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Home is where the heat is: novel model simulates uptake of renewable heating technologies from behaviour and choice at a household level



6th October 2021
Issue 568

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Source:

Knobloch, F., Pollitt, H., Chewprecha, U., Lewney, R., Huijbregts, M.A.J. and Mercure, J.-F. (2021). FTT: Heat – A simulation model for technological change in the European residential heating sector. *Energy Policy* 153:112249 doi: 10/1016/j.enpol.2021.112249.

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Researchers have applied a novel approach to modelling the uptake and replacement of heating technologies. By focusing on the micro-level of households in individual EU Member States, the bottom-up model (a data-first approach) is able to assess how decisions and choices are made in the real world, rather than assuming rationality. On this basis, the study estimates which policy scenarios would be needed to meet targets for renewable heat set by the [Renewable Energy Directive](#).

The Renewable Energy Directive requires Member States to increase their proportion of renewable heat by 1.3 percentage points each year up to 2030. Although insulation of buildings has a role to play in achieving these targets, there is a need for a larger shift to renewable- and electricity-based technologies such as solar-thermal systems and heat pumps.

In order to design effective strategies for reaching these targets there is a need to accurately simulate the outcome of different policy instruments in a way that considers real-world decisions that are not always logical or economical. Current approaches in this area describe what is optimal in terms of cost to society, but this is very different to how individual households make decisions about heating technology. Models that start their simulations at the household level do exist but they tend to cover only one geographic region.

This study presents a bottom-up model, [Future Technologies Transformation: Heat \(FTT: Heat\)](#), that considers some of the behavioural and social-technical (the interaction between people and technology) elements relevant for transitions to new forms of technology. This is the first time a model of this type has been applied to residential heating at the scale of 27 EU countries and the UK.

The research applied the FTT: Heat model to simulate how the composition of a range of heating technologies changed over time in different Member States, based on the decision making of households and the level of inertia around the uptake of new technologies. The level of inertia considered the fact that households only choose technologies that they are aware of and have access to, which is a subgroup of all technology options.

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Home is where the heat is: novel model simulates uptake of renewable heating technologies from behaviour and choice at a household level (continued)

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To cite this article/service:

[“Science for Environment Policy”](#):
European Commission DG
Environment News Alert
Service, edited by
SCU, The University of the
West of England, Bristol.

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On the basis of this, the study could estimate which policy scenarios would be needed for each Member State to reach the EU’s objective of increasing the renewable share in residential heating by 10 percentage points until 2030 and achieving a zero-emissions building stock by 2050.

The model represents the process of technology diffusion with three key elements:

- Representing the diversity of household preferences by a statistical distribution of the different technology characteristics on which choices are made;
- considering the inertia that occurs in household technology uptake, resulting in changes happening several years after the introduction of policies;
- incorporating how the costs of technologies decrease as more of these heating systems are installed over time.

The study demonstrated the model for a scenario that represented current technology and policy and three other policy scenarios — these aimed to increase the uptake of renewable-heating technologies and included different variations in carbon tax, subsidies and kick-start procurement policies.

The model identified four groups of countries which varied in their uptake of renewable heating technologies. The first group of eight Member States were predicted to achieve the renewable-heating target under current policy conditions, so had no need to implement any additional policies. These countries were Greece, Spain, France, Ireland, Portugal, Estonia, Cyprus and Malta. For the second group of five countries, the introduction of a new carbon tax in 2018 was projected to be sufficient to achieve the targets; whilst a third group of seven countries would require a combination of carbon tax and subsidies in order to break the lock-in to current technologies, such as gas and oil heating systems, and approaches such as district heating. The final seven countries were predicted to require kick-start procurement policies to make technologies more economically competitive and create an initial market.

The study provides new insight into the necessary policy effort to change the renewable heat-technology uptake in different countries that are varying in their level of renewable-technology use.