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Research

Talking Point

Climate-neutral building stock by 2050

A highly ambitious goal

March 25, 2021

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Single-family homes have recently been drawn into the discussion about suitable climate-policy measures in Germany. However, arguing about whether and to what extent single-family homes contribute to climate change or consume more resources than multi-family homes simply draws away the attention from the real energy and climate-policy challenges in the building sector. Moreover, the discussion underlines once again that calls for certain climate-policy measures often clash with how millions of people live or would prefer to live.

Single-family homes have recently been drawn into the discussion about suitable climate-policy measures in Germany. According to press reports, Anton Hofreiter, co-leader of the Green parliamentary group in the Bundestag, recently said that single-family homes require lots of space, lots of construction materials, lots of energy and lead to urban sprawl and, ultimately, more traffic. This statement is basically true. Single-family homes require more resources per square metre of living space or cubic metre of building space than multi-family homes. Since, on average, single-family homes offer more living space per capita than multi-family homes, their environmental footprint is larger. In addition, single-family homes require larger plots per dwelling unit than multi-storey multi-family homes. And if single-family homes are built on the outskirts or in rural areas, they lead to more urban sprawl and traffic than multi-family homes in densely populated city centres. In the political discussion, Hofreiter's statement was interpreted as a call for a ban on (new) single-family homes.

However, arguing about whether and to what extent single-family homes contribute to climate change or consume more resources than multi-family homes simply draws away attention from the real energy and climate-policy challenges in the building sector. Moreover, the discussion underlines once again that calls for certain climate-policy measures often clash with how millions of people live or would prefer to live.

More retrofitting of building necessary – but how?

Let us first take a look at the climate-policy challenges. Policymakers aim to make the building stock roughly climate-neutral by 2050. Enormous efforts will be required to even come near this goal, regardless of the type of buildings considered. For years now, about 1% of the building stock has been retrofitted for more energy efficiency per year. This percentage would have to be more than doubled. The endeavour is already quite difficult, simply because there are not enough artisans available. For years now, large parts of the construction sector have been suffering from a lack of qualified craftsmen. And the situation might even deteriorate further, as the number of apprentices is declining in many of the relevant sectors and more and more people are retiring. While comprehensive energy retrofittings may reduce the energy consumption of existing buildings by up to 80% (and, consequently, reduce CO_2 emissions), this is a highly unusual outcome. Emission reductions of this scale are possible only if the building was highly energy-inefficient before the retrofitting. And in any case, retrofitted buildings are usually not climate-neutral. The German Environment Agency also points out that carbon emissions related to the construction, retrofitting and demolition of buildings are not taken into account. Overall, there is much to do to make the building stock “almost climate-neutral”.

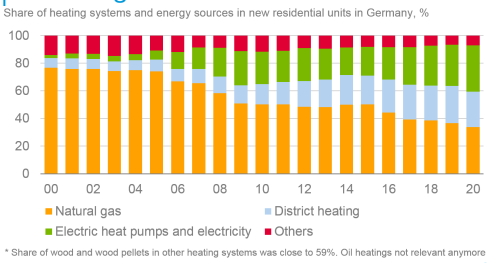
And there is another thorny question: What should policymakers do about homeowners who are unwilling or unable to retrofit their buildings for financial or other reasons? Should they be forced to renovate their homes by strict command and control law provisions? Should carbon prices be hiked to such an extent that homeowners start to consider retrofitting? Or should subsidies for retrofitting measures be increased until almost all owners are willing to invest in climate protection?

It will probably be difficult to find a political majority for either a stricter command and control law or considerable carbon price hikes. Just imagine the situation of a retired couple or a retired single who live in their own homes but have limited funds at their disposal; after all, more than six million people aged above 70 own their homes in Germany. Is there any political party which would force them by command and control law to spend a non-negligible five-figure sum on retrofitting their homes? Policymakers will also take into account social-policy considerations when it comes to carbon prices or taxes on energy consumption. According to the Federal Statistical Office, two million people in Germany were unable to afford sufficient heating for financial reasons in 2019. While the total number has declined in comparison to the figure registered ten years before, it shows nevertheless that energy price increases hit poorer people hardest, unless there is some compensation for higher administered energy prices.

The third option mentioned above, a significant increase of subsidies for retrofittings, is not realistic either simply because of financial constraints. It bears repeating that the government will not be able to subsidise all climate-protection measures. Moreover, subsidies will reinforce the supply shortage in the construction sector and/or lead to higher construction prices.

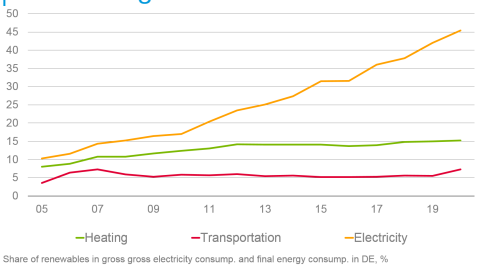
Climate-neutral building stock by 2050

Natural gas holds a narrow lead



Source: BDEW

Progress of renewables still limited in the heating sector



Source: Federal Environment Agency

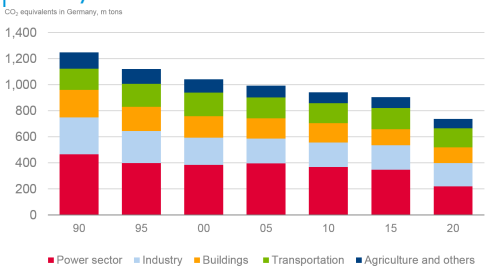
Building stock: A relatively inert system

Achieving a climate-neutral building stock is also difficult because the number of buildings is large and the system is therefore inert. All in all, there are about 19 m residential buildings (including about 15.7 m single- and double-family homes) with roughly 43 m residential units and about 2.7 m non-residential buildings in Germany. About two-thirds of all residential units in Germany were built before 1979. According to the German Association of Energy and Water Industries (Bundesverband der Energie- und Wasserwirtschaft, BDEW), about 50% of the 43 m residential units use gas for heating, 25% oil and 14% district heating, which is produced by thermal power plants (figures for 2020). The rest of the units use wood, electric heating pumps and electricity for heating purposes. Even now, one-third of all newly constructed residential buildings use gas for heating. The share of electric heat pumps amounts to just above 33%, too, ahead of district heating (25%) and wood (4.2%).

Renewables are obviously not yet playing a major role in heating. According to recent figures by the German Environment Agency, renewables had a share of about 15% in total final energy consumption for heating (and cooling) purposes. Bioenergy sources, above all wood, predominated with a share of more than 85%. Retrofitting all residential units for low-carbon or carbon-neutral energy sources by 2050 would require huge investments; by the way, bioenergy is not strictly carbon-neutral either. Apart from investment expenses, there may be prohibitively high technical hurdles for retrofitting. It is not easy to retrofit a building with a gas or district heating system (which relies on warm water flowing through pipes) with an electric heating system. Banning certain heating technologies for climate-policy reasons is unlikely to be a viable option unless affordable, high-performance and comfortable alternatives are available. Wood or bioenergy, which is currently the predominant alternative source of energy, will be available only in limited volumes, and in many cases, a conversion of the heating system will be impossible.

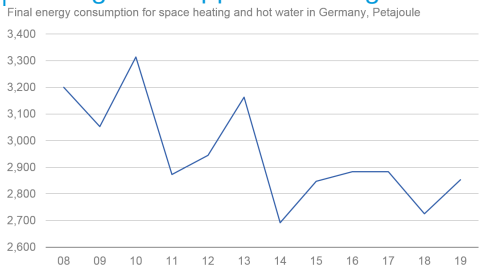
Climate-neutral building stock by 2050

GHG emissions have declined only slowly of late



Source: Federal Environment Agency

Final energy consumption for space heating has stopped declining



Source: BMWi

Final energy consumption for heating currently exceeds electricity production from renewable sources by more than 200%

And finally, we would like to discuss two other figures which illustrate the heating-related climate-policy challenges. Energy-related greenhouse gas emissions from buildings in Germany have declined by 28% between 2000 and 2021, to 120 m tons of CO_2 equivalents. This development is to some extent due to milder winters, which have reduced the need for heating. The annual decline amounts to just above 1.6% or 2.35 m tons. A quicker reduction will be necessary (not least given the increasing residential space) if the building stock is to become climate-neutral by 2050. The official interim target is to reduce emissions from buildings to 70 m tons by 2030. This translates to 5 m tons per year – more than double the current annual decline.

The second figure is even more sobering. According to the Federal Ministry for Economic Affairs and Energy, final energy consumption for heating and hot water amounted to almost 793 terawatt hours (TWh) in 2019. This is only just above 7% less than the average for the period from 2008 to 2012, and again, milder winters played an important role. However, the really important point is that we need to put the energy consumption for heating and hot water into a bigger context. It exceeds total gross electricity production in Germany by more than 30% and gross electricity production from renewable sources (as registered in the record year 2020) by more than 200%. So, if heating energy is to come primarily from renewable sources, current renewable gross electricity production would have to roughly triple to cover the related energy needs (and that is excluding transformation losses and taking into account building retrofittings for more energy efficiency). No renewable electricity would be left for industrial purposes, digital applications, household electricity consumption, lighting, electric vehicles or the production of green hydrogen. Increasing popular resistance against the expansion of onshore wind farms or new power lines is therefore not the only reason to doubt whether this option is viable.

These concerns have been aired before, and the figures are provided by reliable sources. They show just how “ambitious” the official goal of making the building stock almost climate-neutral is. It may be that the goal as such is not the subject of major discussions because 2050 seems a long way off. Still, one thing is clear: “single-family home shaming” is a symbolic action at best, at least in terms of climate policy. It is therefore not surprising that the supporters of the idea are suspected to have other motives.

People prefer to live in owner-occupied homes, even though they have lost importance of late

Let us finally turn to the fact that calls for certain climate-policy measures often clash with what people really want. Surveys have shown that most people in Germany would like to live in their own homes. The coronavirus pandemic has made a home and garden appear even more attractive. A ban on single-family homes would therefore run counter to people's preferences. The discussion reminds us of the issue of SUVs, which are becoming ever more popular. SUVs, too, are regarded as particularly detrimental to the environment, and electric vehicles are thought to form a major part of the solution. Neither statement is fully true. Flying, too, is often lambasted as a particularly harmful activity for the climate. Nevertheless, passenger figures in Germany increased almost every year until the pandemic, simply because people like to travel. There are many more examples of instances in which political and individual priorities clash. If the climate-policy debate focuses on emotional, symbolic issues (single-family homes, SUVs, flying, meat consumption), the main technological challenge shifts out of view: What we really need are better low-carbon sources of energy than those we are currently using to bring forward the energy transformation.

Let us return to the issue of single-family homes. Even though a majority of Germans would like to live in owner-occupied homes, more and more people have been moving to the big cities in the last few years. As a consequence, less space is available in the cities. Over the last few years, the number of newly constructed residential units in multi-family homes has steadily increased, whereas the number of newly built single or double-family homes is now considerably lower than in the 1990s or early 2000s. People are not stupid or naive. They know that it will be difficult to live in an owner-occupied home in the centre of a large city, both for financial and other reasons. And if they attach more importance to living in a city than to owning their home, they will move into an urban flat in a multi-family home. Remember that finding a comfortable flat is difficult enough in many cities.

Against this background, it makes sense to take into account regional circumstances. Not many building permits for single-family homes are issued in densely populated city centres. In fact, in these areas there may be a political majority for not issuing building permits for single-family homes any more in view of spatial constraints. The debate was triggered by a decision to that effect taken in a quarter of Hamburg. As a result, the number of existing homes will become scarcer, and they will probably become more expensive.

The picture is quite different in the country. Anyone who, for climate protection reasons, roundly rejects new construction plots for single-family homes in rural areas is unlikely to get political majorities for such plans. People who live in the country have decided they need the space which their houses and gardens offer and are willing to accept longer commutes and other disadvantages. The political discussion about a "ban on single-family homes" is another reminder just why the Greens are more popular in cities than in rural areas.

Original in German published on March 22, 2021: "Verbot von Eigenheimen? Ein weiteres klimapolitisches Placebo!"