Agent-based modelling for the thermal energy transition of natural gas dependent neighborhoods
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Programme: Smart Energy Systems in the Built Environment (SES-BE)
Project E: Modelling Lab for smart grids, smart policies and smart entrepreneurship
Team members

TU Delft

Technology, Policy and Management

Values Technology and Innovation

Multi-Actor Systems

Engineering Systems and Services

Transport and Logistics

ICT

Energy and Industry

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Energy transition in the European Union

Targeted reductions in greenhouse gas emissions

2050
Down to 80% of 1990 levels

2040
Down to 60% of 1990 levels

2030
Down to 40% of 1990 levels

Heating and Cooling sector

50% of energy consumption

Buildings have old boilers and low renovation rates.

59% of gas consumption

Renewables are not widely used in the sector.

Heat from industries is being wasted.

Smart Energy Systems in the Built Environment (SES-BE)

Smart Energy Management and Services in Buildings and Grids

Academic partners

TU Delft
CWI
TU/e

Industrial partners

Royal HaskoningDHV
Alliander
Project E: smart grids, smart policies and entrepreneurship modelling lab
Research approach and methods

- Socio-technical perspective
- Theory of complex adaptive systems
- Agent-based modelling
Research approach and methods

**Socio-technical perspective**

- Physical and social networks
- Interaction under rules (institutions)

De Bruijn & Herder (2009)

Moncada et al. (2017)
Research approach and methods

Theory of complex adaptive systems

- Systems’ emergent behavior
- Learning and adaptation

Macal & North (2005), Nikolic & Kasmire (2013)
Research approach and methods

• Autonomous agents
• Bounded rationality

Jennings (1998), Macal and North (2005)
Recent work

ABMUS 2018
The 3\textsuperscript{rd} Workshop on Agent-based modelling of urban systems


http://modelling-urban-systems.com/abmus2018

Research question
How can a Dutch neighborhood transition from natural gas-based to natural gas-free heat supply over the coming years while meeting the neighborhood’s heat demand?
Modelling questions

1. Which *combinations of household’s characteristics* lead to low natural gas consumption and low expenses at the end of the simulation?

2. What are *promising combinations of technologies and insulation levels* with which low natural gas consumption and low expenses were achieved?

3. How would the *cost of heat supply* be affected by promising combinations of technologies and insulation levels?
System conceptualization

*AHO: association of house owners

Agent-based model

http://modelling-urban-systems.com/abmus2018
KPIs after 20 simulated years

Percentage of buildings where households invest in building-wide solutions

0%, 50% or 100%

http://modelling-urban-systems.com/abmus2018
Results when households invest individually

All households have/are:
- Able to invest within 0-1 simulated year.
  - More than 10 years as time horizon.
- Able to compare investments.
- Environmentally oriented

**Heat technologies and insulation**
- Immediately:
  - Replaced boilers with aerial heat pumps.
  - Highly insulated dwellings.
- 15 years later:
  - If time horizon > 15 years, no change.
  - Else, replaced aerial heat pumps with radiators.

**Cost of heat supply**
- Likely similar to that of keeping boilers.

http://modelling-urban-systems.com/abmus2018
Outlook

• Exploring long term production contracts.

• Applying the perspective of socio-technical systems to modelling and simulation.

• Research question:
  • Under which contractual conditions could a district heating network with a single supplier transition towards a lower greenhouse gas emissions system?
Keep in touch

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