



 DATA FOR *PROGRESS*

# Advancing Equitable Deployment of Regional DAC Hubs

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# Introduction

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In November 2021, President Joe Biden signed the Infrastructure Investment and Jobs Act (IIJA), allocating an unprecedented amount of funding for improving the nation's infrastructure and ensuring historic investments to protect the country against the detrimental effects of anthropogenic climate change. Among other investments, IIJA set aside \$3.5 billion to create four regional direct air capture (DAC) hubs to aid in carbon dioxide removal (CDR) — drawing past carbon dioxide (CO<sub>2</sub>) emissions out of the atmosphere for permanent storage.

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report suggests that decarbonization is no longer sufficient for meeting the Paris Climate Agreement's goal of keeping global warming below 1.5 degrees Celsius above pre-industrial levels. This means that removing past emissions from the atmosphere is now crucial to achieving international climate goals so long as it doesn't detract from the path toward deep, multisectoral decarbonization. Unlike carbon capture and storage (CCS), which attempts to prevent CO<sub>2</sub> emissions from entering the atmosphere from point-source emissions like power plants, CDR takes legacy emissions out of open air. This means that CDR works to clean up emissions that have already been put in the atmosphere through activities like fossil fuel combustion, although removing past emissions must be paired with the rapid phaseout of fossil fuel use in the first place.

DAC is one approach to carbon dioxide removal, in most cases relying on large fans to push air through a filter that is able to capture CO<sub>2</sub> molecules. Once the filter is full, the CO<sub>2</sub> is extracted and either injected deep underground, turned into rock, or used to create long-lasting building materials. IIJA specifies that each DAC hub must be able to remove at least 1 million tons of CO<sub>2</sub> per year. The “hub” concept implies proximity between the point of CO<sub>2</sub> capture and its storage or utilization site, with a transportation network connecting the two. It is estimated that powering each DAC hub will require between 0.4 and 34 km<sup>2</sup> of land to produce the necessary 270-280 megawatts (MW) of electricity and heat. Given the large land and energy requirements, and the scale of upfront financial investment, DAC should be sited with social and economic considerations in mind.



Suburban Direct Air Capture (Render). Credit: Third Way



Large-Scale Direct Air Capture Hub (Render). Credit: Third Way

Under IIJA, the Department of Energy (DOE) must prioritize project applications for areas with economic reliance on the fossil fuel industry and economic opportunity zones, along with proximity to low-carbon electricity and CO2 storage opportunities. Given DOE's mandate to prioritize applications for economic opportunity zones, which are areas identified by the IRS where developers are offered tax benefits to “spur economic growth and job creation in low-income communities,” it is likely that some or all of the sites will have large shares of Black, Indigenous, and people of color (BIPOC) populations, along with those of lower socioeconomic status (SES). The U.S. has a long history of unjust infrastructure siting in environmental justice communities, which are too often excluded from industrial decision-making processes that directly affect them. While DAC hubs can provide global benefits — such as reduced atmospheric CO2 concentrations and associated impacts of climate repair — it is important to consider how these hubs might be able to contribute to a broader movement of centering the voices and needs of marginalized and low SES communities in the development of large-scale infrastructure projects.

Despite the importance of community buy-in, little public opinion research exists on what voters and specific communities think about DAC, and CDR more broadly. Data for Progress worked to fill this gap by conducting community workshops across the country in partnership with local community-based organizations and researchers at Stanford University. Our early efforts to support community-first climate infrastructure on the ground focuses on DAC hubs given their climate potential, the scale of recent federal investment, and the DOE's intention to grant funds for implementation this year. In this work, we are looking to set a new precedent for project development, particularly the development of climate innovation projects, by engaging communities before projects begin in a meaningful and iterative way.

A key point of the workshops is asking community members for their perspectives directly, rather than assuming what they want or believe. During our workshops, we give community members the opportunity to voice their ideas about local benefits and points of contention surrounding a prospective DAC hub in their community, compensating them for their time and expertise, and amplifying their perspectives to decision-makers in our post-workshop engagement. We also invite environmental justice and environmental organizations to attend, as these are often the groups that are most engaged in — and thus best informed on — local climate issues. In addition to providing information about potential benefits and risks of DAC, we aim to equip communities with information on how to negotiate infrastructural development more broadly to meet their needs. In particular, we present information on community benefits agreements (CBAs), which have allowed communities to negotiate with developers to ensure project benefits are shared equitably. As legally binding agreements, CBAs can benefit both the community and the project developer by clearly defining expectations and timelines for engagement.

To date, we have conducted four community DAC workshops, in East Houston, Texas; Beaver County, Pennsylvania; Bakersfield, California; and Rock Springs, Wyoming. Our goal was not to convince participants to support the development of a DAC hub, but rather to understand community needs, concerns, and support or opposition for a potential DAC hub in their community, and then to amplify these findings in decision-making processes. After being provided an overview of DAC hubs, including potential opportunities and risks, participants broke up into small groups to discuss what a DAC hub might look like in their community, what their preferences for such a project would be, how they think their community would respond, and how they might use a CBA to negotiate local benefits like jobs, social services, and improvements to infrastructure like roads and sanitation, among others.

In addition to collecting a combination of qualitative and quantitative data through the four workshops, we supplemented our findings with a national survey to assess Americans’ attitudes toward DAC and climate infrastructure developments. High-level methodology and results for both of these components are detailed in this memo, complemented by an academic article currently in preprint. In the sections to come, we explore community histories and insights for DAC deployment. While these are only snapshots of vibrant, complex communities, we hope they are able to shed light on the kinds of concerns and opportunities that diverse communities may identify in DAC.

## Site Selection

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Data for Progress selected East Houston, Beaver County, Bakersfield, and Rock Springs as workshop sites because they fit the criteria set forth by Congress for the DOE’s selection of DAC hub applications: access to geological storage reservoirs for CO<sub>2</sub>, ongoing economic reliance on the fossil fuel industry, proximity to low-carbon electricity sources, and location within economic opportunity zones. However, given the histories of these four sites, the characteristics that make East Houston, Beaver County, Bakersfield, and Rock Springs attractive sites for DAC in the federal government’s eyes are the same characteristics that may make these communities particularly skeptical about DAC. Each community has experienced the downside of extractive industries, such as unfulfilled promises of jobs and community benefits, as well as the unclear or detrimental environmental impacts. Beyond these similarities, however, each workshop offers new insights on how — and whether — to implement DAC in their communities.

### EAST HOUSTON, TEXAS

The eastern portion of Houston has a long history with industry, as the city is home to the largest petrochemical corridor in the country. The city is interspersed with railroad lines and truck routes that carry oil, natural gas, raw materials, and plastic in and out of the city. The majority of industry is concentrated along the port of Houston, where barges and boats connect different parts of the oil, gas, and petrochemical supply chain. Houston is often called the “Energy Capital of the World,” and many residents recognize the role of oil and gas in building the city and providing good-paying, union jobs. Yet, many also recognize the environmental and human health harms from industry, including elevated cancer rates and poor air quality, particularly in communities of color and low SES areas. These communities are disproportionately located near industrial facilities due to racist policies like redlining and Houston’s lack of zoning laws, which enable industrial facilities to locate in residential areas.

One study found that children living within 2 miles of the heavily industrialized Houston Ship Channel face a 56 percent greater risk of leukemia, and another study documented elevated levels of cancer-causing formaldehyde along the ship channel as well. Low-income communities of color are most likely to live near the ship channel and, as a result, are most affected by pollution from facilities along the channel. Environmental advocates have documented the frequency with which industrial facilities in Houston violate their air and water permits, and the lack of enforcement of clean air and water laws by the state environmental agency, the Texas Commission on Environmental Quality (TCEQ). When hurricanes or winter storms hit, the same facilities can release thousands of pounds of pollution when shutting down or restarting operations.

Moreover, like in many cities, highways have segregated the city and displaced BIPOC communities, including historically Black communities like the Fifth Ward, the neighborhood in which our workshop was conducted. After the Civil War, freed slaves settled the area, and to this day, many people live in the homes that their grandparents and other ancestors once occupied. Fifth Ward residents and other Houstonians are currently fighting the expansion of Interstate Highway 45. If done without adequate consideration of community needs, a prospective DAC project runs the risk of replicating past infrastructure project harms like displacing residents from their homes, further entrenching Houston's reliance on cars and highways, and worsening the climate and air quality impacts that accompany them.

On the whole, Houston is heralded as the most diverse city in the U.S., with around 1 in 4 Houstonians born outside of the U.S. and 145 languages spoken within city limits. According to the 2020 U.S. Census, Houston is home to 2.3 million people, around 47 percent of whom are white, 23 percent are Black, 45 percent are Latino, and 7 percent are Asian. The median household income in Houston is \$53,000, but, as workshop attendees repeatedly shared, Houston is expansive, and the differences and disparities from neighborhood to neighborhood can be significant. In the Southampton neighborhood near Rice University, for example, the median household income is \$184,000, whereas in the Fifth Ward (where we conducted our workshop), the median household income is \$32,000.

## BEAVER COUNTY, PENNSYLVANIA

Beaver County, which stretches from the Ohio border to the outskirts of Pittsburgh, is home to over 160,000 people. Ninety percent of Beaver County residents are white, 7 percent are Black, and 2 percent are Latino. Residents make a median income of \$59,000 per year. Situated in the Marcellus Shale region, Beaver County residents have historically been employed in the steel industry and, more recently, the oil and gas industry. After the collapse of the Pennsylvania steel industry in the 1970s, many manufacturing and steel jobs in the region moved overseas. Now Pittsburgh's primary industries are finance, education, healthcare, and technology.

The Beaver Valley Nuclear Power Station lies about 11 miles southwest of Beaver, Pennsylvania. The power station's two nuclear reactors can generate enough energy to power 1.5 million homes in the region, and are a major source of clean power in the state. In 2018, First Energy announced that the plant was expected to close in 2021 if the plant was not sold or if it didn't receive financial support from the Pennsylvania Legislature, given the power plant's poor finances. However, after Pennsylvania Governor Tom Wolf decided to join the Regional Greenhouse Gas Initiative (RGGI), demand for clean energy in the state increased and FirstEnergy decided to keep the power station open. During the workshop, multiple participants mentioned the Beaver Valley Power Station, and nuclear generally, as a potential energy source for DAC.

In Beaver County, downstream oil and gas processing and refining facilities followed the Marcellus Shale boom, including a Shell petrochemical complex opened in 2022, to which community members expressed mixed reactions. Some were hopeful that Shell would fulfill its promises of economic revitalization and jobs despite historically failing to do so. Others were wary of Shell's promises, even fleeing the region due to fears of potential environmental and health harms from the plant. Citizen scientists are already monitoring the nearby Ohio River for nurdles, small plastic pellets produced by the facility that are later turned into other plastic materials.

Despite ongoing challenges with discolored water in the borough of Industry, and flaring emissions from the new Shell plant in Potter Township, Pittsburgh's mayor is still eying the region for fossil fuel projects, including blue hydrogen (hydrogen produced from natural gas) and fossil fuel combustion with carbon capture and storage. Citizens' concern over the threat of more fossil fuel projects has led to broader skepticism of industrial projects that could resemble the projects that have been forced upon them. Concerns around water quality are also notable in Bakersfield and other regions in California's Central Valley.

## BAKERSFIELD, CALIFORNIA

Bakersfield is located in Kern County, about 100 miles northeast of Los Angeles, at the base of the Central Valley. According to the U.S. Geological Survey, the Central Valley is one of the main agricultural producers in the U.S., producing a quarter of the nation's food, including 40 percent of the fruits and nuts consumed. The rich, fertile land in the Central Valley is able to grow more than 250 different crops with an estimated value of \$17 billion per year. Over 400,000 people call Bakersfield home, and about 50 percent are Latino, 7 percent are Black, 7 percent are Asian, and about 30 percent are white, according to 2020 U.S. Census data. The same data also shows that 63 percent of the civilians participate in the workforce, and the 2020 median household income was about \$65,000. Moreover, Kern is home to approximately 70,000 undocumented people who lack a voice and representation despite their critical work in agriculture, oil and gas, construction, and other industries. Most undocumented people in Kern County are Latino and many are primarily Spanish speakers who may face additional barriers due to language isolation.

Agriculture and oil and gas are two of the region's major industries, and in 2019, Kern County was the leading oil-producing county in California and the seventh largest oil-producing county in the country. Notably, carbon capture and storage (CCS) technologies have been proposed in Kern County in the past and were opposed by local residents and environmental justice groups. And currently, a \$100 billion carbon management business park focusing on CCS is proposed within the county. Although carbon capture and CDR are different technologies, they are often conflated, and engagement must differentiate between them while understanding the unique community concerns around each technology.

While these industries built Bakersfield into the city it is today, workshop participants were quick to point out the environmental degradation and human health consequences they have brought as well. Though these consequences impact nearly all residents of Bakersfield and the broader Central Valley, the burden falls especially on low-income communities and communities of color. The air impacts of the oil and gas industry have been especially harmful. One study found that Californians living within 2.5 miles of an oil and gas well experienced higher than average levels of particulate matter, nitrous oxide, ozone, and volatile organic compounds — chemicals that can cause asthma, cancer, cardiovascular disease, and preterm birth. Home to 78 percent of the state's active wells, Kern County particularly bears the brunt of oil and gas pollution in the state. In fact, lung cancer was found to be the leading cause of death in Kern County between 2015 and 2017, particularly among people of color.

Pesticide application and unsustainable farming practices have contaminated drinking water in the area and strained water resources. The Central Valley depends on a functioning irrigation system to maintain the land, and droughts have put a massive strain on many households and farms in the area. The 2021 drought caused communities to incur \$1.7 billion in costs and led to the loss of over 14,000 jobs. These issues, coupled with climate change, are a growing problem that continues to affect the agriculture

production that the nation depends on. Climate change is bringing increasingly severe and frequent heat waves and droughts to Kern County, creating dusty conditions, exacerbating air quality that consistently ranks as the worst in the U.S., and threatening human health, especially that of vulnerable populations, like the elderly and those who labor outside, including farmworkers. Valley fever — a fungal infection — is also on the rise with climate change, and outdoor laborers are particularly vulnerable to its spores that are released from the soil into the air. And these issues extend to other Western states, including Wyoming — the location of our fourth and final workshop.

## ROCK SPRINGS, WYOMING

Rock Springs is a city of over 20,000 people, located in Sweetwater County in the southwestern corner of Wyoming. According to the most recent census, about 85 percent of Rock Springs residents identify as white, 15 percent as Latino, 2 percent as Black, 1 percent as Asian, and 1 percent as Indigenous. The median income in Rock Springs is around \$74,000, and mining, oil and gas, healthcare, retail, and education are the largest industries.

Rock Springs was built on coal. Its first coal mine opened in 1868, with many more opening soon after, as the newly built transcontinental railroad, along with rich local deposits of coal, fueled the growth of both the industry and the city. At one point, at least 130 coal mines operated in Sweetwater County. Throughout its history, Rock Springs experienced cycles of boom and bust due to its fossil fuel-based economy. During the 1970s, coal, oil, gas, and trona (used to make glass, paper, and other outputs) were booming. But in the 1980s, both the price of oil and demand for trona declined, leading to the loss of thousands of jobs in these industries. In the early 2000s, a natural gas boom came to Rock Springs with the evolution of new drilling technologies. Since that time, however, the coal industry in Rock Springs has largely been in decline. Wyoming remains the United States' leading producer of coal, however, and coal remains central to Rock Springs' identity. For example, the Rock Springs Coal sign, first erected in 1929, still stands tall over Main Street. And the Jim Bridger power plant — built in 1974 during the boom — continues to run, but talks about the plant's eventual retirement have been ongoing. Now, Wyoming is poised to use its "high energy IQ" to diversify its energy economy, but not everyone is excited about the potential transition.

During the workshop, participants recognized the role of coal, oil, and natural gas in building Rock Springs into what it is today. Some noted the boom-and-bust nature of the industries, reflecting on the decline of the coal industry since the early 2000s and the transformation of Rock Springs during the urban renewal era of the 1970s, when strip malls and hotels were constructed by the highway and businesses in the historic downtown were boarded up. Recent efforts in Rock Springs aim to revitalize the downtown and bring people back to it.

Some workshop participants were skeptical of a new industry's ability to bring the quality and quantity of jobs that coal and oil and gas have brought, reflecting statewide sentiments toward climate and clean energy jobs, but most recognized a need for investment and economic diversification in Rock Springs in order to keep residents, especially young people, from leaving. Many voiced their love for the pace and quality of life in Rock Springs — a quiet, smaller city situated within the wide-open landscape of Wyoming — and expressed a desire for any new industry to fit into the existing culture and environment.

# Workshop Methodology

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Following site selection for each workshop, workshop venues were then selected in consultation with local and state partners. Venues were prioritized for their size, technological capabilities, proximity to the city center, and cultural significance to the community. Each workshop was held in a local university, community recreational space, or conference room.

Workshop participants were recruited using a dual recruitment strategy: The majority of participants were recruited via local recruitment firms in each locality, which prioritized recruiting a demographically representative subset of each community. Data for Progress wrote a screener to ensure representative demography and additional participation from key groups, such as those with close ties to the oil and gas industry and environmentalists. Other participants were recruited to represent local environmental justice and community activist perspectives, and were contacted via connections through local, state, and national partners. Each workshop consisted of roughly 15-20 participants.

Workshop participants were compensated for their time and expertise, at \$125 per hour, amounting to \$375 per attendee. In addition to the labor contributed to the workshop, this compensation was intended to cover transportation, gas, childcare, and parking. Participants were also provided with lunch and refreshments throughout the duration of the workshop.

These community workshops were three hours in length and consisted of the following format:

## **SECTION 1 INTRODUCTION AND PRE-WORKSHOP SURVEY (15 MINUTES)**

Participants each introduced themselves and completed a pre-workshop survey which served as a baseline to assess each participant's understanding of and support for CDR, DAC, and CBAs.

## **SECTION 2 PRESENTATION ABOUT CDR, DAC, AND CBAS (30 MINUTES)**

The Data for Progress team gave high-level background information on CDR pathways and technologies (namely DAC), their various community impacts, investments to date, and leading DAC companies.

## **LUNCH AND Q&A (30 MINUTES)**

Participants were provided with lunch and the opportunity to ask technical questions about CDR and DAC.

## **SECTION 3 GROUP DISCUSSIONS (1 HOUR 15 MINUTES):**

Participants were divided into small groups (4-6 participants per group) to discuss the ideal configuration of, and location for, a DAC hub in their community. Groups also discussed prospective provisions for community benefits agreements for a regional DAC hub in their area.

## **SECTION 4 GROUP PRESENTATIONS (20 MINUTES):**

Small groups reconvened and one participant from each group shared out a summary from each discussion.

## **SECTION 5 SYNTHESIS AND POST-WORKSHOP SURVEY (10 MINUTES):**

The Data for Progress team synthesized and verbally confirmed points of discussion raised during small-group discussions. Workshop participants completed a post-workshop survey to track differences in initial perceptions of CDR, DAC, and CBAs, and the overall shift post-discussion. Participants were provided with contact information to follow up with additional questions and comments.

For the duration of each workshop, participants shared parallel insights on the need to engage communities early and often in order to ensure equitable development of DAC and other emergent industries, and ensure local benefits. Perspectives on how specifically to deploy DAC hubs, and whether they should be deployed in the first place, varied among the four workshop sites.

## Workshop Findings

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### EAST HOUSTON, TEXAS

Workshop participants from East Houston cited a number of concerns with existing infrastructure as they envisioned what a DAC hub in their vicinity might look like and how they might use a tool like a CBA to address these concerns. In particular, participants identified the disruption that freight railroads had imposed on residents of the Fifth Ward: making commutes long and unpredictable, and leading to disruption in services like education and emergency response. In a car-reliant city like Houston that has limited access to public transit, such disruptions are a serious concern. Residents therefore identified the need to prevent additional rail traffic disruptions to commutes. One community member from an environmental justice organization also raised concerns about truck traffic in the construction phases and the potential for additional air pollution. The area already deals with pollution from heavy transport networks and, especially, the industrial facilities these networks connect, including fossil fuels, cement, and other pollutive sectors. Residents cited multiple sources of pollution, including facilities that were linked to high rates of cancer:

*“Right across from here, we had the Maxwell Plant, and we had the emissions plants that were right over by the train tracks that are now in litigation for cancer-causing agents in this community. And so when you talk about communities, you need to be specific, and you need to be concerned about what is the track record of what has happened before, you know.”*

— East Houston workshop participant

An equitable project would take into consideration past harms like these, community members said, and carefully characterize and mitigate any risks associated with the construction and operation of the DAC hub.

Residents discussed where the facility might be sited within or around East Houston, identifying challenges with siting it in densely populated parts of the city. While some participants proposed siting a potential DAC hub in an existing industrial park to avoid adding noise or changing the aesthetics in more residential areas, others worried that the jobs a DAC hub might create wouldn't be sufficiently alluring for fossil fuel workers given high wages in that sector. Were it to be on the outskirts, however, they wanted to ensure that the communities nearby would be the ones to benefit most directly. Many raised related questions of fairness. In the words of one participant:

*“Overall, I think my opinion is kind of like, this is obviously a good thing. That's not the question. The question is how to ensure that the impact that has is actually, 1) managed well, and 2) felt by the right people. I don't know how you do that.”*

— East Houston workshop participant

Intertwined with fairness was the need for project transparency, both in planning and implementation. Residents expressed low levels of trust in local officials, citing corruption and infighting as barriers to the municipality leading the effort. “I’d be very worried about doing something like that in a place like Houston,” one participant voiced, “because I can just see all this money getting divvied up into things totally unrelated.” Instead, participants identified civil society organizations like faith-based and advocacy groups as trusted, knowledgeable community leaders that could democratically collect community input on a potential project and relay it to project developers. Participants were keen to advocate for a community benefits agreement that centered labor considerations, and pointed to civil society organizations as being best positioned to democratically determine what it should include:

*“That’s why the community liaisons are so important, because they know where to reach people. And it won’t be just places like press conferences, or like City Hall hearings, it’s going to be showing up at like food bank distributions or showing up at like church gatherings or, I think, the coalition of churches that somebody brought up earlier, and really meeting people where they’re at, at community events where they’re already receiving either support or other information, and not expecting community members to come to them to like informational sessions that they might not even be aware about, might not be able to make it or it might not be accessible to them.”*

— East Houston workshop participant

Overall, residents expressed greater interest in modular DAC facilities that could either be integrated into the landscape in ways that a single, larger facility could not, or else increased in size as smaller-scale designs proved effective. If the latter, however, community members wanted to discuss the possibility of expansion ahead of breaking ground, worried that they might be cut out of the process down the road. The possibility of a more diffuse network of smaller DAC modules also raised concerns about transporting the CO<sub>2</sub> to centralized injection and storage sites. One member of a local environmental justice organization voiced concern that if the particular DAC design wasn’t thoroughly tested and found to be safe, such a design might simply spread risk to more communities:

*“I wonder if...we would have greater risk of contaminating more communities if we have them spread out in urban areas, as opposed to like, set aside on a random plot of land so they can keep the underground pipelines away from communities.”*

— East Houston workshop participant

Members of environmental justice organizations raised concerns about the safety of pipelines, agreeing that they would advocate that any potential project in the Houston area not be associated with new pipelines, given oil and gas pipelines’ existing harms to fenceline communities — primarily Black, Brown, and low-income residents. There was agreement that if pipelines were to be sited in East Houston, these same communities would have to shoulder the burden:

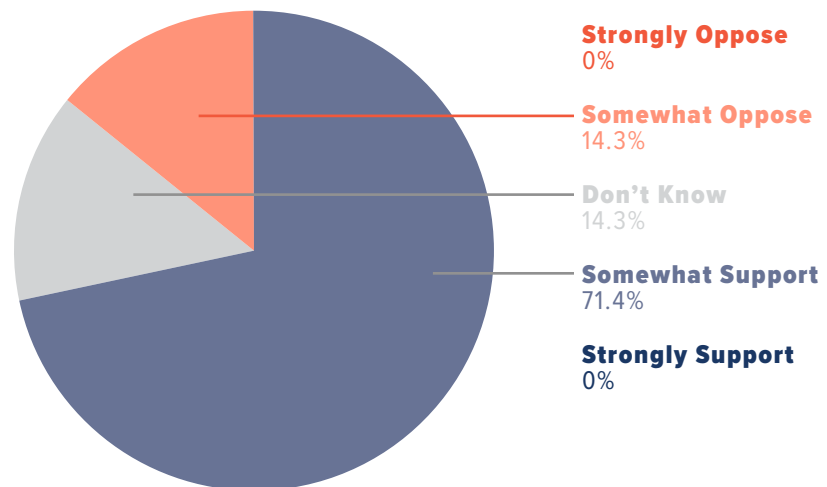
*“I can’t imagine anything else other than it’s going to go directly through our community. And then how are they going to impact, not just leakage but explosions?”*

— East Houston workshop participant

Across discussion groups, preference for on-site storage was expressed in order to limit or even eliminate the need for CO<sub>2</sub> transport. There was also a preference, especially among environmental justice advocates and those who cited climate as a motivating issue, to rely exclusively on renewable energy to power the DAC hub. Criteria pollution from fossil energy was an especially strong concern among environmental justice organization members participating in the workshop.

Despite siting concerns, 71 percent of workshop participants indicated that, under the right conditions, they believe their communities would be supportive of hosting a DAC hub, with 14 percent unsure and 14 percent opposed — numbers that reflect the best-case scenario for DAC deployment. The conditions, as described above, included strong community participation and clear, enforceable benefits like affordable housing and green spaces, renewable energy sources, and on-site storage, among others.

**Overall, do you think people in your community would approve or disapprove of a direct air capture project being built in or near your community?**



Where Houston had some of the highest rates of interest in a potential DAC hub, Beaver County had some of the lowest, drawing on its recent history with fracking and petrochemicals.

## BEAVER COUNTY, PENNSYLVANIA

Beaver County residents take pride in the history of their community, which produced the steel used to build the world we know today, but many also recognize the environmental costs and false promises that came with the steel industry. Residents have been promised jobs, economic revitalization, and environmental stewardship by industries and politicians, but these promises often haven't come true. These themes were central to the discussion of a prospective DAC hub.

There was initial skepticism from Beaver County residents about what the benefits of a DAC hub were when not viewed through the lens of climate change. Participants questioned how the various proposed ownership models would appeal without an obvious revenue stream, or what benefits the hub would bring to their community outside of any benefits negotiated via the CBA. Beaver County residents questioned why their community would host a DAC hub if the carbon removal benefits wouldn't necessarily be felt locally.

On one hand, community members expressed a clear ethos of industrial leadership, and the desire to reassert this leadership through emerging sectors like carbon removal. Some workshop participants were excited by the idea of hosting one of the first large-scale DAC facilities in the U.S. to demonstrate their potential for effective scale-up. As one participant said:

*“And I think it could be a really good opportunity for us to essentially be a role model. The goal was to have more by 2050, have them be more prevalent, and so, the fact that we are potentially in consideration of being one of the first ones, I think could be a really great thing for building up our community.”*

— Beaver County workshop participant

There was also discussion about how Beaver County could learn from its history with industrial boom-and-bust cycles, and their effects on communities and their workforces. These experiences could shed light on how to actively and transparently address project risks in service of creating a positive example for the carbon removal industry. Participants were prompted to think about how they might negotiate with a developer to shape a project that would best meet community needs, for example, through a community benefits agreement. Community members agreed that a core focus of a potential CBA would be mechanisms to support the longevity of the relationship with the community, like long-term job guarantees and services paid out over time, and to increase transparency of potential risks and risk mitigation.

*“[O]ne of the goals in the CBA also can be to be a role model...if you’re thinking about creating these projects across the country, and say, there’s a certain safety concern you have, right, you can, you can build that into the CBA, to try and set the tone for all the other projects, right, like, then hopefully, the other ones that will be built will factor in that same safety concern that you all have here.. It could be whatever you all want. But I do think, yeah, there’s a real first-mover advantage to potentially setting up a CBA with everything that you want in it.”*

— Beaver County workshop participant

This approach of learning by doing led residents to propose a more modular design to a potential DAC hub, beginning with a few units and building up from there.

*“I don’t know, like something to store in this big giant thing and seems like a big undertaking versus maybe starting smaller and building...Yeah, because what if you start running into all these problems, and you can’t anticipate everything? Just start small and build into the others, as you see that you have success.”*

— Beaver County workshop participant

Residents also identified a significant need in the area for supportive physical and social infrastructure for such a project. In particular, residents cited poor road quality, which they worried would worsen with increased truck traffic during the construction phases of a DAC hub.

*“There are so many terrible roads around here. We need some roads fixed...If we’re gonna have this here, then why can’t some of the profit, or whatever that comes out of this, help the actual community? We need to build up some more businesses or roads, things like that.”*

— Beaver County workshop participant

Residents also pointed to the area’s underperforming healthcare system as a barrier to attracting young people who might establish themselves in Beaver County and therefore counteract the trend of an aging population. Young families, they said, wanted to move to the cities to find economic opportunities and social services that just didn’t exist in Beaver anymore.

While healthcare access was important, mental health care specifically was critical. Many residents had stories of friends or loved ones who had gone through mental health crises without access to help. While there was recognition that a DAC hub itself couldn't address mental illness, there was hope that an investment at that scale could allow residents to bargain for mental health services as auxiliary benefits.

Despite these hopes for a Beaver County hub, there was significant skepticism toward the idea. Many cited previous experiences with industries that had come into the community but not delivered local jobs; instead, those jobs had gone to workers from outside the community. There was therefore low trust that benefits, specifically labor benefits, would actually deliver.

■ *"If it's anything like the cracker plant, most of the jobs are going to Texas...it's not going to supply the local industry of jobs. You know what I mean? A majority of people working on the plant are from Texas, so how is that going to help bring jobs to this area?"*

— Beaver County workshop participant

There was also skepticism about the project itself: its financial model, its overall utility, and its potential impacts on local infrastructure. Even when provided with answers to technical questions, many residents simply didn't feel like they had the expertise to be able to support a project. As a result, they leaned against the idea of continuing discussions about a potential DAC hub.

■ *"I'm very skeptical about it. It doesn't make sense to me, and how it's going to operate, and the funding and all of that, it just doesn't add up. There are too many gray areas right now that don't make sense to me."*

— Beaver County workshop participant

Concerns about increased traffic arose in each discussion group, as did potential effects on the electricity grid and, by extension, on energy bills. There was agreement that any project that raised energy prices would be a tough sell in the community. However, if a project could bring with it additional energy resources, that could be a net positive.

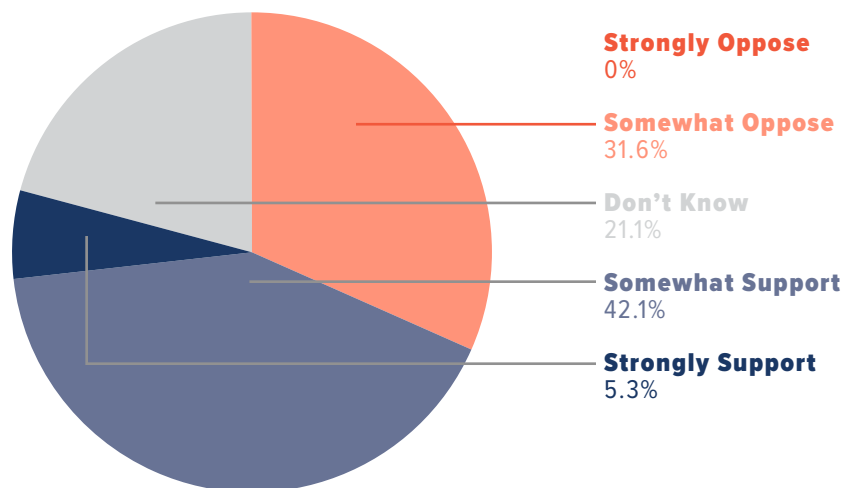
■ *"I lean towards the wind, solar energy. I think that there could be potential other benefits adding those locally, adding wind turbines locally, and I think there probably is plenty of space...we just need to figure that out."*

— Beaver County workshop participant

Overall, while many workshop participants were able to identify ways in which a DAC hub might be beneficial to the community were it to follow their guidance, they still expressed doubt that a DAC hub would be a good fit for the community. The recent and ongoing fracking booms in the area had brought with them new infrastructure like pipelines and drill sites, and had left many community members feeling mistrustful of any new industry. There was especially strong opposition to any form of pipeline from participants involved with local environmental groups.

Where the Houston workshop saw a clear majority of participants in favor of the construction of a local DAC hub, less than half of participants (47 percent) in Beaver County believed their community would strongly support or support such a project, with almost one-third (32 percent) expecting outright opposition and 21 percent indifference or uncertainty.

Overall, do you think people in your community would approve or disapprove of a direct air capture project being built in or near your community?



Such a site might therefore be a more contentious choice among local residents, thus lowering the potential for a fruitful DAC project. Bakersfield workshop participants offered a more optimistic view on the potential for a local DAC hub despite experiences with industry akin to those of Beaver County.

## BAKERSFIELD, CALIFORNIA

Bakersfield residents are no strangers to industry, which has not only provided jobs for the town but was also a source of high levels of pollution. The agricultural and fossil fuel industries in particular play a large role in Bakersfield, with one resident noting that it sometimes felt like they acted in place of the local government in city affairs. “Chevron and Aera Energy own this town,” stated one participant at the beginning of the discussion. While they weren’t opposed to new industry, workshop participants warned that a DAC hub would have to be done differently to secure community buy-in — folks across political parties, class, racial and ethnic identities, and age groups were fed up with large pollutive industries calling the shots.

With environmental harms highly visible in Bakersfield, the prospect of an industry that could help the environment was a source of excitement for many. As one resident noted:

**I feel this is something that is long overdue. We really need to think about the air or we won’t have an Earth inhabited by us.”**

— Bakersfield workshop participant

Some residents were frustrated, however, that fenceline communities (those living proximate to polluting industries) like theirs always seemed to be the first choice for new industrial projects. They voiced skepticism that it would be any different with a DAC hub, with one participant saying, “Why is it always in poor areas? We’re always the ones to be experimented on.” The only way a DAC project could be different is if it had active involvement and oversight from the community — this was a point of consensus among Bakersfield community members. Many also agreed that involving the companies with outsized power over the town — namely, Chevron and Aera Energy — would be a red line for them. Similarly, there were several expressions of mistrust in local elected officials, whom community members perceived to be doing the bidding of big industry while ignoring the concerns and needs of local residents.

Rather, most participants agreed that the community should exert direct control over any potential DAC hub project, aided by trusted experts. There were several suggestions of engaging the Bakersfield Community College and California State University systems to help with specific siting and risk mitigation questions. Research from large industry actors was perceived to be less trustworthy. This was also true for academic research funded by these same industry actors. One environmental justice leader said:

*“We can’t keep the status quo. We’ve had Aera Energy, Occidental, Chevron who’ve known about the problem. Now that the federal government is unloading all this money, now they want to participate? They knew about the harm they were doing to the planet decades and decades ago — they funded their own research. And so we see universities like Stanford now at the forefront of this and we also see that money from oil and gas corporations goes to their research departments, and their research is saying, ‘This is all gravy, baby!’ So I think there definitely needs to be this conflict of interest conversation.”*

— Bakersfield workshop participant

Another workshop participant added:

*“They [oil and gas companies] aren’t going to give you the information that you need, they’re not going to try to do anything that interferes with what they have going on. They’re not going to give us the correct information, so I can’t trust them.”*

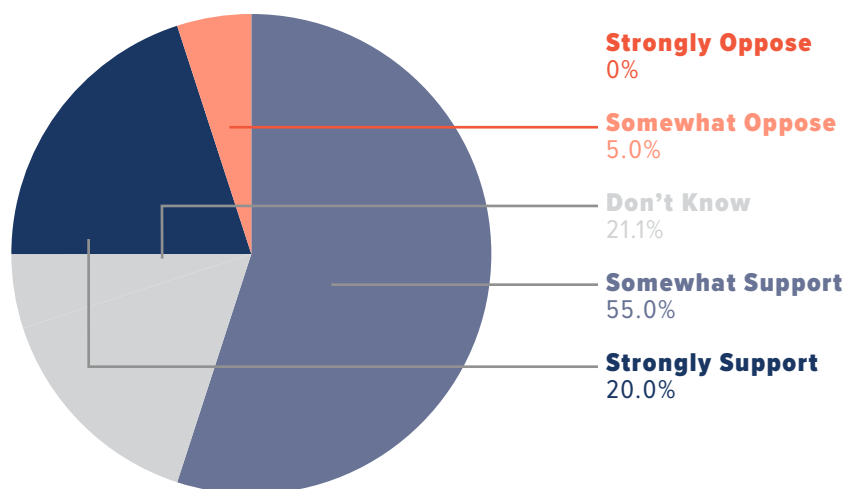
— Bakersfield workshop participant

In partnership with locally trusted academic and public sector sources, participants identified opportunities for a community-led and potentially community-owned DAC hub. Such a project would have to emerge from ongoing discussions in which community members, advocacy and community-based organizations, and small businesses had meaningful decision-making power to shape planning, construction, implementation, and decommissioning stages. Accountability and transparency would be key, participants said, and there would have to be assurances that local jobs and other benefits would actually be delivered. “We shouldn’t get the brunt of the burden without getting the job benefits,” one participant said.

All discussion groups said that any DAC hub in Bakersfield would need to be renewably powered and sensitive to the region’s ongoing drought crisis. A local DAC hub could not have large freshwater needs; rather, the design of the project would need to draw on the region’s resource strengths, namely renewable energy potential, without exacerbating existing challenges. Further, the project would ideally contribute to other parts of the local economy, too. Bakersfield produces building materials, so residents pointed out that the construction of DAC should rely as much as possible on those local materials, both for local economic gain and in service of project sustainability (by minimizing the transportation of heavy materials, which is typically carbon-intensive). Finally, there was interest in using the CO<sub>2</sub> itself to contribute to local industries. The most popular storage pathway for the captured CO<sub>2</sub> was in long-lived building materials, which could then be sold for additional local profits. If this weren’t a possibility, or led to leakage, the second-most popular option would be underground mineralization. “We’d like to see the CO<sub>2</sub> mineralized and used for other materials and possibly another way for more job opportunity,” said one resident.

Overall, Bakersfield residents responded with the highest levels of support for a potential local DAC hub, with 75 percent believing that people in their community would either strongly support or somewhat support a project that followed the community-driven guidelines discussed. Twenty percent of participants remained indifferent or unsure, and only 5 percent indicated that they thought community members would oppose such a project.

**Overall, do you think people in your community would approve or disapprove of a direct air capture project being built in or near your community?**



A successful DAC hub in the Bakersfield area would need to: be transparent (both regarding how community input is being considered and prospective environmental impacts), guarantee local jobs, be renewably powered, and not be water-intensive given the region's water constraints. Rock Springs residents' exposure to industry has similarly informed their perspectives surrounding emerging industries.

## ROCK SPRINGS, WYOMING

Most workshop participants in Rock Springs either worked in the fossil fuel industry themselves or knew someone who did, and many participants said they liked it that way: The pay was good, and in many cases their families had been in the business for multiple generations. They were used to the way things were, and many were skeptical of new industries, especially given Wyoming's low unemployment rate. Several community members could rattle off a list of the many new industries starting to eye Wyoming for its large swaths of land, cheap energy, and lax regulations. State and local governments wanted these industries to move in to boost economic growth, but many of the participants weren't so sure; they'd seen industries come in in the past, hire temporary workers from out of town, raise housing costs, and change the character of local communities without offering much if any benefit to those who'd lived there for generations.

In particular, many were skeptical of the job promises new industries were making. With such a low statewide unemployment rate, they reasoned, new jobs would either replace existing jobs or else be filled by workers from out of state. Wyoming has harsh winters, many pointed out, and they'd seen many people come and then promptly leave the state because they couldn't handle such conditions. People took pride in knowing their neighbors and having deep roots in the community, and outsiders who didn't assimilate were seen as threats to this way of living. For those already living in Wyoming and committed to staying, some doubted there was much need for new jobs. Would these jobs replace those in fossil fuels? And if so, could they offer the same levels of income and benefits? What would a transition in the area's workforce do to the cultural fabric of their communities?

*“But my concern is, would the jobs for that take away jobs that people already currently have? Because that is, that’s a negative. Also, when I see a building like that, I think of Rock Springs turning into a Silicon Valley. I ran away from that. I don’t want that. You know, I understand jobs. It’s great if it’s local. But I’m not, maybe I’m the only one. I like being able to run around in 10 minutes and not have traffic. And so, and the cost of living, I mean, I think, you know, we, we can see everything is just so expensive...But I mean, I, for me, it’s like, I don’t want a job opportunity to come if it’s going to affect what we already have.”*

—Rock Springs workshop participant

If the project were to move forward, participants identified the need to involve community members throughout the project planning process. Wyoming’s population is small, meaning that everyone knows everyone — not involving folks could foster ill will, which could spread quickly. In particular, providing open forums for community education and discussion would be important, given the obscurity and novelty of DAC. Cooperative governance of a DAC hub was also a priority, and could help allay some of the suspicion of a project that might arise.

*“As far as community involvement and project setting, planning and implementation, we kind of had two of those. Workshops held to collect feedback, education is a key to the community. The more they are educated, the better they’ll come along. But also have an elected community advisor board that has voting power over the project. That way you get the community involved in the project. And it’s not just somebody saying, ‘This is how it’s going to be,’ and a company coming in and running it, since the community is part of it.”*

— Rock Springs workshop participant

Cooperative governance could also help avoid risks and unintended consequences, participants noted. Many emphasized that who was involved in the conception, implementation, and governance of the project was also extremely important to folks in Wyoming; those leading it would need to make a case for the project that resonated with the average Wyoming resident, which was notably different, one participant said, from how companies were likely pitching DAC in Silicon Valley. The right story for why DAC and why Wyoming would be crucial to getting folks on board, and that meant emphasizing local economic opportunity over larger climate benefits.

*“How to shape a project in our community: again, the messaging is, is a critical thing – how they explain it, what they say about it...It must come from a political conservative political point of view. I mean, this is Wyoming, we’re a deep red state. That needs to be, people just need to keep that in mind, if they present anything to Wyoming...Nobody wants to have anything that’s going to come in here and fail and leave us with a huge environmental scar that we have to take care of, or have to, you know, mitigate through the years, we need to be very transparent about where the energy and the water is going to come from, for the project...We need to know if it’s water intensive, where that’s going to come from.”*

— Rock Springs workshop participant

Despite an overall resistance to change in their community, a few participants thought that some changes might be welcome, especially for younger generations. While those who had jobs generally liked them, young people were increasingly moving to cities for the kinds of employment opportunities that weren’t available in Rock Springs and surrounding towns. Infrastructural development could mean more than just economic opportunities, too: Additional revenue streams and new ideas could spur the buildout

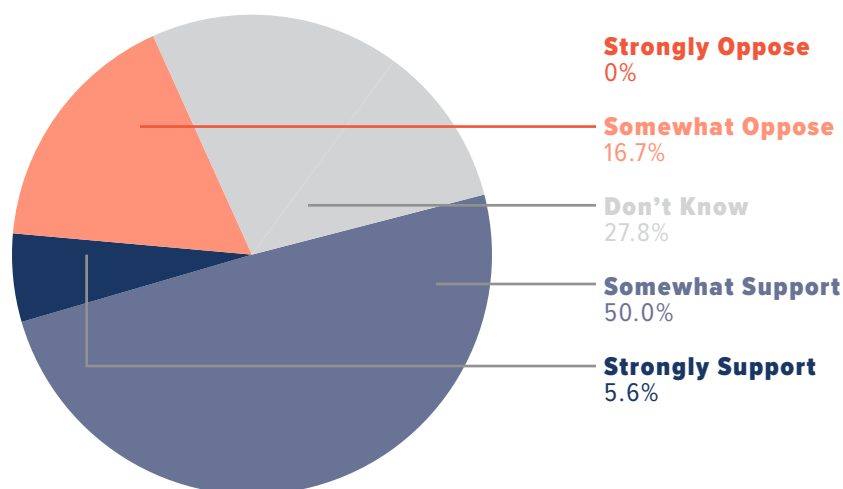
of new physical and social infrastructure like public transportation, better access to healthcare, including for mental health, and other opportunities. These kinds of additions to communities might convince young people to stay.

*“I don’t think that we’re talking about exponential growth, that we’re talking about hope in a community here that like, the young people will see this as like a reason to stick around in Rock Springs, a reason to get educated in Wyoming...Kids have, if they graduate high school here, they get money to use here for school. And they can move into transition into something that they’re proud of, and can keep those, that skill-set here hopefully become homeowners, not just renters and kind of transient population. And that and that with those community benefits. That if anything, can improve the quality of life, the things that we see do well and other big cities that we don’t have much of in the line of public transportation here, that that could, if we’re going to see a growth in numbers, can we improve that? Transportation, infrastructure, childcare, food.”*

— Rock Springs workshop participant

Overall, 50 percent of workshop participants said they believe their community would somewhat support a DAC hub, were it to meet their specifications, and 6 percent said they believe the community would strongly support a hub. Even if the hub were tailored to community needs, however, 17 percent said they would oppose the project. The last 28 percent chose not to answer, as they did not feel they had enough information to make a decision.

**Overall, do you think people in your community would approve or disapprove of a direct air capture project being built in or near your community?**



The announcement of Project Bison, which is considering development in Sweetwater County, has brought even more significance to the sentiments that workshop participants expressed. DAC development in the region must prioritize: creating jobs that are attractive to young residents and offer ample training opportunities, co-developing and improving physical and social infrastructure, and establishing cooperative governance with the local community.

In addition to conducting four community workshops, Data for Progress conducted national polling of American adults to understand perceptions about DAC more broadly and the optimal conditions under which DAC development could be deployed across the country.

## National Conjoint Survey Results

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Conjoint analysis is a survey technique often used in market research that identifies the qualities and features respondents would value in a particular product or proposal. Data for Progress conducted a conjoint analysis to understand which combination of features for a proposed direct air capture facility appealed most to national adults. To conduct a conjoint survey experiment, we show respondents a series of bundles describing various features that could be included in a proposed DAC facility. Respondents are asked to select which package they would prefer out of two proposals, and repeat this process with a number of varied feature packages.

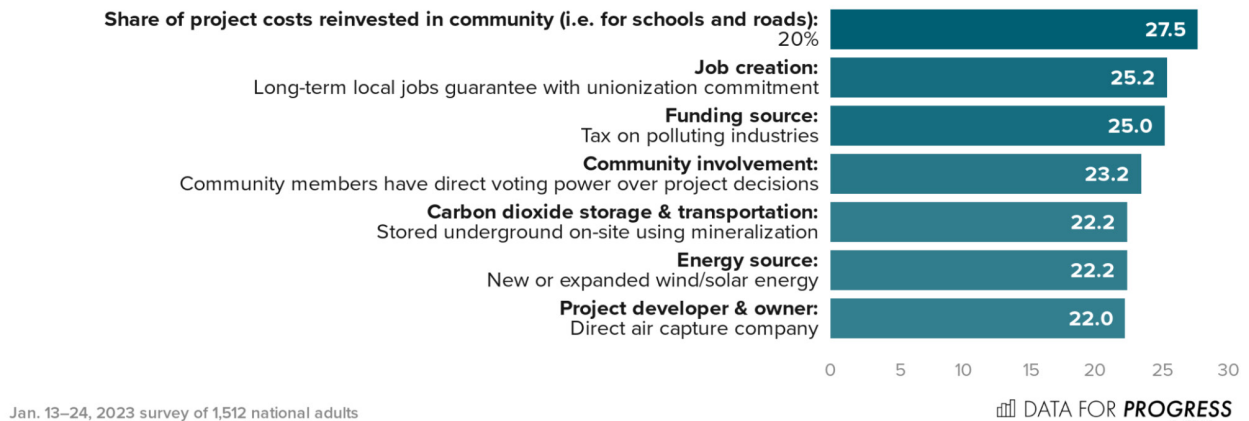
Given low national awareness of carbon removal technologies, we first provided survey respondents a multi-paragraph description of DAC and set a time limit to ensure respondents read the description. Furthermore, we asked an attention check question to ensure respondents read and understood the basic concept of DAC before proceeding to the conjoint experiment. Those who answered the attention check question incorrectly were screened out of the rest of the survey.

In this survey, respondents were shown varying combinations of: funding sources; project developers and owners; energy sources; levels of community involvement in project siting, planning and implementation; carbon dioxide storage and transportation methods; project cost shares reinvested in the community; and job creation commitments. Conjoint analysis aggregates these repeated comparisons across all respondents to identify an optimal “package” of features, in this case, for a proposed DAC facility.

This national conjoint analysis finds that the optimal proposal consists of a direct air capture facility owned by a DAC company and funded by a tax on polluting industries. Additionally, community members would exercise direct voting power over project decisions and receive a long-term local jobs guarantee with a unionization commitment. This proposal would reinvest 20 percent of project costs in the community for needs such as schools and roads, and would source energy from new or expanded wind and solar. Finally, U.S. adults prefer carbon dioxide from this proposed DAC facility to be stored underground on-site using mineralization. The chart below illustrates these findings and lists preferences in an ordinal ranking (by preference score). Preference scores offer an assessment of how favored an element is relative to the other elements of the series. Items that are strongly preferred by respondents are assigned higher preference scores, while elements that underperform relative to other elements are assigned lower preference scores.

## Communities Want Local Jobs and Local Reinvestment From Direct Air Capture Projects

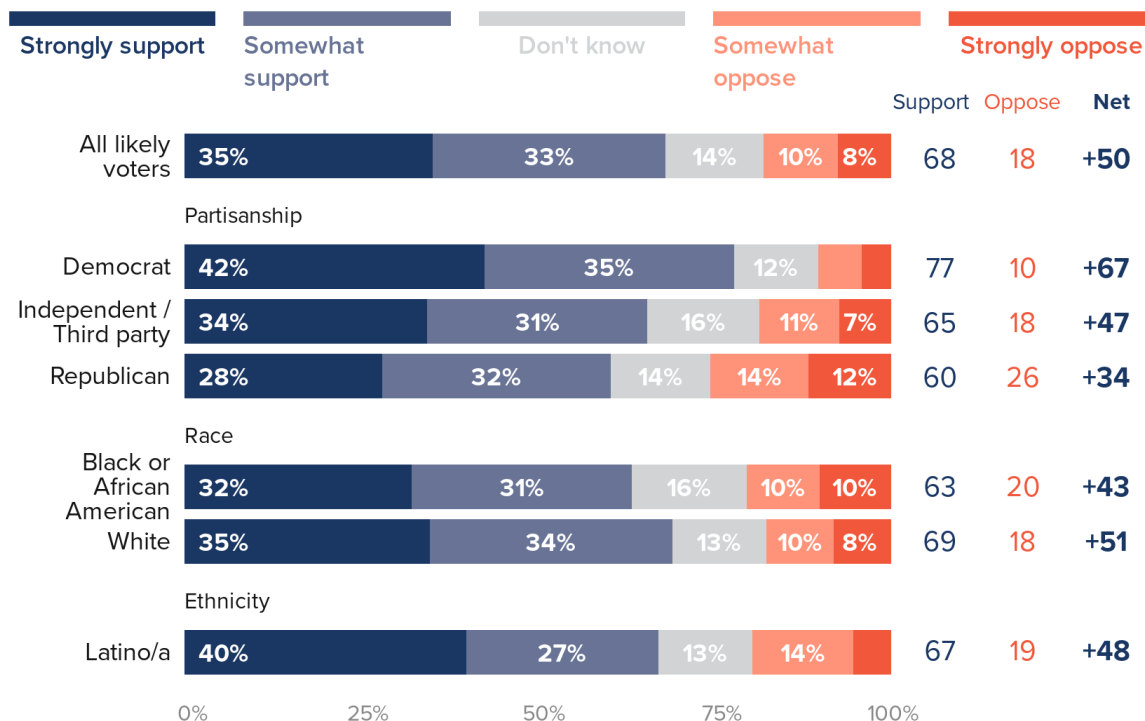
If you recall, direct air capture (DAC) is a new technology that sucks carbon dioxide out of the air. Carbon dioxide is a greenhouse gas that contributes to climate change and global warming. Now, imagine that a direct air capture project is being sited within your community or just outside of it. You will be presented with simplified project plans for a new direct air capture (DAC) facility. Please choose which plan you prefer more from each pair.



We also asked adults about their perceptions of DAC overall, and find that 68 percent of respondents either strongly support or somewhat support building DAC facilities in the U.S., including 77 percent of Democrats, 65 percent of Independents, and 60 percent of Republicans.

## A Majority of National Adults Would Support Building Direct Air Capture Facilities in the U.S.

Based on what you now know, to what extent would you support or oppose building direct air capture (DAC) facilities in the United States?



After hearing participants in our first two workshops express mistrust in new industries' promises to deliver jobs, we tested this perception at the national level. Overall, more than half of national adults believe that new industries would fail to deliver the quality or quantity of jobs promised, or both. Trust is lower among those who self-identify as Independents, younger respondents, and Latino respondents.

## Around Half of U.S. Adults Worry New Industries Won't Deliver on Promised Job Quality, Quantity, or Both

When industries promise to deliver jobs in communities where they set up new facilities, which of the following best describes your expectations about how these industries do or do not deliver on their promises?



Jan. 13–24, 2023 survey of 1,512 national adults

DATA FOR **PROGRESS**

# Workshop and Polling Limitations and Recommendations for Future Improvement

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In spite of rigorous planning and consultation with state and local partners, a number of limitations and learnings arose during both the workshop and polling processes.

There are some differences between the community workshops Data for Progress conducted and conventional focus groups, including:

- *Number of participants:* These workshops included 15-20 participants on average, whereas focus groups typically include 5-10 participants; and
- *Workshop setting:* Workshops were hosted in local community venues rather than a designated focus group facility, not just for inclusivity and accessibility purposes but also because the workshops were largely conducted in rural locations where focus group facilities were not available.

Differences also exist in terms of scope and audience in the quantitative (polling) vs. qualitative (community workshops) research. Community workshops represent very specific geographies/communities and their varied perspectives, whereas polling highlights a broader swath of opinions, particularly as the survey conducted for this work was at the national level, and therefore differs from the insights of individuals and communities at the state and local level.

Other limitations for this work include:

- *Recruitment:* Recruiting participants in rural communities is challenging given that rural areas are typically less densely populated, requiring recruitment to pull from a broader geography (and potentially encompassing counties and cities neighboring the specific workshop site) than that often required for workshops in urban areas in order to get a demographically and regionally representative sample. The more remote a potential workshop site is, the more difficult it is to recruit, so ample time is crucial for ensuring that the recruitment process is robust;
- *Recording and transcriptions:* Given that these workshops were conducted outside of a conventional focus group setting, recording and transcription services were endeavored by the Data for Progress team, which posed several issues given the constraints of not having professional audio services at hand. High-quality recording and transcription services should be top priority when conducting similar workshops in order to ensure that the review of participants' insights is accurate;
- *Novelty and complexity of DAC:* The novel and complex nature of DAC required a significant portion of workshops to be dedicated to explaining DAC at length to ensure all participants had the requisite knowledge base before conversations could be held, thus lengthening the workshop. CCS and DAC are often conflated, and participants may have preconceived notions about prospective risks/benefits of CCS that may not necessarily apply to DAC but that nonetheless may inform a workshop; and

- *Unanticipated in-person issues:* As with any in-person event, not all participants show up on time or attend a workshop even after being recruited and repeatedly confirmed. No-shows, late arrivals, and other unanticipated issues can hamper workshop participation. However, these issues can largely be addressed by over-recruiting participants and ensuring workshop organizers are dynamic and flexible, with a large enough team on hand to address issues as they arise.

In order to make this workshop model more inclusive moving forward, childcare should be provided, as should translation services to better accommodate those for whom English is not their first or primary language. Data for Progress strives to continue learning by process and via input from community members and other stakeholders about how to improve our qualitative research processes, particularly as we begin socializing this work with partners and decision-makers and replicate the workshop model for other issue areas.

## Conclusion

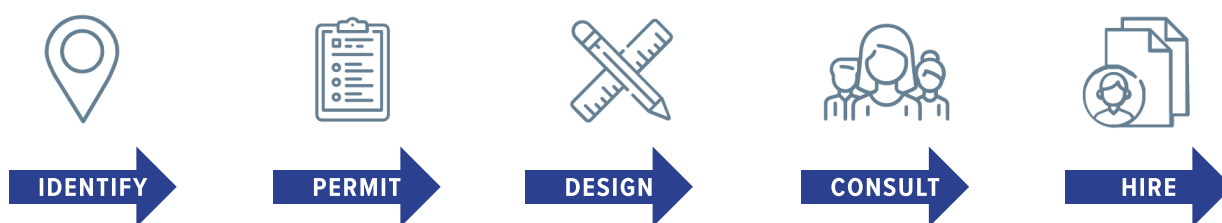
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Communities across the U.S. vary widely geographically, demographically, and politically. Even so, the four communities we engaged in workshops articulated similar questions when introduced to the idea of DAC: Would it cause or exacerbate local pollution? Would it cost local taxpayers, either directly or indirectly? Who would be allowed to decide on the community's behalf if it should move forward and, if so, under what conditions? While many communities are rightfully skeptical of — and often resistant to — the development of new industries in their communities, DAC hubs, if executed with equity at their center, could offer the opportunity for collective governance and community reinvestment, all while advancing multisectoral decarbonization and carbon dioxide removal.

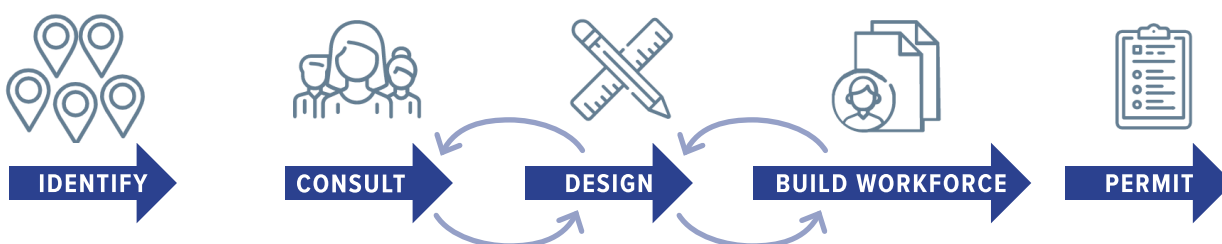
Despite concerns that communities, especially those with historic or ongoing relationships with heavy industry, would be uninterested in new industrial activity, we find that some communities are excited by the opportunity for cooperative decision-making and, ultimately, infrastructural development. These findings lend nuance to a national-level discussion premised on not-in-my-backyard logic, demonstrating that how we build climate-related infrastructure will be intimately linked to whether we are able to build it at the scale and speed necessary to mitigate the climate crisis.

Our conversations with community members show that many believe that DAC hubs present the opportunity to build not only climate-critical infrastructure but also economic and social opportunity. If done correctly, they can be a source of new partnerships, bridging climate-aligned industries to restore trust, repair damages, create new and attractive jobs with transferable skills from industries that are being phased out, and contribute to climate justice. While there is a long way to go in cementing this project development paradigm — as these findings offer a fairly high watermark for support surrounding DAC deployment, and environmental and climate justice dynamics are ever-evolving and vary vastly based on different sociopolitical contexts — DAC hubs provide the opportunity to demonstrate proof of concept. Data for Progress is excited to continue this process by facilitating follow-up workshops for other stakeholders like labor unions, local policymakers, and environmental justice leaders.

In this work, we have taken a project planning process that usually looks like this:



... and are working to turn it into a project planning process that instead looks like this, centering community voices and needs for equitable climate infrastructure deployment:



As the U.S. works to build climate infrastructure beyond DAC hubs, these findings point to the importance of centering community and labor benefits in projects.

## Acknowledgements

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