Simulations of energy efficiency in urban planning

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Content

1. Energy simulation equation
2. Background
3. Case Ravilaakso
4. Conclusions
AIM:

- Finding and developing tools for urban planning
- Transparency and facts for decision making
- Reducing energy and CO$_2$
- Easy to use for planners

Land Use and Building Act 1999: Section 9. Impact assessment in connection with planning. Plans must be founded on sufficient studies and reports. When a plan is drawn up, the environmental impact of implementing the plan, [...] must be assessed to the necessary extent...
Energy planning on district level:

1. Potential energy mix
2. Energy consumption estimates (EPBD) with E-value
3. Calculation tools
4. Create an energy concept & alternatives
5. Decision on Energy concept
Case Ravilaakso, development in Vaasa

Competition 2014, Mandaworks
Dense redevelopment of race course
Innovative and energy efficient housing district
130 000 m² on 17 Hectare
Goals and potential:

Local climate agenda in Vaasa:
- 30 % reduction of $CO_2$ by 2020 (from 1990)
- Carbon neutral by 2035

Research reports:
“Spatial planning departments can influence the energy performance of construction projects, by stating conditions that must be met to obtain planning permission” (Immendoerfer, Winkelmann and Stelzer 2014)
“There is considerable energy saving potential in the urban planning (Rajala et al 2010).
“There is a need to reinforce the collaboration between architects, engineers and energy departments and networks” (PLEEC-project 2014).
The unbearable lightness of energy estimates in urban planning...based on EPBD-rules

\[ \sum 90\% \text{ building right } \times E - \text{value} = \text{Max energy} \]

\[(\text{Heating} + \text{Electricity}) \times \text{Energy mix} = \sum \text{CO}_2 \text{e} \]
Potential energy mix in Vaasa

- District heating 71% renewables
- Electricity 62% renewables
- Excess heat in summer
- Geothermal heat

- Photovoltaic & solar hot water, 100% renewables
Tools for simulations in planning:

KEKO/HEKO 2016
- No evidence of use in planning in Helsinki despite commitment, except co-operation with power company and 7-53 studies on different topics but none on energy
- Comprehensive for non-experts

Ecocity Evaluator
- Tool in Oulu, combined with strategy

District Energy Concept Advisor (D-ECA) 2013
- Found no use of it in planning

--- Resistive professional cultures and a learning problem?
Solar energy potential estimates

- PV System Planner-application based on the PVGIS-project (EU)

- Parameters:
  - Area
  - Angel
  - Calender
  - Solar radiation

http://srp-prototype.herokuapp.com/?token=supersecretusertokenetc
Energy estimates in urban planning

Parameters:
• Building right
• Heated floor area
• Building types, use
• Primary energy coefficients
• Energy supply

Outcome:
• Alternatives and motivation
• Energy mix proposal
• Proposals for reduction (methods)
• Energy plan and decision making
• Implement in building permits and plot assignment contracts
## Estimates for Ravilaakso

### Energy consumption

<table>
<thead>
<tr>
<th>Building right 18.5.2017</th>
<th>Electricity with primary energy coefficient [MWh/a]</th>
<th>District heating with primary energy coefficients according to mix [MWh/a] (H:fors)</th>
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</thead>
<tbody>
<tr>
<td>126 795</td>
<td>7 279</td>
<td>13 914</td>
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<td>10 230</td>
<td>408</td>
<td>1 565</td>
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</table>

### Energy mix for heating

<table>
<thead>
<tr>
<th>Proposal 2018/D3</th>
<th>O-alternative, conventional district heating and electricity</th>
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<tr>
<td></td>
<td>Ground heating</td>
<td>4431</td>
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<td></td>
<td>Ground heating and storage of excessive heat in summer</td>
<td>3219</td>
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<td></td>
<td>Ground heating in combination with solar panels</td>
<td>4067</td>
</tr>
</tbody>
</table>
Conclusions

Influenceable variables

- Local energy mix
- Building codes
- Shape of buildings, sun protection
- Materials
- Contracts

New tasks in planning processes

- Simulations and energy assessments
- Energy concepts
- Communication of alternatives based on facts
- Investor perspectives (energy, infrastructure, housing contractors)
Future and open questions:

• Further testing and implementation?
• CO$_2$ or greenhouse gas reduction or non-fossil fuels?
• Creating carbon sinks in buildings
• Prototype or final interface?
AIKO-project, with sponsors:

- VASEK
- Vaasan yliopisto
- ÖSTERBOTTENS FÖRBUND
- NOVIA