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As of 2021, atmospheric carbon dioxide (CO<sub>2</sub>) levels have reached historically unprecedented levels, higher than at any time in the past 800,000 years. The increase is almost entirely due to anthropogenic CO<sub>2</sub> emissions from activities such as fossil fuel burning, agriculture, and historical land-use change. The current level of human emissions greatly exceeds the ability of nature to remove CO<sub>2</sub>—simply reducing the levels of human emissions may not be enough to stabilize the climate. Carbon dioxide removal (CDR), sometimes referred to as negative emissions technologies, may prove valuable, in conjunction with reduced emissions to meet the global goal of limiting warming to well below 2°C, comparable to preindustrial levels, as established by the Paris Agreement.<sup>1</sup>

The 2015 National Academies report, *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration*, concluded that, to contribute to climate change mitigation, CDR approaches would need to be scaled up massively and that it is critical to begin research now to increase the viability and affordability of existing or new approaches to CDR. In response, the National Academies released a report in 2019 to provide a research agenda for advancing CDR and, specifically, for assessing the benefits, risks, and sustainable scale potential for a variety of land- and coastal-based CDR approaches. The study found that, to meet climate goals, some form of CDR will likely be needed to remove roughly 10 Gt CO<sub>2</sub>/yr by mid-century and 20 Gt CO<sub>2</sub>/yr by the end of the century. To help meet that goal, four land-based CDR approaches are ready for large-scale deployment: afforestation/reforestation, changes in forest management, upland and storage by agricultural soils, and bioenergy with carbon capture and storage, based on the potential to remove carbon at rates below 1 Gt yr<sup>-1</sup> CO<sub>2</sub>. The 2019 report did not examine the more global ocean-based approaches but did recognize the potential for ocean-based CDR and the need for a research strategy to explore these options.

To address this gap in understanding and the need for further exploration into CDR options that could feasibly contribute to a larger climate mitigation strategy, with sponsorship from the Charles and Johanna Busch Foundation, the National Academies convened the Committee on a Research Strategy