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Role of energy system models in municipal decision-making processes in Denmark*

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Introduction

Cities and towns worldwide are the leaders of energy transition. In Denmark, Copenhagen is a well-known case - but middle-sized municipalities such as Helsingør and Sønderborg are also notable examples. To succeed with their ambitious goals, urban areas need coherent and implementable sustainable urban energy strategies. Energy system models can provide support for municipal energy strategies e.g. through the design of pathways, feasibility assessment, cost calculation etc. - especially at the national level. However, energy system models are often developed outside municipal contexts, so their actual applicability and usefulness for policy is debatable. This exploratory study focuses on the relevance of energy modelling for municipal energy planning. We interviewed practitioners from three Danish municipalities to examine their use of modelling tools and modelling outputs.

Name of the tool	Type
Balmorel	investment and operation optimisation tool
CONNIE	spreadsheet tool for CO_2 emissions evaluation
Energy and CO_2 calculator	Danish Energy Agency's geographically-based CO_2 inventory tool
EnergyPLAN	operation optimisation tool
energyPRO	operation optimisation tool
LEAP	model generation tool; possibilities for optimisation
Least Cost Tool (LCT)	spreadsheet tool for individual heating and heat savings calculation
Sifre	operation optimisation tool
Sønderborg's spreadsheet tool	spreadsheet tool for energy consumption inventorying and evaluation of possible measures

Tools examined in this study

The paper contributes to the knowledge on energy planning and best practice development in relation to stakeholder involvement, participative planning and open source models.

Key findings

- The use of modelling tools by municipal planners depends on their perceptions of model functionality and complicatedness
- Practitioners rely on CO_2 calculation/evaluation tools
- Energy system models are used by externals: heat supply companies, consultancies, universities, but municipal planners collaborate with model developers and users to utilize model outputs

Key findings (continued)

- Municipal energy goals are often arbitrary, without prior analysis of all possibilities and synergies
- If modelling results are incorporated into the implementation of municipal energy visions, this happens mostly in the early planning phases
- Models and spreadsheet tools in the urban energy context facilitate mainly: visualisation, strategy calculation and progress evaluation
- Models are viewed as complicated, inflexible and lacking sufficient depiction of policy options
- Municipalities lack expertise, resources and incentives to use models more often. As a consequence, the potential of models for strategic energy planning is underutilised.
- Models and modelling practice can be improved with:
  - transparency and more open data
  - increased inter- and cross-municipal collaboration
  - improving links between modelling and practical implementation

Implications and recommendations

- Clarifying mutual expectations for modelling services could prevent potential conflicts of interest
- Cross-municipal collaboration is beneficial, because it improves the competences of planners and increases understanding of and involvement in energy modelling
- Formalized approach to collaboration and more technical support from the Danish Energy Agency is required
- Using models to align national and local planning and coordinate across different levels of government could help prevent arbitrary or suboptimal energy visions
- Both modellers and users need to question modelling assumptions and outputs more
- Assumptions behind modelling should be made more accessible to planners through the means of comprehensive sensitivity analyses and discussions on limitations, uncertainties etc.
- Incorporating multiple perspectives in the modelling process could be achieved if selected participants take the role of "knowledge transfer intermediaries"
- Whether energy system models should deal with behavioural and spatial aspects remains a challenge, but to avoid misinterpretation, plurality and complementarity of approaches is recommended. The model coupling/linking process should be clear, flexible and iterative.

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