TRANSITION PATHWAYS TO SUSTAINABLE LOW-CARBON SOCIETIES

HEATING

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Towards low-carbon heating: Key drivers and challenges for the forgotten energy sector

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Context

EU-wide, CO_2 emissions from the buildings sector are projected to be just as important as those from electricity generation and mobility. Space heating and hot water are the most important energy services in buildings, together accounting for approximately 80% of total EU residential energy demand. Still, studies focus more at electricity and mobility than at heating and buildings.

Inertia and lock-in play a key role in the buildings sector: Changing the heating sector is difficult due to long investment cycles, low refurbishment rates, as well as low user awareness and a general lack of policy commitment. Nonetheless, there are some positive signs of change with increasing policy and public attention.

The EU FP7 project PATHWAYS explored the possibilities for transitions to a low-carbon, biodiversity-rich, sustainable Europe by combining the analysis of different scientific approaches: integrated assessment modelling, socio-technical transition analysis, and case studies and participative action research. Integrated assessment modelling can provide a macro perspective, linking future goals to short-term actions. Integrated assessment modelling also allows linking different policy issues, such as biodiversity protection and climate change. Socio-technical transition studies seek to explain long-term shifts, taking account of a broad set of institutional, economic, social, and cultural factors, including those enabling behaviour change and adoption of new technologies. Participative action research, finally, engages with concrete projects at the local and regional scale involving diverse social actors such as citizens, businesses, civil society organisations and (local) government, with the aim of fostering innovation and upscaling innovative sustainability solutions.

Key Messages

Decarbonising heating is both urgent and challenging

In the PATHWAYS scenarios that achieve a long-term EU greenhouse gas emission reduction target of 80% by 2050 relative to 1990 levels, CO_2 emissions from residential heating are reduced by 35% to 50% by 2050 relative to 1990. Since

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SEVENTH FRAMEWORK PROGRAMME

existing infrastructure and the built environment are difficult to change, this task is far from easy and requires a rapid introduction of new policies.

Decarbonising heating requires action on both demand and supply side

There are a number of measures that can help to reduce carbon emissions from heating (Figure 1). Important measures at the demand side are measures targeted at more efficient use of heat (through improved insulation, modern glazing and ventilation systems – both for new houses and for existing ones), and at reducing heating needs (lower indoor temperatures, behavioural change, and more smartly controlled heating). Supply-side interventions rely on the deployment of low-carbon heating sources, such as heat pumps powered by renewable electricity, solar heating, and heat networks (e.g. district heating using waste heat).

The PATHWAYS project analysed two alternative pathways in which EU greenhouse gas emissions are reduced by 80% by 2050 relative to 1990. In Pathway A the current regime remains strong, and incumbent actors mainly search technology substitution responses to the current challenges. In pathway B, new actors come in creating a total regime shift with more radical response strategies (including also behaviour changes). In Pathway A, alternative heating systems (including heat pumps and district heating) play an important role. In Pathway B different heating and cooling practices, smart metering, and passive housing play an important role.

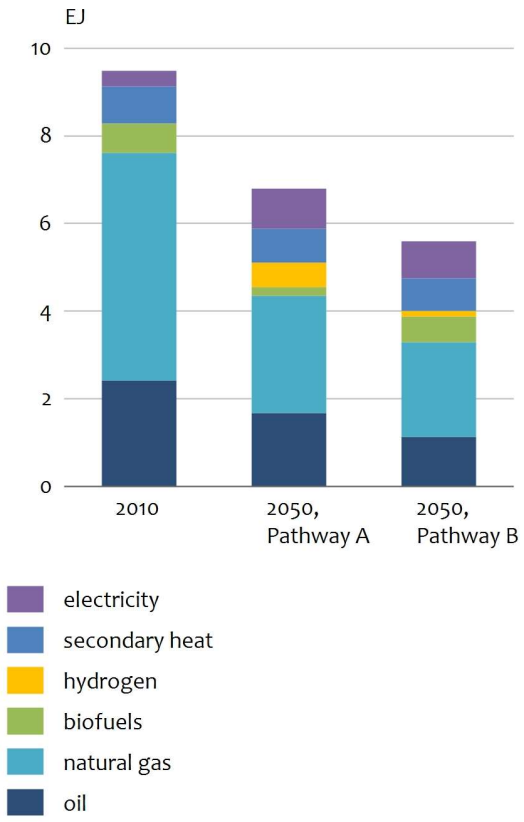

Figure 1 *EU heating energy demand in alternative transition pathways according to the IMAGE model. Source: Results from the PATHWAYS project. See text box on this page for an explanation of Pathway A and B*

Important policies include monetary incentives and providing supply-chains and maintenance networks for low-carbon heating technologies

The technological options to reduce carbon emissions from heating are known, available, and mature. The main challenges are changing existing structures and behaviour as well as introducing the low-carbon technologies. Monetary incentives could support this, as shown by the successful switch in Swedish heating from oil to electricity, district heating, and biomass, which was supported by policies that increased the cost of carbon and incentivised structural

change. Furthermore, supply-chains and maintenance networks for low-carbon heating appliances such as heat pumps need to be developed. Such an infrastructure is largely lacking in many European countries. For successful deployment of capital-intensive options like district heating, several conditions need to be in place, including policy and legal as well as business frameworks that can support long-term investments.

Electrification of heat is a promising strategy, but important challenges have to be addressed

For countries with electric heating, heat pumps could be an important efficiency measure. Also in other countries, an "electrification of heat" could be expected. Indeed, the potential of heat pumps for decarbonisation is large, but 'outsourcing' decarbonisation of heat to the electricity sector also presents significant challenges and adds to existing ones: It elevates the demands on the power sector for decarbonised and renewable energy production. Specifically, addressing power intermittency of sources such as solar and wind will become even more important. Another example is the development of heat networks, which offers huge potential but only if primary energy sources are renewable. In Sweden, there is an on-going discussion related to the import of waste for combined heat power plants. Complementarily, more attention needs to be given to the development of effective energy storage infrastructure. Moreover, there will be an increased need for developing more and smarter grids and incentivising consumers to shift demand to off-peak hours.

Actor-specific barriers need attention

While innovation and improving standards in new low-carbon buildings are essential, the elephant in the room is the difficulty to reduce demand through retrofitting buildings – as it is not possible to reach deep demand reductions without large-scale refurbishment. Especially here, solving actor-specific barriers is of utter importance. In Germany, the split-incentive dilemma between owners and tenants is one of the main decelerators of change as both groups are not willing to bear the costs of refurbishment and therefore are united in hindering effective energy saving measures. Another important issue to be solved is dysfunctional incentive structures in heat supply. In the building sector many companies have a double role. They are incumbents that produce fossil-fuelled appliances, and at the same time are crucial innovators for renewable technologies such as heat pumps. However, as long as the former appliances provide a good pay-off there is little incentive to concentrate more of improving and marketing renewable technologies more forcefully.

Measures targeting behavioural change are effective in the short term and have important co-benefits

Heating is specifically susceptible to behavioural influence. Behavioural change in heating practices can open up effective low-investment opportunities, not only from a government's perspective but also for consumers. However, behavioural measures are difficult to control and can lead to rebound effects, such as when efficiency gains from refurbishment and more efficient appliances are offset by increases in energy consumption. Thus, demand reduction through behavioural change requires active intervention strategies including consumer education, awareness raising, altering the structure of incentives, improved billing, as well as heating devices and related products designed with behaviour change in mind. Such measures

can induce energy saving cheaply and relatively quickly. They can also help to alleviate energy poverty, as they do not require major investments but rather changes in habit, which could help reducing people's energy bill.

Smart meters require careful installation measures including programming and schooling

The roll out of smart meters has been a major part of many national strategies towards energy saving. However, research shows that smart meters perform well below aspired targets due to rebound effects and wrong application in houses. To yield positive results, the diffusion of smart meters requires careful installation measures including programming as well as education for installers and users. In this regard, smart metering has been shown to profit from feedback-giving devices that complement "smart" capabilities with tuning behaviour towards more conscious heating, ventilating etc. It is of vital importance to include such devices into strategies for smart metering and enabling correct use by installers and users. Otherwise, positive effects from smart metering are not likely to occur.

There are important co-benefits of residential sector efficiency programmes

Measures associated with low-carbon heating have important co-benefits. Next to providing help in the face of energy poverty, issues such as indoor air quality and protection from harmful threats to health such as mould are clear advantages. Moreover, they can increase living comfort while at the same time decrease energy use. Effectively addressing and communicating these co-benefits can therefore increase societal acceptance for heat-efficient housing and motivate investments and behavioural change.

A transition to low-carbon heating requires a consistent and coherent strategy

Most European countries lack coherent and consistent strategies for low-carbon transitions in heating and the building sector. Such a strategy should include a spectrum of interventions, starting with cost-effective behaviour-oriented solutions that can also reduce energy poverty, all the way through more challenging and costly structural options involving substantial changes to the building stock and energy infrastructure. Only a well-planned approach, with consistency and coherence in measures over time is likely to be successful. It takes time to build knowledge, to transform infrastructure, and to gradually replace fossil-fuel dependent technologies. These strategies may differ between countries, and a European political strategy should balance European overarching measures with subsidiary strategies and intervention schemes.

About the PATHWAYS project

The EU FP7 project PATHWAYS is a unique project that explores the possibilities for transitions to a low-carbon, sustainable Europe. The essence of PATHWAYS is that it combines the analysis of different scientific approaches: integrated assessment modelling, transition science research, and participative action research. By combining and coordinating information from these different approaches for selected cases, PATHWAYS aims at providing better policy advice for European, Member State and local policy-maker.

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