Can Carbon Capture Save Our Climate– and Our Jobs?

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Labor Network for Sustainability
Background Paper

LABOR NETWORK FOR SUSTAINABILITY

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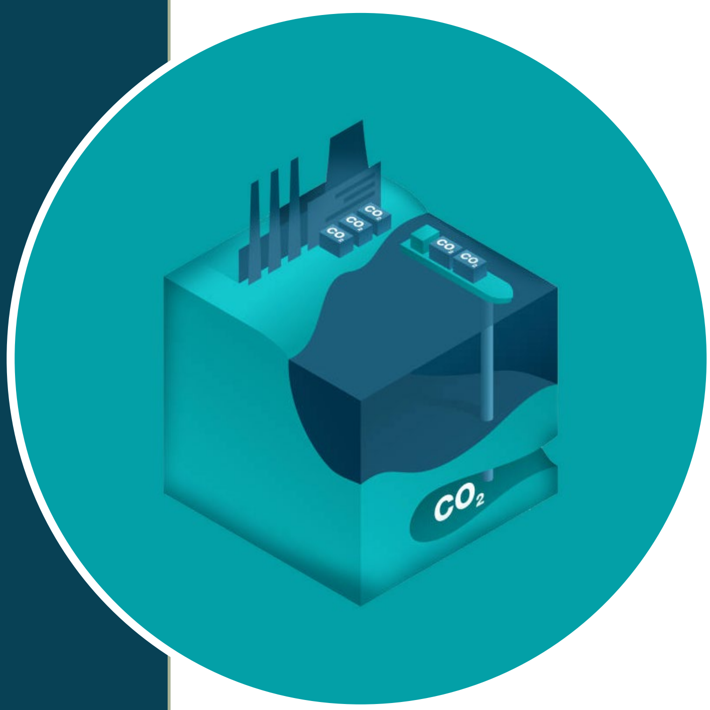


INTRODUCTION

President Biden kicks off the virtual Leaders Summit on Climate in Washington, D.C., on April 22, 2021. Photo: Adam Schultz, White House

As storms, heat waves, fires, floods, and other devastating effects of global warming have grown, more and more people have become convinced of the need to reduce greenhouse gases (GHG) emitted into the atmosphere. The Paris Agreement defined the goal of limiting global average temperature increase to 1.5 degrees Celsius above pre-industrial levels. At the April Climate Summit President Joe Biden announced the U.S. will target reducing emissions by 50-52 percent by 2030 compared to 2005 levels and reaffirmed the U.S. commitment to reach net zero emissions by 2050.[1] These goals indicate what the consensus of climate scientists says is necessary to ward off the most destructive possible effects of climate change. The question remains how to realize them.

There are two well established and proven means to reduce GHG emissions. The first is to replace the burning of fossil fuels with renewable energy from solar, wind, hydropower, and geothermal sources. The other is to reduce the amount of energy we need through a myriad proven means ranging from switching from gasoline to electric vehicles to insulating houses. Numerous studies and thousands of implementations lay out the scientific and economic effectiveness of protecting the climate by reducing fossil fuel emissions.

There is a third means that is being promoted: continue burning fossil fuels but capture carbon–the principal greenhouse gas–either in the smokestack or by sucking it out of the air after it has been released. Various techniques for doing this have been developed with various names–carbon capture and storage (CCS), carbon capture and utilization (CCU), bioenergy with CCS (BECCS), and direct air capture with CCS (DACCS). We will refer to them together as "carbon capture."

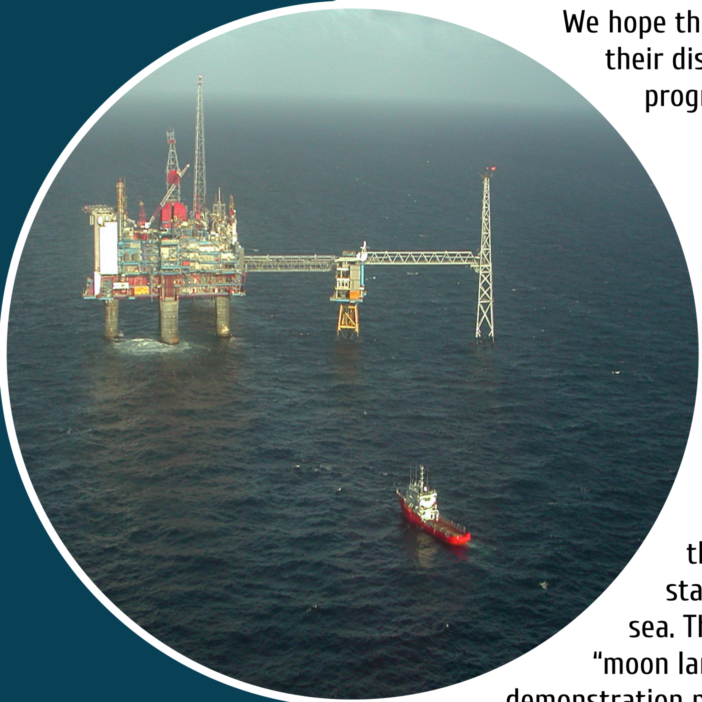
There is a debate in the climate and labor movements about the use of carbon capture as a climate solution. Some maintain that carbon capture is necessary to reduce greenhouse gas emissions. They argue as well that it can be a way to save the jobs of coal miners and fossil-fuel power plant workers and provide power needed for industry while still protecting the climate and that it will create large numbers of jobs. Others say that carbon capture is unproven, costly, problematic for health and the environment, more productive of jobs, and ineffective for climate protection. They argue that renewable energy and energy efficiency are superior both for climate and for workers and communities. They maintain that a transition to fossil-free energy is already underway and that organized labor and the climate movement should take

[1] The White House, "Fact Sheet: President Biden's Leaders Summit on Climate," April 23, 2021.

the lead in ensuring that transition benefits rather than harms workers.

The Labor Network for Sustainability is dedicated to developing strategies for climate protection for workers and their communities. Having been involved with the issue of carbon capture for more than a decade, promoting discussions within the labor movement and publishing evaluations of climate protection strategies. We believe that the use of carbon capture should be determined by scientific evaluation of its full costs and benefits for workers and society. Those include health, safety, environmental, employment, waste disposal, and other social costs and benefits while effectively meeting the targets and timetables necessary to protect the climate. Carbon capture should be used if and only if it provides a means of protecting the climate that is more beneficial to society than other means, such as renewable energy and energy efficiency.

The purpose of this paper is to evaluate how we should determine what role carbon capture should play in our efforts to protect the climate–and ourselves–from devastating climate change while also protecting those who might be adversely affected by those efforts. After reviewing some relevant history and evidence, we make recommendations based on applying our evaluation criteria to the facts. We hope this paper will be useful for labor and climate organizations in their discussions of the role of carbon capture in their climate programs.



Sleipner oil field, North Sea, Norway. Photo: Bair175, Wikimedia Commons

THE HISTORY OF CARBON CAPTURE

Carbon capture is not a new idea or the result of a new technological breakthrough. The idea of carbon capture goes back to soon after global warming was scientifically confirmed.

In 1988, the first Intergovernmental Panel on Climate Change (IPCC) report confirmed that humans are destroying the earth's climate. By 1996, the Sleipner project in Norway started injecting captured carbon dioxide below the floor of the sea. The Prime Minister of Norway described CCS as the country's "moon landing" project. The European Union funded a dozen CCS demonstration projects. The U.S. Department of Energy spent $2.6 billion on carbon capture starting in 2010. In a 2005 report the IPCC asserted that "CCS could contribute 15-55% to the cumulative mitigation effort worldwide until 2100." In 2008 the European Commission said that introducing CCS "may delay the need to reduce levels of fossil fuel use by at least half a century."2

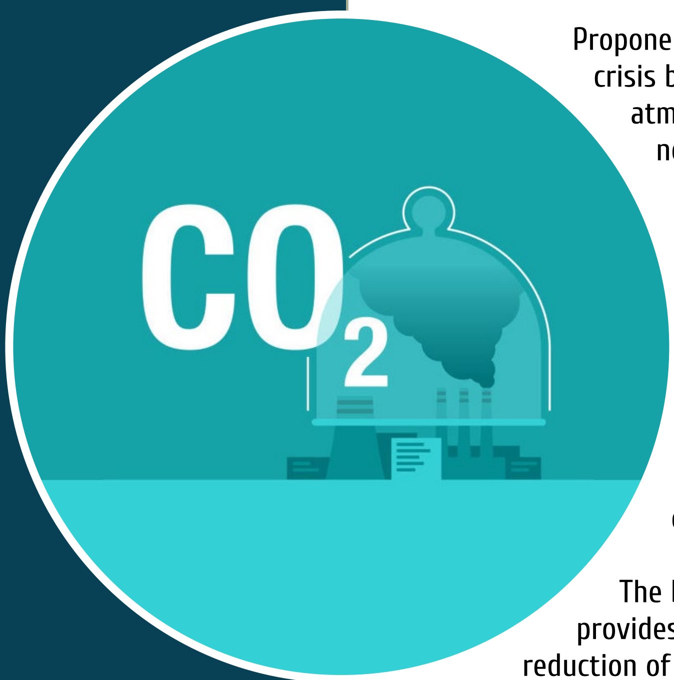
Unfortunately, the rest of the story did not bear out these optimistic expectations. Norway's "moon landing" CCS project was abandoned in 2013 after cost overruns and delays. The three major U.S. projects, FutureGen, Kemper, and Petra Nova, were

[2] "Position: Carbon Capture, Storage and Utilization," Climate Action Network, January 2021, p. 20.

cancelled after cost overruns, delays, and technical problems.[3]

Today there are only 19 carbon capture projects operating worldwide, most of them only at pilot scale and few of them demonstrating the whole of the process from carbon capture to ultimate storage or use.[4] According to the International Energy Agency (IEA), current operational projects are storing only 5 million tons of carbon dioxide per year. By comparison, the IEA's Sustainable Development Scenario calls for 2.8 gigatons by 2050. Despite massive investment, so far such technologies appear to require large amounts of energy themselves and to be costly and largely ineffective for reducing climate-destroying GHGs.[5]

WHY CAPTURE CARBON?



Proponents argue that carbon capture might largely solve the climate crisis by eliminating the release of the major greenhouse gas into the atmosphere. Carbon capture might thereby eliminate possible negative effects of climate protection policies like job loss, community disruption, and economic dislocation.

Even if it is not effective for broad climate protection, carbon capture might provide an effective way to reduce the emissions that are most difficult and costly to remove by renewable energy and energy efficiency.

Carbon capture might save or create jobs both through its own expansion and by making fossil-fuel jobs compatible with climate protection.

The belief that carbon capture will or might be effective now or later provides an argument for those who wish to maintain that rapid reduction of fossil fuel use is unnecessary.

Of course, all of these arguments except for the last depend on carbon capture stopping climate-threatening emissions more effectively, more cheaply, and with fewer negative side effects than alternative means.

[3] CAN, "Position," p. 21.
4 CAN "Position," p. 2.
[5] See CAN "Position."

FREQUENTLY ASKED QUESTIONS ABOUT CARBON CAPTURE

How many coal-fired power plants are there in the U.S where carbon capture is successfully reducing greenhouse gas emissions?

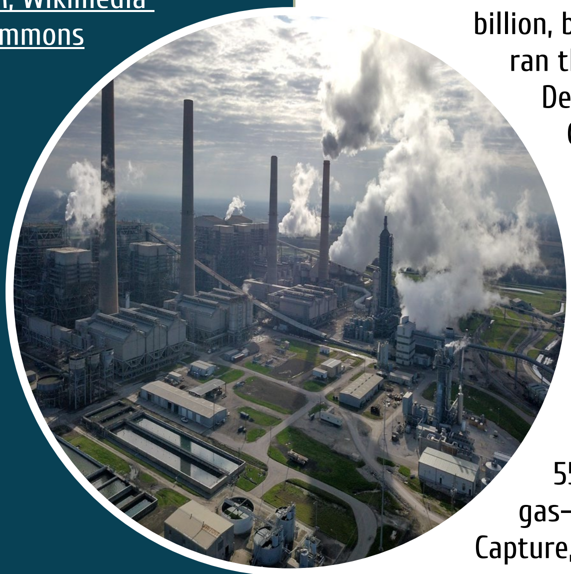
There are none. This February, NRG Energy shut Petra Nova, the only operational coal plant with carbon capture in the U.S. This cost $1 billion (including $190 million from the federal government). It required so much energy to operate that NRG built a completely new gas power plant to produce the electricity for carbon capture and a cooling tower and a water treatment facility to reduce environmental impacts. The GHG emissions from the gas power plant were not captured.[6]

How have other commercial-scale Carbon Capture projects supported by U.S. taxpayers fared?

In 2003, President George W. Bush announced the "FutureGen" project in Illinois to demonstrate the feasibility and effectiveness of carbon capture. The Department of Energy pledged more than $1 billion—more than half the total cost of the project. After serial difficulties, construction began in 2014. In 2015 the federal government suspended the project after spending $378 million on the project.

The Kemper carbon capture project in Mississippi, led by the Southern Company, was intended to demonstrate the benefits of CCS. The project was budgeted to cost $2.4 billion, but costs increased by more than 200% to $7.5 billion and the project ran three years behind schedule. Kemper was suspended in 2017. The Department of Justice has opened an investigation of the Southern Company for reportedly misleading state and federal governments to get more subsidies.[7]

Petra Nova shown on the right. Photo: RM VM, Wikimedia Commons



How effective is carbon capture at reducing GHGs?

Petra Nova was the only carbon capture facility ever to go into operation at commercial scale at a U.S. coal power plant, so we will use it throughout this paper as a unique resource for evaluating carbon capture. At Petra Nova, the carbon capture facility captured 55% of carbon dioxide from the coal power plant. But a whole new gas-fired power plant was built to generate the energy for Carbon Capture, and none of the greenhouse gases from that facility were captured.

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[6] Molly Taft, "The Only Carbon Capture Coal Plant in the U.S. Just Closed," Gizmodo, February 2, 2021.
[7] Ian Urbina, "Piles of Dirty Secrets Behind a "Model" Clean Coal Project," *New York Times*, July 5, 2016. Rachel M. Cohen, "The Environmental Left Is Softening on Carbon Capture Technology. Maybe That's OK," *The Intercept*, September 20, 2019. Steve Wilson, "Two years since Kemper clean coal project ended," *Mississippi Center for Public Policy*, July 17, 2019. For a database of all Carbon Capture projects worldwide see "Facilities Database," *Global CCS Institute.*

So the carbon capture facility actually captured only 34 percent of the carbon burned to produce energy. That leaves aside the "upstream" emissions from mining and processing the coal and natural gas. If they are included the net reduction of carbon dioxide from carbon capture would be 11 percent over 20 years and 20 percent over 100 years.[8]

How much energy does it take to capture carbon?

Current estimates are that carbon capture and storage will add 15-25 percent to the energy required to produce a given amount of energy.[9]

How does the cost of carbon capture for reducing GHG pollution compare to the cost of renewable energy?

A new coal power plant with CCU has about four times the equipment cost of new wind power. The cost per unit of carbon dioxide removed is 39 times over 20 years and 21 times over 100 years.[10] The benefits of solar PV are similar to those of wind.

The total social cost of coal electricity is calculated from equipment cost plus health cost plus climate cost. The total social cost of coal energy produced with natural gas carbon capture is more than twice that of wind or solar replacing coal directly. Indeed, the total social cost of energy produced with coal combined with natural gas carbon capture is 24% higher than coal energy without carbon capture over 20 years and 19% higher over 100 years than energy produced with wind.

When wind replaces coal electricity production the total social cost decreases 43%.[11]

If carbon capture became more efficient, could it compete with renewable energy?

Even if technological improvement allowed 100 percent of carbon to be captured, the total social cost of energy produced with coal and carbon capture would still be more than coal energy without carbon capture.[12]

What are the health impacts of carbon capture?

The health cost of coal emissions in the U.S. is estimated at $80 per megawatt hour. Using natural gas to power carbon capture, the health cost increases about 25% compared with no capture.[13] Since power plants are disproportionately located near

[8] Mark Jacobson, "The Health and Climate Impacts of Carbon Capture and Direct Air Capture," Energy and Environmental Science, 2019, 12.
9 European Environment Agency, "Carbon capture and storage could also impact air pollution," last modified 10 December 2019.
[10] Jacobson, 3569.
[11] Jacobson, 3569.
[12] Jacobson, 3569.
[13] Jacobson, 3569.

low-income communities and communities of color, these communities would bear a disproportionate burden of the resulting sickness and death.

What are the environmental impacts of carbon capture?

To achieve Paris climate goals through carbon capture would require a transportation infrastructure on the scale of today's entire oil and gas pipeline and marine transport networks, with resulting environmental impacts.[14] While properly selected and managed storage sites have a low risk of leakage, there are few guarantees that sites will be managed safely over the hundreds of years that they could leak and the environmental effects of leakage on water, land, and air could be severe.

How secure is the storage for carbon capture?

Both governments and energy companies have a questionable record for maintaining closed facilities with stored fossil fuel products. For example, an investigation by the Associated Press found that oil companies "routinely circumvented" regulations for temporarily abandoned wells. More than 1,000 temporarily abandoned wells in the Gulf of Mexico "lingered in an unfinished condition for more than a decade." State officials estimated that "tens of thousands" of wells were "badly sealed, either because they predate strict regulation or because the operating companies violated the rules."[15]

Are there processes where it is difficult or impossible to reduce GHG emissions and where carbon capture might therefore play a valuable role in climate protection?

The economy includes some products and processes where it is difficult and/or expensive to eliminate GHG emissions using current technologies. These include production of cement, steel, aluminum and other metals, plastics, and chemicals. Carbon Capture is one of a number of technologies that might contribute to reducing their GHG emissions.

The industrial sector produces 27 percent of U.S. GHG emissions. They come from varied sources, including electricity consumption, on-site fossil-fuel burning, and industrial processes. A recent study co-written by a researcher from Chevron evaluated 1,500 industrial facilities for suitability for carbon capture. Seven hundred, producing half of all U.S. industrial emissions, were excluded as "not suitable for carbon capture retrofit." Only 123 of the remaining 656 could capture carbon economically, even with existing federal subsidies and enhanced oil recovery. The study concluded that only 8 percent of all industrial emissions in the U.S. could be economically captured.[16]

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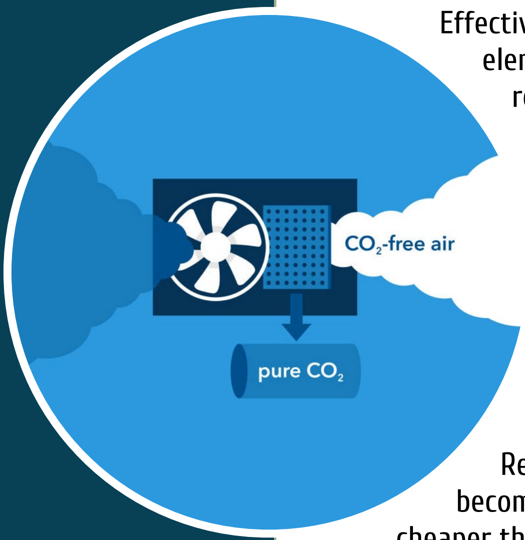
[14] CAN, "Position," p. 3.

[15] CAN, "Position," p. 17. For investigation, see "Gulf awash in 27,000 abandoned wells," AP, July 7, 2010.

[16] Dana Drugmand and Carroll Muffett, "Confronting the myth of carbon-free fossil fuels: Why carbon capture is not a climate solution," Environmental Working Group, April 22, 2021.

Other means of reducing them may include increasing process efficiency, low-GHG processes and materials, new ways of using renewable energy, and increased recycling. In the long run carbon capture might have a role to play in reducing GHG emissions in some of these cases, but its superiority to other possible means has not been demonstrated.[17]

ALTERNATIVES TO CARBON CAPTURE



Effective, job-productive climate protection will involve many different elements that are complementary or even synergistic. Some ways to reduce climate destroying GHGs replace the burning of fossil fuel with other sources of energy. These are primarily renewable sources like solar, wind, geothermal, and waterpower, but they may also include other sources as well. GHG pollution can also be reduced by using energy more efficiently to reduce the amount that is needed. The economic sectors that use the most energy are transportation, electricity, industry, buildings, and agriculture; methods to reduce their use range from insulating houses to powering vehicles by electricity rather than gasoline.

Renewable energy, including solar, wind, and geothermal energy have become much cheaper in recent years, to the point that they are often cheaper than coal and often competitive with oil and natural gas, even disregarding the enormous cost of fossil fuels in health and climate effects. According a recent study by the Goldman School of Public Policy "The U.S.can deliver 90 percent clean, carbon-free electricity nationwide by 2035, dependably, at no extra cost to consumer bills and without the need for new fossil fuel plants" due to plummeting prices for wind, solar and storage.[18]

There are also technologies available or in development to reduce industrial emissions without carbon capture. For production of aluminum for example, 60 percent of carbon emissions could be eliminated by using renewable rather than fossil fuel electricity, according to the World Economic Forum. Fifty-eight percent of U.S. industrial emissions come from burning fossil-fuel to produce heat. Concentrated solar thermal systems can produce temperatures higher than1,000 C., which could replace fossil fuel in heat-intensive processes like cement and aluminum production. For steel, aluminum, petrochemicals, and plastics reuse of existing materials and substitution of climate-safer materials and products can substantially reduce greenhouse gas emissions.[19]

Climate safety can be achieved with existing technology; it does not require waiting

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[17] Jacobson. According to Jacobson's article, "no study has evaluated [carbon capture and storage/use] performance or social cost compared with merely replacing fossil with renewable electricity" prior to Jacobson's article.
[18] "2035 Report: Plummeting Solar, Wind, and Battery Costs Can Accelerate Our Clean Energy Future," Goldman School of Public Policy, June 9, 2020. Silvio Marcacci, "Plunging Renewable Energy Prices Mean U.S. Can Hit 90% Clean Electricity By 2035 - At No Extra Cost," *Forbes*, June 9, 2020.
[19] Dana Drugmand and Carroll Muffett.

for some hoped-for technology of the future. Renewable energy and energy efficiency create far more jobs per dollar invested than either fossil-fuel or high-tech investments like nuclear power or carbon capture and storage. (Because some renewable energy and energy efficiency jobs are currently low paid, it is important to enforce labor rights and standards.[20])

RECOMMENDATIONS

The U.S., along with the rest of the world, is embarking on an unprecedented effort to reduce GHG emissions. While the extent of the necessary reductions has been laid out by climate scientists, specific goals agreed to in the Paris Agreement, and targets and timetable for U.S. GHG reduction laid out by the Biden administration, the strategies and technologies to reach these targets are currently under debate. What role, if any, carbon capture should play in that effort is currently contested.

The following principles should guide the selection of strategies and technologies for climate protection:

- The climate emergency requires an emergency response that reduces GHG emissions at a rate of 6 percent annually starting immediately. Any climate protection plan must include immediate implementation of such reductions.
- Any strategy must be based on scientific evaluation of means and likely effects.
- All impacts, including health, safety, environmental, employment, waste disposal, and other social costs and benefits, must be included in evaluation.
- Costs and benefits must be compared for different strategies and technologies.
- Employment benefits should be evaluated for contribution to creating good jobs for all.

These principles should be applied to all climate protection technologies, including renewable energy, energy efficiency, nuclear energy, and carbon capture.

Applying these principles to carbon capture:

- Priority for investment should go to methods of GHG reduction that can be implemented rapidly over the next decade. Studies indicate that 90 percent of electricity production can be eliminated by 2035 by renewable energy at a lower cost to consumers than fossil-fuel energy. Energy efficiency measures like switching from gasoline to electric cars, converting to energy efficient buildings, and using low-emission agricultural techniques can greatly reduce GHG emissions at a far lower cost and social cost than carbon capture. Carbon capture technologies have little chance of making major reductions in GHG emissions over the next decade and the market cost and social cost of carbon capture is likely to be far higher. Therefore, the priority for climate protection investment should be for conversion to fossil-free renewable energy and energy efficiency, not for carbon capture.

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[20] See for example "Making 'Build Back Better' Better," Labor Network for Sustainability. 2021.

- Possible technological pathways for climate protection should be evaluated for GHG reduction effectiveness, market cost, and social cost including health, safety, waste disposal, pollution, safety, employment. Priority for research and development should go to those technological pathways that offer the best chance of reducing GHGs with the most social benefit and the least social cost. Based on the current low GHG-reduction effectiveness and high market cost of carbon capture, its high health, safety, environmental, waste disposal, and other social costs, and the uncertainty of future improvements, carbon capture is unlikely to receive high evaluation relative to renewable energy and energy efficiency. Research on carbon capture should only be funded if scientific evaluation shows that it provides a better pathway to climate safety than renewable energy and energy efficiency.

- While the first priority for research and development should be for strategies that reduce total GHG emissions at the fastest and most socially beneficial rate, research should also begin on how to reduce GHG emissions in those activities that are difficult to reduce by existing technologies. In particular, some industrial products and processes may meet these criteria. In such cases, pathways for reducing emissions should be evaluated by the principles laid out above: Priority for research and development should go to those technological pathways that offer the best chance of reducing GHGs with the most social benefit and the least social cost. Such evaluation must include the full range of alternatives, including change in use, products, and processes. Research and development for carbon capture technologies should be supported if and only if scientific evaluation establishes that it is the most cost effective and social cost-effective means of reducing GHG emissions for a particular use, product, or process. No funds should be invested in Carbon Capture implementation unless and until research and development have established that it is the most cost effective and social cost-effective means of reducing GHG emissions for a particular use, product, or process.

- Climate protection measures must be carefully planned, sequenced, and phased-in to meet both social and climate needs. In particular, GHG-reduction pathways must include plans for all workers and communities whose livelihoods are adversely affected by climate protection measures. People threatened with job loss as a result of reduction in fossil fuel burning should not expect carbon capture to help protect their jobs any time in the next 10-20 years. There are strong reasons to doubt that it will be either effective or cost competitive in the short run. Those adversely affected by reduction in fossil fuel burning can best protect themselves through managed rather than unmanaged decline in fossil fuel burning combined with vigorous just transition policies.[21]

21 Jeremy Richardson, "Supporting the Nation's Coal Workers and Communities in a Changing Energy Landscape," Union of Concerned Scientists, May 4, 2021.