Helping EU cities and regions cut carbon emissions

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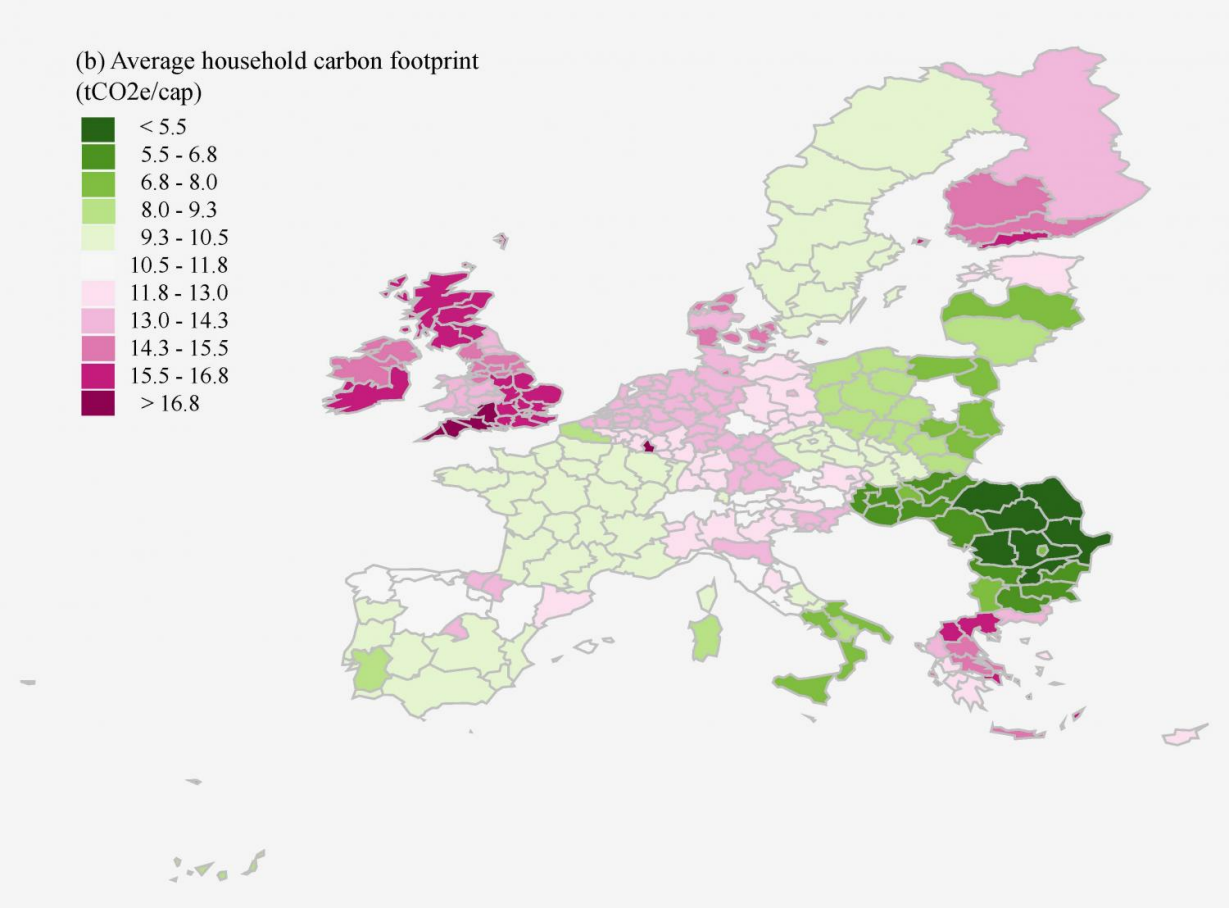

This map shows the average household carbon footprint for different EU regions. The darker the red colour, the larger the carbon footprint per household. The highest carbon footprints shown here are in the UK and in parts of Greece. Credit: NTNU Industrial Ecology Programme/ Environmental Research Letters

In 1915, a Scottish town planner and social activist named Patrick Geddes encouraged the readers of his book on "Cities in Evolution" to think about the big picture when planning on a local level.

His exhortation eventually morphed into the catchphrase, "Think globally, act locally," largely embraced by the environmental movement, especially in the United States.

And when US President Donald Trump announced he would withdraw the United States from the Paris Climate Agreement earlier this year, a range of US cities and states pledged to act on their own version of "Think globally, act locally," by cutting local and regional carbon emissions in keeping with the goals of the Paris deal.

But how does any one city or region know how big its carbon footprint really is? Researchers from the Norwegian University of Science and Technology (NTNU) now have an answer to that question, at least for the European Union.

In "Mapping the carbon footprint of EU regions," first author Diana Ivanova and her colleagues describe how they used consumer expenditure surveys and environmental and trade details to calculate the first-ever carbon footprints for 177 regions in 27 EU countries. These regional level footprints have been visualized as maps. Ivanova is a PhD candidate at NTNU's Industrial Ecology Programme.

The researchers also conducted similar analyses for land, water, and material use associated with consumption to create other interactive maps. These are available at http://www.environmentalfootprints.org/regional

Making cuts, not shifting emissions

The EU's climate policies set binding targets for the region's 27 member states, but Ivanova says the different countries need "a finer spatial dimension of consumption-related and environmental information that moves beyond national averages."

The idea, she says, is to make sure that policies to cut carbon emissions actually do so, instead of moving the production of those emissions from one place to another.

Consider automobile manufacturing. "If we started importing cars instead of producing them domestically, there may be a drop in country-wide emissions, but the consumption emissions may stay the same—or even increase, depending on the production efficiency," Ivanova said.

In theory, if a city or region has policies that encourage biking instead of driving, the researchers should be able to see the change in consumption patterns, with less car fuel consumed and fewer vehicles overall and a drop in consumption-based transport emissions, she said.

Big cities, wealthier individuals have bigger footprints

The researchers found that bigger cities and more populous regions have bigger carbon footprints, when they looked at the total household carbon footprint for a region. That measurement is informative, but the researchers also wanted to look at the effect of individuals, so they calculated a per-capita footprint.

This second calculation allowed the researchers to see that people with higher incomes are responsible for a larger per capita amount of carbon emissions, Ivanova said. Income level alone could explain 30 percent of the total household carbon emissions, she said.

"Different factors influence the way we consume," she said. "In our

study, income appears to explain much of the variation in the regional factors, so essentially if we know how income changes over time, we can hypothesize about how emissions would follow."

The most important link to keep in mind, she says, is that rising incomes are expected to increase greenhouse gas emissions because people will have greater purchasing power.

"It makes sense that the richer you are, the greater your purchasing power and the environmental impacts associated with it," she said. "And the richer you are, the more you fly and drive."

Fashion and emissions

When the researchers looked at emissions from the purchases of clothing, services and manufactured products, they found higher regional differences in carbon footprints, especially in countries with higher income inequalities.

Italy and parts of the UK, especially London, had some of the highest emissions related to clothing.

"These regions had the highest household spending associated with clothing," Ivanova said. "So our hypothesis was that the results were fashion-driven."

Geography matters, but everyone has to eat

Other regional differences in emissions were explained by geography, the researchers found. Emissions related to housing were mostly linked to where a place was located on the map, reflecting how much heating a dwelling might need. The lowest housing-related emissions were in the

Canary Islands, where its tropical location is moderated by the trade winds. An area in Finland called Åland had the highest carbon footprint related to housing.

When the researchers looked at emissions from food consumption, they found very little difference in emissions between different socio-economic groups. In short, everyone has to eat, but not everyone has to heat their homes or travel by plane for their summer holidays.

Between-country differences were most pronounced in Italy, Spain, Greece and the UK, which have the highest footprint differences across each country's different regions.

In contrast, Denmark and the Czech Republic were much more uniform in terms of differences between a country's regions, Ivanova said.

200 products, 43 countries

The key to the researchers' analysis is an extremely large and detailed database called EXIOBASE. It was developed by researchers at NTNU's Industrial Ecology Programme in partnership with researchers from the Netherlands, Austria, Germany, the Czech Republic and Denmark.

The database describes the world economy for 43 countries, five rest-of-the-world regions and 200 product sectors, which allows researchers to ask questions about how the consumption or production of different products or countries affects the environment.

The researchers then coupled that information with information from Eurostat, which provides statistical information to the EU, and different national statistical offices, both of which conduct consumer expenditure surveys.

The combination of these tools allows the researchers to trace all the environmental impacts from the consumption or production of different products and services.

From Austrian cheese to regional climate policies

As an example, consider " the consumption of cheese by an average Austrian," Ivanova said. "What kind of inputs were needed to produce the cheese and where do they come from, from the milk, to the labour, to energy and transport?"

Researchers can even go deeper, she said, by tracing the impact of the grain that was fed to the cows, or the environmental impacts of making the materials that were needed to manufacture the truck that delivers the cheese to the store.

"The story of the cheese gets pretty complex, as you can imagine, and every stage comes with environmental impacts," she said. "We are limited in the detail with which we can explore the global economy and the journey of products."

But whether it's cheese or clothing, heating or hotel use, the approach allows the researchers to compare regions in terms of their consumption and quantify the environmental impacts associated with it.

"This has important implications for environmental policy," Ivanova said. "It highlights the drivers of consumption-based emissions and empowers regions to implement viable mitigation strategies."

More information: Diana Ivanova et al, Mapping the carbon footprint of EU regions, *Environmental Research Letters* (2017). DOI: 10.1088/1748-9326/aa6da9

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