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Wind turbines on the Belgian part of the North Sea. *Source:* © ***Hans Hillewaert***

Opportunity Costs - Carbon Capture & Sequestration

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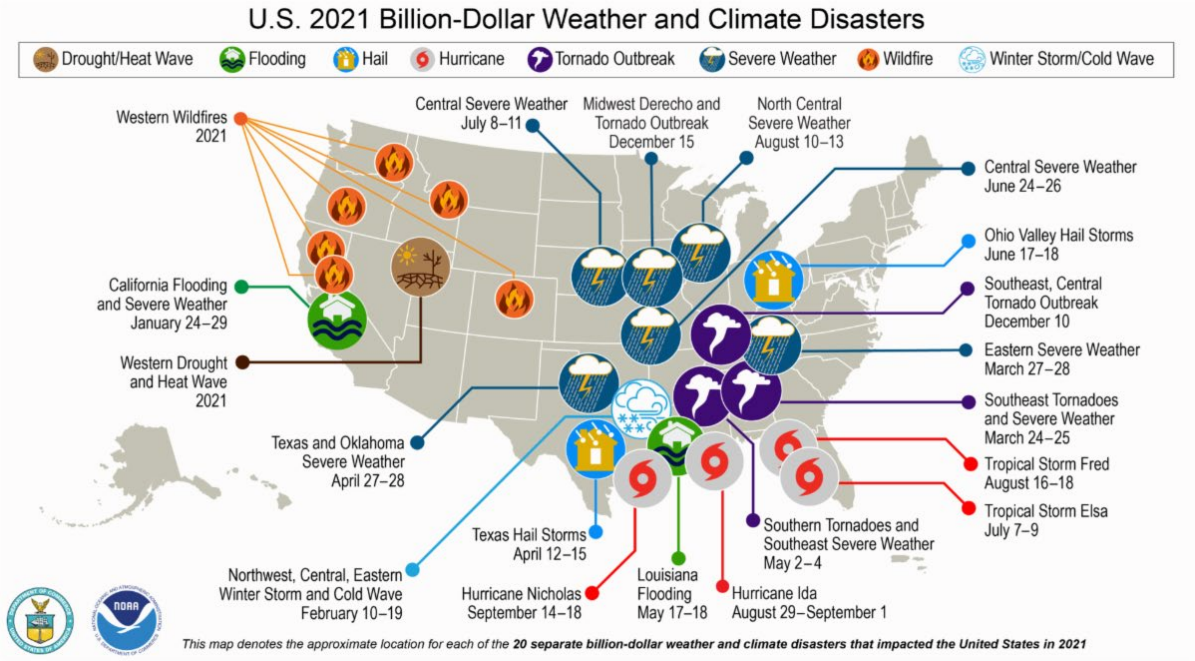
This is the fifth article in a series that has examined concerns, especially health, related to carbon capture. Carbon capture involves a variety of initiatives undertaken purportedly to address looming climate changes. **Our previous report** addressed the relationship between hydrogen production and carbon capture. This report focuses on the major opportunity costs of diverting taxpayer dollars to the dubious benefits of carbon capture.

Billion-dollar Events Driving Urgency

The U.S., like the rest of the globe, experiences increasingly frequent and extreme weather events. In 2021, the U.S. endured twenty billion-dollar climate disasters.

In April this year, the Intergovernmental Panel on Climate Change (**IPCC**) released a **report** announcing it's "now or never" to limit global warming to 1.5°C. Scientific modeling demonstrated that curbing the earth's warming to 1.5°C produces **less devastating outcomes** than warming 2°C or higher.

In May of 2022, the World Meteorological Organization (WMO) released a **climate update** indicating that there is now a 50:50 chance that the annual average global temperature will temporarily reach 1.5°C above the pre-industrial level in at least one of the next five years–with the prospect increasing over time.



Source: NOAA *National Centers for Environmental Information* (NCEI) (2022)

On September 13, 2022, the UN released a new **report** warning of tipping points and announcing that the reduced CO2 emissions experienced during Covid quarantines have returned to pre-pandemic levels. As disasters and warnings arrive at a faster and faster pace, does anything change? How are the warnings heeded?

Carbon capture is aggressively promoted as a climate solution by the fossil fuel industry, but we must ask at what cost for whom and over what time frame? Examining the economic costs of carbon capture without addressing the manifold externalities or alternative opportunities foregone, we run the risk of legitimizing carbon capture as a climate solution. Given its history and failures to date, it cannot be overemphasized that carbon capture is a false promise.

Needing Zero Carbon

The IPCC report emphasized that global GHG emissions must be reduced by 43 percent by 2030 in order to *limit* global warming to 1.5°C and asserted that Global temperatures will stabilize when CO_2 emissions reach "**Net Zero**."

The fossil fuel industry and some members of **academia** promote carbon capture as essential to achieve "Net Zero" by **eliminating CO2 emissions.** Net Zero has been promoted as if it meant an overall balance between emissions produced and emissions taken out of the atmosphere, which it does not. Real Zero is the ultimate goal.

Financing Carbon Capture

On September 23, 2022, the US Department of Energy (DOE) issued a **press release** whose headline read: "Biden-Harris Administration Announces **$4.9 Billion** to Deploy Infrastructure Necessary to Manage and Store Carbon Pollution." This support for carbon capture followed the August Inflation Reduction Bill (IRA) added substantially to public funds for carbon capture projects already found in other earlier sources.

Chart 1. Carbon Capture Project Funding Sources

Funding Source	Amount	Project Type
US Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) (2/10/22)	$96 million	For projects that will develop point-source carbon capture technologies for natural gas power plant and industrial applications capable of capturing at least 95% of CO_2 emissions generated
Infrastructure Investment & Jobs Act (IIJA) (11/15/21)	$12.1 billion	• Carbon capture demonstration & pilot projects • Low interest loans for CO_2 pipeline projects • Class VI permitting & primacy applications • Regional Direct Air Capture (DAC) Hubs program
US DOE's CarbonSAFE Initiative (2016)	$33.2 million	For research and development of geologic storage sites with capacities to store at least 50 million metric tons or more of CO_2
CA's Low Carbon Fuel Standard	*Approximately $5-10 million per 10 million gallons of ethanol*	Point source capture on ethanol plants and storage
45Q Tax Credit	$85 per metric ton	Point source capture and storage
45Q Tax Credit	$60 per metric ton	Point source capture and Enhanced Oil Recovery (EOR)
45Q Tax Credit	$180 per metric ton	DAC and storage
45Q Tax Credit	$130 per metric ton	DAC and EOR

The **45Q tax credit** is one of the main drivers of industry interest in carbon capture; as a tax credit, it is intended to incentivize investment in carbon capture and sequestration. The recently passed Inflation Reduction Act (IRA) increased the credit amounts for the 45Q, further **incentivizing** CCS/CCUS.

In August 2022, researchers at Princeton University **analyzed** the potential for CCS to grow as a result of the 45Q increases. They concluded it led theoretically to a mere 20 percent reduction of emissions by 2030. A separate, **preliminary cost estimate** done in July 2022, of the IRA conducted by a congressional research agency estimated that the new CCS tax credits will cost taxpayers $3.2 billion over

the next ten years to at most, sequester 53 million tons of CO_2 *if* it was all used for Enhanced Oil Recovery (EOR) at $60 per ton. Both sources confirm this is a minuscule amount compared to overall CO_2 emissions. Globally emissions in 2021 were 36.3 billion metric tons, while yearly U.S. emissions amount to 4.46 billion metric tons.

Scope 3 Emissions

Within the energy and corporate sectors, there is a term known as Scope 3 emissions which are indirect emissions that occur in a company's value chain. An example would be a company that makes gas-powered equipment. The emissions resulting from the use of the equipment by customers are Scope 3 emissions. Under the **GHG Corporate Protocol**, reporting Scope 3 emissions is not required. Scope 3 emissions are an example of an externality.

"Externalities" are a concept in economic theory that represent "the impacts of a market decision whose **cost is not accounted for** within the price used in the market transaction." Chart 2 lists many of the externalities associated with carbon capture. When considering the externalities of CO2 pipelines, it is important to bear in mind that the carbon capture projects conceptualized by proponents entail a **massive network of pipelines** in order to accomplish their purported goals.

Chart 2. Externalities Related to Carbon Capture

Externality	Source	Description
Increased threats to frontline communities	CCS Equipment, power plants, and industrial facilities	Typically sited in frontline communities, fossil fuel extraction and industrial processes already adversely impact those who would be further harmed by the increased emissions and water pollution associated with carbon capture units which also extend the life of the facilities.
Increased human trafficking and sexual assault	"Man-camps" for pipeline construction	Studies connect man camps with increased rates of sexual violence and sex trafficking, especially for Indigenous women and girls.
Public health dangers of pipeline rupture and asphyxiation -- especially in rural areas	Compressed CO_2 in the pipeline	Rupture of a highly pressurized liquid CO_2 pipeline causes an explosive release of extremely cold (< -70°C) liquid CO_2 that forms ground-hugging clouds of gas and small particles that displace oxygen and continue to spread until the supply is shut off.
Additional CO_2 emissions	Carbon capture equipment	Capture requires its own energy source –called "parasitic energy."

Additional CO_2 emissions	Equipment used to pump CO_2 into storage area; and potential surface leaks once stored	Sequestering requires its own energy source; surface leaks of CO_2 would increase CO_2 emissions into the atmosphere.
Additional CO_2 emissions	Enhanced oil recovery (EOR)	EOR is another way of extracting more oil, prolonging the use of fossil fuels, and further increasing CO_2 emissions.
Co-pollutants and other GHGs	NO_x, SO_2, $PM_{2.5}$, mercury, and methane	Pollutants emitted by coal plants and methane power plants are not eliminated by carbon capture.
Nitrous oxide (N_2O) emissions, a powerful GHG	Nitrates in fertilizer	Used to grow corn for ethanol
Water pollution	Nitrates in fertilizer	Used to grow corn for ethanol
Acidification of water aquifers	Stored CO_2	CO_2 potentially leaks through sub-surface cracks and acidifies the water table.
Increased water consumption	Equipment used to capture and **compress** CO_2 is water intensive.	Whether CO_2 is from fossil energy plants or corn-ethanol plants CO_2 compression still requires massive water sources.
Land use changes	Growing corn for ethanol	Results in a monocrop agriculture, contributing to food scarcity, and tilling of land that was previously left uncultivated.
Environmental degradation along pipeline routes	Construction of buried pipeline	Use of heavy machinery destroys the environment along the route, including right-of-way and farmland, leading to soil compaction, drainage issues, loss of trees and soil, and a reduction in crop yields.
Increased occurrence of earthquakes	Liquid CO_2	Risks associated with pumping liquid CO_2 into underground storage areas
Noise pollution	During construction periods; carbon capture equipment; pump stations for pipelines; pumping of CO_2 into storage area	Capture equipment and pumps require power sources that *generate noise and vibrations*.
Decreased property values	CO_2 pipelines; pump stations; sequestration site	Nearby pipelines, pump stations, and sequestration sites potentially lower property values.

Carbon Capture's Exaggerated Potential: Red Flags

In a previous **report**, we discussed the Petra Nova plant in TX. When built in 2017, the Petra Nova plant was hailed as the world's largest coal-fired carbon capture facility and cost $1 billion to construct. The plant received $195 million in funding from the DOE. In September 2022, NRG Energy **sold its 50% share** of the plant for a mere $3.6 million to the other owner.

Another example involves the Gorgon plant, a massive LNG carbon capture project based in Australia owned by Chevron. Gorgon has missed its CO_2 sequestration targets for the past 5 years and was forced to purchase carbon credits to compensate for the shortfalls.

Gorgon and Petra Nova are only two problematic carbon capture projects. A recent **analysis** by Food and Water Watch reveals an abysmal track record for many carbon capture projects in the U.S. Their analysis concludes that carbon capture is nothing more than a "handout to fossil fuel corporations." That carbon capture is so aggressively promoted by the fossil fuel industry should be a red flag to everyone. Many assert the fossil fuel industry embraces carbon capture because it will prolong our society's **addiction** to fossil fuels.

Overlooked Milestones

Despite increased accessibility and affordability of renewable energy, the narrative has perplexingly become that carbon capture is something we absolutely must do to save ourselves from global warming. In April of 2022, for the first time, two renewable wind and solar sources generated more electricity than coal or nuclear power. Wind and solar produced 57.73 million MWh during the month, while coal and nuclear both generated less than 56 million MWh.

"Natural" gas was still the top source of electricity during the month, producing 95.61 million MWh. Guggenheim Securities analysts **announced** in October 2022, that utility-scale solar and onshore wind are now less expensive than gas-fired power, and that the lower cost "supports the case for economic deployment of renewables across the US."

Rather Than Carbon Capture

Mark Jacobson, a Stanford University professor, and his team have created a blueprint for the world to fulfill its energy needs using 100% wind, water, and solar (WWS) by 2035. Their plan was recently published in a **peer-reviewed study** in *Energy and Environmental Science*. The plan does not rely on fossil fuels, carbon capture, nuclear power, or blue hydrogen. The cost of making the transition to 100% renewable energy would be $62 trillion. However, the modeling also shows that switching to 100% renewable energy would save $11 trillion a year, which means the initial cost would be recouped in 6 years! The study demonstrates that by switching to a 100% WWS energy system, worldwide energy usage would decrease by 56 percent immediately.

For a real-time example, consider the **100% solar-powered village** of 2,000 homes that never lost power during Hurricane Ian. As a result of resilience planning

and wetlands protection, the community did not flood despite being only 15 miles from Ft. Myers, FL. The community not only survived Hurricane Ian, but they were also able to open their school as a shelter for other victims. Watch an on-the-scene video **here**.

Conclusion

Efforts to implement CCS will effectively prolong society's reliance on climate, environment, and health-damaging fuels, including coal, "natural" gas, oil, and ethanol. CCS is itself an overly complex, expensive, false solution with a long list of unacceptable toxic and harmful environmental consequences and costs. CCS diverts attention and resources needed now to transition to clean energy sources away from fossil fuels. We have the technology, the know-how, the examples, and the blueprints for how to make this transition, but lack the political will. Whether the needed political will can be mustered in time remains to be seen.

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