# FUELING A LOW-CARBON BIOFUEL FUTURE IN MINNESOTA



John Holler Center for Climate and Energy Solutions May 2024

The United States is the top biofuel producer in the world, with the Midwest generating hundreds of millions of barrels of ethanol and tens of millions of barrels of biodiesel annually. As a top-five producer of ethanol and biodiesel in the United States, policymakers, fuel producers, farmers, and communities in the state will be influential in the country's ability to both lower agricultural emissions and deliver low-carbon energy for liquid fuel-reliant transportation modes. Federal funding under the Bipartisan Infrastructure Law and the Inflation Reduction Act offers new opportunities for Minnesota to support its own Sustainable Aviation Fuel Credit and the launch of the Minnesota Sustainable Aviation Fuel Hub through the Greater MSP Partnership. Capitalizing on federal and state initiatives to support sustainable fuel production, Minnesota can leverage its unique position to establish robust supply markets, improve the climate and sustainability impacts of biofuels, bolster community health and wellbeing, and support demand-side opportunities for the long-term uptake of low-carbon biofuels. This brief provides insights from a roundtable hosted in Minneapolis in October 2023 that explored the low-carbon fuels opportunity and the associated market, regulatory, and technological challenges in Minnesota.

by

# INTRODUCTION

## **REGIONAL ROUNDTABLES**

Efforts to accelerate the transition to the low-carbon economy of the future are accelerating across all sectors of the economy. To chart a pathway to sustainable, longterm prosperity, communities must be able to leverage their unique strengths and capitalize on emerging economic opportunities, while addressing barriers that are often poorly understood outside of their communities.

To that end, the Center for Climate and Energy Solutions (C2ES) hosts regional roundtables to bring together local, state, and federal policymakers; businesses of all sizes; community organizations and nonprofits; academics and issue experts; trade associations; investors; philanthropy; economic development organizations; and others. These conversations are meant to elevate the perspectives of a diverse set of stakeholders who are deeply embedded in their communities and uniquely positioned to speak to the needs of their states and regions. They are also meant to create opportunities to integrate local perspectives into state and federal policy decisions and, importantly, identify concrete steps to better align the long-term vitality of these communities with the urgent task of reaching net-zero emissions economywide.

Our October 2023 roundtable, held in Minneapolis, Minnesota, brought together approximately 40 participants, representing companies, nonprofits, government, colleges and universities, and community leaders. This brief summarizes key takeaways from the discussion and—building on insights from the event and other conversations with local stakeholders—provides C2ES recommendations meant to advance a low-carbon biofuels industry in the state in a way that achieves both climate and economic development goals.

# FRAMING THE LOW-CARBON FUELS DISCUSSION IN MINNESOTA

## **Biofuels**

Nineteen ethanol plants in Minnesota convert corn grain into more than one billion gallons of ethanol annually, nearly 9 percent of U.S. ethanol produced in 2021 (5thranked state).<sup>1</sup> In 2023, production volumes in Minnesota are estimated to have grown to over 1.3 billion gallons, supporting 20,914 jobs across fuel production, agriculture, logistics, construction, engineering, marketing and sales, power automation, and transportation.<sup>2</sup> Together, the industry supports \$6.6 billion in economic activity through sales and \$2.5 billion toward the state's gross domestic product (GDP).<sup>3</sup> In 2021, Minnesota also produced 76 million gallons of biodiesel—which is primarily blended with diesel fuel for use in heavy-duty vehicles, trains, and boats— accounting for approximately five percent of U.S. production (4th ranked).<sup>4</sup>

Minnesota—a national leader in agricultural production, ranking 5th in the nation for total crop sales harvests significant amounts of feedstocks for both fuel ethanol and biodiesel.<sup>5</sup> The primary feedstock for fuel ethanol is corn grain, which is fermented into alcohol. Biodiesel, meanwhile, can be produced from a variety of oil-based feedstocks. In Minnesota and nationally, soybean oil is the primary feedstock with the remainder of biodiesel in the state supplied by corn oil and a mix of fats, oils, and greases.<sup>6</sup> Minnesota harvested nearly 7.5 million acres of corn grain in 2022 (approximately 1.46 billion bushels) and another 7.4 million acres of soybeans (approximately 369 million bushels).<sup>7</sup>

State statutes supplement federal biofuel mandates to support the industry. Minnesota is one of seven states to mandate the blending of ethanol (or any other gasoline substitute approved by the U.S. Environmental Protection Agency (EPA) into the gasoline supply with a blend of ten percent (E10).<sup>8</sup> Minnesota was also the first state to mandate biodiesel blends. This regulatory framework has historically buoyed demand-side market dynamics in the state and federally and plays a major role in the Minnesota and broader Midwest economies.

## Hydrogen

Minnesota is a proposed site under the Heartland Hydrogen Hub project, one of the seven regional clean hydrogen projects the U.S. Department of Energy (DOE) selected in October 2023.9 Led by the University of North Dakota's Energy and Environmental Research Center, Marathon Petroleum Corporation, TC Energy, and Minneapolis-based Xcel Energy, the project is negotiating a funding award of up to \$925 million to produce low-carbon hydrogen across Minnesota, Montana, North Dakota, South Dakota, and Wisconsin.<sup>10</sup> The hub would leverage the federal funding to produce hydrogen in Minnesota via electrolysis with clean electricity. Potential applications for regionally generated hydrogen include new fertilizer production in Minnesota in support of the state's agricultural needs while realizing significant emissions reductions from the production process.<sup>11</sup>

## Sustainable Aviation Fuel

The establishment of new federal goals to produce sustainable aviation fuel (SAF) in the United States has coincided with Minnesota positioning itself to become a major SAF producer. SAF is a liquid, drop-in fuel that can be blended with fossil jet fuel and used in today's aircraft. It may be produced from a wide range of both non-petroleum feedstocks and conversion technologies as either a biofuel or power-to-liquid (PtL) (synthetic) fuel. See Box 1 for a breakdown of the different conversion technologies.

In 2023, Minnesota passed a \$1.50 per gallon producer tax credit for qualifying SAF produced or blended, and subsequently used as fuel by a departing aircraft in the state.<sup>12</sup> This measure supplements similar federal production tax credits for SAF. Notably, while the Minnesota SAF production credit extends longer than federal production tax credits (2030 vs. 2027), it also limits eligible SAF to fuel produced with feedstocks that meet the state definition of "biomass."<sup>13</sup> This excludes powerto-liquid SAF, produced using hydrogen and a carbon oxide, unless a broader interpretation of "biomass" can be extended to biogenic carbon dioxide. Notwithstanding these differences, the Minnesota SAF production credit comes at a time when global production is still in its infancy, joining only Washington and Hawaii as states enacting production tax credits for which SAF qualifies.

Collaborative efforts to advance SAF in Minnesota are going beyond production tax credits. Led by the regional economic development non-profit GREATER MSP, a coalition of companies and Minnesota-based organizations launched the Minnesota SAF Hub in August 2023.14 The coalition organizes itself around a phased, multi-year strategy to accelerate commercial scaling of SAF in the state. Immediate objectives of the group involve engaging producers, investors, corporate partners, and other stakeholders to achieve commercial-scale deliveries of SAF to the Minneapolis-Saint Paul (MSP) International Airport by 2025. Looking ahead, the Minnesota SAF Hub seeks to leverage new and existing ethanol infrastructure to produce SAF and advance methods to reduce the carbon intensity of those fuels through the implementation of regenerative agriculture and carbon capture. The production of power-to-liquid fuels from clean hydrogen is a stated long-term goal to maximize the reduction of greenhouse gas emissions.

## Electricity

Electricity is relevant to Minnesota's low-carbon fuel generation as an energy input to both biofuel and hydrogen production. Reducing the carbon intensity of electricity provided in the state in-turn may reduce the carbon intensity of these fuel products.

Renewable and nuclear sources accounted for almost 58 percent of Minnesota's in-state electricity generation in 2022, with coal and natural gas responsible for 27 and 15 percent, respectively.<sup>15</sup> The state also imports electricity from Canada and surrounding states, consuming 23 percent more electricity in 2022 than it produced.<sup>16</sup> In February 2023, Minnesota adopted into law a new carbon-free electricity standard requiring public utilities to generate or procure 80 percent of electricity from carbon-free technologies for retail customers by 2030, increasing by 10 percent every five years to reach 100 percent by 2040. The law also updates the state's existing renewable electricity standard, requiring that 55 percent of a utility's sales be generated or procured from eligible renewable energy technologies by 2035. Eligible renewable energy generation sources under the law include wind, solar, geothermal, biomass, and hydrogen generated from renewables, whereas "carbon-free" technologies include renewables and nuclear.17

#### **Clean Transportation Standard**

In March 2021, a bipartisan and bicameral coalition of the Minnesota Legislature introduced the Future Fuels Act, a bill based on low-carbon fuel standards.<sup>18</sup> Although the House and Senate versions of the bill ultimately did not advance during the 2021–22 session, its introduction laid the groundwork for reexamining the issue in the next legislative session. The bill would have aimed to achieve a 20 percent reduction in carbon intensity for transportation fuels from a 2018 baseline by 2035 through annual stepwise milestones. Transportation fuels included electricity and liquid or gaseous fuels used to propel a motor vehicle, including trains, light rail vehicles, ships, aircraft, forklifts, and other road and nonroad vehicles.<sup>19</sup>

In March 2023, the Minnesota Legislature introduced the Clean Transportation Standard Act (CTS). The bill would have required the establishment of a clean transportation standard in Minnesota to reduce the carbon intensity of its transportation fuels by at least 25 percent below the 2018 level by 2030, 75 percent by the end of 2040, and 100 percent in 2050.20 Also in 2023, a transportation budget deal provided funding to establish the Clean Transportation Standard Working Group to study and address information gaps and opportunities for how to achieve the goals set out in the CTS. The working group report highlights significant challenges meeting these carbon intensity targets based on multiple modeled scenarios. As a result, most working group members advised that the CTS targets be revised to reflect carbonintensity reductions closer to the modeled moderate case scenario, to be re-evaluated every three to five years.<sup>21</sup> The results of the modeling were as follows:

- business-as-usual (BAU) case: five percent in 2030, 15 percent in 2040, and 30 percent in 2050
- moderate case: 13–17 percent in 2030, 40–50 percent in 2040, and 65-75 percent in 2050
- all-in accelerated case: greater than 75 percent in 2040, and greater than 100 percent in 2050.

The compliance scenario modeling in the Clean Transportation Standard Working Group report considered several mitigation strategies, including increased biofuel volumes (e.g., higher ethanol blends and renewable diesel), ways to decrease the carbon intensity of biofuels in the state (e.g., carbon capture and agricultural practices), and zero-emission vehicle deployment. Highlights from the moderate case modeling (the case closest to the working group's recommended CTS stringency) include the following:

## **BOX 1: Sustainable Aviation Fuel Production Technologies and Feedstocks**

Sustainable Aviation Fuel can be produced using a wide range of ASTM-accredited production pathways. Each production pathway involves its own unique chemical process to convert various non-petroleum feedstocks into a liquid fuel which can be blended with conventional jet fuel and used in today's aircraft. While the number of approved pathways continues to grow (11 as of July 2023), several conversion technologies are expected to play a larger role in the near-term:

Pathway	Description	Possible Feedstocks	Approved Blend Ratio
Hydroprocessed esters and fatty acids (HEFA)	Oils and fats are refined into a hydrocarbon fuel using a similar process as that which produces renewable diesel.	Soy, corn, and other veg- etable oils, used cooking oil, animal tallow	50%
Alcohol to jet (AtJ)	Alcohol feedstocks are upgraded into a hydrocarbon fuel.	Alcohol (e.g., ethanol and isobutanol) produced from biomass (e.g., corn, sug- arcane, crop residues) or industrial waste (e.g., steel mill offgas)	50%
Fischer-Tropsch (FT)	Syngas (hydrogen and carbon monoxide mixes) is convert- ed into a liquid hydrocarbon fuel. Syngas can be produced by gasifying carbon-contain- ing materials.	Renewable natural gas, hydrogen via electrolysis, waste carbon dioxide, biomass (e.g., municipal solid waste, agricultural residues, energy crops)	50%

- There is no difference in gasoline and E10/E15 consumption volume between the BAU and moderate case until 2035, when light-duty (LD) electric vehicle energy consumption exceeds the BAU case by eight percent. Post-2035, energy consumption from LD electric vehicles grows significantly, outpacing the BAU case by 45 percent in 2040.
- The carbon intensity of ethanol is projected to decrease from the 2026 base year by five percent in 2030, 10 percent in 2032, 15 percent in 2035, and 20 percent in 2042. Reductions are attributable to 1.2 percent per annum process improvements, the crediting of "climate-smart" agricultural practices, and a 30 percent carbon capture adoption rate on ethanol facilities by 2040.
- While hydrogen is projected to contribute little under fuel consumption volumes, the modeling limits its assessment to hydrogen's role in heavy duty trucking (no penetration until 2031). Notably,

clean hydrogen can also be used as a feedstock for synthetic liquid fuels in the maritime and aviation sector, and as an input in the biofuel and fossil fuel refining process.

## THE FEDERAL BIOFUEL POLICY LANDSCAPE

The United States is responsible for over half of global ethanol production, growing from 1.6 to 15.2 billion gallons during the period of 2000–21, and nearly a third of global biodiesel production.<sup>22</sup> Ethanol represents the largest share of U.S. biofuel production (85 percent).<sup>23</sup> In the United States, liquid biofuels like ethanol, biodiesel, and—to a lesser but growing extent—renewable diesel, are primarily blended with refined petroleum products before consumption as a transportation fuel. Amongst its neighboring Midwest states, a dominant agricultural sector and conducive incentives have historically made Minnesota a top producer of U.S. biofuels. Figure 1 shows U.S. biofuels production by major type from 2000–2021.

### Renewable Fuel Standard

The renewable fuel standard (RFS) was created under the Energy Policy Act of 2005 and updated to its current form in 2007. Through the program, EPA sets an annual volume obligation to blend renewable fuels for refiners and importers of domestic transportation fuel (achieving at least 20 percent greenhouse gas reductions from the petroleum baseline), including biodiesel and advanced biofuel (50 percent reductions), and cellulosic biofuel (60 percent reductions). In 2024, the EPA set a target of 21.54 billion ethanol-equivalent gallons of fuel, to be satisfied in part by higher-credited volumes of cellulosic biofuel, biodiesel, and advanced biofuel.<sup>24</sup>

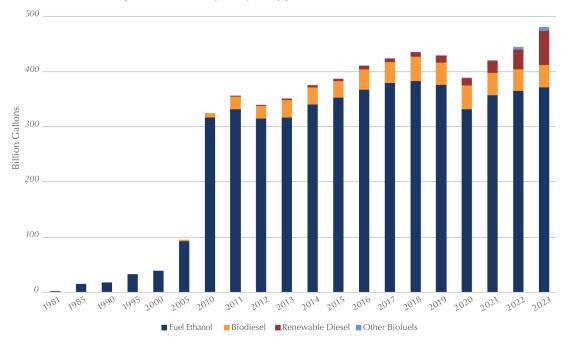
The historic success of the RFS is the subject of considerable disagreement, particularly as it pertains to the use of lower-carbon biofuels and overall reduction of emissions. To date, cellulosic biofuels have failed to be realized in the volumes mandated in the standard (in 2022, the 16-billion-gallon cellulosic biofuel mandate was met with no cellulosic ethanol and less than 1 billion gallons of gaseous fuel), requiring EPA to repeatedly use its authority to waive the requirement.<sup>25</sup> The program's overall effect on emissions is subject to considerable disagreement in literature, due in large part to the various modeling assumptions required to estimate the

mandate's effect on agricultural expansion and associated land use change emissions. A 2021 study examined multiple models' results for the lifecycle emissions of corn ethanol. In its analysis, the researchers included model results ranging from 52.1 to 78.3 grams of carbon dioxide equivalents per megajoule (MJ) and itself assessed a carbon intensity of 51.4 grams of carbon dioxide equivalents per MJ (46 percent lower than gasoline), while another recent study attributed to the mandate considerable increases in emissions compared to the fossil fuel baseline. <sup>26</sup>

#### **Biodiesel Tax Credit**

The Biodiesel Mixture Excise Tax Credit was implemented in 2005 and establishes a \$1.00 per gallon federal tax incentive for biodiesel or renewable diesel blended with petroleum diesel.<sup>27</sup> Production volumes are responsive to the credit due to the higher cost of biodiesel and renewable diesel relative to petroleum diesel. The credit has expired and been renewed four times since 2009, resulting in uncertainty and the use of risk-sharing contracts to account for potential lapses.<sup>28</sup> Domestic production, and especially imports, of biodiesel increase significantly when the credit is in effect, demonstrating the influential nature of the credit.<sup>29</sup>

FIGURE 1: U.S. biofuels production by major type, 2000-2021



Source: EIA 2021 https://www.eia.gov/energyexplained/biofuels/

## Production tax credits in the Inflation Reduction Act

The 2022 Inflation Reduction Act established the Sustainable Aviation Fuel Credit and the Clean Fuel Production Credit.<sup>30</sup> The SAF production tax credits are available for non-petroleum aviation fuel sold in 2023 through the end of 2024 where the fuel is produced, and transferred to the tank of an aircraft, in the United States. Eligible fuel must meet a 50 percent emission reduction threshold compared to petroleum aviation fuel and cannot be derived from palm fatty acid distillates or co-processed with petroleum. The base value of the credit is \$1.25, with an additional \$0.01 added for each percentage point by which the carbon intensity of the fuel exceeds the 50 percent reduction threshold, up to an additional \$0.50.<sup>31</sup>

The broader Clean Fuel Production Credit will be available for both non-petroleum aviation and nonaviation transportation fuels sold in 2025 through the end of 2027 with a carbon intensity not greater than 50 kilograms of carbon dioxide equivalents per million British thermal units (MMBtu) (approximately 47 grams of carbon dioxide equivalents/MJ). Eligible fuels must be derived from biomass or other non-petroleum feedstocks. Co-processing with petroleum is not permitted. The credit amount is up to \$1.00 per gallon for non-aviation fuel and \$1.75 per gallon of aviation fuel where prevailing wage and apprenticeship requirements are satisfied.<sup>32</sup>

### Other Federal Incentives (Non-Exhaustive)

In addition to the laws and incentives described above, the federal government makes available a range of payments, grants, and loan guarantees for biofuel feedstocks and infrastructure.<sup>33</sup>

- The **Biomass Crop Assistance Program** aids feedstock producers who provide feedstock crops to advanced biofuel production facilities in the form of reimbursements and annual payments.<sup>34</sup>
- The **Biorefinery Assistance Program** provides loan guarantees for commercial-scale biorefineries producing advanced biofuels (not made from corn starch) and grants for demonstration-scale biorefineries.<sup>35</sup>
- The **Bioenergy Program for Advanced Biofuels** provides payments to advanced biofuel producers to support expanded production.<sup>36</sup>
- The Alternative Fuel Refueling Property Credit

provides a tax credit of up to 30 percent of the cost (up to \$100,000) of any qualified alternative fuel vehicle refueling property, including ethanol (E85), natural gas, propane, hydrogen, biodiesel, diesel blended with at least 20 percent biodiesel, and electricity.<sup>37</sup>

- The Higher Blends Infrastructure Incentive Program provides competitive cost-share biodiesel and ethanol infrastructure grants through the U.S. Department of Agriculture (USDA) for the installation, retrofitting, or upgrading of infrastructure to dispense ethanol blends greater than ten percent or biodiesel blends greater than 5 percent (up to the lesser of 75 percent of total eligible project costs or \$5 million).<sup>38</sup>
- The **Rural Energy for America Program (REAP)** provides loans and grants to agricultural producers and rural small businesses. The funding REAP provides to renewable energy systems and for energy efficiency improvements can support, amongst other things, the installation of biodiesel and ethanol blend pumps.<sup>39</sup>

## STATE-LEVEL CLEAN FUEL PROGRAMS

Minnesota's standup of the Clean Transportation Standard Working Group to examine a Clean Transportation Standard adds to a growing number of states that have implemented or introduced legislation to enact similar programs. These programs are also known as low-carbon fuel standards (LCFSs) or clean fuel standards (CFSs) and are distinct from federal- and state-level volume or blending mandates in that they instead establish increasingly rigorous carbon intensity targets for transportation fuel sold in their respective states. Like the federal renewable fuel standard, these market-based programs have historically allowed for the generation of tradeable credits for obligated parties to meet compliance obligations. The establishment of such programs generates demand not just to produce lower-carbon fuels in participating states, but it also incentivizes the importation of same from other states. In addition to biofuel, credited low-carbon pathways may include hydrogen, electrification, or project-based methods to reduce supply chain emissions like the implementation of carbon capture and storage technology.

To date, California (2010), Oregon (2016), Washington (2023) have implemented LCFSs, with New Mexico approving the establishment of a CFS program in 2024. The market impact of these programs on the interstate flow of low-carbon fuels has been significant. In 2021, California accounted for an estimated 99 percent of the country's renewable diesel consumption while generating 16 percent of nationwide production. The remaining one percent of estimated renewable diesel consumption took place in Oregon, which produces none.<sup>40</sup> As more states consider implementing similar programs, this demand dynamic could make it more challenging to meet compliance targets with biofuel-dominant gasoline displacement and necessarily require a deliberate approach to diverse low-carbon energy sources and safeguarding against unintended environmental consequences. In addition to Minnesota, other states that have examined the implementation of similar programs include New York, New Jersey, Illinois, and Michigan.<sup>41</sup>

## **BOX 2: Key Recommendations**

Below is a list of key recommendations from the discussion. Additional recommendations can be found in each section.

#### SUPPLY A LOW-CARBON BIOFUEL MARKET

- **Congress** should reauthorize and fund the following USDA programs, as part of the farm bill's five-year reauthorization (currently extended until September 2024):
  - Reauthorize the Higher Blends Infrastructure Incentive Program to fund the construction and maintenance of infrastructure compatible with higher blends of ethanol and biodiesel, with a revised prioritization toward freight, rail, and marine infrastructure because of their longer-term reliance on liquid fuel. The USDA should also prioritize funding the replacement of aging infrastructure such as underground tanks.
  - Fund the Biorefinery, Renewable Chemical, and Biobased Produce Manufacturing Assistance Program to assist the development, construction, and retrofitting of new and emerging advanced biofuels technologies.
  - Fund the Advanced Biofuel Payment Program to expand production of advanced biofuels.
  - Fund the **Rural Energy for America Program** to provide loans and grants to agricultural producers and rural small businesses for renewable energy systems and energy efficiency improvements.
- **Congress** should extend the duration of production tax credits for low-carbon fuel (the combined duration of 40(b) Sustainable Aviation Fuel Credit and the 45(z) Clean Fuel Production Credit is five years) to a minimum period of 10 total years.

#### **IMPROVE SUSTAINABILITY**

- **Congress** should establish a national clean fuel standard for the transportation sector consistent with achieving net-zero emissions by midcentury. The new technology-neutral fuel standard should credit low-carbon fuels for ground, maritime, and aviation sectors with differentiated compliance obligations for each to accommodate each sector's respective stages of developing and adopting alternative fuel solutions.
- Minnesota State Government should establish a state clean transportation standard which establishes a compliance market to support in-state production and consumption of credited fuels. The standard should support the long-term competitiveness of Minnesota-produced fuel by adopting carbon intensity benchmarks and methodologies that are robust and consistent with national-level goals (e.g., net-zero by 2050).
- The Minnesota Legislature should amend (or the Minnesota Department of Revenue should interpret) the Minnesota SAF production tax credit to apply to fuel produced using biogenic carbon dioxide and clean hydrogen.
- **Congress** should clearly designate a federal agency as having regulatory authority over the siting of interstate carbon dioxide pipelines. The federal siting authority should have a formal process for engaging and consulting with Tribal governments.

## **BOX 2: Key Recommendations (cont.)**

- **Congress** should authorize and fund a Conservation Equipment Loan Program under the Farm Service Agency (FSA), either through an existing program or as a standalone endeavor. This targeted loan program should offer financial incentives (e.g., lower interest rates and longer terms compared to traditional FSA loans) to help producers access expensive equipment necessary for climate-smart agriculture such as variable rate application technologies (VRT) or tools like roller-crimpers, which terminate cover crops without soil tillage. The agency should prioritize applications for equipment that directly facilitates greenhouse gas reductions or carbon sequestration. The loan program should be supplemented by an education and outreach program which supports training for the use of loan-eligible equipment and resources for farmers to project the financial costs and returns of implementing related practices.
- Minnesota Government should continue to support the Minnesota Pollution Control Agency's Nutrient Reduction Strategy (NRS) to identify and scale agricultural best management practices (BMPs). Following the release of the 2024 NRS update, which will mark the 10-year implementation milestone, the Minnesota Government should consider what additional resources can be made available to ensure significant progress in scaling BMPs.

## ADDRESS COMMUNITY CONSIDERATIONS FOR LOW-CARBON FUELS PROJECTS & INFRASTRUCTURE

- The **Council on Environmental Quality (CEQ)** and other **federal agencies** should provide clear, transparent guidance on Justice40, which commits to assign 40 percent of the overall benefits of applicable federal investments to disadvantaged communities. Clearer guidance can be provided by indicating, for example, how benefits are quantified and in what geographic radius the "communities" are defined. Covered federal programs that are applicable to Minnesota's communities and biofuel workforce include those under the USDA (e.g., FSA), DOE (e.g., Loan Program Office [LPO]), and DOT (e.g., Federal Transit Administration (FTA), Tribal Transportation Program).
- **Congress** should establish a funding program through **DOE** and **EPA** that facilitates engagement between lowcarbon fuel infrastructure developers and communities, including environmental justice groups, tribal communities, and farmers. This program should focus on proposed hydrogen hubs, pipelines, and biorefineries that will be used to advance the low-carbon biofuel economy. Information gained from these engagements should be collected and summarized in a comprehensive report describing community concerns and opportunities related to low-carbon biofuel, while offering recommendations to update regulations and implementation guidelines to better meet the needs of communities.
- Minnesota State Agencies should prioritize and support local capacity building to assist the state and local communities in accessing federal resources, including under the Loan Programs Office Title 17 Clean Energy Financing Program, related to upgrading essential infrastructure, adopting emissions mitigation technologies and practices, and climate resilience preparation.
- **Congress** should expand **U.S. Department of Education** resources for career and technical education that can support recent graduates and mid-career workers in skilled trades to acquire expertise relevant to the clean-energy industry. Congress should also fund K-12 outreach programs that educate young people—especially those in marginalized communities—on career opportunities and skills needs in the sector.

# **KEY TAKEAWAYS FROM THE DISCUSSION**

## SUPPLYING A LOW-CARBON BIOFUEL MARKET

## Opportunities for biofuels to strategically reduce emissions

The transportation sector in the United States is evolving, and a forward-looking view of demand dynamics should inform Minnesota's approach to supplying the market with biofuel. Incentives and compliance markets are prioritizing greenhouse gas reductions-an environment where domestic consumption of lower-carbon liquid fuels shifts toward "hard-to-decarbonize" modes of transportation like ground freight and aviation. While such demand dynamics do not themselves limit the use cases of exported biofuel (globally, most biofuel demand growth will come from emerging economies), the emergence of electric vehicles will overtake biofuel's historic place as the largest gasoline alternative in the United States.42 Meanwhile, the growth of ethanol production in Minnesota, mirroring the rest of the United States, has slowed significantly.<sup>43</sup> Under this context, there are opportunities in the state to leverage its existing agricultural resources, ethanol infrastructure, and workforce assets by supplying a growing biofuel appetite from heavy-emitting transportation sectors and commercializing new types of feedstocks for low-carbon fuels.

## Innovative technologies for next-generation biofuels

The prospect of growing with, and adapting to, new market forces was a major area of interest for roundtable participants. There was widespread recognition that while electrification is an economically and technologically feasible decarbonization approach that may ultimately narrow the typical demand for homegrown ethanol as a light-duty vehicle fuel, ethanol-based fuels will still play a growing role as a drop-in solution for hard to electrify sectors such as aviation, shipping, rail, and heavy-duty trucking.

Participants highlighted that meeting such needs will often require the construction of new infrastructure as more advanced fuel conversion pathways develop towards commercialization. For example, today's limited production of commercially available bio-jet fuel in the United States is derived from the hydroprocessed esters and fatty acids (HEFA) conversion process, which closely matches the well-established technology to produce renewable diesel (Minnesota produces no renewable diesel) (See Box 1). In the next decade, more advanced conversion pathways are expected to fulfill a growing volume of supply toward three billion gallons of renewable jet fuel by 2030, including through alcohol-to-jet (ATJ) and Fischer-Tropsch (FT) technology.<sup>44</sup> The implementation of

## **BOX 3: Key Roundtable Takeaways**

- Long-term certainty is crucial for companies to invest in technology and infrastructure for low-carbon fuels. New infrastructure like biorefineries, storage tanks, and pipelines are expensive and can take a long time to build. Companies need to know they will see a return on their investment before committing the time and capital to build out this infrastructure. Supporting policy must be predictable and durable.
- Equity must be central to the development of any state-level decarbonization policy. Often, the worst impacts of air pollution from transportation are felt disproportionately by low-income communities and/or communities of color. Policies to reduce emissions from fuels must prioritize air quality and health improvements in these communities.
- Farmers must receive a share of the benefits of low-carbon fuel production. Practices to improve yield, soil health, and water quality create an entry point for innovation on sustainable production of fuel feedstocks. How-ever, new technologies—like digital tools and climate-smart equipment—often have high up-front cost barriers and steep learning curves. Policies and outreach supporting these innovations should accommodate farmers' financial and training needs, while reducing risks associated with new types of crops and practices.
- Decarbonization must be an all-of-the-above effort. While light-duty transportation may be best suited for electrification, heavy-duty trucking, rail, maritime, and aviation will be best served in the near- to mid-term by low-carbon drop-in biofuels and hydrogen-based products.

different production processes will be time-intensive and require significant up-front capital investments to build, update, or replace refining equipment and supporting infrastructure. Long-term, predictable revenue sources in the form of tax incentives and emissions compliance credits improve the bankability of these projects.

Even still, relying on private project financing alone is particularly challenging in these cases because of the perceived risk of newer production technology and the creditworthiness of potential offtakers. Meeting the capital requirements to advance the biofuel sector demands federal support in the form of grants and loan guarantees. Roundtable participants also raised concerns that, due to long permitting timelines in the state, it is difficult for companies to build the physical infrastructure necessary to support the industry in a timely, competitive manner. They noted that other states with shorter permitting timelines may be more competitive to developers, thereby reducing Minnesota's ability to benefit from investments absent a comprehensive examination of where efficiencies may be levered in the permitting process.

## Diverse feedstocks for advanced biofuels

Looking ahead to a low-carbon biofuel industry with advanced production methods provides new opportunities to diversify feedstocks to include underutilized wastes, agricultural residues, and cover or double-cropped oilseeds—all of which would grow the biofuel feedstock supply without the emissions trade-offs associated with the direct or induced expansion of agricultural land. Winter camelina, for example, is suitable for the upper Midwest and can be double cropped with corn or soy as a winter annual crop or grown as a cover crop.<sup>45</sup> Grown as a secondary crop in a manner that avoids displacing other crops, camelina-based jet fuel could reduce fuel lifecycle emissions by nearly 68 percent.<sup>46</sup> Supplying a local biofuel industry with new types of biogenic feedstocks is a challenge.

At the roundtable, stakeholders representing growers made clear that farmers need to be incentivized with strong business cases and protections to expand into new practices. While insurance coverage under the USDA Double Cropping Initiative has recently expanded, winter oilseed crops and other biofuel feedstocks do not enjoy the same insurance protections as traditional feedstocks.<sup>47</sup> For farmers, access to seeds for more novel feedstocks is also a limiting factor. In addition to the fuel feedstocks, hydrogen or renewable natural gas are needed to power existing and advanced feedstock processing and local production of these energy inputs can be funded under programs like the USDA's REAP.

#### Supporting down-stream infrastructure

Supplying biofuel to consumers requires investments in downstream infrastructure. Access to fueling pumps and maintaining aging storage tanks can be an equity issue. Many rural communities, according to community and tribal participants in the roundtable, will not have the resources to be early investors in zero-emission transportation options such as electric vehicles, or to build and maintain the supporting infrastructure. Failing to maintain and update aging infrastructure in these areas will negatively affect surrounding communities and their economies. Ethanol-blended gasoline and biodiesel needs will persist for the foreseeable future, and distributors must weigh the uncertainty of long-term returns on investment with the need to replace aging tanks and equipment.

There is existing policy support in this area. In 2023, the USDA announced over \$8.6 million in funding to fuel stations in Minnesota under the Higher Blends Infrastructure Incentive Program. Six of the 18 awardees were granted funds to replace storage tanks, while nine stations used funds to install new E15 dispensers not typically used in hard-to-decarbonize vehicle sectors.<sup>48</sup> While the program's purpose is to expand the use of higher blends of biofuel in gasoline and diesel—potentially counterproductive in directing biofuels to those harderto-decarbonize sectors—selective application of these grants toward storage tank replacements and heavy-duty trucking has clear benefits.<sup>49</sup>

#### **Policy Recommendations:**

- **Congress** should reauthorize and fund the following USDA programs, as part of the Farm Bill's five-year reauthorization (currently extended until September 2024):
  - Reauthorize the Higher Blends Infrastructure
    Incentive Program to fund the construction and maintenance of infrastructure compatible with higher blends of ethanol and biodiesel, with a revised prioritization toward freight, rail, and marine infrastructure because of their longerterm reliance on liquid fuel. The USDA should also prioritize funding the replacement of aging infrastructure such as underground tanks.

## **BOX 4: Understanding the Life Cycle Analysis Value**

The LCA value of a biofuel (often denoted using the unit grams of carbon dioxide equivalent per megajoule) will vary depending on the methodology and data inputs used, its feedstocks, and the production process. The total lifecycle emissions value of a biofuel is the sum of two components: a core LCA value and a LUC value. The core LCA value is a calculation of emissions from the full supply chain, including the cultivation of the crop, the conversion of the feedstock into fuel, and the combustion of the fuel in an engine. Components of the core LCA value are typically measurable and can be reduced by implementing various mitigation strategies, such as replacing the refinery's use of natural gas with a cleaner alternative. LUC value calculations model how the demand for biofuel feedstocks will influence the expansion of agricultural land and estimate the emissions associated with the conversion of grasslands, forests, and other natural ecosystems into farmland. The estimated effects can be indirect and subject to uncertainty (e.g., the removal of soybean oil from U.S. markets for biofuel production can generate more demand for palm oil produced in Southeast Asia). Inclusion of soil organic carbon flows within the LUC accounting boundary can add to or reduce this value, depending on context. Methods to reduce LUC values include increasing feedstock yield per acre, growing feedstocks on land that doesn't risk displacing other crops (e.g., as a cover crop or on degraded land), or improving soil carbon sequestration through agricultural practices. There is an extensive and growing body of literature assessing, building on, and critiquing various LCA methods.\*

\* National Academies of Sciences, Engineering, and Medicine. 2022. Current Methods for Life-Cycle Analyses of Low-Carbon Transportation Fuels in the United States. Washington, DC: The National Academies Press. https://doi.org/10.17226/26402.

- Fund the Biorefinery, Renewable Chemical, and Biobased Produce Manufacturing Assistance
   Program to assist the development, construction, and retrofitting of new and emerging advanced biofuels technologies.
- Fund the **Advanced Biofuel Payment Program** to expand production of advanced biofuels.
- Fund the Rural Energy for America Program to provide loans and grants to agricultural producers and rural small businesses for renewable energy systems and energy efficiency improvements.
- **Congress** should instruct the USDA to broaden the coverage of insurance for double cropping. The U.S. Double Cropping Initiative under the USDA Risk Management Agency (RMA) is intended to increase the number of counties where double cropping is insurable. However, recently expanded insurance coverage is limited to soybeans and grain sorghum, which may disincentivize double cropping systems that include winter annual biofuel crops and other biofuel feedstocks.
- **Congress** should extend the duration of production tax credits for low-carbon fuel (the combined duration of 40(b) Sustainable Aviation Fuel Credit and the 45(z) Clean Fuel Production Credit is five years) to a minimum period of ten total years to support certainty among investors and reduce the risk of investment in advanced, capital-intensive production facilities and distribution infrastructure. Considering the time required to plan, finance, and build new clean fuel production infrastructure, the benefit of relatively short duration tax credits is largely limited to existing producers and does not adequately incentivize new production capacity.
- Minnesota State Government should establish a multi-agency task group to examine comprehensive permitting reform for low-carbon fuel production to reduce permitting timelines in the state to be comparable to the broader region.

## **OPPORTUNITIES TO IMPROVE SUSTAINABILITY**

# Greenhouse gas impacts of biofuel and feedstock production

Identifying opportunities for economic development alongside low-carbon technology deployment in Minnesota necessarily requires an understanding of biofuelrelated greenhouse gas emissions. As with any energy source, there are trade-offs to acknowledge and mitigate through innovation and supportive policy frameworks. The carbon intensity of a biofuel is determined through a lifecycle analysis (LCA) to assess the emissions associated with each stage of its production, which takes into account both its core LCA value and a land use change (LUC) value. See box 4 for more information on lifecycle emissions analysis of biofuels.

For the purpose of policy discussions, the LCA value is key in understanding how various biofuels perform on an emissions basis. For policy frameworks seeking to advance low-carbon fuels in the public interest, the LCA value of a biofuel may determine whether or to what extent its production may be eligible for support from public resources. Likewise, robust lifecycle assessments are of value to producers seeking access to emerging markets and customers where lower emissions are prioritized. It is therefore in the interest of all stakeholders to understand how to both incentivize production of lower-carbon biofuels and deploy mitigation techniques to improve LUC and core LCA emissions from biofuel production in the state.

LUC emissions from biofuels produced in Minnesota can be reduced by adopting agricultural practices to directly increase soil carbon sequestration or by diversifying feedstock sourcing beyond primary crops like corn and soy, the cultivation of which has historically led to significant land conversion and associated emissions. With respect to increasing soil carbon sequestration, the prospect of adopting climate-smart agricultural practices like low-till agriculture and the use of cover crops was a topic of high interest in the roundtable discussion. The deployment of these practices was widely acknowledged to not only benefit carbon sequestration, but also generate additional benefits for farms, such as improved soil health and protection from erosion.

Labor and agriculture group participants described implementation challenges. New "climate-smart" agriculture technologies like digital tools and farm equipment often have high up-front costs and steep learning curves, which are barriers to an aging workforce who must make decisions about the returns on these investments. With 62 percent of Minnesota farms' principal producers over the age of 55, labor groups spoke of the need for training, cost-benefit analysis tools, and equipment financing, and for young farmers to take on newer crops and management practices.<sup>50</sup> Stakeholders representing fuel producers and farmers spoke of the need for incentives and a business case for adjusting standard practices. Specifically, some advocated for fuel production tax credits under the Inflation Reduction Act (or a state-level Clean Fuel Standard) to recognize soil carbon sequestration as a way to the lower the LCA values of Minnesota-produced corn ethanol.

Regardless of the incentive mechanism, policymakers should recognize and account for the trade-offs in crediting reduced LCA values from soil carbon sequestration—namely that quantifying or predicting rates of soil carbon stock change is extremely difficult and that the re-release of sequestered soil carbon into the atmosphere is a realistic problem.<sup>51</sup> These conditions present a significant risk of overestimating the impact of practices designed to increase soil carbon sequestration. Nonetheless, there is massive potential for these practices when applied nationwide to restore the soil carbon lost from agriculture-induced land use change. Providing the right balance of incentives is critical to ensuring that these practices gain widespread use.

Beyond soil carbon sequestration, crop diversification can produce lower LUC values for Minnesota biofuel. Policies and outreach supporting innovative feedstocks and practices are needed to meet the financial and training needs of farmers. Minnesota produces millions of tons of uncollected crop residues, (e.g., corn stover) the use of which as a feedstock results in no land use change. Biogenic wastes diverted from landfills, and by-products like technical corn oil also have no or low land use change impacts. Cover crops or secondary crops like camelina, or energy crops like poplar or switchgrass grown on marginal land may have the benefit of significantly reduced or negative emissions associated with land use due to their lack of displacement effects combined with carbon dioxide removals attributed to agricultural biomass (e.g., roots), changes in soil carbon, and other factors.<sup>52</sup> Participants at the roundtable shared a desire to pursue innovation in feedstocks as a major economic opportunity, including commercialization of oilseed crops like camelina and pennycress, and increased yield on existing farmland to reduce the carbon intensity and increase the competitiveness of biofuels in the state.

Reducing core LCA emissions from the production of biofuels requires the availability of lower-emitting energy inputs. Of the approximately 25.6 grams of carbon dioxide equivalent per megajoule from the corn ethanol refining stage, nearly 80 percent of emissions are attributable to natural gas consumption and nearly 14 percent are derived from electricity consumption.<sup>53</sup> Displacing conventional fossil-derived natural gas with renewable natural gas (also known as biomethane) from landfills or livestock management and reducing grid emissions with clean electricity will benefit the emissions profile of the refining stage. Notably, the extent to which renewable natural gas can reduce ethanol's emissions profile largely depends on its own carbon intensity, which can vary significantly depending on the assumptions used for avoided emissions (e.g., the MN Clean Transportation Working Group modeling assigned carbon intensities of landfill gas and animal manure as 40 g/MJ and -275g/MJ, respectively).<sup>54</sup> Nonetheless, even absent avoided emissions crediting, policy which ensures that the collection and production of renewable natural gas and continuous additions of clean electricity would support refinery-level decarbonization. As large point sources of carbon dioxide emissions (the fermentation process alone emits 45 metric tons of biogenic carbon dioxide annually in the United States), ethanol biorefineries are a prime target of carbon capture technologies.55 The ability to sequester the carbon dioxide depends on both the suitability of nearby sequestration options (e.g., geologic storage) or the ability to transport the carbon dioxide via pipeline.

Recent state and legal actions in the Midwest—like the rejection of carbon dioxide pipeline permit applications in South Dakota and Iowa—are inhibiting the development of the infrastructure needed to transport captured carbon dioxide to sequestration sites. Developers, communities, and policymakers should work collaboratively to ensure the responsible and rapid build-out of supportive infrastructure so carbon capture and sequestration can be effectively deployed to reduce the carbon intensity of fuel production.

Lacking sequestration options, local demand for carbon dioxide as a feedstock could support a market for the waste gas. Power-to-liquid fuels are a key example of an emerging fuel class where biogenic carbon dioxide from ethanol facilities may be utilized in the production of low-carbon synthetic fuels. Ensuring that state and federal clean fuel production incentives are inclusive of power-to-liquid fuels will incentivize such producers to build in Minnesota, as will supporting a clean hydrogen market to satisfy the demands of both biorefinery and PtL production demands (the Minnesota SAF production tax credit does not credit PtL unless a very broad interpretation of "biomass" is allowed to include biogenic carbon dioxide).

### **Policy Recommendations:**

- **Congress** should establish a national clean fuel standard for the transportation sector consistent with achieving net-zero emissions by midcentury. The new technology-neutral fuel standard should credit low-carbon fuels for ground, maritime, and aviation sectors with differentiated compliance obligations for each to accommodate each sector's respective stages of developing and adopting alternative fuel solutions.
- Minnesota State Government should establish a state clean transportation standard which establishes a compliance market to support in-state production and consumption of credited fuels. The standard should support the long-term competitiveness of Minnesota-produced fuel by adopting carbon intensity benchmarks and methodologies that are robust and consistent with national-level goals (e.g., net-zero by 2050).
- The **Minnesota Legislature** should amend (or the **Minnesota Department of Revenue** should interpret) the Minnesota SAF production tax credit to apply to fuel produced using biogenic carbon dioxide and clean hydrogen.
- Minnesota State Government, in coordination with surrounding states, should build on the momentum of the Heartland Hydrogen Hub and create a matching program to connect clean hydrogen producers with potential customers who are willing to pay a premium for clean hydrogen. This program could be modeled on DOE's H2 Matchmaker program.
- Minnesota Public Utilities Commission should work with state agencies to develop renewable energy zones (REZ) where clean electricity projects can be developed and connected to high-voltage transmission lines. Pre-screened zones meeting resource, environmental, and social criteria would help Minnesota leverage its significant renewable energy potential and facilitate the evaluation and approval of transmission projects passed by the Midwest's grid manager MISO.

- **Congress** should clearly designate a federal agency as having regulatory authority over the siting of interstate carbon dioxide pipelines. While DOT's Pipeline and Hazardous Materials Safety Administration regulates carbon dioxide pipelines safety, siting oversight of these pipelines at the federal level needs clarification. The federal siting authority should have a formal process for engaging and consulting with Tribal governments. At present, pipeline siting authority rests mainly at the state and local level, where confusion and delays caused differing usage of eminent domain, rights of way, and lawsuits could potentially hinder deployment of interstate carbon dioxide pipelines and the deployment of carbon capture technologies.
- **Congress** should provide additional, expanded funding for DOE's Carbon Conversion Program to support research, development, and deployment of carbon utilization pathways to reduce the costs of low-carbon products (e.g., synthetic fuels) to be more competitive with traditional products.

#### Non-climate impacts of biofuels & feedstock production

While opportunities for economic development alongside low-carbon biofuel deployment understandably focus on greenhouse gas impacts, both positive and negative impacts on soil health, water quality, and ecosystem services must also be considered and addressed in policy. Roundtable participants representing community health and environmental interests described the detrimental environmental and health impacts of agricultural fertilizers entering the state's water systems.

Agricultural fertilizers such as nitrogen and phosphorus are applied to soil to promote crop growth. Excess nitrogen and phosphorus can enter water sources through soil erosion and runoff, and dissolved nitrogen can leach through the soil profile to underground water resources. The presence of both nutrients in surface water and drinking supplies can create ideal conditions for cyanobacteria to reproduce quickly and bloom. These harmful algal blooms can produce toxins that are harmful to both humans and wildlife. Harmful algal blooms can also deplete oxygen levels in localized water systems, leading to anaerobic conditions. These conditions damage environmental and economic resources as these anaerobic conditions kill fish and other aquatic life.

Nitrogen runoff in the drinking water supply also leads to adverse health impacts, including blood disor-

ders, cancers, adverse reproductive outcomes, diabetes, and thyroid conditions.<sup>56</sup> According to the Minnesota Department of Health, levels of nitrate in surface and groundwater which exceed those caused by natural processes (above three mg/L) are attributable to nonnatural sources including runoff from fertilized soil. The Minnesota Pollution Control Agency identifies cropland as contributing 70 percent of the nitrate in Minnesota surface waters. Separately, the agency found that 27 percent of surface water samples contained nitrate above the levels representing a health concern (10 mg/L).<sup>57</sup> A separate analysis from Environmental Working Group identified that 75 percent of communities with nitrate levels at or above the legal limit had incomes below the state's median.58 The impacts of fertilizer runoff are not limited to the state's boundaries. An average of 158 million pounds of nitrate enters the Mississippi River from Minnesota every year, affecting aquatic life and commercial fishing in the Gulf of Mexico.<sup>59</sup> Per the EPA's 2023 Mississippi River/Gulf of Mexico Watershed Nutrient Task Force Report to Congress, the five-year moving average of nitrogen and phosphorous nutrient loads to the Gulf were on an upward trajectory.<sup>60</sup> Recent investments from the Infrastructure Investment and Jobs Act have injected resources toward federal and state collaboration on nutrient load management. Roundtable participants stressed the need to address these issues from both a health and equity perspective.

Precision agriculture methods offer an opportunity to optimize fertilizer application, which would help in addressing over-fertilization. Roundtable participants touted important co-benefits from some practices: biomass yield and soil carbon sequestration-for example, the use of cover crops or growing energy crops like switchgrass on marginal fields-can also reduce soil erosion and fertilizer runoff. Leveraging and communicating the advantage of practices with such co-benefits can accelerate adoption potential of nutrient reduction strategies. However, these methods require training, greater data sets, and financial assistance to gain greater adoption. Similarly, reducing the expansion of agricultural land by increasing feedstock yield per acre and diversifying into wastes, residues, and energy crops which do not displace primary crops will protect the health of soils and preserve natural ecosystem services like pollination, healthy air, water filtration, and wildlife support.

Roundtable participants also discussed biofuel's role in air quality, particularly in vehicle-dense areas like urban areas and locations near major roads. Beyond carbon dioxide, vehicles combusting liquid fuel (including ethanol-blended gasoline and biodiesel) release nitrogen dioxide, carbon monoxide, hydrocarbons, benzene, and formaldehyde, all of which can cause negative health effects.<sup>61</sup> Participants representing public health and environmental interests spoke to how exposure to air pollution and its harmful health effects are disproportionately concentrated among Black, Indigenous, and other communities of color. Policies to address air pollution must prioritize environmental justice for these communities, including support for access to low- and zeroemission technologies. Policies which prioritize the use of low-carbon liquid fuels (including biofuel) in hardto-decarbonize sectors of the transportation system, like aviation, while promoting zero-emission transportation options for viable applications, will pay health dividends for Minnesotans.

#### **Policy Recommendations:**

• Congress should authorize and fund a Conservation Equipment Loan Program under the Farm Service Agency (FSA), either through an existing program or as a standalone endeavor. This targeted loan program should offer financial incentives (e.g., lower interest rates and longer terms compared to traditional FSA loans) to help producers access expensive equipment necessary for climate-smart agriculture such as variable rate application technologies (VRT) or tools like roller-crimpers, which terminate cover crops without soil tillage. The agency should prioritize applications for equipment that directly facilitates greenhouse gas reductions or carbon sequestration. The loan program should be supplemented by an education and outreach program which supports training for the use of loan-eligible equipment and resources for farmers to project the financial costs and returns of implementing related practices.

- USDA should identify and address data gaps on the implementation of precision agriculture within its Agricultural Resource Management Survey (ARMS) and Conservation Effects Assessment Project (CEAP), including more complete data on the adoption of precision agriculture practices and emissions reduction potential in real-world applications.
- **Congress** should incentivize climate-smart practices through the Federal Crop Insurance Program (FCIP) by instituting premium discounts for producers who implement approved risk-reducing practices, such as climate-smart management practices that can bolster resilience to natural disasters and reduce risk on farmers' operations. FCIP does not currently consider the benefits of these practices implementing the program.
- **Congress** and the **Minnesota State Government** should build on Minnesota's existing buffer law to fund or incentivize the expansion of riparian buffers and bioreactors to reduce runoff of nitrates and other pollutants that make water unsafe for human consumption, such as through the Conservation Reserve Program.
- Minnesota Government should continue to support the Minnesota Pollution Control Agency's Nutrient Reduction Strategy (NRS) to identify and scale agricultural best management practices (BMPs). Following the release of the 2024 NRS update, which will mark the 10-year implementation milestone, the Minnesota Government should consider what additional resources can be made available to ensure significant progress in scaling BMPs.
- **Congress** should direct an interagency effort to develop practical monitoring and verification methods to accurately quantify soil carbon sequestration/ retention and ensure continuation of related practices (to protect against re-releasing carbon once sequestered). Such methods should be incorporated into any program which seeks to create a market for soil carbon, whether that include carbon markets, biofuel programs, or otherwise.

## COMMUNITY-LEVEL CONSIDERATIONS FOR PROJECTS & INFRASTRUCTURE

## Siting considerations for low-carbon fuels infrastructure

Roundtable participants described the ecosystem of new infrastructure that would be required to advance the production of low-carbon biofuel and supporting technologies in Minnesota. The emergence of advanced fuel production methods will utilize new refinery designs. Different chemical makeups of ethanol and hydrogenbased fuels may require new or upgraded storage and distribution infrastructure. Reducing the carbon intensity of biofuels in the state requires both new clean energy and new grid capacity and the ability to capture, transport, and store carbon dioxide. Each of these components represent economic opportunities in the state, and a risk when communities are not engaged to protect their interests and well-being. Roundtable participants agreed: companies have an obligation to engage with communities early and often to foster constructive transparency, solve problems, and to mitigate potential harms to neighboring or affected residents and workers.

Pipelines and other linear infrastructure were of particular concern and importance to roundtable participants and have been the subject of significant debate in the larger Midwest region, where recent legal action and permit rejections have blocked carbon dioxide pipeline applications. Concerns about the sovereignty of Tribal nations, pipeline safety, and private land rights have historically been sources of conflict and courtroom challenges. One way to mitigate an adversarial relationship, according to attendees, is for developers to engage with communities early in the planning process, including local residents, workers and labor groups, county commissioners, mayors, and school boards. In the experience of participants, engaging local communities too late in the planning or development process is disempowering for affected stakeholders and leads to unconstructive results. Transparent dialogue and involving stakeholders in decision-making considerations creates a positive and mutually beneficial pathway forward to infrastructure development.

The state can support the responsible siting of new projects and guarantee greater benefits to local communities by investing in build-ready sites and strategically siting infrastructure projects to maximize the health and economic wellbeing of disadvantaged or rural com-

munities. Community and labor groups represented at the roundtable discussed brownfield remediation as a priority with opportunities to make use of otherwise underutilized land with infrastructure to support a low-carbon fuel economy. Likewise, federal investments in disadvantaged communities (e.g., as guided by the Justice40 initiative) can be responsive to these opportunities. As the transportation sector shifts toward lower-carbon solutions, population-dense communities and those along major transportation corridors should benefit from investments in electric vehicle charging and other supporting infrastructure to reduce localized air pollution. Meanwhile, roundtable participants described the likelihood that rural communities, especially Tribal and low-income rural communities, will likely be slower to adopt electric vehicles due in part to challenges maintaining distributed charging infrastructure. Policymakers must support continued and expanded access among rural communities to affordable fueling options. Longterm policy approaches are required to provide communities and business owners with the certainty required in making capital-intensive investments in transportation infrastructure, including fueling stations and storage tanks.

## Policy Recommendations

- The **Council on Environmental Quality (CEQ)** and other **federal agencies** should provide clear, transparent guidance on Justice40, which commits to assign 40 percent of the overall benefits of applicable federal investments to disadvantaged communities. Clearer guidance can be provided by indicating, for example, how benefits are quantified and in what geographic radius the "communities" are defined. Covered federal programs that are applicable to Minnesota's communities and biofuel workforce include those under the USDA (e.g., FSA), DOE (e.g., Loan Program Office [LPO]), and DOT (e.g., Federal Transit Administration (FTA), Tribal Transportation Program).
- **Congress** should establish a funding program through **DOE** and **EPA** that facilitates engagement between low-carbon fuel infrastructure developers and communities, including environmental justice groups, tribal communities, and farmers. This program should focus on proposed hydrogen hubs, pipelines, and biorefineries that will be used to advance the low-carbon biofuel economy. Information gained from these engagements should be collected

and summarized in a comprehensive report describing community concerns and opportunities related to low-carbon biofuel, while offering recommendations to update regulations and implementation guidelines to better meet the needs of communities.

- Minnesota Department of Transportation should continue to direct federal funding for the expansion of electric vehicle chargers to major corridors (as identified in the 2022 Minnesota Electric Vehicle Infrastructure Plan) and densely populated areas most susceptible to the harmful particulates associated with fossil and biofuel combustion.
- Minnesota Legislature should direct investments in energy communities by funding brownfield remediation, supporting local workforce development, expanding human services, and streamlining permitting processes. Repurposing retired, remediated, and retiring fossil fuel plants with new cleaner electricity generation leverages existing electricity infrastructure—including switchyards, substations, transmission, and distribution—and can minimize permitting timelines and total investment required.

## WORKFORCE DEVELOPMENT AND LOCAL WORK-FORCE INCLUSION

Roundtable participants made clear that establishing and maintaining a strong local workforce in the low-carbon fuel economy is critical to Minnesota's ability to attract new business. Some skills in the existing workforce can be transferrable to the low-carbon fuel economy, while other skillsets will need to be developed. Both transferrable and new skillsets present different challenges and require varied approaches to ensure the workforce is prepared to support the low-carbon fuel economy. To utilize existing skillsets, roundtable participants present proactive outreach to labor groups to utilize and redeploy the workforce that is already present in the area as a key step. Labor group participants at the roundtable described how the career-building opportunities, income and employment benefits, and improved safety standards would benefit economic development. Developing new skill sets locally will also be important for emerging technologies (e.g., clean hydrogen). To that end, the Minnesota Jobs Skills Partnership-an organization that works with business, education, and non-profit institutions to expand workforce training in the state— and similar programs should continue to support company-sponsored to build out new skillsets.

In addition to local workforce recruitment and development, community buy-in of new projects demands a broader view of how discrete infrastructure projects link to the rest of the local economy. Impacts on housing, schools, water systems, local roads or rail networks, and other civil infrastructure will be a focus in the approval and buy-in of any project. To address these needs and mitigate economic risks to communities, one roundtable participant suggested that state and local policy should focus on developing clusters of industry to leverage shared infrastructure requirements. Such an approach requires establishing a broader vision of economic development that can strengthen the value proposition for incoming companies. This approach would also be more attractive to any communities asked to balance the tradeoffs of economic development with civil infrastructure and resource needs.

## **Policy Recommendations**

- Minnesota State Agencies should prioritize and support local capacity building to assist the state and local communities in accessing federal resources, including under the Loan Programs Office Title 17 Clean Energy Financing Program, related to upgrading essential infrastructure, adopting emissions mitigation technologies and practices, and climate resilience preparation.
- Congress should expand U.S. Department of Education resources for career and technical education that can support recent graduates and mid-career workers in skilled trades to acquire expertise relevant to the clean-energy industry. Congress should also fund K-12 outreach programs that educate young people—especially those in marginalized communities—on career opportunities and skills needs in the sector. Currently, this kind of training, outreach, and certification is led at the local level by a patchwork of non-government actors. Federal funding and standardization are needed to ensure the workforce has access to high quality career and technical training and subsequent opportunities.

# **CONCLUSION**

The citizens of Minnesota have built a diverse economy while maintaining agricultural roots. Today, the North Star State continues this growth as industry, government, and community groups advance forward-thinking policies and initiatives to build a thriving low-carbon energy economy. The Heartland Hydrogen Hub project, the GREATER MSP-led Minnesota SAF Hub, and the Clean Transportation Standard Act are recently examples of Minnesotans seizing new opportunities to improve the climate and sustainability of biofuels, protect the health of its communities, and support local workforces in the establishment of advanced energy solutions. Our October 2023 Minnesota round-table made clear that to fully realize this success, the federal government should build on its programs supporting the agricultural sector to de-risk advanced bioenergy feedstocks and sustainable agricultural practices. Long-term, predictable policies and programs are required to support new low-carbon infrastructure and build markets for the next generation of biofuels, hydrogen products, and emission-reducing technologies. Minnesota policymakers and government leaders must also be responsive to shifting markets to ensure the state is build-ready and supportive of tomorrow's energy economy. The time, effort, and expertise that participants brought to the roundtable discussion demonstrates the citizenry's commitment to Minnesota's enduring success.

## **Other C2ES Resources**

**Regional Roundtables** 

https://www.c2es.org/accelerating-the-us-net-zero-transition/regional-roundtables/

Firing Up Clean Hydrogen in Texas https://www.c2es.org/document/firing-up-clean-hydrogen-in-texas/

**Fueling a Low-carbon Future in Utah: The Role of Hydrogen** *https://www.c2es.org/document/fueling-a-low-carbon-future-in-utah-the-role-of-hydrogen/* 

## **Unlocking Precision Agriculture's Climate Potential**

https://www.c2es.org/document/unlocking-precision-agricultures-climate-potential/

#### Decarbonizing U.S. Agriculture, Forestry, and Land Use

https://www.c2es.org/document/decarbonizing-u-s-agriculture-forestry-and-land-use/

## **Reaching for 2030: Climate and Energy Policy Priorities**

https://www.c2es.org/document/reaching-for-2030-climate-and-energy-policy-priorities/

## **ENDNOTES**

1 U.S. Energy Information Administration (EIA), "Table P1. Primary Energy Production Estimates in Physical Units, 2021," accessed March 19, 2024, *https://www.eia.gov/state/seds/sep\_prod/pdf/P1.pdf*.

2 U.S. Energy Information Administration (EIA), "Table P1. Primary Energy Production Estimates in Physical Units, 2021," accessed March 19, 2024, *https://www.eia.gov/state/seds/sep\_prod/pdf/P1.pdf*.

3 U.S. Department of Energy (DOE) Bioenergy Technologies Office, *Benefits of Biofuel Production and Use in Min*nesota (Washington, D.C.: DOE, 2015), https://www.energy.gov/sites/prod/files/2015/10/f27/minnesota\_biofuels\_benefits.pdf; Brigid Tuck, *Economic contribution of Minnesota's ethanol industry*, 2023 (St. Paul: University of Minnesota Extension Economic Impact Analysis Program, 2024), https://mnbiofuels.org/images/Economic\_contribution\_of\_ethanol\_in\_MN\_2023\_FINAL.pdf.

4 U.S. Energy Information Administration (EIA), "Table P1. Primary Energy Production Estimates in Physical Units, 2021," accessed March 19, 2024, *https://www.eia.gov/state/seds/sep\_prod/pdf/P1.pdf*.

5 Su Ye, *Minnesota Agricultural Facts and Stats* (Minneapolis, MN: Minnesota Department of Agriculture, 2023), *https://www.mda.state.mn.us/sites/default/files/docs/2023-11/MN%20Ag%20Facts%20%26%20Stats%2011-1-2023.pdf*.

6 Minnesota Department of Agriculture, *Annual Report on Biodiesel* (Saint Paul: Minnesota Department of Agriculture, 2023), *https://www.lrl.mn.gov/docs/2023/mandated/230165.pdf*; EIA, "Monthly Biofuels Capacity and Feedstocks Update," accessed March 19, 2024, *https://www.eia.gov/biofuels/update/*.

7 U.S. Department of Agriculture (USDA), "2023 State Agriculture Overview: Minnesota," accessed March 19, 2024, https://www.nass.usda.gov/Quick\_Stats/Ag\_Overview/stateOverview.php?state=MINNESOTA.

8 2023 Minnesota Statutes, §239.791, https://www.revisor.mn.gov/statutes/cite/239.791.

9 University of North Dakota Energy & Environmental Research Center, "Heartland Hydrogen Hub," accessed March 19, 2024, *https://undeerc.org/research/projects/heartland-h2-hub.html*.

10 University of North Dakota Energy & Environmental Research Center, "Heartland Hydrogen Hub Selected for U.S. Department of Energy Funding," blog post, October 13, 2023, https://blog.undeerc.org/2023/10/13/heartland-hydrogen-hub-selected-for-u-s-department-of-energy-funding/.

11 U.S. DOE, "Biden-Harris Administration Announces \$7 Billion for America's First Clean Hydrogen Hubs, Driving Clean Manufacturing and Delivering New Economic Opportunities Nationwide," press release, October 13, 2023, https://www.energy.gov/articles/biden-harris-administration-announces-7-billion-americas-first-clean-hydrogen-hubs-driving; University of Minnesota West Central Research and Outreach Center, "Taking the Lead in Green Ammonia," release, April 27, 2023, https://wcroc.cfans.umn.edu/news/lead-green-ammonia.

12 2023 Minnesota Statutes, §41A.30, https://www.revisor.mn.gov/statutes/cite/41A.30.

13 2023 Minnesota Statutes, §41A.30, Subd.2e, https://www.revisor.mn.gov/statutes/cite/41A.15#stat.41A.15.2e.

14 GreaterMSP, "Minnesota Sustainable Aviation Fuel Hub," accessed March 19, 2024, https://www.greatermsp.org/ pages/saf/.

15 U.S. EIA, Electricity Data Browser, Net generation for all sectors, Minnesota, Fuel Type (Check All), Annual, 2022. *https://www.eia.gov/electricity/data/browser/*.

16 U.S. EIA, Minnesota Electricity Profile 2022, Table 10, Supply and disposition of electricity, 1990 through 2022. https://www.eia.gov/electricity/state/Minnesota/.

17 Minnesota S.F. No. 4 (2023), https://www.revisor.mn.gov/bills/text.php?number=SF4&version=latest&session=ls93&sessi on\_year=2023&session\_number=0.

18 Minnesota H.F. 2083 (2022), https://www.revisor.mn.gov/bills/bill.php?b=house&f=HF2083&ssn=0&y=2021; Minnesota S.F. 2027 (2022), https://www.revisor.mn.gov/bills/bill.php?f=SF2027&b=senate&y=2021&ssn=0.

19 Minnesota H.F. 2083 (2022), https://www.revisor.mn.gov/bills/text.php?number=HF2083&type=bill&version=0&session =ls92&session\_year=2021&session\_number=0.

20 Minnesota H.F. 2602 (2023), https://www.revisor.mn.gov/bills/text.php?number=HF2602&type=bill&version=0&session =ls93&session\_year=2023&session\_number=0; Minnesota S.F. 2584 (2024), https://www.revisor.mn.gov/bills/text.php?number=SF258 4&session=ls93&version=latest&session\_number=0&session\_year=2023.

21 Minnesota Department of Transportation, "Clean Transportation Standard Work Group," accessed March 19, 2024, https://www.dot.state.mn.us/sustainability/clean-transportation-fuel-standard-working-group.html.

22 Alternative Fuels Data Center, "U.S. Production, Consumption, and Trade of Ethanol," accessed March 19, 2024, *https://afdc.energy.gov/data/10323*; International Energy Agency (IEA), "Biofuel production by country/region and fuel type, 2016-2022," accessed March 19, 2024, *https://www.iea.org/data-and-statistics/charts/biofuel-production-by-country-region-and-fuel-type-2016-2022*.

23 EIA, "Biofuels explained," accessed March 19, 2024, https://www.eia.gov/energyexplained/biofuels/.

24 U.S. Environmental Protection Agency (EPA), "Final Renewable Fuels Standards Rule for 2023, 2024, and 2025," accessed March 19, 2024, https://www.epa.gov/renewable-fuel-standard-program/final-renewable-fuels-standards-rule-2023-2024-and-2025.

25 Lashof, Dan, "EPA's New Renewable Fuel Standard Will Increase Global Carbon Emissions—Not Lower Them," World Resources Institute, blog post, July 3, 2023, https://www.wri.org/insights/us-renewable-fuel-standards-emissions-impact.

26 Scully, Melissa J, et al., "Carbon intensity of corn ethanol in the United States: state of the science," *Environmental Research Letters* 16, 2021, *https://iopscience.iop.org/article/10.1088/1748-9326/abde08/pdf*; Lar, Tyler J., et al., "Environmental outcomes of the U.S. Renewable Fuel Standard," *Proceedings of the National Academy of Sciences* Vol. 119, No. 9, 2022, *https://www.pnas.org/doi/full/10.1073/pnas.2101084119*.

27 U.S. Code Title 26, Subtitle F, Chapter 65, Subchapter B § 6426, https://www.law.cornell.edu/uscode/text/26/6426.

28 Mazzone, Daniel, Aaron Smith, and Julie Witcover, Pass-Through of Alternative Fuel Policy Incentives: Evidence from Diesel and Biodiesel Markets, the U.S. Renewable Fuel Standard, and Low Carbon Fuel Standards in California and Oregon (Davis, CA: University of California, Davis Institute of Transportation Studies, 2022), https://files.asmith.ucdavis.edu/NCST\_Pass\_Through. pdf.

29 EIA, "U.S. biomass-based diesel tax credit renewed through 2022 in government spending bill," release, January 28, 2020, https://www.eia.gov/todayinenergy/detail.php?id=42616.

30 Inflation Reduction Act of 2022, Pub. L. No. 117-169 §13204.

31 U.S. Code Title 26, Subtitle A, Chapter 1, Subchapter A, Part IV § 40B https://www.law.cornell.edu/uscode/ text/26/40B.

32 U.S. Code Title 26, Subtitle A, Chapter 1, Subchapter A, Part IV, Subpart D § 45Z, https://www.law.cornell.edu/ uscode/text/26/45Z.

33 Alternative Fuels Data Center, "Ethanol Laws and Incentives in Federal," accessed March 19, 2024, *https://afdc. energy.gov/fuels/laws/ETH?state=US.* 

34 U.S. Code Title 7, Chapter 107, § 8111, https://www.law.cornell.edu/uscode/text/7/8111.

35 U.S. Code Title 7, Chapter 107, § 8103 https://www.law.cornell.edu/uscode/text/7/8103.

36 U.S. Code Title 7, Chapter 107, § 8105 https://www.law.cornell.edu/uscode/text/7/8105

37 U.S. Code Title 26, Subtitle A, Chapter 1, Subchapter A, Part IV, Subpart B § 30C, *https://www.law.cornell.edu/uscode/text/26/30C*.

38 USDA Rural Development, "Higher Blends Infrastructure Incentive Program," Accessed March 19, 2024, https:// www.rd.usda.gov/programs-services/energy-programs/higher-blends-infrastructure-incentive-program.

39 USDA Rural Development, "Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants," https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans.

40 EIA, "Table F27: Renewable diesel consumption estimates, 2022," accessed March 19, 2024, https://www.eia.gov/ state/seds/sep\_fuel/html/pdf/fuel\_use\_rd.pdf; EIA, State Energy Production Estimates 1960 through 2021 (Washington, D.C.: EIA, 2021), https://www.eia.gov/state/seds/archive/SEDS\_Production\_Report\_2021.pdf.

41 New York State Assembly Bill A5262A §2 (§19-0329(1)); https://legiscan.com/IL/text/SB1556/id/2687544; https://www. legislature.mi.gov/documents/2023-2024/billintroduced/Senate/pdf/2023-SIB-0275.pdf; New Jersey Senate Bill 2425 (Introduced January 29, 2024), https://pub.njleg.state.nj.us/Bills/2024/S2500/2425\_I1.PDF.

42 International Energy Agency, *Renewables 2023: Analysis and forecast to 2028* (Paris, France: International Energy Agency, 2024), *https://iea.blob.core.windows.net/assets/96d66a8b-d502-476b-ba94-54ffda84cf72/Renewables\_2023.pdf*.

43 EIA, "State Energy Data System (SEDS), Primary Energy Production Estimates in Physical Units, United States," as of April 4, 2022, *https://www.eia.gov/state/seds/sep\_prod/xls/PT1\_US.xlsx*.

44 U.S. Department of Energy et al., *SAF Grand Challenge Roadmap: Flight Plan for Sustainable Aviation Fuel* (Washington, DC: Department of Energy, Department of Transportation, Department of Agriculture, and Environmental Protection Agency: 2022), *https://www.energy.gov/sites/default/files/2022-09/beto-saf-gc-roadmap-report-sept-2022.pdf*; O'Malley, Jane, Nikita Pavlenko, and Yi Hyun Kim, *Meeting the SAF Grand Challenge: Current and Future Measures to Increase U.S. Sustainable Aviation Fuel Production Capacity* (Washington, DC: International Council on Clean Transportation, 2023), *https://theicct.org/wp-content/uploads/2023/11/ID-37-%E2%80%93-SAF-Grand-Challenge-white-paper-letter-40036-v3.pdf*.

45 Gregg, S. et al., "Double-Cropped Winter Camelina with and without Added Nitrogen: Effects on Productivity and Soil Available Nitrogen," *Agriculture* 2022, 12, 1477. *https://doi.org/10.3390/agriculture*12091477.

46 International Civil Aviation Organization (ICAO), CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels (Montreal, Canada: ICAO, 2022), https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA\_Eligible\_Fuels/ICAO%20document%2006%20-%20Default%20Life%20Cycle%20Emissions%20-%20June%202022.pdf.

47 USDA, "USDA Highlights Progress in Partnering with Farmers to Increase Innovative Domestic Fertilizer Production, Expand Double Cropping through Investing in America Agenda," press release, October 16, 2023, https://www. usda.gov/media/press-releases/2023/10/16/usda-highlights-progress-partnering-farmers-increase-innovative.

48 USDA, "USDA Rural Development Higher Blends Infrastructure Incentive Program: June 26, 2023," accessed March 19, 2024, https://www.rd.usda.gov/media/file/download/usda-rd-nr-hbiip-chart-06262023pdf.

49 USDA Rural Development, "Higher Blends Infrastructure Incentive Program," fact sheet, accessed March 19, 2024, https://www.rd.usda.gov/sites/default/files/fact-sheet/508\_rd\_factsheet\_hbiip.pdf.

50 USDA, "2017 Census of Agriculture," *Geographic Area Series* Vol. 1, Part 51, 2019, https://www.nass.usda.gov/Publications/AgCensus/2017/index.php.

51 Elless, Mark P., Charlotte Levy, and Anne Otwell, Bioenergy's Role in Soil Carbon Storage: Decarbonizing Transportation, Agriculture, and Industrial Sectors (Washington, DC: DOE, 2023), https://www.energy.gov/sites/default/files/2023-03/beto-2023-soil-carbon-wkshp-report.pdf. 52 Mitchell, Rob et al., "Dedicated Energy Crops and Crop Residues for Bioenergy Feedstocks in the Central and Eastern USA," *BioEnergy Research.* 9, 2016, 10.1007/s12155-016-9734-2; ICAO, CORSIA *Eligible Fuels—Life Cycle Assessment Methodology* (Montreal, Canada: ICAO, 2022), *https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA\_Eligible\_Fuels/CORSIA\_Supporting\_Document\_CORSIA% 20Eligible% 20Fuels\_LCA\_Methodology\_V5.pdf.* 

53 Xu, H., Lee, U. and Wang, M., "Life-cycle greenhouse gas emissions reduction potential for corn ethanol refining in the USA.," *Biofuels, Bioprod. Bioref.*, 16 (2021): 671-681. *https://doi.org/10.1002/bbb.2348*.

54 Minnesota Department of Transportation, "Clean Transportation Standard Work Group," accessed March 19, 2024, https://www.dot.state.mn.us/sustainability/clean-transportation-fuel-standard-working-group.html.

55 U.S. Government Accountability Office (GAO), *Decarbonization: Status, Challenges, and Policy Options for Carbon Capture, Utilization, and Storage* (Washington, D.C.: GAO, 2022), *https://www.gao.gov/assets/gao-22-105274.pdf.* 

56 de Vries, Wim., "Impacts of nitrogen emissions on ecosystems and human health: A mini review," Current Opinion in Environmental Science & Health 21 (2021): 100249; https://crsreports.congress.gov/product/pdf/R/R43919.

57 Minnesota Department of Health, "Nitrate in Drinking Water," accessed March 19, 2024, https://www.health.state. mn.us/communities/environment/water/contaminants/nitrate.html; Minnesota Pollution Control Agency, "Nitrogen," accessed March 19, 2024, https://www.pca.state.mn.us/pollutants-and-contaminants/nitrogen.

58 Schechinger, Anne, "In Midwest farm states, nitrate pollution of tap water is more likely in lower income communities," *Environmental Working Group*, release, June 23, 2021, *https://www.ewg.org/news-insights/news/2021/06/midwest-farmstates-nitrate-pollution-tap-water-more-likely-lower-income*.

59 Minnesota Pollution Control Agency, "Water Pollutant: Nitrogen," accessed March 19, 2024, https://www.pca.state. mn.us/pollutants-and-contaminants/nitrogen.

60 EPA, Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2023 Report to Congress (Washington, D.C.: EPA, 2023), https://www.epa.gov/system/files/documents/2023-11/10305\_2023-htf-report-to-congress\_508.pdf.

61 EPA, "Learn About How Mobile Source Pollution Affects Your Health," accessed March 19, 2024, *https://www.epa.gov/mobile-source-pollution/learn-about-how-mobile-source-pollution-affects-your-health.* 



The Center for Climate and Energy Solutions (C2ES) is an independent, nonpartisan, nonprofit organization working to secure a safe and stable climate by accelerating the global transition to net-zero greenhouse gas emissions and a thriving, just, and resilient economy.

3100 CLARENDON BLVD SUITE 800 ARLINGTON, VA 22201 703-516-4146