costs and prices</p> <p><i>Are we moving to a fairer and more efficient pricing system, which ensures that external costs are internalized?</i></p>  | <p>5. Transportation expenditures and pricing</p> <p><i>Are the patterns of expenditure by governments, businesses, and households, and the associated pricing systems, consistent with moving towards sustainability?</i></p> |
| <p>6. Technology and utilization efficiency</p> <p><i>How rapidly are improved technologies being implemented and how efficiently are vehicles being used?</i></p>   | <p>6. Technology adoption</p> <p><i>Is technology being used more in ways that make vehicle transport systems and their utilization more sustainable?</i></p>  |
| <p>7. Management integration</p> <p><i>How effectively are environmental management and monitoring tools being used to support policy- and decision-making?</i></p>  | <p>7. Implementation and monitoring</p> <p><i>How effectively are environmental management and monitoring tools being used to support policy- and decision-making towards sustainability?</i></p>                              |



## New plan

Identify an initial set of STPI.

Identify STPI that could be added to the initial set within three years.

Identify desirable STPI that will take long than three years to develop.

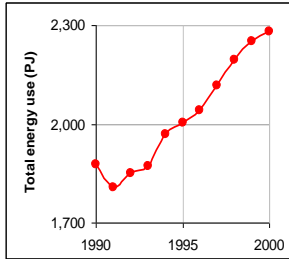


## Criteria for selection of variables for use in STPI development

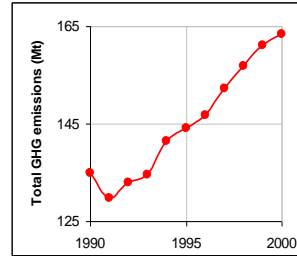
1. A qualifying variable should **concern sustainable transportation**, as elaborated in CST's definition, or provide a clear answer to one of the seven framework questions.
2. A qualifying variable should be **a time series**, so that information would be provided on changes in performance.
3. A qualifying variable, to the extent possible, should **represent all of Canada**.
4. A qualifying variable should come from what the project team considers to be a **reputable and reliable source**, usually a federal government source for Canada-wide data.

# Project results: initial indicator set

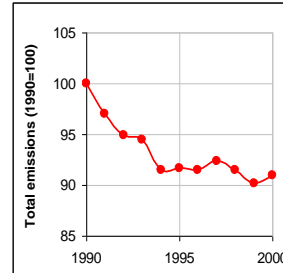
1. Use of fossil fuel energy for all transport



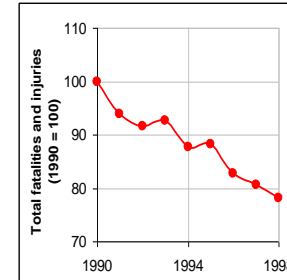
2. Greenhouse gas emissions from all transport



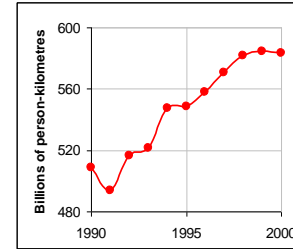
3. Index of emissions of air pollutants from road transport



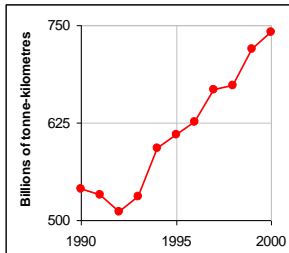
4. Index of incidence of road fatalities and injuries



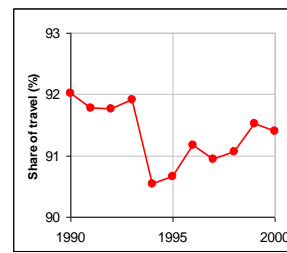
5. Total motorized movement of people



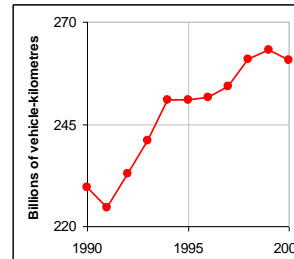
6. Total motorized movement of freight



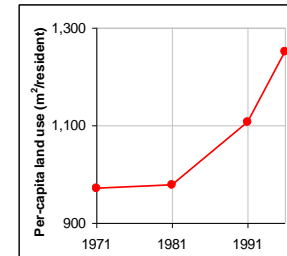
7. Share of motorized movement of people *not* by land-based public transport



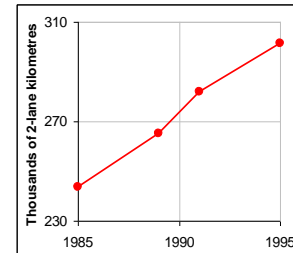
8. Movement of light-duty passenger vehicles



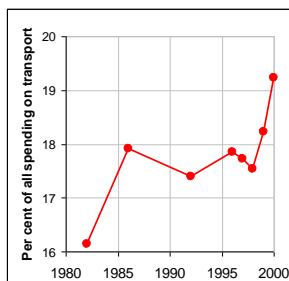
9. Urban land use per capita



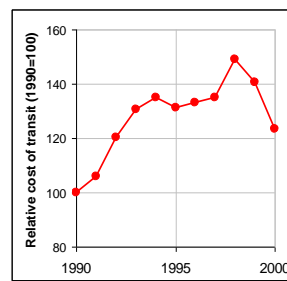
10. Length of paved roads



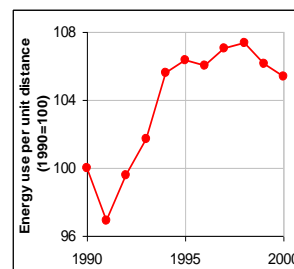
11. Index of relative household transport costs



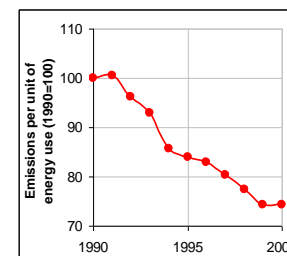
12. Index of the relative cost of urban transit

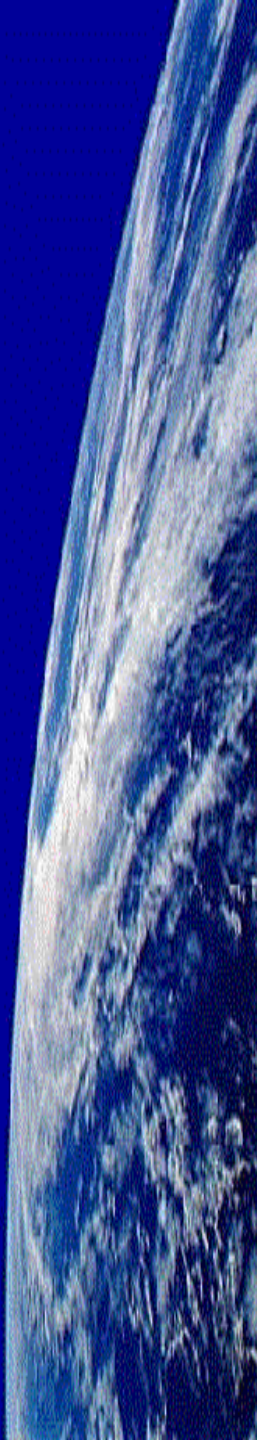


13. Index of the energy intensity of cars and trucks



14. Index of the emissions intensity of the road vehicle fleet





## Smiley faces

| Indicator  | Progress? |
|--|-----------|
| Indicator 1: Use of fossil fuel energy for all transport                                     | ☹️        |
| Indicator 2: Greenhouse gas emissions from all transport                                     | ☹️        |
| Indicator 3: Index of emissions of air pollutants from road transport                        | 😊⇒☹️      |
| Indicator 4: Index of road fatalities and injuries   | 😊         |
| Indicator 5: Total motorized movement of people  | ☹️⇒😊      |
| Indicator 6: Total motorized movement of freight   | ☹️        |
| Indicator 7: Share of motorized movement of people <i>not</i> by land-based public transport | ☹️        |
| Indicator 8: Movement of light-duty passenger vehicles                                       | ☹️⇒😊      |
| Indicator 9: Intensity of use of urban land  | ☹️        |
| Indicator 10: Length of paved roads  | ☹️        |
| Indicator 11: Index of the relative cost of transport  | ☹️        |
| Indicator 12: Index of affordability of urban transit fares                                  | ☹️⇒😊      |
| Indicator 13: Index of energy intensity of cars and trucks                                   | ☹️⇒😊      |
| Indicator 14: Index of fleet emissions intensity   | 😊         |

## Questions, answers

| Framework topic and question  | Answer | Comment  |
|---|--------|--|
| <p>1. Environmental and health consequences of transport (Indicators 1-4)</p> <p><i>Is the performance of the transport sector improving in respect of its adverse impacts on environment and health?</i></p>                                     | No     | Except for safety (which is positive), human health impacts are not yet being addressed, nor are ecosystem health impacts, nor are intermediate factors such as air pollution.   |
| <p>2. Transport activity (Indicators 5-8)</p> <p><i>Is transport activity changing in directions consistent with positive answers to the other questions?</i></p>   | Partly | Freight transport is the pressure point. Passenger transport and movement of passenger vehicles is levelling off. Transit is holding ground.   |
| <p>3. Land use, urban form and accessibility (Indicator 9)</p> <p><i>Are land use, urban form, and transportation systems changing so as to reduce transportation effort?</i></p>   | No     | More land per person is being used in urban areas; they are becoming less dense.   |
| <p>4. Supply of transport infrastructure and services (Indicator 10)</p> <p><i>Are we increasing the efficiency of use of current infrastructure and changing the infrastructure supply in sustainable ways?</i></p>                              | No     | Total length of paved roads is increasing; the issue of efficiency of use is not yet addressed.  |
| <p>5. Transportation expenditures and pricing (Indicators 11-12)</p> <p><i>Are the patterns of expenditure by governments, businesses, and households, and the associated pricing systems, consistent with moving towards sustainability?</i></p> | No     | Both the overall relative costs of transport and the relative costs of urban transit in relation to gasoline costs are increasing, suggesting a lack of affordability that is not consistent with good access and thus sustainability. |
| <p>6. Technology adoption (Indicators 13-14)</p> <p><i>Is technology being used more in ways that make vehicle transport systems and their utilization more sustainable?</i></p>  | Yes    | Energy intensity is only recently beginning to decline, but unit emissions declined throughout most of the 1990s   |



## What next (until end of 2005)?

1. Maintain and improve the initial set of STPI.
2. Develop some or all of the proposed shorter-term additions.
3. Prepare for development of some or all of the proposed longer-term additions.

# Shorter- and longer-term additions

| Framework topic and question  | Shorter-term additions  | Longer-term additions  |
|---|---|--|
| 1. Environmental and health consequences of transport<br><i>Is the performance of the transport sector improving in respect of its adverse impacts on environment and health?</i>                                   | Air quality<br>Waste from road transport<br>Discharges into water<br>Land use for transport<br>Proximity of infrastructure to sensitive areas and ecosystem fragmentation         | Noise<br>Effects on human health<br>Effects on ecosystem health  |
| 2. Transport activity<br><i>Is transport activity changing in directions consistent with positive answers to the other questions?</i>   | Utilization of passenger vehicles<br>Urban automobile vehicle-kilometres<br>Travel by non-motorized modes in urban areas<br>Journey-to-work mode shares                           | Urban and intercity person-kilometres<br>Freight modal participation<br>Utilization of freight vehicles  |
| 3. Land use, urban form and accessibility<br><i>Are land use, urban form, and transportation systems changing so as to reduce transportation effort?</i>  | Urban land use by size class and zone<br>Employment density by CMA, and urban size class and zone<br>Mixed use (per cent walking to work; ratio of jobs to employed labour force) | Share of urban population and jobs served by transit<br>Share of population and employment growth on already-urbanized lands<br>Travel and modal split by urban zone |
| 4. Supply of transport infrastructure and services<br><i>Are we increasing the efficiency of use of current infrastructure and changing the infrastructure supply in sustainable ways?</i>                          | Length of sustainable infrastructure<br>Transit seat-kilometres per capita  | Congestion index   |
| 5. Transportation expenditures and pricing<br><i>Are the patterns of expenditure by governments, businesses, and households, and the associated pricing systems, consistent with moving towards sustainability?</i> | Per cent of net government transport expenditures spent on ground-based public transportation   | Transport-related user charges<br>Expenditures by businesses on transportation   |
| 6. Technology adoption<br><i>Is technology being used more in ways that make vehicle transport systems and their utilization more sustainable?</i>  | Per cent of alternative fuel vehicles in the fleet  | Per cent of passenger-km and tonne-km fuelled from renewable energy<br>Per cent of labour force regularly telecommuting  |
| 7. Implementation and monitoring<br><i>How effectively are environmental management and monitoring tools being used to support policy- and decision-making towards sustainability?</i>                              | Number of sustainable transport indicators regularly updated and widely reported<br>Public support for initiatives to achieve sustainable transportation                          | Number of CMAs where planning and delivery of transport and related land use matters have a single authority   |



# Framework for developing ideal indicators 1

| Definition element  | Criteria | Present state | Indicator |
|---|----------|---------------|-----------|
| 1. limits emissions   |          |               |           |
| 2. limits waste   |          |               |           |
| 3. minimizes consumption of non-renewable resources                         |          |               |           |
| 4. limits consumption of renewable resources to the sustainable yield level |          |               |           |
| 5. reuses and recycles components   |          |               |           |
| 6. minimizes use of land  |          |               |           |
| 7. minimizes production of noise  |          |               |           |
| 8. meets access needs of individuals  |          |               |           |
| 9. meets access needs of society  |          |               |           |
| 10. access needs are met safely   |          |               |           |
| 11. access needs are met consistent with human health                       |          |               |           |
| 12. access needs are met consistent with ecosystem health                   |          |               |           |
| 13. access needs are met with equity within this generation                 |          |               |           |
| 14. access needs are met with equity across generations                     |          |               |           |
| 15. is affordable   |          |               |           |
| 16. operates efficiently  |          |               |           |
| 17. offers choice of transport mode   |          |               |           |
| 18. supports a vibrant economy  |          |               |           |

## Framework for developing ideal indicators 2

| Definition element | Variable             | Criterion                               | Present state                            | Performance indicator*                |
|--------------------|----------------------|---|--|---------------------------------------|
| Limits emissions   | Greenhouse gases     | 20% of 1990 total (composite, weighted) | 120% of 1990 total (composite, weighted) | Percentage points above target (=100) |
| Limits emissions   | Other air pollutants | 5% of 1990 total (composite, weighted)  | 60% of 1990 total (composite, weighted)  | Percentage points above target (=55)  |

\*Value of zero represents attainment of sustainable transportation; higher values represent less sustainable transportation