Cogeneration

Implies the co-production of electricity and useful heat, for the use in industrial or commercial facilities and for heating and cooling purposes.

Reduces emissions by displacing the consumption of fossil fuels that would otherwise have been used. There are currently 41 CHP facilities in GA with a total installed capacity of 1.44 GW.

Cogenerating plants could create thousands of jobs in the state throughout their lifecycles and can bring about over $150 million in monetary benefits from the reduction of atmospheric pollutants.

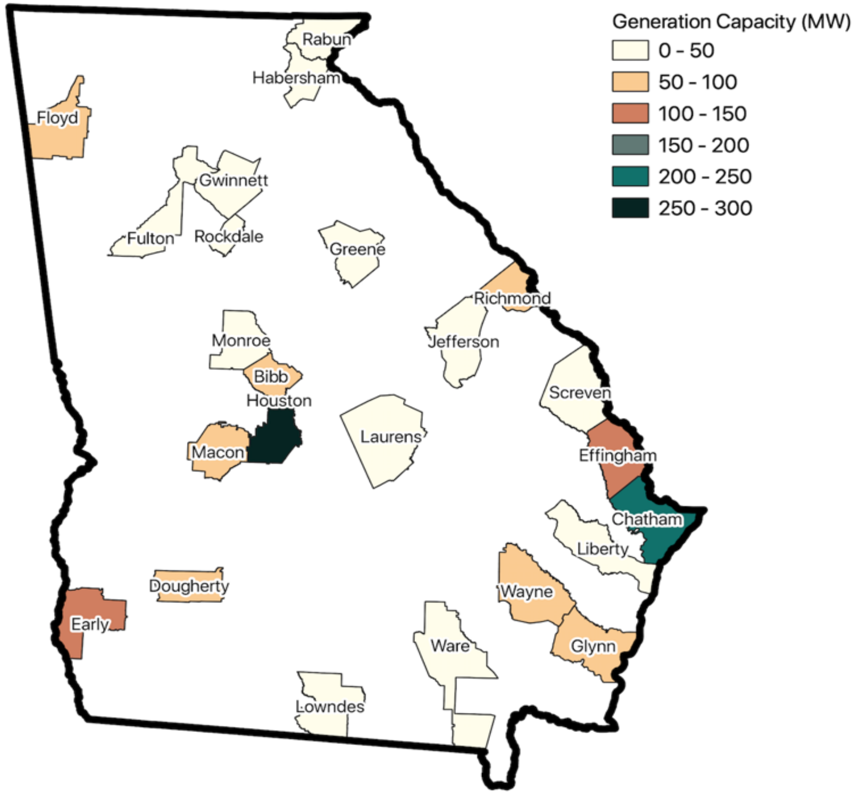
Albany Green Biomass Plant, co-generating ~400 GWh
Source: Energy News Network, 2017

Georgia Tech | University of Georgia | Emory University | the Ray C. Anderson foundation

Cogeneration (CHP)

Implies the co-production of electricity and useful heat, for the use in industrial or commercial facilities and for heating and cooling purposes.

- Located where both electricity and thermal energy are needed and can be placed at individual facilities or be a utility resource or district energy .
- Reduces emissions by displacing the consumption of fossil fuels that would otherwise have been used.
- System configuration
  - Topping cycle CHP
  - Bottoming cycle (Waste heat to Power)
- Technologies: gas turbines, reciprocating engines, fuel cells, microturbines and boiler/steam turbines.
- Overall efficiency of 65%-75% (U.S. DOE)
- 41 CHP facilities in GA (installed capacity of 1.44 GW)



Potential for Carbon Reduction Estimation

Georgia has 5,110 MW of technical potential at 9,374 sites. 835 MW = "achievable".

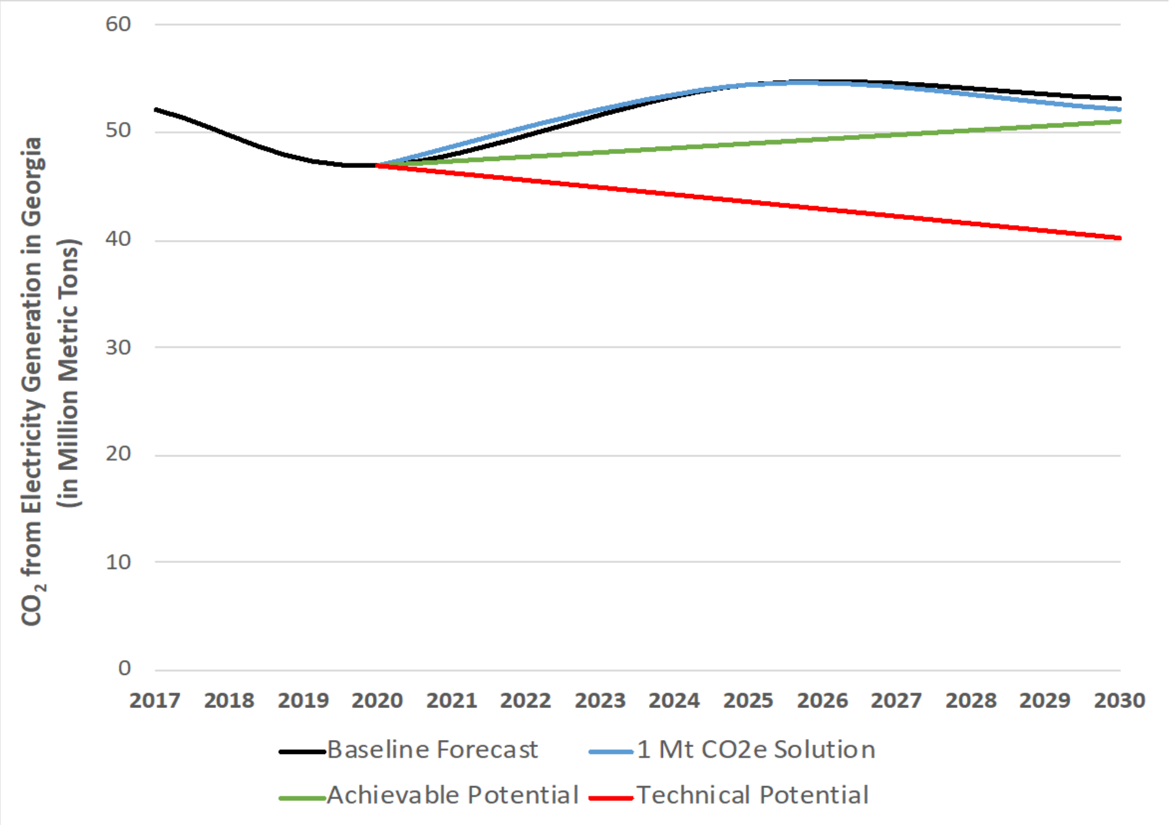
Methodology:

- Achievable potential is defined as a percentage of industrial technical potential, by size.
- Assumes a capacity factor of 75%.

Installed capacity	50-500 kW	0.5 - 1 MW	1 - 5 MW	5 - 20 MW	> 20 MW
% of technical potential	10%	10%	20%	30%	50%

Industry	Achievable total capacity (MW)	Achievable net generation (GWh)	Achievable emissions reduction (tCO_2)
Chemicals	260	1,705	661,564
Textiles	210	1,382	536,403
Paper	174	1,140	442,338
Food Processing	66	435	168,695
Lumber and Wood	49	321	124,383
Subtotal	**758**	**4,983**	**1,933,383**
Others	76	501	194,427
Total	**835**	**5,484**	**2,127,809**

Drawdown potential in Georgia in 2030



Baseline = Emissions from electricity generation in GA in 2020 are estimated to be 49 $MtCO_2$; GT-NEMS forecasts that these will rise to 53 $MtCO_2$ in 2030.

Achievable Potential = Reduction of **2.13 $MtCO_2$** in 2030, with the installation of a total of 835 MW of CHP nameplate capacity; favorable NPV of $380M in 2030.

Technical Potential = Reduction of **13.02 $MtCO_2$** in 2030, with a total of 5,107 MW nameplate installed capacity (adding 33,600 GWh of low-carbon electricity).

1 $MtCO_2e$ solution in 2030 = sixteen 25 MW CHP plants generating electricity with waste heat from industrial processes.

+Diverse energy supply
+Grid Resilience
+Less air pollution
-High upfront cost
+Local jobs and local taxes
+Public health benefits

Private Benefits Exceed Private Costs – Achievable Potential

Assumptions

- Installed and O&M costs were estimated with the costs that correspond to the prime mover.
- Thermal energy was estimated using the P/H ratio that corresponds to the prime mover.

	Steam Turbine	Reciprocating Engine/Gas Turbine
Installed capacity (MW)	277	557
Net generation (MWh/year)	1,822,387	3,661,658
Capital investment ($2017)	189,723,080	970,504,800
O&M costs ($2017/year)	11,728,764	45,127,490
Fuel input - natural gas (MMBtu/MWh)	54.4	11.5
Fuel cost - natural gas ($/MBtu)	5	5
Percent natural gas	30%	90%
Thermal energy (MBtu)	852	200
Steam price ($/MBtu)	10	10
Avoided cost of electricity (¢/kWh)	8	8
Discount Rate (%)	7.00%	7.00%
Financing Interest Rate (%)	4.38%	4.38%
Lifetime (years)	25	25
Financing Term (years)	20	20

Results

PV Private Costs	PV Private Benefits	NPV
$5,539 M Avg. per t$CO_2$ removed = $2,603	$5,918 M Avg. per t CO_2 removed = $2,781	$380 M Avg. per t CO_2 removed = $178

Job Creation Benefits are Also Significant

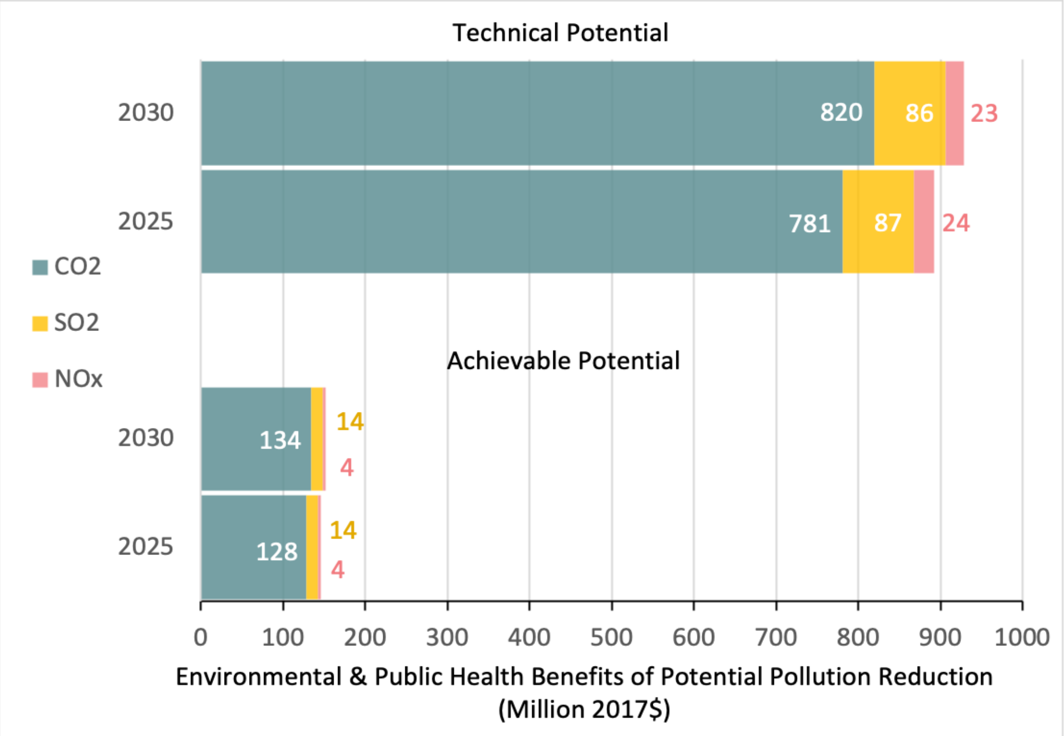
- Jobs are created throughout the lifetime of the CHP system
- Many created jobs are local to the CHP facility
- FTE jobs created include direct jobs in manufacturing, construction, and O&M
- In addition, other indirect and induced jobs are created by the supply chain of CHP installations and from the reduction of utility bills that frees up discretionary funding for the purchase of other goods and services that are more labor intensive than purchasing fuel.

	Low estimate (0.34 FTE/GWh)	**High estimate (0.44 FTE/GWh)**
Achievable potential (FTE/year)	1,865	2,413
Technical potential (FTE/year)	11,409	14,764

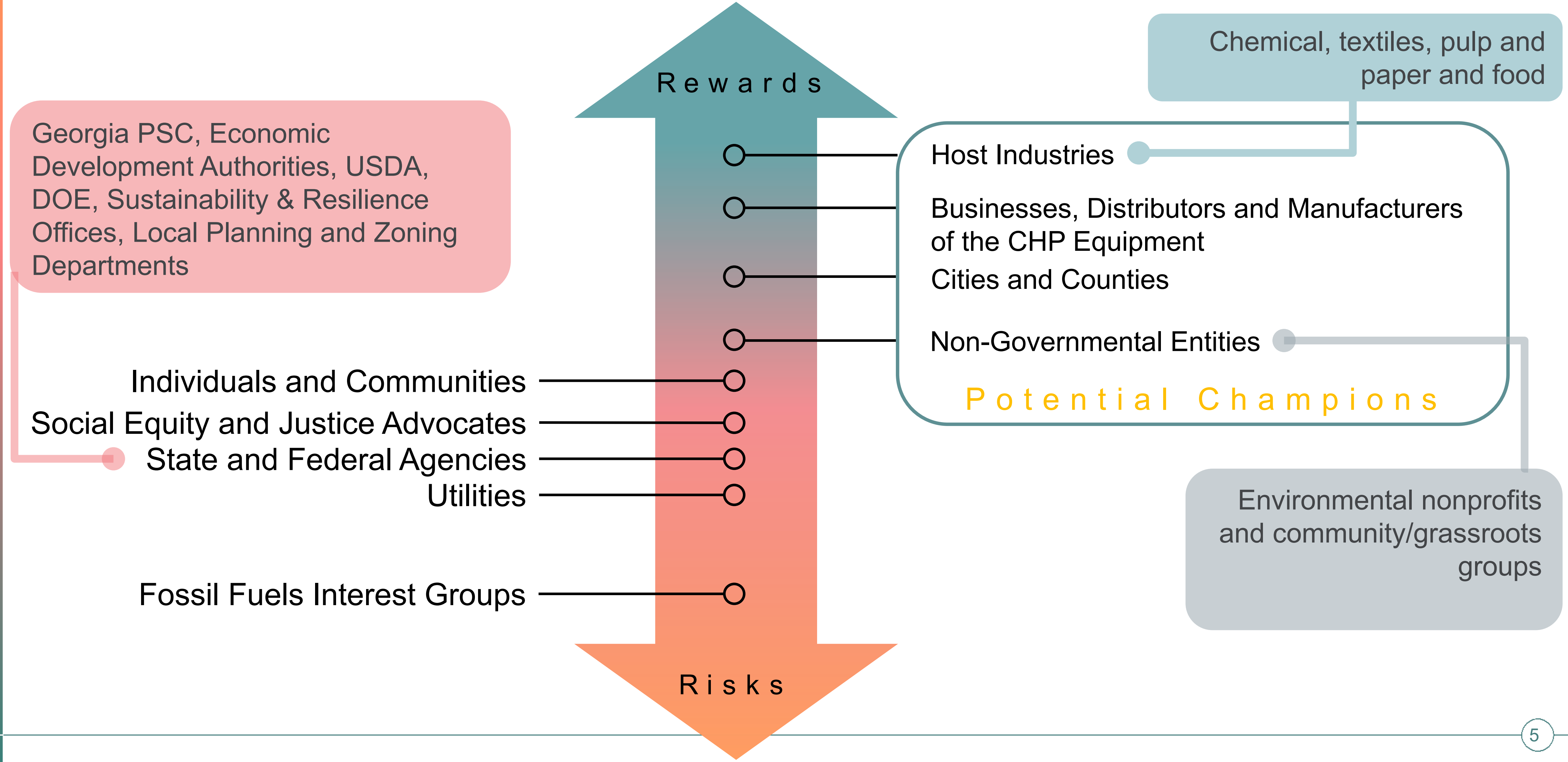
Air Pollutants Show Sizeable Reductions and Monetary Benefits

- Lower SO_2 and NOx levels result in fewer respiratory illnesses such as asthma, particularly in children.
- Reducing fine particulates has significant health benefits:
  - especially for children – lower incidence of preterm birth, low-birth weight, and autism spectrum disorder.
  - also for adults – fewer premature deaths, heart attacks, and respiratory illnesses.
- Other important benefits include increased workforce productivity and quality of life.

- The monetary benefits of reduced SO_2 and NOx in the achievable scenario totals $18 million in 2030.
- Adding the avoided costs from CO_2 brings the total to $152 million in 2030.



Stakeholder Analysis of Cogeneration



Interactions with other solutions

Demand Response

- CHP can enhance demand-response by generating on-site electricity during the local utility's peak hours.

Large-Scale Solar

- CHP and other dispatchable generation can complement variable renewables such as solar.
- CHP competes with other low-carbon technologies to decarbonize the electric grid.

Landfill Methane

- Landfill methane can be used to generate electricity with a CHP system

Challenges and Possible Initiatives for Cogeneration in Georgia

Barriers & Challenges

- Low electricity prices make CHP unattractive
- High upfront costs and long payback periods
- Lack of policy support for CHP programs and incentives
- Limitations of current CHP tax credits
- Fear of “lock-in” if natural gas is ultimately displaced by renewables

Possible Initiatives

- Policy Innovations
- Initiatives Targeting Air Pollution
- Emerging Technologies

Tools & Accelerants

- Clean Energy Portfolio Standards
- Investment Tax Credits
- Incentive schemes for increased adoption
- Exhaust treatment technologies
- Replacing natural gas with renewable fuels in CHP
- Grid independent systems

CONCLUSIONS

- Cogeneration has the potential to significantly reduce CO_2 emissions in Georgia by 2030
- Realizing could provide needed jobs and wealth to Georgia communities
- Air quality throughout the state would be improved, with significant associated public health benefits

DRAWDOWN GA

Corresponding author:
Dr. Marilyn A. Brown
Interim Chair, School of Public Policy
Georgia Institute of Technology
Email: mbrown9@gatech.edu
Phone: 404-385-0303
Climate and Energy Policy
Lab: www.cepl.gatech.edu

Georgia Tech | University of Georgia | Emory University | the Ray C. Anderson foundation