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CDE POLICY BRIEF

Photo: S. Moser

Good intentions, big footprints: Facing household energy use in rich countries

Up to 97% of scientists agree that human activity – above all emission of CO_2 by burning fossil fuels – is altering our climate.[1] The risks of maintaining this carbon-burning trajectory[2] – including sea level rise, ocean acidification, more frequent droughts and other extreme weather events, population displacements, and resource conflicts – make it imperative to change course. This means drastically reducing our dependence on fossil fuel-based energy as quickly as possible. Households account for a large share of CO_2 emissions, especially in rich, consumption-driven economies. But which households consume the most energy and how could their carbon footprints be reduced? This policy brief explores these questions in Germany – both Europe's top CO_2 emitter and a leader in the push for clean, renewable energy.

The research featured here is focused on Germany.

Rich-country emitters

"How is it possible that the most intellectual creature that's ever walked the planet is destroying its only home?" asked esteemed primatologist Jane Goodall in an interview at the recent United Nations Climate Change Conference in Paris.[3] Her question has no easy answer. But it helps to focus the mind on key issues – especially humanity's collective responsibility for overconsumption of resources and emission of climate-altering CO_2.

The responsibility for such emissions is not shared *equally* by human populations, however. Historically, the top 5 CO_2-producing countries are the US, China, Russia, Germany, and the UK (total cumulative emissions, 1850 to 2007).[4] These countries are largely accountable for the unprecedented concentration of CO_2 in Earth's atmosphere[5] – a global common. Today, the world's top 5 *ongoing* emitters (in absolute terms) are China, the US, the EU,

KEY MESSAGES

- Wealthy industrialized countries bear particular responsibility for climate-altering CO_2 emissions – especially the US and the EU, which rank after China. Their climate actions, positive or negative, have sweeping implications.
- Household energy use plays a major – frequently underrated – role in rich-country CO_2 emissions. In Europe, for example, home heating and electricity use account for at least 25% of all energy-related CO_2 emissions.
- In wealthy countries like Germany, the richest population segments – including people who value the environment – appear to cause the highest emissions of CO_2.
- Policies to shrink people's carbon footprints must be income-sensitive, must target technology and behaviour change, and must address people's tendency to underestimate or ignore their CO_2 emissions in high-impact areas like home heating and personal mobility (e.g. driving and air travel).

Box 1: Determinants of personal energy use and CO_2 emissions in Germany

The estimates of personal energy use and emissions discussed here stem from a joint study by researchers from CDE and Germany's ECOLOG Institute, mandated by the German Federal Environment Agency. They conducted a representative survey of 1,000 people aged 18+ from across Germany to assess personal energy consumption and related CO_2 emissions in different areas (e.g. heating, lighting, travel, nutrition). The resulting "bottom-up" estimates of shares of energy used were largely consistent with the figures of other studies using official "top-down" national averages.[7] The findings show that the biggest energy users (and CO_2 emitters) are people with higher incomes and, surprisingly, higher self-identified environmental awareness. The biggest causes of people's private carbon emissions are home heating and personal mobility (Kleinhückelkotten, Neitzke, and Moser 2016).

India, and Russia (Germany alone ranks no. 7).[6] Of course, countries like China and India are high emitters partly because they produce goods for rich-country consumers. Indeed, if we re-rank countries based on the *emissions embodied in goods consumed* (per capita), a small country like Switzerland climbs near the top of the European rankings (no. 17 globally), even ahead of Germany (no. 34) and not far behind the US (no. 11).[8]

These rankings show vividly that richer, industrialized countries retain some of the biggest carbon footprints globally, while growth in other countries is also tied to rising CO_2 emissions. But the world has a carbon budget: According to many experts, we can only limit warming to 2 °C above pre-industrial temperatures – the estimated threshold for climate stability[9] – if we leave the majority of proven fossil fuel reserves (e.g. oil, coal) in the ground.[10] Thus, richer countries must quickly reduce their own use of carbon-based fuels to leave poorer ones space to develop. The recent Paris climate pledges were a start, but did not go far enough. The German Federal Environment Agency estimates that German emissions, for example, must be cut to 1 tonne of CO_{2e} per person by 2050 to achieve the goal of staying below 2 °C of warming.[11]

Private energy consumption

Importantly, the responsibility for carbon emissions is not evenly distributed *within* individual countries either. Energy use is by far the biggest cause, accounting for 79% of all CO_2 emitted in the EU.[12] Industrial sectors (e.g. steel) play a big role, but so do private households. Indeed, private households are a major – frequently underrated – contributor to energy-related CO_2 emissions. According to the European Environment Agency (EEA), household heating and electricity consumption alone are responsible for 25% of total energy-related CO_2 emissions in the EU.[13] But households' true impact is likely greater – especially if we consider that emissions often attributed to other sectors (e.g. transport, agriculture, manufacturing, cement) are partly driven by households (e.g. personal vehicle use, diet, appliance purchases, homebuilding).[14]

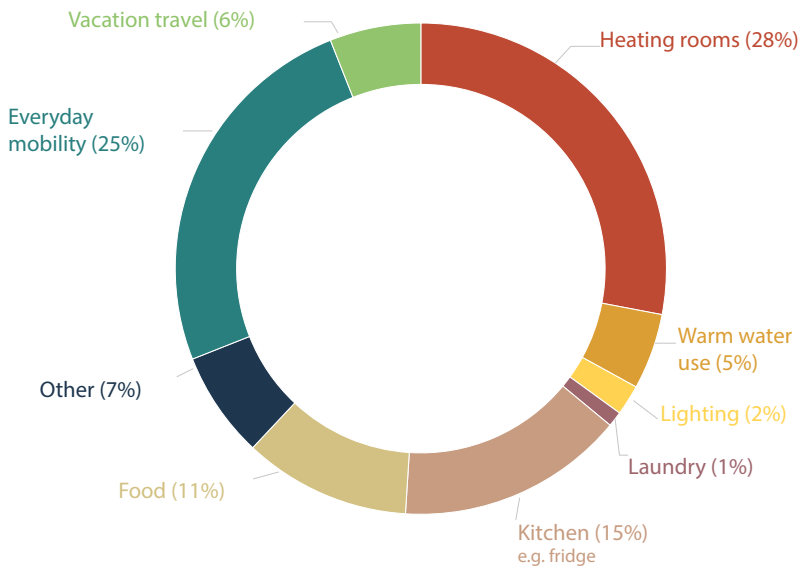

Figure 1. Contribution of different consumption areas to annual per capita CO_2 emissions of German households (based on Kleinhückelkotten, Neitzke, and Moser 2016).

At the same time, individual households vary considerably in their patterns and levels of energy use. Indeed, the way we personally consume resources has important implications for efforts to curb global CO_2 emissions. Researchers from CDE and Germany's ECOLOG Institute sought to shed light on such personal carbon footprints, conducting a representative survey of 1,000 individuals across Germany on behalf of the German Federal Environment Agency (see Box 1).

Europe's biggest emitter of greenhouse gases (21%)[15] and widely regarded as its economic engine, Germany's annual per capita CO_{2e} emissions (roughly 11.15 tonnes) are nevertheless closer to the EU average (8.44 tonnes) than might be expected.[16] Moreover, its citizens lead lifestyles not unlike those in neighbouring countries, making Germany a valuable test case for household consumption in Europe.

Biggest drivers

To reduce households' carbon footprints, we need to know what consumption areas cause the most (direct) energy-related CO_2 emissions. The survey of German households revealed the following:

Heating is the biggest contributor to private energy-related CO_2 emissions, accounting for 28% of the CO_2 emissions addressed in this study (see Figure 1). But the size and form of people's dwellings are key: People living in large, freestanding homes generally consume the most energy, while those living in smaller apartments consume less.

Mobility and travel also account for major shares of private emissions, encompassing use of personal vehicles for commuting and shopping (everyday mobility: 25%) as well as plane and car trips for pleasure (vacation travel: 6%).

Kitchen activities make up another big share (15%) of emissions, including cooking and use of energy-intensive home appliances like dishwashers and refrigerators. Just running a typical fridge can use more electricity in a year than a person in a developing country consumes.[17]

Food rounds out the high-impact areas at 11%, with dietary choices (e.g. levels of meat eating) giving considerable scope for change.

Biggest consumers

Knowing who is using the most fossil fuel energy is also key.

High earners. One trend was unmistakeable in the survey results, echoing the findings of similar studies in France[18], Canada[19], the UK[20], and beyond[21]: As personal income increases, so do energy consumption and emission of CO_2 (see Figure 2). On average, individuals earning over EUR 3,000 net per month emitted almost twice as much CO_2 as individuals earning less than EUR 1,000 per month. Unsurprisingly, higher earners tended to have larger dwellings, more and bigger cars, greater numbers of appliances and personal electronic devices, etc. – all implying increased energy use.

Lifestyle choice vs. necessity. Notably, the highest earners stand apart not only in their higher greenhouse gas emissions in absolute terms, but also in the activities accounting for the biggest shares of these emissions (see Figure 2). Their carbon pollution results disproportionately from activities like everyday mobility (35.5% share) and long-distance vacation travel (17.6%). By contrast, most of the CO_2 emitted by less well-off population segments is due to satisfying basic needs such as home heating, warm water use, kitchen activities (together about 50%), and food (up to 13%).

Eco-conscious, yet carbon-intensive

Closer analysis of social factors revealed a controversial, but not implausible pattern: People identifying themselves as environmentally aware tended to have larger carbon footprints than others, all else being equal.[22] A profound mismatch was found between environmentally concerned people's expressed intent and their actual impact, at least in terms of energy use. This is not necessarily for lack of trying. Indeed, those viewing themselves as eco-conscious tended to own more energy-efficient household appliances and favoured organically produced food and clothing, for example. But these choices were overshadowed in their bigger energy use picture.

The income effect is a key reason for this. Environmentally concerned people are typically higher earners, too. Their higher income leads them to use carbon-intensive energy in ways not unlike those of "unconcerned" consumers in the same income group: They tend to drive long distances in personal vehicles, live in relatively big homes, and seldom refrain from air travel on holiday or on business. They may have good intentions of reducing their carbon footprints, but they emphasize many actions with relatively small positive effects (e.g. upgrading their fridge or washing machine). Meanwhile, they often neglect areas like mobility or dwelling that cause the most CO_2 emissions. The one notable exception was food, a key area in which eco-conscious people's choices (e.g. vegetarianism) display comparably beneficial impacts.

Notably, many high-income, environmentally concerned people are also highly educated. They should be the perfect target group for evidence-based campaigns to reduce personal carbon footprints. So, clearly communicating the observed gap between their intentions and impacts may have some benefit.

But as the opening quote from Jane Goodall also suggests, policies that appeal solely to people's intellect are unlikely to be enough, whether among top earners or in other income groups. Sharper policies are needed – combining highly tangible incentives and disincentives – that will jump-start personal and systems-level transformations to a low-carbon future (see Box 2). Indeed, policymakers will need to appeal to people's heads (targeted information and communication), hearts (shared desire for a liveable world), and wallets (financial means to adapt) to enable change. Conversely, segments of civil society may have to make corresponding demands on policymakers, given the considerable pressure faced by the latter from industry lobbies (e.g. fossil fuel companies, manufacturers).

Box 2. Facing climate change risks and the energy challenge

Ongoing use of fossil fuels for heating, mobility, and consumption purposes is posing a grave environmental risk. Our current global emissions trajectory most closely aligns with the "worst case" scenario modelled by the Intergovernmental Panel on Climate Change (IPCC). According to its (median climate response) projections, "Global mean surface temperature increases in 2100 in baseline scenarios – those without additional mitigation – range from 3.7°C to 4.8°C" above pre-industrial temperature averages.[23] To put this into perspective: The difference in mean global temperatures between the last Ice Age (20,000 years ago) and today is around 5 °C.[24] Avoiding the worst risks of climate instability requires immediate action – concerted efforts to halt global growth of CO_2 emissions by 2020, then steadily reduce them by roughly 3% each year.[25] We can do this, but it demands major technology and behaviour change. First, we must fully commit to sweeping construction of renewable energy infrastructure – e.g. electricity grids based on solar and wind – and more sustainable housing and transport structures.[26] Second, we must live more intentionally, viewing our chosen lifestyles and consumptive habits as chances to create the world we want. Political courage, societal engagement, and human solidarity and ingenuity are the orders of the day.

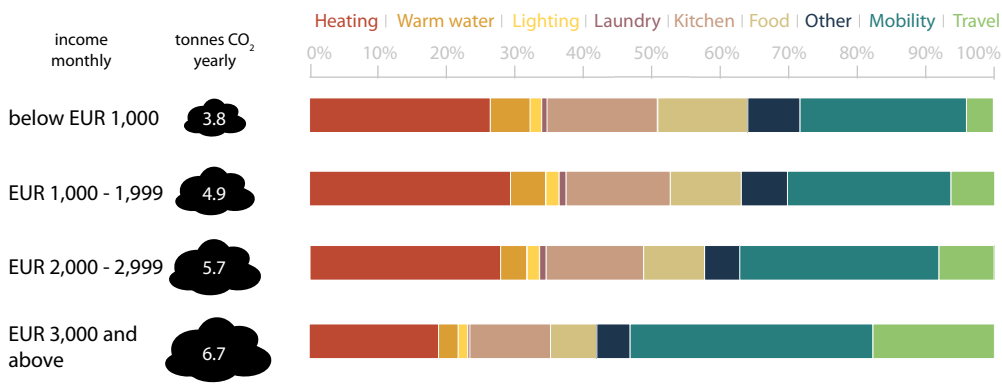

Figure 2. Annual per capita CO_2 emissions and consumption area shares according to income groups (net monthly income per capita) in Germany* (based on Kleinhückelkotten, Neitzke, and Moser 2016).

* Note: These emission estimates reflect *direct* personal energy use – assessed on the basis of individual and household consumption data – and do not include, for example, national industrial emissions. Only in the area of food consumption were indirect emissions factored in.

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Policy implications of research

Steer wealthier households towards reducing their carbon footprints
What is true of countries appears true of households: The richest emit the most CO_2. Policies to cut the emissions of wealthier households should focus on *technology and behaviour change* in *high-impact areas* (e.g. heating, mobility). Financial *incentive* and *disincentive* measures are key. Incentives include offering tax reductions or direct compensation schemes for investments in home weatherization or installation of renewable energy infrastructure (e.g. rooftop solar). Disincentives include mandating higher energy standards (e.g. net zero) for new homes; raising taxes on large or multiple (fossil fuel) cars; increasing aviation fees (especially luxury class) or requiring the purchase of carbon offsets.

Support low-income households in doing the same
The terms, funding, and ease of entry of incentive programmes for household energy improvement should be kept generous and even extended to enable wider participation. Other support to low-income households might include mandating clearly advertised, standardized energy ratings of dwellings to aid renter choice and expanding access to affordable public transportation networks.

Steadily raise the price of carbon, while shielding people from financial harm
One broader conclusion is unavoidable, however: We need rapid systems-level (e.g. electricity grid) transitions to clean energy, and markets are failing to deliver them. Oil, coal, and gas remain too cheap. This could be corrected by adding a steadily rising fee/tax to all fossil fuels. But the revenues should be given back to citizens on an equitable (per capita) basis, thus aiding low-consuming poorer households. Revenues could also fund energy upgrades for households on a similarly fair, income-sensitive basis.[27]

Effectively communicate policies to aid public understanding and acceptance
Any such policies impacting people's wallets and lifestyles must be accompanied by effective communications campaigns. These must emphasize clarity, credibility, fairness, and citizen involvement from day one.[28] Given a chance, people want to have a stake in solutions. And the overall goal must remain clear: preserving a thriving, liveable world.

Suggested further reading

Kleinhückelkotten S, Neitzke HP, Moser S. 2016. *Repräsentative Erhebung von Pro-Kopf-Verbräuchen natürlicher Ressourcen in Deutschland (nach Bevölkerungsgruppen)* [Representative survey of per capita consumption of natural resources in Germany (by population group)]. Dessau-Rosslau, Germany: German Federal Environment Agency. ISSN 1862-4804. https://www.umweltbundesamt.de/publikationen/repraesentative-erhebung-von-pro-kopf-verbraeuchen

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