The Role of Households in Danish Energy Policy: Visions and Contradictions

Inge Røpke, Charlotte Jensen and Maj-Britt Quitzau

Abstract This chapter outlines the transformation of the Danish energy system from the oil crises in the 1970s to the present challenges. Energy policies have ensured a successful implementation of district heating based on combined heat and power and high penetration of wind power in the electricity system, but also substantial dependence on the use of biomass. The transformations have concentrated mainly on the supply side, where the involvement of households has been somewhat scattered. Turning to the future challenge of decarbonization, more focus on the demand side is needed, including energy savings and the electrification of mobility and heating. In this process, households may need to be involved differently. An innovative example of multi-actor engagement in energy renovation of private homes is presented.

I. Røpke (✉) · C. Jensen · M.-B. Quitzau
Department of Planning, Aalborg University, Copenhagen, Denmark
e-mail: ir@plan.aau.dk

C. Jensen
e-mail: cjensen@plan.aau.dk

M.-B. Quitzau
e-mail: quitzau@plan.aau.dk

Keywords Denmark · Danish energy system · Transformation · Energy savings · Role of households in energy transformation

INTRODUCTION

This chapter outlines developments and tendencies in Danish national energy policy, contextualized in brief descriptions of the Danish energy system as well as current energy reduction approaches.

The chapter is divided into four overall sections, beginning with a short, historical illustration of how and why the current Danish energy system has come to be. Subsequently, current trends in Danish energy policy are presented and discussed in relation to how the role of households is portrayed in current and future strategies for low carbon transitions. Danish national energy policy and approaches tend to utilize mainstream understandings, or problem framings, of energy demand, wherefore strategies and approaches for energy reductions usually take on technocratic or consumer-behaviour oriented perspectives on change. There are, however, a few examples of Danish sustainable energy consumption initiatives that take a broader perspective of change, and bring forward the need for practice-based, systemic changes in order to obtain low carbon transitions. The chapter will provide a short introduction to one such initiative, followed by an overall conclusion.

THE DANISH ENERGY SYSTEM

The Danish energy system has been through continuous transformations since the oil crises in the 1970s. Presently (the late 2010s), the system is characterized by a relatively high penetration of wind power in the electricity system, a large share of district heating based on combined heat and power (CHP), a high degree of self-sufficiency in energy, and considerable use of (imported) biomass.

The first steps towards a modern utilization of wind power were taken by pioneers and popular movements in the wake of the oil crises, but the endeavour played a limited role in the first decades and met with much resistance from incumbent interests. Instead, electricity companies focused on replacing oil with coal, and tried to promote the introduction of nuclear power, but this was blocked by a combination of factors, including public resistance. When global warming began to attract public

attention in the late 1980s, politicians forced electricity companies to invest in wind turbines. Gradually, wind power gained an increasing role in the system, comprising 43% of annual average electricity demand in 2017 (Energistatistik 2017).

The expansion of district heating and CHP was another result of the oil crises, which encouraged considerable heat planning efforts aimed at decentralization. Previously, nearly all electricity was produced by large central power stations, which were gradually converted to CHP to provide district heating to larger cities. In addition, existing local district heating plants were converted to also generate electricity, and the number of decentralized CHP plants increased considerably, standing at about 400 today (Dansk Fjernvarme 2018).

When the oil crises emerged, fossil fuel extraction from the Danish part of the North Sea was in its infancy. The government decided to establish a system that could make use of the related natural gas to replace oil in residential heating. Two collective pipe-based systems were thus established: direct provision of natural gas to households (and other sectors) and district heating based on CHP. Heat planning stipulated which areas should be supplied in which way. By and large, both the electricity system and CHP plants were collectively owned by consumers or municipalities until about the year 2000, after which the system underwent liberalization and partial privatization (Hvelplund 2007). Combined with legislation that allowed municipalities to commit consumers to connect to the collective systems, this form of ownership enabled a remarkable transformation to a more rational energy utilization. While about 25% of households were connected to district heating in 1975, today about 65% of households use district heating, while 15% are heated with natural gas (Wistoft et al. 1992: 204; Energistyrelsen 2018). In an EU context, a similar penetration of district heating occurs only in the Baltic countries.¹

Resource extraction from the North Sea also provided oil, and, as production increased, the dependency on imports fell. The degree of self-sufficiency in total energy use grew from 5% in 1980 to 52% in 1990, and in 1997 Denmark became energy self-sufficient (Dietrich and Morthorst 2016).

¹<http://www.euroheat.org/wp-content/uploads/2016/03/2015-Country-by-country-Statistics-Overview.pdf>.

Peaking in 2004, the degree of self-sufficiency reached 155%, but since then the production of oil and gas has fallen, and the degree of self-sufficiency fell to 85% in 2017 (Energistatistik 2017).

Security of supply was the main concern in the wake of the oil crises and encouraged conversion from oil to coal in power plants. When climate concerns later intensified, the phase-out of coal emerged on the political agenda. Local CHP plants adopted the use of a variety of fuels including wood pellets, waste, straw, natural gas and biogas, and more recently, large power plants increasingly converted from coal to biomass. Since 2000, the use of biomass has more than doubled, with imports accounting for 43% of biomass used in 2016 (Klimarådet 2018). With the inclusion of biomass, renewable energy constituted 33% of Danish energy consumption in 2017, up from 6% in 1990 (Energistatistik 2017).

When corrected for trade in electricity and weather, total Danish energy consumption was 5.7% lower in 2017 than in 1990. In terms of CO₂ emissions, Danish emissions fell by 38% from 1990 to 2017 (Energistatistik 2017). However, the Danish CO₂ emissions per capita are still a little above the EU average in 2016.² Part of the explanation why Denmark lacks behind some rich countries, such as Sweden and the UK, is that Denmark neither has hydropower, nor nuclear power.

CURRENT TRENDS IN ENERGY POLICY

As the outline above illustrates, the transformations of the Danish energy system have concentrated mainly on the supply side. But some of the changes involved the cooperation of households, who changed their heating installations from oil burners to district heating installations and natural gas boilers. The oil crises also led to other initiatives on the demand side, including campaigns aimed at persuading people to lower the temperature in dwellings and turn off lights. Subsidies were provided for thermal insulation and double-glazing, and building regulations were tightened. Compulsory energy labelling of appliances was introduced, and campaigns to shut off standby mode on appliances were implemented (Christensen et al. 2007). In spite of all these initiatives,

² https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_rd300&plugin=1.

energy consumption has been relatively stagnant. Both population and living standards have increased, implying increased car ownership, more square metres per person, more appliances, more leisure travel, etc. In addition—and not included in these accounts—part of the energy consumption related to improved living standards has been outsourced to other countries as part of globalization.

The top priority of Danish energy policy is currently to reduce carbon emissions. All parties in Parliament agreed in 2018 on the goal that Denmark should be carbon neutral in 2050. This means that carbon can only be emitted if the emissions are compensated by a similar uptake in soil or forests or through technologies that capture and store carbon. This Energy Agreement includes measures to reduce emissions from the energy sector and energy-intensive industrial plants (covered by the EU Emissions Trading System, ETS), for instance, the establishment of offshore wind farms and other investments in wind, solar power and biogas.³ However, little is included to reduce emissions from the sectors that are not covered by ETS, such as transport, agriculture and buildings. These issues are due to be dealt with in separate agreements, but the challenge is tough due to substantial political disagreements.

In the long term, the extensive use of biomass for energy purposes is problematic because the land use competes with food production and the protection of biodiversity. Presently, the proposed solution is electrification of mobility and heating, based on electricity from wind and solar power. Households are encouraged to buy electric cars and to replace remaining oil burners with heat pumps, and the local CHP or heat plants are encouraged to invest in large heat pumps instead of using biomass. While some steps towards electrification have been taken, much remains to be done. One incentive for electrification has been the reduction of electricity tariffs, but this measure also has the unintended effect of reducing an incentive for energy savings. To avoid this rebound, electric cars and heat pumps would have to be promoted more effectively by targeted measures. If electrification succeeds, the need for wind and solar power will increase more than corresponding to the planned investments. Furthermore, the demand for increased capacity is amplified, as Denmark presently attracts large data centres because the high share of wind power serves to legitimize electricity use.

³<https://efkm.dk/ministeriet/aftaler-og-politiske-udspil/energiaftalen/>.

Equally, a missing focus on energy savings is reflected in the lack of measures to reduce energy use in existing buildings. New buildings are constructed to high energy standards, but there is significant potential for energy renovation of the older housing stock, which would be a relatively cheap way to reduce carbon emissions (Klimarådet 2017). The need for thermal improvement of the existing housing stock can partly be seen as a paradoxical result of the previous success with CHP, which ensured cheap heating for many years (recently, some plants have had to raise prices because the increasing electricity production from wind reduces the demand for electricity from CHP plants and thus increases the price of heating).

The relatively high share of wind power in the electricity system and growing prospects of electrification of heating and transport call for preparations of the energy system for more flexibility. Since 2010, smart grid solutions and flexible demand have attracted much interest, involving research and experiments. The smart grid concept concentrates on the electricity system, but it is increasingly acknowledged that a low carbon transition must involve the coevolution of several other systems. The discourse thus tends to change towards smart energy systems (Lunde et al. 2016).

THE ROLE OF HOUSEHOLDS IN THE LOW CARBON TRANSITION

For a long time, households have had access to various subsidies for retrofits, installation of solar panels and replacement of oil burners with heat pumps. Some subsidies are still available, for instance, mediated through the electricity distribution companies,⁴ but the present level is low. The support for solar panels has been characterized by stop-go policies, as the impacts and expenses have been difficult to predict. The Energy Agency runs a webpage with advice on energy savings, renovation, subsidies, etc.,⁵ but in practice, it does not appear to be a high priority for the state to involve households actively in the transition. Households are mostly seen as passive consumers that can be motivated

⁴<https://efkm.dk/aktuelt/nyheder/2016/dec/ny-energisparsaftale-paa-plads/>.

⁵<https://sparenergi.dk/>.

through prices, including reduced tariffs on electricity and electric cars. Based on smart grid solutions, households are also expected to react to flexible electricity prices.

Considering the scale of the challenge ahead, it might be beneficial to involve households more actively in the energy system. Some citizens take on this task themselves and organize both energy savings and provision of renewable energy, however some initiatives may raise complex dilemmas. For instance, it is not always desirable from a systems perspective when households increase self-sufficiency (e.g. through solar panels, domestic wind turbines and batteries). Nevertheless, engagement is decisive for the promotion of overall change, and active municipalities may facilitate a reasonable fit between considerations of systems and engagement.

SUSTAINABLE ENERGY CONSUMPTION INITIATIVES

It is evident from the above description that the Danish energy system, Danish national energy policies, and initiatives for energy reductions have developed and changed over time in such a way that several aspects have become interlaced. Dependence on rational choice mechanisms across policy, initiatives and evolving system configuration has resulted in complex, and sometimes contradicting dynamics (such as a push for cheap district heating and resulting lack of thermal insulation measures). It is therefore no surprise that energy demand dynamics are multi-dimensional and difficult to address. Equally, it is of no surprise that several, sometimes contrasting initiatives for energy reduction come about, as also highlighted in the previous section.

National sustainable energy consumption initiatives tend to either focus on technological optimization and consumer adoption of more energy efficient products (e.g. energy saving contests; various Danish Energy Agency campaigns), or an altogether different approach of establishing small eco-communities that develop their own independent grids and alternative lifestyles (e.g. eco-villages; transition towns). As mentioned earlier, municipalities hold the potential for establishing initiatives that enable broader, systemic changes as well as local engagement, and a few sustainable energy consumption initiatives have been developed with this consideration in mind. An example of one such initiative is given below.

MY CLIMATE PLAN MIDDELFART: A GOOD PRACTICE EXAMPLE

As part of a broader climate commitment strategy, Middelfart Municipality initiated a somewhat alternative approach to energy renovation of private homes in 2011, called 'My Climate Plan'. The municipality had good experiences with energy renovations of public and commercial buildings through the so-called ESCO models. Here, Energy Service Companies help the owner of a building to invest in optimizing energy consuming installations within the building, paid by the obtained energy savings. This setup was, however, not commercially viable for small private households, which the municipality also wished to address in their climate policy. As a result, Middelfart Municipality developed the idea of an 'ESCO light' initiative, where the professional Energy Service Companies were substituted with a local strategic partnership, consisting of a number of local stakeholders (craftsmen, a bank, and utility companies, among others) in order to provide better incentives for homeowners in the municipality to carry out energy renovations of their homes (Westergaard 2011).

A key challenge was that municipalities have no persuasive or regulative planning instruments to mobilize energy renovations among private homeowners. As a result, the lack of energy optimization for small privately owned buildings represents a hindrance for reaching ambitious climate targets in many Danish municipalities. Numbers from Teknologirådet (2008) show that while 145,000 households renovated their kitchen, 165,000 renovated bathrooms, and many fitted new floors, put in new windows and renovated roofs, only 20,000 carried out energy retrofits. Formerly available national subsidies for energy renovations have almost disappeared, so incentives are low. The strategic lever developed in Middelfart was built on the foundation that energy retrofits can be meaningful for homeowners to perform if investment in energy optimization is carried out together with general renovation projects in the house. For example, it is much cheaper to insulate a roof, if you are already installing a new one. The municipality saw the potential of using local craftsmen as spokespersons for energy renovations, when bidding on general renovation projects. Together with the Knowledge Center for Energy Savings in Buildings, the municipality helped to provide a supplement to an existing energy advice training that was offered

to local craftsmen on commercial terms. The municipality facilitated meetings and dialogue with the local craftsmen in order to inspire them to take the training at the Knowledge Center, and provided a framework on how to approach private homeowners with energy saving advice. The course introduced the local craftsmen to energy related aspects of building renovations across different professions. Based on this course, the craftsmen advised homeowners about when it would be suitable to think about energy optimizations, and they started recommending each other, when they saw that complementary services were needed. The project gained political endorsement in the municipality due to the perspective of strengthening the business plans of local craftsmen.

Besides the partnership with the local craftsmen and the Knowledge Center, the municipality also developed a framework concerning further financial incentives for the homeowners. This involved the local utility company that could reimburse the private homeowners with 1 DKK per saved kWh, if the local craftsmen filled out a quality documentation of the energy savings (Escommuner 2013; Westergaard 2011). This reimbursement was based on the commitment that utilities have towards the Danish state to apply a certain amount of their income to carry out energy saving initiatives. A local bank agreed to provide more attractive loans for private homeowners that needed finance to carry out this kind of energy renovation (Jensen and Quitzau 2017). This was driven by the prospect of increased local opportunities and a possibility to market their local embeddedness and sustainability profile through involvement in the project.

By shifting the focus towards multi-actor engagement including craft professions, financial services and utilities, the municipality has developed a more 'structural' perspective that acknowledges renovation practices among homeowners. The case represents a good example of how such perspectives can include and address several complex situations related to energy renovations of private homes.

CONCLUSION

Although the Danish electricity system has come to utilize high levels of wind power over the years, and the Danish heating system to a large extent is based on district heating, Denmark still needs considerable

efforts to meet the targets of the Paris Agreement (Klimarådet 2018). Much of the national carbon-reduction measures focus on energy-intensive industrial plants (covered by the EU Emissions Trading System, ETS), through the establishment of offshore wind farms and other investments in wind, solar power and biogas.⁶ Little is included to reduce emissions from the sectors that are not covered by ETS, such as transport, agriculture and buildings. Equally, a missing focus on energy savings is reflected in the lack of measures to reduce energy use in existing buildings. New buildings are constructed to high energy standards, but there is significant potential for energy renovation of the older housing stock, which would be a relatively cheap way to reduce carbon emissions. Finally, households have had access to various subsidies for retrofits, installation of solar panels and replacement of oil burners with heat pumps, however, although some subsidies are still available (often mediated through the electricity distribution companies⁷), the present level is low. The support for solar panels has been characterized by stop-go policies, as the impacts and expenses have been difficult to predict. The Energy Agency runs a webpage with advice on energy savings, renovation, subsidies, etc.,⁸ but in practice, it does not appear to be a high priority for the state to involve households actively in the transition. The focus on energy reductions, particularly related to household energy demand is ultimately low, and the energy transition potential is seen mainly as a technical problem with technical solutions. Very little is done to target levels of energy demand at a national level. The presented good-practice example is a rare, but good, example of how everyday life perspectives, matters of convenience and institutionalized conditions around energy retrofitting potentials (or lack thereof) have been addressed at a municipal level.

⁶<https://efkm.dk/ministeriet/aftaler-og-politiske-udspil/energi aftalen/>.

⁷<https://efkm.dk/aktuelt/nyheder/2016/dec/ny-energispareaftale-paa-plads/>.

⁸<https://sparenergi.dk/>.

REFERENCES

- Christensen, T. H., Godskesen, M., Gram-Hanssen, K., Quitzau, M.-B., & Røpke, I. (2007). Greening the Danes? Experience with consumption and environment policies. *Journal of Consumer Policy*, 30, 91–116.
- Dansk Fjernvarme. (2018). <http://www.danskfjernvarme.dk/viden-om/fjernvarmeinfo>.
- Dietrich, O. W., & Morthorst, P. E. (2016). Danmark—Energiforsyning. In *Den Store Danske*. Gyldendal. <http://denstoredanske.dk/index.php?sideId=70753>.
- Energistatistik. (2017). <https://ens.dk/sites/ens.dk/files/Statistik/pub2017dk.pdf>.
- Energistyrelsen. (2018). <https://ens.dk/ansvarsomraader/varme/information-om-varme>.
- Escommuner. (2013). <https://escommuner.middelfart.dk/>.
- Hvelplund, F. (2007). Fra fælleseje til fjernejskab og monopolkontrol. In E. Christensen & P. Christensen (Eds.), *Fælledejer i forandring*. Aalborg Universitetsforlag.
- Jensen, C. L., & Quitzau, M. (2017). Towards more eclectic understandings of energy demand and change—A tale of sense-making in the messiness of transformative planning. *Energy Research and Social Science*, 31, 253–262.
- Klimarådet. (2017). *Omstilling frem mod 2030. Byggeklodser til et samfund med lavere drivhusgasudledninger*. <https://www.klimaraadet.dk/da/rapporter/omstilling-frem-mod-2030>.
- Klimarådet. (2018). *Biomassens betydning for grøn omstilling*. https://www.klimaraadet.dk/sites/default/files/downloads/klimaraadet_biomassens_rapportno4_digi_01.pdf.
- Lunde, M., Røpke, I., & Heiskanen, E. (2016). Smart grid: Hope or hype? *Energy Efficiency*, 9, 545–562.
- Teknologirådet. (2008). *Klimarigtigt byggeri – vi kan, hvis vi vil!* [Climate-friendly buildings – We can do it, if we want to!]. http://www.tekno.dk/wp-content/uploads/2014/12/p08_miljoebyg_rapport.pdf. (Old name: Teknologirådet; New name: Fonden Teknologirådet).
- Westergaard, M. (2011, February). *ESCO-Light i Middelfart Kommune* [ESCO-Light in Middelfart Municipality] (pp. 32–33). Silkeborg: Teknik & Miljø.
- Wistoft, B., Thorndahl, J., & Petersen, F. (1992). *Elektricitetens Aarhundrede. Dansk elforsynings historie. Bd. 2. 1940–1991*. Danske Elværkers Forening.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.