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# Flexing the residential energy demand

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**POLICY BRIEF**

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## Why this topic?

**To integrate more renewable electricity generation into the system, we need a more flexible demand side.**

Currently, there is no (sufficient) monetary incentive for individuals in the residential sector to shift their demand to times when renewable generation is high (and when prices are low!).

## Key legislation

**Fit for 55**
In March 2023, a provisional agreement was reached between the European Parliament and the Council to reinforce the EU Renewable Energy Directive. It raises the **EU's binding renewable target for 2030 to a minimum of 42.5%**, up from the current 32% target. Negotiators also agreed that **the EU would aim to reach 45% of renewables by 2030**. Furthermore, the revised Directive will introduce a specific renewable energy benchmark of 49% for energy consumption in buildings by 2030.

The **REPowerEU Communication (COM(2022) 108 final) and plan (COM(2022) 230 final)** proposed measures to rapidly end the dependence on Russian fossil fuels and tackle the energy crisis by accelerating the clean energy transition and joining forces to achieve a more resilient energy system.
Following these strategic documents, in March 2023, the European Commission issued *Recommendations* (2023/C 103/01), which highlight that **flexibility will be particularly relevant in the coming years as the share of renewable energy in the electricity system is expected to reach 69 % by 2030**.

# What have we found?

The potential of shifting electricity through the residential building stock is substantial and can be relatively easily accessed without major investments. Figure 1 visualizes the average percentage of own electricity consumption that buildings with electrified heating systems can shift.

Figure 2 shows the absolute values of this shifted electricity for the whole country. The shifted electricity demand through prosumaging can be very high in the future, especially in Southern European countries.

**Major influencial factors that determine the amount of shiftable electricity are:**

1. The number of installed electrified heating systems;
2. The amount of installed storage applications (thermal and electrical), including thermal inertia of buildings as such;
3. The frequency and volatility in variable price change to incentivise load shifting;
4. The amount of installed PV capacity.

Northern countries with higher shares of hydro power and thus lower volatility in electricity price change, shift less electricity than countries in central and southern Europe.

In Southern countries, the ability to shift cooling demand by pre-cooling buildings also significantly increases the share of shifted electricity.

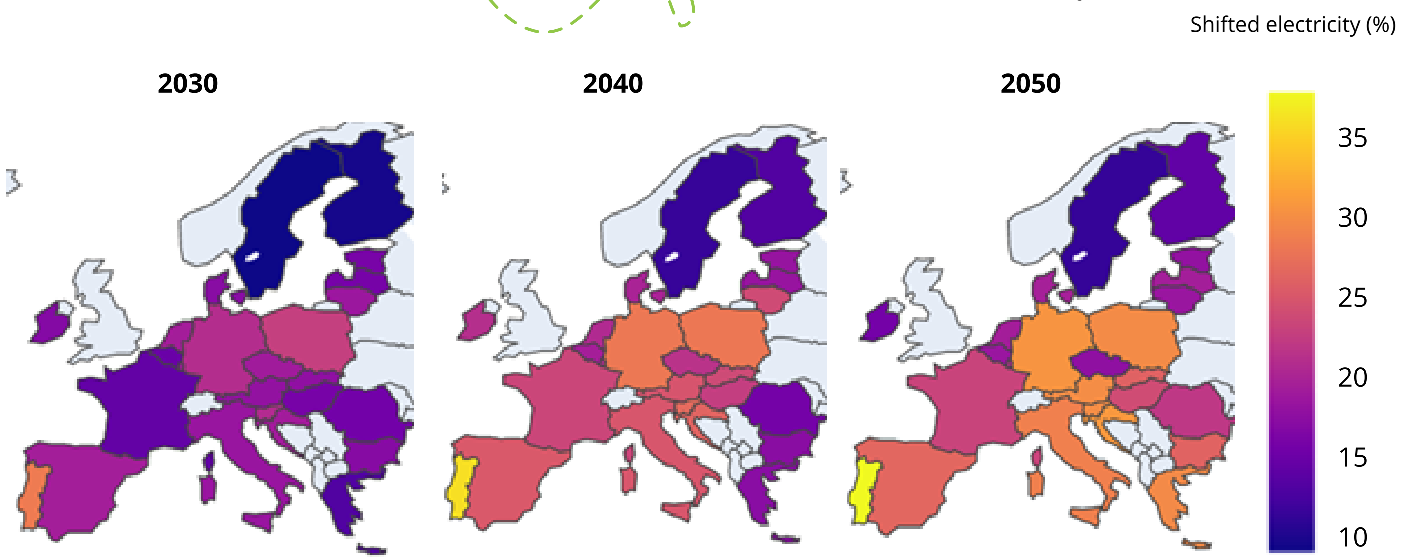


*Figure 1: Projected percentages of electricity demand that residential prosumagers with electrified heating systems can shift in the years 2030, 2040, and 2050, according to the newTrends project decarbonisation scenario.*

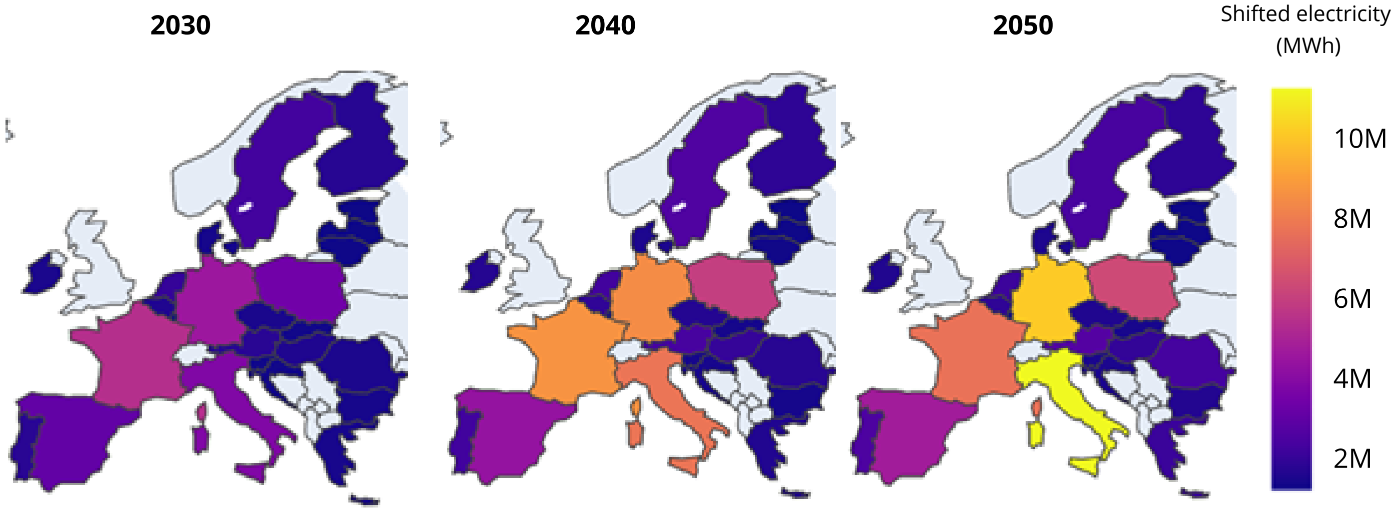


*Figure 2: Amount of shifted electricity demand that residential prosumagers with electrified heating systems can shift in the years 2030, 2040, and 2050, according to the newTrends decarbonisation scenario.*

**Visualizing the Potential Impact of Electrified Heating Systems on Electricity Load**

In Figure 3, we demonstrate the potential effect of electrified heating systems on the overall electricity load in residential buildings. We have used France's electricity demand as an example, from January 31 to February 2. The simulation of the wholesale price and the collective response of all buildings with electrified heating systems shows the significant potential of the building sector to actively shift load.

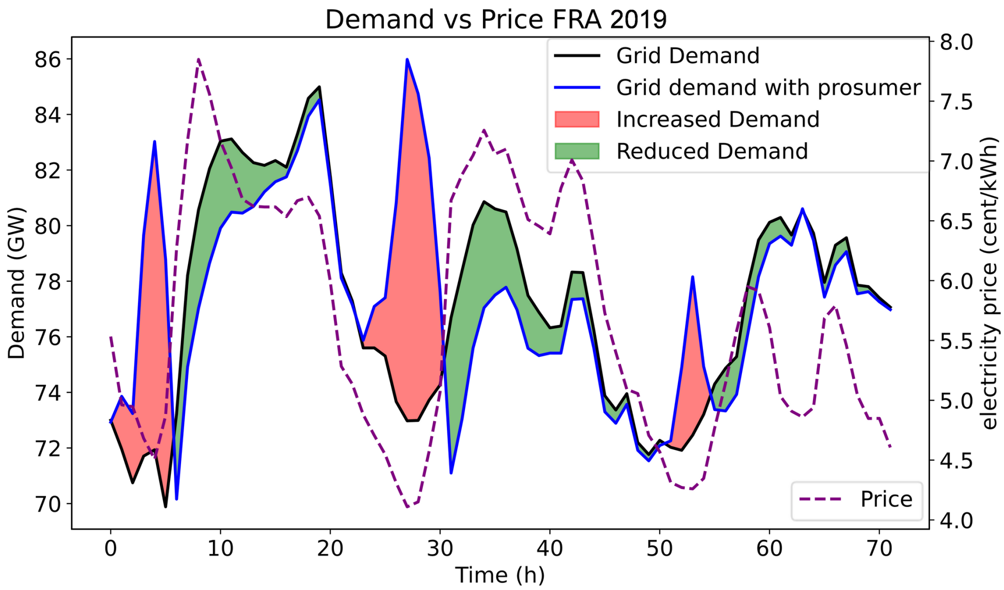


*Figure 3: Electricity demand in France in 2020 with the respective increase and decrease in required generation, if all households with electrified heating systems reacted to the electricity price profile as observed in 2019. The figure shows 3 days (31 January-2 February). Generation data and electricity price downloaded from ENTSO-E[1].*

*[1]. https://transparency.entsoe.eu/, accessed on the 11.10.2023*

## What changes do we want in policies?


**Variable electricity tariffs are the first important step to incentivise demand**. The economic incentive, currently through variable prices, is not sufficient to lead to a wide spread penetration of smart energy management systems. However, in the future, with rising electricity prices, the potential savings of smart operated heat pumps can be significant.

To prevent energy poverty of households without the means to invest in such smart technology, measures should be put into place supporting these households in a tailormade way.

**Enhancing Smart Energy Management Systems for Low-Income Households through Subsidies**

To help foster and encourage the use of smart devices for energy management among low-income households, **governments can introduce legislation to standardise heat pumps**. These would automatically respond to external signals for a certain reimbursement. By combining subsidies for thermal storage with heat pumps, individual buildings can make a significant contribution to overall energy systems.

Smart meters are crucial for making demand response possible, which is why there needs to be an accelerated rollout across most EU countries.

## Suggested revisions in policy. What are the various options?

**Avoid price caps for electricity prices to increase the incentive to shift and reduce demand.**

**Design alternative policy instruments to protect vulnerable consumers, such as subsidies for refurbishment, demand response appliances (storage), and smart controls.**

**Additionally, a legislation forcing heat pump producers to make them controllable through an external signal would help poor households and increase the overall potential to shift load drastically.**

# Advantages and disadvantages of each policy option. What are the potential benefits? What will it cost? What side effect might be there?

A potential side effect that might occur when all users react to the same price profile is grid congestion. Therefore, local price signals or other time-based incentives could be needed to shift the demand based on the local capacity on the grid side and renewable generation available close by. This will of course lead to more decentralized system configurations. Control of single households can also be done through aggregators on regional (local) level to minimize risk of distribution grid congestion.

| Policy option | Benefits, advantages | Costs, disadvantages | Potential side effects |
|---|---|---|---|
| **Local and dynamic electricity tariffs combined with a faster roll-out of smart meters** | Shifting the demand based on the local capacity on the grid side and renewable generation available locally<br><br>More decentralised, sustainable and resilient energy system configurations | Upfront costs for installation, metering equipment, communication systems, and data management<br><br>Challenging for consumers to understand and may require education and awareness campaigns | When all users react to the same price profile, grid congestion and extremely high price volatility may occur<br><br>Disproportionate effects on low-income households or those with limited flexibility in their energy consumption |
| **Subsidies for thermal storage combined with heat pumps and system optimisation to maximise the contribution of single buildings to the overall system** | Improved energy efficiency and reduced reliance of buildings on traditional heating and cooling systems during peak times, such as heatwaves or extreme cold<br><br>Cost savings for building owners and avoided high electricity prices during peak times<br><br>Enhanced grid stability and reduced greenhouse gas emissions | Upfront costs for installation of thermal storage systems, heat pumps, and system optimisation<br><br>Restrictions or constraints on the responsiveness of the thermal storage systems during peak demand periods, which may be getting more and more severe due to climate change | If buildings become more energy-efficient through the use of thermal storage and heat pumps, occupants may be more inclined to use additional energy or increase their overall energy demand, offsetting some of the energy savings initially expected (rebound effect)<br><br>Increased demand during charging periods for thermal storage systems |

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## newTRENDs partners:

*This policy brief is mainly based on the results of WP5 of the newTRENDs project.*

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