Rooftop Solar: A high-impact solution for reducing carbon emissions in Georgia

DRAWDOWN GA

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

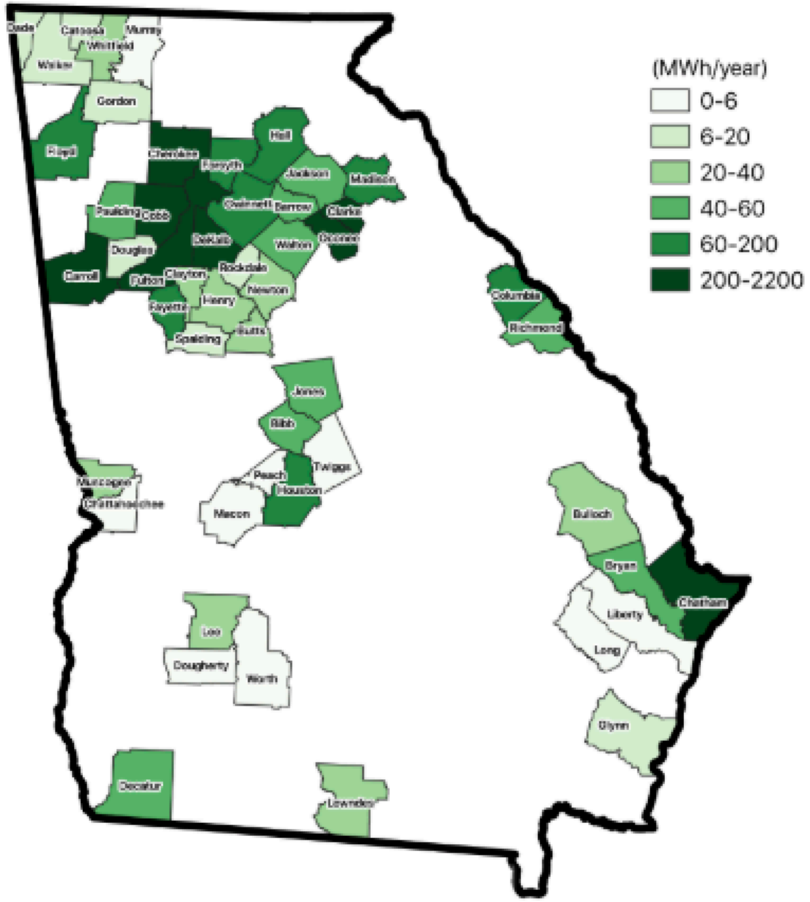
ROOFTOP SOLAR

Current Capacity:
5.9 MW (4.0 MW from Solarize Programs)

Technical Potential:
Reduction of
12.1 Mt CO_2 in 2030

Achievable Potential:
Reduction of
1.0 Mt CO_2 in 2030

- Most of the existing capacity is in large cities: Atlanta, Savannah, Athens,…
- Key obstacles:
  - ✓ high capital costs
  - ✓ system capacity caps,…
- Current growth is driven by community campaigns that:
  - ✓ reduce costs through bulk purchasing
  - ✓ streamline procedures.

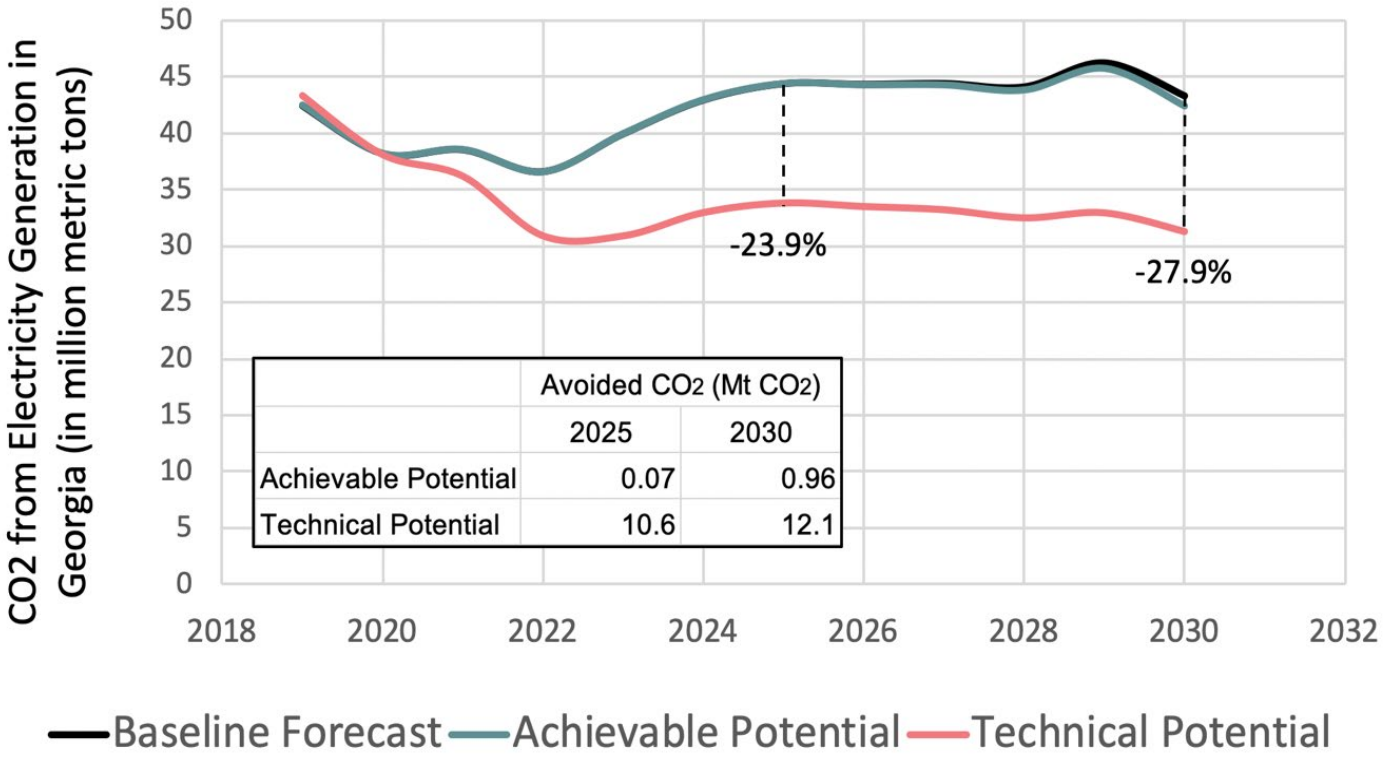


Solar PV on Georgia rooftops in 2019

Source: Authors, based on data from the Google Project Sunroof

Rooftop Solar

A gradual learning curve, with Solarize campaigns as first-movers



	Avoided CO2 (Mt CO2)	
	2025	2030
Achievable Potential	0.07	0.96
Technical Potential	10.6	12.1

Baseline = GT-NEMS forecasts that the electricity sector's carbon emissions will be 6.4 Mt CO_2 higher in 2030 than 2020, with little rooftop solar.

Achievable Potential = Reduction of **1.0 $MtCO_2$** in 2030.

Technical Potential = Maximum south-facing rooftop capability of abating **12.1 $MtCO_2$**, flattening the growth of CO_2 in GA over the decade.

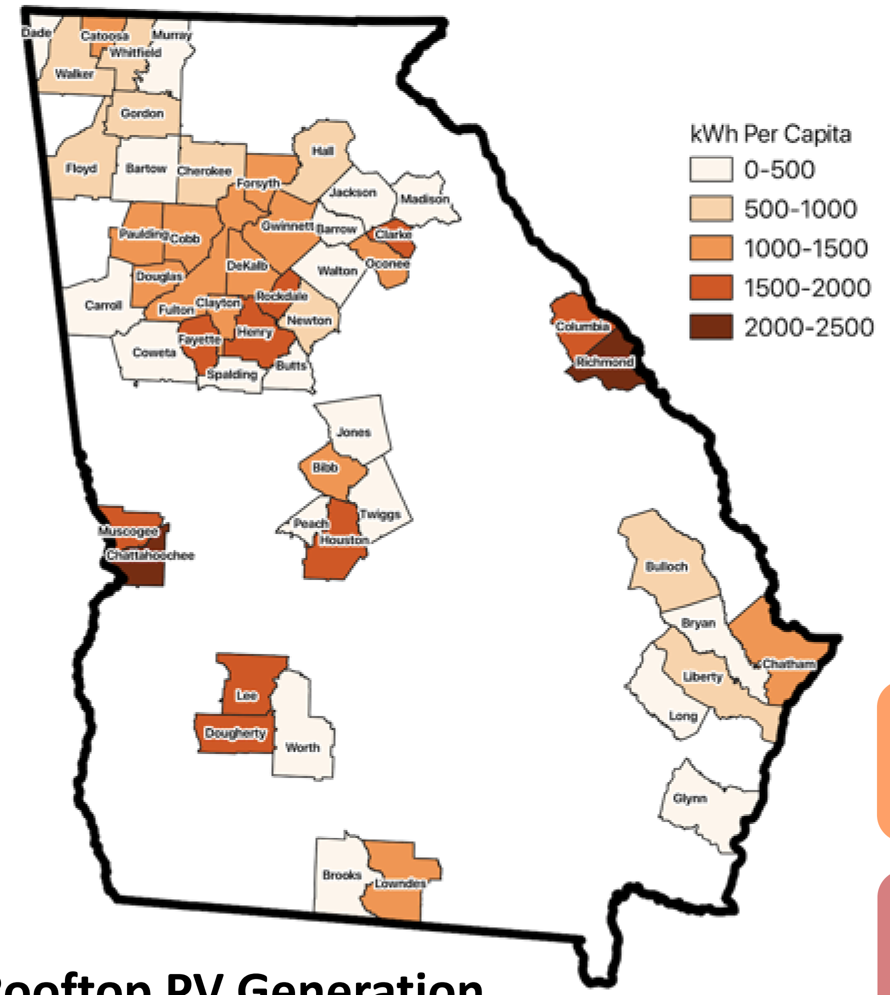
+ Less air pollution
– High capital costs
– Need for trained & more diverse workforce
+ W/ buyback at 100% retail, owners can save \$106-184/tCO_2 averted over system lifetime

1 $MtCO_2$ solution in 2030 ~295,000 5 kW solar rooftops

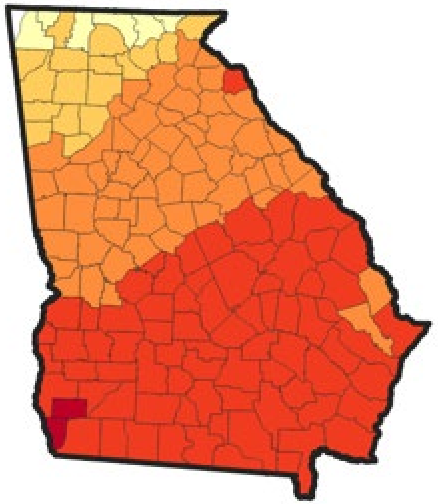
7.2 GW available capacity from south-facing & flat rooftops
4.0 MW current installed capacity from Solarize

Rooftop Solar Technical Potential

Substantial reductions possible by 2030



Rooftop PV Generation Potential per Capita



Solar radiation levels
(208 to 228 W/m^2)

5,858 kW existing rooftop capacity in 2019

4,008 kW capacity installed from **Solarize** projects

47.35 km² available space from south-facing rooftops

7.2 GW total available capacity

Technical Potential

12.1 $MtCO_2$ annual reduction (1 Mt CO_2 per 2,580 GWh)

9,153 GWh (CHECK) annual generation capacity

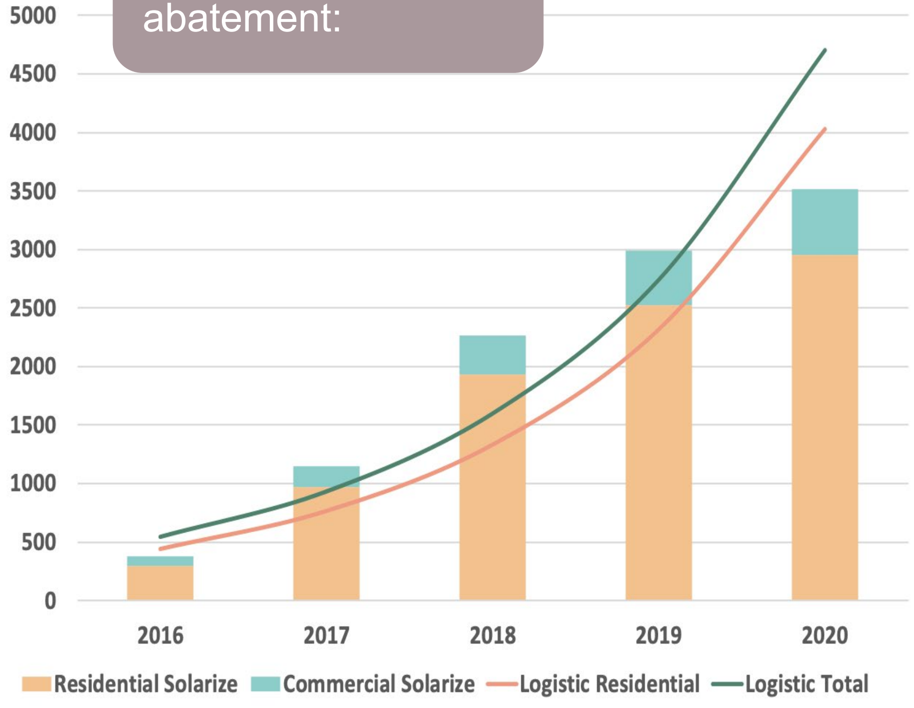
Source: Authors, based on Google Project Sunroof data explorer (March 2020)

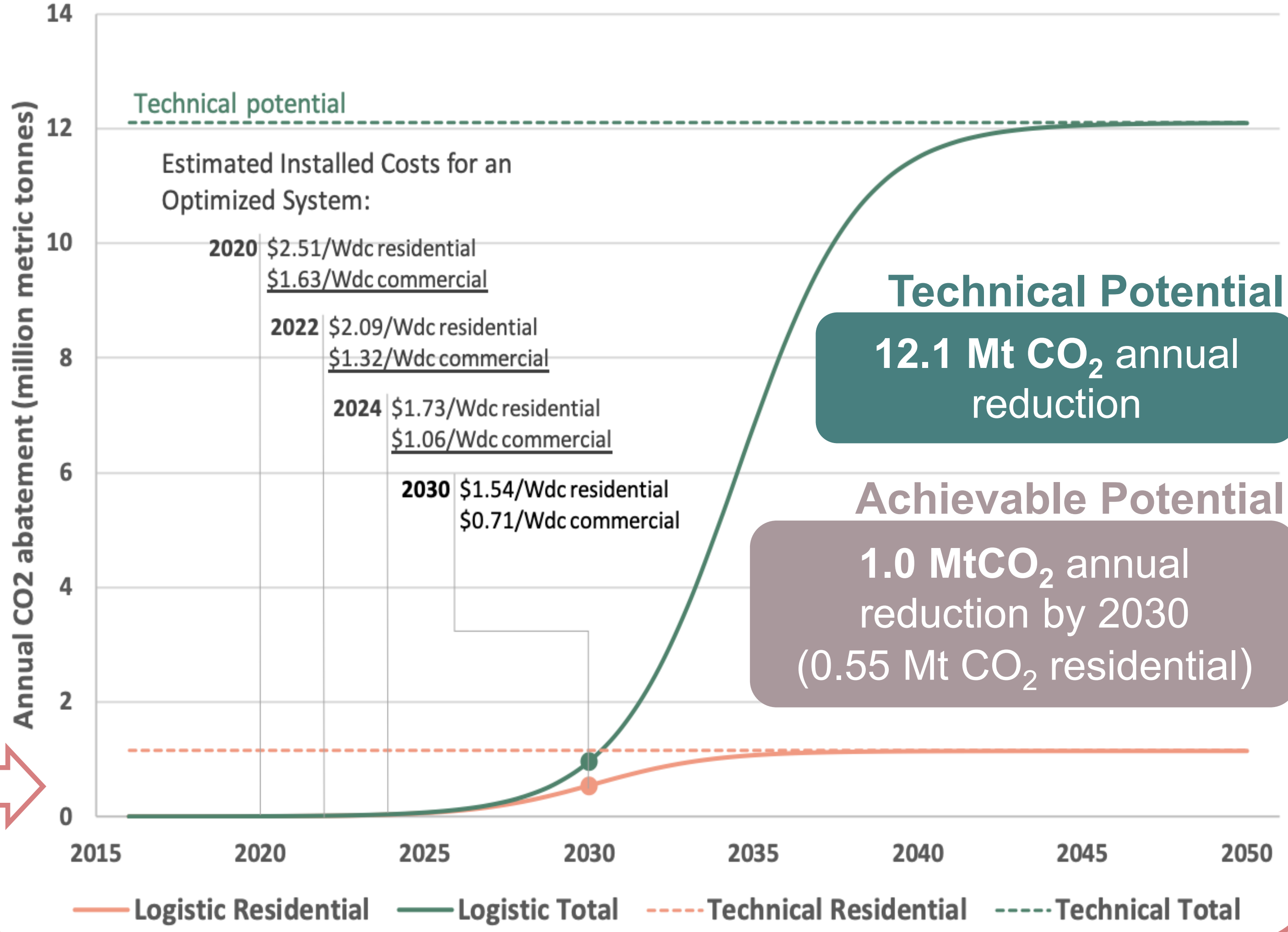
Rooftop Solar Achievable Potential: A megaton of carbon reductions is possible by 2030, and building owners with solar panels would save money

5,858 kW existing installed rooftop capacity

4,008 kW capacity installed from **Solarize** projects

Annual Solarize abatement:





Technical Potential

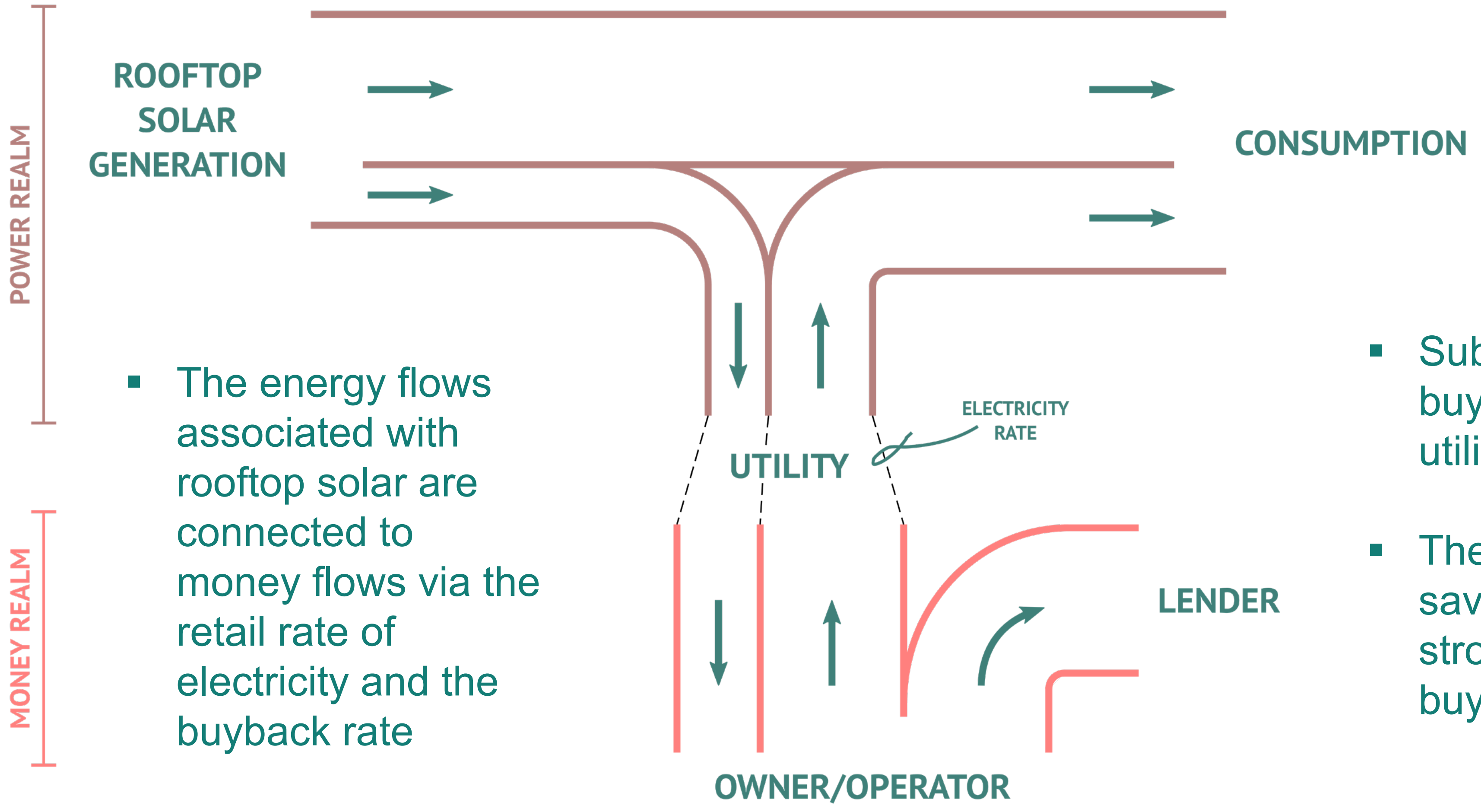
12.1 Mt CO_2 annual reduction

Achievable Potential

1.0 MtCO_2 annual reduction by 2030 (0.55 Mt CO_2 residential)

Costs and Benefits of Rooftop Solar Installations

Combination of free solar energy and net metering benefit the owner/operator



- The energy flows associated with rooftop solar are connected to money flows via the retail rate of electricity and the buyback rate

- Without storage, not all electricity generated can be consumed and not all electricity consumed can be generated
- Subject to the retail and buyback electricity rates, the utility acts like storage
- The owner/operator's net savings vs. not having solar is strongly sensitive to retail and buyback rates

Costs and Benefits of Rooftop Solar Installations

Archetypical residential and commercial rooftop systems in Georgia

Panel Generation Decay (%/yr)	0.5
Capacity Factor (Generation/Nameplate)	14.7%
Year of installation/financing	2030
Financing Period = System Lifetime (yr)	25
Surplus Buyback Ratio (% of Retail Price)	100%

Residential

Nameplate (DC) Power (kW)	6.2
System Cost As Installed (2017$)	$9,533
Initial Year Generation (MWh)	8
Annual Consumption (MWh)	10.97
Initial Year Electricity Price (2017¢/kWh)	12.45
Financing Annual Interest Rate	5.00%
Financing Fee (2017$)	$1,000
Annual payments (current year $)	$832.55
PV of Net Savings vs. No Solar (2017$)	$7,619
CO_2 from outside generation avoided (tonnes)	72.0
Net Cost to Owner Per Tonnes CO_2 Abated	-$106
Initial Yr Elec Price for No Savings (2017¢/kWh)	8.32

Commercial

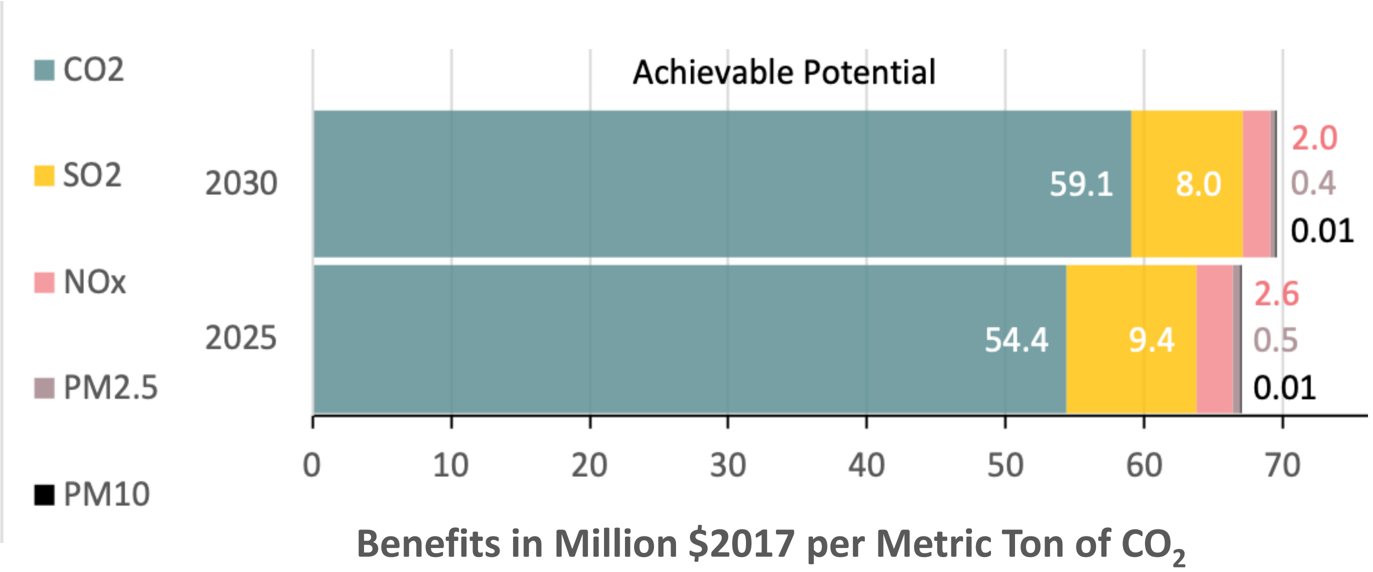
Nameplate (DC) Power (kW)	200
System Cost As Installed (2017$)	$141,150
Initial Year Generation (MWh)	258.1
Annual Consumption (MWh)	354.8
Initial Year Electricity Price (2017¢/kWh)	10.50
Financing Annual Interest Rate	3.50%
Financing Fee (2017$)	$0
Annual payments (current year $)	$10,556
PV of Net Savings vs. No Solar (2017$)	$427,096
CO_2 from outside generation avoided (tonnes)	2324
Net Cost to Owner Per Tonnes CO_2 Abated	-$184
Initial Yr Elec Price for No Savings (2017¢/kWh)	3.16

Weighted Average of Residential and Commercial: $134/t$CO_2$

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.

Environmental, public health, and ecosystem benefits of reduced air pollution from rooftop solar



- Total benefits for SO_2, NOx, PM10, and PM2.5 = $10 million in 2030.
- Total for CO_2 = $67 million in 2030.

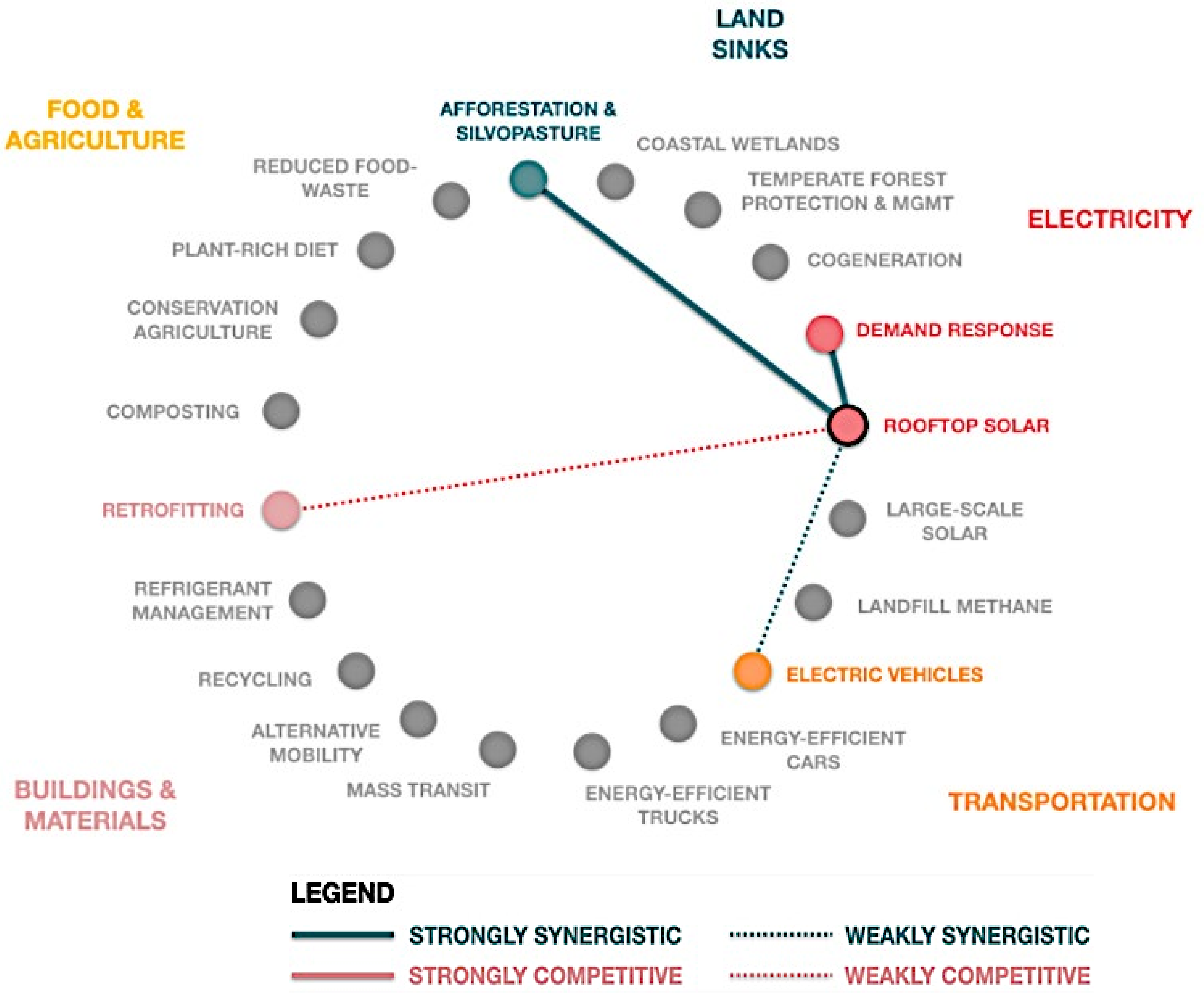
Rooftop Solar Solution Interactions

Demand response
- Rooftop solar helps reduce peak usage and is incorporated into microgrids and smart grids

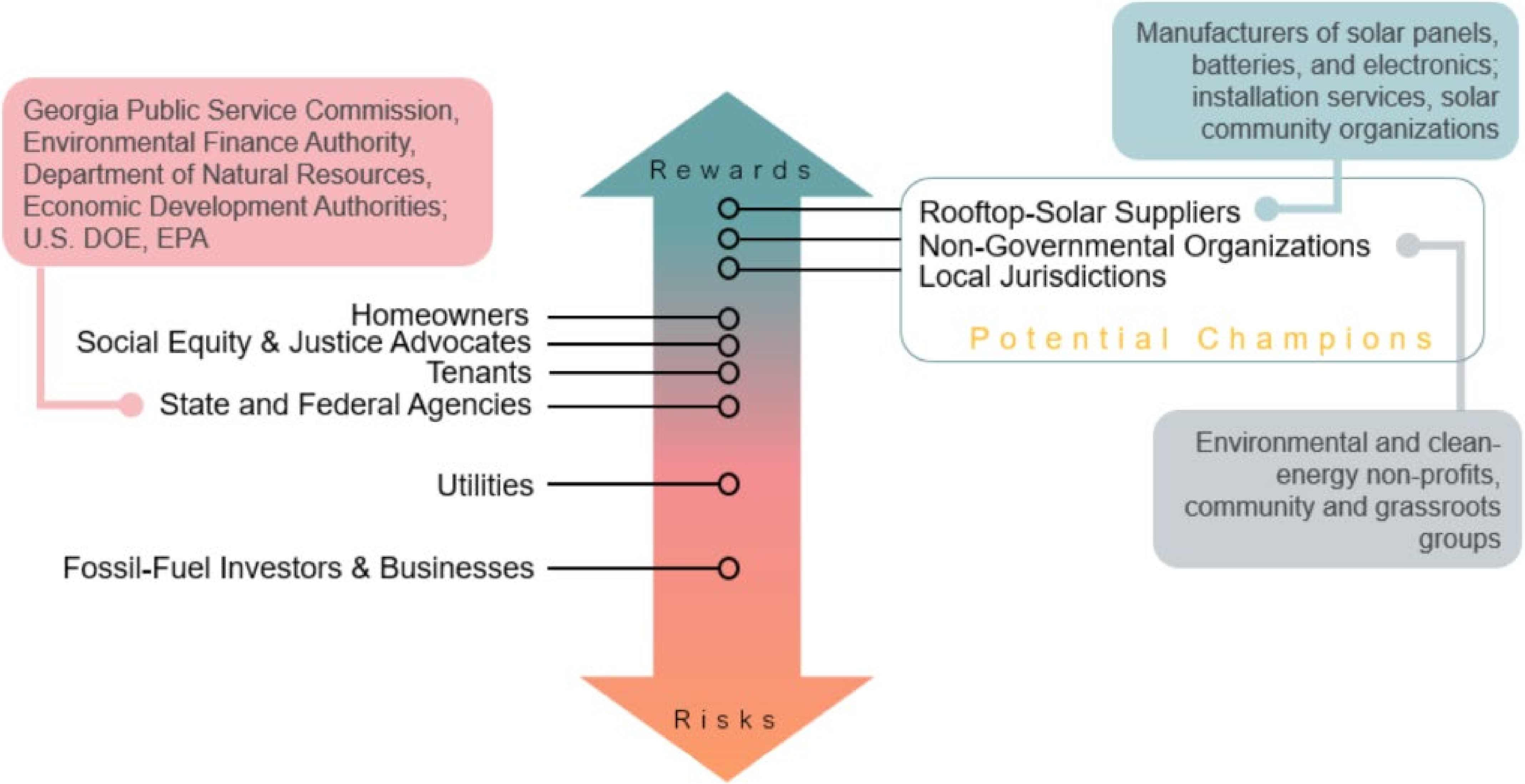
Afforestation/Silvopasture
- Low land-use impacts of rooftop solar

Electric Vehicles
- EV's produce less carbon emissions when solar-powered

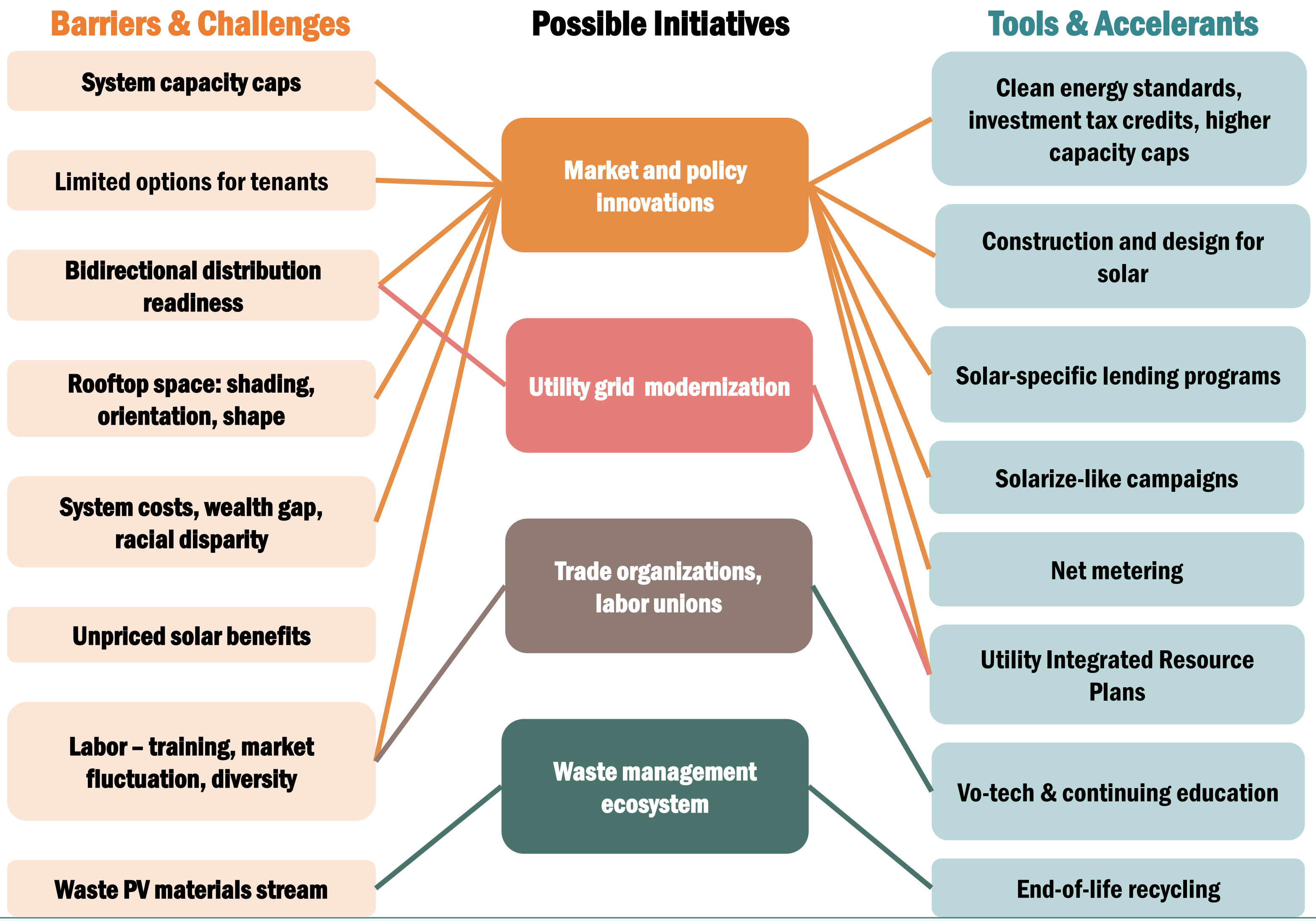
Retrofitting
- Efficiency and rooftop solar reduce each other's carbon-reduction potential



Stakeholder Analysis of Rooftop Solar



Challenges and Possible Initiatives



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