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

Julie Buffenbarger, LEED AP, Lafarge
Northeast and Mid-Atlantic States In-Place Recycling Conference
August 24, 2010
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 1,200 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

The Future
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

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

**Economic**
- Accessibility - Commuting
- Accessibility - Land Use Mix
- Accessibility - Smart Growth
- Transport Diversity
- Affordability
- Facility Costs
- Freight Efficiency
- Planning

**Social**
- Safety
- Health and Fitness
- Community Liveability
- Equity - Fairness
- Equity - Non-drivers
- Equity - Disabilities
- Non-motorized Transport Planning
- Citizen Involvement

**Environmental**
- Climate Change Emissions
- Other Air Pollution
- Noise Pollution
- Water Pollution
- Land Use Impacts
- Habitat Protection
- Resource Efficiency
Sustainable Transportation Initiatives

- 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

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>ID</th>
<th>DESCRIPTION</th>
<th>Available Points</th>
<th>Project Points</th>
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<tbody>
<tr>
<td>P-1</td>
<td>P-1a</td>
<td>Identify stakeholders and develop stakeholder involvement plan</td>
<td>2</td>
<td>0</td>
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<tr>
<td></td>
<td>P-1b</td>
<td>Engage stakeholders to conduct context audit and develop project purpose</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>P-1c</td>
<td>Involve stakeholders to develop and assess alternatives</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>P-1d</td>
<td>Employ stakeholder involvement techniques to achieve consensus for preferred project alternative</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P-2</td>
<td>P-2a</td>
<td>Promote reduction in vehicle trips by accommodating increased use of public transit</td>
<td>2</td>
<td>N/A</td>
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<tr>
<td></td>
<td>P-2b</td>
<td>Accommodate multi-modal transportation uses (e.g., transit riders, pedestrians, and bicyclists)</td>
<td>2</td>
<td>N/A</td>
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<tr>
<td></td>
<td>P-2c</td>
<td>Increase transportation efficiencies for moving freight through features such as dedicated rail or intermodal facilities</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>P-2d</td>
<td>Partnerships that provide environmental or technological enhancements while promoting environmental stewardship</td>
<td>2</td>
<td>0</td>
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<tr>
<td></td>
<td>P-2e</td>
<td>Project is consistent with regional plans and local managed growth-based Master or Comprehensive Plan</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>P-2f</td>
<td>Project is compatible with local efforts for Transit Oriented Design</td>
<td>1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

19 min 9/12x417%
%2 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

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Design Technologies</td>
<td>To optimize sustainable designs. These include long life pavements, permeable pavements, noise mitigating pavements, and pavements that minimize the heat island effect.</td>
<td>9</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>To optimize the usage/reusage of recycled materials and to minimize material transportation distances.</td>
<td>14</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>To minimize energy consumption and GHG emissions.</td>
<td>9</td>
</tr>
<tr>
<td>Innovation &amp; Design Process</td>
<td>To recognize innovation and exemplary efforts made to foster sustainable pavement designs.</td>
<td>4</td>
</tr>
</tbody>
</table>

**Maximum Total:** 36
MTO Green Rating System Overview

1. **Pavement Technologies (9 points)**
   - Long-life pavement design (3 points)
   - Permeable Pavements (1 point)
   - Noise Mitigation (3 points)
   - Cool Pavements (2 points)

2. **Materials & Resources (14 points)**
   - Recycled Content (6 points)
   - Reuse of Pavement (3 points)
   - Local Materials (3 points)
   - Construction Quality (2 points)

3. **Energy & Atmosphere (9 points)**
   - Reduce Energy Consumption (3 points)
   - GHG Emissions Reduction (2 points)
   - Rolling Resistance (1 point)
   - Pollution Reduction (3 points)

4. **Innovation & Design Process (4 points)**
   - Innovation in Design (2 points)
   - Exemplary Process (2 points)
PaLATE for Pavements

Infrastructure Life Cycle

Potential Material Substitutes → Raw Materials → Construction → Use → End-of-Life

Infrastructure Performance Requirements → Use

Environmental Indicators
- Energy Consumption
- Material Resources
- Land Use
- Emissions
- Solid Waste
- Ecological Health

Economic Indicators
- Project Costs (mats', construction, repair and demol.)
- Pollution Costs
- Vehicle Repair Costs
- Pers'1 & Fght Costs (time and productivity)

Social Indicators
- Human Health
- Roadway Accidents
- Repair-related Congestion
- Noise
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

- Life Cycle Cost Benefit
- Mitigate Environmental Burden
- Promote Human Health / Safety

- Energy Use (10% reduction)
- GHG Emission (24% reduction)
- Human Health / Safety (10% less hazardous waste)
- Life Cycle Cost (10% reduction)
- Material Reuse/Recycling (20% of CWD)
- Water consumption / Noise Production (10% reduction)

Green Highway
**BE²ST In-Highways**

**Structure of the System**

**1st Layer**
- Mandatory Screening Layer
  - Regulatory Indicator
  - Project Specific Indicator

**2nd Layer**
- Judgment Layer
  - Environmental Indicator
  - Economic Indicator
  - Social Indicator

- Green Highway
  - Gold (90%)
  - Silver (75%)
  - Bronze (50%)

* Laws, local ordinances, and quality requirement
** Preservation of historic site and schedule requirement
### BE²ST In-Highways

#### Judgment layer: Environmental indicator

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

<table>
<thead>
<tr>
<th>STAR Project Version 0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Name:</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Contact:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yes ? No</th>
<th>Project Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One Star __ points, Two Star __ points, Three Star __ points, Four Star __ points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yes ? No</th>
<th>Integrative Process</th>
<th>Project Phase(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP 1: Comprehensive Project Goals &amp; Objectives (purpose &amp; need)</td>
<td>Planning</td>
</tr>
<tr>
<td></td>
<td>IP 2: Multi-Discipline Project Team</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>IP 3: Public Stakeholder Engagement</td>
<td>All</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yes ? No</th>
<th>Access</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 1: Establish Mode Split Goal</td>
<td>Purpose &amp; Need</td>
</tr>
<tr>
<td></td>
<td>A 2: Evaluate Expanded TDM Strategies</td>
<td>Alternatives Analysis</td>
</tr>
<tr>
<td></td>
<td>A 3: Evaluate Expanded TSM Strategies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 4: Evaluate Expanded Transportation Options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 5: Evaluate Expanded Land Use Strategies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 6: Implement Expanded Options, TDM, TSM and Land Use Strategies</td>
<td>Design, Implementation</td>
</tr>
<tr>
<td></td>
<td>A 7: Access Performance</td>
<td>Operation</td>
</tr>
</tbody>
</table>

![STARS Rating](image)
• 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 CH2M Hill
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

![GreenLITES Certifications](image-url)
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

<table>
<thead>
<tr>
<th>Materials and Resources</th>
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<tbody>
<tr>
<td>MR Prerequisite 1: Lifecycle Costing</td>
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<tr>
<td>MR Credit 1: Construction Site Footprint</td>
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<td>MR Credit 2: Construction Waste Management</td>
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<td>MR Credit 3: Recycled Content</td>
<td>1-8</td>
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<tr>
<td>MR Credit 4: Long Life Pavements</td>
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<td>Totals</td>
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<table>
<thead>
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<tbody>
<tr>
<td>EI Prerequisite 1: Construction Activity Pollution Prevention</td>
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<td>EI Credit 1: Stormwater Management Life-Cycle Costing</td>
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<td>EI Credit 2: Stormwater Management</td>
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<tr>
<td>EI Credit 3: LID Stormwater Management</td>
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<tr>
<td>EI Credit 4: Water Efficient Landscaping</td>
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<td>EI Credit 5: Reflective Pavement</td>
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<td>Totals</td>
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<table>
<thead>
<tr>
<th>Community Impacts</th>
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<tbody>
<tr>
<td>CI Prerequisite 1: Community Outreach and Involvement</td>
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<tr>
<td>CI Prerequisite 2: Noise Mitigation Plan</td>
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<tr>
<td>CI Credit 1: Traffic Noise Reduction</td>
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<td>CI Credit 2: Light Pollution Reduction</td>
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<td>CI Credit 3: Visual Elements</td>
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<table>
<thead>
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<tbody>
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</tr>
<tr>
<td>ID Credit 2: Exemplary Performance</td>
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</tr>
<tr>
<td>Totals</td>
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</tbody>
</table>

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 $\geq 25\%$
- Good $\geq 40\%$
- Very Good $\geq 60\%$
- Excellent $\geq 75\%$
ASCE System Framework

- Guidance, Decision support and Rating
- 12 Sections

- Project Contribution and Setup
- Neighbors communities
- Land Use
- Energy & Carbon
- Project Management
- Historic Environment
- Water Resources
- Resource Management
- Community Stakeholder
- Landscape
- Ecology & Biodiversity
- Transport

- Each has targeted assessment questions arranged in sub-sections
Pathway Contribution Structure

Infrastructure Projects
- Transportation
  - Roads
  - Bridges
  - Rail
  - Transit
  - Aviation
- Dams/Levees
- Water/Wastewater
- Energy
- Parks/Recreation

People
- Life
- Work
- Family
- Recreation

Living in different settings

People

Categories
- Access/mobility
  - Cars
  - Mass Transit
  - Walking/Bicycling
- Knowledge, information
  - Schools, libraries
  - Internet
  - Telecommunications
- Public space
  - Livable streets
  - Parking
  - Parks & recreation
- Quality of life
  - Art & culture
  - Business & economy
  - Public health
  - Safety & security
  - Social equity
- Environment
  - Pollution
  - Air quality
  - Climate change
  - Wastewater
  - Solid waste
  - Hazardous waste
- Resources
  - Water
  - Energy
  - Minerals, fuels
  - Agricultural land

Community plans, goals, aspirations, priorities

Context-sensitive solutions categories

Access/Mobility
- Vehicle miles traveled
- Travel time index

Knowledge/Information
- Public space
  - Walkability
  - Open space/capita
- Quality of life
  - Unemployment rate
  - GINI Index

Public space
- Environment
  - Air quality index
  - GHG emissions/capita
  - Ecosystem services

Resources
- Energy consumption/capita
- Recycling rates

Examples

Measured by

Short, medium and long term measures
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