ENERGY earthshots
U.S. DEPARTMENT OF ENERGY

Clean Fuels & Products™

# Clean Fuels & Products Shot™: Alternative Sources for Carbon-based Products

## Overview

The U.S. Department of Energy's (DOE) Energy Earthshots™ aim to accelerate breakthroughs and adoption of more abundant, affordable, sustainable, and reliable clean energy solutions.

Achieving the Energy Earthshots™ will help meet the U.S. government's target of net-zero carbon emissions by 2050 and position the United States as a global leader in deploying innovative solutions to address the climate crisis.

The Energy Earthshots™ also create new high-quality jobs; provide enhanced energy security; and inform equitable research, development, and deployment of energy technologies.

## The Opportunity

Many of our day-to-day activities and products rely on fuels and materials sourced from carbon, traditionally from fossil fuels. The fuels that power large vehicles like planes, boats, and trains, and the inputs that are used today to create products like carpets and rubber, require a carbon foundation. To meet the United States' goal of a net-zero carbon economy by 2050, we will need to find alternative ways to make carbon-based products, and produce them in ways that minimize greenhouse gas (GHG) emissions to achieve U.S. net zero goals.

The GHG emissions from carbon-based fuels and products largely come from the transportation and industrial sectors. In transportation, large planes, boats, and trains currently require energy-dense liquid fuels for long-haul travel. In the industrial sector, the majority of consumer products rely on the manufacturing of carbon-based chemicals that account for 40% of GHG from industrial chemicals production.

If alternative carbon sources such as bio-based, waste carbon dioxide, and other waste streams are used for carbon foundations to produce materials, there is great potential to reduce GHG emissions.

This Energy Earthshot is aimed at reducing the negative impacts of GHGs by transforming waste and renewable carbon into fuels, materials, and products that are better for the environment than current petroleum-derived components.

## Impact

This Energy Earthshot™ can help eliminate more than 650 million metric tons (MMT) of carbon dioxide equivalent per year by 2050. This significant decrease in the U.S. carbon footprint will establish the United States as a global innovation leader in decarbonized fuels and products, create jobs in both alternative feedstocks mobilization and conversion technology development, and bolster energy security through growth of robust and versatile domestic supply chains needed for fuels and products.

The Clean Fuels & Products Shot™ will reduce the impact on air, water, and environment as development of new technologies can alleviate reliance of carbon-rich fuels and chemicals production at existing refining and petrochemical facilities. Additionally, the shift from fossil fuel feedstocks to other abundant resources delocalized throughout the country results in new job opportunities creation.

**Goal:** The Clean Fuels & Products Shot™ is the seventh Energy Earthshot™ and is an initiative launched by DOE to reduce emissions from the fuels and chemicals industry by developing sustainable sources of carbon. This initiative aims to lower GHG emissions at least 85% as compared to fossil-based sources by 2035. This Energy Earthshot specifically aims to meet 2050 projected demand for 100% of aviation fuel; 50% of maritime, rail, and off-road fuel; and 50% of carbon-based chemicals by using sustainable carbon resources.


**85% Reduction**

**2035**

# DOE has identified five critical research areas to decarbonize the fuels and chemicals industries:

### MOBILIZE BIOMASS AND WASTE FEEDSTOCK

New technologies to enable low-cost, low emissions feedstocks at scale

Increased carbon incorporation into biomass

### EFFICIENTLY CAPTURE AND CONVERT $CO_2$

Innovation to improve $CO_2$ capture and catalytic conversion efficiency

Solar fuels, carbon dioxide electrolysis

### DEVELOP CARBON-EFFICIENT CONVERSION PROCESSES

New carbon-efficient conversion technologies

Processes using green electricity and hydrogen

### DEMONSTRATE INTEGRATED PROCESSES

Integrated pilot and demonstration scale facilities to de-risk technology for rapid industry adoption

### UNDERSTAND SUSTAINABILITY IMPLICATIONS

Cradle to grave life-cycle analysis and sustainability modeling to prioritize the most impactful R&D

Differentiated regional strategies

## Alignment of Resources

This Earthshot is a DOE research, development, and demonstration effort. It will be implemented and supported by several DOE offices, including: the Office of Energy Efficiency and Renewable Energy including the Bioenergy Technologies Office and Industrial Efficiency and Decarbonization Office; the Office of Fossil Energy and Carbon Management; Basic Energy Sciences; Office of Science's Biological and Environmental Research; Office of Clean Energy Demonstrations; and Advanced Research Projects Agency–Energy.

The Clean Fuels & Product Shot™ aligns with the Sustainable Aviation Fuel Grand Challenge, an inter-agency initiative, while synergizing with the broader Energy Earthshots portfolio and leveraging breakthroughs in critical energy technologies from the Carbon Negative Shot™, the Hydrogen Shot™, and the Industrial Heat Shot™.