Designing for Sustainability: A Consultant’s Perspective

Timothy A. Bevan, P.E. / CH2M HILL
Presentation Outline

- What is the designer’s perspective on sustainable transportation?
- Why would designers address sustainability?
- Is considering sustainability a good business model?
- What will it mean as we address sustainability?
What is the designer’s perspective on sustainable transportation?

**Sustainable Development:**

*Improving the economic and social quality of human life while limiting our impacts on the environment to the carrying capacity of nature*
What is the designer’s perspective on sustainable transportation?

Sustainable Transportation:

- **Business** – supports economic needs; cost-efficient
- **Nature** – compatible with natural environment; less pollution & use of resources
- **People** – equitable access; mobility choices; asset to the community
What is the designer’s perspective on sustainable transportation?

- **Builds on Context Sensitive Solutions Approach**
  - Effective Decision Making
  - Reflecting Community Values
  - Achieving Environmental Sensitivity
  - Ensuring Safe and Feasible Solutions

- **Two Step Sustainability Framework:**
  - Step 1: Solution to Mobility Need
  - Step 2: Sustainable Infrastructure Options

*Authored by CH2M HILL*
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

Accommodate Needs Without Growth in Mobility Demand

Maximize Efficiency of Existing Transportation Infrastructure

Expand Streets and Highways Infrastructure

Accommodate Mobility Demand Without Expanding Infrastructure

Expand Railroad, Transit, Bicycle & Pedestrian Infrastructure

Examples

- Jobs/housing balance in subareas
- Affordable housing in employment centers
- Promote telecommute programs
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

- Accommodate Needs Without Growth in Mobility Demand
- Maximize Efficiency of Existing Transportation Infrastructure
- Expand Streets and Highways Infrastructure

Accommodate Mobility Demand Without Expanding Infrastructure

Expand Railroad, Transit, Bicycle & Pedestrian Infrastructure

Examples

- Ridesharing programs
- Increased transit service levels
- Bicycle sharing programs
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

Accommodate Needs Without Growth in Mobility Demand

Maximize Efficiency of Existing Transportation Infrastructure

Expand Streets and Highways Infrastructure

Examples

- Incident management & response
- Advanced Traffic Management Systems
- Access Management
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

- Accommodate Needs Without Growth in Mobility Demand
- Maximize Efficiency of Existing Transportation Infrastructure
- Expand Streets and Highways Infrastructure

Expand Railroad, Transit, Bicycle & Pedestrian Infrastructure

Examples

- Bikeways
- HOV/busways/BRT
- Light Rail Transit
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

- Accommodate Needs Without Growth in Mobility Demand
- Maximize Efficiency of Existing Transportation Infrastructure
- Expand Streets and Highways Infrastructure

Examples

- Streets and roadways
- Limited access highways/freeways
- Highway grade separations
Two Step Sustainability Framework

Step 1: Solution to Mobility Need

- Accommodate Needs Without Growth in Mobility Demand
- Maximize Efficiency of Existing Transportation Infrastructure
- Expand Streets and Highways Infrastructure

Implementation Time

Environmental Impacts

Capital Cost

Institutional Requirements
### Sustainable Urban Streets Options

#### Five Comprehensive Objectives

1. **Reduce Energy Consumption**
2. **Reduce Consumption of Material Resources**
3. **Reduce Impacts to Environmental Resources**
4. **Support Healthy Urban Communities**
5. **Support Sustainability During Implementation**
Sustainable Urban Streets Options

First Comprehensive Objective

Reduce Energy Consumption

- Support non-motorized travel
- Support energy efficient movement of people and goods
- Use resources with lower operations and maintenance requirements
Reduce Consumption of Material Resources

Use recycled materials in construction

Require less infrastructure in solution

Increase durability and life of design solution

Sustainable Urban Streets Options
Second Comprehensive Objective
Reduce Impacts to Environmental Resources

Minimize impact on natural environment

Encourage and support biodiversity

Reflect historical and cultural context

Sustainable Urban Streets Options

Third Comprehensive Objective
Supports Healthy Urban Communities

I. Incorporate features that support community and livability
II. Incorporate features that support public services and adjacent land uses
III. Incorporate features that enhance public health, safety and security

Sustainable Urban Streets Options

Fourth Comprehensive Objective
### Support Sustainability During Implementation

#### Support local economic, social and resource management needs during construction

- Reduce environmental and community impacts during construction

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### Sustainable Urban Streets Options

#### Fifth Comprehensive Objective
Reduce Energy Consumption

Use resources with lower operations and maintenance requirements

Example Options

- Water-appropriate plantings
- Low maintenance pavements
- Low maintenance plantings

Low energy lighting

- Solar power photovoltaic energy sources
- Reuse of stormwater for irrigation
- Mulch planting areas
- Digital Sign Inventory with Geographic Positioning Systems (GPS)
- Digital Tree Inventory with GPS (to track maintenance, health, etc.)
## Reduce Consumption of Material Resources

### Use recycled materials in construction

#### Example Options

- **Recycled base course**
- **Recycled asphalt**
- Recycled aggregates
- Recycled pavers
- Recycled material in sign posts
- Recycled material for sign panels
- Recycled material for luminare poles
- Recycled material for street furniture
- Recycled material for bollards
- Recycled material for utility trench backfill
- Recycled utility covers
- Incorporation of recycled vegetative material
- Recycled material in sound attenuation walls
- Recycled rubber for sidewalks

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**Cold In Place Recycling, Eastern Washington, U.S.A.**

**In-Place Concrete Recycling**

[Image of recycling trucks and construction site]

[Image of a road and a recycling truck]

[Image of a sign post and a recycling bin]

[Image of a rubber mat and a recycling bin]

[Image of a sign panel and a recycling bin]

[Image of a paver and a recycling bin]

[Image of a recycled material in a sign post and a recycling bin]
## Reduce Impacts to Environmental Resources

### Minimize impact on natural environment

#### Example Options

<table>
<thead>
<tr>
<th>Storm water infiltration basins in planters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain gardens for storm water infiltration</td>
</tr>
<tr>
<td>Porous pavement for traffic lanes</td>
</tr>
</tbody>
</table>

#### Porous pavement in parking areas

<table>
<thead>
<tr>
<th>Porous sidewalk pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm water treatment vaults</td>
</tr>
<tr>
<td>Reuse of storm water for irrigation</td>
</tr>
<tr>
<td>Planted/pervious strips</td>
</tr>
<tr>
<td>Planted/pervious medians</td>
</tr>
<tr>
<td>Tree retention</td>
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<tr>
<td>Tree pit enhancement</td>
</tr>
</tbody>
</table>

#### Natural drainage systems

| Bioengineered planting strips |
| Interconnected bioretention swales |
| Soil amendments to reduce use of fertilizer |
Pedestrian Refuges, New York, New York, U.S.A.

Supports Healthy Urban Communities

Incorporate features that enhance public health, safety and security

Example Options

**Signalized pedestrian crossings**

**Pedestrian refuges in medians**
- Sidewalk bollards to separate or illuminate potential conflict locations
- Open visibility to sites and public spaces

**Curbed medians at high traffic conflict locations**
- Continuous curbed medians to control or focus left turning traffic
- Driveway reduction or consolidation to minimize traffic/bicycle/pedestrian safety conflicts
- Directional left-turn pockets

**Signal protected turns**

**Illumination of traffic/bicycle/pedestrian conflict areas**

**Surveillance cameras for increased security and/or emergency response**
Business Access During Construction, SeaTac, Washington, U.S.A.

<table>
<thead>
<tr>
<th>Sustainable Urban Street Options</th>
<th>Reduce Energy Consumption</th>
<th>Reduce Consumption of Natural Resources</th>
<th>Reduce Impacts to Environmental Resources</th>
<th>Supports Healthy Urban Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize impacts</td>
<td>Use recycled materials in construction</td>
<td>Minimize overall cost of construction</td>
<td>Minimize impacts on natural environment</td>
<td>Incorporate features that support public safety and health</td>
</tr>
<tr>
<td>Example Options</td>
<td>Minimization of traffic interruptions, including detours</td>
<td>Driveways for access to affected businesses</td>
<td>Noise reduction (quieter equipment, reduced working hours)</td>
<td>Erosion and sedimentation control</td>
</tr>
<tr>
<td></td>
<td>Safe pedestrian access during construction</td>
<td>Encourage carpooling &amp; transit use by construction workers</td>
<td>Maintain and service utility systems</td>
<td>Clean up of existing hazardous materials</td>
</tr>
<tr>
<td></td>
<td>Reduce air emissions through restrictions on idling, use of low sulfur fuels, etc.</td>
<td>Support business continuity</td>
<td>Minimize construction “footprint”</td>
<td>Off-site construction worker parking</td>
</tr>
</tbody>
</table>

Support Sustainability During Implementation

Reduce environmental and community impacts during construction

Example Options

- Minimization of traffic interruptions, including detours
- Driveways for access to affected businesses
- Noise reduction (quieter equipment, reduced working hours)
- Erosion and sedimentation control
- Maintenance of utility services
- Safe pedestrian access during construction
- Encourage carpooling & transit use by construction workers
- Clean up of existing hazardous materials
- Minimize construction “footprint”
- Off-site construction worker parking
Why would designers address Sustainability?

- Sustainability is a key issue for the public & stakeholders
  - Climate change, energy, water
- In response, government clients are enacting policy and legislation

“In 1995, only 15 local governments in the United States were engaged in climate change protection activities, by 2006, that number had grown to 200 cities, representing 66 million people.”

– Pew Center on Global Climate Change
Why would designers address Sustainability?

- Sustainability is a key issue for clients
  - To fulfill their missions and goals
  - To address stakeholder pressures

“In 2006, 41 US cities had implemented sustainability policies and/or programs, including New York, Seattle, Portland, Chicago, and Austin.”

– Kent E. Portney, Tufts University
Why would designers address Sustainability?

- Respond to Regulations / Policies

Ecology Embankments

- WSDOT’s highway runoff treatment BMP
- No stormwater vault or detention pond needed
- Reduce Right of Way need

Ecology Embankment, Redmond, WA, U.S.A.
Why would designers address Sustainability?

Industry Recognition for Sustainable Projects

“Our strategy is to infuse CH2M HILL with the sustainability-inspired principles, knowledge, technologies, tools, and methods that will lead to better management of our company and better long-term solutions for our clients.”

- Ralph Peterson, CH2M HILL CEO

2007 Globe Award for Environmental Excellence Shoreline, WA, U.S.A.
Is Considering Sustainability a Good Business Model?

- New business opportunities

- Toyota
- Patagonia
- Whole Foods Market
- Chipotle
- Herman Miller
- Google
Is Considering Sustainability a Good Business Model?

- New business opportunities

<table>
<thead>
<tr>
<th>1990</th>
<th>2000</th>
<th>2008</th>
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</thead>
<tbody>
<tr>
<td>Travel Demand Management</td>
<td>Traffic Safety</td>
<td>Decision Analysis</td>
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<tr>
<td>Transit</td>
<td>Context Sensitive Solutions</td>
<td>Program Management / GEC</td>
</tr>
<tr>
<td>APD / Design/Build</td>
<td>Sustainable Transportation Solutions</td>
<td></td>
</tr>
</tbody>
</table>

New Transportation Market Opportunities
Is Considering Sustainability a Good Business Model?

- Enables market differentiation
  - **Strategic** - response to global trends
  - **Innovative** - break away from traditional solutions
  - **Effective** - over the long term
  - **Beneficial** - to people, business, and nature
Is Considering Sustainability a Good Business Model?

- Benefit and Value-added service to customers yields follow-on business

Porous Concrete Sidewalks

- Reduce need for Right of Way
- Natural drainage – no vault or detention pond
- Green Material – made of recycled material and can be recycled
- Pedestrian facility
What will it mean as we address Sustainability?

Evaluating cost-effectiveness & life-cycle cost savings

<table>
<thead>
<tr>
<th>Annual Operating and Maintenance Costs</th>
<th>Incandescent</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption (kWh)</td>
<td>1,997,438</td>
<td>182,010</td>
</tr>
<tr>
<td>Energy Cost ($)</td>
<td>$165,622</td>
<td>$15,092</td>
</tr>
<tr>
<td>Tariff Costs ($)</td>
<td>$44,848</td>
<td>$43,381</td>
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<tr>
<td>Scheduled Maintenance</td>
<td>$51,169</td>
<td>$49,685</td>
</tr>
<tr>
<td>Emergency Maintenance</td>
<td>$4,120</td>
<td>$0</td>
</tr>
<tr>
<td>Total Annual O&amp;M Costs</td>
<td>$265,759</td>
<td>$108,157</td>
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<table>
<thead>
<tr>
<th>Life Cycle Costs</th>
<th>Incandescent</th>
<th>LED</th>
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</thead>
<tbody>
<tr>
<td>Operating Costs</td>
<td>$2,104,698</td>
<td>$584,723</td>
</tr>
<tr>
<td>Maintenance Costs</td>
<td>$552,890</td>
<td>$496,849</td>
</tr>
<tr>
<td>Installation Costs</td>
<td>$0</td>
<td>$621,061</td>
</tr>
<tr>
<td>Total Life Cycle Costs</td>
<td>$2,657,588</td>
<td>$1,081,582</td>
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</table>

<table>
<thead>
<tr>
<th>Primary Savings</th>
<th>Per Year</th>
<th>Life Cycle</th>
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<tbody>
<tr>
<td>Energy Savings (kWh)</td>
<td>$1,815,428</td>
<td>18,154,277</td>
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<tr>
<td>Energy Cost Savings</td>
<td>$151,997</td>
<td>1,519,975</td>
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<tr>
<td>Maintenance Savings</td>
<td>$18,025</td>
<td>180,253</td>
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<tr>
<td>Total Savings</td>
<td>$170,023</td>
<td>1,700,228</td>
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</tbody>
</table>

Financial Results
- Installation Costs: $621,061
- Simple Payback (yrs.): 3.0
- Return on Investment - ROI: 25%
- Net Present Value - NPV: $415,201
- Internal Rate of Return - IRR: 29%
What will it mean as we address Sustainability?

Allowing flexibility to fit customer and context

<table>
<thead>
<tr>
<th>Solution to Mobility Need</th>
<th>Sustainable Urban Street Options</th>
<th>Support Sustainability Goals</th>
<th>Related Projects &amp; Innovations</th>
<th>Expected Benefits &amp; Outcomes</th>
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<tbody>
<tr>
<td>Accommodate Needs Without Capacity Expansion</td>
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<tr>
<td>Shift to Higher Mode of Transportation</td>
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<td>Promote Telecommute Programs</td>
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<td>Affordable Housing in Employment Centers</td>
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<td>Tandem Taxis</td>
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<td>Competition in Pricing</td>
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<td>Roadway Tolls</td>
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<td>Lane Use Controls Along Traffic Cones</td>
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<td>Move Freight During Off-Peak Periods</td>
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<td>Peak Period Pricing</td>
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<td>Parking Revenues</td>
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<td>Locally Preferred Pedestrian Routes</td>
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What will it mean as we address Sustainability?

- Additional research and development effort
What will it mean as we address Sustainability?

Demonstration Project – SR 520

Tire/Pavement Noise Sound Intensity
(SR 520 Eastside)

- Less road noise
- Reduces noise at the source
- No noise walls, berms or vegetation required to mitigate noise impacts
- Decreases landfill waste

Quiet Pavement, Bellevue, WA, U.S.A.
Conclusions – Designing for Sustainability

- Global and urban trends drive sustainability
- **Sustainability should be a comprehensive, 2-step approach**
  - Sustainable solutions should include demand management, efficiency, and supply elements
  - Sustainable infrastructure options provide another level for addressing sustainability
- **Sustainability is a great business opportunity for our industry**

*Sustainable Solutions - It’s the right thing to do!*
Questions?

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http://www.ch2m.com/corporate/services/sustainable_solutions/