

The Essential Role of Integrated Nuclear-Renewable Energy Systems in Achieving Economy-Wide Net Zero Solutions

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Background/Objectives. The Biden administration has committed to full decarbonization of the U.S. electricity grid by 2035 and economy-wide net zero emissions by 2050. These aggressive goals demand immediate action if we are to be successful, and they require us to think more holistically about our clean energy options. Focused laboratory initiatives, such as the INL Integrated Energy Systems (IES) Initiative, and multiple programs within the Department of Energy are working together to address these holistic solutions.

Approach/Activities. Traditionally, electricity generation and management and meeting energy demands for industry and transportation are considered independently. As we seek to achieve net zero, we need to reassess our energy demands. When we consider overall energy use, only one-third is in the form of electricity. Additional energy demands are in the form of heat or steam for industrial processes, as well as transportation. Emissions across these sectors are much harder to abate, and electrification may not be the best option. Reducing environmental emissions at an affordable cost, while maintaining grid reliability and resilience, will require us to use all of the clean energy resources that we have available. That means coordinating the use of nuclear, renewables, and fossil fuels with carbon capture to meet growing demands for electricity, industrial applications, and mobility.

The primary focus of IES research is to assess the technical and economic potential of various IES solutions to enhance the flexibility and utilization of nuclear energy generators working alongside renewable generators to meet an array of energy demands—thereby maximizing the utilization of clean energy resources across all energy sectors. Various energy applications and product streams beyond electricity are being evaluated, ranging from generation of potable water to production of hydrogen, fertilizers, synthetic fuels, and various chemicals.

Results/Lessons Learned. This presentation will highlight the wide array of RD&D being conducted to develop and deploy nuclear-based IES that will be key to achieving our net zero goals. By working with key collaborators in the nuclear industry, analytical studies are now becoming a reality in multiple demonstration projects.