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The Sustainable Highway: Implementation of Green Rating Systems within Transportation Infrastructure

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Northeast and Mid-Atlantic States In-Place Recycling Conference

August 24, 2010

Roadways Today

ASCE Grade Card	
D-	Roads

The number of worldwide paved roads is 15.99 million kilometers which is almost 20 roundtrips to the moon.

In 97% of the continental United States, you're no more than three miles from a paved road of one kind or another.

$186 Billion is required to just improve US highways!

Road Construction Today

The US spends $85 billion annually on rolling out tens of thousands more miles.

Building and maintaining a single mile of freeway

- Energy use of 200 US homes use in a year.
- Consumes as much raw material as 1,000 households in 365 days
- Generates more waste than 1200 homes produce annually.

Environmental Impacts of Transportation

- **Transportation was responsible for 27% of total US Greenhouse Gas (GHG) in 2008.**
  - Over the last two decades, transportation has been the nation's fastest growing GHG source, responsible for 47% of the net increase in emission between 1990 and 2007.
- **Transportation accounts for close to 70% of US oil consumption.**
  - The national driving rate has increased three times the rate of population growth since 1970 (driving more miles per capita, more frequently).

Social and Economic Impacts of Transportation

- Americans spend 4.2 billion hours a year stuck in traffic at a cost to the economy of $78.2 billion, or $710 per motorist.
- Poor road conditions cost motorists $67 billion a year in repairs and operating costs
- And cost 14,000 Americans their lives.

Sustainability

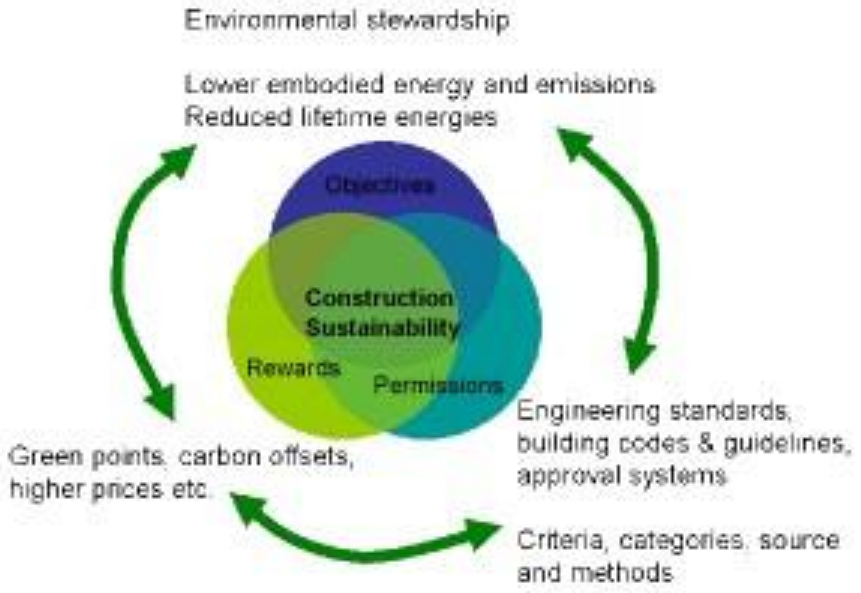
Sustainability Principles ?

Fundamental Goals and Practices

- Comprehensive Analysis
- Integrated and Strategic Planning
- Focusing on Goals, Performance and Outcomes
- Consideration of Equity
- Market Principles
- Precautionary Principle
- Conservation Ethic
- Transparency, Accountability and Public Involvement

The Seven Principles of Sustainable Construction

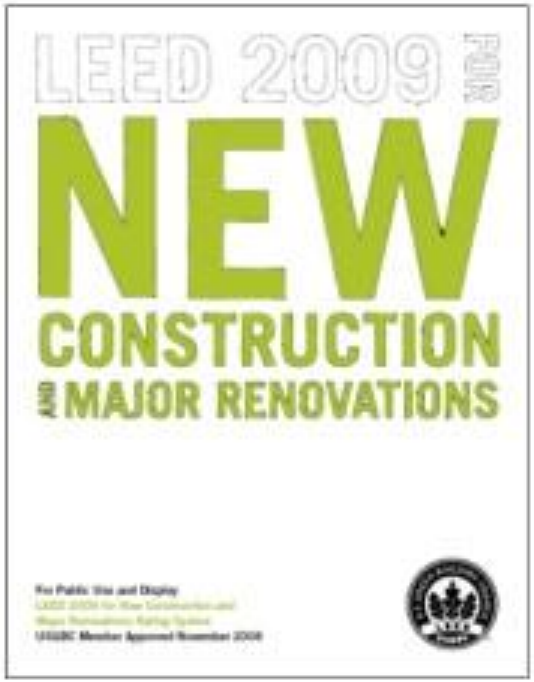
- Reduce Resource Consumption (Reduce)
- Reuse Resources (Reuse)
- Use Recyclable Resources (Recycle)
- Protect Nature (Nature)
- Eliminate Toxins (Toxins)
- Apply Life-cycle Costing (Economics)
- Focus on Quality (Quality)



Sustainable Design ?

Green Design for buildings has quickly been integrated into the building marketplace.

- Various green initiatives including legislation, executive orders, resolutions, ordinances, policies, and incentives are found in 43 states, including 190 Localities (126 cities, 36 counties, and 28 towns), 33 state governments, 13 federal agencies or departments, 16 public school jurisdictions and 39 institutions of higher education across the U.S.



However, the requirements for transportation are vastly different as each project is unique to the region and area in which it is built.

Sustainability ?

Transportation infrastructure is lagging significantly behind the commercial and residential building sectors in environmental sustainability.

And in an era of accountability, the development and acceptance of transportation sustainability performance measures are long overdue.

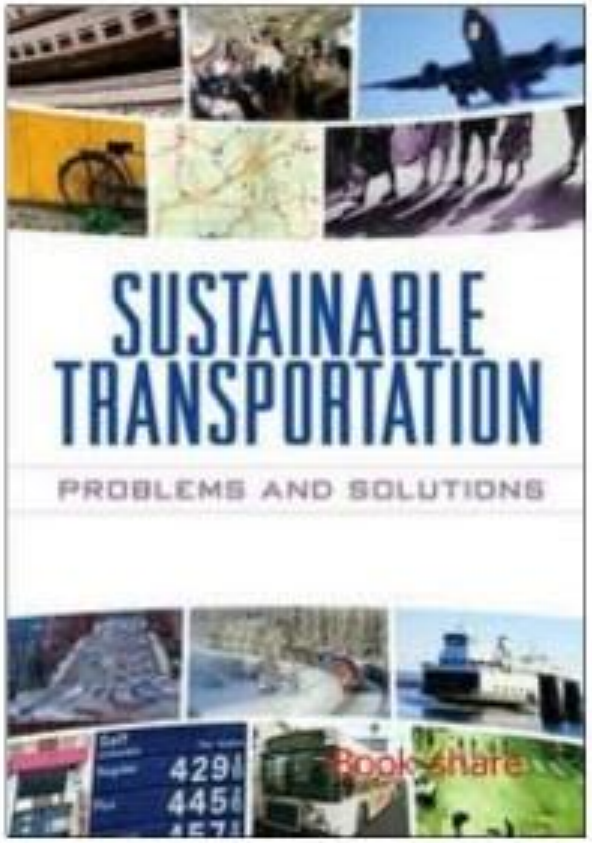
What is Sustainable Transportation ?

A comprehensive definition of sustainable transportation system developed by the Canadian Center for Sustainable Transportation states that sustainable transportation:

- "Allows the basic access needs of individuals and societies 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; and
- Limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable, 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."

Visions of Sustainable Transportation

- **Technical**
  - Innovation to solve specific problems, create wealth and increase mobility (e.g. alternative fuels, super-efficient vehicles)
- **Demand Management**
  - Changing travel behavior through travel time, route, mode and destinations by increasing travelers choices
- **Economic Reform**
  - Optimal transportation market by reforming prices and investment practices (e.g. full cost pricing, congestion pricing, tax shifting and least cost planning).
- **Alternative Modes**
  - Improvements to public transit, ridesharing, non-motorized transport, telecommuting and road design features to promote these modes.
- **Land Use/Community Design Changes**
  - Land use pattern changes to reduce travel distances and increase mode choice (e.g. locating more services and jobs near residential neighborhoods, creating neighborhoods more suitable for public transit, walking and cycling.)



Transportation Impacts and Indicators on Sustainability

Economic	Social	Environmental
Traffic Congestion	Inequity of Impacts	Air Pollution
Mobility Barriers	Mobility Disadvantaged	Climate Change
Crash Damages	Human Health Impacts	Habitat Loss
Transportation Facility Costs	Community Cohesion	Water Pollution
Consumer Transportation Costs	Community Livability	Hydrological Impacts
Depletion of Non-Renewable Resources	Aesthetics	Noise Pollution

Economic	Social	Environmental
Accessibility - Commuting	Safety	Climate Change Emissions
Accessibility - Land Use Mix	Health and Fitness	Other Air Pollution
Accessibility - Smart Growth	Community Liveability	Noise Pollution
Transport Diversity	Equity - Fairness	Water Pollution
Affordability	Equity - Non-drivers	Land Use Impacts
Facility Costs	Equity - Disabilities	Habitat Protection
Freight Efficiency	Non-motorized Transport Planning	Resource Efficiency
Planning	Citizen Involvement	

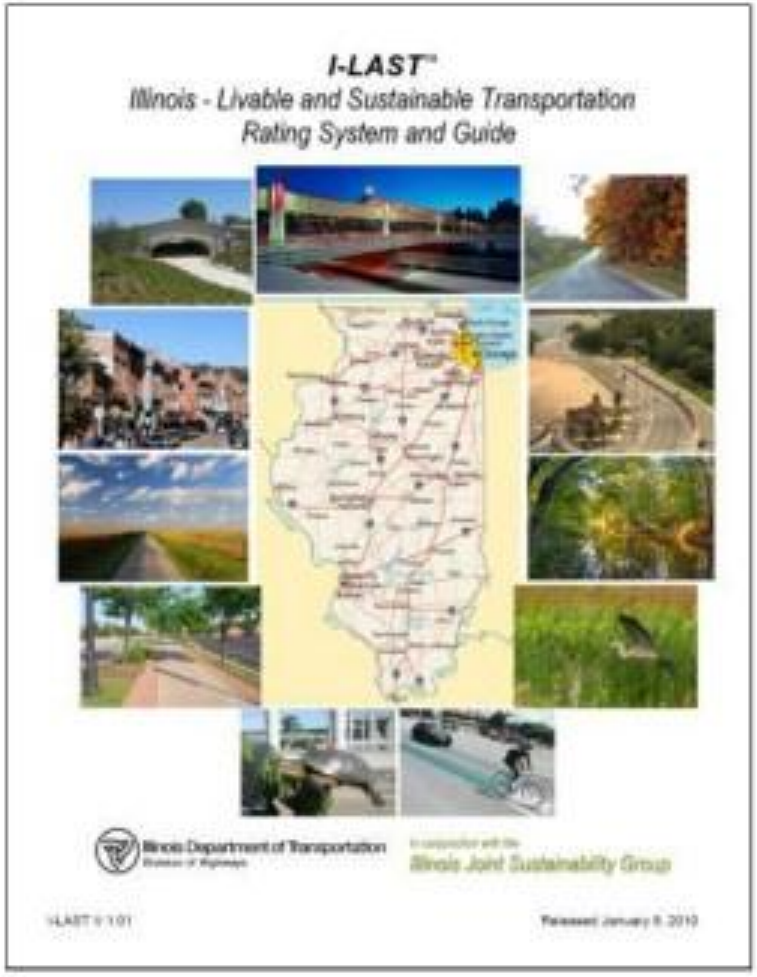
Sustainable Transportation Initiatives

I-LAST™

CEEQUAL: the Civil Engineering Environmental Awards Scheme

- GreenLites – Leadership in Transportation and Environmental Sustainability
- Illinois – Livable and Sustainable Transportation Rating System and Guide; WisDOT – Connections 2030; Mississippi
- MTO – Green Pave
- BE²ST In-Highways – Building Environmentally and Economically Sustainable Transportation Infrastructure-Highways
- Greenroads
- Guide to Green Roads – Alberta/Stantec
- Green Guide for Roads – Transportation Association of Canada
- Green Highway – Federal Highway Administration
- CEEQUAL
- STARS – Sustainable Transportation Access Rating System

Illinois – Livable and Sustainable Transportation Rating System and Guide



- Voluntary Trial Period
- Point Based System
  - 223 Points on 153 Sustainable items that can be considered in the design of highway projects
  - Weighted Scoring
  - 8 Major Categories
    - Planning
    - Design
    - Environmental
    - Water Quality
    - Transportation
    - Lighting
    - Materials
    - Innovation

Sample Project

- Scoring is based upon percentage of applicable items
- Resulting score is a percentage
- Self scoring
  - No certification
  - No calculations
  - Project manager scores project
- Future
  - Multiple rating systems
    - Comprehensive
    - Specific
  - Funding may be tied to ratings

Sample Scoring

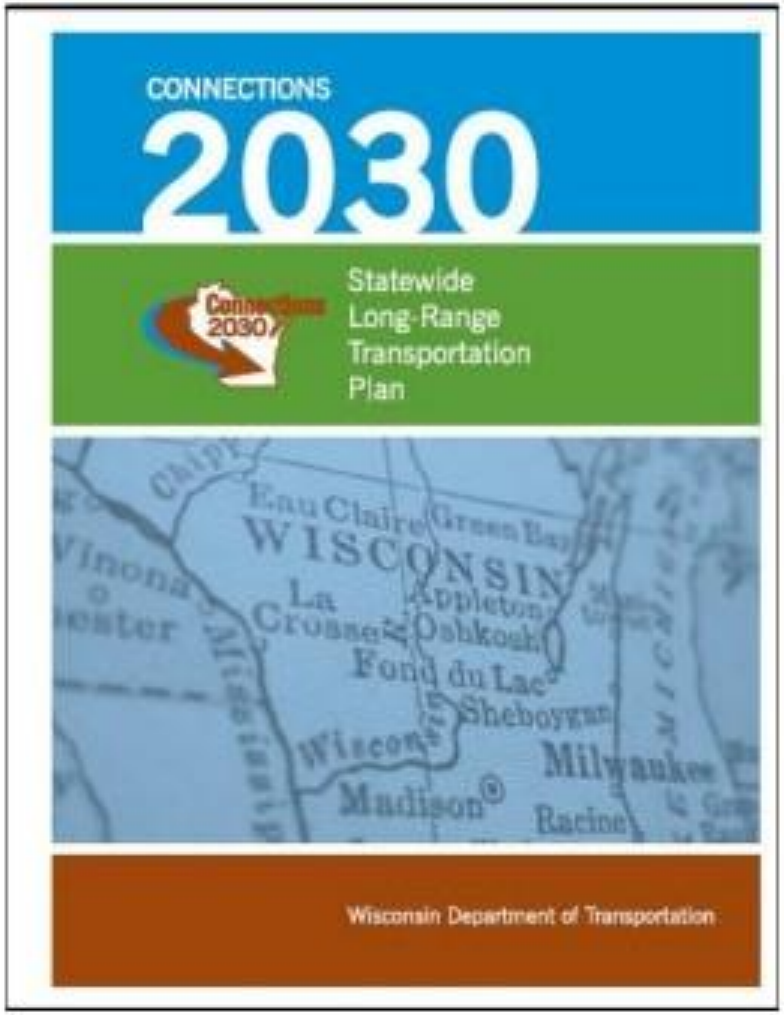
CATEGORY		ID	DESCRIPTION	Available Points	Project Points
Planning	P-1 Context Sensitive Solutions	P-1a	Identify Stakeholders and develop Stakeholders Involvement Plan	2	0
		P-1b	Engage Stakeholders to conduct Context Audit and develop project purpose	2	2
		P-1c	Involve Stakeholders to develop and evaluate alternatives	2	2
		P-1d	Employ Stakeholder involvement techniques to achieve consensus for Preferred Project Alternative	2	2
	P-2 Land Use/ Community Planning	P-2a	Promote reduction in vehicle trips by accommodating increased use of public transit	2	N/A
		P-2b	Accommodate multi-modal transportation uses (e.g. transit riders, pedestrians, and bicyclists)	2	2
		P-2c	Increase transportation efficiencies for moving freight through features such as dedicated rail or intermodal facilities	2	N/A
		P-2d	Partnerships that provide environmental or technological advancements while promoting environmental stewardship	2	0
		P-2e	Project is consistent with regional plans and local managed growth-based Master or Comprehensive Plans	2	N/A
		P-2f	Project is compatible with local efforts for Transit Oriented Design	1	N/A

19 max 8/12 = 67%

12 applicable

WISCONSIN and MISSISSIPPI DOTs

- Partnerships with universities to create point-based rating systems.
- Highway centric
- Expectations:
  - Reduced energy use
  - Mitigate environmental burden
  - Human Health and Safety
  - Preservation of Natural Resources
- Both rating systems are under development



Ministry of Transportation Ontario

GREEN PAVE

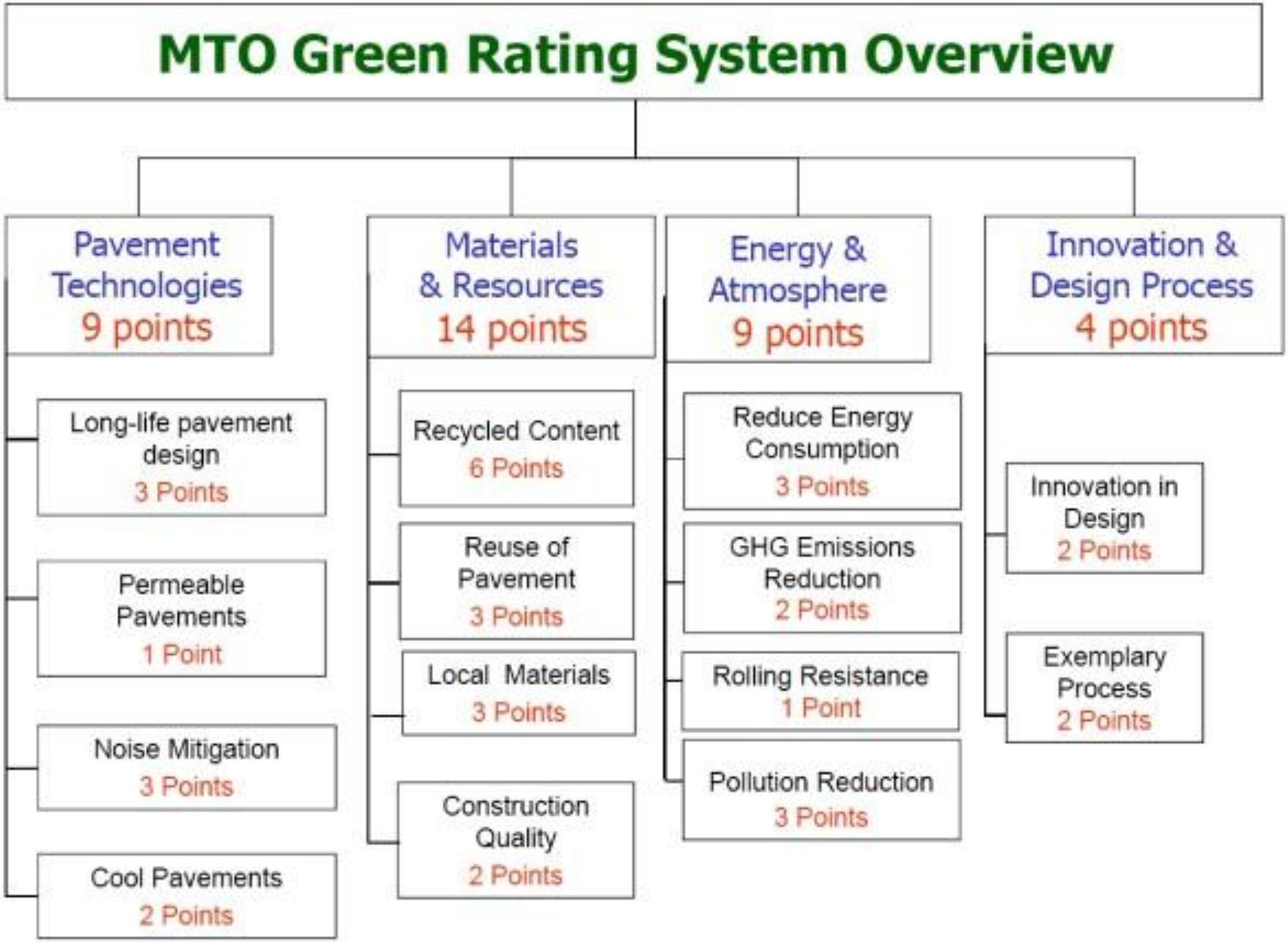
- **Point-based system**
- **Focus on Pavement Preservation strategies**
  - Optimizing the use of natural resources
  - Reducing energy consumption
  - Reducing GHG emissions
  - Limiting pollution
  - Improving health, safety and risk prevention
  - Ensuring a high level of user comfort and safety
- **Utilizes LCA and LCCA approach**
  - PaLATE software

Bronze 7-10 points
Silver 11-14 points
Gold 15-19 points
Trillium 20-35 points

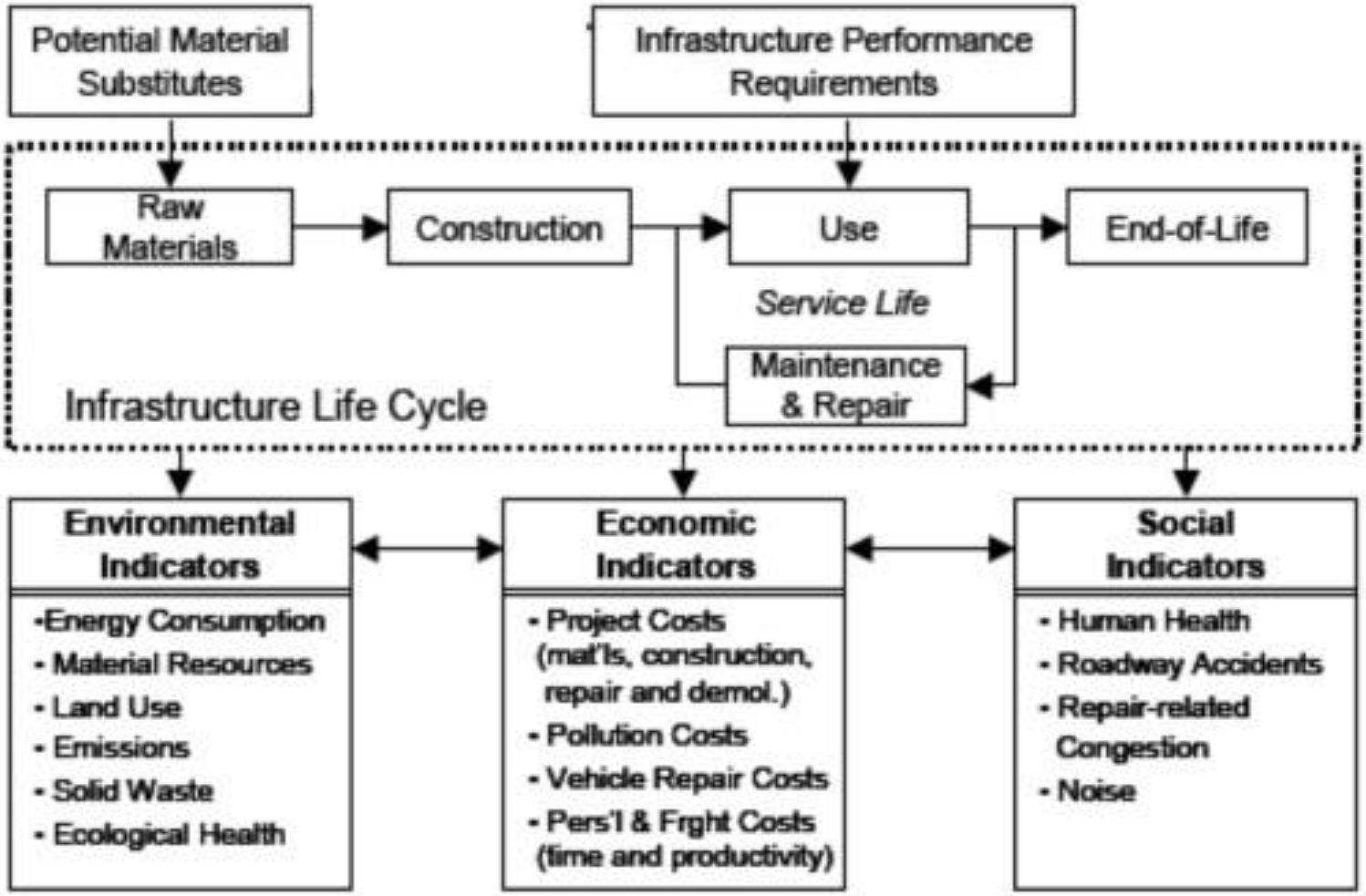
Ministry of Transportation Ontario

Category	Goal	Points
Pavement Design Technologies	To optimize sustainable designs. These include long life pavements, permeable pavements, noise mitigating pavements, and pavements that minimize the heat island effect.	9
Materials & Resources	To optimize the usage/reusage of recycled materials and to minimize material transportation distances.	14
Energy & Atmosphere	To minimize energy consumption and GHG emissions.	9
Innovation & Design Process	To recognize innovation and exemplary efforts made to foster sustainable pavement designs.	4
	Maximum Total:	**36**

MTO Green Rating System Overview

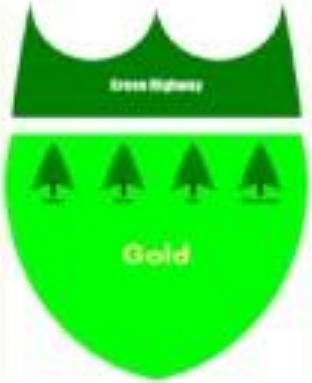


PaLATE for Pavements



BE²ST In-Highways – Building Environmentally and Economically Sustainable Transportation Infrastructure-Highways

- **Weighted System**
  - 3 Options using Analytical Hierarchy Process
- **Prediction of Service Life**
- **Performance Simulation**
  - PaLATE, Real Cost
- **Score Summary and Labeling**

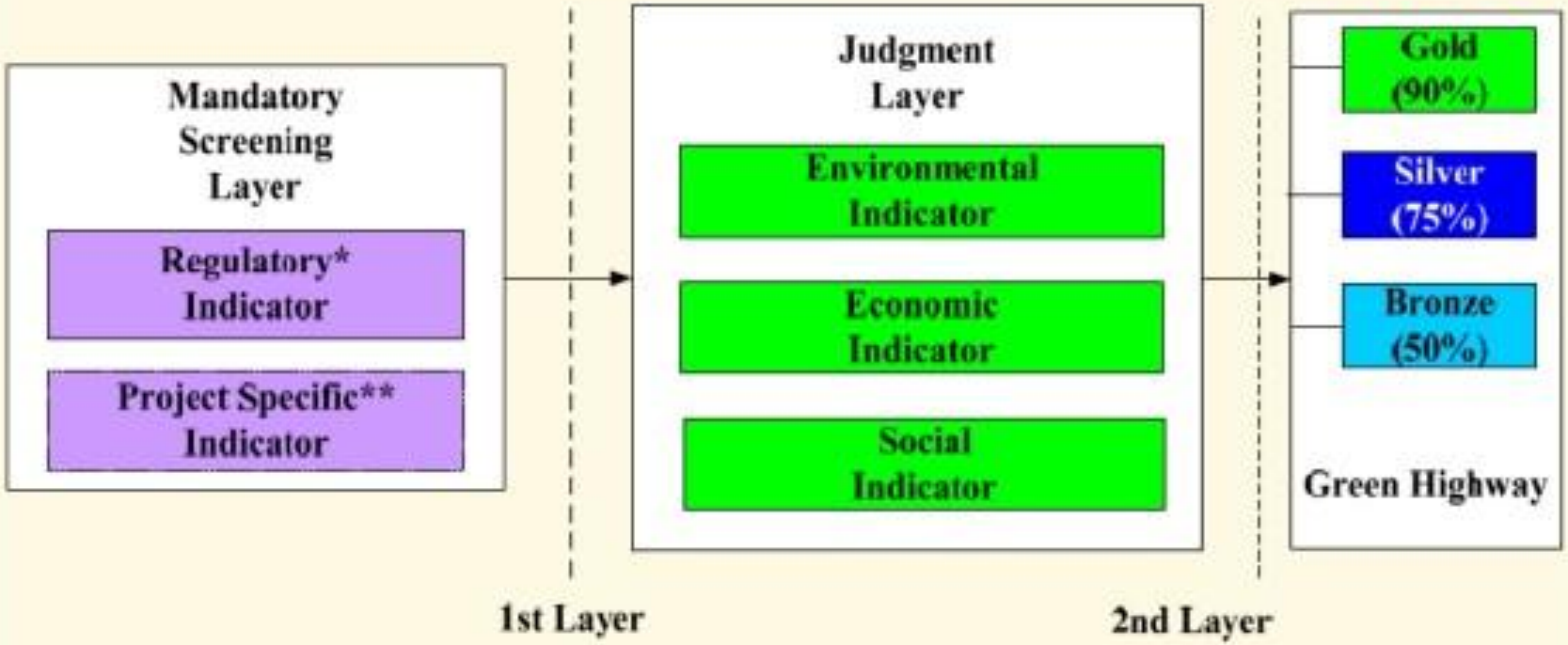


University of Wisconsin at Madison
And Recycled Materials Resource Center

BE²ST In-Highways – Building Environmentally and Economically Sustainable Transportation Infrastructure-Highways

BE²ST In-Highways

Structure of the System



* Laws, local ordinances, and quality requirement

** Preservation of historic site and schedule requirement

BE²ST In-Highways

Judgment layer: Environmental indicator

Main Criteria	Sub-criteria	Target	Intention
Environment	GWP	• 12% reduction (1pt) • 24% (2pts)	Contribute to keeping GWP under the current level
	Energy use	• 5% reduction (1pt) • 10% (2pts)	10% reduction is a practical goal
	Water consumption	• 5% reduction (1pt) • 10% (2pts)	Reduce the waste to landfill
	Recycling content	• More than 10% (1) • More than 20% (2)	Reduce resource mining / waste landfilling
	Hazardous waste	• 5% reduction (1pt) • 10% (2pts)	Hazard free highway construction
Economic	LCCA	• 5% saving (1pt) • 10% saving (2pts)	Rethinking construction (Egan 1998)

Green Guide to Roads – Transportation Association of Canada

Green Guideline is under way with a September 2010 timeline.

- **Self-evaluation performance measurement criteria incorporating sustainable/green principles and environmental stewardship.**
  - *Roadway Planning*
  - *Design*
  - *Innovation and Green Procurement Process*
  - *Construction*
  - *Maintenance and Operation*

Green Guide to Roads – Transportation Association of Canada

Scope and Application Areas

- *Community Interface*
- *Environmental Footprint*
- *Mobility Choices*
- *Intersections and Driveways*
- *Hard Surfaces*
- *Landscaping*
- *Street Furnishings*
- *Drainage*
- *Safety*
- *Energy Consumption*
- *Construction*
- *Operations and Maintenance*

Performance Measurement/Evaluation Methodologies

STARS – Sustainable Transportation & Access Rating System

- Voluntary Program
- Point-based rating system and planning tool with a "menu" in 6 credit categories
- Based on full life cycle analysis
- Independently verifiable
- Focused on Transportation
  - Projects
  - Employer programs
  - Plans
- Under development

Credit Categories

- Access
- Climate and Energy
- Ecological Function
- Benefit/Cost
- Innovation

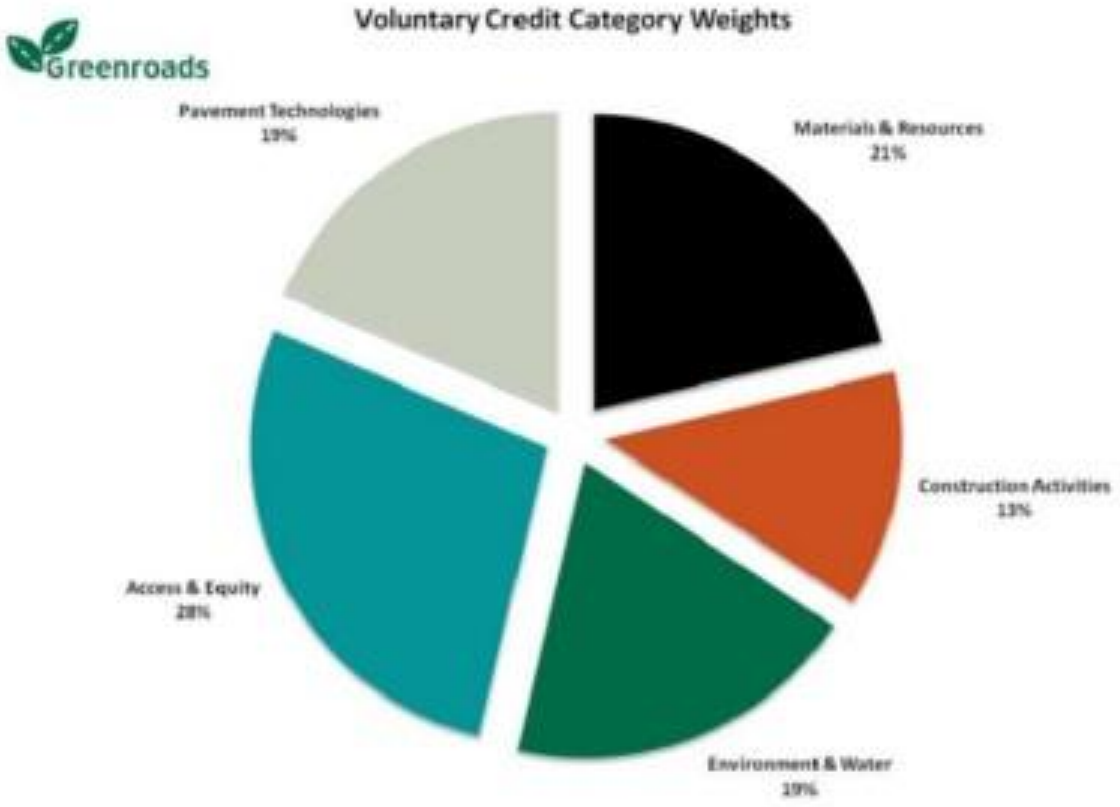
Evaluates five strategies:

- Transportation Demand Management
- Transportation Systems Management
- Transit
- Land Use
- New Construction

STARS – Sample Project Scorecard

STARS Project Version 0.6					
Project Name: _____					
Contact: _____					
Yes	?	No			
			Project Totals		
			One Star _-_ points, Two Star _-_ points, Three Star _-_ points, Four Star _-_ points		
Yes	?	No			
			Integrative Process		Project Phase(s)
			IP 1	Comprehensive Poject Goals & Objectives (purpose & need)	Planning
			IP 2	Multi-Discipline Project Team	All
			IP 3	Public Stakeholder Engagement	All
Yes	?	No			
			Access		
Required			A 1	Establish Mode Split Goal	Purpose & Need
			A 2	Evaluate Expanded TDM Strategies	Alternatives Analysis
			A 3	Evaluate Expanded TSM Strategies	" "
			A 4	Evaluate Expanded Transportation Options	" "
			A 5	Evaluate Expanded Land Use Strategies	" "
			A 6	Implement Expanded Options, TDM, TSM and Land Use Strategies	Design, Implementation
			A 7	Access Performance	Operation

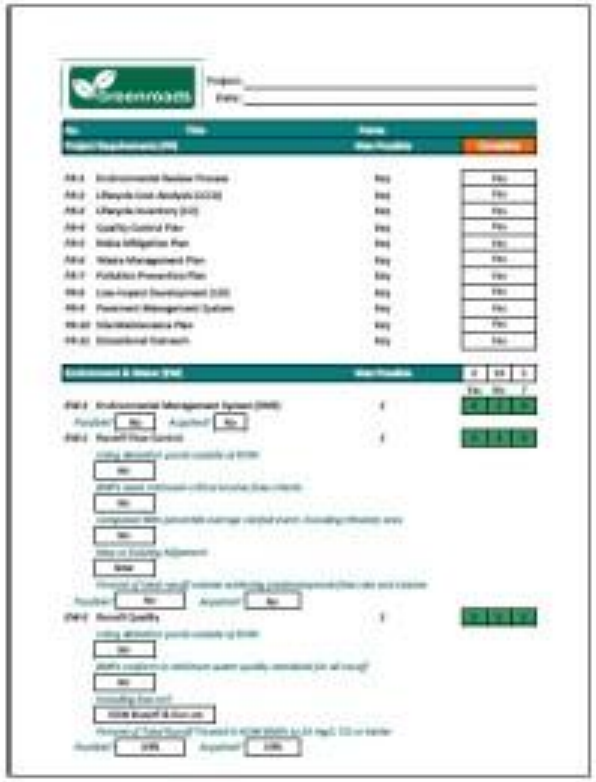
Greenroads



- Voluntary
- Point Based System
  - 11 Project Requirements
  - 37 Voluntary Credits – Weighted
    - Environment and Water
    - Access and Equity
    - Construction Activities
    - Materials & Resources
    - Pavement Technologies
  - Custom Credits
    - 118 Total Points

University of Washington
And CH2MHill

Greenroads



Certification Levels

Certified

- All Project Requirements + 32-42 Voluntary Credit points (30-40% of total)

Silver

- All Project Requirements + 43-53 Voluntary Credit points (40-50% of total)

Gold

- All Project Requirements + 54-63 Voluntary Credit points (50-60% of total)

Evergreen

- All Project Requirements + 64+ Voluntary Credit points (>60% of total)

GreenLITES – Leadership in Transportation and Environmental Sustainability (NYSDOT)

- Self-certification Program
- Point-based System
  - 175 Sustainable item in 5 categories
- Categories:
  - Sustainable Sites
  - Water Quality
  - Materials and Resources
  - Energy & Atmosphere
  - Innovation/Unlisted

Green Guide to Roads -

- Voluntary
- Point Based System modeled after LEED – 100 Points
- Seven categories approach the four different phases of a roadway including
  - Planning
  - Design
  - Construction
  - Operation
- Award criteria similar to LEED
  - Certified 40% or more of the credits
  - Silver 50% or more
  - Gold 60% of more
  - Platinum 80% or more

Worcester Polytechnic Institute
And Stantec Consulting Ltd.

Green Guide to Roads -

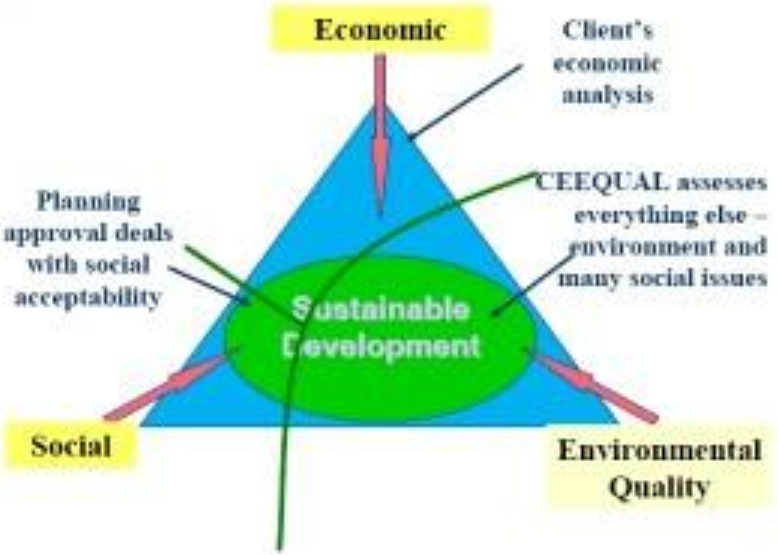
Categories

- Mobility for All
- Transportation Planning
- Energy and Atmosphere
- Materials and Resources
- Environmental Impacts
- Community Impacts
- Innovation and Design

Materials and Resources			
MR Prerequisite 1: Lifecycle Costing	Required		
MR Credit 1: Construction Site Footprint	2	2	2
MR Credit 2: Construction Waste Management	3	2	3
MR Credit 3: Recycled Content	1 to 8	1	5
MR Credit 4: Long Life Pavements	4	0	2
Totals	17	5	12
Environmental Impacts			
EI Prerequisite 1: Construction Activity Pollution Prevention	Required	X	X
EI Credit 1: Stormwater Management Life-Cycle Costing	2	0	2
EI Credit 2: Stormwater Management	1 to 4	0	2
EI Credit 3: LID Stormwater Management	1 to 4	0	2
EI Credit 4: Water Efficient Landscaping	1 to 2	2	2
EI Credit 5: Reflective Pavement	3	0	0
Totals	15	2	8
Community Impacts			
CI Prerequisite 1: Community Outreach and Involvement	Required	?	X
CI Prerequisite 2: Noise Mitigation Plan	Required	X	X
CI Credit 1: Traffic Noise Reduction	3	0	2
CI Credit 2: Light Pollution Reduction	3	0	3
CI Credit 3: Visual Elements	3	0	1
Totals	9	0	6
Innovation and Design Process			
ID Credit 1: Innovation & Design Process	1 to 3	0	0
ID Credit 2: Exemplary Performance	1 to 5	0	1
Totals	8	0	1
	100		
	Score	29	68

CEEQUAL – The Civil Engineering Environmental Quality Assessment and Awards Scheme

- Incentive to apply best environmental practices
- Applicable to all types and sizes of civil engineering projects
- A point-based assessment scheme for the environmental quality of civil engineering projects
- Assesses *what* is built and *how* it is built
- Scoping, Assessment, Verification and Ratification
- Voluntary Award
- Not a competitive scheme, but an achievement scheme



CEEQUAL – The Civil Engineering Environmental Quality Assessment and Awards Scheme

12 Weighted Schemes

- Project Management, 10.9%
- Land Use, 7.9%
- Energy and Carbon, 9.5%
- Landscape, 7.4%
- Material Use, 9.4%
- The Historic Environment, 6.7%
- Ecology & Biodiversity, 8.8%
- Effects on Neighbors, 7.0%
- Water Resources and the Water Environment, 8.5%
- Transport, 8.1%
- Waste Management, 8.4%
- Relations with the Local Community and Other Stakeholders, 7.4%

Award Grades

Pass ≥ 25%

Good ≥ 40%

Very Good ≥ 60%

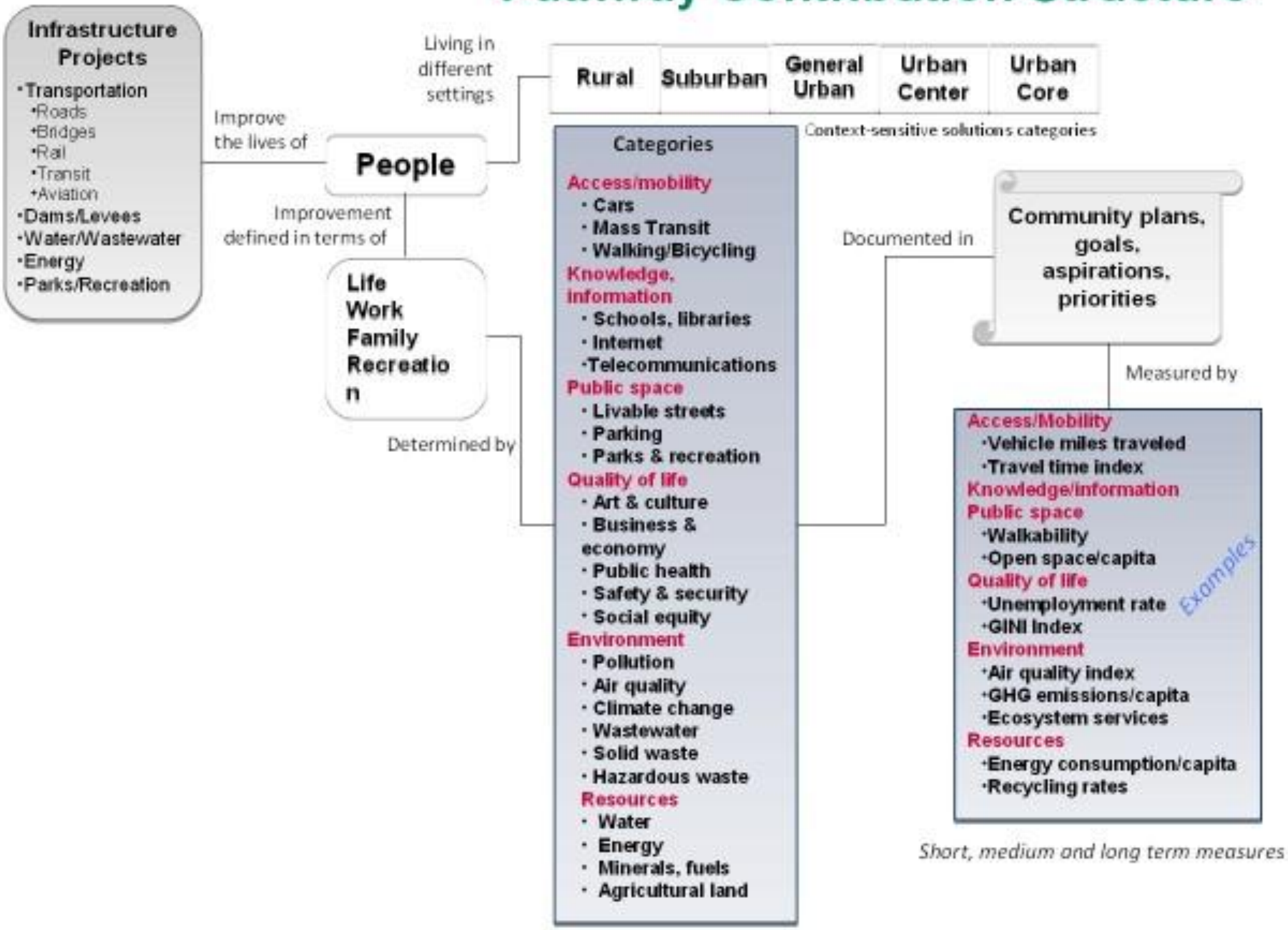
Excellent ≥ 75%

ASCE System Framework

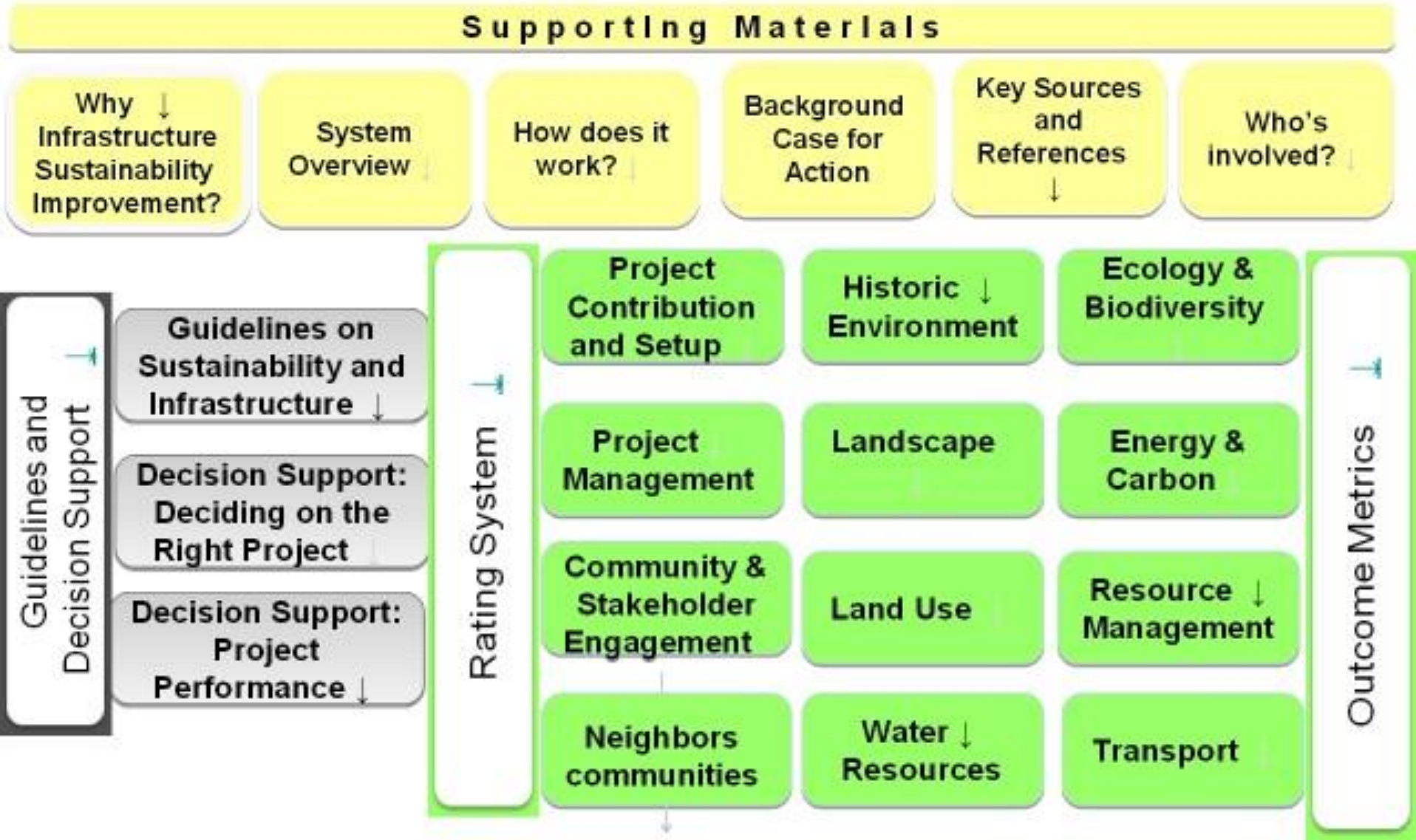
- Guidance, Decision support and Rating
- 12 Sections

- Each has targeted assessment questions arranged in sub-sections

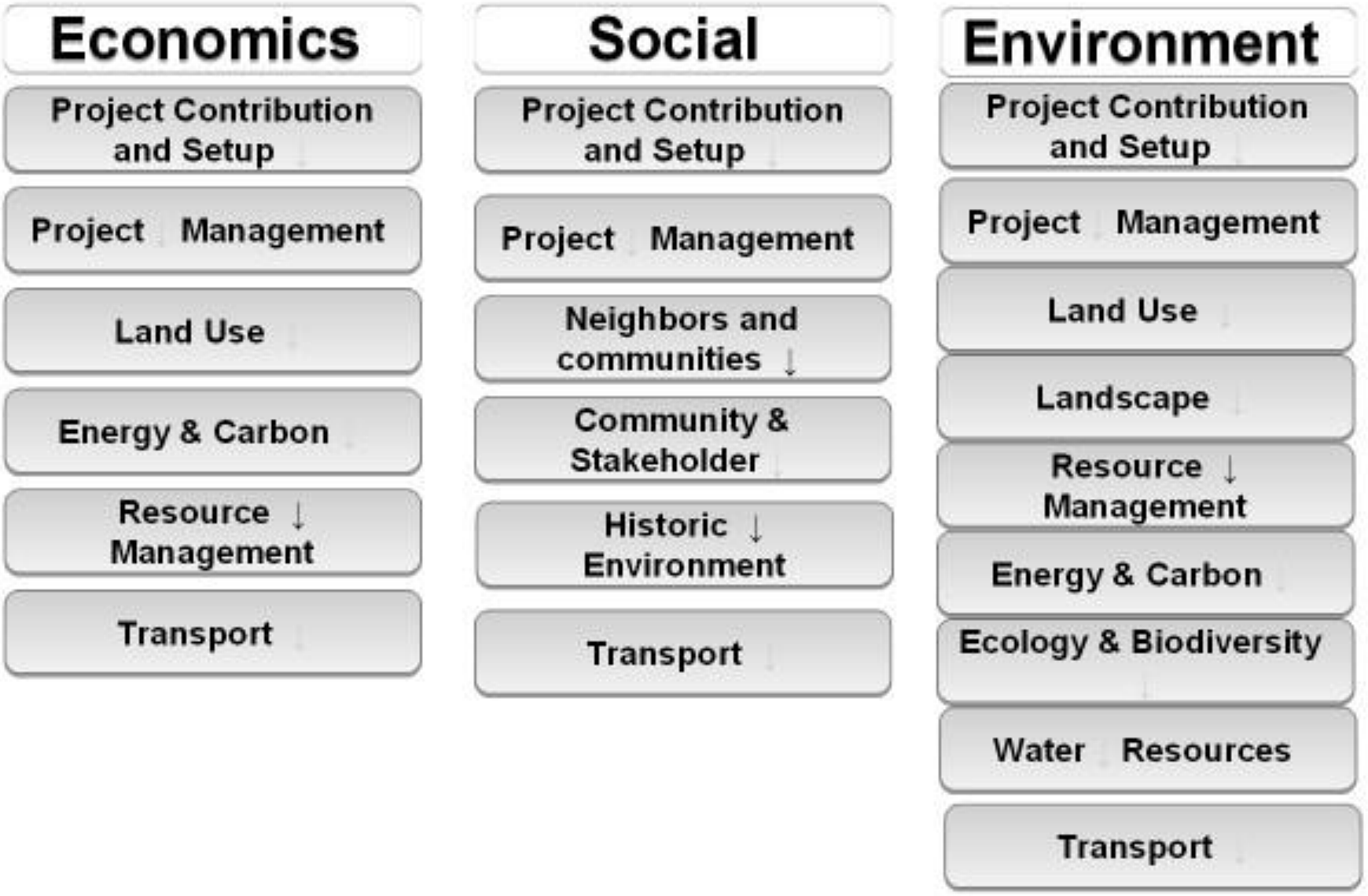
Pathway Contribution Structure



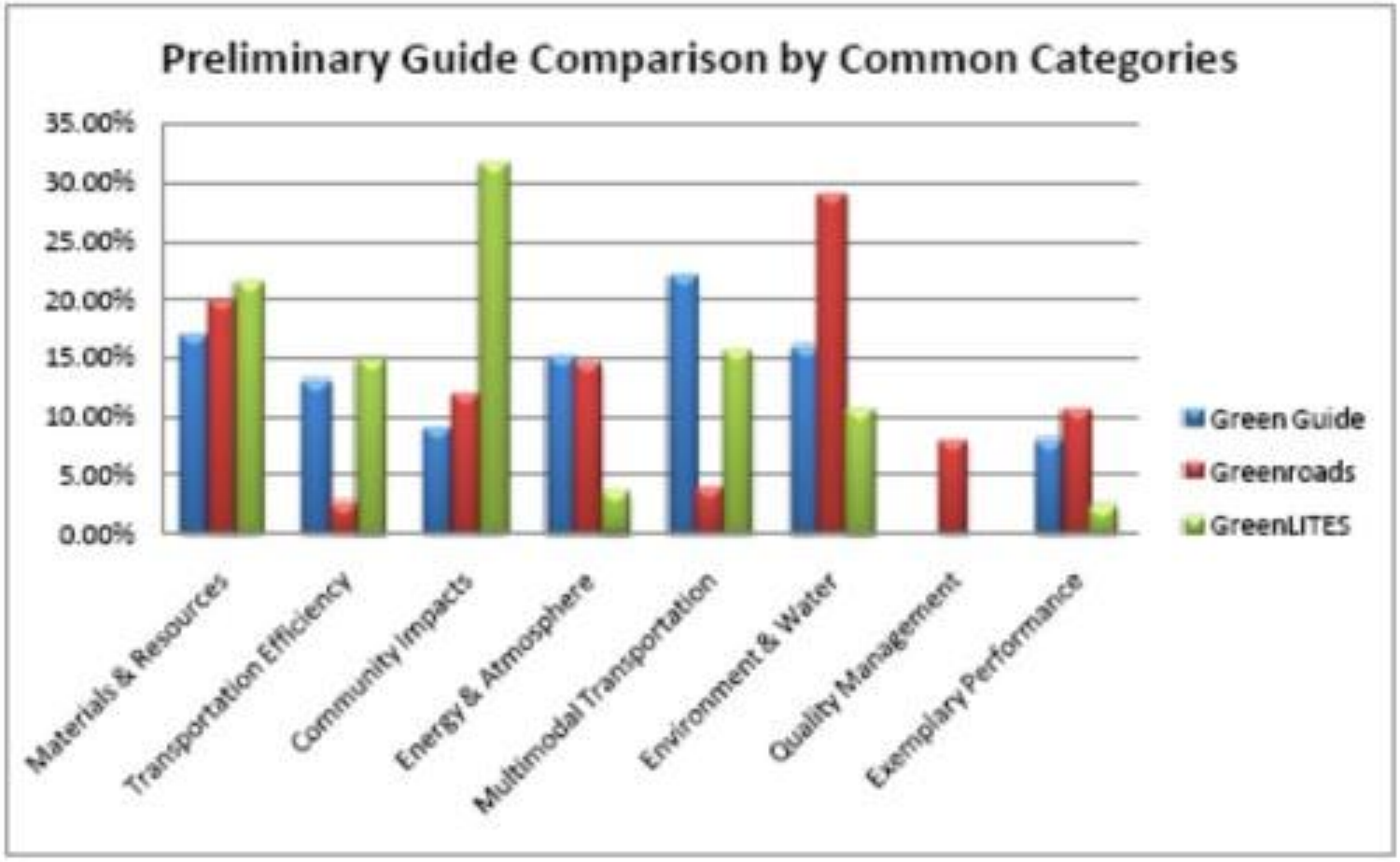
ASCE Sustainability Rating System: Guidelines, Rating and Improvement (Rollout October 2010)



Rating System Triple Bottom Line



Conclusions



Sustainable Transportation Systems are very similar.

Conclusions

Sustainable transportation planning raises a number of issues regarding the definition of sustainability and sustainable transportation, how goals and objectives are defined, evaluated, and the type of decision-making process that should be used.

Sustainability requires more comprehensive and integrated planning, which accounts for a broad set of economic, social and environmental impacts, including those that are difficult to measure.

Sustainability planning requires adequate stakeholder involvement to allow diverse perspectives and preferences to be incorporated.

Conclusions

Sustainability tends to support transportation planning and market reforms that result in more diverse and economically efficient transportation systems, and more compact land use patterns that reduce automobile dependencies.

These reforms help increase economic efficiency, reduce resource consumption and harmful environmental impacts, and improve mobility for non-drivers.

Questions and Discussion

LAFARGE
NORTH AMERICA

CEMENT