Beyond Ratings: The Cost Savings Potential of Sustainability Practices
The Sustainability Triple Bottom Line

The Triple Bottom Line (TBL) means addressing Environmental, Economic and Social Equity dimensions of a project or program.
Sustainable Highways Systems:

- Are an integral part of sustainable development
- Satisfy functional requirements
  - Fulfill transportation goals and needs
  - Address development and economic growth
- Avoid, minimize and reduce impacts
  - Environment
  - Consumption of resources
Research Objectives

The objectives of this research:

- To create a business case for sustainable practices;
- To present TBL benefits and costs in tangible and comparable metrics (e.g., time saved, costs saved in dollar value, etc.);
- To provide real world examples of cost savings; and
- To inform decisions about use of sustainable transportation practices
Misperception:
Sustainability Costs More

Why Conduct this Research?

Reducing Transportation Costs
Implementing Sustainable Practices

Project Costs

Sustainability
Savings Analysis
The Analysis

- Selected six (6) sustainability practices
- Explored agency experiences
- Determined “order of magnitude” savings

Potential Savings:

- $ ~ 1M
- $$ ~ 10M
- $$$ ~ 100M
- $$$$ ~ 1B

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Balancing TBL benefits with cost savings:

- Implementing sustainable practices can be cost neutral or result in cost savings while benefiting the natural and human environment.
- Benefits were realized by agencies and users.
- In many cases, more savings are realized over time.
SP-6: Safety Planning

**GOAL:** INTEGRATE QUANTITATIVE MEASURES OF SAFETY INTO THE TRANSPORTATION PLANNING PROCESS, ACROSS ALL MODES AND JURISDICTIONS
Potential Triple Bottom Line Savings:

- DOTs can save on the cost of emergency response, property damage, administrative, legal, and liability costs of crashes. ($$

- Highway users can save millions of dollars in crash (property damage), travel delay, and workplace productivity costs. ($$$)

- Reducing crashes can prevent adverse environmental impact costs (added fuel usage and air quality emissions caused by congestion). ($$

- Safety planning can save people’s lives and enhance quality of life. ($$$$)

*Order of Magnitude Savings: $ ~ 1M, $$~ 10M , $$~ 100M, $$~ 1B*
In 2012, motor vehicle crashes involved:

- 33,561 fatalities
- 2.36 million injuries
- 9.9 million vehicles

**TBL costs approaching $1 trillion**

**Source:** National Highway Traffic Safety Administration (NHTSA)
Agency Experience:

• NHTSA estimated that the cost of motor vehicle crashes in the United States **approached $1 trillion** (2012).

• California DOT Highway Safety Improvement Program (HSIP)
  - Reduced number of fatal collisions by **19.6 percent**
  - Number of persons injured by **18.8 percent**

• **INVEST Pilot Study**: Washington State DOT
  - Evaluated three corridor studies
  - Determined SP-6 criteria could be used to integrate quantitative safety planning into projects
GOAL: REDUCE VEHICLE TRAVEL DEMAND THROUGHOUT THE SYSTEM
Potential Triple Bottom Line Savings:

- Reduced congestion and parking demand can reduce the need for additional roadway capacity.

- Congestion reduction improves reliability, enhancing overall mobility.

- Reduced greenhouse gas and principal pollutant emissions lessens environmental impact.

- Traffic reductions and expanded transportation options can improve safety, health, and access.

Order of Magnitude Savings: 

$ ~ 1M, $$ ~ 10M, $$$ ~ 100M, $$$$ ~ 1B
SP-9: Travel Demand Management

Basis for Potential Savings:

Implementation of travel demand management (TDM) strategies creates efficiencies that may generate cost savings to agencies and users.

- TDM strategies can reduce the need for billions of dollars in additional roadway capacity and associated maintenance while maximizing returns on existing infrastructure.
- Improving mobility and system reliability can provide savings to users. Commuters using public transportation can save almost $800 per month by avoiding congested urban traffic.
- Reducing travel demand can improve air quality by decreasing emissions from single-occupancy vehicles (SOV) and reduce land needed for transportation infrastructure.
- Costs associated with the lack of transportation options and congestion is in the tens of millions of dollars. Managing travel demand helps improve safety and access for users.

Sources: FHWA Office of Operations
SP-9: Travel Demand Management

Agency Experience:

- New Jersey: commuting cost calculator estimates carpool savings to users

- Los Angeles County: ridesharing program reduced cost per trip by $2.80

- **INVEST Pilot Study**: Washington State DOT
  - Annual reduction of **62 million** vehicle miles traveled (VMT) and prevented **3 million gallons** of fuel from being consumed
  - Reduced downtown Bellevue SOV commute rate by **30 percent**
**SP-9: Travel Demand Management**

- Congestion pricing shifts travel time and reduces vehicle travel.
- Results vary depending on congestion, location and traffic volume levels.
- Benefits include revenue generation, and reductions in congestion and pollution.

### Benefits of Value/Congestion Pricing Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Revenue Generation</th>
<th>Congestion Reduction</th>
<th>Pollution Reduction</th>
<th>Increased Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Toll (fixed)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Congestion Pricing (variable)</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>HOT Lanes</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cordon Fees</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Rating scale from 3 (very beneficial) to -3 (very harmful). A score or 0 indicates no impacts or mixed impacts.*
GOAL: IMPROVE THE EFFICIENCY OF TRANSPORTATION SYSTEMS WITHOUT ADDING INFRASTRUCTURE CAPACITY IN ORDER TO REDUCE EMISSIONS AND ENERGY USE AND IMPROVE ECONOMIC AND SOCIAL NEEDS
Potential Triple Bottom Line Savings:

- DOTs can save by avoiding expensive capacity investments. ($$

- User benefits from reduced congestion and improved reliability. ($$$

- Greenhouse gas and pollutant emissions as well as traditional capacity expansion impacts avoided. ($

- Improved safety, accessibility, and emergency response. ($$

Order of Magnitude Savings: $ \sim 1M, $$\sim 10M, $$$\sim 100M, $$$$ \sim 1B
ITS investments can produce dramatic improvements for a small fraction of the costs needed to build additional capacity.

Improves mobility with smoother, safer travel conditions, resulting in fewer incident causing delays and improving system reliability.

ITS enhancements can reduce emissions generated by traffic backups attendant to poor travel conditions by tens of percentage points.

Improves safety and access associated with otherwise avoidable costs of crashes; provides a safer and more reliable system for all users.
Agency Experience:

- Carnegie Mellon’s SURTRAC (Scalable Urban Traffic Control):
  - Benefits estimated for nine test intersections: approximately $7,184 daily and $1,875,127 annually.
  - Estimated citywide benefits for expanded implementation would be over $125 million annually.
  - Return on investment realized after 3 months of operation.

<table>
<thead>
<tr>
<th>Period</th>
<th>Travel Time</th>
<th>Vehicle Speed</th>
<th>Number of Stops</th>
<th>Wait Time</th>
<th>Emissions, Fuel Consumption</th>
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<tbody>
<tr>
<td>AM Rush</td>
<td>30%</td>
<td>34%</td>
<td>29%</td>
<td>48%</td>
<td>24%</td>
</tr>
<tr>
<td>Mid-day</td>
<td>33%</td>
<td>49%</td>
<td>53%</td>
<td>50%</td>
<td>29%</td>
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<tr>
<td>PM Rush</td>
<td>23%</td>
<td>27%</td>
<td>9%</td>
<td>36%</td>
<td>18%</td>
</tr>
<tr>
<td>Evening</td>
<td>18%</td>
<td>28%</td>
<td>35%</td>
<td>28%</td>
<td>14%</td>
</tr>
<tr>
<td>Overall</td>
<td>26%</td>
<td>34%</td>
<td>31%</td>
<td>41%</td>
<td>21%</td>
</tr>
</tbody>
</table>
INVEST Pilot Study: Springfield Sangamon County Regional Planning Commission

- Employed ITS practices for emergency signal preemption, speed enforcement and special event signage.
GOAL: REDUCE LIFECYCLE IMPACTS FROM EXTRACTION, PRODUCTION AND TRANSPORTATION OF VIRGIN MATERIALS THROUGH RECYCLING

PD-20: Recycle Materials
PD-20: Recycle Materials

Potential Triple Bottom Line Savings:

- **$** DOTs can save 10-50 percent of their paving costs.
- **$** System users benefit from reduced traffic congestion and reliability costs due to bridge postings and closures.
- **$** Environmental impacts of trucking materials, and mining and land filling can be avoided.
- **$** Agencies set a good example and provide safety benefits.

*Order of Magnitude Savings: $ ~ 1M, $$~ 10M, $$$~ 100M, $$$$ ~ 1B*
Basis for Potential Savings:

Many agencies report cost savings through the use of Reclaimed Asphalt Pavement (RAP), Recycled Concrete Aggregate (RCA), and/or in-place construction recycling methods.

- Recycled materials can aid in the use of best available materials while minimizing transportation, land fill, and mining impacts.
- Shorter construction times and less trucking of construction materials minimizes traffic disruptions and associated costs on the public.
- Less trucking reduces energy use, emissions, and traffic congestion; also reduces impacts associated with mining of virgin materials.
- Direct dollar savings generated by recycling sets examples that encourage communities to understand and promote recycling practices.
PD-20: Recycle Materials

Agency Experience:

- FHWA research:
  - More than **68.3 tons** of Reclaimed Asphalt Pavement (RAP) was used, which saved U.S. tax payers approximately **$2.2 billion** (2012).
  - Recycled Concrete Aggregate (RCA) could save as much as **$4 per square yard** of Portland Cement Concrete; some estimates indicate as much as **$5 million** in savings on a single project.
  - DOTs reported **20-30% savings** when using Cold In-Place Recycling (CIP) in lieu of conventional methods

<table>
<thead>
<tr>
<th>% RAP</th>
<th>% Savings</th>
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<tbody>
<tr>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>20</td>
<td>14-15</td>
</tr>
<tr>
<td>25</td>
<td>14-20</td>
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<tr>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>50</td>
<td>30-40</td>
</tr>
</tbody>
</table>
• **INVEST Pilot Study**: Ohio DOT, Cleveland Inner Belt Bridge

• Nearly all materials from the closed bridge will be recycled or reused.
GOAL: LEVERAGE A BRIDGE MANAGEMENT SYSTEM (BMS) TO BALANCE ACTIVITIES THAT EXTEND THE LIFE AND FUNCTION OF BRIDGES WITH IMPACTS TO THE HUMAN AND NATURAL ENVIRONMENT.

OM-8: Bridge Management System
OM-8: Bridge Management System

Potential Triple Bottom Line Savings:

- DOTs can save by extending the useful service-life of bridges through more efficient maintenance.
- Highway users can save travel time from reduced construction delay.
- Less frequent and shorter construction reduces emissions released from congestion and detours associated with bridge closures.
- Safety and access costs avoided due to bridge closures.

Order of Magnitude Savings: $ ~ 1M, $$~ 10M, $$$~ 100M, $$$$ ~ 1B
OM-8: Bridge Management System

Basis for Potential Savings:

BMS helps agencies identify bridge preservation and improvement activities that provide the maximum cost benefit for minimum given level of investment.

BMS can reduce life cycle costs by supporting investments in preventative maintenance repair, rehabilitation, or replacement projects.

Can provide road-user benefits by reducing travel time, vehicle operation and accident-related costs resulting from bridge reconstruction, often worth 10 times the direct cost of the project.

By decreasing traffic congestion and detour vehicle miles, BMS can lead to reductions in environmental impacts caused by fuel consumption and CO2 emissions.

May improve safety and access benefits while reducing the avoidable cost of traffic impacts caused by major reconstruction projects.
Agency Experience:

- BMS information can help agencies make balanced decisions that increase the number of structurally healthy bridges and reduces life-cycle costs.
- Oregon: reduced bridge deficiency from 33 to 23 percent (2012).
- Michigan: good and fair bridges increased from 79 percent in 1998 to 92 percent in 2011.
- Virginia: good and fair bridges increased from 90 percent in 2000 to 92 percent in same year.
OM-8: Bridge Management System

North Carolina DOT:

- Initial BMS program calculated annual user costs of over $560 million due to detours and accidents on bridges.

- BMS information led to increased investments in the State’s bridge maintenance budget.

- Supported implementation of cost efficient low impact bridge designs:
  - Decreased replacement time by as much as 4 years.
  - Reduced project costs by 25%.

### NCDOT

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<tbody>
<tr>
<td>Initial Investment</td>
<td>$40-60 Million</td>
</tr>
<tr>
<td>Additional Investment</td>
<td>$100 Million</td>
</tr>
<tr>
<td>Annual Cost Savings</td>
<td>&gt;$300 Million</td>
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OM-12: Road Weather Management Program

**GOAL:** PLAN, IMPLEMENT, AND MONITOR A ROAD WEATHER MANAGEMENT PROGRAM (RWMP), INCLUDING SNOW AND ICE CONTROL, TO REDUCE ENVIRONMENTAL IMPACTS WITH CONTINUED OR BETTER LEVELS OF SERVICE
Potential Triple Bottom Line Savings:

$$
DOTs can save 10 to 25 percent of their winter maintenance costs.

$$$
Highway users can save millions of dollars in travel delay.

$
Salt and deicing chemical impacts can be reduced by 10 to 20 percent.

$$$
Safety and access benefits during winter storms can generate benefits well into the millions.

Order of Magnitude Savings: $ ~ 1M, $$~ 10M, $$$~ 100M, $$$$ ~ 1B
OM-12: Road Weather Management Program

Basis for Potential Savings:

RWMP’s address impacts to transportation from all types of weather events. In particular, enhanced use of technology in snow and ice control to monitor and predict deterioration of travel conditions and recommend event and site specific treatment plans can generate significant agency savings.

- Can decrease costs of snow and ice control by reducing unnecessary deployment of labor, equipment and materials to treat highways.
- Improves mobility and reduces impact on vehicle miles traveled during storms, reducing costs to the public related to delays.
- Reduces impacts to infrastructure caused by salt and other deicing chemicals, emissions from traffic congestion, and unneeded treatment miles logged by trucks.
- Improves safety and access, and reduces avoidable costs associated with accidents during winter storms or other hazardous weather conditions.
OM-12: Road Weather Management Program

Agency Experience:

- NCHRP 20-7(117): reduce approximately 10-20 percent of an agency’s snow and ice control budget.
- Wisconsin: savings of approximately $144,000/storm.
- Other state experiences with RWMP:

<table>
<thead>
<tr>
<th>Agency</th>
<th>Cost Savings</th>
<th>Benefit-Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa DOT</td>
<td>5.6%</td>
<td>1.8</td>
</tr>
<tr>
<td>Michigan DOT</td>
<td>19.5 to 50%</td>
<td>2.8 to 7.0</td>
</tr>
<tr>
<td>Nevada DOT</td>
<td>6.5%</td>
<td>3.2</td>
</tr>
<tr>
<td>Utah DOT</td>
<td>11.0 to 25.0%</td>
<td>11.0</td>
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</table>
Try INVEST at www.sustainablehighways.org

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