

# Public Perception of Technological Carbon Capture

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*Abstract: As climate change worsens and we struggle to reduce our global emissions to levels that will slow down global temperature rise, the concept of pulling carbon directly out of the atmosphere is gaining traction. While development of potential technology began in the 1970s (IEAGHG. n.d), the concept of Direct Air Capture (DAC) of carbon is relatively recent with many start-ups being created in just the last few years (Merchant 2022). Opinions on this technology vary widely, partially due to how recently this technology began gaining attention and the fact that all implementations of this technology are still at pilot stages (“Direct Air Capture – Analysis” 2021.). This study found that the concerns and hopes of the public and experts in the field only somewhat align, leading to challenges in communication between experts and the public about DAC. This study, through an analysis of comments on LinkedIn and Youtube, aims to categorize public opinions and call attention to key areas where research needs to be done.*

Keywords: Carbon Capture, Direct Air Capture, Public Perception, Public Opinion

## Introduction to Carbon Capture

Carbon capture is the process of removing carbon dioxide (hereafter carbon) from the atmosphere (Lebling et al. 2021). Carbon capture is not an entirely new concept but has been gaining the public’s attention in recent years (Lebling et al. 2021). According to the International Panel on Climate Change’s “Climate Change 2022: Mitigation of Climate Change”, carbon capture is no longer avoidable if we are to keep global temperature rise below 1.5 degrees C. The first form of carbon capture has existed for millennia: plants. Plants are part of the natural carbon cycle of the earth (“The Carbon Cycle” 2011) and are a commonly believed solution to Climate Change. In addition, many technological solutions for carbon capture draw inspiration from natural processes (Institute 2018). However, there is debate over whether planting and preserving trees and other plant life falls short of capturing the levels of carbon the human race is emitting (“Why Planting Tons of Trees Isn’t Enough to Solve Climate Change” 2021). In addition, plant life does not last forever and releases much of the captured carbon after it dies (“The Carbon Cycle” 2011). Development of technological solutions began in the 1970s, however this early technology was developed by the oil industry to enhance oil recovery by pumping the captured carbon into depleted wells (IEAGHG. n.d). In recent years the technology has been adapted to help solve our climate issues and now has been modified to take carbon directly out of the air (“Direct Air Capture – Analysis” 2021.). There are currently 19 DAC companies globally but only a few test facilities in existence (“Direct Air Capture – Analysis” 2021.). Larger scale facilities are in various stages of development as well as many nature-based potential solutions (“Direct Air Capture – Analysis” 2021.).

## Methods

This study, composed of two parts: public opinion and expert opinion, aimed to discover broad trends in public and expert opinions on DAC through literature review and review of comments in internet communities. The goal of the ‘public opinion’ section of this study was to analyze the most accessible opinions expressed by the segment of the public that is engaging in the carbon capture conversation. Public opinion was gathered from comments on three YouTube videos on carbon capture titled: “7 Ways To Pull Carbon From The Atmosphere”, “The Truth about Capturing CO2 to Reverse Climate Change” and “Money Is Pouring Into Carbon Capture Tech, But Challenges Remain,” and three LinkedIn posts on the same subject titled: “An Excellent Read on the European #carbonremoval Policy Landscape,” “Climate Experts Say Vacuuming CO2 From the Sky is a Costly Boondoggle,” and “Direct Air Carbon Capture Requires Almost as Much Energy as Burning Fossil Fuel”. Videos and posts were chosen for their relevance to DAC as well as the relevance of their comment threads. Four sources were educational in nature and 2 were opinion pieces. All sources were published between 2020 and 2022. 121 comments were gathered from these sources based on their relevance and the order listed on the site. Comments were rejected from this study if they did

not fit into the category of opinions on carbon capture but were not rejected for ‘correctness/accuracy’ of their opinion. Comments were then categorized into general themes and separated into concerns and hopes. .

Expert opinion was gathered from an expert elicitation survey titled: “Future Prospects of Direct Air Capture Technologies: Insights From an Expert Elicitation Survey,” analyzing the slides and transcribing a webinar by the European consulting company AFRY titled: “Carbon Removal for a Net Zero World,” and the article “Direct Air Capture: Resource Considerations and Costs for Carbon Removal,” from the World Resources Institute. Opinions were then categorized into general themes. In addition, expert opinions on background information not directly relating to DAC were gathered through a literature review.

Although not comprehensive and not necessarily representative of the population, these surveys generated themes and questions that illuminate a divide in opinions, concerns and communication between the public and experts in relation to DAC.

## Results

**Public Concerns regarding carbon capture fell roughly into 11 categories. (See fig. 1)**

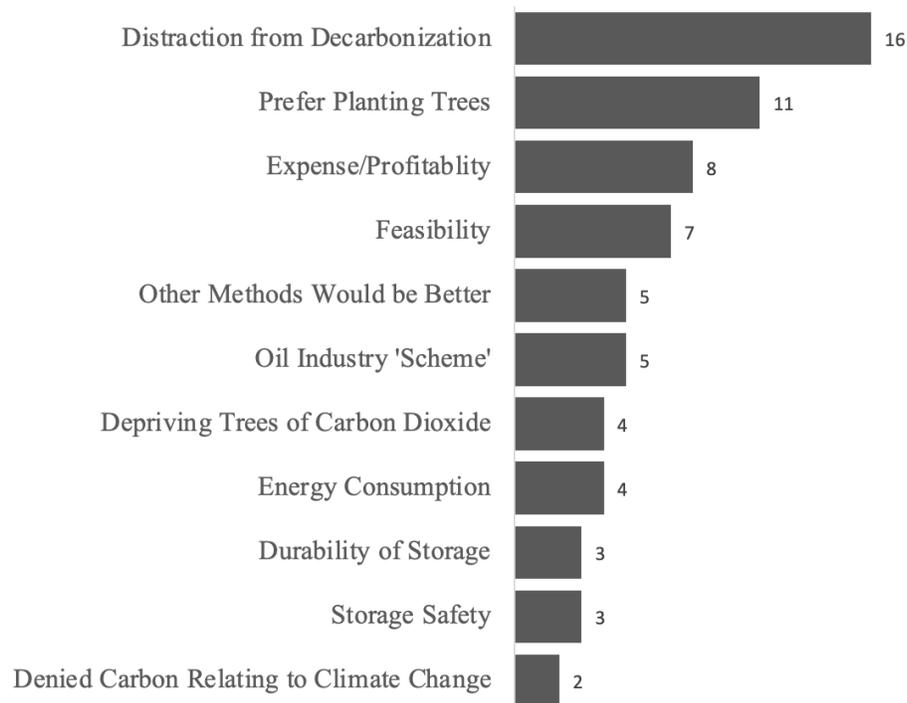


Figure 1: Public Concerns on Carbon Capture by Number of Comments  
Source: Chanders

The following selection of quotes from comments in the above categories where selected for relevance:

### Distraction from Decarbonization:

“The problem with CCS is that many might think of it as a get out of jail free card or a "no regret - all you can eat diet pill".” (Comment from Ulrich Suter, Undecided with Matt Ferrell 2020)

“Direct air capture technology is not only a waste of money and energy, it is a dangerous distraction FROM decarbonization. It's the fossil fuel industry selling you on the notion that you don't need to worry-burn baby burn!- because somebody will come along later with a giant vacuum cleaner to suck up your sins from the atmosphere. It's worse than merely being ahead of its appropriate time by many decades- it's much more nefarious than that.” (Paul Martin 2022 comment on “An Excellent Read on the European #carbonremoval Policy Landscape,” 2022.)

### Preferred Planting Trees:

“There is a very cheap direct from air carbon dioxide capture technique - it's called "photosynthesis" and operates in green plants known as "trees"” (Micky Allen comment on “Direct Air Carbon Capture Requires Almost as Much Energy as Burning Fossil Fuel,” 2021.)

Expense/Profitability:

“Carbon capture- in general- is costly and inappropriate” (Maxime Katgely 2022 comment on “Climate Experts Say Vacuuming CO2 From the Sky is a Costly Boondoggle.” 2022.)

Other Methods Would be Better

“Can the captured CO2 be used to make batteries? Also, the captured CO2 can be used to make cement less atmospherically toxic.” (Ezio Cutarelli comment on CNBC, 2021)

Comments in the ‘Other Methods Would be Better’ category included proposed methods involving water, wax, algae, nuclear, cover crops, purely emissions reductions, biochar and whales.

Oil Industry Scheme:

“They are making money from it. Anything to do with carbon is just to be able to ask for the money! This is the new industry. Money from "climate saving innovation".” (Paul Davies 2022 comment on “An Excellent Read on the European #carbonremoval Policy Landscape,” 2022.)

Depriving Trees of Carbon:

“This whole co2 blame for global warming is pure politics and has nothing to do with science. Now tell me what the plants think of you taking away the gas that keeps them alive?” (Leo Jones comment on CNBC 2021)

Energy Consumption:

“Unfortunately it takes energy to do it that is what the money is for... money is energy” (timeWaster76 comment on Undecided with Matt Ferrell 2020)

Durability of Storage:

“it sounds to me like selling the captured carbon will just release it into the atmosphere again. it has to be put underground, or at least sold only to companies that won't cause it to be released into the atmosphere again.” (Arthur comment on CNBC 2021)

Storage Safety:

“Wouldn't carbonating the ground water make it acidic? Anyone see a problem with this?” (Abstract Idea comment on CNBC 2021)

Denied Carbon Relating to Climate Change

“The current and near future CO2 levels aren't "unhealthy" in fact it is opposite. Study prehistoric CO2 levels there were many periods had higher CO2 levels and amazing animal and plant growth for example the Devonian and Carboniferous periods.” (Dag\_of\_the\_West comment on CNBC, 2021)

**Public Hopes for carbon capture fall roughly into 7 categories. (See fig. 2)**

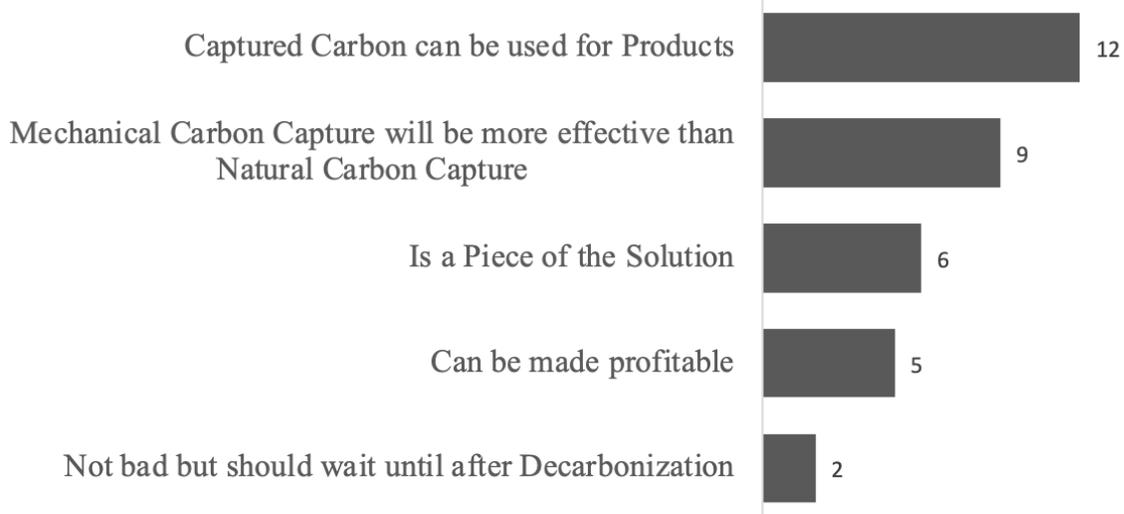


Figure 2: Public Aspirations for Carbon Capture by Number of Comments  
Source: Chanders

The following selection of quotes from comments in the above categories were selected for relevance:

Mechanical Carbon Capture will be more effective than Natural Carbon Capture:

Nature never evolved with the efficiency of carbon capture and storage in mind. That has never been a task life has truly concerned itself with before now, and as such even the most rudimentary of human techniques easily beats out nature's best alternatives. (96ace96 comment on CNBC 2021)

Is a Piece of the Solution:

“The general efficiency of sunlight to useful energy in plants is generously considered about 1%, whereas solar panels are pushing towards 20% or more. Plants' ability to store carbon long-term is practically non-existent unless they get compressed into the earth/beneath the ocean and turned into coal/oil over literal millennia. We don't have that kind of time.” (96ace96 comment on CNBC 2021)

Can be made Profitable:

“If we put these inside fossil fuel power plants, those companies can convert their carbon byproduct into a source of revenue” (Billious comment on CNBC 2021)

Captured Carbon can be used for Products:

“Is it possible to combine carbon capture and vertical farming to increase crop yield?” (Skeleton Man comment on CNBC 2021)

Comments in the ‘Captured Carbon can be used for Products’ category mentioned repurposing captured carbon as carbon neutral fuels, batteries, other products and integrated into air conditioning units.

### **Expert Concerns and Hopes for DAC**

5 main areas of expert concerns and hopes relating to DAC were noted: durability of storage, energy use, cost, scalability, and lack of policy support.

**Durability of storage:** This is a measure of how long the captured carbon stays out of the earth's carbon cycle. “Durability of storage being a key issue for some technologies”. (Brown, Lonsdale, and Woodhouse, 2022.)

**Energy Use:** DAC technologies differ in energy consumption but many require being heated to upwards of 1600 degrees F to collect the carbon they have captured. This can be quite energy intensive. (Lebling et al. 2021) Experts predict that the energy needed will be reduced to 4-8 GJ/tonCO<sub>2</sub> by 2050. (Shayegh, Bosetti, and Tavoni 2021)

**Cost:** Current cost estimates for DAC range from \$200-\$600/ton compared to 50/ton for some nature based solutions. (Lebling et al. 2021) Experts predict in a best case scenario we will get down to \$200 per T by 2050 “costs for DAC could fall to around \$150-\$200 per tonne over the next 5-10 years”. (Shayegh, Bosetti, and Tavoni 2021)

**Scalability:** One of the largest capture plants in operation captures 4000 ton/year which is 0.000004% of a gigaton. (“Direct Air Capture – Analysis” 2021.) According to (“Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive” 2022.) we need to capture “at least 70 to 220 [gigatons] of carbon removals between now and 2050 to limit cumulative net emissions.” Consulting company AFRY (Brown, Lonsdale, and Woodhouse, 2022.) predicts we need 1.4 gigatons/year of capture capacity by 2030, though they believe 1 gigaton can be achieved with nature based solutions. Experts believe “that DAC could contribute to reaching the 2°C climate target by removing several [gigatons] CO<sub>2</sub> by mid century”. (Shayegh, Bosetti, and Tavoni 2021)

**Lack of policy support:** Climate policy is being put in place but not at a rate that is fast enough according to experts in this field. “Half of the experts indicated lack of supporting policy as a major obstacle in developing DAC projects”. (Shayegh, Bosetti, and Tavoni 2021)

### **Discussion**

Public opinion splits roughly into three overarching trends: misconceptions/unrealistic expectations, concerns/hopes that align with expert opinions, and ethical/political questions.

Beginning with inaccurate concerns and unrealistic expectations, commenters expressed a strong preference for 'just planting trees' even though whether it is actually an effective strategy is heavily debated by those involved in the field. ("Why Planting Tons of Trees Isn't Enough to Solve Climate Change" 2021) Some viewers also were concerned that pulling carbon out of the atmosphere would starve the trees. Additionally there were a few comments denying carbon is causing climate change. Many of the other hopes and concerns, such as turning carbon into batteries, capturing carbon with wax or integrating the technology into air conditioning units, are potential possibilities, however they fall into this category because they are fundamentally different from what DAC is intended to achieve and theoretically capable of achieving. These comments align with a study done by Wolske et al. (2019), showing people have a strong preference for natural sounding solutions, such as 'mechanical trees,' kelp forests or others that draw on language traditionally used when referring to nature, as they seem less threatening.

Expert and public opinions do align in some areas, specifically when it comes to technical challenges and potential to solve our carbon problem. This is where most research on DAC is currently being developed. There are several main issues to be addressed: cost, durability of storage, safety of storage, scalability and energy use (Brown, Lonsdale, and Woodhouse, 2022.). These categories tend to be less concerning to the public because they know fewer specifics of the technology. However comments specifically mentioned concerns over feasibility, cost, profit, storage outcome and energy consumption. Experts do not believe these challenges are insurmountable (Shayegh, Bosetti, and Tavoni 2021) but these issues and possibilities are not well communicated with the public.

While the above categories are critical, they are already part of the conversation on DAC between experts and the public. However commenters also brought up several ethical/political concerns which are mostly neglected in the public-expert conversation. These comments largely are concerned with carbon capture distracting from other progress to reduce emissions or using claims of carbon capture offsets being an 'easy out'. Many comments related to concerns that this is a scheme by the oil industry to distract us and allow the continuation of burning fossil fuels. Others worry that if we put resources, time and hope into carbon capture we will not put as much into actually solving the problem or that it will become a "get out free card" for polluters because they can just pay someone to clean up their mess. These concerns reveal a deep disconnect between the public's views on carbon capture and what the experts are communicating about it. In addition to the comments collected, nearly every article in the literature review mentioned at least one of these opinions as a 'some people are worried about...' but no data or formal studies were cited.

## **Conclusion**

The ethical/political questions above likely do not have definitive answers, however clearly the public has a stake in their conclusions. By being asked and unanswered, these questions are undermining to the public's confidence in the technology and have the potential to divide those working towards the same end goal. As the technological research of DAC proceeds, the author argues it will be critical to invest research into these challenging questions. Even more critically this research must be communicated to the public so those who wish to be involved in the conversation have the ability to pass their judgment on the technology not from simply a place of wispy possibilities but from models, data qualified opinions and predictions.

As innovation continues and climate efforts edge further into the global conversation DAC will likely continue to garner attention. Yet with so many unanswered questions, it is likely to further divide the population which is fundamentally working towards the same goal. Whether it comes in the form of misunderstandings, physical setbacks, or concerns over prioritization of resources and influence of oil giants these questions are likely to cause unnecessary disagreement and slow down progress among those fundamentally working towards the same goal of a climate stable future unless answered and communicated.

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