Researchers predict global energy needs will increase 25% by 2050

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As our climate heats up in coming decades, Ian Sue Wing, a BU associate professor of earth and environment, worries the increased energy needs for air-conditioning could ramp up greenhouse gas emissions. "That's what keeps me up at night," he says. Credit: Cydney Scott

Many of the consequences of climate change are well reported in the

press: rising seas, more severe storms, droughts and floods, and increasing numbers of heat-related illness and deaths. Now Ian Sue Wing, a Boston University College of Arts & Sciences associate professor of earth and environment, Bas van Ruijven, a former visiting scholar at the Frederick S. Pardee Center for the Study of the Longer-Range Future, and Enrica De Cian, a professor at Ca' Foscari University of Venice in Italy, project another troubling outcome: a significant increase in global energy needs, largely anticipated to arise from cooling and air-conditioning usage.

In a new paper published in *Nature Communications*, Sue Wing, De Cian, and van Ruijven (now a scientist at the International Institute for Applied Systems Analysis in Laxenburg, Austria), warn that by 2050, even a modest warming of our climate could increase the world's energy needs by as much as 25 percent. And if greenhouse gas emissions continue unabated, we could demand up to 58 percent more energy than would be needed in a stable climate.

Anthony Janetos, chair of BU's Climate Action Plan Task Force and a CAS professor of earth and environment, says the findings underscore the need for rapidly deploying zero-carbon options for generating energy, so that climate change itself—and all the air-conditioning that will be used to cool a warmer world—doesn't end up accelerating the demand for more fossil fuel-generated electricity.

"We've known for a long time that energy demand would grow as a function of population growth and economic development," says Janetos, who is also director of the Pardee Center for the Study of the Longer-Range Future. "But for the first time, this paper has given us estimates of the growth in energy demand as a function of climate change itself—a potentially disruptive positive feedback."

Sue Wing says earlier research that focused on areas like the United

States suggested that a warming climate might actually reduce energy consumption. But when the research team coupled statistical models of energy demand with global temperature projections under warming scenarios (simulated by 21 independent climate models and 5 different scenarios for economic and population growth), the results showed substantial increases in energy needs.

But understanding that calculation is complicated, Sue Wing says, because the influence of climate change on an area's energy demand depends on the interaction of two uncertain drivers: how the area's population and income are projected to grow, and how its prevailing local temperature patterns are projected to change.

"In tropical areas, as the climate warms, it is simply going to get hotter," says Sue Wing. "In order for people in tropical areas to keep cool, they are going to have to use more electricity. But as you move toward the poles, things become more complicated."

That's because in temperate zones, a warming climate will increase the energy used for cooling during summer but reduce the energy used for heating during winter.

"In the tropics, we see a positive effect—energy increase—but as you move away from the tropics, we see a positive and a negative effect," he says. "When you add up the two positives and the negative, you could in principle get a negative.. .but what we actually see is a substantial positive"—a significant net increase in energy usage.

The researchers' calculations project that by 2050, the global demand for energy resulting from socioeconomic development will be two to three times what it is today, growing by a factor of 1.4 to 2.7 in industrialized nations, and by a factor of 2 to 4 in poorer but rapidly developing countries in the tropics. Moderate warming would increase the global

baseline amount of energy demands by 11 to 17 percent, while vigorous warming would increase it by 25 to 58 percent.

Regionally, demands for energy could increase by more than 50 percent in the tropics and southern parts of the United States, while Southern Europe and China could see increases greater than 25 percent. Total energy consumption may actually decline in northern Europe, Russia, Canada, and the US Pacific Northwest, but by a much smaller amount than the increases projected for other locations.

Simply put, demand for electricity is very likely to rise across much of the world.

These findings highlight two important unanswered questions: how much of the additional demand will be satisfied by increases in energy supplies versus behavioral changes like conservation, and whether producing the needed additional energy might add to emissions of greenhouse gases, setting in motion a vicious circle that could accelerate global warming.

"At this point, we don't know," says Sue Wing, who explains that the outcome depends on the choices made today by businesses and private citizens. "To cool my house, I could buy a bigger air-conditioner and it would use more electricity," he says. "Or if higher demand makes electricity more expensive, I could choose to open my window or run a fan."

How we choose to generate the additional electricity for cooling will also have big implications for the climate. The International Energy Agency estimated that in 2018, two-thirds of global energy needs were met by oil and gas, while less than 10 percent was provided by solar and wind. Hydro and nuclear energy produced about 25 percent of global electricity.

"That is the focus of our research right now," says Sue Wing. "What happens will not just influence the climate, it will influence energy markets, and it will influence the ways we think about energy policy. It can change the economic and political relationships between countries."

By 2050, whether renewable sources can be scaled up quickly enough to make a difference—and what that might cost—is still an open question.

"We could use coal, or we could use renewable sources, and those two choices mean very different things for our future. With coal, [an increase in demand] will mean more greenhouse gas emissions. That's what keeps me up at night."

More information: Bas J. van Ruijven et al, Amplification of future energy demand growth due to climate change, *Nature Communications* (2019). DOI: 10.1038/s41467-019-10399-3

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