LOCAETA Data Explorer: Industrial Emissions and Decarbonization

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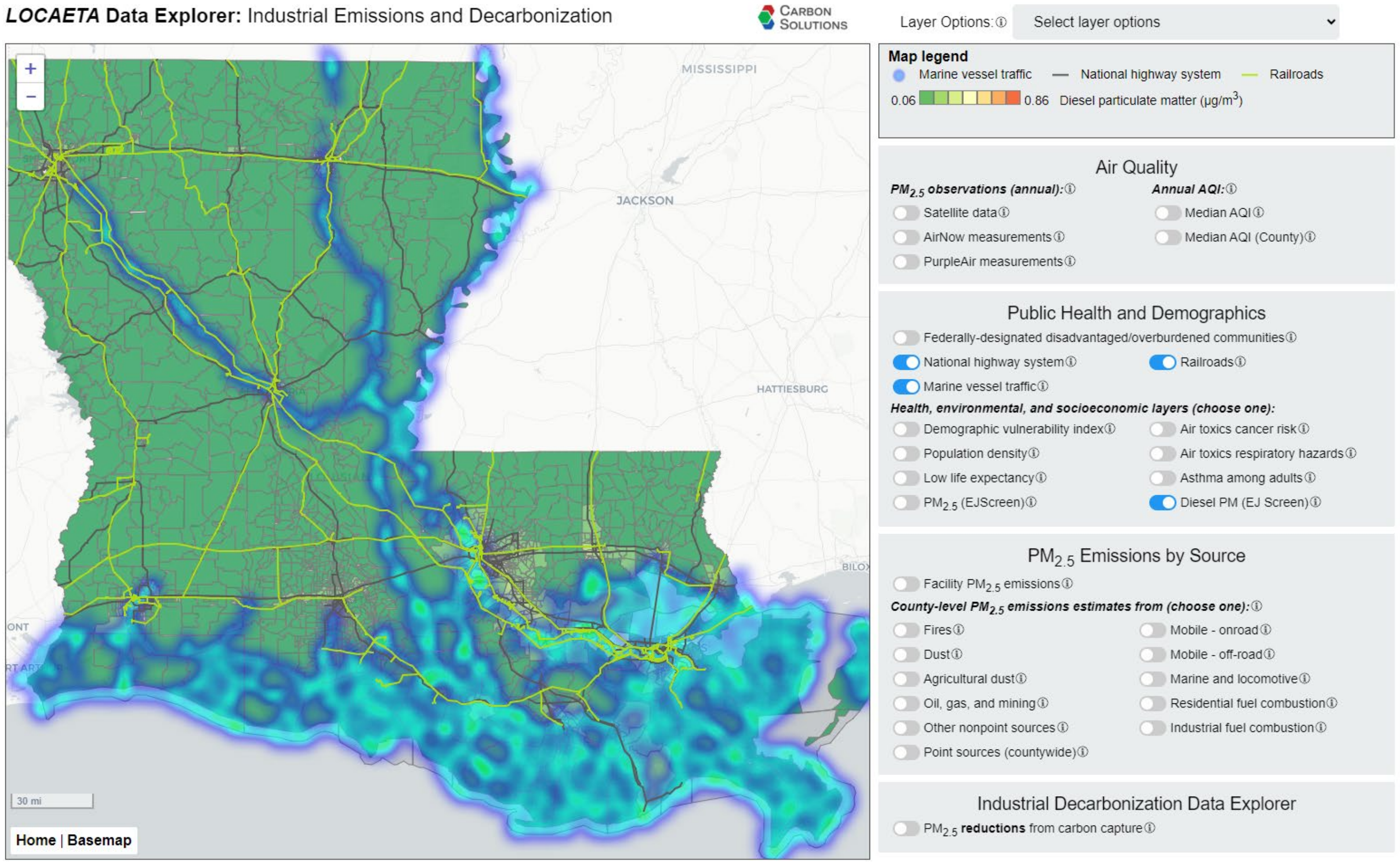
Outline

Introducing the *LOCAETA* Data Explorer: motivation, goals, and approach

Quantifying air quality co-benefits from carbon capture

Interactive tool demo →



LOCAETA - LOcal Climate and Air Emissions Tracking Atlas

Air pollution is an important public health factor and disadvantaged communities are impacted more.

Reducing greenhouse gas emissions will often also reduce air pollution from those sites.

We can decarbonize while enacting a just, efficient energy transition.

The goal of *LOCAETA* is to **identify community impacts from industrial emissions** and to help **estimate the air quality health benefits** from decarbonizing these industries to specific communities.

***LOCAETA* combines multiple disparate datasets to answer three questions:**

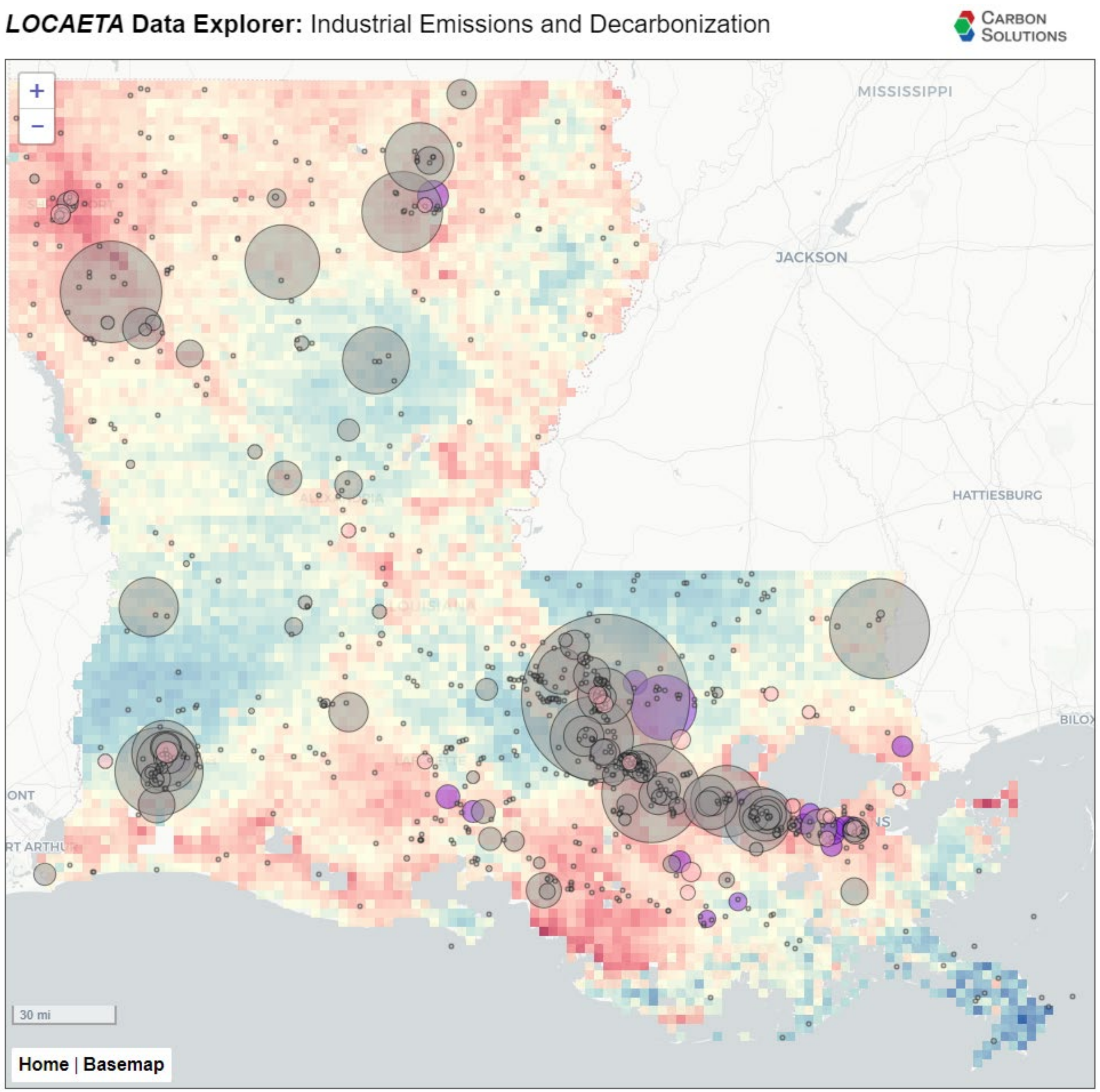
1. Which communities are impacted by industrial emissions of air pollution?
2. What are the benefits to local air quality from decarbonizing industry?
3. How much are these communities impacted?

Phase I of the project:

- Demonstrated for Louisiana
- Focuses on 2020 data
- Plain-language info boxes and pop-ups
- Mainly shows $PM_{2.5}$ impacts
- Includes satellite and *in situ* observations
- Local health risks for cancer and respiratory hazards
- Demographic layers and disadvantaged communities
- Emissions sources: facilities, fires, dust, transportation, other non-point sources
- $PM_{2.5}$ reductions estimated from carbon capture

Future work:

- Work with communities on prototype
- Nationwide, more temporal options
- Other pollutants (NO_x, SO_2)
- Additional decarbonization options (fuel-switching, electrification, etc.)
- Advanced air quality and public health modeling



Quantifying air quality co-benefits from carbon capture

Amine-based carbon capture systems will typically require pre-treatment to operate efficiently

Pre-treatment would remove PM, NO_x, and SO_2 to levels that are appropriate for the system

Amine-based systems may also *generate* co-pollutants such as NH_3 and VOCs

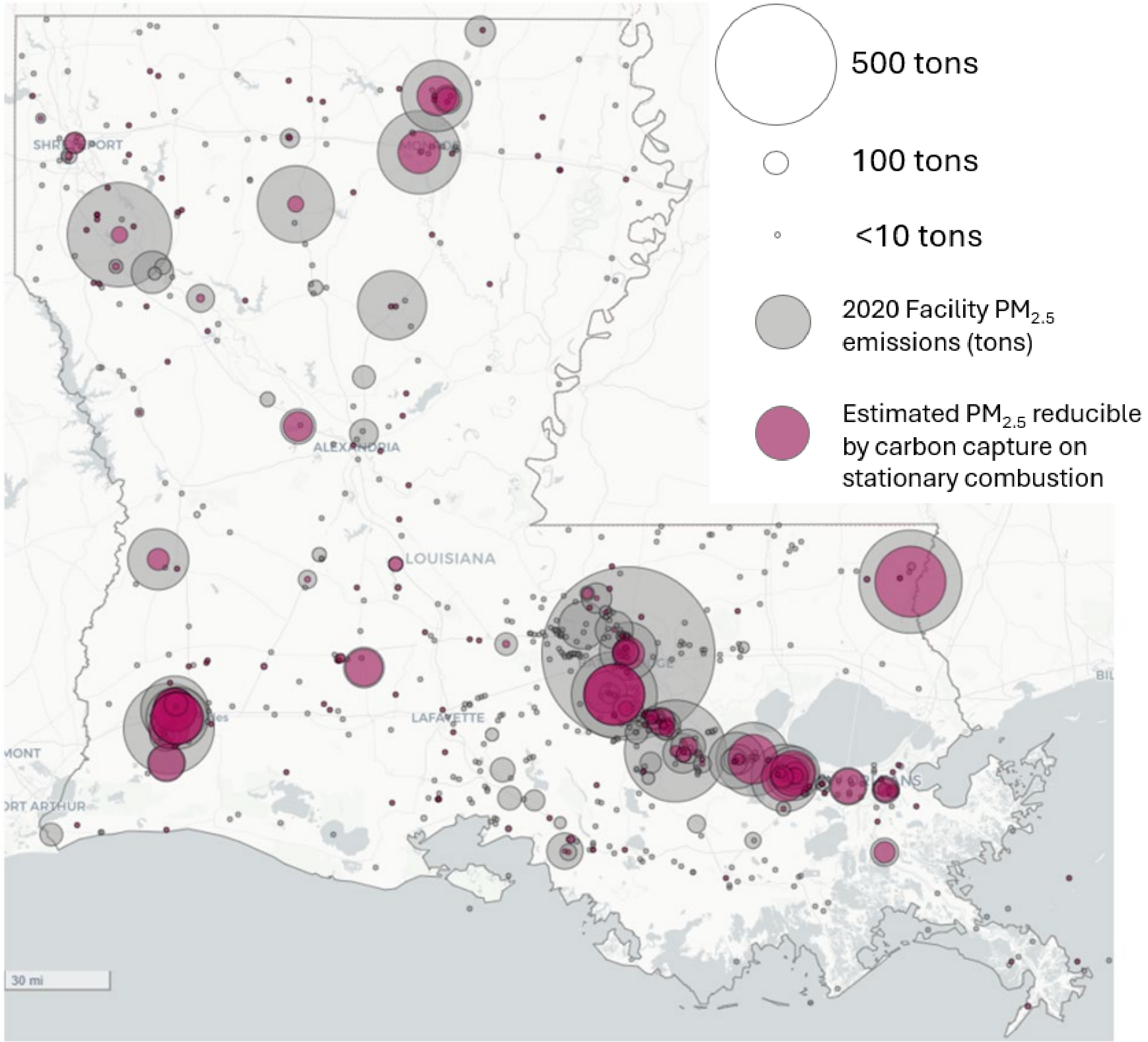
See Bennett et al. 2023, 2024

Quantifying air quality co-benefits from carbon capture, cont'd.

Approach:

1. Run *CO_2NCORD* to assess capturable CO_2 streams (and costs)
2. Match facilities between the Greenhouse Gas Reporting Program (GHGRP) and the National Emissions Inventory (NEI, 2020)
3. Match units in NEI to steams in *CO_2NCORD*
4. Apply reduction percentages for filterable and condensable $PM_{2.5}$ from Brown et al. (2023) to the captured *stationary combustion* streams
5. Compute possible NH_3 and VOC formation

See Bennett et al. 2023, 2024



Comparison of Four Facilities

Facility	Sector	tCO_2 facility total[1]	tCO_2 stationary combustion[2]	tCO_2 reduced[3]	$tPM_{2.5}$ facility total[4]	$tPM_{2.5}$ stationary combustion[5]	$tPM_{2.5}$ reduced[5]	tVOCs produced[5]	tNH_3 produced[5]
ExxonMobil Baton Rouge Refinery	Refining	6,250,926	4,509,343	4,058,327	736	142	136	8.9	852
Dow Chemical – Louisiana Operations	Chemicals	1,938,708	1,725,271	1,542,835	365	270	259	3.4	324
CF Industries Donaldsonville Nitrogen Complex	Ammonia	7,206,880	2,744,964	2,470,468	432	47	46	5.4	519
International Paper Co. Mansfield Mill	Pulp and Paper	1,789,935	803,123	719,176	444	72	68	0.9	89

Sources:

1. U.S. EPA, https://www.epa.gov/system/files/other-files/2023-10/2022_data_summary_spreadsheets_0.zip
2. U.S. EPA, https://data.epa.gov/efservice/C_SUBPART_LEVEL_INFORMATION/EXCEL
3. *CO_2NCORD* results (this study)
4. U.S. EPA, https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data
5. *LOCAETA* results (this study)

LOCAETA Current Limitations

CCS only

- Assumes amine-based capture
- Uses preliminary literature values for co-pollutant reductions necessary for capture

Only considers stationary combustion (subparts C and D)

- Other streams at a facility may be capturable
- Uses SCC codes in NEI data to determine what is stationary fuel combustion (not listed by subpart)
- Future work: align SCC codes with other GHGRP Subparts to match emissions reductions based on carbon capture feasibility and cost; sector-specific analysis

Uses an algorithm to match facilities between *CO_2NCORD* output and NEI – has some uncertainty

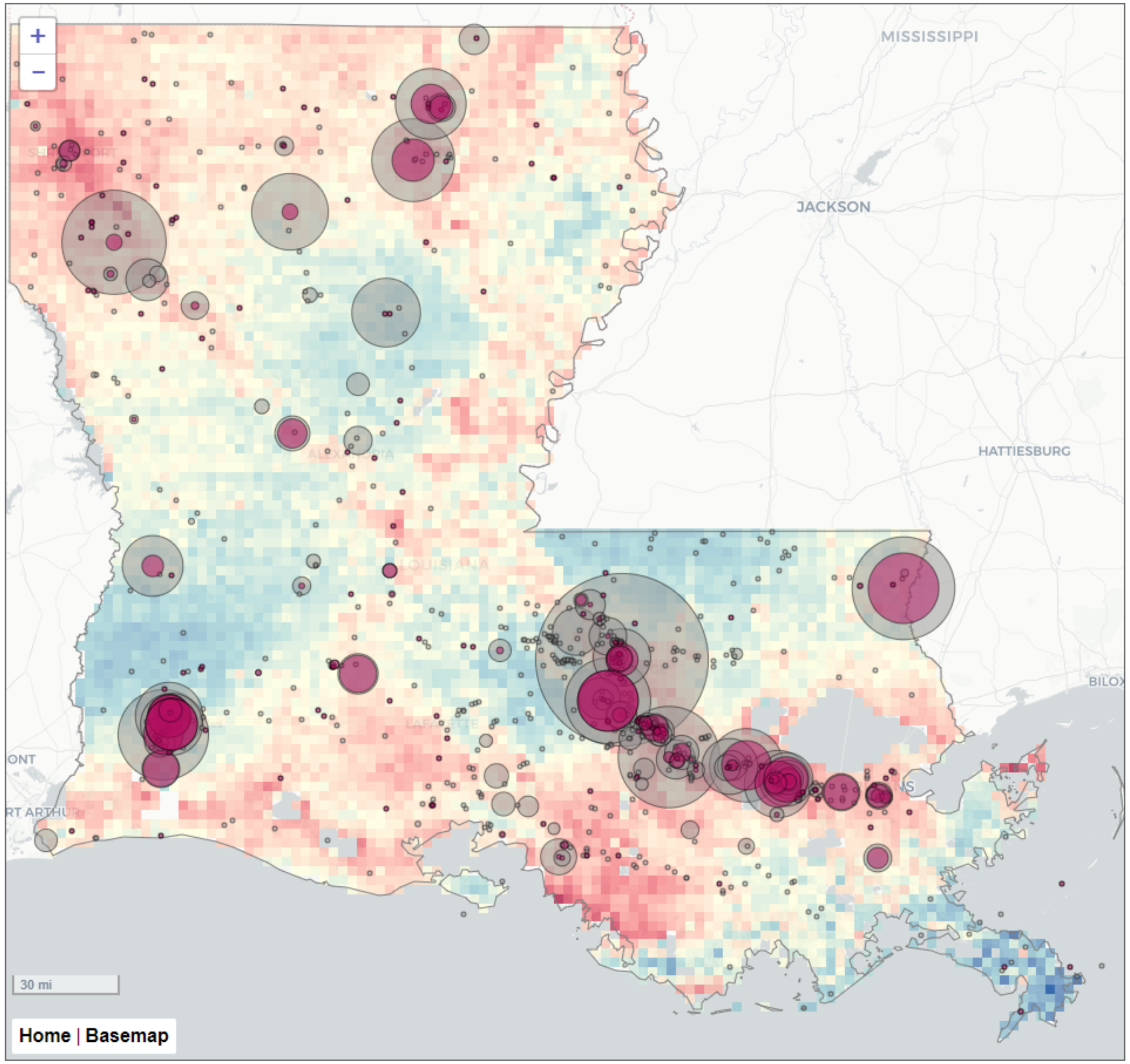
- 2021 *CO_2NCORD* vs 2020 NEI
- Facilities may be split and named differently between the two databases

LOCAETA demo http://apps.carbonsolutionsllc.com/locaeta

***LOCAETA* Data Explorer:** Industrial Emissions and Decarbonization

Carbon Solutions

Layer Options: ⓘ Select layer options



Map legend

Estimated $PM_{2.5}$ reducible by CCS (tons) — 2020 facility $PM_{2.5}$ (tons)

4 — 11.6 Satellite $PM_{2.5}$ (ug/m^3)

Air Quality

$PM_{2.5}$ observations (annual): ⓘ
- Satellite data ⓘ
- AirNow measurements ⓘ
- PurpleAir measurements ⓘ

Annual AQI: ⓘ
- Median AQI ⓘ
- Median AQI (County) ⓘ

Public Health and Demographics

- Federally-designated disadvantaged/overburdened communities ⓘ
- National highway system ⓘ
- Railroads ⓘ
- Marine vessel traffic ⓘ

Health, environmental, and socioeconomic layers (choose one):
- Demographic vulnerability index ⓘ
- Air toxics cancer risk ⓘ
- Population density ⓘ
- Air toxics respiratory hazards ⓘ
- Low life expectancy ⓘ
- Asthma among adults ⓘ
- $PM_{2.5}$ (EJScreen) ⓘ
- Diesel PM (EJ Screen) ⓘ

$PM_{2.5}$ Emissions by Source

- Facility $PM_{2.5}$ emissions ⓘ

County-level $PM_{2.5}$ emissions estimates from (choose one): ⓘ
- Fires ⓘ
- Mobile - onroad ⓘ
- Dust ⓘ
- Mobile - off-road ⓘ
- Agricultural dust ⓘ
- Marine and locomotive ⓘ
- Oil, gas, and mining ⓘ
- Residential fuel combustion ⓘ
- Other nonpoint sources ⓘ
- Industrial fuel combustion ⓘ
- Point sources (countywide) ⓘ

Industrial Decarbonization Data Explorer

- $PM_{2.5}$ **reductions** from carbon capture ⓘ

Future work

Feedback from users

Sector-specific analysis (CCS, other)

- May be able to compare results better within sectors than across the board
- Include more streams than stationary combustion

Expand the Data Explorer

- Nationwide
- Other pollutants (NO_x, SO_2)

Additional decarbonization options

- Industrial electrification
- Fuel-switching
- Facility decommission

Advanced air quality and public health modeling

- Determine the air quality effects on specific communities from facility emissions
- Analyze likely public health benefits

Go check it out!

http://apps.carbonsolutionsllc.com/locaeta/

References

Bennett, J., Gilhooley, C., Harrison, A., Jordan, A., Rodriguez, D., Sale, K., Taylor, J., 2024. *Chapter 2: Capturing CO2: Technology and Impacts*, in: Acks, A., Devine, E. (Eds.), Carbon Capture and Storage: Safety and Impact Considerations from Source to Sequestration. Colorado Energy and Carbon Management Commission.

Bennett, J., Kammer, R., Eidbo, J., Ford, M., Henao, S., Holwerda, N., Middleton, E., Ogland-Hand, J., Rodriguez, D., Sale, K., Talsma, C., Thomley, E., Fry, M., 2023. *Carbon Capture Co-benefits: Carbon Capture's Role in Removing Pollutants and Reducing Health Impacts*. Great Plains Institute and Carbon Solutions Report, https://carboncaptureready.betterenergy.org/wp-content/uploads/2023/08/Carbon-Capture-Co-Benefits.pdf.

Brown, J., Thompson, J., Longstreth, B., Graham, J., Jaruzel, M., Nagabhushan, D., Sheff, E., Dombrowski, K., Jones, C., 2023. *Air Pollutant Reductions From Carbon Capture: An Analysis of the Air Quality and Public Health Benefits of Carbon Capture and Storage.* Clean Air Task Force Report, https://cdn.catf.us/wp-content/uploads/2023/11/28104644/air-pollutant-reductions-carbon-capture-report.pdf.