WHAT IS CARBON CAPTURE & STORAGE?

Carbon capture and storage (CCS), sometimes called carbon capture and sequestration, refers to processes that collect or "capture" carbon dioxide (CO_2) from industrial processes or electricity generation, compress it into a liquid-like state, and transport it via pipeline for use in additional industrial processes or storage underground. CCS processes do not remove CO_2 from the atmosphere, but prevent some emissions caused by high-emitting activities—such as coal- or gas-fired power production and plastics manufacturing—from reaching the atmosphere. Moreover, there is no guarantee that CO_2 will stay underground; the captured gases could still be released later on by leaks or earthquakes, for example.

Carbon capture and storage was initially developed more than 40 years ago for enhanced oil recovery. To access deeper reserves, oil companies pump liquid CO_2 into old wells.[10] **Today, the top destination for captured carbon is still enhanced oil recovery, rather than underground storage (See Box 1).[11] In other words, the biggest market for captured carbon is the fossil fuel industry, largely enabled by federal policy.**

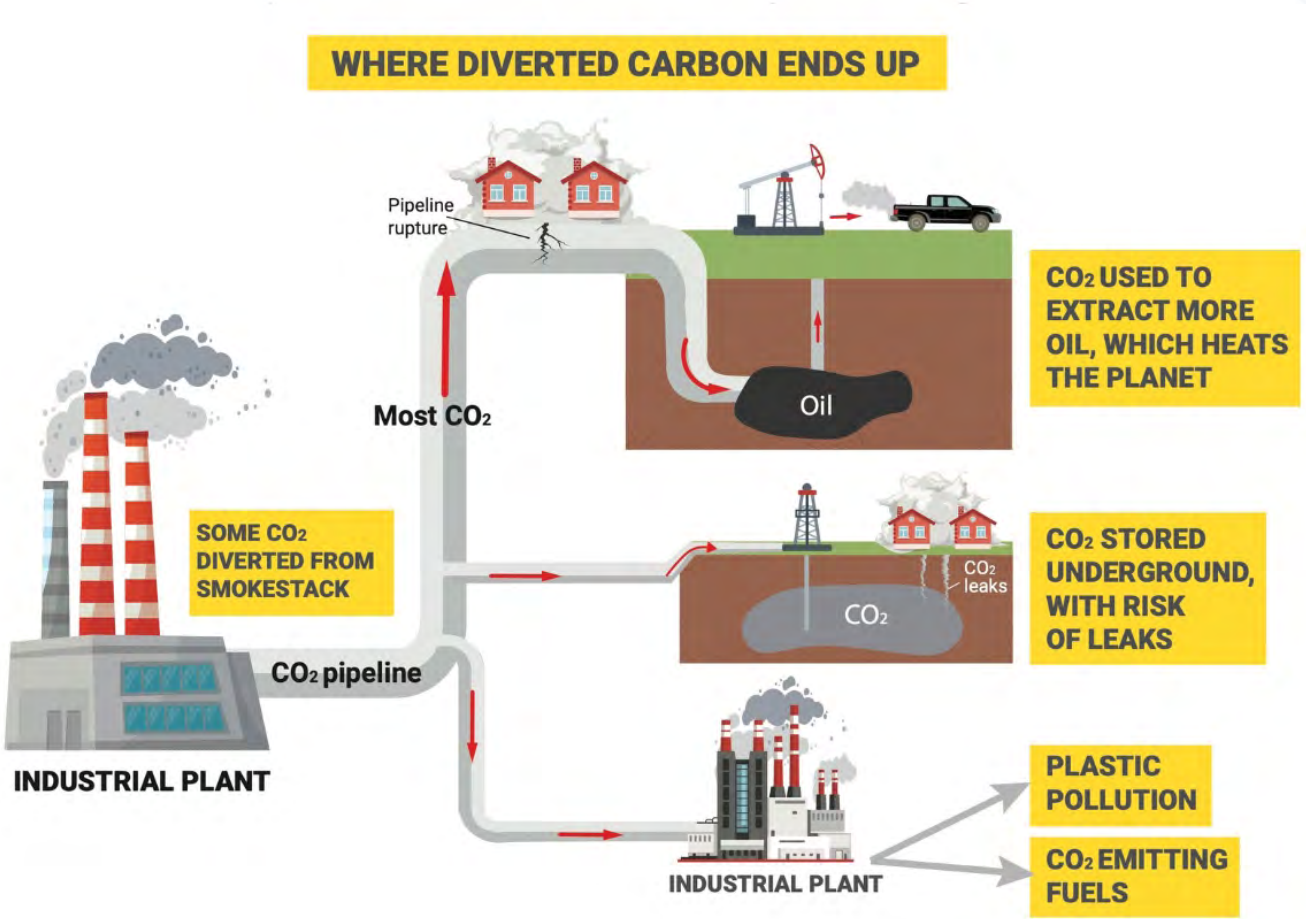

Image from Center for Biological Diversity | BiologicalDiversity.org

10 https://cleanwater.org/publications/EOR-risks
11 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

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THERE ARE A NUMBER OF SERIOUS RISKS AND DOCUMENTED HARMS ASSOCIATED WITH ALL TYPES OF CCS PROCESSES

DANGEROUS LEAKS OR RUPTURES:

Transporting and storing carbon has a significant risk of leaks and ruptures[12] that can cause devastating impacts to nearby communities.[13] The harm and danger of CO_2 pipelines cannot be overstated, yet the risks are often overlooked in discussions of CCS as a climate solution.

During the CCS process, high-pressure CO_2 is turned into a liquid-like "supercritical" state for transport.[14] Moisture or contaminants can corrode the pressurized pipelines, increasing the risk of leaks and fractures. Nearby residents can be injured or even suffocated when the escaped CO_2 rapidly freezes the surrounding area and displaces oxygen from the air.[15] An explosion of a CCS pipeline in Satartia, Mississippi, resulted in hospitalization of dozens of residents **(see Box 2)**. And in 1986, a sudden release of CO_2 from Lake Nyos in Cameroon, killed more than 1,700 people and 3,500 livestock.[16]

Federal and state regulators are beginning to acknowledge the need for new CO_2 pipeline safety measures **(See Box 3)**.[17] However, the required infrastructure still poses major risks. The Intergovernmental Panel on Climate Change (IPCC) notes that extensive deployment of CCS will require a vast network of pipelines, possibly even larger than the 2.6 million miles of existing petroleum pipelines.[18] Since the industry has little experience safely managing CO_2 pipelines and responding to CO_2 accidents, the potential harm for frontline communities is alarming.[19]

Credit: PHMSA report—Aerial Drone Photograph Courtesy of the Mississippi Emergency Management Agency, https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2022-05/Failure%20Investigation%20Report%20-%20Denbury%20Gulf%20

BOX 2. CO_2 PIPELINE RUPTURES IN SUFFOCATING, SICKENING BLAST

On February 22, 2020, a green cloud settled over the predominantly Black rural town of Satartia, Mississippi. More than two dozen people were trapped inside the cloud, gasping for air and collapsing. Their cars stalled out as they tried to evacuate, and those who didn't lose consciousness were disoriented. Many who breathed the fumes of this harmful cloud suffered lasting impacts, including lung dysfunction, chronic fatigue, and stomach disorders. To the surprise of many, including the emergency response teams, this disaster was caused by a catastrophic CO_2 pipeline leak. More than 250 people were evacuated from nearby areas, and many were hospitalized. Satartia was "lucky" because people were awake and the wind was blowing away from town, but other locations with CCS infrastructure or CO_2 pipelines may not be so fortunate. [http://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f]

12 Notably, IPCC cautions against relying on carbon capture due to concerns about safety and leaks. IPCC SR1.5, Ch. 5, Section 5.4.1.2, https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SR15_Chapter_5_HR.pdf (noting the "non-negligible" risk of leakage).
13 https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f
14 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
15 https://www.dnv.com/oilgas/laboratories-test-sites/dense-phase-spadeadam-video.html
16 https://pstrust.org/wp-content/uploads/2022/03/3-23-22-Final-Accufacts-CO2-Pipeline-Report2.pdf
17 https://link.springer.com/content/pdf/10.1007/s41247-020-00080-5.pdf
18 https://www.everycrsreport.com/files/20080117_RL33971_e9b75f9639ed7835dcbc3c565c1b1e03b632b204.pdf
19 http://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f

MORE DEADLY AIR POLLUTION:

Power plants and industrial sources with CCS still emit toxic, health-damaging air pollution (e.g., mercury, lead, volatile organic compounds, particulate matter, etc.) because CCS only captures carbon emissions. The air pollutants emitted by these facilities can affect lung and heart function, create a higher risk of respiratory disease and cancer, and increase smog, which can affect air visibility, damage plant life, and be deadly to humans.[20]

Relying on CCS to reduce CO_2 emissions can actually result in more air pollution because of the additional fuel CCS equipment uses to capture carbon dioxide. Estimates show that a power plant must burn 10 to 40 percent more fuel than a plant without CCS to generate the same amount of power.[21] Especially if it's dirty and fossil-fuel based, this additional fuel can produce more toxic pollution—including particulate matter, mercury, and nitrogen oxides—in comparison to a scenario with no carbon capture.[22]

INCREASED WATER USE AND POLLUTION:

Using CCS can double the water requirements of a power plant.[23] In addition, carbon capture would likely increase the mercury pollution and nitrogen discharges from a facility's wastewater. There are also risks of contaminating drinking water sources: studies show that permanently storing CO_2 underground could contaminate underground aquifers, which millions of people rely on for drinking water.[24] CO_2 and water mix to form carbonic acid, which can leach toxic metals out of rocks—including arsenic, uranium, radium, cadmium, chromium, copper, lead, and mercury—leading to severe health impacts if water sources become contaminated.[25] Furthermore, one of the most common uses of captured carbon is for oil production, which is especially water intensive, using 13 barrels of water for every barrel of oil produced.[26] Oil production also involves significant drinking water impacts and wastewater disposal challenges.

RISKY UNDERGROUND STORAGE:

CO_2 could also leak from underground storage back into the atmosphere. Research shows that CCS should not be deployed to mitigate climate change if more than 1 percent of 3,000 gigatons of stored CO_2 leaks over 1,000 years, as it would contribute to overall rising temperatures reaching dangerous levels.[27] Leakage rates at the scale needed for commercial CCS are unknown, but projections confirm the detrimental risks of not getting it 100-percent right. A disaster like an earthquake or a technical failure would immediately release the carbon dioxide.

BOX 3. FEDERAL SAFETY REGULATIONS UNDER REVIEW

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the federal agency charged with regulating the safety standards for construction, maintenance, and operation of CCS pipelines. In response to the Satartia pipeline disaster **(see Box 2)** and noting the lack of sufficient research on CO_2 pipelines, PHMSA recently announced its intent to open a rulemaking to revise the standards for CO_2 pipelines, including requirements related to emergency preparedness and response.

In December, PHMSA hosted a conference to discuss some of these emerging issues. There, presenters revealed that there is no specific "potential impact radius" established for CCS pipelines, and that commercial modeling systems are often unable to account for the wide range of factors (i.e. wind speed, atmospheric stability, terrain roughness, and elevation profile), which influence the size and scope of the potential impact radius. Given the absence of federal regulations which leaves states with vast uncertainties about the real risks posed by CO_2 pipelines, a number of environmental justice, public health, indigenous rights, and environmental advocates have called for states to suspend permitting of CCS transport infrastructure until the PHMSA regulations are finalized. [https://www.carboncapturefacts.org/blog/phmsa-sign-on-letter]

20 https://www.edf.org/sites/default/files/9553_coal-plants-health-impacts.pdf
21 http://precaution.org/lib/ccs_energy_penalty_for_coal_vs_natural_gas.2016.pdf
22 https://web.stanford.edu/group/efmh/jacobson/Articles/Others/19-CCS-DAC.pdf
23 https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3
24 See e.g., https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3
25 http://www.reuters.com/article/idUS15720845420101207
26 https://www.cleanwateraction.org/2020/01/30/water-impacts-co2-eor
27 https://www.scientificamerican.com/article/can-stored-carbon-dioxide-leak/

WHY DOESN'T CCS WORK AS A CLIMATE SOLUTION?

Sometimes incorrectly referred to as "carbon removal" or "negative emissions technology," CCS was only rebranded as a potential climate solution in recent years. Unsurprisingly, the fossil fuel industry is the main backer of carbon capture and storage as a "climate solution."

Image created using NightCafe AI Art Generator

PROLONGS CONTINUED RELIANCE ON FOSSIL FUELS AND FOSSIL FUEL INFRASTRUCTURE:

CCS masks the harmful carbon emissions from the fossil fuel source and enables that source to continue operating rather than being replaced with clean energy alternatives, while creating additional risks, impacts, and costs. Fossil fuels emit harmful pollution at each stage of their lifecycle—including extraction, refining, transport, use, and disposal—and carbon capture fails to address nearly all of these emissions. In fact, by requiring greater use of fossil fuels, carbon capture may exacerbate these issues.

Moreover, the most pervasive use of captured carbon today is to enhance oil recovery, which boosts oil production and prolongs the fossil fuel economy **(see Box 1)**.[28]

FAILS TO MEANINGFULLY REDUCE HARMFUL CLIMATE POLLUTION:

Even if carbon capture technologieswere more effective than proven so far, CCS facilities simply cannot reduce harmful climate emissions at a meaningful rate. A recent study shows that a carbon-capture-equipped coal plant only captures around 10 percent of the total CO_2 over 20 years, meaning that the vast majority of CO_2 is still released into the atmosphere.[29]

Even the most effective carbon capture technology does not limit the greenhouse gases (GHGs) released during extraction, transport, and most of the refining processes. CCS also exacerbates GHG emissions from extraction, transport, and refining processes because power plants and industrial facilities must burn more fuel to power carbon capture equipment—as much as 40 percent more fuel.[30]

REMAINS UNPROVEN, OVERPROMISED, AND UNDER-DELIVERED:

Despite being subsidized with billions of dollars for decades, carbon capture technologies have not been shown to be feasible or economic at scale.[31] Pilot projects have repeatedly been overpromised and under-delivered. For example, according to a 2021 Government Accountability Office investigation and report, the Department of Energy invested $1.1 billion over 10 years on 11 carbon capture projects but only three were ever built.[32] Of those, two remain in operation today and none have ever met their capture goals.

28 For a recent scientific review of the climate and environmental impacts of CCS/CCUS in coal- and gas-fired power plants, see "Evaluation of Coal and Natural Gas with Carbon Capture as Proposed Solutions to Global Warming, Air Pollution, and Energy Security" in M. Z. Jacobson (2020) 100% Clean, Renewable Energy and Storage for Everything. https://web.stanford.edu/group/efmh/jacobson/Articles/I/NatGasVsWWS&coal.pdf

29 https://web.stanford.edu/group/efmh/jacobson/Articles/Others/19-CCS-DAC.pdf

30 http://precaution.org/lib/ccs_energy_penalty_for_coal_vs_natural_gas.2016.pdf

31 https://www.foodandwaterwatch.org/2022/09/27/carbon-capture-failures/

32 https://www.gao.gov/assets/gao-22-105111.pdf

MORE EXPENSIVE THAN CLEAN TECHNOLOGIES:

According to the Institute for Energy Economics and Financial Analysis, carbon capture technologies are "prohibitively expensive compared to other GHG mitigation options, such as renewable energy and energy storage technologies."[33] Renewable energy prices have decreased dramatically in recent years, making solar and wind energy even cheaper than continuing to operate fossil fuel facilities in many places.[34] In contrast, adding carbon capture technologies to a power plant can more than double the construction costs and increase the cost of energy produced by up to 61 percent.[35] In other words, CCS projects are not economically viable unless they are significantly subsidized and, in most cases, used for enhanced oil recovery.[36] To make carbon capture economical, the carbon must be used to generate more fossil fuels.

REMOVING THE MAJORITY OF INDUSTRIAL EMISSIONS IS NOT FEASIBLE:

Simply put, carbon capture won't work for the vast majority of industrial sources. As one report found, around one half of industrial facilities are not suitable for carbon capture technologies, less than 10 percent could capture carbon economically, and major sources in each facility would not be captured. For example, for metals processes, only around a quarter of emissions are fit for carbon capture.[37]

In total, industry researchers found that the most successful carbon capture could only capture around 8 percent of all industrial emissions.[38] Furthermore, even if industrial emissions are amenable to capture, the vast majority of industrial facilities are not located in areas suitable for storing carbon and transporting carbon and injecting it into the ground has many risks.

HOW DOES CCS PERPETUATE ENVIRONMENTAL INEQUITIES?

The deployment of CCS will likely target regions already burdened with polluting facilities and follow the siting trends of fossil fuel infrastructure, which is overwhelmingly located in low-income communities and communities of color. Current regional trends show that most operating and proposed facilities are in the Midwest, Texas, and the Gulf Coast. As covered above, CCS infrastructure comes with a heavy environmental footprint and significant safety and health hazards. Wide-scale deployment of CCS would not only maintain and expand fossil fuel infrastructure, it could significantly worsen pollution and other environmental harms for frontline communities.

Moreover, CO_2 pipelines are most likely to be sited near communities with less political power and/or existing frontline communities. In Louisiana, several CO_2 pipelines from Denbury Enterprises run through "Cancer Alley," the heavily polluted petrochemical corridors predominantly populated by communities of color.[39] Proposed CO_2 pipelines in the Midwest would run through dozens of counties, endangering rural and agricultural communities in exchange for meager compensation, if any **(See Box 4)**.[40] It is likely other CO_2 pipeline buildouts would follow these trends.

33 https://ieefa.org/wp-content/uploads/2020/07/CCS-Is-About-Reputation-Not-Economics_July-2020.pdf
34 https://about.bnef.com/blog/scale-up-of-solar-and-wind-puts-existing-coal-gas-at-risk/; https://www.bloomberg.com/news/articles/2021-06-23/building-new-renewables-cheaper-than-running-fossil-fuel-plants
35 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
36 http://www.energyandpolicy.org/petra-nova/
37 http://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
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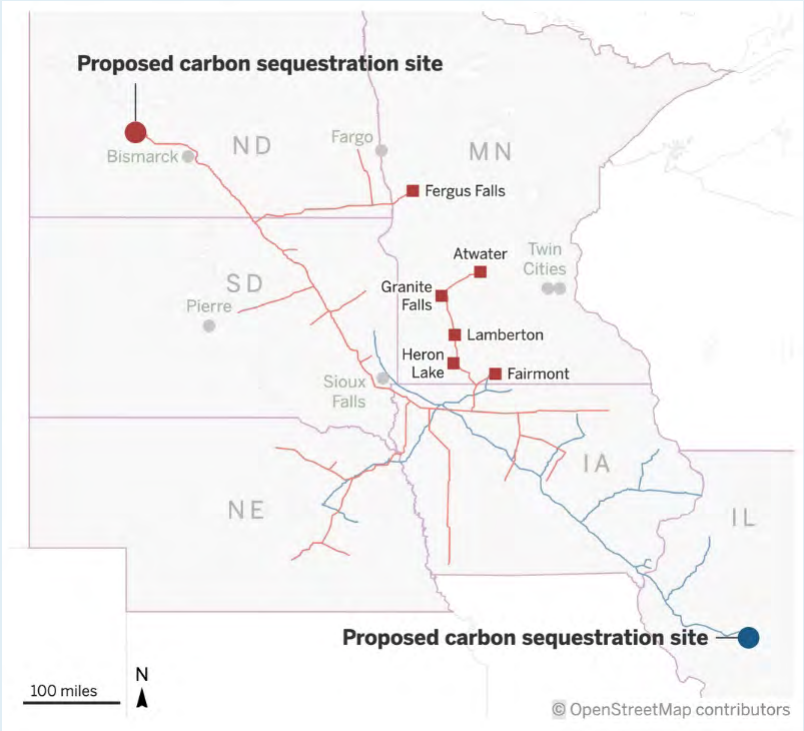
39 https://www.ewg.org/news-insights/news/confronting-myth-carbon-free-fossil-fuels-why-carbon-capture-not-climate
40 One company, Summit Carbon Solutions, has offered to compensate landowners for three years in exchange for permanent easements. The company has acknowledged that the pipelines would not be possible without the prospect of enhanced oil recovery and the federal tax credits. See https://www.cureriver.org/carbon-pipelines-mn/; https://www.startribune.com/carbon-express-pipeline-runs-into-skepticism-in-minnesota-farm-country/600246167

BOX 4. CO2 PIPELINES IN MINNESOTA

Multiple large-scale, multi-state CO_2 pipeline networks are being proposed in the Midwest by out-of-state corporations that aim to "capture" CO_2 from a variety of industrial facilities. There are currently two on the horizon in Minnesota — one from Summit Carbon Solutions called the Midwest Carbon Express and the other from Navigator CO2 Ventures called the Heartland Greenway. If built, these pipeline networks will span thousands of miles of farmland and prairie carrying CO_2 from dozens of ethanol and fertilizer plants throughout the Midwest to "storage" sites in North Dakota and Illinois. Surveyors for the companies are out in Minnesota farm fields and farmers and landowners are being pressured to sign easements to allow the pipelines across their property. This is all happening before any environmental assessments, community input, meaningful tribal consultation, or broad public discussions on CO_2 pipelines have occurred.



Mark Boswell , Star Tribune Source: Summit Carbon Solutions, Navigator CO_2 Ventures | [*https://www.startribune.com/carbon-express-pipeline-runs-into-skepticism-in-minnesota-farm-country/600246167/*](https://www.startribune.com/carbon-express-pipeline-runs-into-skepticism-in-minnesota-farm-country/600246167/)

CONCLUSION

Carbon capture and storage is a bad fit for Minnesota. CCS is expensive, unproven, and risky. CCS technologies prop up the fossil fuel industry and carbon-intensive industrial activity and prolong pollution and other environmental injustices. Framing CCS as a climate solution is dangerously misleading because, in practice, the outcome of CCS is rarely climate mitigation and more often boosted oil production. At the end of the day, the false hope for CCS distracts Minnesotans from the urgent task of transitioning away from an extractive, fossil-fuel-based energy system. Instead of channeling billions of dollars each year into the CCS industry, governments, leaders, and key decision-makers should focus on proven, economical, and safe climate solutions that can lead to equitable change. Rather than falling for the false promise of CCS and "cleaner fossil fuels," Minnesota can continue on the pathway to a real zero emissions clean energy future that benefits Minnesotans today and for years to come.

Contact Sarah Mooradian, CURE Government Relations & Policy Director, sarah@cureriver.org to learn more about carbon capture and Minnesota policy.

ACKNOWLEDGEMENTS | *Thanks to the Equity Fund (www.theequityfund.org) for providing with permission much of the content herein from their August 2022 Policy Brief —* https://static1.squarespace.com/static/5fb58e0bd182a42ba80eabdd/t/62ed51360894d71066512646/1665523250835/CCEEF_Carbon+Capture+Policy+Brief_Aug+2022.pdf