Comparison of two methods for finding Least Cost Solutions for Heat Saving and Heat Supply in Buildings

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Contents

(1) Motivation and aim of the work

(2) Technical description of the two methods

(3) Case study for the city of Brasov (Romania)

(4) Conclusions and Discussion
Motivation and aim of work
Motivation and Aim

- Emission reduction target of the EU
- Big potential for energy saving in the building stock in order to decrease CO₂ emissions
- Find cost optimal combinations of heat savings (renovation measures) and heat supply (DH or individual supply technologies) for space heating and preparation of hot water in the building stock
- Compare two different approaches which have the same objective
Technical description of the two methods
Introduction to cost curves

Additional (annualised) investments

Net levelized costs

[€/m²_{GFA}]
[€/kWh]

Indicator for costs

[kWh/m²a]
[TWh] [-]

Indicator for savings or supply

in terms of energy need

vs.

in terms of total final energy demand

[€/m²_{GFA}]
[€/kWh]

[€/kWh]
Method 1

Costs of heat savings and costs of heat supply are calculated separately and compared afterwards to find cost optimal solutions for single buildings.

Heat savings cost curve (savings are treated as a form of supply)

Economically feasible amount of savings

Maximum amount of savings

Useful heat demand [GWh]

Current heat demand

Costs of heat supply for cheapest supply technology

Annualised costs of heat saving / supply [€/kWh]
Method 2

1) Calculation of heat saving costs for all saving options (renovation combined with change in heating system) for a building class

2) Selection of cheapest combination of renovation measure and heating system

3) Calculation of overall potential with chosen least cost combination in all buildings of the class

4) Calculation of step 1-3 for all buildings in the stock + ordering from lowest to highest costs

Levelized cost of heat saving (€/kWh)
Overview of differences between the methods

<table>
<thead>
<tr>
<th>Methodological differences</th>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy indicator</td>
<td>Useful energy demand</td>
<td>Final energy demand</td>
</tr>
<tr>
<td>Cost indicator</td>
<td>Separate calculation for saving and supply</td>
<td>Costs for combination of saving measure and supply technology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Differences in implementation</th>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>District heating</td>
<td>Distinction between district heating areas, next to district heating areas and individual areas</td>
<td>Distinction between district heating areas and no district heating areas</td>
</tr>
<tr>
<td>Representation of building stock</td>
<td>10 building categories, 3 building classes, 5 supply technologies</td>
<td>10 building categories, X building classes, Y supply technologies</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Case study for the city of Brasov
Short introduction to city of Brasov (Romania)

- Old district heating system
  - Old coal CHP replaced by new CHP gas engines (2010-2012)
  - A lot of costumers disconnected from DH
  - Very high network losses (>50%)
    → high reinvestment costs

- Currently
  94% individual gas boiler,
  5% DH,
  1% individual biomass
Exemplary results method 1 – private economic calculation

Depreciation time:
- 15 y for supply technologies
- 20 y for renovation measures

Results

Around 60% savings of energy demand for all buildings

DH is not competitive
- High reinvestments
- Low gas price for privates

Smaller individual buildings change to biomass boilers, bigger buildings to gas boilers

Heat pumps depend on electricity price assumptions and COP
Preliminary Results method 2 – private economic calculation

4-7% interest rate

depreciation time:
  15 y for supply technologies
  20 y for renovation measures

Results

saving of 40 – 80% of useful energy demand for all buildings

change to heat pumps (a/a and w/w) as well as to gas boilers

unrenovated old buildings lead to the cheapest savings

a higher interest rate leads to less ambitious saving as cost minimal solution
Conclusions and Discussion
Conclusions

- Important influencing factors on the resulting technology and savings combinations:
  - price sensitivity of district heat to the supplied heat demand (and the technologies used for supply of district heat)
  - rebound effect in the buildings after renovation
    - Overestimation of heat savings
    - Assumptions on building stock
  - socio- vs. private-economic conditions (interest rates, depreciation times, taxes, subsidies)

- Both methods provide important insights
  - Method 1: better suited for visualisation of combinations in single buildings
  - Method 2: better suited for visualisation of overall savings potential and resulting costs
Discussion / open issues

Open Issues:

- Show more results of each implementation:
  - CO₂ emissions (reduction)
  - Compare results per building class
- Verification of input data
- Sensitivity analysis still to be conducted for both methods to get more reliable results
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