Alternative renewable energy solutions

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In the early 20th century, just as electric grids were starting to transform daily life, an unlikely advocate for renewable energy voiced his concerns about burning fossil fuels. Thomas Edison expressed dismay over using combustion instead of renewable resources in a 1910 interview for Elbert Hubbard"s anthology, "Little Journeys to the Homes of the Great."

"This scheme of combustion to get power makes me sick to think of -- it is so wasteful," Edison said. "You see, we should utilize natural forces and thus get all of our power. Sunshine is a form of energy, and the winds and the tides are manifestations of energy. Do we use them? Oh, no! We burn up wood and coal, as renters burn up the front fence for fuel."

Over a century later, roughly 80 percent of global energy consumption still comes from burning fossil fuels. As the impact of climate change on the environment becomes increasingly drastic, there is a mounting sense of urgency for researchers and engineers to develop scalable renewable energy solutions.

"Even 100 years ago, Edison understood that we cannot replace combustion with a single alternative," adds Reshma Rao PhD "19, a postdoc in MIT"s Electrochemical Energy Lab who included Edison"s quote in her doctoral thesis. "We must look to different solutions that might vary temporally and geographically depending on resource availability."

Rao is one of many researchers across MIT"s Department of Mechanical Engineering who have entered the race to develop energy conversion and storage technologies from renewable sources such as wind, wave, solar, and thermal.

Despite these advantages, wave-energy harvesting is still in its infancy. Unlike wind and solar, there is no consensus in the field of wave hydrodynamics on how to efficiently capture and convert wave energy. Dick K.P. Yue, Philip J. Solondz Professor of Engineering, is hoping to change that.

"My group has been looking at new paradigms," explains Yue. "Rather than tinkering with small improvements, we want to develop a new way of thinking about the wave-energy problem."

One aspect of that paradigm is determining the optimal geometry of wave-energy converters (WECs). Graduate student Emma Edwards has been developing a systematic methodology to determine what kind of shape WECs should be.

"If we can optimize the shape of WECs for maximizing extractable power, wave energy could move significantly closer to becoming an economically viable source of renewable energy," says Edwards.

Another aspect of the wave-energy paradigm Yue"s team is working on is finding the optimal configuration for WECs in the water. Grgur Toki? PhD "16, an MIT alum and current postdoc working in Yue"s group, is building a case for optimal configurations of WECs in large arrays, rather than as stand-alone devices.

Before being placed in the water, WECs are tuned for their particular environment. This tuning involves considerations like predicted wave frequency and prevailing wind direction. According to Toki? and Yue, if WECs are configured in an array, this tuning could occur in real time, maximizing energy-harvesting potential.

In an array, "sentry" WECs could gather measurements about waves such as amplitude, frequency, and direction. Using wave reconstructing and forecasting, these WECs could then communicate information about conditions to other WECs in the array wirelessly, enabling them to tune minute-by-minute in response to current wave conditions.