Zero-Carbon Buildings

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Abstract

Buildings are a critical piece of our transition to a lower-carbon future. In 2019, greenhouse (GHG) emissions from the building sector were nearly 14 gigatons of carbon dioxide ($GtCO_2$), or 38% of the total energy-related GHG emissions, including 28% from building operation (operational carbon) and 10% from building construction (major part of the embodied carbon). Global building floor area is expected to double by 2060 due to the growth of the world population. Over the next 40 years, the world will be adding new floor areas equivalent of an entire New York City to the global building stock every month.

Early approaches to lower the carbon footprint of buildings since the 70s have focused on lowering building energy use. For example, the Passivhaus approach, originated in Germany, aims to reduce heating energy use, which accounts for a large portion of building energy use especially in the more energy-intensive countries. However, focusing only on one aspect of building energy- and resource-consumption is inadequate to reach our goal of developing a sustainable, carbon-neutral built environment. The challenge that we are facing is multidimensional.

We must scale up decarbonization strategies from buildings to communities and cities, considering buildings as nodes of an interconnected energy system. We must expand our focus from energy use during building operation to the total energy balance and correspondent environmental impact over a building's whole lifetime (i.e., material extraction, manufacturing, construction, operation, and end-of-life re-use and disposal). We must shift our view from product-oriented to user-oriented and broaden our scope from efficiency to more comprehensive concepts such as robustness and resiliency. It's time for us to re-envision the way we have designed, built, and operated our built environment. A holistic perspective calls for new technical solutions that are capable of handling a degree of complexity that has never been experienced before, both in terms of interconnectivity and scale.

In this session, we will explore how cutting-edge building technologies, digital tools, and big data analytics can enables a paradigm shift for creating new methods and processes through which we can create sustainable buildings for a clean energy future. Our four speakers will bring their diverse expertise and unique perspective to the forum and jointly paint an outlook of our future built environment. Dr. Sawyer had worked for the U.S. federal government for a number of years before she recently took a leadership role in one of the national laboratories under the Department of Energy. She brings a broad view of the government's role in technology advancement. Dr. Jackson has led building research in two national laboratories for over a decade and can represent the R&D community. Dr. Strømn-Andresen, as a practitioner, has been exploring new design approaches and closely collaborating with universities to grow the next generation of leaders. Dr. De Wolf will bring her perspective on digital innovation in this domain.

Speakers

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