

March 5, 2021
12 – 1 pm



Dr. Martin Keller

Research at the National Renewable Energy Laboratory (NREL) to Enable a Decarbonized Economy by 2050

Presented by Dr. Martin Keller, Director of NREL

Integrated
Energy Pathways

Electrons to
Molecules

Circular
Economy for
Energy Materials

AzSEC

ARIZONA STUDENT ENERGY CONFERENCE



RESEARCH, DISCOVERY & INNOVATION

Institute for Energy Solutions

NAU
NORTHERN
ARIZONA
UNIVERSITY

ASU
ARIZONA STATE
UNIVERSITY



Abstract

The United States Department of Energy's National Renewable Energy Laboratory (NREL) conducts advanced scientific research that is transforming energy. Three initiatives are pivotal to our strategy at NREL and drive most of our research: Integrated Energy Pathways, Electrons to Molecules, and Circular Economy for Energy Materials. Integrated Energy Pathways research develops foundational knowledge and technologies to optimize the integration of renewables into a modernized, secure, and resilient grid. The Electrons to Molecules research underway at NREL focuses on converting electricity and small waste gases (e.g., CO₂, H₂O, N₂) into chemical bonds for fuel synthesis and/or energy storage. NREL's third initiative, Circular Economy for Energy Materials, is establishing foundational knowledge/technology for design, recycle, reuse, remanufacture, and reliability for energy materials/processes. To formulate our strategy, leaders at NREL deliberated upon the following assumptions:

- Growth of energy use in the developing world will far outpace growth elsewhere.
- Global renewable power demand will grow.
- Hydrocarbons will remain a necessary part of the global energy mix.
- Urbanization trends will dominate new infrastructure growth.
- Electrification and electric vehicle adoption will grow strongly.
- Demand for high-density liquid fuels will grow.
- Digitization, data, and decentralization will be strong drivers of the energy transition.

These same assumptions must be considered as implementation plans are developed to decarbonize the economy by 2050. For example, current energy systems deliver power in one direction to end use customers. As energy storage and distributed and variable generation are added to the grid, bi-directional power flows and other issues that impact control and optimization must be addressed. NREL's vision is to develop Autonomous Energy Grids that are optimized for secure, resilient, and economic operations. This will be achieved through advanced science in controls, optimization, complex systems, and big data analytics. Electrification of the residential, industrial, and transportation sectors will also play a vital role in the path to decarbonizing the economy. Toward this end, NREL researchers are working to understand how to control the millions upon millions of power electronics that will interact with the grid on a broader scale while still ensuring that the grid is resilient, reliable, and secure.



Biography

Martin Keller, Ph.D.

Director

National Renewable Energy Laboratory

Golden, Colorado

303-275-3011

martin.keller@nrel.gov

Martin Keller has served as Director of the National Renewable Energy Laboratory (NREL) and President of the Alliance for Sustainable Energy—the company that operates NREL for the U.S. Department of Energy—since 2015. Under his leadership, the number of full-time employees at NREL has increased by more than 32%. Martin is a visionary leader who is committed to people, teams, and partnerships. He innovatively and pragmatically applies private sector best practices at NREL to achieve game-changing scientific outcomes. Working collaboratively with his leadership team, Martin developed a strategy for NREL focused on three key initiatives: integrated energy pathways, circular economy, and electrons to molecules. This strategy drives advanced scientific research, programs, projects, and partnerships at NREL. For example, NREL signed a ten-year, \$100 million agreement with ExxonMobil to research and develop lower emission energy technologies and accelerate new ideas about energy. NREL also has valuable partnerships with Eaton Corporation, Wells Fargo, Hewlett Packard Enterprise, Royal Dutch Shell, and more than 900 private and public sector organizations.

From 2006 to 2015, Martin led energy, biological, and environmental research programs at the Oak Ridge National Laboratory (ORNL). His efforts culminated in his being promoted to serve as the Associate Laboratory Director for the Energy and Environmental Sciences Directorate during his last six years at ORNL.

Earlier in his career, Martin's dedicated work in a variety of research management positions at Diversa Corporation enhanced and developed the microbiology expertise of this biotech company.

Currently, Martin is a Fellow of the American Association for the Advancement of Science (AAAS), and he recently retired as chair of the AAAS Industrial Science and Technology Section. In addition, he is a member of the Scientific Advisory Council for Julich Forschungszentrum and serves on numerous other scientific advisory boards.

Martin received his Ph.D. in Microbiology from the University of Regensburg, Germany.