Sandia National Laboratories

Energy, Climate & Infrastructure Security

The Energy Security program area accelerates the development of transformative energy solutions that will enhance the nation's security and economic prosperity.

Vision

To enhance the nation's security and prosperity through sustainable, transformative approaches to our most challenging energy, climate, and infrastructure problems.

Goal: Demonstrate, in a working prototype, 12.5% sunlight to syngas & analysis for a system design to achieve >6% end-to-end sunlight to fuel and a roadmap to >10% lifecycle sunlight to fuel.

The nation faces a significant time gap before we can transition to a non-fossil-fuel-based transportation sector. In the interim, strategic investments are needed to identify ways that clean energy solutions can provide a significant contribution and mitigate climate change risks.

In order to address the nation's vulnerabilities with regard to energy security/independence, innovative approaches are needed to ensure a diverse energy and fuel supply. The Solar-Driven Carbon Capture and Recycle to Fuels program is designed to provide a meaningful solution to augment our current fuel supply base by developing a methodology and implementation of a clean, renewable fuel.

Given today's transportation energy infrastructure and the efficiency of our current suite of liquid fuels, replacement solutions will be both difficult and take time to develop. Sandia has leveraged existing capabilities and resources to begin to answer some of the fundamental questions and approaches to this dilemma. Initial results have shown promise and the ability to generate clean fuels, but investments and partnerships are still needed to fully realize the opportunity.

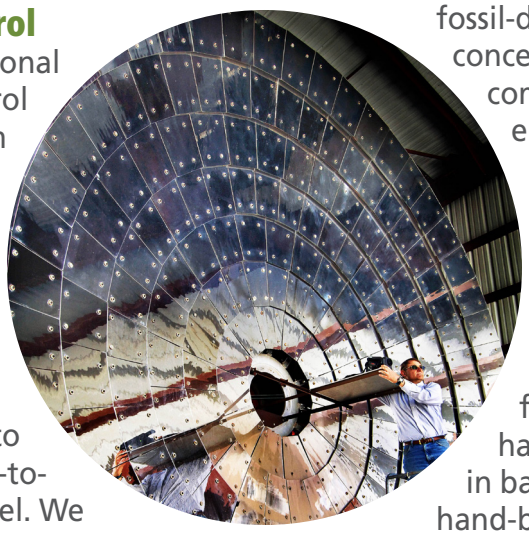
Sandia is working with other institutions to develop a roadmap to 10% lifecycle efficiency. In addition to providing a renewable-based fuel, this approach leverages existing solar-based technologies that enable an efficient approach.

The prototype CR5 thermochemical engine.

U.S. DEPARTMENT OF ENERGY

The methodology is significantly more efficient when compared to other approaches, but also provides a scale-up strategy that leverages the existing infrastructure and can deliver a significant percentage of our fuel needs.

Sunshine to Petrol

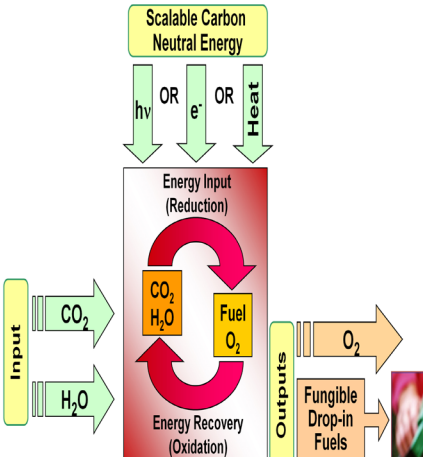


Our multi-institutional Sunshine to Petrol (S2P) team is working to develop/demonstrate 12.5% sunlight-to-syngas energy conversion and analysis for a system design to achieve 6% end-to-end sunlight to fuel. We have developed a prototype thermochemical engine, the Counter Rotating Ring Receiver Reactor Recuperator (CR5), which has been tested at Sandia's National Solar Thermal Test Facility (NSTTF).

The S2P team's CR5 thermochemical heat engine uses concentrated solar irradiation to provide high temperatures that drive chemical reactions. The engine converts either carbon dioxide or water to carbon monoxide or hydrogen, respectively—the energy-rich building blocks for producing synthetic fuels that can be equivalent to today's fossil-derived liquid fuels. To realize this concept, the team must address and solve complex chemical, materials science, and engineering problems associated with thermochemical heat engines and the crucial enabling metal-oxide working materials.

The S2P team, assembled from Sandians in both New Mexico and California and including collaborators from universities across the country, has proven the concept in the laboratory in batch mode in their prototype device—a hand-built precision device currently undergoing tests at the solar furnace at the NSTTF.

Although S2P is years away from a market-ready device, we are on a program of continuously improved generations of prototypes and S2P systems, a new generation every three years with significant improvements in performance, greater durability, and reduced cost.



A process flow for the Sunshine-to-Petrol concept.

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