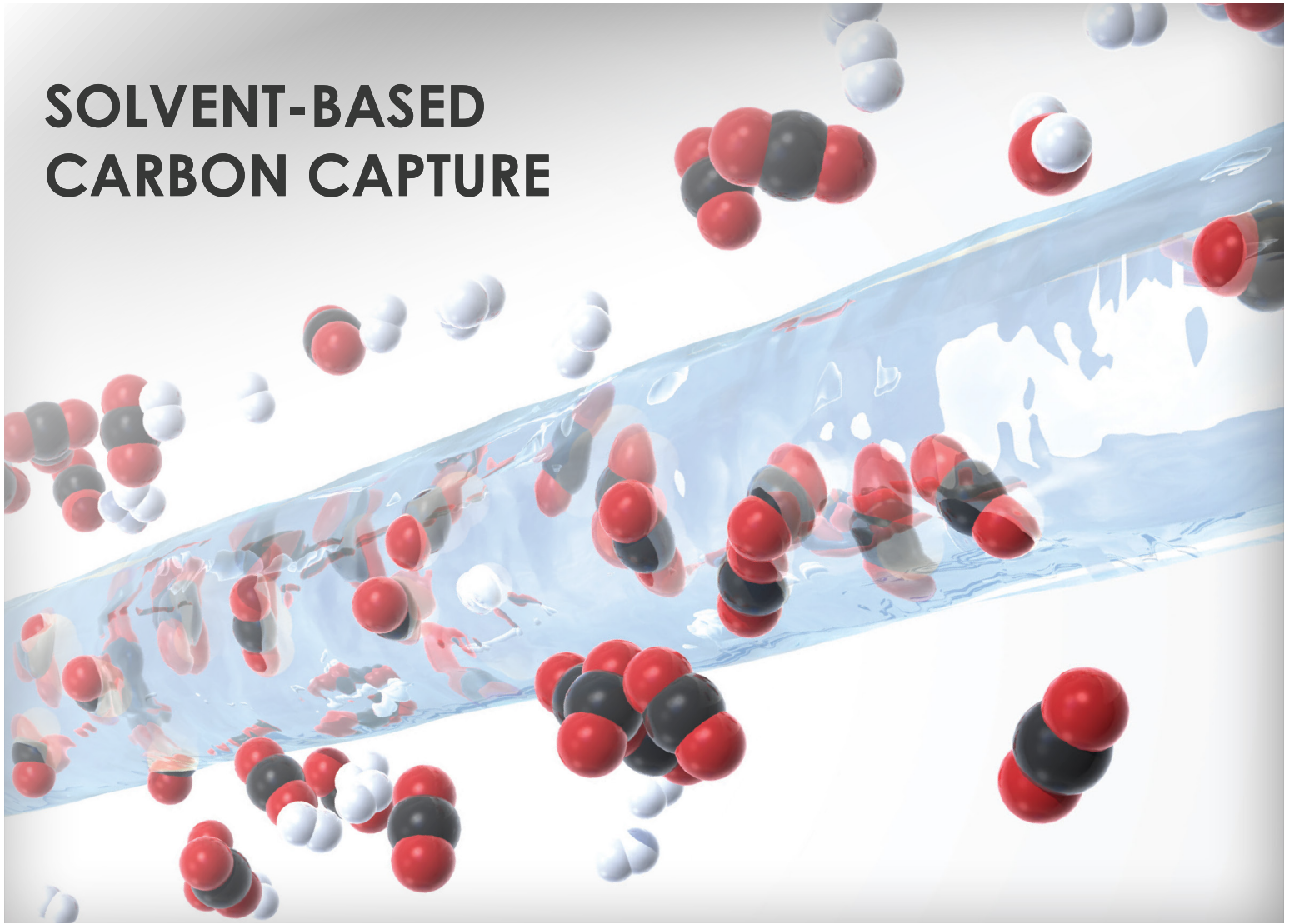


SOLVENT-BASED CARBON CAPTURE



Program 148, August 2024



NETL's Point Source Carbon Capture (PSCC) Program is developing the next generation of advanced carbon dioxide (CO₂) capture concepts to support the United States in achieving ambitious goals for a greenhouse gas (GHG)-neutral economy by 2050, a carbon-pollution-free power sector by 2035, and a 50% reduction from 2005 levels in economy-wide net GHG pollution by 2030. The PSCC Program is accelerating commercially deployable solutions that can be applied to a wide spectrum of CO₂ emissions sources with varying characteristics, including facilities that produce power, hydrogen, chemicals, cement or steel, as well as exhaust CO₂ emissions from mobile sources, such as marine vessels, long-haul trucks and rail transport vehicles.

R&D efforts to date have led to reductions in both capital and operating costs through implementation of energy and process efficiencies and development of advanced CO₂ capture media (e.g., solvents, sorbents, and membranes). To achieve deep decarbonization of emissions sources, the program is focused on developing highly efficient, scalable carbon capture technologies with cost reductions that can operate under a flexible duty cycle and can achieve greater than 95% carbon capture.

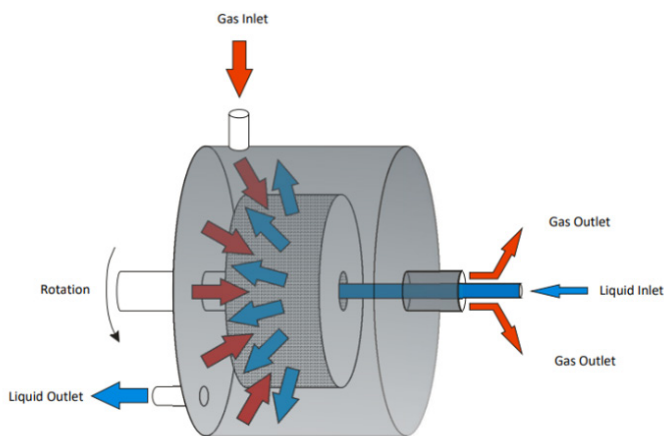
SOLVENT-BASED CAPTURE TECHNOLOGY

Solvent-based CO₂ capture involves chemical or physical absorption of CO₂ from a gas into a liquid carrier. The absorption liquid is regenerated by increasing its temperature or reducing its pressure, releasing the captured CO₂. Solvent-based systems offer opportunities for effective heat integration and management as well as selective capture from low-concentration gas streams.

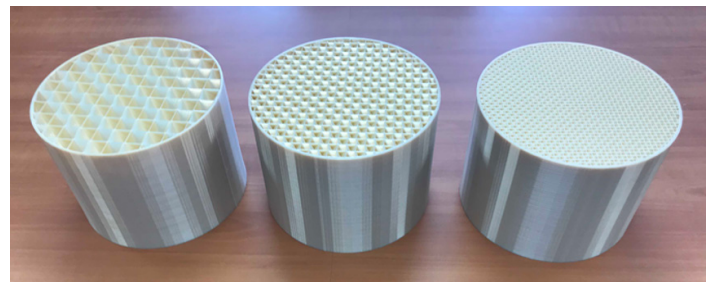
Advancements in solvent-based technology development are being pursued along three main innovation pathways: materials, processes and equipment. R&D objectives include development of low-cost non-corrosive solvents that have a high CO₂ loading capacity, improved reaction kinetics, low

energy investment and resistance to degradation. Targeted process R&D includes improvements in system configuration and operation that result in enhanced heat recovery and mass transfer rates.

The PSCC Program has examined a broad array of solvent-based capture approaches including water-lean solvents, phase-change solvents, high-performance functionalized solvents, amine solvents, carbonate-based solvents and catalyzed processes. Process innovations and equipment improvements (e.g. two-stage stripping and additive manufacturing) have contributed to overcoming technical challenges, including absorber and desorber designs for optimized gas-liquid contact, process intensification techniques, methods to mitigate aerosol formation, heat integration approaches and hybrid systems.



Process intensification using a rotating packed bed absorber



3D printed intensified packings for enhanced solvent-based CO₂ capture

NETL is a U.S. Department of Energy national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. Through its world-class scientists, engineers and research facilities, NETL is ensuring affordable, abundant and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans, advancing environmental justice and revitalizing the economies of disadvantaged communities.

Leveraging the power of workforce inclusivity and diversity, highly skilled innovators at NETL's research laboratories in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania conduct a broad range of research activities that support DOE's mission to ensure America's security and prosperity by addressing its energy and environmental challenges through transformative science and technology solutions.

NETL lends its expertise toward achieving a carbon-free power sector by 2035 and a net-zero economy by 2050 while catalyzing economic revitalization, creating good-paying jobs and supporting workers in energy communities, especially hardhit coal, oil and gas, and power plant communities, across the country. One of the most rewarding aspects of NETL's research is that our innovations and our technologies have the potential to improve people's lives in meaningful ways.

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