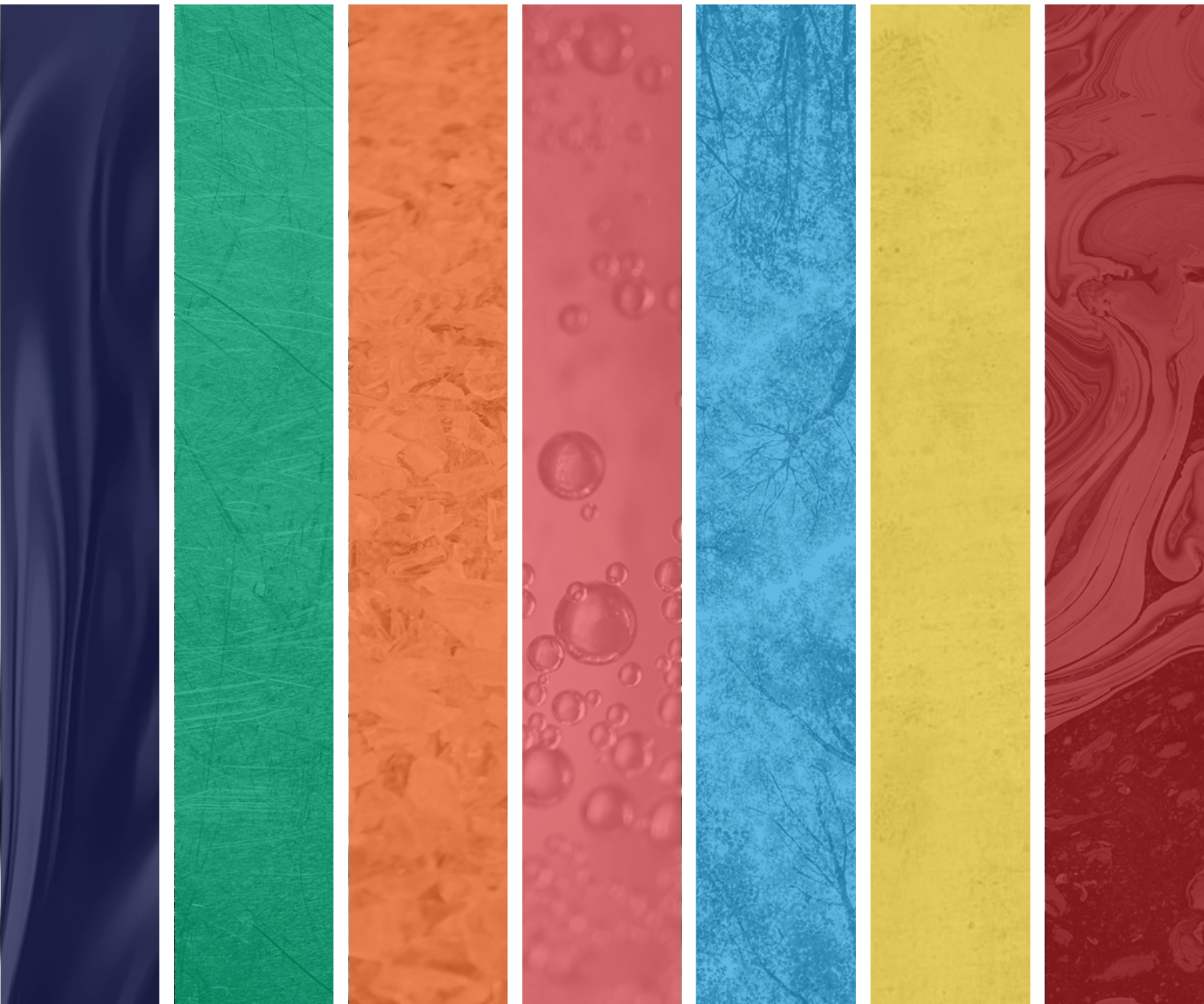
Research, Development, Demonstration, & Deployment (RDD&D)



2.2 Research, Development, Demonstration, & Deployment (RDD&D)

Overview
RDD&D covers the suite of activities needed to develop and commercially scale industrial decarbonization solutions in the near term while advancing innovative solutions for the long term. Policies that support industrial decarbonization RDD&D will help drive down the cost of emissions-reducing technologies and serve as a complement to and accelerant of other policy solutions. [88]

While universities and corporations largely conduct early-stage research and development (R&D), government RDD&D policies broadly enhance the investment muscle and speed of technology maturation, in addition to reducing market and financial barriers the private sector will not overcome on its own. The United States has a far-reaching ecosystem of RDD&D, including its national laboratories, public-private partnerships, research institutes, and incentives for corporate R&D. This ecosystem has helped reduce the cost and increase the scale of critical clean energy technologies in the power and transportation sectors. [89]

State actions
States have complemented federal programs and fostered innovation primarily through two policy mechanisms: direct investment in state-level RDD&D programs and supporting innovative companies with tax credits. The following examples highlight state actions supporting industry:

- **California's** Electric Program Investment Charge (EPIC) program invests over $130 million per year in R&D projects that advance the sustainability and reliability of the electric system. This includes $133 million invested over 10 years toward industrial and agricultural innovation projects. [90]

- The **Maine** Clean Energy Innovation Challenge, a joint initiative of the Governor's Energy Office and the Maine Technology Institute, is a $500,000 grant program that helps clean energy startups or small businesses market and scale technologies that will help the state reach its climate goals. [91]

- The **Massachusetts** Clean Energy Center funds numerous programs to accelerate clean energy technologies, such as InnovateMass, which provides up to $250,000 in bridge funding and technical support to help early-stage companies achieve commercialization, [92] and IncubateMass, which funds climate and clean technology startups. [93]

- To help meet state climate goals, **Michigan** provided $1.55 million in seed funding to a cleantech accelerator hosted by Lawrence Technological University. The C3 Accelerator offers $50,000, zero-interest investments to support the commercialization of "renewable energy, energy efficiency, emission reduction, clean air and water, and recycling and upcycling technologies." [94]

- **Minnesota's** Conservation Applied Research and Development (CARD) program is a state-sponsored applied research and development program that funds projects that help utilities achieve energy efficiency goals. [95]

- **New York's** Innovation Program supports multiple types of clean energy incubators and accelerators, including Scale for ClimateTech, which helps startup companies overcome commercialization and scaling barriers. [96] New York is currently developing a $10 million Carbontech Development Initiative, which aims to "develop support for emerging technologies, and award grants to advance technologies that capture existing carbon or lower carbon emissions and transform this carbon into useful products." [97]

Gaps and opportunities

To reach 2050 net-zero milestones, government, academia, and industry will need to greatly increase their RDD&D in multiple areas to develop and deploy technologies associated with the pillars and to overcome barriers (***Figure 5***). [98] These barriers range from technology- or industry-specific (e.g., iron ore electrolysis for steel, green hydrogen-based ammonia for chemicals) to broad, cross-cutting breakthroughs (e.g., transitioning process heat to non-combustion technologies, such as high-temperature heat pumps).

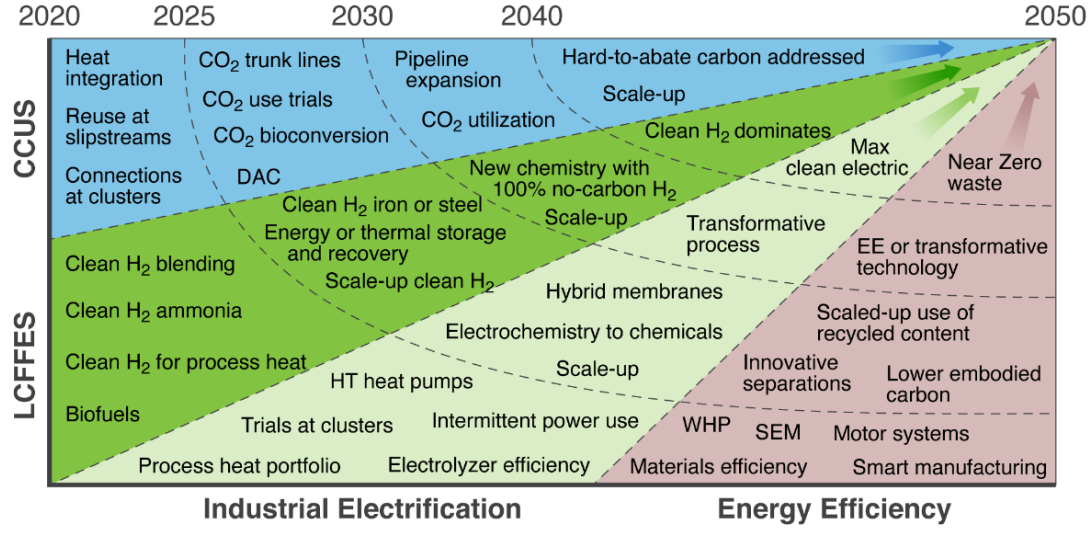


Figure 5: Landscape of major RD&D investment needs and opportunities for decarbonization, by decade and decarbonization pillar. LCFFES = Low carbon fuels, feedstocks, and energy sources. CCUS = carbon capture, utilization, and storage. Source: U.S. Department of Energy.

In recent climate and clean energy action plans, some states have recommended investment to develop and expand LCFF and CCUS specifically (i.e., **Louisiana, Michigan, Washington, Wisconsin**); while **New York** has proposed establishing a "research agenda" for industrial decarbonization solutions broadly. [99]

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