

Climate impact of natural gas often worse than assumed, shows new calculation model

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Dr. Florian Dietrich (blue shirt) and prof. Jia Chen check the measuring systems on the roof of the TUM. Credit: Andreas Heddergott / TUM

Heating and cooking with natural gas often has a greater impact on the climate than commonly believed. This is a conclusion of a new

calculation model developed by researchers at the Technical University of Munich (TUM). The difference: the researchers' model also takes into account the enormous quantities of unused gas released into the atmosphere.

"We wanted to know whether—when gas leakage is also considered—gas or [electricity](#) is more climate friendly for heating and cooking," explains Dr. Florian Dietrich, a researcher at the TUM Associate Professorship of Environmental Sensing and Modeling.

In collaboration with researchers at ETH Zurich, the University of Utrecht and the Dutch organization for applied research in natural sciences TNO, the international team used a high-tech measurement station to capture carbon dioxide, methane and carbon monoxide. They also used laser spectrometers for onsite methane measurements. They then combined all variables in a specially designed calculation model. The results were published in the journal *Earth's Future*.

Incompletely burned natural gas an important factor in climate impact

At the 2019 Munich Oktoberfest, for example, the researchers observed that 1.4% of the gas used was lost. With a total volume of 185,000 cubic meters, this means that 2,500 cubic meters of unused gas was released into the atmosphere.

"Our calculation model takes into account these amounts of escaped natural gas and provides a comprehensive emission factor for evaluating the use of natural gas for cooking and heating purposes," explains Dr. Dietrich.

Renewable energy sources in the power mix reduce

the emission factor

To determine whether natural gas or electricity is the more climate friendly option, however, the power mix is decisive. "A high share of renewables reduces the emission factor for electricity, while the use of electricity from such sources as coal-fired power stations has the opposite effect," says Dr. Dietrich.

By incorporating all of these factors into their calculation model, the researchers created a quantitative basis for identifying the countries where electricity is already a more climate-friendly choice than [natural gas](#). They also concluded what the other countries need to do in order to arrive at this point.

For all 25 countries covered in the study, it is clear. "When we factor in leakage and incomplete combustion, a smaller share of [renewable energy sources](#) in the electric power mix is needed than previously assumed," says Jia Chen, a professor of environmental sensing and monitoring, who is also the head of the Environment Innovation Sector at the TUM Robotics and AI Institute MIRMI. Consequently, it is possible for most countries to make the switch from gas to electricity at a much earlier stage.

Electricity clearly preferable in Canada

Looking at [individual countries](#), that means that Canada, for example, with its high share of hydroelectric power, could already rely entirely on electricity for heating and cooking from a climate protection standpoint. In China the picture is different: due to the dominant role of coal in the power mix, electricity causes higher CO₂ emissions than gas assuming identical energy output.

For Germany, despite the rapidly increasing share of wind and solar energy, electricity is not yet clearly better than gas. Germany has plenty of company in that respect—in 18 of the 25 countries evaluated in the study, including Spain, Italy, the Netherlands, Japan and Australia, electricity is not yet superior to gas in climate terms. However, a look at the TUM researchers' graphs shows that electricity will soon be the more climate-friendly alternative for many of those countries due to the ongoing expansion of renewables.

More information: Florian Dietrich et al, Climate Impact Comparison of Electric and Gas-Powered End-User Appliances, *Earth's Future* (2023). [DOI: 10.1029/2022EF002877](https://doi.org/10.1029/2022EF002877)

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