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Beyond Ratings:
The Cost Savings Potential of Sustainability Practices

U.S. Department of Transportation
Federal Highway Administration

The Sustainability Triple Bottom Line

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

Sustainable Highways

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Sustainable Highway Systems:

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

Research Objectives

The objectives of this research:

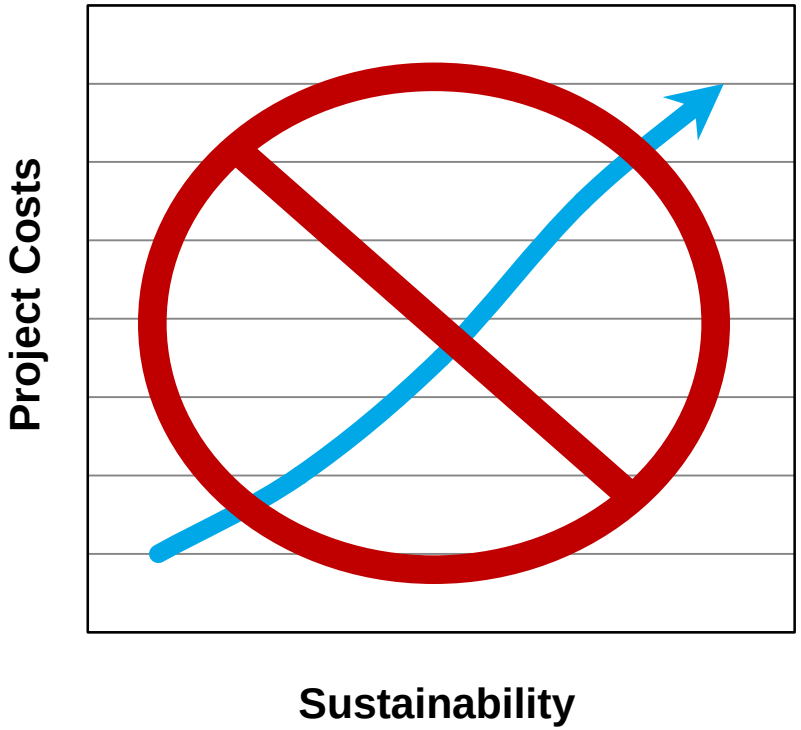
- To create a business case for sustainable practices;
- To present TBL benefits and costs in tangible and comparable metrics (e.g., time saved, costs saved in dollar value, etc.);
- To provide real world examples of cost savings; and
- To inform decisions about use of sustainable transportation practices

Why Conduct this Research?

Misperception: Sustainability Costs More

Reducing Transportation Costs

Implementing Sustainable Practices



Savings Analysis

The Analysis

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

Potential Savings:
$ ~ 1M
$$ ~ 10M
$$$ ~ 100M
$$$$ ~ 1B

SP-6: Safety Planning

SP-9: Travel Demand Management

PD-14: ITS for System Operations

PD-20: Recycle Materials

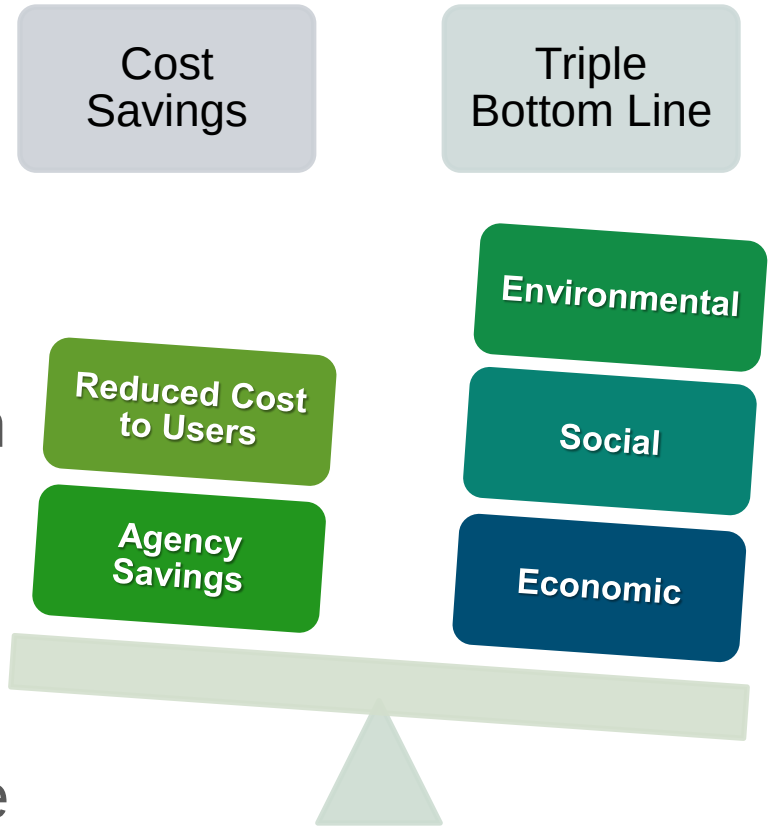
OM-8: Bridge Maintenance System

OM-12: Road Weather Management Program

The Triple Bottom Line: Benefits and Costs

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

SP-6: Safety Planning

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

SP-6: Safety Planning

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Basis for Potential Savings:

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)

Safety Planning can prevent property damage, emergency response, litigation and liability costs associated with crashes.

Crash reduction can help reduce the economic cost of motor vehicle crashes which, in 2010, were estimated to be about $277 billion in the U.S.

By reducing the number of crashes, Safety Planning can lower associated adverse environmental impact costs, estimated to exceed $28 billion in 2010.

Can reduce the societal costs of motor vehicle crashes (reflected as impacts to quality of life) which, in 2010, exceeded $590 billion.

SP-6: Safety Planning

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

SP-9: Travel Demand Management

GOAL: REDUCE VEHICLE TRAVEL DEMAND THROUGHOUT THE SYSTEM

SP-9: Travel Demand Management

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.

Sources: FHWA Office of Operations

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.

SP-9: Travel Demand Management

Agency Experience:

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

Mode	Estimated Savings per Days of Carpool Use in a Week ($)				
	1 Day	2 Days	3 Days	4 Days	5 Days
Carpool-2	6.11	12.22	18.33	24.44	30.55
Carpool-3	8.14	16.28	24.42	32.56	40.70
Carpool-4	9.16	18.32	27.48	36.64	45.80

- 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

Strategy	Revenue Generation	Congestion Reduction	Pollution Reduction	Increased Safety
Road Toll (fixed)	3	2	1	1
Congestion Pricing (variable)	2	3	2	1
HOT Lanes	1	2	1	0
Cordon Fees	2	3	1	1

Rating scale from 3 (very beneficial) to -3 (very harmful). A score or 0 indicates no impacts or mixed impacts.

PD-14: ITS for System Operations

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

PD-14: ITS for System Operations

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.

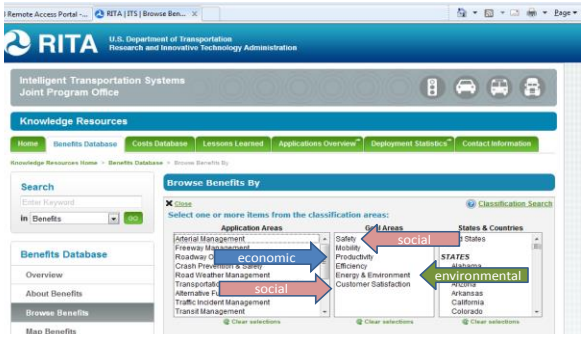
$$ Improved safety, accessibility, and emergency response.

Order of Magnitude Savings: $ ~ 1M, $$~ 10M , $$$~ 100M, $$$$ ~ 1B

PD-14: ITS for System Operations

Basis for Potential Savings:

Intelligent Transportation Systems (ITS) technology in transportation can **yield low-cost, high-value benefits** across the triple bottom line.



Source: Research and Innovative Technology Administration (RITA)

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.

PD-14: ITS for System Operations

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**.

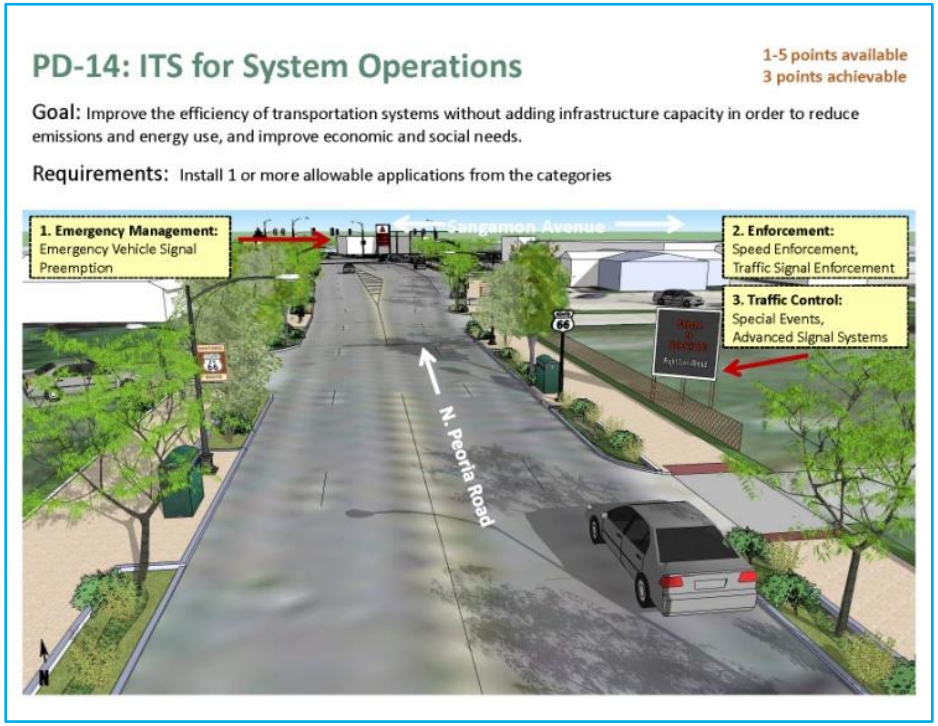
Period	Percent Improvement				
	Travel Time	Vehicle Speed	Number of Stops	Wait Time	Emissions, Fuel Consumption
AM Rush	30%	34%	29%	48%	24%
Mid-day	33%	49%	53%	50%	29%
PM Rush	23%	27%	9%	36%	18%
Evening	18%	28%	35%	28%	14%
Overall	26%	34%	31%	41%	21%

  - Estimated citywide benefits for expanded implementation would be over **$125 million annually**.
  - Return on investment realized after 3 months of operation.

PD-14: ITS for System Operations

INVEST Pilot Study: Springfield Sangamon County Regional Planning Commission

- Employed ITS practices for emergency signal preemption, speed enforcement and special event signage.



PD-20: Recycle Materials

GOAL: REDUCE LIFECYCLE IMPACTS FROM EXTRACTION, PRODUCTION AND TRANSPORTATION OF VIRGIN MATERIALS THROUGH RECYCLING

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

PD-20: Recycle Materials

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

% RAP	% Savings
10	8
20	14-15
25	14-20
30	21
40	28
50	30-40

PD-20: Recycle Materials

- **INVEST Pilot Study**: Ohio DOT, Cleveland Inner Belt Bridge
- Nearly all materials from the closed bridge will be recycled or reused.

OM-8: Bridge Management System

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

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.

OM-8: Bridge Management System

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.

NCDOT	
Initial Investment	$40-60 Million
Additional Investment	$100 Million
Annual Cost Savings	>$300 Million

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

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

OM-12: Road Weather Management Program

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:

Agency	Cost Savings	Benefit-Cost Ratio
Iowa DOT	5.6%	1.8
Michigan DOT	19.5 to 50%	2.8 to 7.0
Nevada DOT	6.5%	3.2
Utah DOT	11.0 to 25.0%	11.0

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