Transportation Infrastructure Project Evaluation: Transforming CBA to include a more encompassing Life Cycle Perspective

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• HSR-the “greener” option

• **Goal** is to integrate economic, social and environmental dimensions into a single project evaluation tool
Environmental Impacts

- Disagreement on whether (and how) environmental impacts should be accounted

- Some impacts (biodiversity loss, value of land and aesthetics if nothing were to be built, etc.) are **very project specific** and difficult to estimate
  - EIA/SEA at later stages but usually still no monetization

- Emissions from only **operation stage** are usually included
  - PM$_{10}$, SO$_2$, NO$_X$ and CO$_2$
• **CBA** is the chosen tool by governments and agencies
  – OECD; UN; World Bank; **EU-IPA, CF, SF; US; Canada; Mexico; Netherlands; UK; France and Germany**
Introduction

CBA Steps

- Objectives Definition
- Project Identification
- Feasibility and Options Analysis
- Financial Analysis
- Economic Analysis
- Multi-criteria Analysis
- Sensitivity and Risk Analysis
Research Process

*Answers RQ 1

**CBA**
- Critical Factors
- Traffic Forecasts
- Cost Estimates
- VSL
- Safety
- VOT
- Equity

**LCA**
- Define Goal
- Inventory Analysis
- Impact Assessment
- Interpret Results
- Local Impacts
- Regional Impacts

**Environmental Impacts**

**Discount Rate**

**LCP – CBA Focus**

**Residual Value**
Most Transport CBAs include only the operation stage
Environmental Impacts

LCA

System Boundaries
Case Study

- HSR Line from Lisbon to Porto
  - €4.5 billion
  - 297 kilometers
  - 5 stations
  - 5 years construction
  - 35 years operation

- Methods
  - EI only operation stage
    - Benefits from modal switch
Environmental Impacts

LCA

684,000 tons of CO₂ eq.
31% missing

2,433 tons PM₁₀
18% missing

4,856 tons SO₂
24% missing

TÉCNICO LISBOA

684,228,220 Kg CO₂-eq.
684,233,341 Kg PM₁₀
4,856,352 Kg SO₂
### Environmental Impacts

**LCA**

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Impacts from <strong>additional</strong> life cycle stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{CO}_2)-eq.</td>
<td>172,675 tons</td>
</tr>
<tr>
<td>( \text{SO}_2 )</td>
<td>833 tons</td>
</tr>
<tr>
<td>( \text{PM}_{10} )</td>
<td>350 tons</td>
</tr>
<tr>
<td>( \text{NMVOC}^6 )</td>
<td>707 tons</td>
</tr>
<tr>
<td>( \text{N} )</td>
<td>33 tons</td>
</tr>
</tbody>
</table>
# Environmental Impacts
## Monetizing Emissions

### Difference in emissions and NPV based on life cycle stages (thousands)

<table>
<thead>
<tr>
<th></th>
<th>Case Study (non-LCP)</th>
<th>LCP</th>
<th>Reduction in Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions</td>
<td>€468,069</td>
<td>€456,950</td>
<td>€11,119</td>
</tr>
<tr>
<td>NPV</td>
<td>€3,047,785</td>
<td>€3,042,250</td>
<td>€5,535</td>
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</tbody>
</table>
Environmental Impacts
Conclusions

• Difference between including life cycle impacts or not may seem minor in relative terms, it still represents **millions of Euros** in absolute terms
  – In some situations the inclusion or exclusion of life cycle impacts can **change the sign of the NPV**

• Not including the life cycle impacts would mean **not accounting for** 172,675 ton CO$_2$-eq., and other emissions for a value of at least €7.4 million and more likely between €11.1 and €14.5 million

• HSR is claimed as a **greener** option. The impacts from all life cycle stages should be evaluated when making this claim
Thank You

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