



Clean Fuels & Products Shot™ Summit Audience Questions & Answers

Below is a list of audience questions from the [Clean Fuels & Products Shot Summit](#), which was hosted by the U.S. Department of Energy (DOE) in April 2024. For more information, email CleanFuelsandProductsEnergyShot@ee.doe.gov.

Updated as of June 3, 2024

Funding

- [Regarding DOE’s recent budget cuts to the national lab \[Energy\] Earthshot Centers, what is the reason for the cuts and how does this align with this broader vision?](#)

The budget for the Energy Earthshot™ Research Centers is based on the final FY24 appropriations bill passed by Congress.

- [What is the reason behind the differences in available funding for developing biomass-based solutions and developing captured CO₂ solutions?](#)

DOE supports a variety of decarbonization pathways, including biomass and carbon dioxide (CO₂) capture for hard to decarbonize sectors. The ultimate funding for technologies and projects will often be determined by various program-specific factors, including available appropriated funds and stakeholder input.

- [Does 45Q provide incentives for biochar production?](#)

DOE provides technical review of life cycle analyses (LCAs) submitted for carbon utilization under the 45Q tax credit. Ultimate eligibility determinations and approval for the tax credit rests with the Internal Revenue Service (IRS) and interested applicants should consult current eligibility guidelines. Questions may also be submitted to lbi.eef.45qlca@irs.gov.

- [In regard to CCU \[carbon capture and utilization\] and needing recommendation/approval by DOE prior to qualifying for 45Q tax credits, has DOE provided a positive recommendation/approval of any LCAs \[life cycle analyses\] for CCU pathways for fuels yet?](#)

DOE cannot speak to any outcomes of the 45Q tax credit review process. DOE provides technical review of life cycle analyses submitted for carbon utilization under the 45Q tax credit. Ultimate eligibility determinations and approval for the tax credit rests with the Internal Revenue Service.

- Given that the CO₂ [carbon dioxide] for e-fuels [electrofuels] goes right back into the air, along with the energy needed to produce an e-fuel, will those ever qualify for 45Q credits?

DOE provides technical review of LCAs submitted for carbon utilization under the 45Q tax credit. Ultimate eligibility determinations and approval for the tax credit rests with the Internal Revenue Service. Interested applicants should consult current eligibility guidelines. Questions may also be submitted to lbi.eef.45qlca@irs.gov.

- What is the DOE FOA [funding opportunity announcement] number for the Clean Fuels & Products [Shot]?

The [Clean Fuels & Products Shot](#) is not a specific DOE funding opportunity announcement (FOA), but rather an initiative to focus collaborative efforts towards the Energy Earthshot goals. Therefore, many FOAs fall within this scope.

- Is there a timeline to expect FOAs [funding opportunity announcements] related to this [Energy] Earthshot?

Funding opportunities related to this Energy Earthshot are being released regularly from the DOE offices represented in the [Clean Fuels & Products Shot Summit](#), including the Bioenergy Technologies Office, the Office of Science, the Office of Fossil Energy and Carbon Management, the Industrial Efficiency and Decarbonization Office, the Advanced Materials and Manufacturing Technologies Office, and the Hydrogen and Fuel Cell Technologies Office. Please subscribe to the listservs of any of these offices to stay up-to-date on funding opportunities announcements. The Clean Fuels & Products Shot [website](#) also has a section with relevant funding opportunities.

- How can Canadian private organizations access some of these funding calls? Is there a way to participate?

The possibility of participation by Canadian private organizations would depend on the specific type of funding opportunity. Some funding opportunities have foreign work waivers, and sometimes participation would be possible through collaboration with a U.S.-based subsidiary or partner.

- Is there any current/upcoming DOE solicitation on clean product R&D from waste biomass?

All open and announced solicitations can be found on the [Bioenergy Technologies Office website](#).

- If we missed the 2024 program for decarbonizing chemicals, will we have a chance to fund for 2025?

All open and announced solicitations from DOE's Industrial Efficiency & Decarbonization Office can be found on the office [website](#). Funding opportunity announcement information can also be found on the [Office of Energy Efficiency & Renewable Energy Exchange](#) website. Stay up-to-date

on stakeholder engagement including requests for information, workshops, webinars, and funding opportunity announcements by subscribing to the [Production Line newsletter](#).

- Where can I find information about the BIL [Bipartisan Infrastructure Law] Carbon Utilization Procurement Grants program?

This information can be found on the [Office of Fossil Energy and Carbon Management office website](#).

- EERE [Office of Energy Efficiency and Renewable Energy] appears to have no info on DE-FOA-0003209 (the FY24 fuel biomass FOA). Can you please post a link to the FOA [funding opportunity announcement]?

The funding opportunity announcement (FOA) can be found on the [EERE Exchange website](#). You can type the last four digits of the FOA number in the FOA number column.

- When will the new SAF [sustainable aviation fuel] funding opportunity be announced?

The [Agriculture Food Research Initiative Sustainable Agricultural Systems Request of Applications](#) closed on June 6, 2024.

- The focus of these [Energy] Earthshot meetings has been on land-based energy crops. Will upcoming FOAs [funding opportunity announcements] include ocean-based biomass (seaweed)?

Macroalgae is included in one of the [funding opportunity announcements](#) presented by Dr. Dana Mitchell during the Summit (DE-FOA-0003209). Please also see another relevant FOA, the [Mixed Algae Conversion Research Opportunity](#).

- Is there a funding mechanism that connects USDA [U.S. Department of Agriculture] labs and DOE labs?

DOE and USDA have signed Memorandum of Understandings (MOUs), including a [MOU](#) specific to the Sustainable Aviation Fuel Grand Challenge.

- Where can suppliers find additional details on approval process with NETL [National Energy Technology Laboratory] for carbon-conversion products that would be eligible/approved for UP [Utilization Procurement] Grants?

To learn more about the Utilization Procurement Grants and the life cycle analysis review process, interested product manufacturers and grant applicant candidates should visit the [NETL UPGrants homepage](#).

Data & Measurement

- Why is the decarbonization [goals] for rail and marine transportation at 50% reduction while the aviation sector is at 100% decarbonization? Is it based exclusively on liquid fuel figures?

The Clean Fuels & Products Shot recognizes that there are a variety of different decarbonization options being pursued by DOE and others for the targeted fuel and chemicals sectors. The [Sustainable Aviation Fuel Grand Challenge](#) and resulting [Roadmap](#) guide DOE's strategy with respect to aviation emissions and targets, replacing 100% of aviation fuel with sustainable aviation fuel by 2050. For maritime, rail, off-road, and hydrocarbon-based chemicals, additional decarbonization routes are being pursued in addition to replacement using sustainable hydrocarbon-based alternatives. For example, in maritime emissions, the use of ammonia, methanol, hydrogen, fuel cells, and other decarbonization methods are all under consideration. The Energy Earthshot goals were set while recognizing that some of these solutions are likely to complement the hydrocarbon-based replacements in the Energy Earthshot, and those sectors were set at 50% replacements.

- Which accounting method will be used for analyzing emissions reductions? GREET? CORSIA? Has that been finalized?

This has not yet been finalized.

Agriculture

- In the [2023 Billion-Ton] report, it seems energy crops are geared to vegetable oil conversion processes. Could this be boosted if cellulosic processes provided for faster growing non-oil seed crops (grasses, weeds, etc.)?

As stated in the [2023 Billion-Ton Report](#), this report is end-use agnostic with no assignment of any feedstock for a particular end use. Certainly, cellulosic energy crops drive the volumes to attain a billion tons (approximately 400 million tons per year, depending on the market maturity level), especially those crops that favor faster growth and higher yields.

- How big is the uncertainty around crop residue estimates?

Of the approximately 550 million tons per year of agricultural residues produced annually in the United States, the 2023 Billion-Ton Report estimates a production capacity of 183 million tons per year in the mature-market medium scenario within specified constraints for soil conservation and at a price of up to \$70 per dry ton at the farmgate. The total amount of crop residues is well understood, but sources of uncertainty include farmer willingness/adoption practices, market pull, and annual variability in crop production.

- Why are there no crop residues assumed for soybean straw?

The [2023 Billion-Ton Report](#) is not an exhaustive assessment, and soybean straw could be considered as an additional resource, if adequate constraints for soil conservation are realized.

- Do scenarios take into account changes in agricultural productivity due to climate change?

No, but Chapter 13 of the [2016 Billion-Ton Report Volume 2](#) assesses changes in the geographic distribution of energy crops in a range of climate change scenarios.

- Are [agricultural] residues used as compost by farmers today? What is the cost to the farmer for using this residue?

Of the approximately 550 million tons per year of agricultural residues produced annually in the United States, it is estimated that 3.2 million tons are currently re-purposed for a variety of post-harvest uses. A potential cost to the farmer of using this residue is macronutrients, which is accounted for in the assessment with region- and crop-specific nutrient replacement cost assumptions.

Algae

- Why does the [Energy] Earthshot focus so little on algae?

Algae is an acceptable feedstock for various funding opportunities, including in the Bioenergy Technologies Office and in the Office of Fossil Energy and Carbon Management.

- To confirm, does the [Billion-Ton Report] not include Sargassum production in international waters with nutrient uplifting?

Correct, the Billion-Ton Report does not include waste Sargassum. [Chapter 7](#) of the 2023 Billion-Ton Report covers macroalgae.

Biomass

- Is there research into the benefits/effects for rural communities regarding biomass?

Benefits and impacts to rural communities is an active area of research at DOE. There are two biomass-specific projects being funded through the Bioenergy Technologies Office. One project, being conducted by Oak Ridge National Laboratory, is examining methods to better quantify the value of ecosystem services associated with bioenergy crops, including water quality improvements and increased biodiversity. The project is also developing a tool that landowners can use to better visualize the direct benefits on their own land. Another project, being conducted by Argonne National Laboratory, is called Ecosystem Services Entrepreneurship Assistance. They recently published an online version of their Scaling Up PERennial Bioenergy Economics and Ecosystem Services Tool ([SUPERBEEST](#)). Researchers are in the process of attending relevant trade shows and conferences to demo the tool with landowners. The tool allows landowners in 12 midwestern states to map out economically and/or environmentally marginal farmland that could be converted from traditional corn/soybean to more suitable perennial bioenergy crops with the intent of creating resilient rural communities. They have also partnered with the American Farmland Trust to host targeted listening sessions with groups of non-traditional landowners including women and different minority groups.

- What are the differences between the USDA's [U.S. Department of Agriculture] report, [Building a Resilient Biomass Supply] Plan and Implementation Framework, and the DOE Billion-Ton Report?

The U.S. Department of Agriculture's (USDA), [Building a Resilient Biomass Supply: A Plan to Enable the Bioeconomy in America](#), focuses on systems of production of biomass as raw materials and the preprocessing needed to convert these raw materials into feedstocks for bioenergy applications, particularly biobased products. It also summarizes the current and future availability of biomass resources, once demands for food, feed, fiber, and exports are met, and cites the 2016 Billion-Ton Report as their source for resource availability. Essentially, the Billion-Ton Report focuses on production capacity while the USDA report focuses on production and use. One other key difference between these reports is that the Billion-Ton Report is end-use and policy agnostic, whereas the USDA report focuses on biomass for bioproducts and describes policies and programs for building and developing markets for biomass supply chain systems.

- Are there any reports combining the demand projections for biomass for fuels coupled with the demands for electricity generation?

There may be, but the 2023 Billion-Ton Report is end-use agnostic, and the analysis stops at roadside/farmgate.

- Does DOE see a benefit in using biomass to fuels in which hydrogen was required for hydrotreating and having that CO₂ sequestered (resulting in a negative carbon intensity fuel)? Is there a reason to have such carbon capture subsidized by fuel production or is CO₂ only used for more fuels (FT [Fischer-Tropsch] fuels, etc.) per the flowsheet?

DOE supports carbon capture across a range of technologies and as a decarbonization pathway for hard-to-decarbonize sectors and products such as fuels. The ultimate financing and incentive structure for technologies and projects, such as the most efficient end use of resulting CO₂ emissions, will often be determined by various, project-specific factors.

Carbon Capture & Removal

- Would FECM [DOE Office of Fossil Energy and Carbon Management] consider technologies that carry out concurrent removals, which one could label CDR [carbon dioxide removal]?

DOE's Office of Fossil Energy and Carbon Management supports a range of carbon management technologies including carbon conversion, point source capture, and carbon removal. Those research efforts include processes that may include dual-function approaches such as reactive carbon capture.

- Regarding carbon sequestration in geological formations by transporting CO₂ [carbon dioxide] via pipeline, have you looked at the impact of having various exit points for the pipeline and using the CO₂ at each of the exit points to serve industries making CO₂-based products?

[Recently announced funding](#) aims to help expand carbon dioxide (CO₂) transportation infrastructure for such use cases through future growth grants. The grants are intended to provide financial assistance for designing, developing, and building CO₂ transport capacity up front that will then be available for future carbon capture and direct air capture facilities as they are developed as well as for additional CO₂ storage and/or conversion sites as they come into operation.

- [Is there any mechanism for identifying failing near-term technologies for CO₂ \[carbon dioxide\] capture and channeling investment in more promising directions?](#)

Across programs, projects and research awards are consistently reviewed for performance and evaluated on progress made toward stated program and research goals. Technologies that consistently fail to meet stated project and research goals are generally not recommended for continued funding. Similarly, our programs work to ensure we are responsive to new, emerging, or more efficient technologies.

- [What is the full definition of "carbon capture" beyond carbon dioxide and carbon monoxide? Does it include biobased hydrocarbon that is released in industrial processes that could be captured and used to make bioproducts for the bioeconomy?](#)

Carbon capture technologies - in the context of DOE's Office of Fossil Energy and Carbon Management portfolio - focus on point source carbon oxide capture, such as from electrical generation and industrial processes, as well as direct air capture, which removes legacy anthropogenic carbon from the atmosphere. DOE's Bioenergy Technologies Office is investing in technologies that can reduce emissions from biobased conversion processes. This includes utilization of carbon oxides, other light gases, and any other waste streams from bio-based conversion processes. Similarly, DOE's Industrial Efficiency & Decarbonization Office focuses on carbon capture and conversion from industrial gaseous waste.

Hydrogen

- [Is H2ICE \[Hydrogen Internal Combustion Engine technology\] happening in the U.S.? Or \[are\] FCEVs \[fuel cell electric vehicles the only focus area\]?](#)

Fuel cell electric vehicles have been the focus for transportation applications within DOE's Hydrogen Program, but hydrogen combustion is also included in the overall portfolio. Program plans and strategy documents can be found on DOE's [Hydrogen Program website](#).

- [Hydrogen mixing with CNG \[compressed natural gas\] is expected to grow. How is it happening? What is the maximum \[percentage\] hydrogen can be mixed in CNG? What changes in a vehicle occur \[when\] increasing \[the percentage\] of \[hydrogen\]?](#)

Hydrogen blending has been explored for gas transmission distribution infrastructure through DOE's [HyBlend initiative](#). Due to the chemical properties of hydrogen, there is a limit to how much can be blended in existing infrastructure - typically about 15%.

In the [U.S. National Clean Hydrogen Strategy and Roadmap](#), partnering government entities identified hydrogen blending into natural gas to be an application that has a lower willingness to pay for clean hydrogen due to the competition with natural gas prices. The Roadmap identifies the priority, strategic application of clean hydrogen blending to be for industrial heat applications by 2050.

- Which Phase 1 H2Hubs [Regional Clean Hydrogen Hubs Program] includes CCUS [carbon capture, utilization, and storage]?

The [Regional Clean Hydrogen Hubs Program](#) (H2Hubs) has not yet entered Phase 1. Hydrogen Hubs have been [selected for negotiations](#), but the negotiations process is still ongoing.

- Which [Hydrogen] Hub plans to use ammonia as a transport carrier for [hydrogen]?

The [Regional Clean Hydrogen Hubs Program](#) (H2Hubs) has selected Hubs, but is still in the process of negotiating each project.

- We are seeing a real challenge on the Power-to-X domain with the transient nature of renewables and its impact with [hydrogen] and 45Q [tax credit]. Is this something you are exploring? How can this be mitigated?

Managing intermittency of renewable energy for clean hydrogen production has long been a focus of analysis and research for the Hydrogen and Fuel Cell Technologies Office (HFTO). For example, in 2020, HFTO published a [program record](#) examining the cost of hydrogen production from various wind and solar resources with lower capacity factors compared to grid generation with high capacity. The record found that prime renewable resources can compete on cost with grid-based systems. Further improvements can be made by combining complementary wind and solar resources and optimally sizing the electrolyzer.

Waste-to-Energy & Upcycling

- Does BES [Basic Energy Sciences] support synthesis/design of chemicals/materials using waste biomass for electrochemical technologies? If yes, which BES programs?

DOE's Office of Science Basic Energy Sciences program funds [catalysis science research projects](#) with biomass-related components.

An example of a publication that came out of one of those projects is titled "Electrochemical hydrogenation, hydrogenolysis, and dehydrogenation for reductive and oxidative biomass upgrading using 5-hydroxymethylfurfural as a model system," available through [ACS Catalysis](#).

- What office is providing information and funding for the waste-to-energy industry efforts in the development of clean fuels?

DOE's Bioenergy Technologies Office funds [waste-to-energy](#) research and technical assistance opportunities.

- [Can lawn/yard waste be a significant contribution? Why not incentivize homeowners with rewards for lawn waste?](#)

Lawn and yard waste is explicitly considered in the 2023 Billion-Ton Report as a part of municipal solid waste feedstocks. The estimate for near-term potential is 14.2 million dry tons per year, which plays a significant role in providing convertible feedstock.

Sustainable Aviation Fuel

- [Shruti Mishra referenced studies regarding the SAF \[sustainable aviation fuel\]/health benefits around LAX and SeaTac. Where can we find information about these studies?](#)

This work was recently funded by the DOE's Bioenergy Technologies Office, and research is ongoing.

- [Will aviation and marine fuels created from plastic waste be considered as part of this \[Energy\] Earthshot? If not, are there DOE programs that would support such efforts?](#)

This Energy Earthshot considers alternative feedstocks for carbon-based chemicals, fuels, and products such as biomass, industrial waste gases (CO₂, CO, CH₄), direct air capture carbon dioxide (CO₂), and industrial, agricultural, or municipal solid wastes, including plastics, among others. Whether a particular feedstock is a priority for a particular chemical, fuel, or product will depend on the net life cycle effects as well as community and environmental impacts. For plastic feedstocks specifically, DOE's [Strategy for Plastics Innovation](#) emphasizes material to material applications.

- [When looking at SAF \[sustainable aviation fuel\] applications for aviation fuel, is it worthwhile to look at biofuel tanker trucks located at major airports hauling biofuel from production facilities, providing biopower at airports to drive HVAC for aircraft parked at bays for passenger boarding until the time the aircraft is moved for takeoff?](#)

This Energy Earthshot is focused on sustainable aviation fuel used to power flights due to the required energy density. The energy needed for plane operations at airports could come from other sources, similar to the efforts to provide shore power to ships while they are in port.

- [What blend of SAF \[sustainable aviation fuel\] reaches a 65% reduction?](#)

The reduction in greenhouse gas (GHG) emissions associated with sustainable aviation fuel depends on the particular feedstock and conversion process used to make the fuel and would be determined using a cradle-to-grave life cycle assessment. The addition of other fuel components will further affect the overall GHG reduction for the final blend.

Water

- Is there interest in water treatments that eliminate biofilm contamination and fouling that are validated to save ~50% energy in agro-industrial processes, water treatments, biomass production, fermentation, etc.? Water seems to be a category always omitted, but central to decarbonization.

DOE's Industrial Efficiency and Decarbonization Office funds research related to [water usage and treatment](#) within the [Cross-Sector Technologies](#) portfolio, which accelerates technology readiness across a broad range of industries.

Public Engagement

- Who will be a good contact person to understand the connection (and work scope) between [the Clean Fuels & Products Shot] and HFTO [Hydrogen and Fuel Cell Technologies Office]?

Connect with the Hydrogen and Fuel Cell Technologies Office by emailing hftoinquiries@ee.doe.gov.

- What would be a good way to find relevant industry partners?

Participating in events and workshops hosted by relevant DOE offices could be a way to connect with relevant industry partners. Staying up-to-date on funding opportunities and recipients of those funding opportunities could be another way to connect with relevant industry partners. Some funding opportunities include teaming partnering lists to encourage collaboration and facilitate the formation of project teams. [Sign up](#) for and customize your email updates from different DOE offices.

- What is the best way for an individual researcher (and specifically, an algae scientist) at the postdoc level to get involved with this [Energy] Earthshot? Is it correct that there are no fellowships to fund individual researchers?

Individual researchers can get involved with this Energy Earthshot through a variety of DOE funding opportunities and programs. Individual offices supporting the Energy Earthshot will announce funding opportunities that align with the Energy Earthshot goals for cooperative research projects, the [Small Business Innovation Research and Small Business Technology Transfer programs](#), and the [Lab-Embedded Entrepreneurship Program](#). [Sign up](#) for and customize your email updates from different DOE offices.

- Are there opportunities for community colleges along the Texas Gulf Coast to work with the University of Houston and others on the Methanol project?

Since DOE's Office of Clean Energy Demonstrations is entering award negotiations with the selected projects, at this time we encourage anyone interested in working with the projects and their partners to reach out directly to understand opportunities to get involved. Contact

information for the methanol project is listed below and information for additional projects can be found in the [Southern Regional Briefing slide deck](#).

Orsted Media Inquiries
Charlotte Bellotte, CBELL@orsted.com

Orsted Vendors & Suppliers
Andre Gafford, ANDGA@orsted.com <https://orsted.com/en/who-we-are/our-organisation/suppliers>

Other Project Inquiries
David Galey, DAVIE@orsted.com

Miscellaneous

- Is there a Renewable Resource Hub to drive feedstocks for chemical production (bioproducts), similar to clean energy?

The [Regional Biomass Resource Hub Initiative](#) is a new DOE initiative designed to accelerate the sustainable mobilization of purpose-grown energy crops to create clean fuels and products. The hubs developed under this initiative will also work to build markets for these crops and support the development of new clean fuels and products industries.

- What priority is being given to minimize waste heat by fully utilizing the process heat?

DOE supports waste heat recovery as one example of an energy efficiency technology. Learn more about the potential impact of energy efficiency in the [2022 DOE Industrial Decarbonization Roadmap](#). Learn more about DOE's Industrial Efficiency & Decarbonization Office research to [decarbonize process heat](#).

- Is there a website that described Adoption Readiness Levels (like NASA's publishing of TRL levels) so we may use this "construct" in our proposals in the future?

Learn more on DOE's [Adoption Readiness Level](#) website.

- Is there any DOE research focused on PM [particulate matter] 2.5 micron emissions reduction technologies?

DOE's Office of Fossil Energy and Carbon Management (FECM) is working with the U.S. Environmental Protection Agency and other relevant agencies to evaluate the air quality impacts associated with carbon capture and to identify research needs, including on particulate matter 2.5 (PM 2.5).

Additional information on this ongoing work can be found in the publicized findings from the [Workshop on Measurement, Monitoring and Controlling Potential Environmental Impacts from](#)

[the Installation of Point Source Capture](#), hosted by FECM and the United States Energy Association in 2023.

- [How do the panelists assess the potential of combined heat and power as a feasible option for decarbonizing industrial operations?](#)

DOE cannot speak to the analysis done by specific panelists. [DOE's Industrial Decarbonization Roadmap](#) describes how "industrial CHP [combined heat and power] can provide significant GHG [greenhouse gas] emissions in the near- to mid-term" and that "RNG [renewable natural gas] and hydrogen-fueled CHP systems can be a long-term path to decarbonizing industrial thermal processes..." (p. 14). For an introduction to CHP, please see DOE's Industrial Efficiency and Decarbonization Office's [Combined Heat and Power Basics](#). Additional resources are available at [DOE's Better Buildings website](#) and [Onsite Energy Program](#).

- [Is it worth establishing a maximum BTU \[British thermal unit\]/unit product production for industries based on pilot studies and decarbonizing fossil fuel usage in order to help reduce CO₂ emissions, pollution particulate emissions, and water usage while alleviating the problem associated with environmental justice?](#)

Industrial decarbonization, sustainable chemistry, and environmental justice (EJ) are intrinsically linked. New chemistries and manufacturing processes for fuels and products should consider environmental justice-related aspects across the full life cycle of a product, including acute and cumulative impacts to workers, end product consumers, and neighboring communities. The benefits should impact local communities through improved public health metrics, improved local air quality, and environmental co-benefits such as water usage. More information on energy use and product production is available through DOE's Industrial Efficiency & Decarbonization Office's [Energy Analysis Resources](#), including as the manufacturing energy bandwidth studies and energy footprints.

- [Can conversion technology repurpose existing manufacturing facilities or must they be purpose built? If so, will the stranded assets need to be considered?](#)

The Carbon-Efficient Conversion Processes pillar of the Clean Fuels & Products Shot focuses the technology development needed to maximize conversion of sustainable resources into clean fuels and products. DOE supports research and development efforts at basic science, applied R&D, demonstration, and technical assistance stages. This includes conversion technologies, which repurpose existing manufacturing facilities, as well as next-generation reactors along with separations, process design, and optimization. DOE also supports integration with clean hydrogen, clean electricity, and clean heat.