Photovoltaics could cool our homes with the power of the sun

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The International Energy Agency has dubbed increased global cooling demand as one of the most critical blind spots in today's energy debate. A new study titled "Meeting Increased Global Cooling Demand with Photovoltaics during the 21st Century" yields critical new insight to a fundamental question: What is the required photovoltaic (PV) capacity to power the world sustainably?

The study is a collaborative effort of an international team of solar energy experts from Aalto University of Finland, Massachusetts Institute of Technology and SMART (Singapore-MIT Alliance for Research and Technology). It analyses the intersection of two dominant trends in the energy sector during the 21st century: the impetus to decarbonize the energy sector to mitigate dangerous anthropogenic climate change, and the increased economic prosperity in tropical countries, which creates higher demand for cooling than heating.

More specifically, the study investigates whether the several billions of air-conditioning devices expected to come online within the 21st century could be powered by clean PV electricity, avoiding the need for additional carbon-based electricity generation, and accelerating the growth of the PV industry in the process. Dr. Hannu Laine, the study's lead author, says, "As we scoured through the scientific literature, we found many detailed theoretical and experimental studies demonstrating the synergy of cooling and PV on a small scale, such as single buildings or communities. However, we were unable to locate a single analysis assessing the scope and degree of the synergy of cooling and PV at a global level."

Another blind spot was the discussion of how the picture will change as global warming proceeds, tropical countries gain wealth and as air conditioners grow more efficient. "This deficiency makes it impossible for policymakers, investors and researchers to estimate the global impact of the phenomenon," Dr. Laine says.

The team set out to estimate how much PV electricity generation would be required to power the global cooling demand today and how that number would change as tropical countries gain wealth, as global warming proceeds, and as technological innovation creates more efficient air-conditioners. Using established socioeconomic, climate change and energy efficiency improvement projections, they predicted

that the cooling demand would increase from approximately 400 TWh/year in 2018 to nearly 14 000 TWh/year by the end of the century, a dramatic 35-fold increase, despite air conditioners' growing efficiency. In monetary terms, this means that the cooling industry increases from an approximately $50 billion/year industry to a $1.5 trillion/year industry.

The study concluded that the potential added AC PV capacity is on par with the global PV production capacity today as a whole, or enough to power the entire country of France with PV, and by the end of the century, it will grow to be enough to meet that of India. Dr. Laine concludes, "We expect these results to drive significant additional policy interest, as well as research and business investments into the synergy of cooling and solar photovoltaics."

The study was published in the journal *Energy and Environmental Science* and was highlighted on the back cover of the journal's September issue published September 11.

More information: Hannu S. Laine et al. Meeting global cooling demand with photovoltaics during the 21st century, *Energy & Environmental Science* (2019). DOI: 10.1039/C9EE00002J

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