



The Climate Challenge and Solutions for Communities



Marilyn A. Brown, PhD
Regents & Brook Byers Professor
NAE, NAS, AAAS, CEM
School of Public Policy
Georgia Institute of Technology

Rachel Carson Distinguished Lecture, Michigan State University

October 1, 2024

- Georgia Tech
- University of Georgia
- Emory University
- Georgia State



- Southface Institute
- Greenlink Analytics
- Partnership for Southern Equity



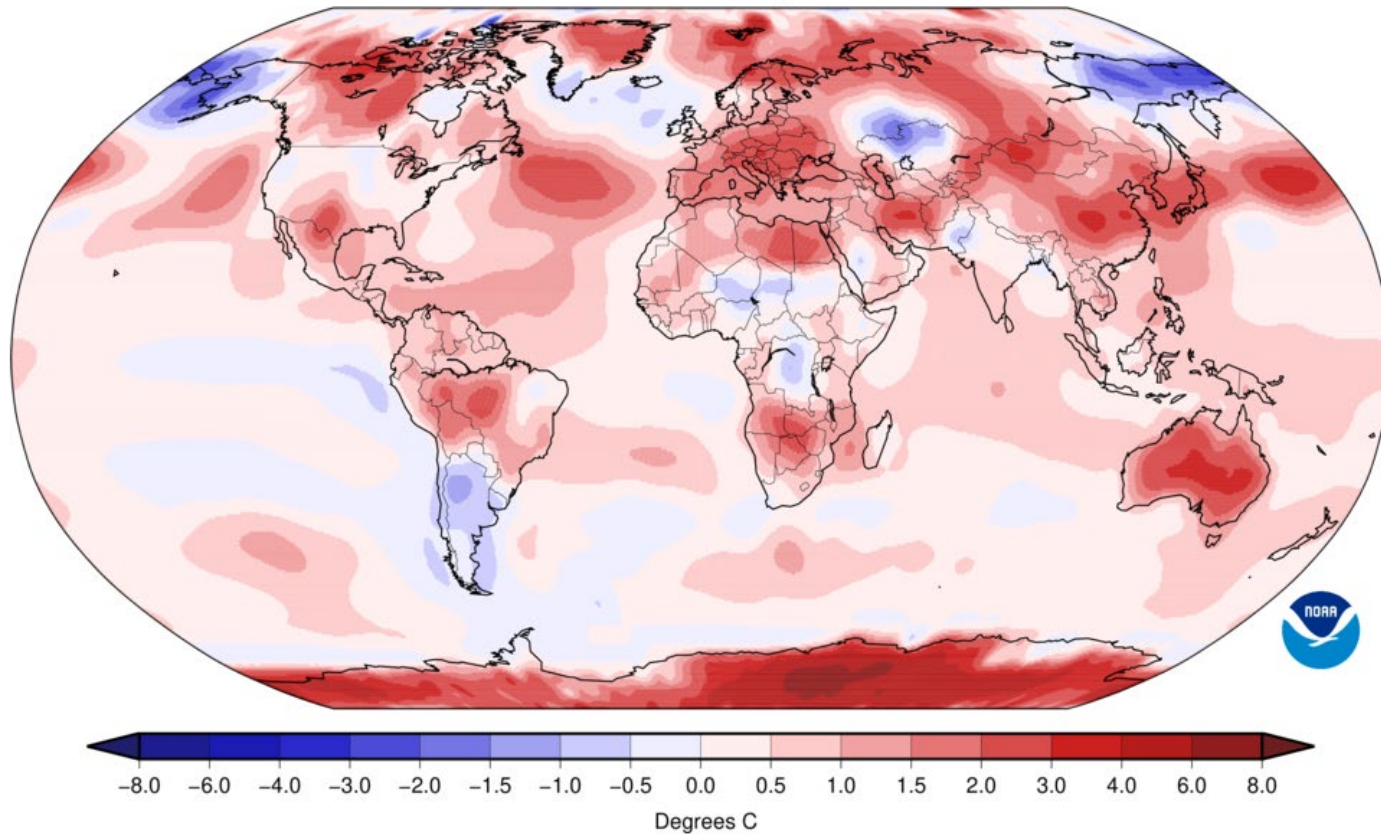
- Atlanta Metropolitan
- Georgia State College
- Kennesaw State
- Morehouse College
- Spelman College

Our motivation: Global climate change and the harm it is causing

August 2024 was the 15th consecutive record -warm month since 1850.

Land & Ocean Temperature Departure from Average Aug 2024
(with respect to a 1991-2020 base period)

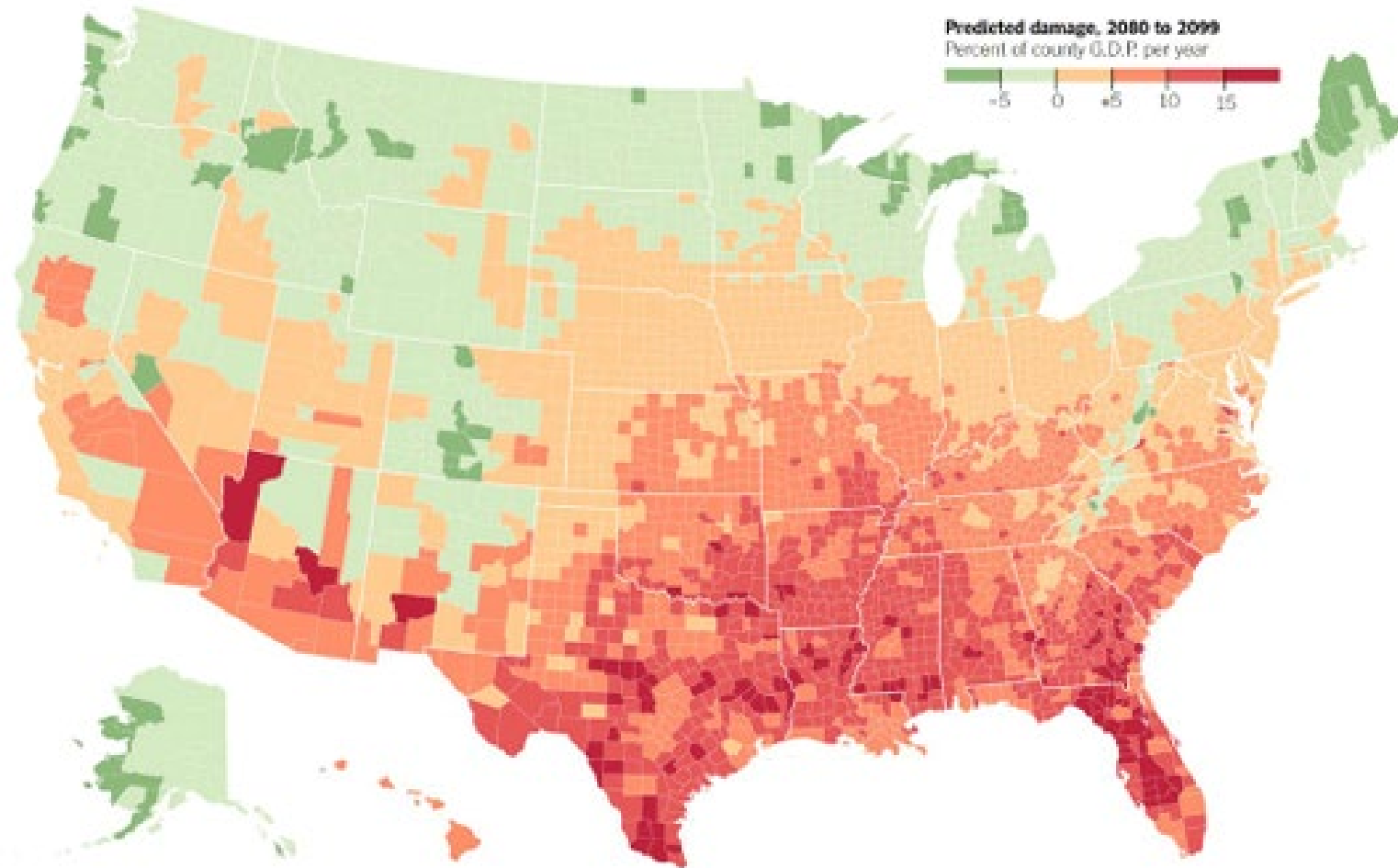
Data Source: NOAAGlobalTemp v6.0.0-20240908



Think global,
Act local

Most of the U.S. will experience damages from climate change, especially the Southeast

Predicted county-level economic damage from climate change, 2080-2099, under a high-emissions scenario. Could lead to 10-20% loss of GDP in much of the Southeast.



(Source: Adapted from Solomon Hsiang et al., as published by the New York Times June 29, 2017)



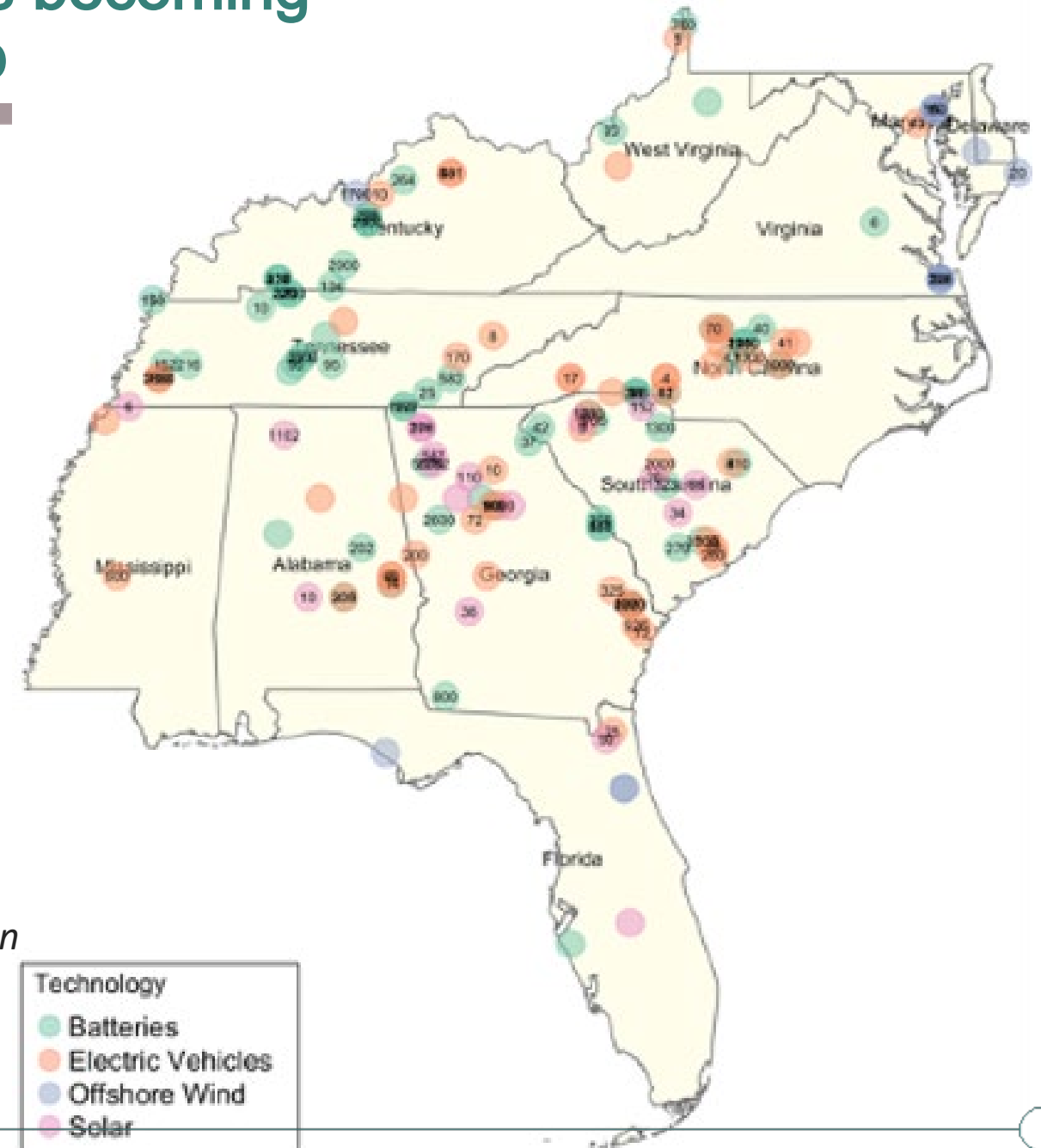
At the same time, the Southeast is becoming a clean energy manufacturing hub

The US government will spend more than \$500 billion on climate technology over the next decade.

This is the biggest downpayment on climate change solutions every made:

- Infrastructure Investment and Jobs Act
- Inflation Reduction Act (IRA)
- CHIPS and Science Act

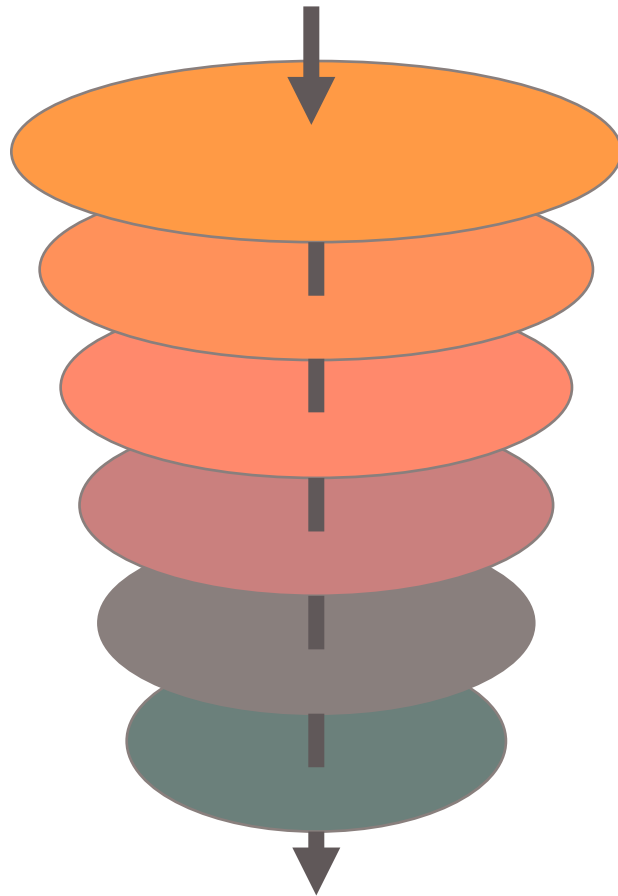
The SE received 47% of the first \$179 billion of this funding.



Source: Brown, M. A. et al. 2024. *Southeast Decarbonization Workshop - Activating science, business, and community partnerships*. Oak Ridge National Laboratory.

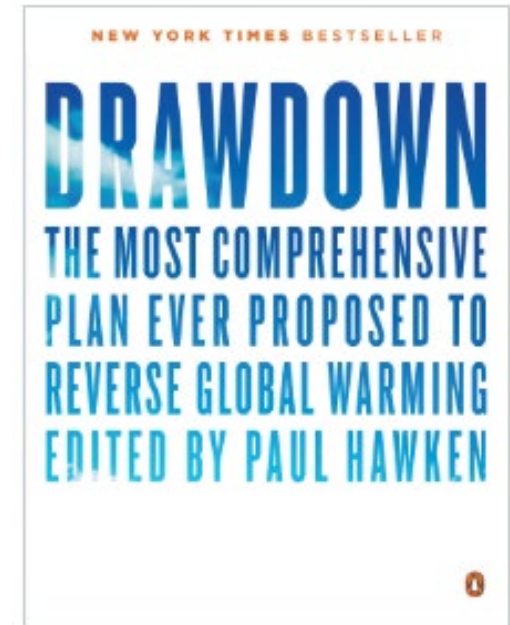
<https://www.osti.gov/biblio/2404612/>

In the absence state targets and plans, we launched a grass roots project in 2018 called “Drawdown Georgia”



The research team put 100 global solutions through a series of filters to “localize” them

- Is it market ready?
- Is there local experience?
- Can it have a meaningful impact by 2030?
- Is it affordable?
- What about equity, jobs, public health and other social values “beyond carbon”?



Standardized methods were used to evaluate solutions



Technical Potential: Maximum realistic application without regard to cost or other impacts, up to hard limits on resources such as available land and materials.

e.g., Recycling 95% of disposed recyclable materials.

Achievable Potential: A realistic scenario that considers costs, impacts, and stakeholder acceptance, but consistent with a greater commitment to success.

e.g., Growing large-scale solar from 2 to 11% of its electricity mix.

Baseline Forecast: “No new policies,” slow rate of performance improvement, and economic growth resulting in a flat trajectory of climate pollution.

The result: A roadmap of 20 high -impact climate solutions for Georgia

Drawdown Georgia climate solutions come from all sectors of the economy



Electricity

- Utility-Scale Solar*
- Demand Response*
- Rooftop Solar + Storage*
- Cogeneration
- Landfill Methane

Transportation

- Electric Vehicles*
- Energy-Efficient Cars
- Energy-Efficient Trucks
- Mass Transit
- Alternative Mobility

Food & Agriculture

- Composting
- Climate-Smart Agriculture
- Plant Rich Diet
- Reduced Food Waste

Buildings & Materials

- Recycling
- Refrigerant Management
- Retrofitting Buildings*

Land Sinks

- Planting Trees
- Wetlands
- Forest Management

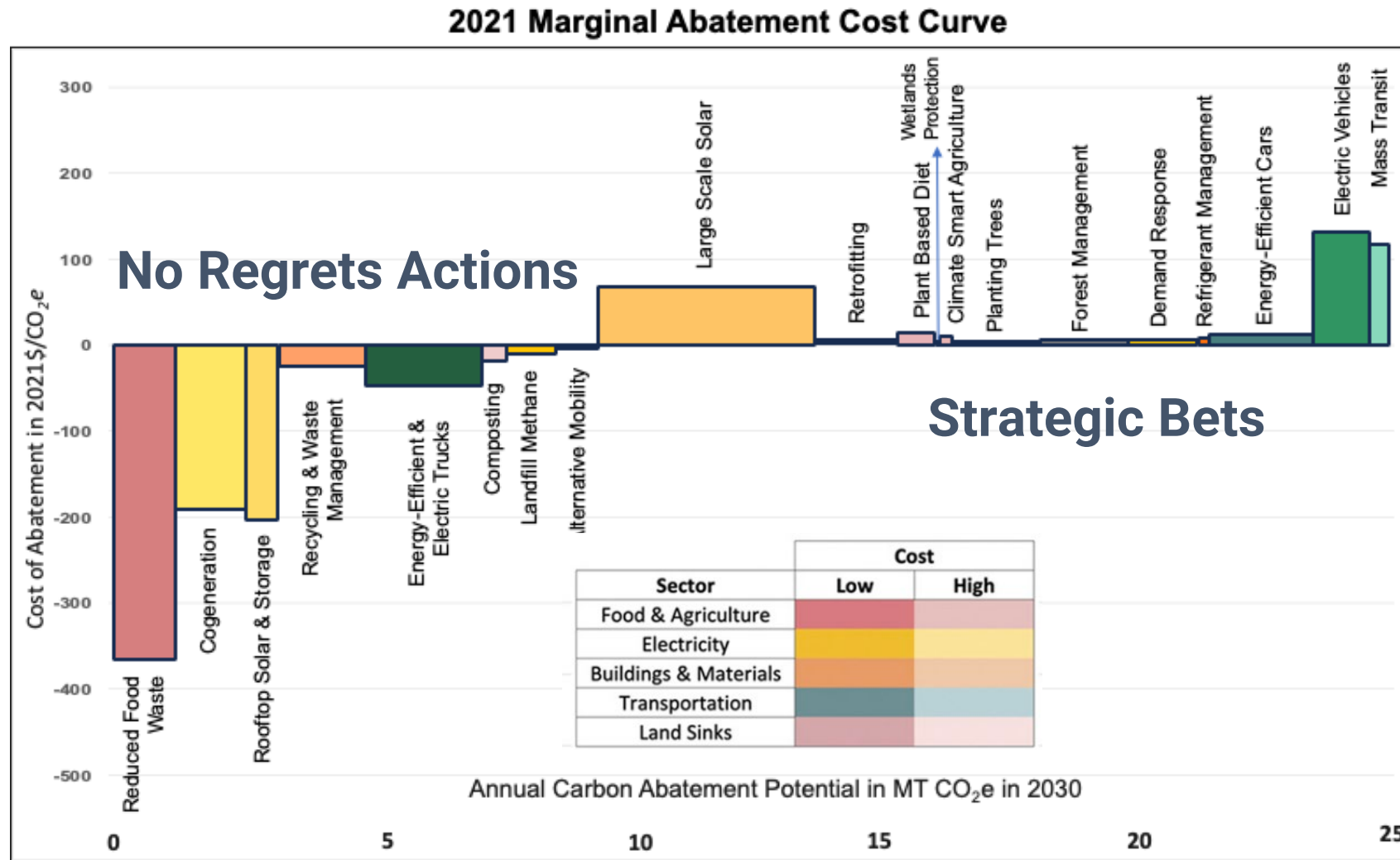
Beyond Carbon

- Equity
- Economic Development & Jobs
- Public Health
- Environmental Quality

*Many of these involve electrification of the economy.

There were both “no regrets actions” and “strategic bets”

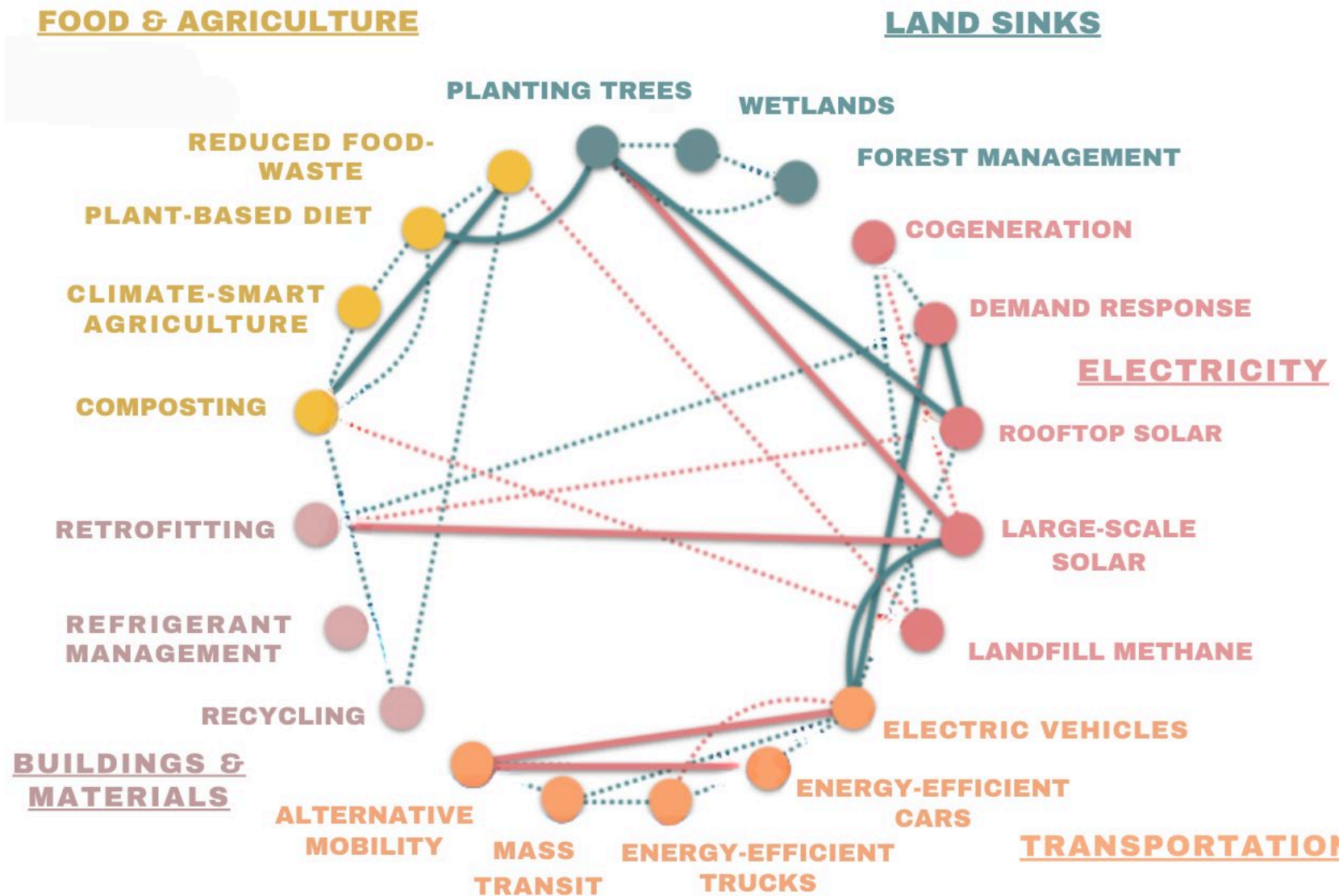
Cost of Abatement in 2021\$/tCO₂e



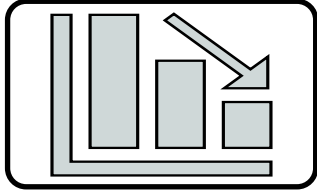
Annual Carbon Abatement Potential in Mt CO₂-e in 2030

Note: Lighter-colored shapes document the higher estimate of cost estimates

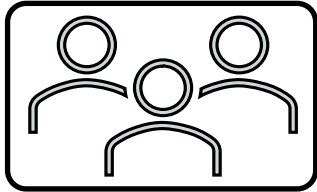
Interactions between solutions were modelled.



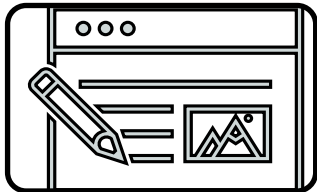
In 2021, we created the first state Business Compact focused on climate solutions with 4 expectations:



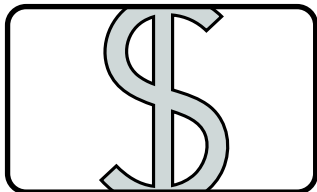
Support the target to achieve net -zero greenhouse gas emissions in Georgia by 2050



Participate in collaborative initiatives



Report annually on activities to support the state -wide target



Contribute resources to sustain the compact

We now have ~60 Business Compact Members

accenture

ADVANTAGE
CAPITAL

AES
Alternative Energy Southeast

amazon

Anthem

ASCEND
ELEMENTS

Atlanta Gas Light

AUTODESK

betterearth

BLUE BIRD

BRIGHTMARK

CARBONCENTS

COX
ENTERPRISES

CHERRY
STREET
ENERGY

CISCO

cloverly

THE
Coca-Cola
COMPANY

COM
POST
NOW
.ORG

consequent

CREATURE
COMFORTS
Brewing Co.

DELTA

effecterra

einride

energyefficient
TECHNOLOGIES

EVERSHEDS
SUTHERLAND

ewaste
ePlanet

EY

FHLBank
ATLANTA
A FEDERAL HOME LOAN BANK

fresh harvest

GAS
SOUTH

GOODR

Google

Interface

Jamestown

KIA

LanzaTech

Last Bottle
CLOTHING

LONGLEAF RIDGE

Mannington
COMMERCIAL

NCX

NORFOLK SOUTHERN

OKABASHI

pela

PROPERTYworks

Retaaza

RYAM

shades of green
PERMACULTURE

Shaw

SolAmerica
ENERGY

Southwire

STRYTEN ENERGY

TENCATE
protectivefabrics

treeswift

TRUIST

TKE

ups

WHITE OAK
PASTURES
BLUFFTON, GEORGIA

YAMAHA

YKK

ZKB ENERGY
SERVICES, LLC

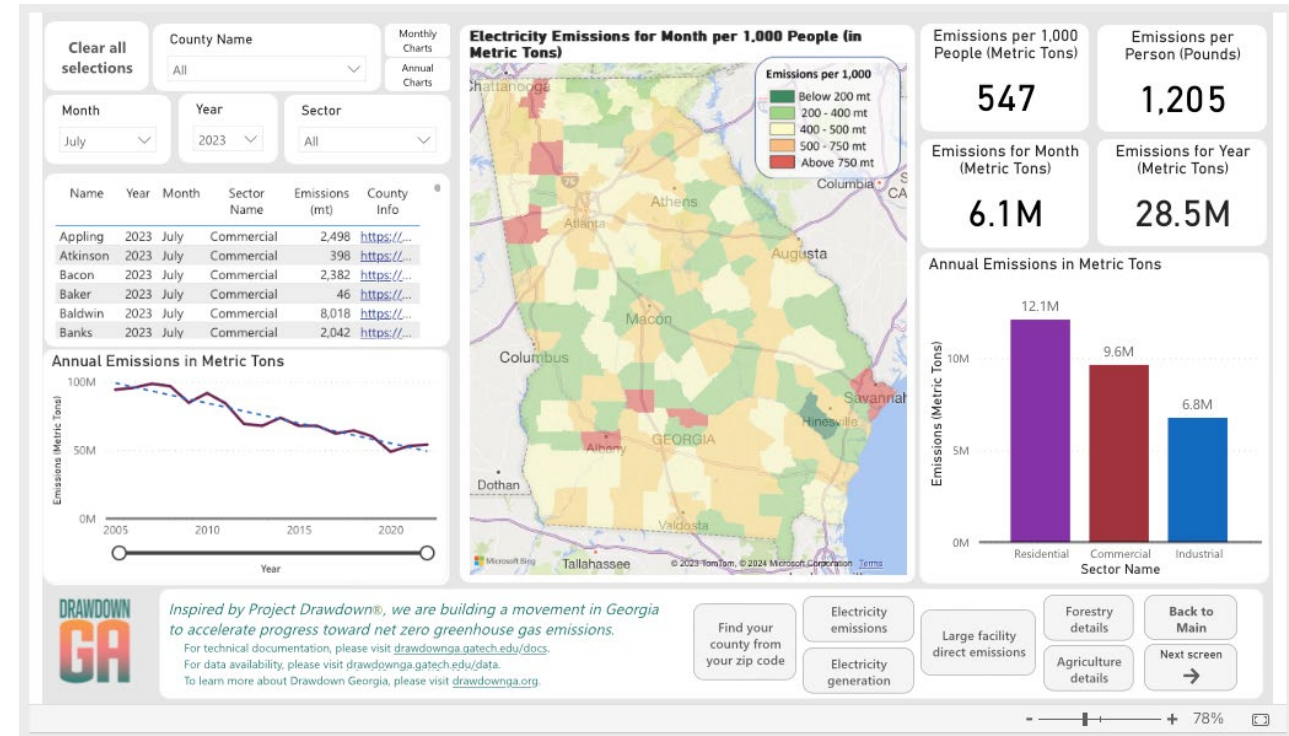
Emissions are being tracked monthly across 159 counties

Tracker goals:

- Help understand Georgia's GHG emissions by making them local, timely, and as accessible as possible
- Monitor progress toward net zero—requiring that we track both emissions and removals

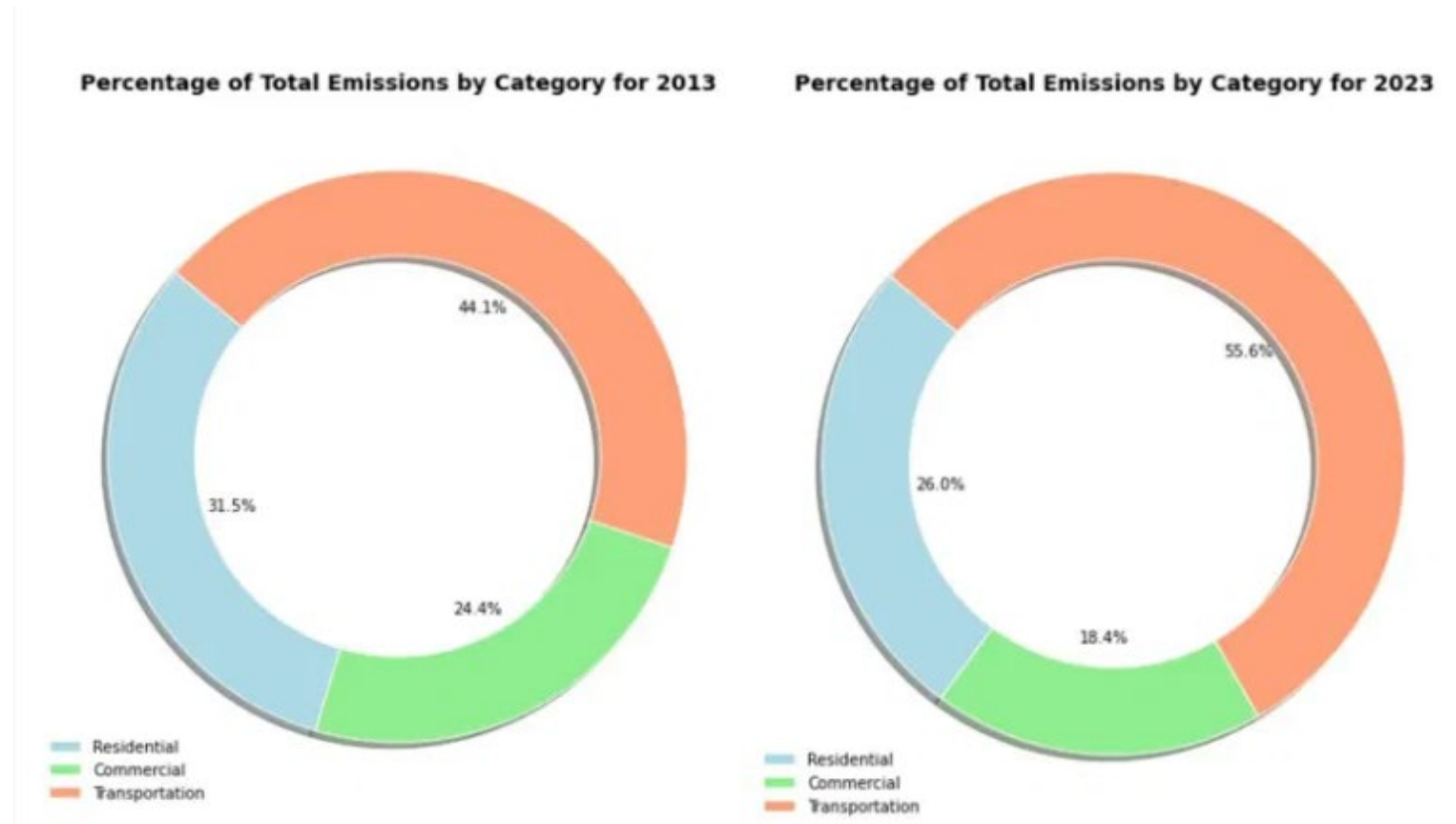
A city tracker will be launched in December 2024

The tracker is available at: <https://climatesolutions.gatech.edu/>



Transportation in Georgia has become the dominant source of the state's GHG emissions

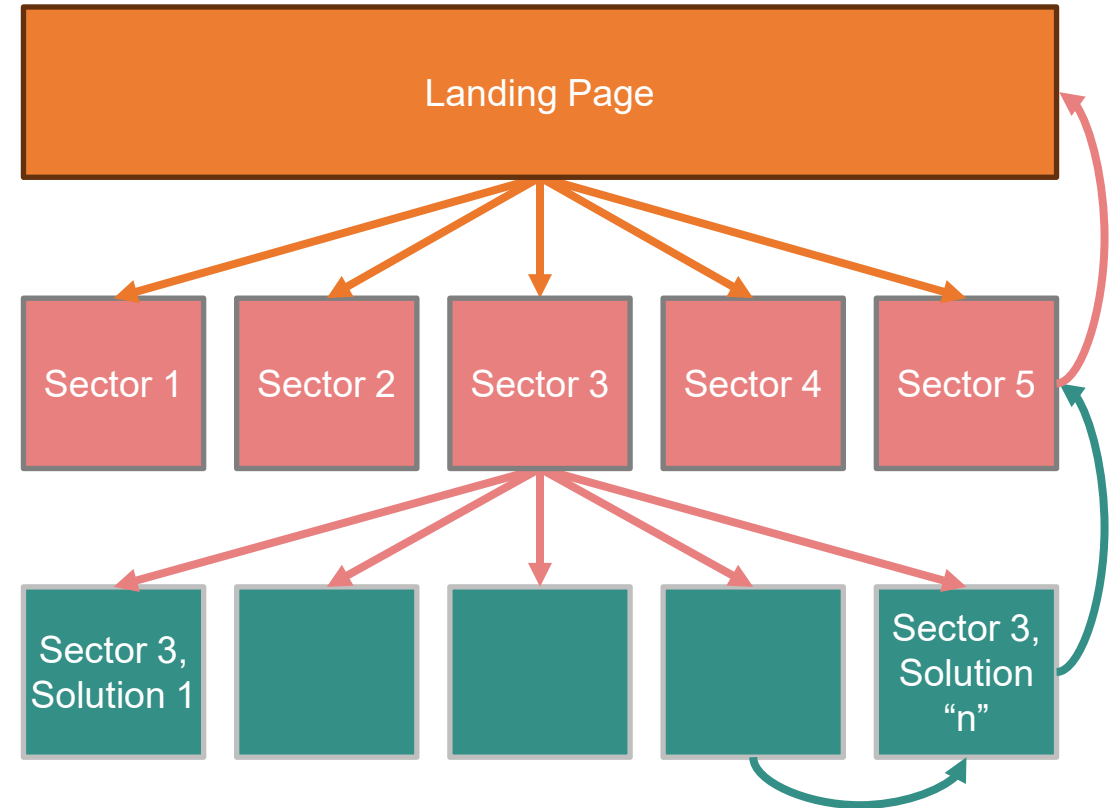
From 2013 to 2023, transportation has grown from 44% to 56% of the emissions included in Emissions Tracker.



Source: Maisunath Amin, [Atlanta Regional Commission](#) September 10, 2024



We have also developed a Climate Solutions Tracker for Georgia



The solutions tracker is available at: <https://climatesolutions.gatech.edu/>

Solutions Tracker Tour: Landing Page

Goal: Enable accessible, intuitive, and powerful interaction with the Solutions Tracker

Solutions for a Changing Climate

Each Drawdown Georgia solution has a strong track record, is cost-competitive and 'market-ready'. By bringing what's possible into focus, Drawdown Georgia puts us on a path to a low-carbon, high-quality of life future for all.

ELECTRICITY

BUILDINGS & MATERIALS

FOOD & AGRICULTURE

LAND SINKS

TRANSPORTATION

The Science of What's Possible

We love geeking out over our potential to dramatically reduce greenhouse gas emissions in Georgia, and we have a feeling you will too. Click "Explore" on the State of Georgia graphic to see what's possible. Our Carbon Reduction Visualizer allows you to see where emissions in the state are headed under the status quo -- and how that trajectory will change as our solutions begin to scale.



Every color-coded wedge represents how each solution can contribute ambitious, but achievable, emission reductions. It helps us visualize what's possible, and we believe if you can see it, you can achieve it. These calculations are a work in progress based on estimates and forecasts gathered from numerous sources. Stay tuned as this graph changes over time and as our emissions projections change.



Solutions Tracker Tour: Electricity Sector Page

Goal: Enable accessible, intuitive, and powerful interaction with the Solutions Tracker

← Back to Main ← Previous → Next

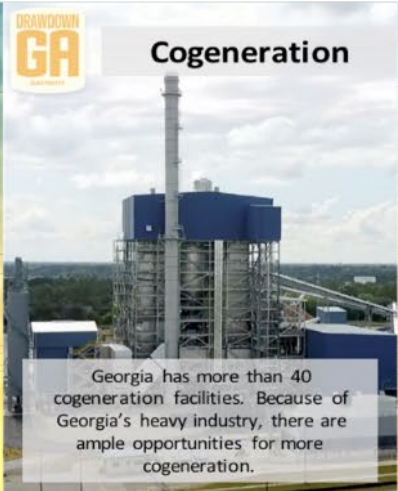
DRAWDOWN GA

ELECTRICITY

Here's the deal

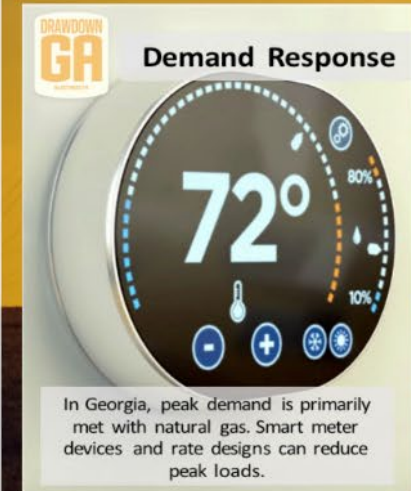
Accelerating Georgia's progress to renewables means increasing solar and putting waste heat to work in co-generation plants, capturing methane from landfills and turning it into power, and shifting our electricity usage to off-peak.

Cogeneration



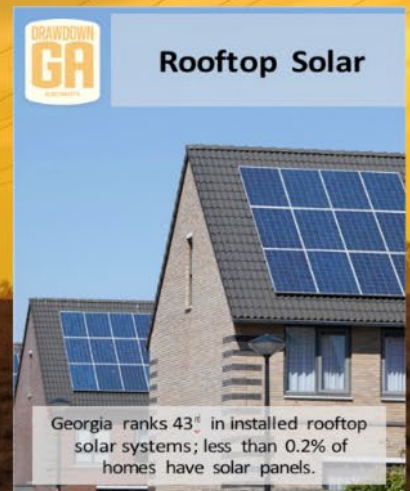
Georgia has more than 40 cogeneration facilities. Because of Georgia's heavy industry, there are ample opportunities for more cogeneration.

Demand Response



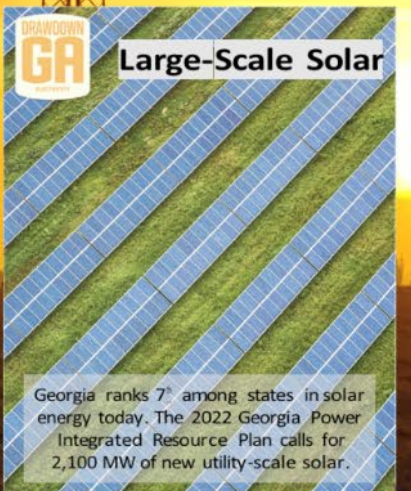
In Georgia, peak demand is primarily met with natural gas. Smart meter devices and rate designs can reduce peak loads.

Rooftop Solar



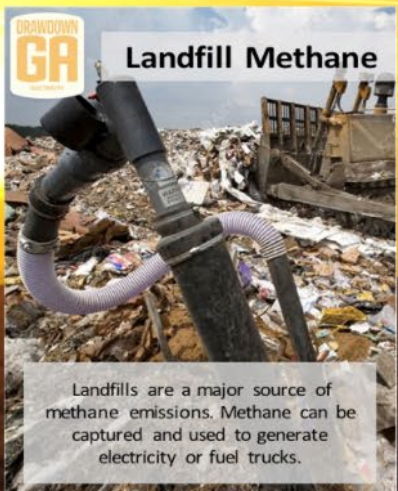
Georgia ranks 43rd in installed rooftop solar systems; less than 0.2% of homes have solar panels.

Large-Scale Solar



Georgia ranks 7th among states in solar energy today. The 2022 Georgia Power Integrated Resource Plan calls for 2,100 MW of new utility-scale solar.

Landfill Methane



Landfills are a major source of methane emissions. Methane can be captured and used to generate electricity or fuel trucks.



Heat pumps are constrained by natural gas heating

Retrofitting
BUILDINGS & MATERIALS

Next Solution
→

Jump to Sector...
ELECTRICITY BUILDINGS & MATERIALS FOOD & AGRICULTURE LAND SINKS TRANSPORTATION

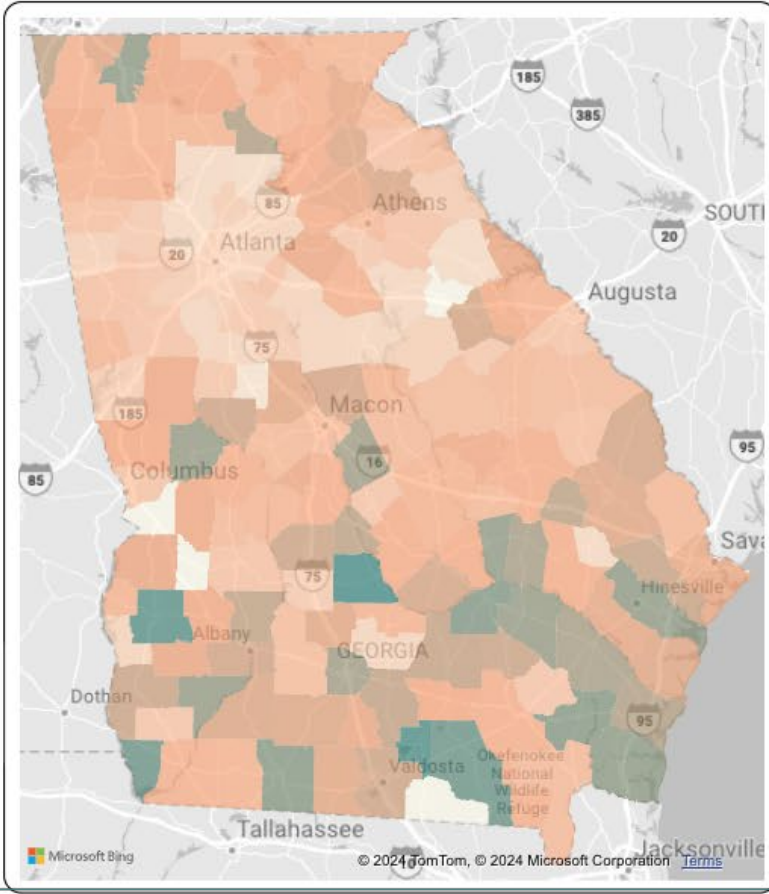
Retrofitting Solution

Heat Pumps (% Total Homes)

- Variable
- AC Rated SEER...
 - Ceiling Insulati...
 - Heat Pumps (...)
 - Homes With L...
 - Students at En...

Min	0.00
Q 1	18.60
Med	26.06
Q 3	32.35
Max	57.14

Avg 26.26
Gini Coef 0.22



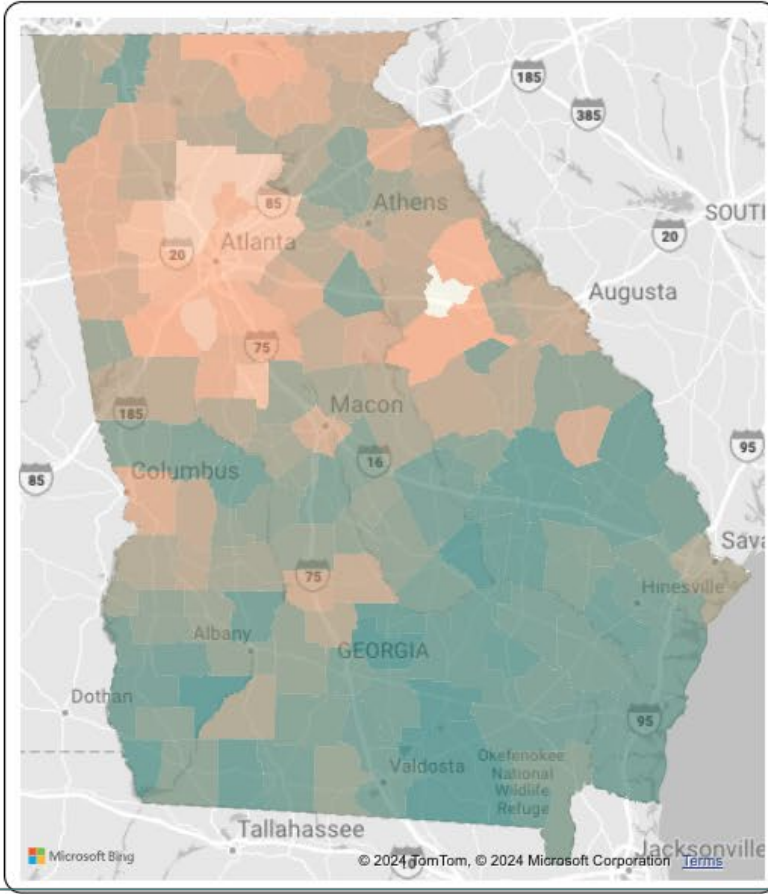
Comparison Variable

Electric HVAC Fuel (% Total Homes)

- Variable
- CEJST Disadva...
 - Electric HVAC ...
 - Electric Water ...
 - Home Actual Y...
 - Home Effectiv...

Min	0.00
Q 1	61.07
Med	73.47
Q 3	87.65
Max	100.00

Avg 72.53
Gini Coef 0.20



EVs are urban and infrastructure constrained

Electric Vehicles (EVs)

TRANSPORTATION

Previous Solution ← → Next Solution

Jump to Sector...
ELECTRICITY

BUILDINGS &
MATERIALS

FOOD &
AGRICULTURE

LAND SINKS

TRANSPORTATION

EV Adoption

EVs per 1,000 People

Comparison Variable

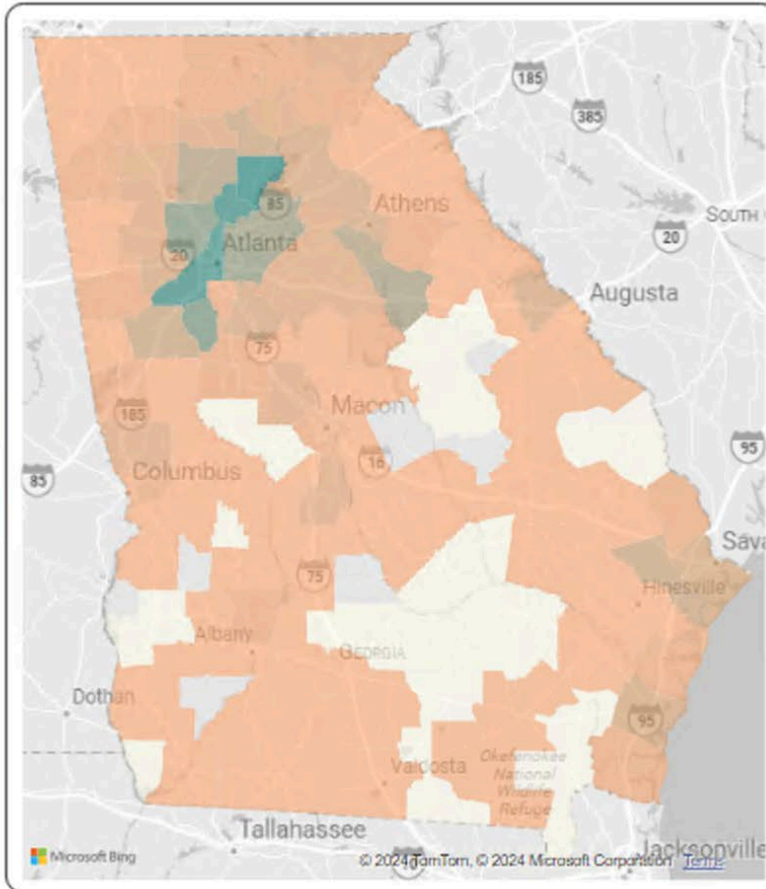
Charging Ports per 1,000 People

Variable

■ EVs per 1,000 ...

Min	0.12
Q1	0.62
Median	1.07
Q3	2.19
Max	18.31

Mean 1.98
Gini Coef 0.48

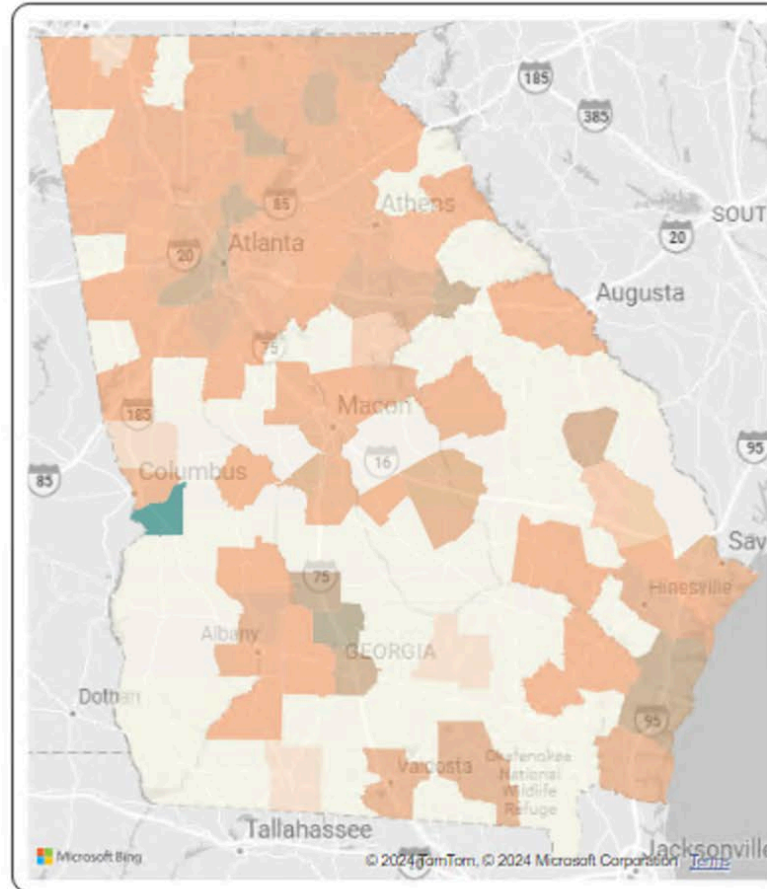


Variable

□ CEJST Disadva...
■ Charging Ports...
□ Charging Ports...
□ MHHI (Median...
Filter, Share, and More icons

Min	0.00
Q1	0.00
Median	0.07
Q3	0.25
Max	4.76

Mean 0.23
Gini Coef 0.49



Demand response tracks the service territories of electric coops

Demand Response ELECTRICITY

Previous Solution ← → Next Solution

Jump to Sector...
ELECTRICITY BUILDINGS & MATERIALS FOOD & AGRICULTURE LAND SINKS TRANSPORTATION

Demand Response

% of households enrolled in DR programs

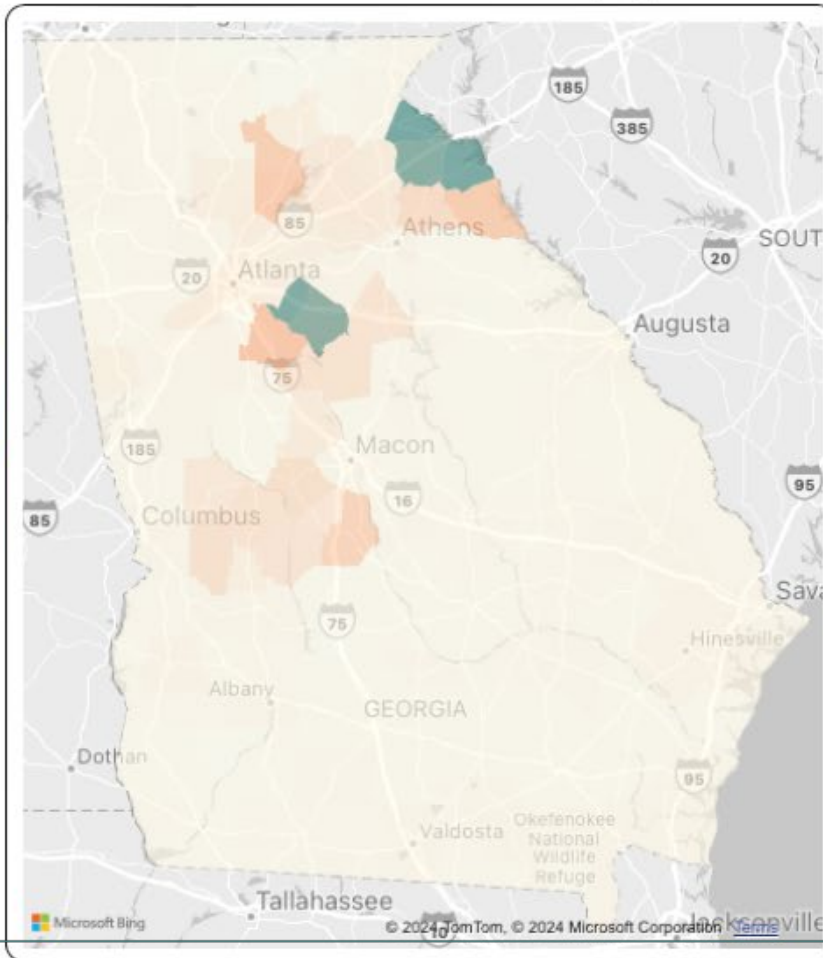
Variable

- # of househol...
- % of househol...

Min	0.00
Q 1	0.91
Median	1.45
Q 3	2.68
Max	86.53

Mean 6.07

Inequality Index
0.70



Comparison Variable

% AMI Households

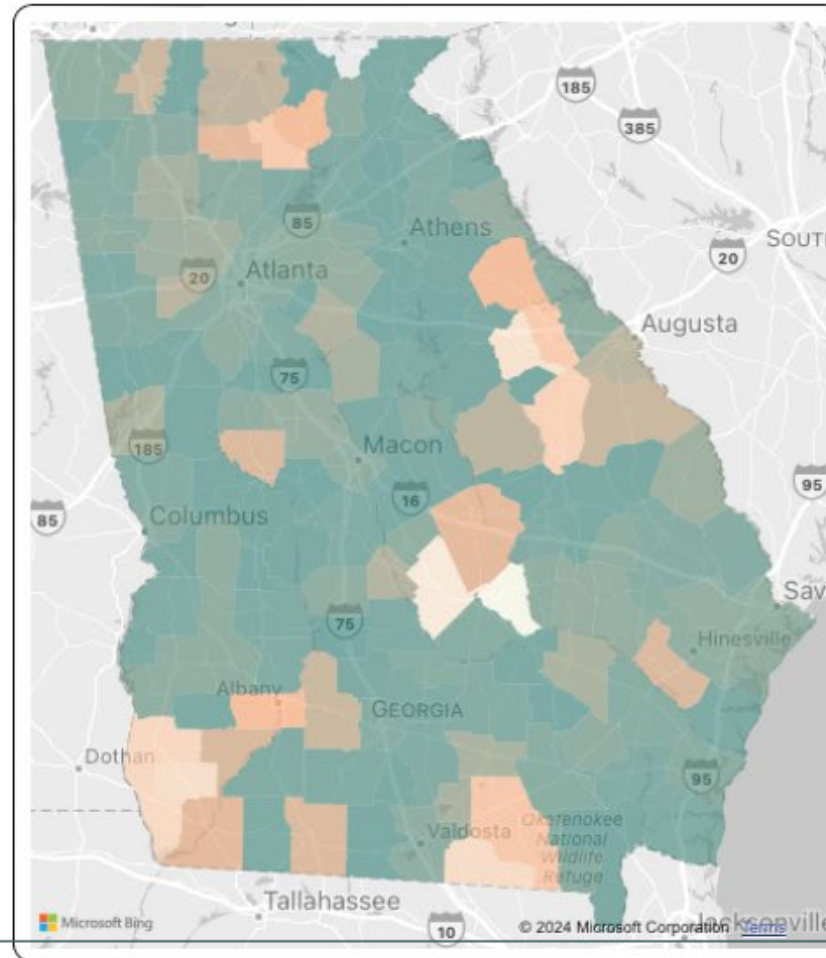
Variable

- % AMI Househ...
- % AMR House...
- % Direct Load ...
- % Households...
- Total AMI Hou...

Min	7.72
Q 1	83.10
Median	90.07
Q 3	96.17
Max	100.00

Mean 84.44

Inequality Index
0.06



Rooftop solar is wealth & urban constrained

Rooftop Solar ELECTRICITY

Previous Solution ← → Next Solution

Jump to Sector...
ELECTRICITY BUILDINGS & MATERIALS FOOD & AGRICULTURE LAND SINKS TRANSPORTATION

Rooftop Solar Solution

Residential Total Generation (KW)

Comparison Variable

Urban Area (% Land Area)

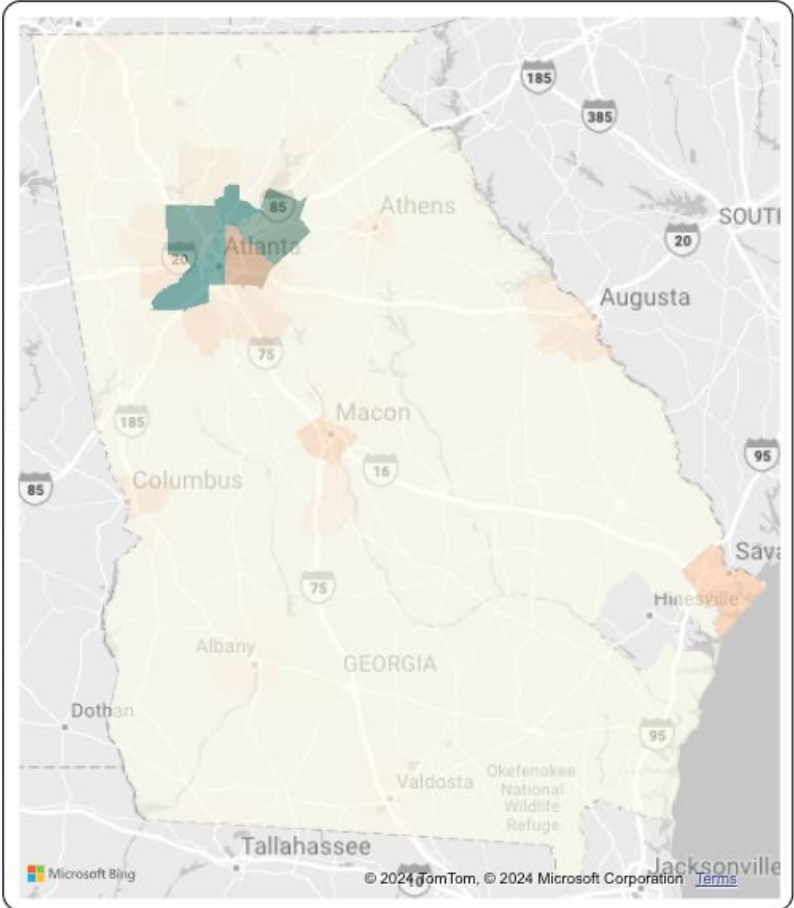
Variable

- Residential Tot...

Min	0.00
Q 1	1.48
Median	12.42
Q 3	69.14
Max	859.05

Mean 87.71

Inequality Index
0.9



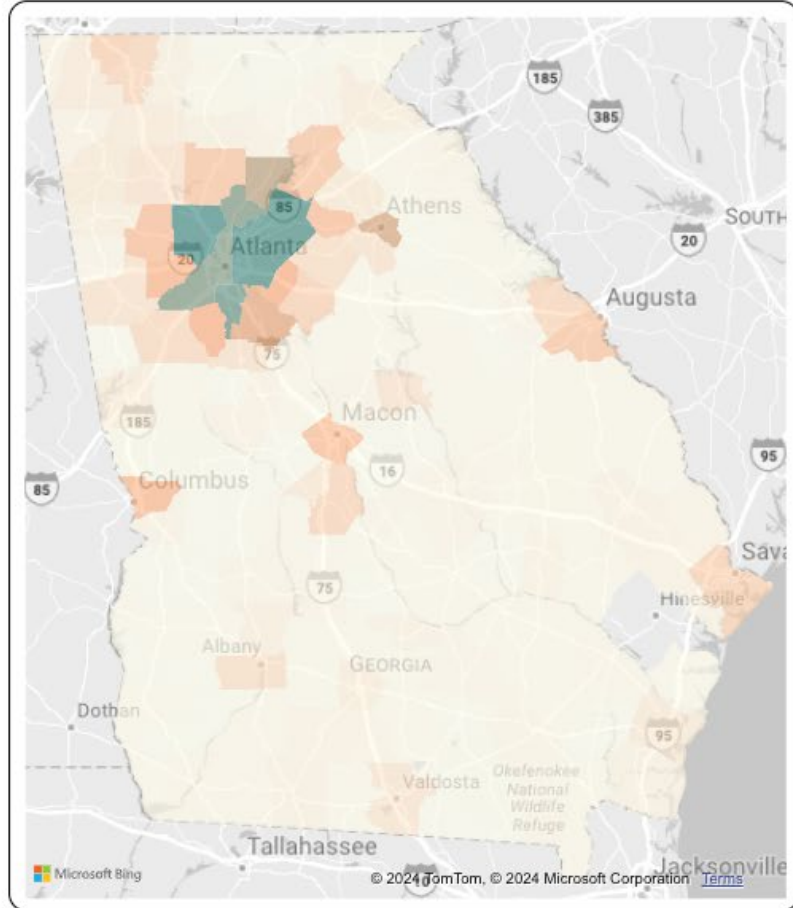
Variable

- CEJST Disadva...
- MHHI (Median...
- Residential Pot...
- Urban Area (%...

Min	0.00
Q 1	0.59
Median	1.47
Q 3	6.88
Max	98.11

Mean 9.60

Inequality Index
0.76



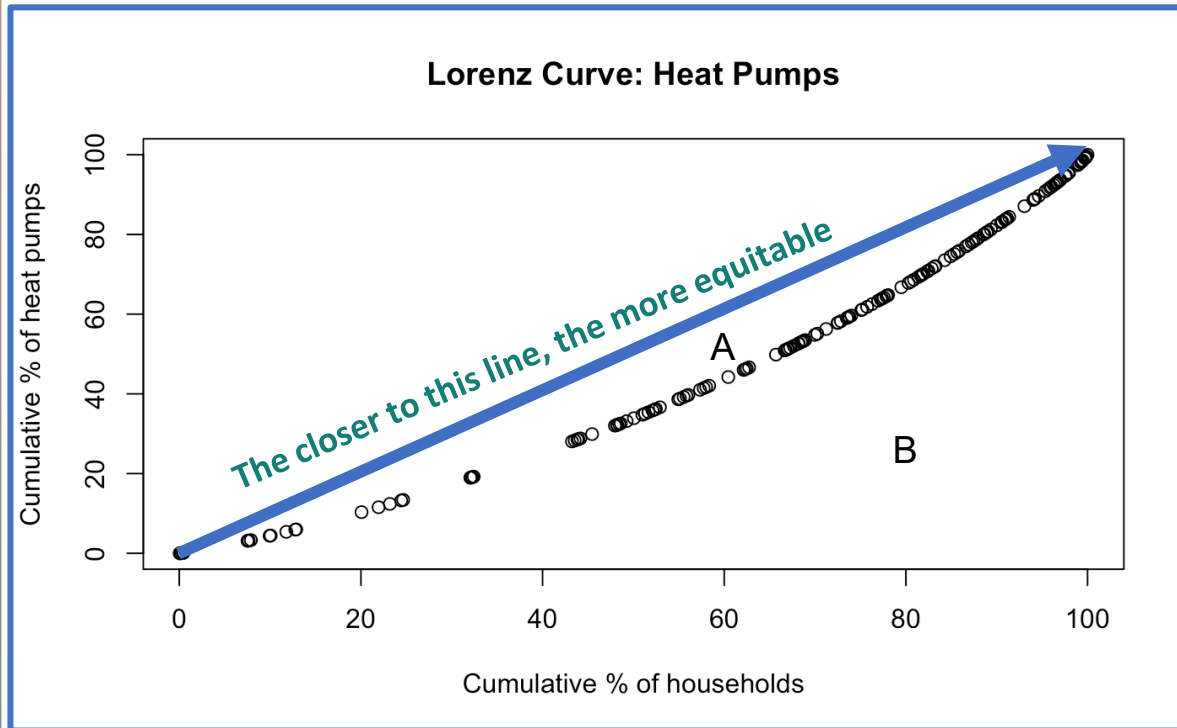
Gini coefficients can measure some equity aspects of climate solutions

Measuring equity with a Gini Coefficients:

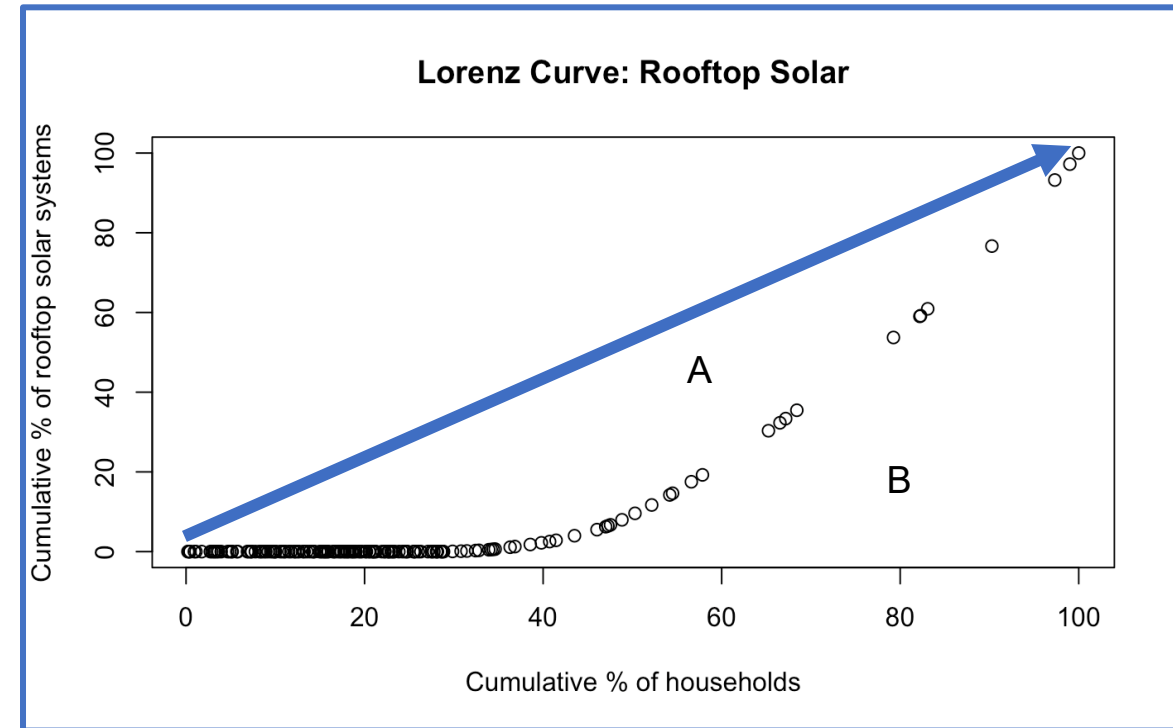
$$\text{Gini Coefficient} = \frac{A}{A+B}$$

↓
Distributed
less equitably
across Georgia

Solution	Gini
Heat pumps per household	0.22
EVs per capita	0.48
Demand response per household	0.70
Rooftop solar KW per household	0.90

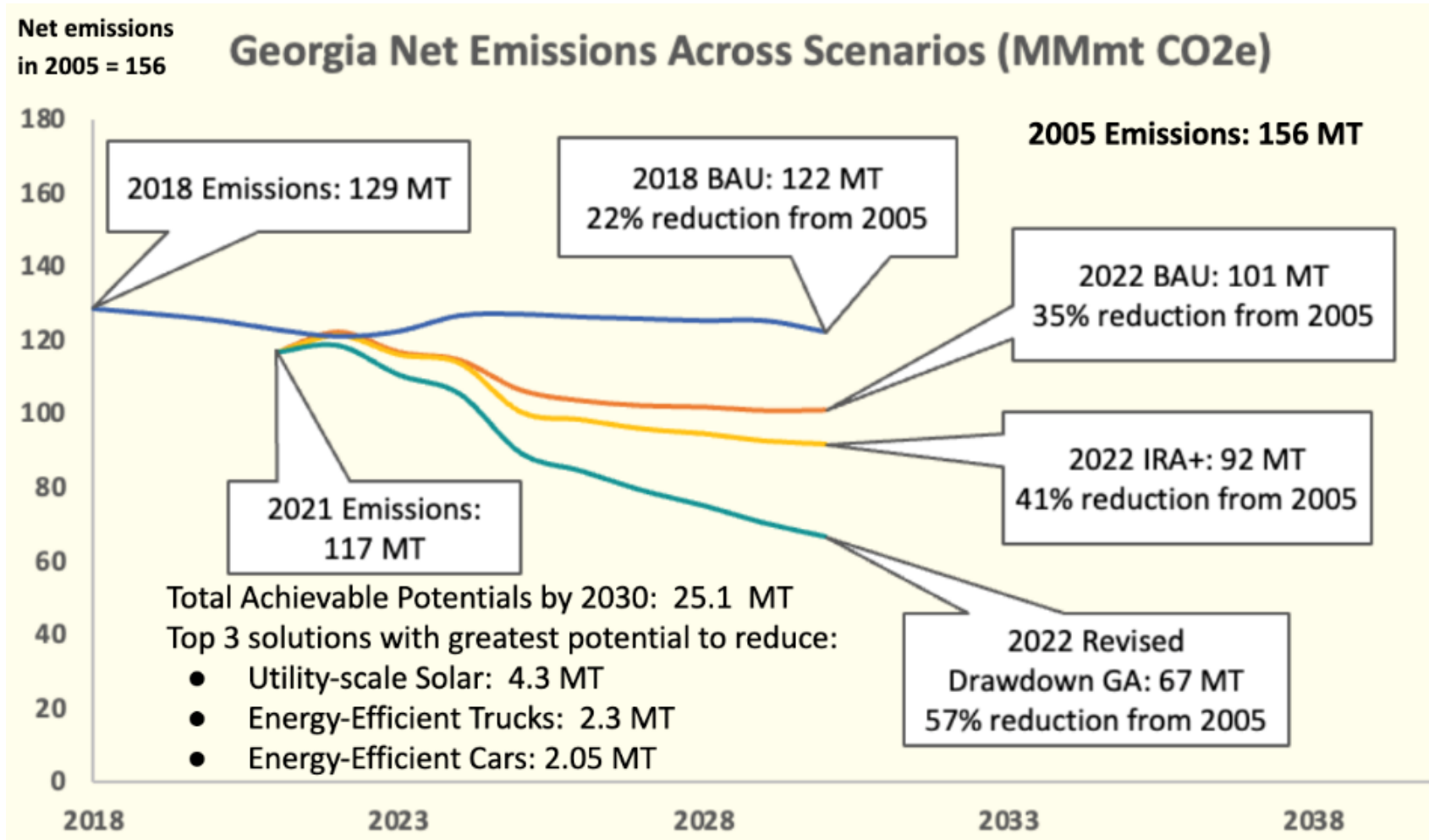


Heat pumps: 0.22



Rooftop Solar: 0.90

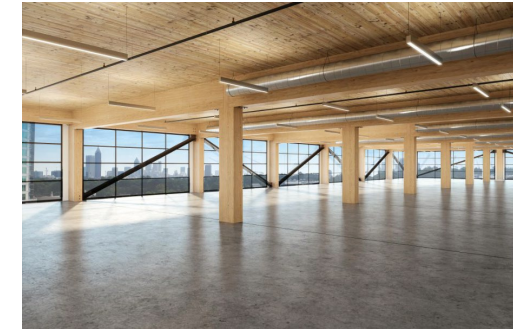
Our estimates of impacts are periodically update, especially following the 2022 “paradigm shift”



We are extending our planning horizon to 2035 and adding some new solutions

The “[Peach State Voluntary Emission Reduction Plan](#)”, expert consultations at the SE Decarbonization Workshop, and our own research have led the team to consider six emerging technologies:

- Sustainable Aviation Fuel
- Alternative Cement
- Mass Timber
- Green Hydrogen
- Carbon Capture and Use
- Small Modular Reactors



The road ahead



Launch the Solutions Tracker in December 2024



Expand our reach to more communities with the new City Emissions Tracker



Extend our timeline and portfolio of solutions



Demonstrate how communities can work together to dial down carbon emissions





Thank You!

For more about
Drawdown Georgia:
www.drawdownga.org

Climate and Energy Policy
Lab: cepl.gatech.edu/

Go to Climatesolutions.gatech.edu for more about
Drawdown Georgia's research program, trackers, and
the business compact.

Learn more about the roadmap of 20 solutions, go
here: <https://doi.org/10.1073/pnas.210008118>

You can reach me at mbrown9@gatech.edu
or on LinkedIn.

References



All of these are “open access” papers.

Marilyn A. Brown, Niraj Palsule and Jeffrey Hubbs, 2024. “Anticipating the response of climate solutions to a policy paradigm shift: Case study of the U.S. and the State of Georgia,” *Energy Strategy Reviews*, Vol. 53.

<https://doi.org/10.1016/j.esr.2024.101411>.

Brown, M. A. et al. 2024. *Southeast Decarbonization Workshop - Activating science, business, and community partnerships*. Oak Ridge National Laboratory. <https://www.osti.gov/biblio/2404612/>

Brown, Marilyn A., et al. (2021a) “Translating a Global Emission-Reduction Framework for Subnational Climate Action: A Case Study from the State of Georgia,” *Environmental Management*. 67: 205-227. <https://doi.org/10.1007/s00267-020-01406-1>.

Brown, MA, et al. (2021b). “A Framework for Localizing Global Climate Solutions and their Carbon Reduction Potential,” *Proceedings of the National Academy of Sciences*, 118 (31); <https://doi.org/10.1073/pnas.2100008118>