Improving the representation of modal choice into bottom-up optimization energy system models

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Improving the representation of modal choice into bottom-up optimization energy system models

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MOTIVATION AND OBJECTIVE

• Bottom-up energy system models (E4 models) describe in detail the technical, economic and environmental characteristics of the technologies
• They are weak in representing consumer behaviour: only one average-representative decision maker is considered [1, 2]
• The behavioural dimension cannot be neglected, as it is fundamental in decision making in the transportation sector [3]
• This study proposes and discusses a novel methodology to incorporate modal choice within E4 models

METHODOLOGY AND MODEL

• The new approach has been named MoCho-TIMES (Modal Choice in TIMES)
• MoCho-TIMES has been tested for the standalone transportation sector of TIMES-DK, the TIMES energy system model of Denmark
• The methodology requires a transport model, consistent with the scope of the analysis, as a support model (Figure 1). For Denmark this is the LTM [4]

![Figure 1: Data provided from the support model LTM to TIMES](Image)

• The methodology consists in two main steps:

1. DEMAND SIDE HETEROGENEITY

![Figure 2: Heterogeneous consumer groups with different modal preferences](Image)

2. INTANGIBLE COSTS

Intangible Cost\(_{\text{m,c,g,y}}\) = Level of Service\(_{\text{m,c,g,y}}\) x Value of Time\(_{\text{m,c,g,y}}\)

Level of Service_{\text{car}} = f(Travel Time, Congestion Time, Ferry Time)
Level of Service_{\text{public transport}} = f(In Vehicle Time, Waiting Times, Walking Time)
Level of Service_{\text{multi modality}} = f(Travel Time)

![Figure 3: Intangible costs for very low income group in 2030](Image)

<table>
<thead>
<tr>
<th>Income class</th>
<th>Personal VoT in 2010 [DKK/hour]</th>
<th>Weighted average VoT in 2010 [DKK/hour]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>17.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Medium</td>
<td>34.9</td>
<td>24.0</td>
</tr>
<tr>
<td>High</td>
<td>240.5</td>
<td>240.5</td>
</tr>
</tbody>
</table>

![Figure 4: Scheme of MoCho-TIMES](Image)

REFERENCES

3. Venturini, G., Tatinni, J., Mulholland, E., O’Gallachoir, B. Improvements in the representation of behaviour in integrated energy and transport models, Submitted to International Journal of Sustainable Transportation on 03/04/2017