LEDS Global Partnership

Clean Transport Development Webinar Series

Development Impact Assessments for Transportation

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www.LEDSGP.org
• Introduction to Development Impact Assessments (DIA) for transportation projects
• Impacts most commonly assessed
  – Why they are assessed
  – How they are assessed
  – What techniques, guides, and tools are used for assessment
  – Difficulties to assessment
• How to prioritize between impacts
  – Specific goals and initiatives
  – Livability indexes or gross national happiness
  – Monetizing “externalities”
• DIA: a systematic way to make sure that projects and policies contribute towards a country’s development goals.
• Each country has different development goals, but the United Nations’ Millennium Development Goals (right) provide a good insight
• They can be categorized as economic, social, and environmental/health
• Transportation has strong impacts on all of these development categories
Transportation DIA in LEDS Context

- DIA Identifies and evaluates the link between low carbon transport and other development objectives
- Also referred to as co-benefits analysis, but DIA recognizes that some impacts may be negative
- Informs and supports transport decisions and data-driven choices
- Can be applied to projects, policies, or entire transportation systems
- Incorporates new partners that may not otherwise be interested in climate protection
Transportation Projects & Policies to be Assessed

- New access to road or rail systems
- Road expansion to increase capacity
- **Avoid** kilometers travelled
  - Urban development planning
  - Transportation demand management projects
- **Shift** kilometers travelled
  - Non-motorized transport
  - Mass transit
- **Improve** kilometers travelled
  - Fuel economy technologies
  - Alternative fuels

Increases GHG

Reduces GHG
Variety of Development Impacts

• Economic Performance
  – Cost savings for travelers and businesses
  – Trade (gross domestic product)
  – Employment and wages
  – Energy Security (and business security)

• Environment and Public Health
  – GHG emissions
  – Air Pollution (linked to public health)
  – Road safety
  – Exercise increase

• Social Performance
  – Accessibility
  – Community cohesion
  – Equity (socioeconomic, gender, race, disability)
  – Time savings
Assessment Strategy, as Level of Sophistication Increases

- Studies
  - Determines causal relationships to extrapolate from

- Guide
  - A series of steps to help you choose the best way to extrapolate and what data to use

- Tools/Models
  - Asks for specific data, automatically extrapolates from most appropriate studies, calculates and reports end result

- Transportation Demand Model
  - Geographic framework model of entire transportation system, complete with feedback loops, that can incorporate more specific models

- Depends on availability of studies, data, experts, funding, and tools
- Various impacts have more of these resources available than others
- Assessment strategy depends on how many resources are available
- All strategies build on and incorporate each other
Why Assess Economic Impacts?

• Overarching goal of “development”
• “Job Creation” carries much political weight in most countries
• Assessments help compete for private sector investment and development bank funding
• Appeals to portions of population that might not be motivated by environmental, health, or social benefits

Transportation projects and policies can boost the economy through five mechanisms:

1. Reduce business travel and transport costs
2. Reduce personal travel costs (thereby increasing customer’s expendable income)
3. Increase business market reach for suppliers, customers, and workers
4. Improve job access
5. Energy security
• Most money spent on petroleum leaves the local economy (economic loss instead of transfer)
• Reductions achieved through avoiding, shifting, or improving kilometers traveled make businesses more competitive and enable customers to purchase more
• Very quantifiable with numerous calculators and good default assumptions available. . .
<table>
<thead>
<tr>
<th>Model</th>
<th>Audience</th>
<th>Project</th>
<th>Output</th>
<th>Difficulty 1-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Cost Calculator</td>
<td>Vehicle Purchasers</td>
<td>FE improvements and alternative fuels</td>
<td>Cumulative $ spent on owning and operating various vehicles</td>
<td>2</td>
</tr>
<tr>
<td>Fueleconomy.gov Trip Calculator</td>
<td>Vehicle Purchasers</td>
<td>FE improvements and alternative fuels</td>
<td>$ fuel cost for specific trip</td>
<td>1</td>
</tr>
<tr>
<td>Future Automotive Systems Technology Simulator</td>
<td>Fleet Operators, Road designers</td>
<td>Traffic Flow Improvements, PHEVs</td>
<td>fuel savings of specific vehicles on various drive cycles</td>
<td>9</td>
</tr>
<tr>
<td>Vehicle Infrastructure Cash-flow Evaluation (VICE) Model</td>
<td>Fleet Operators</td>
<td>CNG vehicles and refueling station</td>
<td>NPV, ROI, and payback period</td>
<td>5</td>
</tr>
<tr>
<td>Petroleum Reduction Planning (PReP) Tool</td>
<td>Fleet Operators</td>
<td>Alt Fuel, Fuel Econ, Idle and KMT Reduction, Ecodriving</td>
<td>Fuel Cost Savings</td>
<td>2</td>
</tr>
<tr>
<td>Marginal Abatement Cost (MAC) Tool</td>
<td>Companies, Policymakers</td>
<td>FE improvements and alternative fuels</td>
<td>$/ton carbon abated for various projects</td>
<td>?</td>
</tr>
<tr>
<td>APTA Transit Savings Calculator</td>
<td>Commuter</td>
<td>Bus, BRT, or Rail</td>
<td>Annual cost savings</td>
<td>1</td>
</tr>
<tr>
<td>Health Economic Assessment Tool (HEAT)</td>
<td>Commuter, Public Health Official</td>
<td>Bicycling, Walking</td>
<td>Comprehensive (including health) cost comparison between driving, cycling, and walking</td>
<td>?</td>
</tr>
<tr>
<td>Transport Emissions Evaluation Models for Projects (TEEMP)</td>
<td>Regional Planners</td>
<td>BRT and Metro</td>
<td>Annual costs and saving, including health externalities</td>
<td>6</td>
</tr>
<tr>
<td>Tool for Rapid Assessment of City Energy (TRACE)</td>
<td>City Planners</td>
<td>Passenger Transport</td>
<td>Recommendation of most cost-effective efficiency-improving projects</td>
<td>7</td>
</tr>
</tbody>
</table>
• Assesses the changes in sales, gross regional product, employment, and wages associated with transportation projects
• Assessed by “input-output models,” often tied to transportation demand models
• These models are expensive and data-intense, but lessons can be learned from related assessments
  – Guides highlight these lessons learned and help with model choice

www.ilo.org/

Increase Business Market Reach and Job Access

www.vtpi.org/
Transportation Demand Models

- Can be the backbone of many development impact assessments and models (Economic, Environmental, and Social)
- Most use 4 steps →
- Numerous model choices with contractor support
- TRANSIMS is the leading open-source model

Source: mwcog.org
• Price volatility kills business plans
• Some fuels are less volatile than others
• Increasing fuel economy by 25% decreases fuel price volatility by 25%
• Decreasing VKT by 25% decreases price volatility by 25%

Why Assess Environmental and Health Impacts?

- International companies are increasingly being held accountable for their safety and environmental impacts in developing countries.
- Many environmental issues are global—drawing international support:
  - Foundations (i.e. Clinton and Gates)
  - Global Environment Facility
  - Development Banks
  - Carbon Markets

2013 Savar (Bangladesh) garment factory building collapse
Source: Voice of America
• Avoid, Shift, and Improve projects reduce GHG emissions, generally in that order
• Need to assess the lifecycle (well-to-wheel) emissions of fuels
• Numerous tools and default values to calculate and compare GHG emissions from specific transportation projects
• GEF Guide introduces good process and tools
## GHG Calculators

### Model
- **Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET)**
- **GREET Fleet (Simplified version of GREET)**
- **Petroleum Reduction Planning (PReP) Tool**
- **Transport Emissions Evaluation Models for Projects (TEEMP)**
- **Long-range Energy Alternatives Planning (LEAP) System**

### Project
- **Alternative Fuels (current and emerging) with over 100 feedstock/production pathway/vehicle combinations**
- **Existing Alternative Fuels**
- **Alt Fuel, Fuel Econ, Idle and KMT Reduction, Ecodriving**
- **Bikesharing program, Bikeway, BRT, Commuter Strategies, Ecodriving, Expressway, Parking Pricing, Pay-as-you-go Insurance, Rail (Freight and Commuter)**
- **Energy Policy- big picture**

### Audience
- **Analysts & Policymakers**
- **Fleet Operators**
- **Fleet Operators**
- **Transportation Planners, Analysits, Policymakers**
- **City Policymakers**

### Difficulty 1-10
- 7
- 3
- 3
- 2-6
- ?

All outputs are tons CO2e reduced, accounting for the full lifecycle of the fuel.

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### Savings Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Petroleum Reduction goal</th>
<th>GHG Reduction tons CO2e</th>
<th>Fuel Cost Savings</th>
<th>Impact on Plan percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace Vehicles</td>
<td>61,308</td>
<td>319</td>
<td>$117k</td>
<td>120%</td>
</tr>
<tr>
<td>Replace 100 medium gas cars with 100 electric vehicles (EVs)</td>
<td>yes</td>
<td>21,982</td>
<td>200</td>
<td>$22,443</td>
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<tr>
<td>Replace 50 large diesel trucks with 50 small EVs using ELECTRIFY</td>
<td>yes</td>
<td>20,907</td>
<td>110</td>
<td>$34,228</td>
</tr>
<tr>
<td>Ux Alternative Fuel</td>
<td>yes</td>
<td>67,087</td>
<td>165</td>
<td>$20,062</td>
</tr>
<tr>
<td>Use ethanol (E85) in 150 large gas pickups</td>
<td>yes</td>
<td>67,087</td>
<td>165</td>
<td>$40,052</td>
</tr>
<tr>
<td>Reduce ID</td>
<td>yes</td>
<td>88,323</td>
<td>1,097</td>
<td>$31,217</td>
</tr>
<tr>
<td>Reduce ID in 200+ diesel heavy-duty trucks from 50% to 25%</td>
<td>no</td>
<td>88,323</td>
<td>1,097</td>
<td>$17,126</td>
</tr>
<tr>
<td>Reduce Mpg</td>
<td>yes</td>
<td>209k</td>
<td>3,655</td>
<td>$2m</td>
</tr>
<tr>
<td>Reduce miles travelled in 2,000 medium gas cars from 11,019 miles to 11,000 miles</td>
<td>yes</td>
<td>295.3k</td>
<td>3,655</td>
<td>$1.3m</td>
</tr>
<tr>
<td>Zero Efficiency</td>
<td>yes</td>
<td>0.71k</td>
<td>10k</td>
<td>$33,367</td>
</tr>
<tr>
<td>Improve efficiency in 500 small, all-electric pickup by 3%</td>
<td>no</td>
<td>0.71k</td>
<td>10k</td>
<td>$33,367</td>
</tr>
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</table>

Total savings from plan per year: 61,308 gallons, 8,360 tons of CO2e, $117k, 120%

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### WTW emissions (g CO2-eq/mile) (DOE EERE Record)

- **Conventional Internal Combustion Vehicles**
  - Hybrid Electric Vehicles (gasoline and diesel)
  - Plug-in Hybrid Electric Vehicles (gasoline and electric)
- **Battery Electric Vehicles (BEVs)**
  - Plug-in Hybrid Electric Vehicles (BEVs and electric)
- **Fuel Cell Electric Vehicles**
  - High-temperature PEM fuel cells

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### Diagrams
- **GREET**
- **PReP**

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*Image credits: LEDs Global Partnership*
Local Air Pollution

First determine change in CO, NO\textsubscript{x}, SO\textsubscript{2}, PM emissions, then extrapolate impacts from previous studies with the help of WHO Air Quality Guidelines, linked documents, and models.

Models
- **AirQ 2.2.3** (WHO)
- **BenMAP** (U.S. EPA) calculate steps after “air pollution data”

### Main Steps of Health Impact Assessment, from WHO Air Quality Guidelines 2005

- **Air pollution data** (or monitored)
- **Population risk** Overall Susceptible groups
- **Exposure estimate**
- **Concentration–response function(s)**
- **Background data** Mortality rates Morbidity rates
- **Impact estimate**

\(^{a}\) If modelled data are used, the approach can be used to assess the impact of emission reduction strategies on different health outcomes.
Models to estimate changes in emissions from transportation projects

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<td>Energy Policy- big picture</td>
<td>City Policymakers</td>
<td>?</td>
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<td>Motor Vehicle Emission Simulator (MOVES)</td>
<td>Change in vehicle stock</td>
<td>Transportation Planners, Analysits, Policymakers</td>
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<td>2-6</td>
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</table>
• Mode shift is key to assessing mass transit
• Bicycle and Pedestrian projects have safety indices, and models to calculate
• Bicycle and Pedestrian projects have “critical mass” levels at which they become much safer

- Relationships between land use mix, multi-modal communities, time in car, active transit, obesity, multiple diseases, and longevity have been established.
- The Health Economic Assessment Tool (HEAT) for Cycling and Walking was developed by WHO to quantify health (and other) benefits.

Source: Frank et. al., Obesity Relationships with Community Design, Physical Activity and Time Spent in Cars, 2004
• Many “developed” nations are unhappy and unstable despite strong economies and healthy environments
• In many places, the local society is deteriorating even more quickly than the environment
• Most happiness studies show that human interaction is the #1 driver of happiness
  – Human interaction is highly interrelated to the transportation system
Why Assess Social Impacts?

- Powerful interest groups based upon social impacts
- Foundations very interested in social impacts
- Much of development bank funding goes towards social projects

• Rate access to three services
  – Basic services (health care, education, child care, public safety)
  – Quality-of-life destinations (shopping, recreation, worship, and cultural centers)
  – Markets (employers, employees, suppliers, and customers)

• Four measures of accessibility
  – Change in travel time to given location
  – Change in travel costs to given location
  – Change in number of choices to given location
  – Change in market reach for businesses

• Interviews, focus groups, surveys, and site analysis can detect much that models miss

• Weighted accessibility values estimated by gravity models

• Transportation demand models forecast changes in aggregate travel time and distance
• Overarching Goal: Minimize the number of hours people are spent isolated in congested traffic
  – Time spent on alternative modes of transportation isn’t as socially (or economically or environmentally) destructive
• Travel demand models can usually minimize travel time
  – Savings calculated as difference between pre-project infrastructure and post-project
• Also important to reduce *variability* in travel time
• Well established methods determine the value of travel time savings (VTTS), based on income, comfort level, multi-tasking
“Community cohesion” is used to describe patterns of social networking within a community
- Impact with least systematic assessment methodology (with no models)

Attributes of a pro-cohesion project:
- Doesn’t require relocation of residents or businesses
- Overcomes a physical barrier, or at least doesn’t divide a highly-cohesive neighborhood with a physical barrier
- Reduces traffic noise, dust, and hazards that prevent people from socializing outside
- Protects cohesion of a poor neighborhood, since the poor are more dependent on their immediate community
• Increased choice of modes is key to an equitable transportation system
• Bicycle and Pedestrian “compatibility Indices” are different than “safety indices” because they take convenience factors into account
• “Barrier Effect” must be assessed for roads and rails
  — Quantified in terms of additional travel delay experienced by age-specific pedestrians and cyclists

Table 5.2. Modes that are particularly important for specific user groups
(A = primary mode; B = potential mode)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Non-Driver</th>
<th>Low-Income Person</th>
<th>Disabled Person</th>
<th>Commuters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Bicycle</td>
<td>A</td>
<td>A</td>
<td>—</td>
<td>B</td>
</tr>
<tr>
<td>Taxi</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>—</td>
</tr>
<tr>
<td>Fixed-route transit</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Paratransit</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Automobile</td>
<td>—</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Ridesharing</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
</tbody>
</table>

Source: Guidebook for Assessing Social & Economic Effects of Transportation Projects, Transportation Research Board, 2001
• Most countries [reactively] focus on problematic areas of development
• Livability Indexes and Gross National Happiness ratings are more pro-active

Source: Economist Intelligence Unit 2013, www.eiu.com

Source: A Short Guide to Gross National Happiness Index, Center for Bhutan Studies 2012
Some environmental, health, and social “externalities” have well-established quantification methods

• Time savings (based largely on salary)
• Road safety, air pollution, and lack of exercise (based on health care costs or risk payments in the case of mortality)
• Accessibility (based on willingness to pay)
Some environmental, health, and social “externalities” have well-established quantification methods

- Time savings (based largely on salary)
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- Accessibility (based on willingness to pay)
• DIA Identifies and evaluates the link between low carbon transport and other development objectives
• One reason to do DIA is to incorporate new partners that may not otherwise be interested in climate protection
• Numerous economic, health, environmental, and social impacts have well established ways to assess impacts
• The studies, guides, and tools available for assessments depend on the impact
• Prioritizing impacts is up to the country, but some systems are being developed
• Impacts are increasingly being converted to currency in order for broad comparison
<table>
<thead>
<tr>
<th>Website</th>
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<th>LEDS Contacts</th>
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