

Science and Technology Challenges and Opportunities for Net-Zero Emissions Energy Systems

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Abstract

A successful transition to a future net-zero emissions energy system is likely to depend on vast amounts of inexpensive, emissions-free electricity; mechanisms to quickly and cheaply balance large and uncertain time-varying differences between demand and electricity generation; electrified substitutes for most fuel-using devices; alternative materials and manufacturing processes for structural materials; and carbon-neutral fuels for the parts of the economy that are not easily electrified. Recycling and removal of carbon from the atmosphere (carbon management) is also likely to be an important activity of any net-zero emissions energy system. The specific technologies that will be favored in future marketplaces are largely uncertain, but only a finite number of technology choices exist today for each functional role. To take appropriate actions in the near term, it is imperative to clearly identify desired end points. To achieve a robust, reliable, and affordable net-zero emissions energy system later this century, efforts to research, develop, demonstrate, and deploy candidate technologies must start now.

Biography

Nathan S. Lewis, Ph.D., is the George L. Argyros Professor of Chemistry at the California Institute of Technology where he has been a faculty member since 1988. Lewis is best known for developing artificial photosynthesis technology that enables sustainable production of hydrogen fuel using sunlight, water and carbon dioxide as well as an “electronic nose” for artificial olfaction. From 2009 to 2019 he served as editor-in-chief of *Energy and Environmental Science*, a journal focusing on sustainable energy research, published by the Royal Society of Chemistry. He is the recipient of the Princeton Environmental Award and the American Chemical Society Award in Pure Chemistry. In 2017, Lewis was elected to the National Academy of Inventors. He holds approximately 70 U.S. and foreign patents. Lewis has authored more than 500 papers and mentored more than 100 graduate students and postdoctoral researchers.

