FTT:Heat: a simulation-based model of technological change in the EU's residential heating sector

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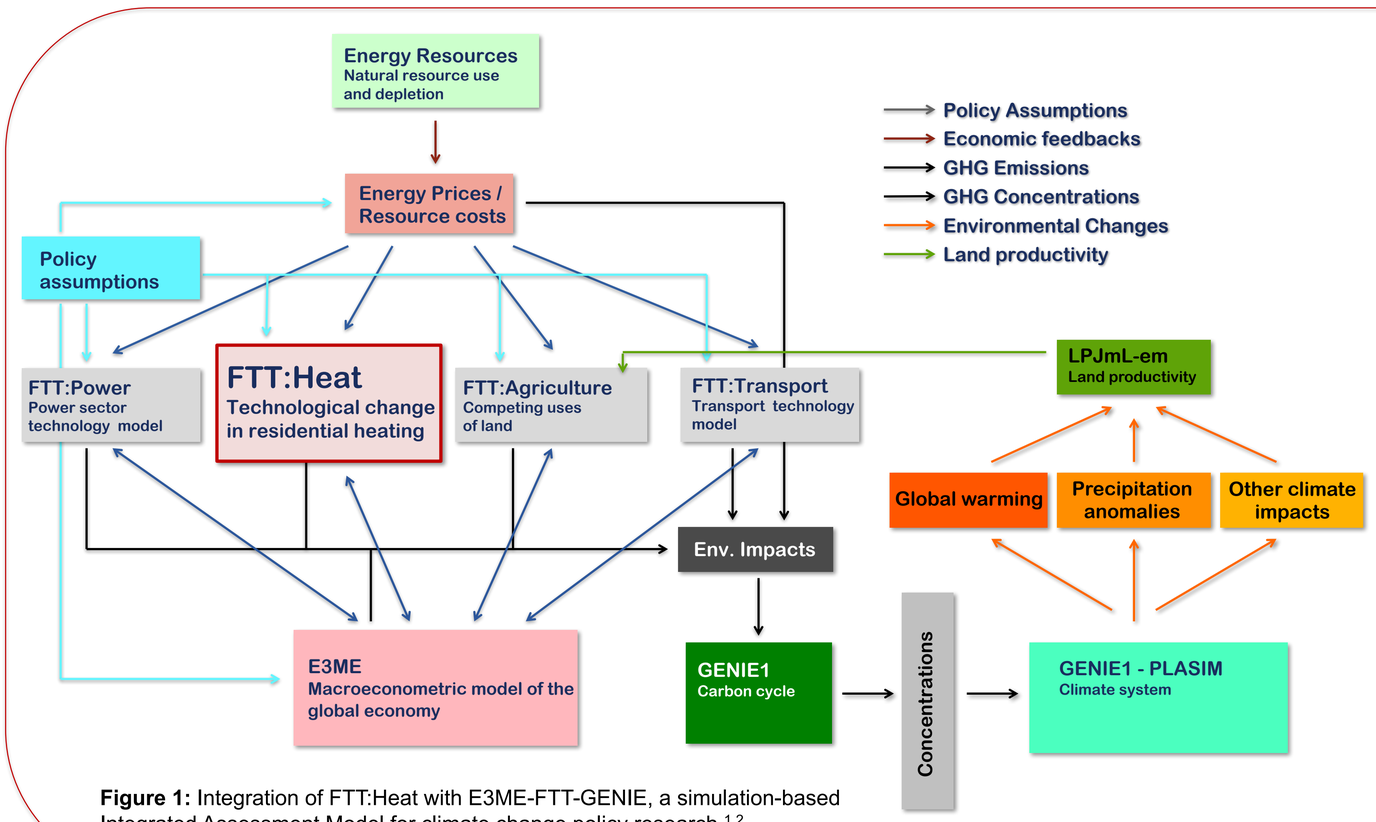

Figure 1: Integration of FTT:Heat with E3ME-FTT-GENIE, a simulation-based Integrated Assessment Model for climate change policy research.[1,2]

A model of technology choice and substitution

- Simulates future investments in heating technologies
- By households within the EU (country-level resolution)
- Based on dynamical shares equations and learning curves (the '**F**uture **T**echnology **T**ransformations' method)
- Exogenous driver: useful heating demand per country
- Outputs: technology composition, final energy demand, fuel use, CO_2 emissions, investments

Integration with the E3ME-FTT-GENIE IAM

- Coupled with simulation of future energy prices
- Macroeconomic feedbacks on GDP and employment
- Emissions feedback on climate system

Behavioural choice structure

- Decisions based on Levelised Costs of Heating (LCOH)
- Diversity of choices, resulting from distributed parameters
- Observed preferences: calibration to historic data
- Limited information and bounded rationality: choices depend on market shares in previous period
- Endogenous scrapping: based on payback time criterion[3]

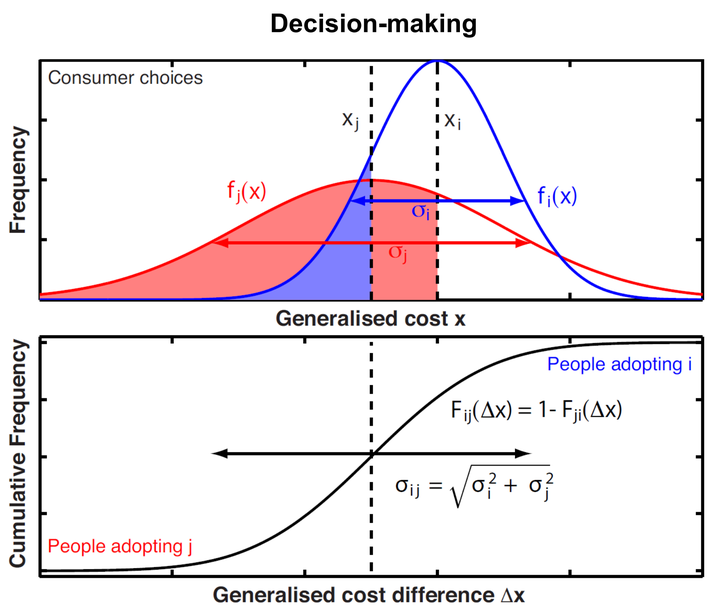

Figure 2: Process of decision-making between two technologies *i* and *j* under diversity of households and technologies.[4]

Top panel: the blue and red curves represent the distributions of generalised heating costs.

Bottom panel: diversity makes choices distributed, so that they only change gradually as costs change.

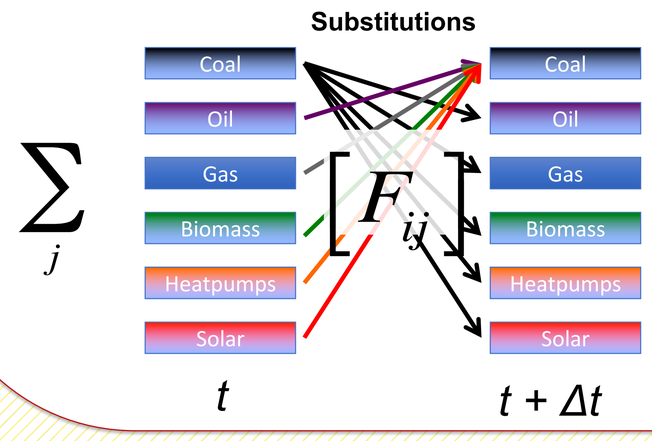

Figure 3: In each period *t*, a fraction of households decides between available heating systems. The matrix F_{ij} describes their distributed preferences for technologies, which are based on generalized heating costs. Over time, this results in gradual substitution and diffusion of technologies.[5]

Policy simulation

- Market-based: taxes, subsidies, cost of finance
- Regulatory: phase-outs, capacity limits, procurement
- Behavioural: effects of different decision criteria

Example: 30% investment subsidy for renewable heating technologies between 2018-2027

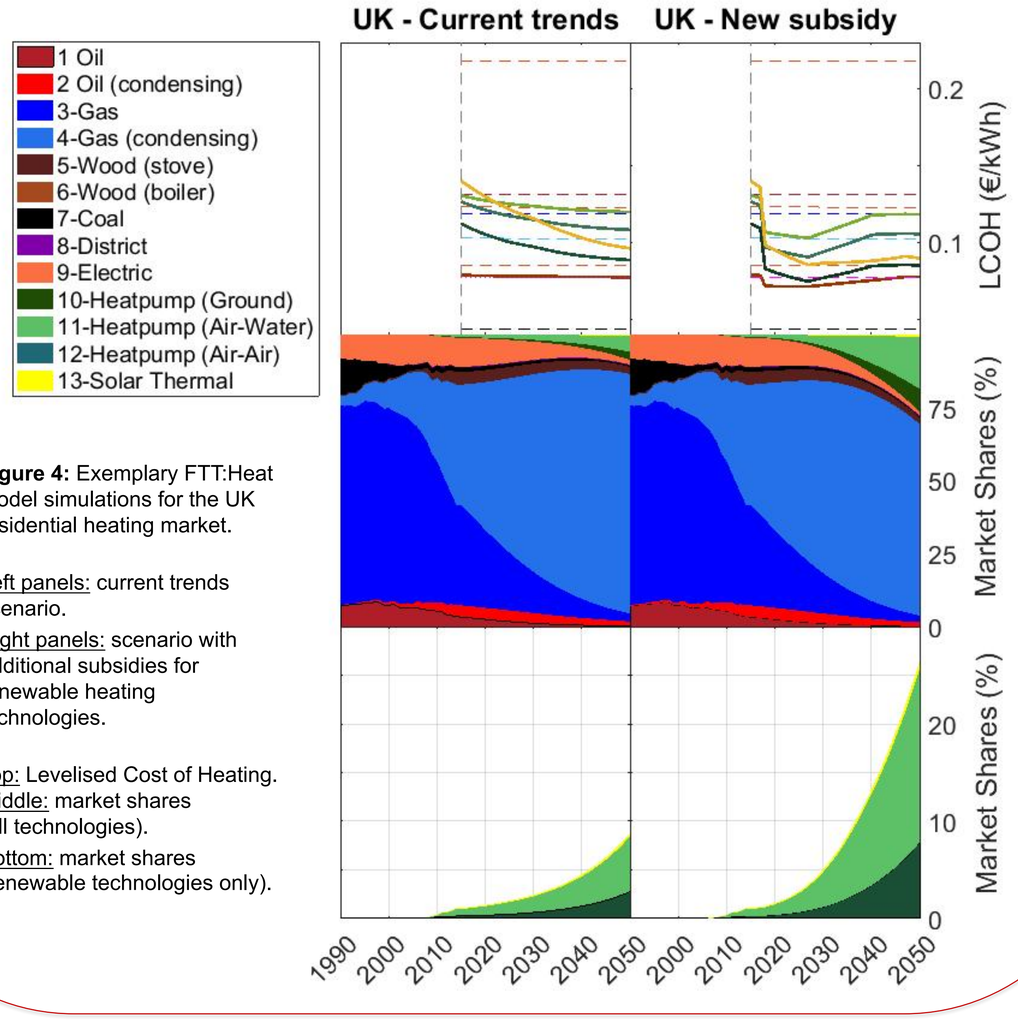

Figure 4: Exemplary FTT:Heat model simulations for the UK residential heating market.

Left panels: current trends scenario.

Right panels: scenario with additional subsidies for renewable heating technologies.

Top: Levelised Cost of Heating.
Middle: market shares (all technologies).
Bottom: market shares (renewable technologies only).

References

(1) Cambridge Econometrics, *E3ME Technical Manual: Version 6.0* (2014)
(2) Mercure, Pollitt, Vinuales, Bassi & Edwards, *Global Environmental Change* **37**, 102-115 (2016).
(3) Knobloch and Mercure, *Environmental Innovation and Societal Transitions* **21**, 39-55 (2016).
(4) Mercure, *Journal of Evolutionary Economics* **25**, 787-820 (2015).
(5) Mercure, *Energy Policy* **48**, 799-811 (2012).

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