Danish researchers explore how to reduce transport carbon emissions

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When cycling or walking, you have chosen some of the most climate-friendly modes of transport. But they are not always useful for going to Ikea, the recycling center, or doing the weekly groceries, and this is

where most of us grab the car.

This is reflected in the accounts of the Danish transport sector's carbon emissions, with road transport accounting for about 90%. About two-thirds of road emissions come from passenger cars, while the remaining third comes from trucks, buses, and vans.

In Denmark, the passenger car is the means of transport that people use the most, according to the Danish National Travel Survey, which is prepared by DTU. The latest study shows that in 2023, passenger cars accounted for 73% of all the kilometers we traveled domestically.

Errands and chores in our spare time are our most common transport reasons, with shopping being the main purpose. Only a quarter of Danes' travel are due to commuting to our work or education. However, we still like to use our car: 65% of our trips to and from work are made by car.

We drive longer

Passenger cars take up a lot of space—both on the roads and in the CO_2 accounts. Carbon emissions from road transport have—apart from a few outliers—remained fairly constant in recent decades, despite the fact that cars have become more energy-efficient.

"The carbon emission reductions that cars' increased energy efficiency should have produced have just made Danes take longer trips. The number of trips we make by car has remained virtually unchanged, but the number of kilometers we travel has changed: Now we go for longer trips. This has led to our driving emitting as much CO_2 as we did 30 years ago," says Hjalmar Christiansen, Senior Executive Officer at DTU Management and Project Manager of the Danish National Travel Survey.

Another reason why efficiency improvements in the fuel economy of cars have not resulted in major reductions in emissions is that we gradually have chosen larger and more comfortable cars with, for example, air conditioning, so the energy consumption of the cars thus remains high.

Last but not least, the increasing transport volume also reflects the fact that the Danish population is increasing, and more and more people need transport.

Surprising increase in number of electric cars

More electric cars on Danish roads is good news for road transport emissions of greenhouse gases. In 2023, electric cars accounted for 8% of car transportation in Denmark, while hybrid cars accounted for 6%.

In the Danish Energy Agency's report "Climate status and projection 2023," the Agency predicts that even though we are expected to drive more kilometers in our cars in the future, greenhouse gas emissions from road transport will still fall by an average of 3.1% per year until 2035, and this decrease will be driven in particular by electric cars.

Ninette Pilegaard, Deputy Head of Division and Head of Section at DTU Management, Transport Division, points to electrification as one of the key solutions that can address emissions from the transport sector.

"Electric cars essential to reducing road transport emissions of greenhouse gases. We can see that things are moving really fast now with getting more electric cars on the Danish roads. An increase in electric car sales in Denmark was anticipated, but it has been much faster than expected," says Pilegaard, who explains that the increasing demand is partly due to the development in electric cars and the many new models, partly because prices for electric cars have fallen and that taxes are lower

on electric cars than on petrol and diesel cars—so far at least.

The almost explosive increase of electric cars on Danish roads is evident in new car sales statistics. In 2023, the demand for electric cars broke all records, as more than one in three new passenger cars sold was an electric car. The market share of electric cars of 36% in 2023 was thus three times as high as had been predicted a few years ago, when it was thought at the time that one in ten new cars in 2023 would be an electric car.

Transport is a problem child

The transport sector is the second-largest CO_2-emitting sector in Denmark after agriculture, which emits the most. If agricultural emissions are reduced, e.g. through CO_2 taxes, as the expert group for a 'green tax reform' proposed in early 2024, then the transport sector will soon take the lead as the largest CO_2-emitting sector.

The transport sector's heavy footprint in the emission accounts is also seen outside Denmark's borders, says Kirsten Halsnæs, Professor of Climate Economics at DTU Management. For more than three decades, she has been lead author of the Intergovernmental Panel on Climate Change (IPCC), which publishes reports on greenhouse gas reductions. In the latest report, "Mitigation of Climate Change 2022," projections show that the transport sector will continue to emit large amounts of greenhouse gases.

"All over the world, the transport sector—like the agricultural sector—is called a problem child. This is because these are sectors that are difficult to convert and because we still need technology development before it can be done profitably. However, if we are to limit the temperature increase on Earth to 1.5–2 degrees Celsius, then all sectors must be included—including the hard ones," says Halsnæs.

"In addition, the transport sector is constantly growing. The need for transport is increasing all the time, whether it's passenger transport or freight transport, whether by land, sea, or air."

The professor also sees electrification as one of the crucial solutions, but it's well known that electrifying ships and aircraft is a challenge. However, the two modes of transport are not the largest CO_2 emitters, as they each account for less than 3% of global man-made carbon emissions. But over the past four decades, the demand for both aircraft and ships has only been trending upwards—apart from the brief slowdown during the pandemic. So there is a focus on replacing fossil fuels with other fuel types.

"We have a great need to develop fuel alternatives, such as hydrogen, ammonia, or methanol that can compete on price with fossil fuels," says Halsnæs.

Low-hanging fruit

Although electrification and alternative fuels are necessary technologies for transforming transport sector, we should remember the low-hanging fruit that can bring us towards a more climate-friendly sector, says Pilegaard. "Our analyses show that it is relatively inexpensive to invest in good conditions for cyclists to make these transport solutions more attractive. Although it does not save huge amounts of CO_2, these small gains come almost free—or at least much cheaper than developing new technologies."

She points out that we could also have a more focused urban development, because the layout of our cities affects whether we need a means of transport to do various chores. The incentive for carpooling could also be increased, so fewer people drive their cars alone.

Taxes are effective

Then there are the measures that limit driving. Here we could look at taxes on petrol and diesel, as well as road pricing, says Professor Jeppe Rich from DTU's Transport Policy Section at DTU Management.

"There is broad consensus that taxes on petrol and diesel are the most effective instrument because they are a direct tax on CO_2 emissions. Because the more petrol and diesel you use, the more CO_2 you emit. Higher taxes can curb the consumption of fossil fuels and thus reduce carbon emissions," he says.

By introducing road pricing—i.e. tolls on certain road sections—it is likely that some drivers will limit their driving. But imposing higher taxes on cars owners has a social bias, warns Jeppe Rich. He adds, "Higher petrol and diesel prices will always hit low-income households harder, as they will have to spend a proportionately larger share of their disposable income on refueling than those who are better off."

Several of the solutions are also about political priorities and decisions in addition to technology development. But as Head of Section Pilegaard points out, there is a need to push all buttons in order to significantly reduce transport emissions.

"The point is that if carbon emissions from transport are to be significantly reduced, we must use all measures available," she says.

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