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Policy Brief: Energy Transition Concerns

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# 03. Carbon Capture and Storage: A Dangerous Distraction


1 What is carbon capture and storage and why is it harmful?
2 Why doesn't CCS work as a climate solution?
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4 How can we push back against CCS hype? What can we invest in instead?
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**Carbon capture and storage (CCS) technologies are being promoted by the very industry that benefits from such technologies: the fossil fuel industry. Not only is CCS unnecessary for rapid decarbonization, but these processes are also dangerous because they delay an equitable clean energy transition, risk public health and safety, and provide the fossil fuel industry with a license to continue polluting.**

**This brief explains why carbon capture and storage is simply *not* a climate solution and how we can push back against the unproven promises of CCS.**

## Key Facts

- **Worsens Pollution and Environmental Injustices:** Polluting facilities that use CCS still release health-damaging air pollution, which can actually become worse because 10 to 40 percent more fuel is required to power CCS equipment.[1] CCS can also double water requirements and increase toxic wastewater discharge, and underground storage of carbon dioxide ($CO_2$) can contaminate aquifers.[2] Such air, water, and land pollution would disproportionately harm frontline communities, predominantly low-income people of color.
- **Dangerous and Risky:** The dangers of transporting and storing carbon cannot be overstated, yet they are often overlooked in discussions of CCS as a climate solution. $CO_2$ pipelines have significant risks of ruptures or leaks that freeze over the surrounding area almost immediately and can injure and even suffocate nearby residents.[3] Past incidents underscore how ill-prepared we are to regulate $CO_2$ pipeline safety and handle $CO_2$ accidents.[4]
- **Not Proven to Meaningfully Address Climate Change:** CCS projects have repeatedly failed to deliver on promised climate targets.[5] A recent study shows that CCS at a coal plant only captured around 10 percent of its carbon emissions over a 20-year period.[6]
- **Prolongs the Fossil Fuel Economy:** CCS enables polluting sources to continue operating, while creating additional risks and impacts. In 2021, only one out of 13 CCS facilities in the United States actually stored carbon underground; most captured carbon is used for "enhanced oil recovery," which increases oil drilling and production.[7] In other words, CCS enables existing fossil fuel operations and more oil production.
- **High Costs:** 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.[8] Unless they are significantly subsidized, CCS projects are not economically viable.
- **Propped up by Federal Funds:** Despite failed projects, missed targets, and documented risks, the CCS industry remains afloat due to billions of dollars in federal incentives each year.[9]
- **Distracts From Proven Solutions:** To promote climate policies and technologies that result in real change, governments must axe CCS subsidies and plans that prop up the fossil fuel industry. Instead, policymakers should invest in natural carbon capture, like reforestation and soil sequestration; zero-emission electricity, such as renewables and storage; and safer, cleaner ways to decarbonize the industrial sector.

1 http://precaution.org/lib/ccs_energy_penalty_for_coal_vs_natural_gas.2016.pdf; https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20933.pdf
2 See e.g., https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3
3 https://pstrust.org/wp-content/uploads/2022/03/CO2-Pipeline-Backgrounder-Final.pdf
4 https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f
5 See **Box 5**; https://www.gao.gov/assets/gao-22-105111.pdf
6 https://web.stanford.edu/group/efmh/jacobson/Articles/Others/19-CCS-DAC.pdf
7 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
8 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf (citing https://pubs.acs.org/doi/10.1021/acs.est.9b06147).
9 See Box 1; https://cen.acs.org/environment/greenhouse-gases/45Q-tax-credit-s-luring/98/i8

# 1 What is carbon capture and storage and why is it harmful?

Carbon capture and storage (CCS), sometimes called carbon capture and sequestration, refers to processes that collect or "capture" carbon dioxide ($CO_2$) from high-emitting industrial processes or electricity generation, compress it into a liquid, and transport it via pipeline for use in additional industrial processes or storage underground. Most 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. **Table 1** on page 5 describes the array of CCS processes.

Carbon capture and storage is not rooted in a climate-friendly initiative, but 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.[11] In other words, the biggest market for captured carbon is the fossil fuel industry, largely enabled by federal policy (see **Box 1**).

*Today, the top destination for captured carbon is still enhanced oil recovery, rather than underground storage.*

## Box 1. How Federal Policy Enables CCS

**The carbon capture and storage industry has benefited greatly from federal policy support and incentives, such as:**

- **Tax Credit Incentive:** In 2008, Congress added a credit to the tax code to incentivize carbon capture and storage/sequestration. The 45Q tax credit[12] was further revised in 2018 to require that carbon be sequestered in "secure geological storage."[13] Companies receive up to $50 per metric ton for $CO_2$ captured and stored and up to $35 for $CO_2$ captured and used, which incentivizes additional carbon capture development.[14]

- **Financial Support From the 2021 Infrastructure Act:** Enacted in November 2021, the Infrastructure Investment and Jobs Act provides significant expenditures to prop up carbon capture, including $3.5 billion to support and expand carbon capture demonstration projects and large-scale pilot projects, $2.1 billion for low-interest loans to large $CO_2$ pipelines, $2.5 billion for carbon storage, and $3.5 billion for regional direct air capture hubs.[15]

- **Bi-Partisan Support:** Both Republicans and Democrats have proposed extending—and in some cases increasing—the credits for carbon captured and stored. For example, the 2021-2022 Congressional Session included the following proposals with either extensions or increases to the carbon capture credit: SB 2230 (Lujan, D-NM); HR 2633 (Schweikert, R-AZ); HR 1062 (McKinley, R-WV); SB 969 (Smith, D-MN); and SB 1298 (Wyden, D-OR).

By far, the largest beneficiaries of federal policy support for CCS are oil companies that claim the tax credits for injecting carbon into underground deposits for more oil. The majority of existing CCS facilities offset some of their costs by selling captured $CO_2$ for enhanced oil recovery.[16] In other words, captured carbon and the billions of dollars in federal incentives for CCS are a clear win for oil producers.

10 https://climatejusticealliance.org/wp-content/uploads/2020/11/Carbon-Capture-v4.pdf
11 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
12 The tax credit is reflected in Section 45Q of the Internal Revenue Code.
13 https://sgp.fas.org/crs/misc/IF11455.pdf
14 https://cen.acs.org/environment/greenhouse-gases/45Q-tax-credit-s-luring/98/i8
15 https://www.congress.gov/bill/117th-congress/house-bill/3684/text
16 https://sgp.fas.org/crs/misc/R44902.pdf; https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

**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[17] that can cause devastating impacts to nearby communities (see **Box 2**).[18] 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 for transport at a low temperature.[19] 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.[20] Deadly explosions from a CCS pipeline in Satartia, Mississippi, hospitalized hundreds of residents (see **Box 3**), and an accident in Lake Nyos, Cameroon, killed more than 1,700 people.[21]

  Federal and state regulations are beginning to acknowledge the need for new $CO_2$ pipeline safety measures.[22] 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.[23] Since the industry has little experience safely managing $CO_2$ pipelines[24] or responding to $CO_2$ accidents,[25] the potential harm for frontline communities is alarming.


## Box 2. What Does a Carbon Pipeline Rupture Look Like?

Watch this video clip of a $CO_2$ pipeline rupture, simulated by a research facility, for an example of the potential and immediate devastation to surrounding areas.


## Box 3. $CO_2$ 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.[26] Their cars died as they tried to evacuate, and those who didn't lose consciousness were disoriented. Anyone 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.[27] 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.

17 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).
18 https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f
19 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
20 https://www.dnv.com/oilgas/laboratories-test-sites/dense-phase-spadeadam-video.html
21 https://pstrust.org/wp-content/uploads/2022/03/3-23-22-Final-Accufacts-CO2-Pipeline-Report2.pdf
22 Federal regulations: https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures; state example from MN: https://apnews.com/article/politics-minnesota-sd-state-wire-140aa5a9eeec610d496ec88981bcac43
23 https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_chapter4-1.pdf; https://link.springer.com/content/pdf/10.1007/s41247-020-00080-5.pdf
24 https://www.everycrsreport.com/files/20080117_RL33971_e9b75f9639ed7835dcbc3c565c1b1e03b632b204.pdf
25 https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f
26 https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f
27 Hydrogen sulfide was also in the pipeline. See ibid.

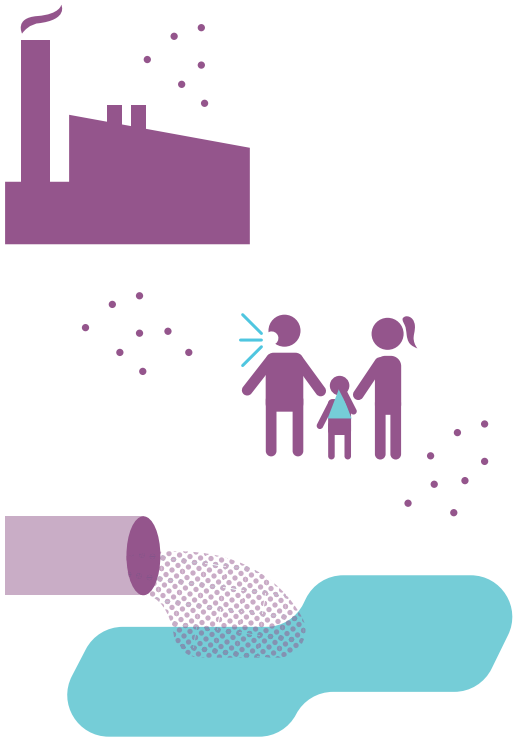
- **More Deadly Air Pollution:** Power plants and industrial sources with CCS still emit toxic, health-damaging air pollution (e.g., volatile organic compounds, particulate matter, etc.) because CCS only addresses carbon emissions. The air pollutants emitted by these facilities can affect lung and heart function, imply a higher risk of respiratory disease and cancer, and increase smog, which can affect air visibility, damage plant life, and be deadly to humans.[28]

  Relying on CCS 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.[29] 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.[30]

- **Increased Water Use and Pollution:** Using CCS can double the water requirements of a power plant.[31] 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.[32] $CO_2$ 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.[33] 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.[34] 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.[35] 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.

*Relying on CCS can actually result in more air pollution because of the additional fuel CCS equipment uses to capture carbon dioxide.*



28 https://www.edf.org/sites/default/files/9553_coal-plants-health-impacts.pdf
29 http://precaution.org/lib/ccs_energy_penalty_for_coal_vs_natural_gas.2016.pdf; https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20933.pdf
30 https://web.stanford.edu/group/efmh/jacobson/Articles/Others/19-CCS-DAC.pdf
31 https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3
32 See e.g., https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3
33 https://www.reuters.com/article/idUS15720845420101207
34 https://www.cleanwateraction.org/2020/01/30/water-impacts-co2-eor
35 https://www.scientificamerican.com/article/can-stored-carbon-dioxide-leak/

## Table 1. Types of Carbon Capture and Storage Processes

| Type of Process | Description | Specific Concerns |
|---|---|---|
| Carbon Capture and Storage (CCS) | $CO_2$ is collected from smokestacks, compressed into a liquid, and transported to a site where it can be pumped underground for storage in saline aquifers, oil or gas reservoirs, or beneath the ocean. | ▪ There is no guarantee that stored carbon will remain underground without leakage.<br>▪ Transporting captured carbon presents huge safety and health concerns, especially if equipment leaks or ruptures. |
| Carbon Capture, Use, and Storage (CCUS) | Same as above, but the captured carbon is used for feedstock in manufacturing, like plastic production. | ▪ $CO_2$ emissions are embedded in manufactured goods and eventually will be released back into the atmosphere if products are incinerated or when they decompose. |
| Direct Air Capture | Current techniques use large fans to move air through a filter, where it passes through a chemical adsorbent to capture carbon dioxide. This is the only process that directly removes carbon from the atmosphere.<br>See **Section 6** for FAQs on Direct Air Capture. | ▪ Largely theoretical and unproven at a useful enough scale to have a significant effect on the climate.<br>▪ A significant amount of toxic waste is produced.<br>▪ Highly energy-intensive process would need to be powered by renewable energy to have a positive climate impact.<br>▪ DAC is costly and requires a lot of space. |
| Bioenergy With Carbon Capture and Storage | Biomass (organic matter such as trees, wood, or agricultural products) is planted and then burned for energy; the carbon is captured in geologic reservoirs. | ▪ Based on energy usage for biomass today, this process would not capture much carbon. The biomass needed to scale up would require an unrealistic and dangerous amount of current global cropland (35 to 80 percent). |
| Hydrogen With Carbon Capture and Storage | Natural gas plants used to produce hydrogen gas would capture $CO_2$ in industrial smokestacks for use or storage. | ▪ Only a portion of $CO_2$ is prevented from being released in the atmosphere.<br>▪ Processes to produce natural gas are still carbon intensive.<br>▪ Fossil-fuel-powered carbon capture equipment could generate more climate emissions than the production of natural gas without CCS. |

Sources: Geoengineering Monitor; Climate Justice Alliance; the Equity Fund's Hydrogen Gas Policy Brief.

# 2 Why doesn't CCS work as a climate solution?

Sometimes misleadingly referred to as "carbon removal" or "negative emissions technology," CCS was only rebranded as a potential climate solution in recent decades. Unsurprisingly, the fossil fuel industry is the main backer of carbon capture and storage as a "climate solution." Other supporters include "climate-friendly" policymakers, energy research groups, and some traditional environmental groups that often cite IPCC research as justification (see **Section 6** for FAQs from the IPCC). Referring to CCS as a climate solution is problematic because the process:

- **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.[36] 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 4**).[37]

- **Fails to Meaningfully Reduce Harmful Climate Pollution:** Even if carbon capture technologies were 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.[40]

  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 must burn more fuel to power carbon capture equipment—as much as 40 percent more fuel.[41]

- **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. Pilot projects have repeatedly been overpromised and under-delivered.[42] A recent IPCC report notes that the technology is less mature.[43] For example, **Box 5** describes how the first and only existing carbon capture project at a U.S. fossil-fueled power plant significantly under-delivered on its climate goals and eventually shut down, even after a $1 billion investment.

## Box 4. Very Little Captured Carbon Is Actually Being Sequestered

Existing CCS facilities capture less than 1 percent of global carbon emissions. The 28 CCS facilities currently operating around the world are only able to capture 0.1 percent of all fossil fuel emissions. Of that amount, just 19 percent is being captured for actual geological sequestration, while the vast majority is being used to produce more oil.[38] In the United States, 13 facilities with CCS were operational in 2021, and only one facility injected $CO_2$ into the ground for geologic sequestration.[39]

36 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

37 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

38 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

39 https://sgp.fas.org/crs/misc/R44902.pdf

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

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

42 See, e.g., https://www.gao.gov/assets/gao-22-105111.pdf

43 IPCC 2022 Mitigation Report, Executive Summary, p. 32, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

## Box 5. First Large U.S. Coal Plant With CCS Shuts Down Due to Technical Problems and Missed Targets

Petra Nova, the nation's first large power plant with carbon capture and storage, started operations just outside of Houston, Texas, in 2017. The CCS infrastructure retrofit cost more than $1 billion and was made possible with $190 million of federal funding: $160 million from the Department of Energy (DOE) Clean Coal Power Initiative and the rest from other DOE programs.[44]

**This major test for the potential of CCS suffered tremendous failures:**

- Only 7 percent of the power plant's total $CO_2$ emissions were captured, despite the company's promise to reduce them by 90 percent.[45]
- The facility routinely missed required $CO_2$ emissions savings targets over its three years of operations.
- Reliability was a major issue, with significant outages averaging one day down for every three days in operation.[46]

**In the meantime, the project enabled the continued use of fossil fuels and harm to frontline communities:**

- When in operation, the project relied on potentially dangerous $CO_2$ pipelines to transport captured carbon more than 80 miles to an oil field for enhanced oil recovery.
- The captured $CO_2$ was anticipated to increase oil production in the field from 300 to 15,000 barrels per day.
- The project was used to justify the continued operations of a coal-fired power plant and its resulting environmental damage and climate pollution.

The facility shut down in 2020, citing high costs and chronic mechanical failures.[47] Studies highlight how this failure points to "deep financial risks" facing other CCS projects still in the works.[48]

- **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."[49] 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.[50] 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.[51] In other words, CCS projects are not economically viable unless they are significantly subsidized and, in most cases, used for enhanced oil recovery.[52] 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,[53] 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.

  In total, industry researchers found that the most successful carbon capture could only capture around 8 percent of all industrial emissions.[54] 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. **Section 5** presents more effective and more equitable approaches to reducing industrial sources of pollution.

44 https://sgp.fas.org/crs/misc/R44902.pdf
45 https://www.energyandpolicy.org/petra-nova/
46 https://www.energyandpolicy.org/petra-nova/
47 https://www.reuters.com/article/us-usa-energy-carbon-capture/problems-plagued-u-s-co2-capture-project-before-shutdown-document-idUSKCN2523K8
48 https://ieefa.org/wp-content/uploads/2020/08/Petra-Nova-Mothballing-Post-Mortem_August-2020.pdf
49 https://ieefa.org/wp-content/uploads/2020/07/CCS-Is-About-Reputation-Not-Economics_July-2020.pdf
50 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
51 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf (citing https://pubs.acs.org/doi/10.1021/acs.est.9b06147)
52 https://www.energyandpolicy.org/petra-nova/
53 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
54 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

# 3 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 of color. Current regional trends show that most operating and proposed facilities are in the Midwest, Texas, and the Gulf Coast (see **Figure 1**). As covered in **Section 1**, 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.**

A clear example of this trend is in California, where environmental justice groups have been organizing against proposals for carbon capture and storage at refineries and many types of industrial facilities such as glass and cement operations.[55] Refineries and industrial facilities are usually sited near low-income communities of color.[56] Hotly contested state incentives for carbon capture would help these facilities stay open and continue polluting indefinitely, even if the carbon were successfully captured and stored.

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.[57] Proposed $CO_2$ pipelines in the Midwest[58] would run through dozens of counties, endangering rural and agricultural communities in exchange for meager compensation, if any.[59] It is likely other $CO_2$ pipeline buildouts would follow these trends.

## Figure 1. CCS projects in the United States are mostly concentrated in the Midwest, Texas, and the Gulf Coast


Note: The majority of facilities in red and blue are for the industrial sector. For the power sector, only one facility, Petra Nova, was operational (it was shut down in May 2020, citing chronic mechanical failures, high costs, and missed targets, see **Box 5**). However, several power-sector facilities are under development (in red).

Source: Global CCS Institute, 2021.

55 Seventy-three organizations throughout California submitted a letter to the California Air Resources Board on concerns of the 2022 Scoping Plan, including on CCS: https://earthjustice.org/sites/default/files/files/73_orgs_letter_-_a_just_and_ambitious_scoping_plan.pdf?utm_id=59107&sfmc_id=4509553

56 https://thehill.com/opinion/energy-environment/599950-biomass-is-not-health-neutral/

57 https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

58 For a map of proposed pipelines in the Midwest, see: https://www.cureriver.org/carbon-pipelines-mn/

59 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.mprnews.org/story/2021/03/02/iowa-company-wants-to-store-carbon-dioxide-under-north-dakota

# 4 How can we push back against CCS hype? What can we invest in instead?

1. **Eliminate subsidies.** Several subsidies for carbon capture technologies currently prop up the fossil fuel industry (see **Box 1**). In addition to the billions of dollars available under the Infrastructure Act, carbon capture projects claim tax credits under Section 45Q of the IRS code. Oil companies that use captured carbon to produce more oil are the major beneficiary of these tax credits.[60] An inspector general investigation in 2020 found that fossil fuel companies were able to claim around $900 million in clean air tax credits.[61] Congress must take action to eliminate these subsidies and remove the incentives that keep outrageously expensive carbon capture projects afloat.

2. **Invest in natural carbon capture.** Much more effective natural ways exist to reduce carbon that do not rely on harmful, unproven carbon capture processes. Reforestation, improved forest management, soil carbon sequestration, and peatland restoration are all examples of methods that can capture carbon while enhancing biodiversity and providing local benefits such as employment.[62] Composting organic matter—rather than throwing it in a landfill—reduces methane emissions, improves soil health, and conserves water.[63] Such methods should be explored as ways to naturally capture and reduce carbon while providing local benefits, instead of relying on unreliable and costly machines to remove carbon or prevent it from reaching the air.

3. **Pass local and regional policies to limit carbon capture.** Limiting the harm of CCS at a local or regional level is especially critical for climate and air pollution hotspots and is sometimes more politically feasible than similar actions at state or federal levels. For example, on June 9, 2022, the New Orleans City Council passed an ordinance prohibiting carbon capture and storage.[64] This type of local action is crucial to protect local communities from the devastating risks of leaks and ruptures.

4. **Generate electricity with clean green alternatives.** Rather than relying on harmful CCS, the most effective way to mitigate GHGs is to stop extracting fossil fuels and expand our use of renewable, sustainable resources. Cleaner and cheaper[65] alternatives can meet our energy needs, including:

   *A. Wind and solar:* Wind and solar energy must be increased to meet rising demand and decarbonize the electricity, energy, and transportation sectors. Increasing the geographical diversity of solar and wind increases its reliability.

   *B. Demand-side management:* A variety of methods can be used to reduce and change energy demand, including increasing the energy efficiency of homes and buildings and paying households to reduce energy usage at the highest peak times. These methods should be integrated into the grid to help manage demand and eliminate reliance on harmful fossil fuel facilities.

   *C. Energy storage:* Energy storage captures energy produced at one time to be used later and can complement wind and solar energy to ensure higher reliability of the system.

   *D. Geothermal and hydropower:* Some clean and green energy sources can provide renewable energy and meet needs even on calm days and after the sun goes down.

***Rather than relying on harmful CCS, the most effective way to mitigate GHGs is to stop extracting fossil fuels and expand our use of renewable, sustainable resources.***

60 https://www.menendez.senate.gov/imo/media/doc/TIGTA%20IRC%2045Q%20Response%20Letter%20FINAL%2004-15-2020.pdf

61 https://www.menendez.senate.gov/newsroom/press/menendez-releases-inspector-general-investigation-finding-fossil-fuel-companies-improperly-claimed-nearly-1b-in-clean-air-tax-credits

62 IPCC 2022 Mitigation Report, Executive Summary, p. 40, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf; https://www.decadeonrestoration.org/

63 https://www.nrdc.org/stories/composting-101#benefits

64 https://www.dscej.org/the-latest/deep-south-center-for-environmental-justice-commends-new-orleans-city-council-for-prohibiting-carbon-capture-and-storage

65 The IPCC found that many other types of energy sources, including solar and wind, are more economical and have a greater potential to reduce GHG emissions. IPCC 2022 Mitigation Report, Executive Summary, p. 42 (table showing CCS as the most expensive potential option for mitigating electric sector emissions), https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

5. **Decarbonize the industrial sector.** Carbon capture is often promoted as a way to decarbonize hard-to-electrify industrial sources, but there are better solutions that do not rely on continued use of harmful fossil fuels.[66] Some potential alternatives include:

   *A. Recycle materials to limit industrial emissions.* One of the most effective ways to reduce industrial emissions is to reuse materials by increasing recycling rates and processing less virgin material.[67]

   *B. Rely on clean sources to power processes.* Relying on clean resources to power industrial resources is the best way to reduce the impact of industrial emissions. For example, estimates have found that around 60 percent of carbon emissions from aluminum production can be eliminated by producing electricity from renewable resources.[68]

   *C. Utilize clean resources to decarbonize process emissions.* Technologies like geothermal or solar thermal can be explored to decarbonize industrial process emissions, and the type of materials utilized can be improved.[69]

## 5 Conclusion

Carbon capture and storage is extremely expensive, unproven, and exceptionally 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 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 and key decisionmakers should focus on proven, economical, and safe climate solutions that can lead to equitable change.

***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.***

66 The IPCC found that other actions, including energy efficiency and material efficiency, are more economical and have a greater potential to reduce GHG emissions. IPCC 2022 Mitigation Report, Executive Summary, p. 42 (table showing CCS as the most expensive potential option for mitigating electric sector emissions)

67 For a description of how increasing recycling would reduce emissions by around 300 million tons per year, see https://international-aluminium.org/resource/aluminium-sector-greenhouse-gas-pathways-to-2050-2021/

68 World Economic Forum, *Aluminum for Climate: Exploring pathways to decarbonize the aluminum industry*, pp. 13 (Nov. 2020). https://www3.weforum.org/docs/WEF_Aluminium_for_Climate_2020.pdf

69 World Economic Forum, *Aluminum for Climate: Exploring pathways to decarbonize the aluminum industry*, pp. 13 (Nov. 2020). https://www3.weforum.org/docs/WEF_Aluminium_for_Climate_2020.pdf

# 6 Frequently Asked Questions

***What about projections by the Intergovernmental Panel on Climate Change (IPCC) that include a role for CCS and geoengineering? Don't the IPCC reports make the case for investing in "negative emissions" technologies now, so we're ready by the 2030s/2040s?***

Many IPCC pathways to limit warming to 1.5 degrees include carbon capture and storage, but there are pathways that do not rely on CCS. This report shares a good summary of how CCS is considered in various international reports (but does not cover the last few years).[70] The IPCC acknowledges that the use of CCS is "less mature in the power sector, as well as in cement and chemical production."[71] With regard to negative emissions, the IPCC found that "land-based mitigation measures [reforestation and other nature-based measures] represent some of the most important options currently available. They can both deliver carbon dioxide removal (CDR) and substitute for fossil fuels, thereby enabling emissions reductions in other sectors."[72]

***What is the most common method for capturing carbon and what is its most common use?***

Currently, the most common methods for capturing carbon are CCS and CCUS, and the most pervasive use of captured carbon is enhanced oil recovery. In 2021, 13 facilities with CCS were operational in the United States. Out of these 13, only one injected $CO_2$ into the ground for geologic sequestration.[73] In order words, the most common outcome of CCS projects is more carbon emissions through boosted oil production, as opposed to permanently avoided carbon emissions.

*The vast majority of CCS facilities do not permanently remove carbon and do nothing to reduce air pollution, so they are not cleaner.*

***What about direct air capture? Seems more promising, right?***

Direct air capture (DAC), the only method that directly pulls carbon out of the atmosphere, accounts for a very small percentage of operational CCS projects. Most DAC plants are in the "proposed" stage, and their viability is speculative at best. They require a lot of land and energy as well as a certain set of conditions to be a worthwhile investment.[74]

Advocates of DAC often point to Orca in Iceland, the world's first large-scale DAC facility, launched in September 2021.[75] It is important to note that the success of this facility is enabled by a certain set of conditions largely unavailable to most parts of the world. It is powered by an existing geothermal power plant, has an available water supply, and is near geological storage so the captured carbon does not need to travel far. But Orca has suffered from several setbacks due to the harsh Arctic winters, so it remains to be seen whether the plant can meet its promised climate targets.[76]

***The fossil fuel industry claims they can retrofit existing power plants with CCS to generate "clean electricity." Is this true? Are there any examples that show this success can be replicated across the industry?***

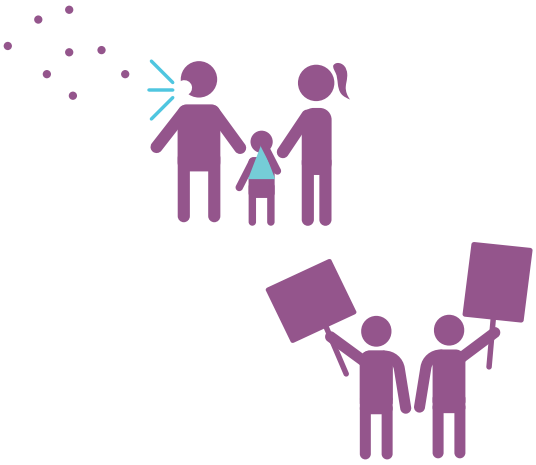
No. The vast majority of CCS facilities do not permanently remove carbon and do nothing to reduce air pollution, so they are not cleaner. As of 2021, the Petra Nova project in Texas was the first and only U.S. fossil-fueled power plant generating electricity and capturing $CO_2$ in large quantities (more than 1 million tons per year), but CCS operations were suspended in 2020 (see **Box 5** for more details).[77] The captured carbon from this plant was being sent to an oil field for enhanced oil recovery, with the goal of increasing oil production from 300 to 15,000 barrels per day.[78] Replicating this example across the industry would be a huge step back for a truly clean and equitable energy transition.

70 https://www.research.manchester.ac.uk/portal/files/184755890/CCS_REPORT_FINAL_v2_UPLOAD.pdf
71 IPCC 2022 Mitigation Report, Executive Summary, p. 32, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf
72 Chapter 7, IPCC Sixth Assessment Report, Mitigation, Executive Summary, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter07.pdf
73 https://sgp.fas.org/crs/misc/R44902.pdf
74 https://ecostandard.org/wp-content/uploads/2020/06/CCS-false-solution-food-water-action-europe.pdf
75 https://climeworks.com/roadmap/orca
76 https://www.newscientist.com/article/2315695-carbon-removal-project-in-iceland-suffers-setback-due-to-harsh-winter/
77 https://sgp.fas.org/crs/misc/R44902.pdf
78 https://sgp.fas.org/crs/misc/R44902.pdf

# 7 Additional Resources

**Good Overviews:**

- Climate Justice Alliance, 2021. Geoengineering 101: Carbon Capture and Storage
- Center for International Environmental Law, 2021. Confronting the Myth of Carbon-Free Fossil Fuels: Why Carbon Capture Is Not a Climate Solution
- Food & Water Action Europe, 2020. Carbon Capture and Storage: An Expensive and Unproven False Solution



**Health and Climate Impact Examples:**

- Physicians for Social Responsibility, 2022. Danger Ahead: The Public Health Disaster That Awaits From Carbon Capture and Sequestration (CCS)
- Mark Z. Jacobson, 2019. The Health And Climate Impacts of Carbon Capture and Direct Air Capture. *Energy Environ. Sci.*

**Advocacy Actions:**

- Letter to the California Air Resources Board from 73 organizations in California for a Just and Ambitious 2022 Scoping Plan, which includes concerns on CCS