



Natural carbon sequestration on working and urban lands:

Benefits for our climate, health, water, food,
biodiversity, economy & more

the
climate
center

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“Code red for humanity” –UN Sec General António Guterres, Aug 9 2021

“Climate change is a threat to human well-being and planetary health. Any further delay....will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all.”

– IPCC 6th Assessment, WGII, Feb. 28, 2022



“No temperature rise is safe”...rapidly warming climate is the "greatest threat" to global public health

–220 medical journals globally, Sept. 7 2021

https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

<https://www.reuters.com/business/environment/un-sounds-clarion-call-over-irreversible-climate-impacts-by-humans-2021-08-09/>

<https://www.theguardian.com/environment/2021/jul/02/canadian-inferno-northern-heat-exceeds-worst-case-climate-models>

<https://grist.org/science/is-climate-change-happening-faster-than-expected-a-climate-scientist-explains/>

<https://www.npr.org/2021/09/07/1034670549/climate-change-is-the-greatest-threat-to-public-health-top-medical-journals-warn>

Current global climate goals

UN IPCC 1.5C Report- Oct 2018

- Cut emissions by 45% by 2030

AND

- remove up to 1000 Gt CO₂e from atmosphere

to achieve **net-zero emissions** by **2050** and **stay under the 1.5C** dangerous warming threshold



UN operates by consensus.

Goals are conservative and not enough.

We must do more sooner per new science...

Western US now in global warming-induced severe megadrought; worst in 1200 years

- **Threatens dustbowl & ag economy by as early as 2027 in CA**
- 2015 drought cost ~\$2.7 billion and 20k lost ag jobs in California
- Climate impacts likely to worsen by 50% in next few years in California



<https://www.motherjones.com/environment/2014/02/california-drought-matters-more-just-california/>

<https://ramanathan.ucsd.edu/>

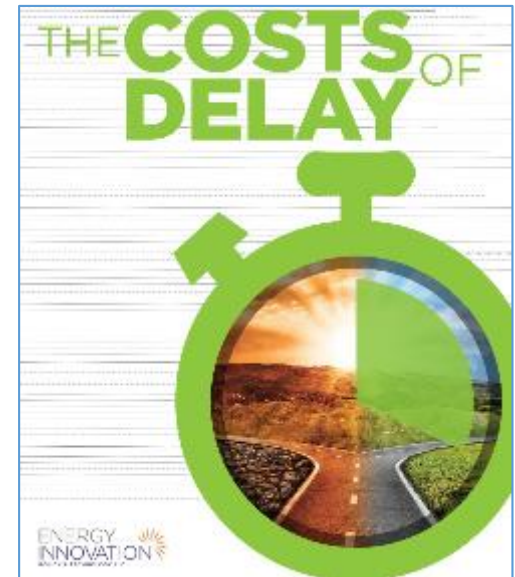
Williams et al *Nat. Clim. Chang.* (2022). <https://doi.org/10.1038/s41558-022-01290-z>

<https://www.latimes.com/environment/story/2022-02-14/western-megadrought-driest-in-1200-years>

<https://www.scientificamerican.com/article/drought-takes-2-7-billion-toll-on-california-agriculture/>

Climate action delay/inaction costs lives and dollars, bankrupting our future

- Eliminating fossil fuel air pollution in bldgs. & transportation in CA yields \$44 billion/year in improved health & avoiding ~5,000 premature deaths
- Costs much less investing big today rather than waiting until 2030 *(For CA: est. \$47 billion/year now vs. \$110 billion/year starting in 2030 based on CA =14.6% of GDP)*
- \$150 Billion in damages from 2018 CA wildfires *but \$80 Billion invested in California generate ~725,000 jobs*



https://energyinnovation.org/wp-content/uploads/2021/01/Cost_of_Delay.pdf

<https://www.ethree.com/new-e3-reports-quantify-the-health-benefits-of-reducing-fossil-fuel-use-in-california/> Jan 2022

<https://www.federalreserve.gov/publications/files/financial-stability-report-20201109.pdf>

<https://www.nytimes.com/2020/09/08/climate/climate-change-financial-markets.html>

Wang, D et al. **Economic footprint of California wildfires in 2018.** *Nature Sustainability*, 2020 DOI: [10.1038/s41893-020-00646-7](https://doi.org/10.1038/s41893-020-00646-7)

<https://www.accuweather.com/en/weather-news/california-wildfires-will-cost-tens-of-billions-accuweather-estimates/612548>

Political Economy Research Institute https://www.peri.umass.edu/images/CA-EconRecProgram-6-12-20_Final.pdf

World Resources Institute <https://www.wri.org/blog/2020/07/economic-benefits-climate-action-us>

“I don’t at all feel that we [in California] are leading the world anymore.”

– Assembly Speaker Anthony Rendon, COP26, Glasgow



<https://calmatters.org/newsletters/whatmatters/2021/11/california-climate-change-newsom/>

CLIMATE-SAFE CALIFORNIA

accelerate existing state goals 15 years...

2045 is too late

- **Net-negative emissions by 2030** (remove more climate emissions than we emit) ([Brown 2018 EO by 2045](#))
 - **80% below 1990 GHG levels by 2030** ([Schwarzenegger 2005 EO by 2050](#))
 - **~100 MMT/year CO₂e sequestered on natural, working and urban lands by 2030**



One pathway to Net Negative Emissions by 2030: *by sector*

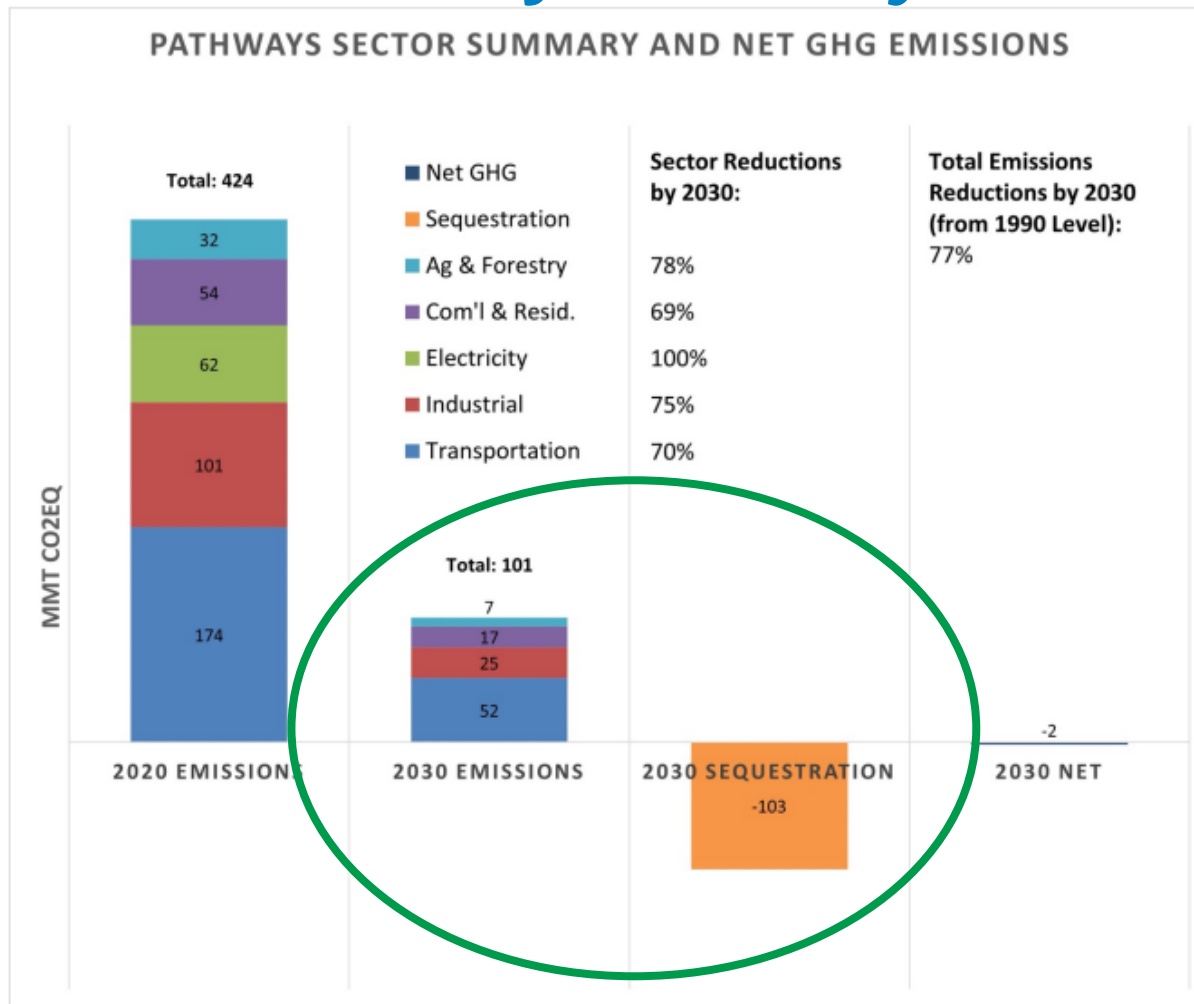
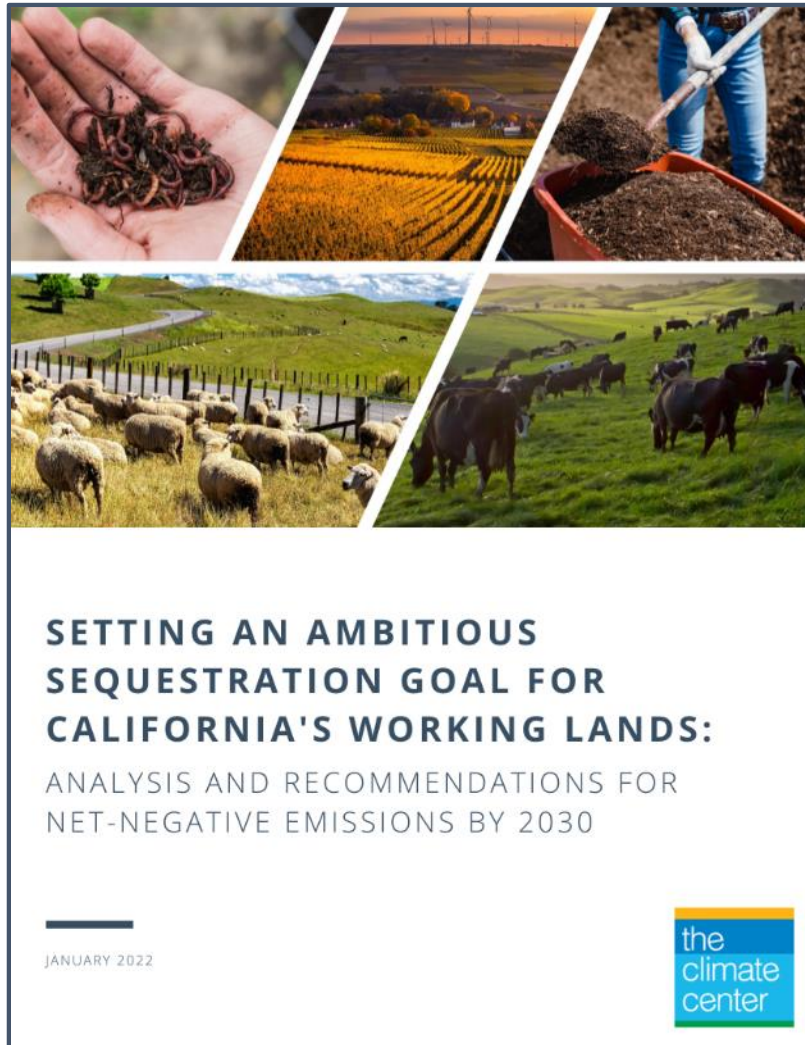


Figure 2. Pathway of emissions reductions by sector that result in net-negative emissions by 2030. Analysis using The Climate Center GHG Accounting Tool.

<https://theclimatecenter.org/our-open-source-pathways-model-offers-climate-action-blueprint/>
<https://arxiv.org/abs/2103.07801>

New Report: Sequestration Goals for California's Working Lands by 2030



- ✓ Report quantifies maximum sequestration potential of CA working and urban lands by 2030
- ✓ Does not include additional sequestration potential from natural lands, forests, montane and coastal wetlands, and nearshore habitat
- ✓ Builds on partnership with Carbon Cycle Institute (Torri Estrada and Dr. Jeff Creque)
- ✓ Reviewed by expert soil scientists (Dr. Keith Paustian, Dr. Tim Bowles, Dr. Libby Porzig)

www.theclimatecenter.org/working-lands

Benefits of scaling up soil carbon storage on California's working and urban lands

- Sequestration potential of ~100 MMT CO₂e per year by 2030



- ✓ Water security, retention
- ✓ Drought, heat, wildfire resilience
- ✓ Cleaner air & water- esp. for frontline communities
- ✓ Crop yield stability & resilience
- ✓ Biodiversity
- ✓ Jobs

www.theclimatecenter.org/working-lands

Significant water security and drought resilience benefits from natural sequestration

- Increasing soil health (soil organic matter) 1% stores an extra 20,000 gallons of water per acre
- Increasing soil health (soil organic matter) by just 3% on 47M acres of the state's working lands:
 - Would store an additional 1.5 trillion gallons of water
 - Equivalent to the capacity of Shasta Dam



<https://nrcspad.sc.egov.usda.gov/DistributionCenter/pdf.aspx?productID=1027>

Carbon sequestration potential using these proven practices on working and urban lands

Practice	Annual Acreage (new)*	Rate (MT CO ₂ e/ac/yr)	Annual MT CO ₂ e (new acres)	2030 Acreage Total	Cumulative 2021-2030 (MMT CO ₂ e)	2030 Annual Rate (MMT CO ₂ e)
Rangeland compost	352,000	1	352,000	3,520,000	19.36	3.52
Pasture compost	1,155,00	1	1,155,000	11,550,000	63.53	11.55
Cropland compost	1,200,000	4.5	5,400,000	12,000,000	54.00	54.00
Agroforestry	760,000	2	1,520,000	7,600,000	83.60	15.20
Riparian restoration	160,000	1.48	236,800	1,600,000	13.02	2.37
Prescribed grazing	436,000	0.05	21,800	4,360,000	1.20	0.22
Urban forestry	147,258	4.04	594,922	1,472,580	32.72	5.95
Roadside forest buffers	155,152	1.77	274,619	1,551,520	15.10	2.75
N fertilizer avoidance	1,600,000	0.44	704,000	16,000,000	7.04	7.04
Selected totals					289.57	102.59

*total acreage not shown because multiple practices can be implemented on same acres

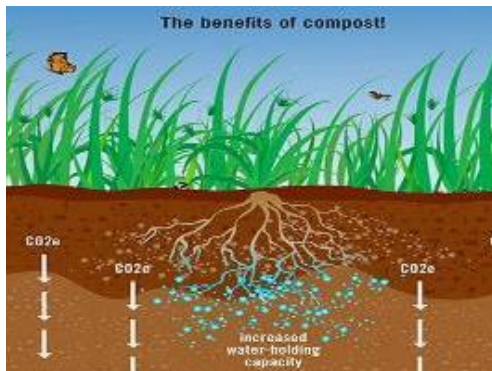
Nature-based sequestration-- *not* technological carbon removal-- by 2030



✗ Carbon Capture, Utilization and Storage (CCS/CCUS): to remove CO₂ from power plants and industrial processes, placing the CO₂ into long-term storage but 81% used for “enhanced oil recovery” [~26 CCS plants operate globally; \$11 Billion+ invested by US; potential use in non oil&gas production – eg, cement and steel]



? Direct Air Capture (DAC): extracts CO₂ from the air by pulling air through filters where it reacts with chemicals and is stored or used to make synthetic fuels [~19 direct air capture (DAC) plants operating worldwide, capturing ~0.01 Mt CO₂/year]



✓ Nature-based sequestration (NbS): absorption of CO₂ in natural media like trees, plants, soil, oceans, and other natural or biological settings.

<https://foe.scot/wp-content/uploads/2021/01/CCS-Research-Summary-Briefing.pdf>
<https://crsreports.congress.gov/product/pdf/IF/IF11501/3>
<https://www.eco-business.com/news/carbon-capture-and-storage-wont-work-critics-say/>
<https://theclimateconnection.org/carbon-capture-and-storage-pros-cons/>
<https://www.treehugger.com/carbon-capture-and-storage-ccs-pros-and-cons-5120005>
<https://www.iea.org/reports/direct-air-capture>
www.theclimatecenter.org/working-lands

Carbon farming on working & urban lands *potential for carbon removal at scale*

20+ m acres = ~100 MMT/year CO₂e by 2030

CARBON FARM PLANNING in Marin

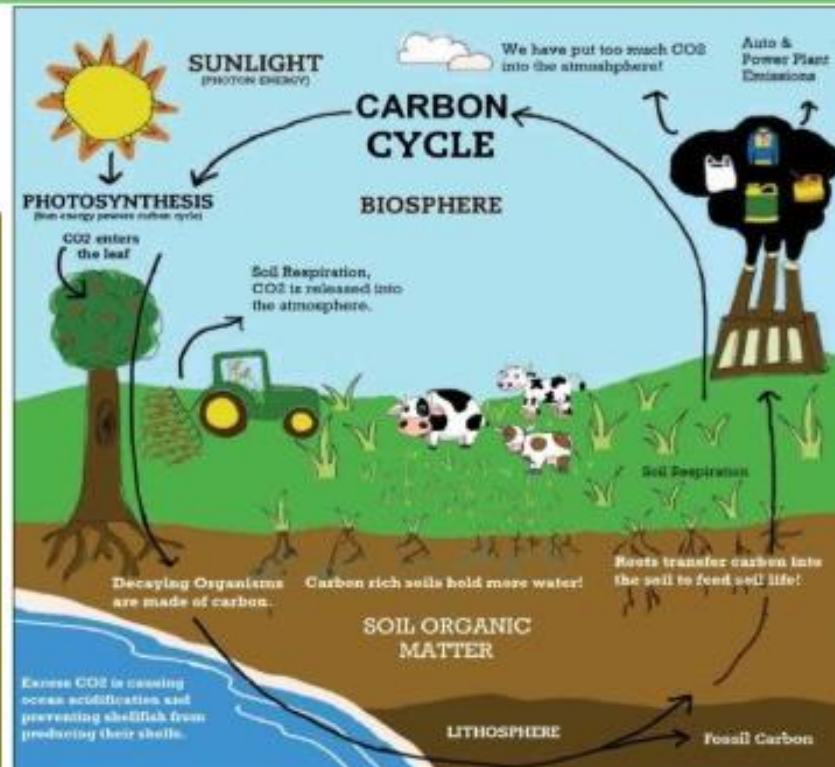
**Assistance is available for
farmers and ranchers!**

Plan for carbon sequestration and
climate adaptation conservation
practices with Marin RCD!

Potential List of Conservation Practice(s)* in a Carbon Farm Plan:

- Compost Application • Anaerobic Digester
- Silvopasture/ Shrub & Tree Establishment
 - Windbreak/ Shelterbelt/ Hedgerow
 - Riparian and Wetland Restoration
 - Filter Strips • Grassed Waterways
 - Forage & Biomass Planting
 - Rangeland Management
- Prescribed Grazing and Range Planting
 - Nutrient Management
- Residue & Tillage Management, No-Till
 - Cover Crops

*NRCS Standard Conservation Practices



NWL Carbon Sequestration: Priority policy recommendations

- Establish bold statewide short- and mid-term targets
- Scale up technical assistance for land managers
- Scale up compost production (food waste) and application
- Increase state funding for NWL carbon sequestration programs
 - Total estimated public/private funds needed: ~\$29 Billion over 10 yrs



Partners interested in supporting bold NWL sequestration goals

Carbon Cycle Institute



CALIFORNIA ASSOCIATION OF
RESOURCE
CONSERVATION DISTRICTS



CENTRAL CALIFORNIA
ENVIRONMENTAL JUSTICE NETWORK



The Natural Carbon Sequestration and Resilience Act of 2022

(AB 2649/C. Garcia)

Targets: 60 MMT CO₂e by 2030, 75 MMT by 2035

Natural carbon removal on rural and urban lands => benefits our climate, health, water, food, environment and economy

Co-authors: Asm. M. Stone, Co-Author, and Senator J. Becker



Thank you!



Bold targets work!

As goes California, goes the world

- AB1493 (2002) **tailpipe emissions cuts**
 - later adopted by 13 other states; basis for 2010 national clean car standards
- SB100 (2017)- **100% carbon-free electricity** by 2045
 - already adopted by 10 other states and Biden Administration with earlier deadlines
- CA launched **Under2 Coalition** (2017); now includes 220 jurisdictions with 1.3 billion people and 43% of the world economy
- Gov. Newsom EO **100% ZEV car sales** by 2035 (Sept 2020) – must be earlier but...
 - GM announces will sell only 100% ZEV cars by 2035 (Jan 2021); Volvo by 2030 (Mar 2021); New York State (Sept 2021)



Governor Newsom heard us: ordered Air Resources Board to evaluate pathways to carbon neutral by 2035, 10 years ahead of current policy

July 9, 2021



<https://www.gov.ca.gov/2021/07/09/governor-newsom-holds-virtual-discussion-with-leading-climate-scientists-on-states-progress-toward-carbon-neutrality/>

Also asked CPUC to establish a more ambitious greenhouse gas emissions target for electricity procurement by 2030

The climate solution in California's compost and crops

These nature-based solutions are cheaper than climate tech

By [Justine Calma](#) | [@justcalma](#) | Jan 26, 2022, 9:24am EST

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Rows of composting grape pomace are covered for the winter in Sonoma County's Alexander Valley on December 13, 2015, near Geyserville, California. | Photo by George Rose/Getty Images

“By 2030, that capacity could increase to almost 100 million metric tons of CO₂ equivalent sequestered a year. ...

The majority of that sequestered carbon would come from composting across the state's croplands and pasturelands. Planting more trees on farms and in cities would also have a significant impact.”

Carbon Capture, Utilization and Storage (CCUS or CCS)

to remove CO₂ at the source at power plant and industrial smokestacks and put into long term storage

- BUT 81% used for “enhanced oil recovery” → injecting underground for more fossil fuel production
- ~26 CCS plants operating globally
 - In Australia: Chevron’s Gorgon Liquefied Natural Gas Plant– captured half of 80% goal in first few years (by July 2021)
- \$11 Billion to date invested by US [\$6 Billion+ (as of 2020) & \$5.1 Billion more in Biden’s Infrastructure Bill (2021)]
- >80% of 39 CCS projects attempted in the U.S. failed
 - Latest in US: NRG Energy’s Petra Nova coal-fired plant in Texas closed permanently in Jan. 2022
- Limited potential use in non oil & gas production, e.g., cement & steel



<https://gizmodo.com/the-only-carbon-capture-plant-in-the-u-s-just-closed-1846177778> Jan 2022

<https://foe.scot/wp-content/uploads/2021/01/CCS-Research-Summary-Briefing.pdf> Jan 2021

<https://iopscience.iop.org/article/10.1088/1748-9326/abd19e/meta>

<https://crsreports.congress.gov/product/pdf/IF/IF11501/3>

<https://www.eco-business.com/news/carbon-capture-and-storage-wont-work-critics-say/>

<https://www.canarymedia.com/articles/carbon-capture/the-carbon-capture-project-that-couldnt-chevron-misses-targets-for-its-huge-australia-facility>

<https://theclimatconnection.org/carbon-capture-and-storage-pros-cons/>

<https://www.treehugger.com/carbon-capture-and-storage-ccs-pros-cons-5120005>

<https://www.iea.org/reports/direct-air-capture>

Direct Air Capture (DAC)

new technology to extract past CO₂ pollution from the atmosphere



Credit: Climeworks.

- <https://www.rechargenews.com/energy-transition/the-amount-of-energy-required-by-direct-air-carbon-capture-proves-it-is-an-exercise-in-futility/2-1-1067588>
- <https://www.reuters.com/business/cop/global-carbon-emissions-rebound-near-pre-pandemic-levels-2021-11-04/>
- <https://www.greenbiz.com/article/direct-air-capture-ready-its-closeup>
- www.carbon180.org
- Direct Air Capture fact sheet (Carbon 180):
<https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/6193e4c60dc10420edc0f5cd/1637698407681/Carbon180+Ed+Pack+et+DAC.pdf>

- Pulls air through filters where it reacts with chemicals and is stored or used to make synthetic fuels
- ~19 Direct Air Capture (DAC) plants operating worldwide
- Only captures ~0.01 Mt CO₂/year, tiny fraction of the 34 Gigatons of fossil emissions in 2021
- Estimated to remove ~5 Gigatons by 2050
- Very energy intensive (requires almost same energy as in the fossil fuels that produce the CO₂)
- \$3.5 Billion for 4 regional DAC facilities in Biden's 2021 Infrastructure Bill