THIRD WAY

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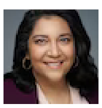
Picture It: Carbon Management Across America



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The recently enacted Inflation Reduction Act and Bipartisan Infrastructure Law are transforming the carbon management landscape, investing billions of dollars into clean energy projects, encouraging private sector investment, and removing hurdles to make carbon management technologies easier to access and integrate into American communities, towns, and villages. The economic and climate opportunities of carbon management and carbon removal solutions, such as Direct Air Capture (DAC), are worth getting excited about. But with only a handful of these facilities in operation worldwide, it is difficult for most Americans to get a sense of how these projects will fit into their local economies, culture, and landscape.

That's why Third Way partnered with Gensler, a world-renowned architecture and design firm, to develop visual renderings that showcase examples of DAC and other carbon management solutions, paired with clean energy technologies in various settings. These renderings can be used by NGOs, advocates, and policymakers to engage with the public and highlight a visual template for a future economy that provides cleaner, more affordable, secure, and reliable energy for various American communities.

This project's portfolio consists of five detailed graphic renderings in total. The first two scenarios were developed in partnership with the National Wildlife Federation, depicting a more localized vision of small, modular DAC units within suburban and rural communities. The remaining three scenarios illustrate large-scale DAC, primarily for the purpose of carbon removal, either to target legacy emissions or in conjunction with other technologies, to capture residual emissions from other industrial facilities.

Each scenario is explained below. You can also click here to view, download, and share all of these images (plus a few bonus shots!). Please credit all images to Third Way.

The Case for Carbon Management

The Climate Change Case: The Intergovernmental Panel on Climate Change (IPCC) has emphasized the essential role of carbon dioxide removal technologies like DAC for meeting our net-zero emissions targets and cutting carbon pollution from hard-to-abate sectors like transportation and heavy industry. Simply put, we will not reach net-zero by 2050 without carbon management. To meet our net-zero goal, DAC technologies, alongside other carbon removal strategies, would have to capture 85 Mt of carbon in 2030 and 980 Mt of carbon in 2050, a rate not currently achievable unless we see DAC deployment at a tremendous scale.

The Economic case: Given the extraordinary amount of decarbonization that is required across many different sectors, the rapid build out of carbon management technologies, including carbon capture, utilization and storage as well as DAC, presents a significant opportunity for the US. Analysis indicates that nearly 300 thousand jobs can be created by DAC deployment alone, in fields like construction, maintenance and engineering, and industrial equipment manufacturing jobs. The global market for DAC could be massive, on the order of $4 trillion during the 2020 – 2050 period, according to a recent report from Boston Consulting Group, Third Way, and Breakthrough Energy. The US is well-positioned to compete for a big slice of that pie.

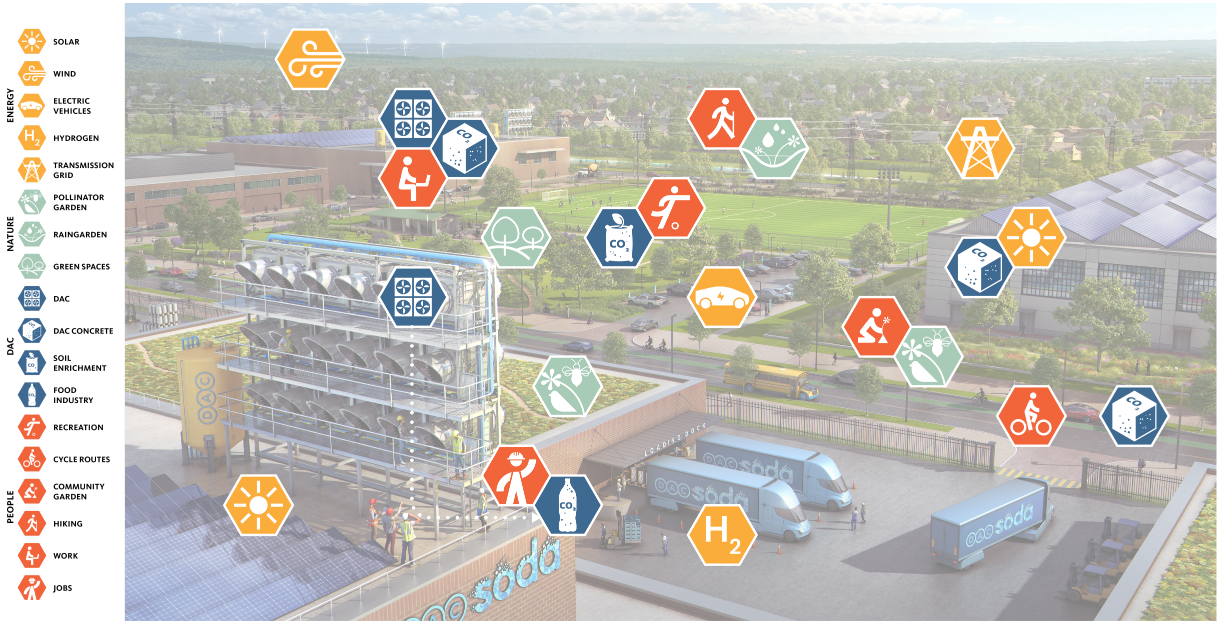
1. Suburban Direct Air Capture

Created with Dr. Simone Stewart (National Wildlife Federation)

The suburban direct air capture (DAC) setting beautifully illustrates not only the modular potential of DAC to fit a community's needs but also demonstrates that the deployment of carbon removal technology alongside natural climate solutions like rain gardens and local pollinator sites can succeed in a community without being invasive.

In this scenario, set in the not-so-distant future, modular DAC is powered by renewable energy, indicated by the rooftop solar and wind turbines in the distance, as well as the presence of transmission lines. This decarbonized grid powers not only the DAC facility but the entire region. These lines would also provide clean electricity for fleets of electric vehicles and electric school buses.

Small-scale DAC that can be powered by localized renewable energy is seen in harmony here with the local community. Shared infrastructure can play dual roles—for example, the deployment of electric school buses benefits from a renewable grid, while also qualifying under programs covered by President Biden's Justice 40 Initiative which ensures that 40 percent of the benefits arising from federal dollars are flowing back into local communities.

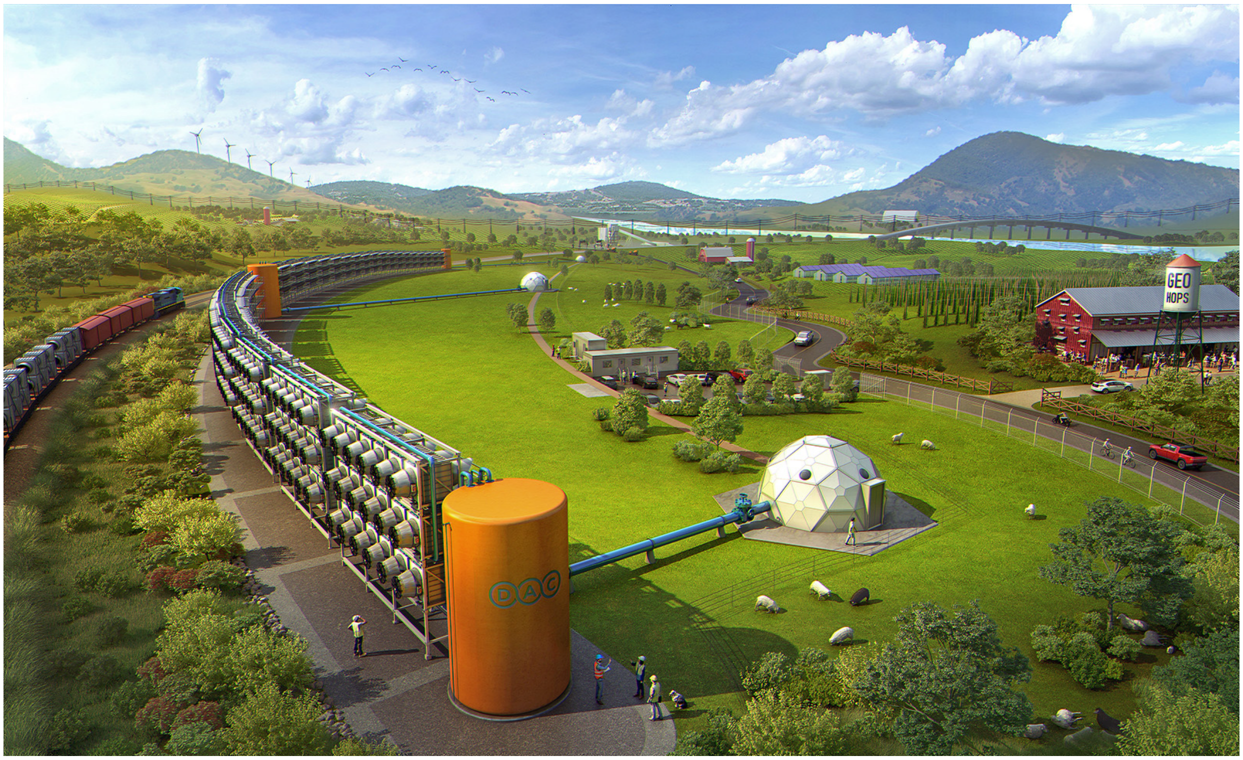


While the modular DAC design depicted in this scenario will likely only draw down carbon dioxide (CO2) on the scale of several hundred tons annually (approximately 500 tons/year), there are plenty of localized uses for that removed CO2 evident in this rendering. For example, DACME Construction in the background is a low-carbon concrete company. Its products are used throughout the pictured community in its buildings as well as the roads and parking lots necessary for everyday travel.

A local business, DACSoda thrives on the removal of CO2, as it will use the CO2 in its beverage creation process to give its soda the fizz we all know and love. Heavy-duty vehicles, such as the trucks transporting DACSoda, are low-carbon hydrogen-fueled vehicles. Such fuels can also be produced using DAC at a larger scale. These uses of CO2, along with the construction and maintenance of the DAC facility itself will provide family-sustaining jobs for the community, some of which build on the skillsets local workers may already have.

In addition, captured carbon used to enhance soil fertilizes the green spaces where communities gather, providing the nutrients for lush rain gardens and local flora to flourish, allowing local residents to breathe in cleaner air and share space with one another to promote activities that directly benefit their health, like the planting of community gardens.

Thanks to the Bipartisan Infrastructure Law and Inflation Reduction Act, communities will be able to invest in these kinds of projects to build cleaner and more reliable infrastructure while reinvesting in local communities.

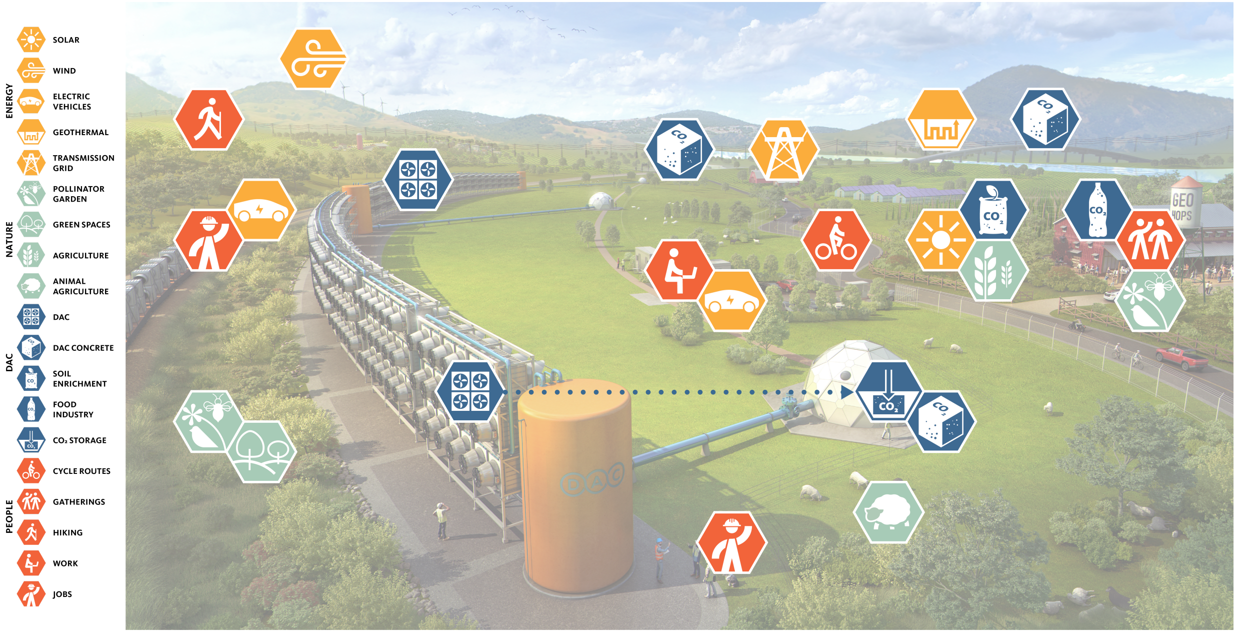


2. Rural Direct Air Capture

Created with Dr. Simone Stewart (National Wildlife Federation)

The rural setting for DAC illustrates how a larger facility can complement nature-based carbon removal by annually drawing down thousands of tons of CO2 from the atmosphere. While this larger rural facility will require more energy than a suburban DAC plant, wind turbines on the horizon and geothermal energy coming from the plant across the river will minimize costs and power the capture process with zero-emissions energy.

Clean energy supplied via the transmission lines in the distance powers not only the DAC facility itself, but also the electric train transporting individual DAC components smoothly across the countryside. Clean electricity brought into this rural community will also support a local network of electric charging stations that power the vehicles used by employees of the facility and citizens of the surrounding community.



Rather than dropping a facility in the middle of a scenic landscape, the DAC plant can be built to follow the natural curves of the countryside and be placed in a way that prioritizes natural greenspaces full of trees and plants local pollinators depend on. This means the landscape can continue to support local animal agriculture and crop farming. Sheep can comfortably roam in their pens on the hillside, undisturbed by the presence of the facility while across the roadway farmers use solar power and carbon-rich fertilizer to nurture their plants and provide hops for a local brewery.

In this scenario, the amount of CO2 removed is far greater than that in the suburban setting. Given the region's particular geologic makeup, it can be sequestered underground on site. Geologic storage of carbon is both well understood and safe. Engineers and scientists on site enhance the stability of the practice by converting captured carbon into a solid mineral, ensuring that the captured CO2 is not going anywhere.

The captured CO2 can also be used to produce low-carbon concrete, which is manufactured locally at the DACME cement plant in the distance and serves as a solid foundation for the DAC facility and roadways used by local drivers and cyclists alike. And while the CO2 is not responsible for the bubbly foam on top of a glass of beer, it can be used in other industrial processes. These even include cleaning the machinery to make beer and purging it of impurities before the beer is bottled. Techniques like this ensure the GeoHops brewery can sell their product to be enjoyed in shared spaces, where both locals and visitors can take in the natural landscape.

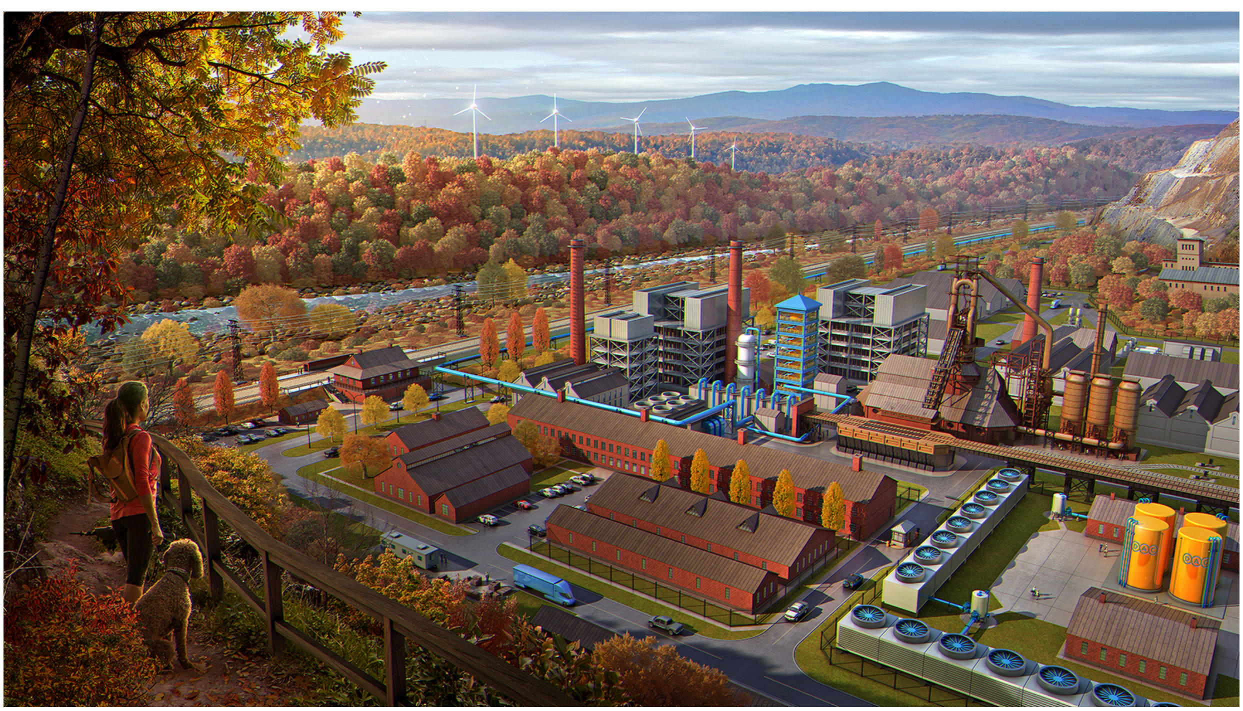
3. Large-Scale Direct Air Capture Hub (Megaton Scale)

The megaton DAC scenario specifically highlights the significant scale of CO_2 removal that will be necessary to draw down the historic emissions that have been in the atmosphere since the Industrial Revolution. To prevent further warming beyond the planet's already critical level, gigatons of CO_2 will need to be removed from the atmosphere and these DAC "citadels" are the key.

In this scenario, large scale DAC facilities occupy the arid desert space where they capitalize on readily available oil and gas pipeline infrastructure and the skill sets the region's workers have carried over from the fossil fuel industry. With the help of funding from the Bipartisan Infrastructure Law, existing fossil fuel transportation infrastructure has been converted to support the transport of CO_2. These lines connect megaton hubs spread across the region, creating a network of DAC facilities that work together to draw down historic emissions. The location of this facility was chosen not only to utilize existing fossil fuel infrastructure and the skill sets of workers in those industries. It was also chosen because of its access to secure geologic storage, which allows for short pipeline distances. Below these facilities, there are rock formations that are ideal for sequestering carbon.

The transmission lines pictured ensure zero-carbon nuclear energy is being delivered to the DAC hub as well as the electric charging and filling stations for electric vehicles and the hydrogen fueled semi trucks transporting goods from one region to another. The robust deployment of transmission lines makes all of this possible.

This scenario depicts the future scale that DAC will need to achieve to ultimately meet climate goals and draw down the megatons of CO2 in the atmosphere while also spurring industry growth and job creation. Despite the size of these facilities, the region still maintains its natural landscape allowing for local agriculture and other industries to thrive.



4. Carbon Capture Utilization & Sequestration Industrial Cluster

Set in the rolling valleys of a former mining region, this example highlights how DAC technology can be integrated within a diverse industrial facility. This scenario illustrates a combination of Carbon Capture Utilization and Sequestration (CCUS) technology and DAC, demonstrating the synergy between multiple decarbonization efforts. Resources, emission reductions, and economic gains can be maximized when multiple clean energy solutions are located in close proximity.

At the center of this scenario is an existing steel plant. Industrial processes such as steel making, cement making, refining, food and chemical manufacturing require large amounts of high-temperature heat that make the switch to electrification challenging and make these industries especially tricky to decarbonize. Multiple technological and design interventions are therefore needed to cut carbon from industrial facilities like the one pictured here.

This facility has been retrofitted in two ways to make these reductions possible: the facility uses carbon capture technology to directly capture the carbon-rich exhaust emitted during heat generation and additional carbon capture units capture direct emissions at different stages of the steel-making process.

In addition to the CO2 exhaust there is also a large amount of waste heat created during the steel-making process. This stream can be recovered and used to power the modular DAC units attached to the exhaust columns. Additional DAC units are located on the L-shaped facility in front of the steel plant.

CO_2 captured from both of these sources can be compressed and fed into the same pipeline. The pipelines laid alongside the railway tracks can transport the compressed CO_2 to the north-east of the industrial facility, where unmined coal seams can store it for thousands of years.

Combined, these two solutions help decarbonize direct emissions and process emissions from the steel-making facility. Such modifications that reduce industrial emissions are supported by investments and incentives provided in the Bipartisan Infrastructure Law (like CCUS demonstration funding) and in the recently passed Inflation Reduction Act (like the enhanced 45Q tax credit for carbon sequestration and the 48C credit for advanced manufacturing).

5. Hydrogen Hub/Direct Air Capture

Created with Dr. Meron Tesfaye (Bipartisan Policy Center)

As global gateways of goods, climate-resilient and low-emission American ports are critical for a strong supply chain and a robust national and global economy. The depicted hydrogen hub paints a picture of a near-future scenario where bustling port terminals along US coastlines can run on low-carbon fuels.

In this scenario, renewable power is drawn from large windmills located 30 miles offshore to power the electrolyzers and hydrogen fuel blending facility located on shore. The renewable power used to produce hydrogen can also be utilized by the whole terminal. Temporary storage is provided by the hydrogen tanks located on-site.

In the near future, a deeply decarbonized port could have a combination of electric-powered, hydrogen-powered, and other low-carbon-fueled activities. Therefore, hydrogen produced in excess would not go to waste and instead could have multiple end-uses. For example, hydrogen powered fuel-cells can produce electricity to power nearby equipment and activities. Excess hydrogen can also be fed into existing pipelines to be utilized by nearby industrial facilities for producing low carbon aviation fuel or chemicals. Combined with CO2 from the modular DAC units, synthetic, low-carbon fuel can also be produced onsite.

Hydrogen fuel-cell powered harbor craft vessels and ferries generally stay near ports for activities such as fishing, passenger transport, and patrolling. Within minutes, they can refuel with hydrogen, enabling them to conduct their routine activities all day with zero emissions. Newly designed hydrogen powered vessels can refuel at this port as they drop off their cargo from other parts of the world. Hydrogen-powered cargo handling cranes, excavators, forklifts and off-highway trucks are depicted working up and down the terminal.

A scenic biking and hiking path is laid across the port and through nearby thriving communities as local emissions and smog is eliminated. Roughly ten miles off to the right of the coast is a formerly decommissioned gas rig that is now producing off-shore hydrogen using wind energy. Installed desalination equipment makes seawater suitable for hydrogen production using an electrolyzer stack. Hydrogen produced at this platform is transported on-shore using existing gas pipelines. This demonstrates the alternative use of existing oil and gas infrastructures near our ports, which can be repurposed through the federally funded programs in the Bipartisan Infrastructure Law and the Inflation Reduction Act.

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