Large-Scale Solar

- Large-Scale Solar includes solar farms and community solar projects.
- Solar farms can have capacities ranging from a few hundred kW to over 100 MW.
- Smaller, community solar projects generally range from a few hundred kW to a few MW.

Silicon Ranch/Green Power EMC, 55 MW System

Jekyll Island, 1 MW Community Solar System

The Ray Along Georgia Route 85

Solar Farms & Community Solar

Achievable & Technical Potential Modelled with GT-NEMS*

Current Capacity:
Solar PV capacity in Georgia in 2019 totalled > 1,570 MW, offsetting ~1.3 Mt CO_2

Achievable Potential:
Reduction of
11.2 Mt CO_2 in 2030

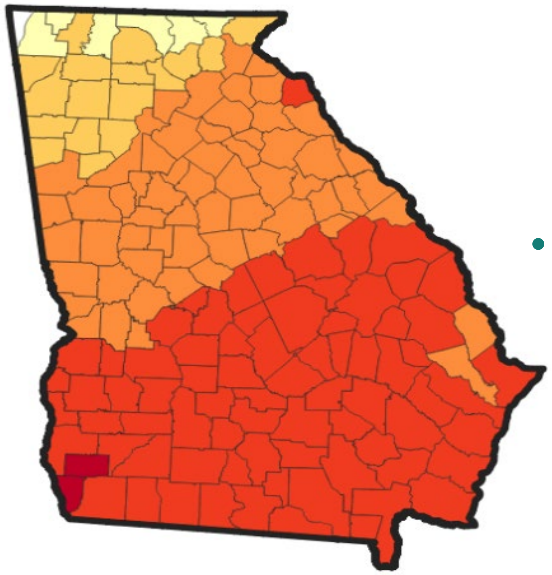
Technical Potential:
Reduction of
21.4 Mt CO_2 in 2030

- We estimate the achievable potential for large-scale solar by modeling a carbon tax of $10/t$CO_2$ levied on carbon dioxide emitted by the electricity sector
- Implemented at $10 in 2022, the tax increases to $12 in 2025 and $15 in 2030 (in $2017).
- Technical potential is modelled similarly, starting with a carbon tax of $15/t$CO_2$.
- All carbon tax revenues are recycled back to households on a per capita basis.
- GT-NEMS models the 22 NERC regions, and we model Georgia as 40.9% of the generation and emissions of the SERC-SE region.

*NEMS=National Energy Modeling System

Georgia is well suited for large-scale solar

Solar Radiation in Georgia

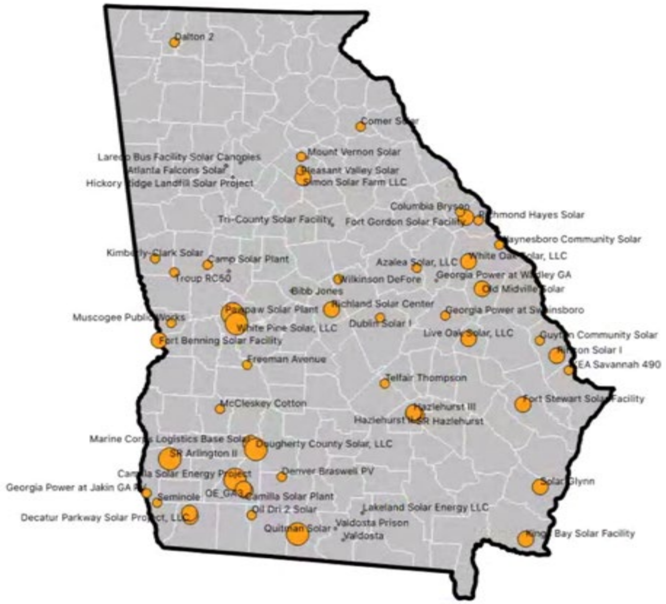


Source: World Bank’s Global Solar Atlas, 2020

- Georgia has ample solar radiation – comparable to Florida – and land is plentiful & affordable

- Solar farms and community solar are widely distributed across Georgia

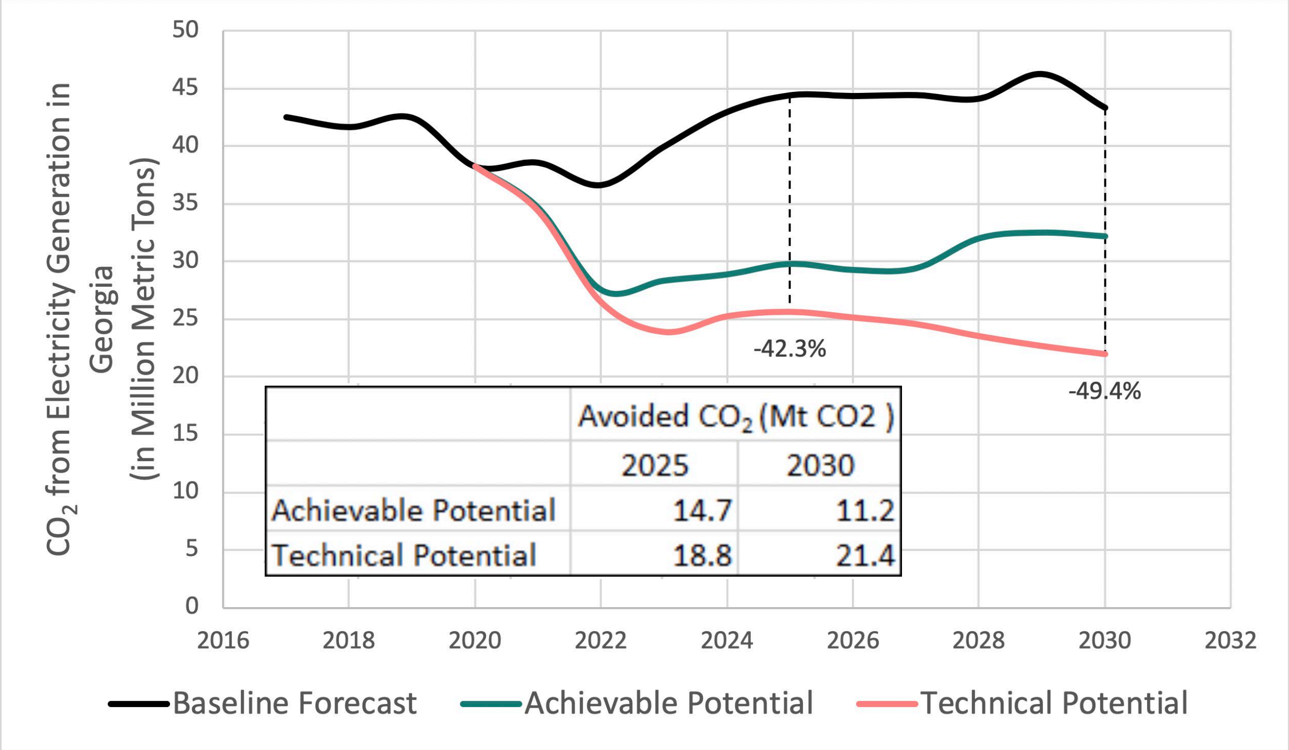
Utility-Scale Solar in 2019



Source: EIA, 2020; Bolinger et al., 2019

Lage-Scale Solar

Our working scenarios suggest significant carbon reduction potential by 2030



	Avoided CO_2 (Mt CO2)	
	2025	2030
Achievable Potential	14.7	11.2
Technical Potential	18.8	21.4

Baseline Forecast = Growth of utility solar to ~2.5 GW in 2030, ~4.5% of Georgia's generation.

Achievable Potential = Reduction of 11.2 $MtCO_2$, with 11% of solar generation in 2030 – 5.4 GW, and associated energy-system upgrades.

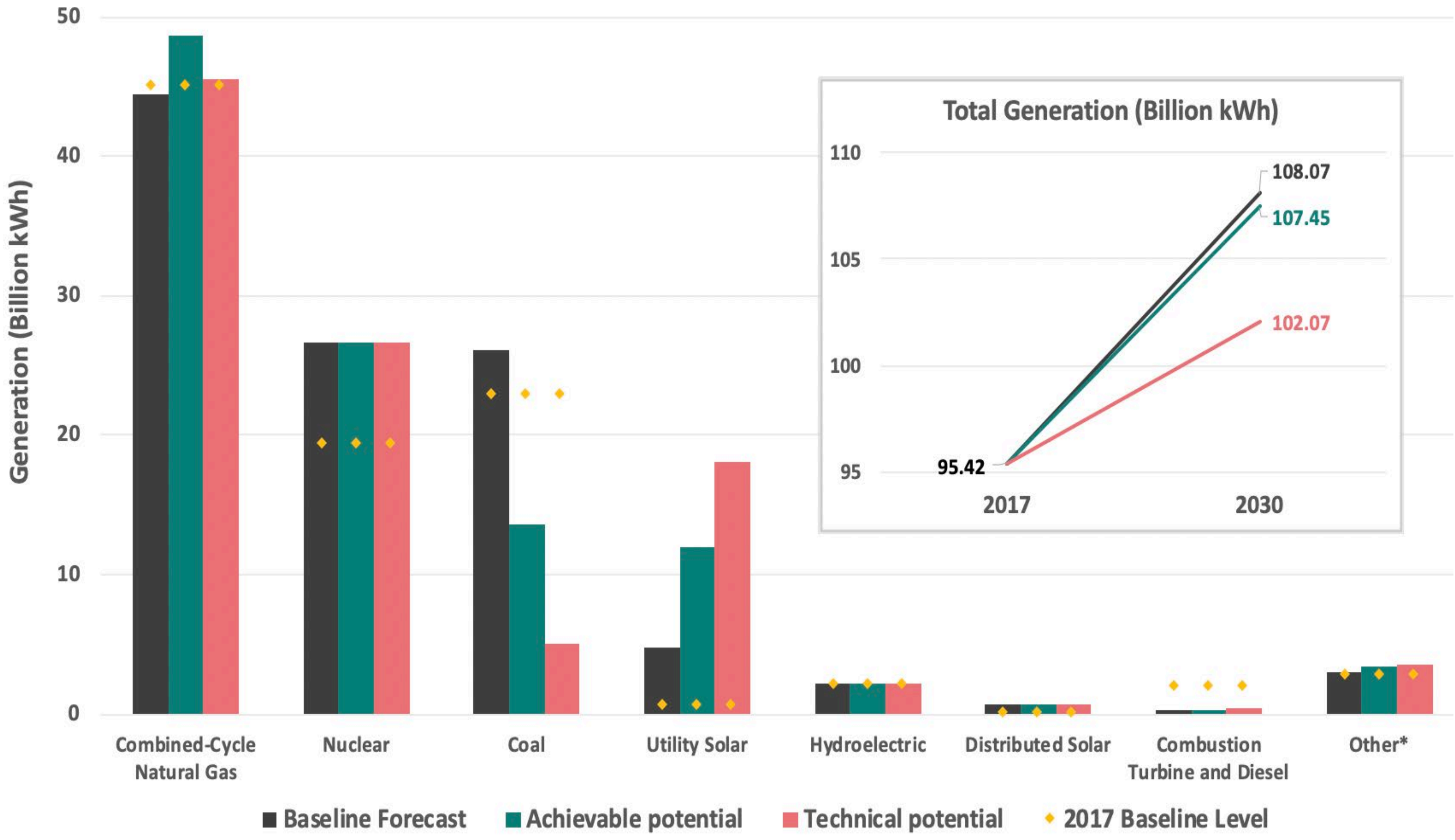
Technical Potential = Reduction of 21.4 $MtCO_2$, with 18% of solar generation in 2030 – 8.7 GW.

1 $MtCO_2e$ solution in 2030 = 20 more 50 MW solar farms and 36 more 5 MW community solar systems in 2030, for a total of ~1.2 GW, occupying ~15 square miles of land.

- ~0.1% of Georgia's farmland
- ~0.04% of Georgia's 24 million acres of forestland
- <size of Dalton, GA

+Local jobs and local taxes
+Rents to landowners
+Less air pollution
+Public health benefits
-Ecosystem impacts
-Costs/tCO_2 averted = $51-63

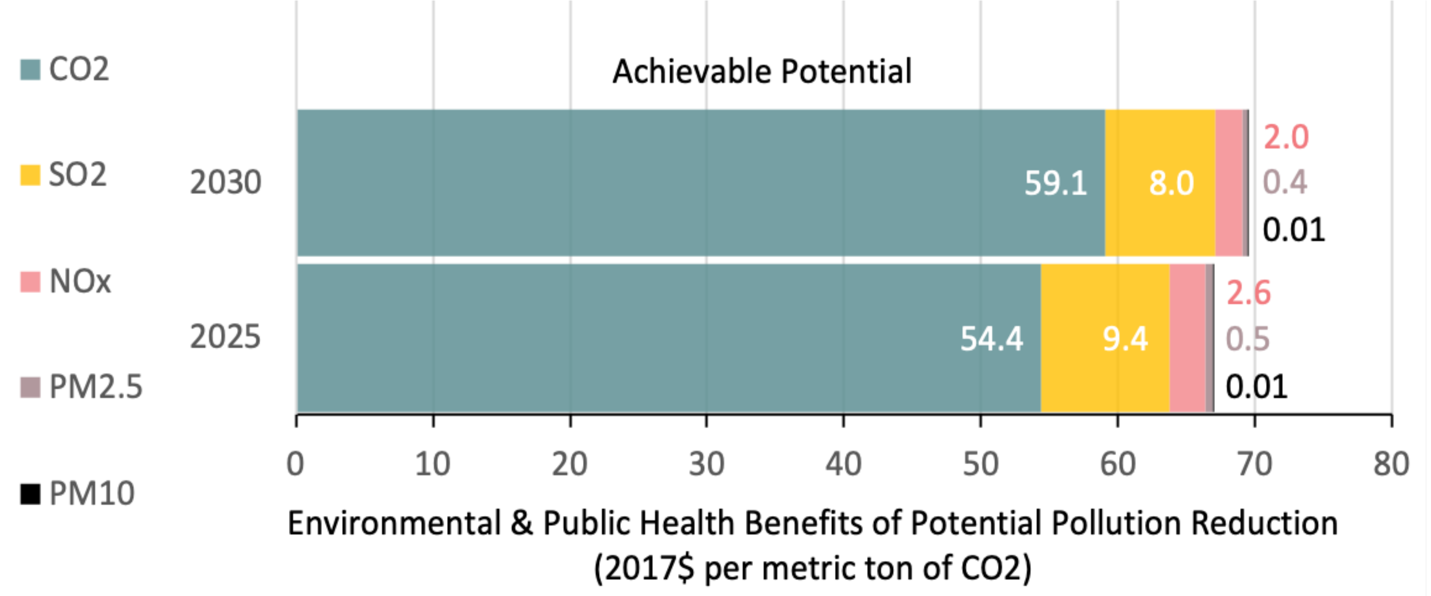
Electricity Generation in Georgia in 2030 Would be Significantly Cleaner



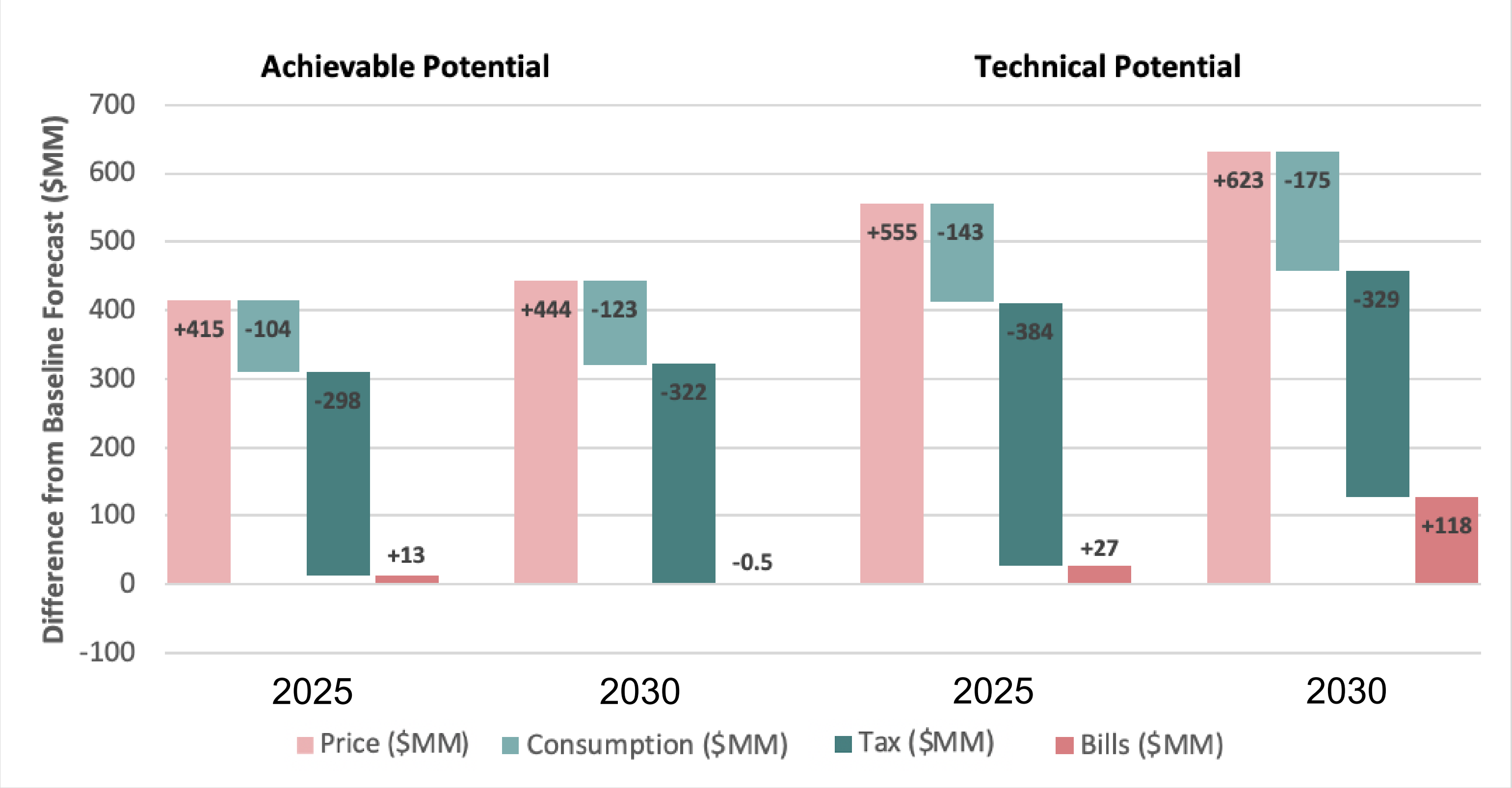
Air Pollutants Show Sizeable Reductions and Monetary Benefits

- 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, NOx, PM10, and PM2.5 in the achievable scenario totals \$116 million in 2030.
- Adding the avoided costs from CO_2 brings the total to \$778 million in 2030.



Increase in Residential Energy Bills is Significantly Lessened by Tax Dividends



Baseline = Average annual household energy bills increase 4.6% from 2020 to 2030.

Achievable Potential = Tax dividends save households $322 Million, lowering energy bills below baseline.

Technical Potential = Tax dividends save households $329 Million, increasing energy bills only 5.6% over baseline.

Costs from Power Purchase Agreements in 2030

Estimated Private Costs and Benefits of the 1 Mt CO_2 Opportunity in 2030, in $2017

Costs in 2030	Benefits in 2030
Assume a levelized cost of $33.5/MWh of solar generation. Year 1 cost = $86.4 million (2,580 GWh x $33.5/MWh).	Assume that a utility in Georgia issued a purchase power agreement (PPA) for $35/MWh of solar generation. Year 1 revenues = $90.3 million (2,580 GWh x $35/MWh).
Conclusion: The net present cost (NPC) of investing in 1,178 MW of new solar capacity, or a 1 Mt CO_2 reduction in Georgia's carbon footprint in 2030 is $86.4 million - $90.3 million = -$3.9 million (in $2017). This is equivalent to a cost of -$3.9 (in $2017) per metric ton of avoided carbon.	

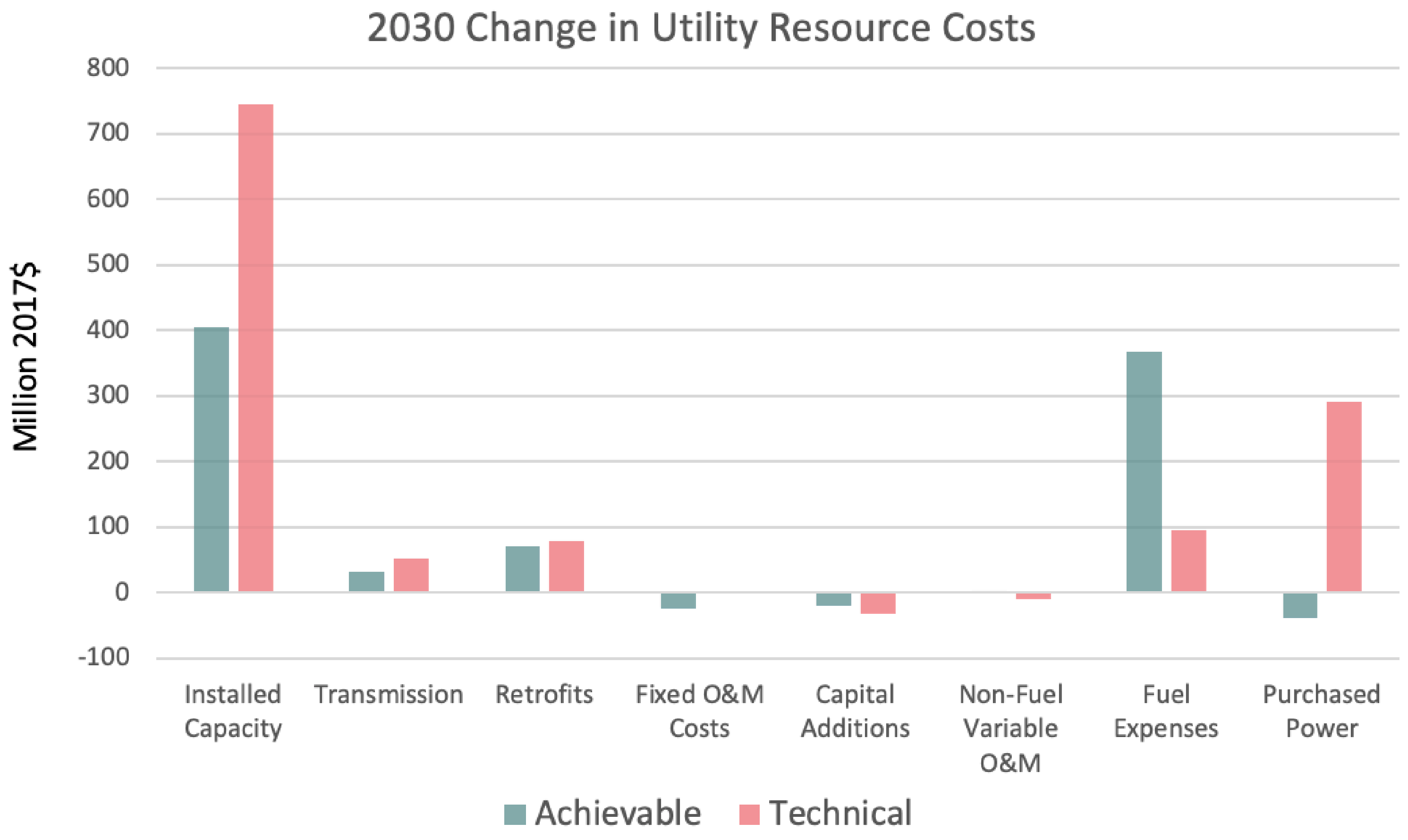
The Net Present Cost (NPC) of investing in enough utility-scale solar to reduce CO_2 emissions in Georgia by 1 MT CO_2 would be -$3.9 million (in 2017$), or -$3.9 per metric ton of avoided carbon.

Although a net savings is encouraging, it is greatly dependent on the PPA.

Changing the PPA assumption to $33.49/MWh (4.3% decrease) results in the elimination of this net benefit.

Large-scale solar would yield further benefits to utilities in scenarios where carbon taxes are implemented.

Sizeable Increase in Utility Resource Costs Prior to Revenues from Carbon Dividends



Under the baseline forecast, utility costs will increase approximately $97 million by 2030.

The achievable potential increases these costs by $792 million in 2030, equal to $70.71 per ton of avoided CO2. After a $10/ton carbon tax is applied, this is equivalent to $680 million or $60.71 per ton avoided in 2030.

The larger technical potential increases these costs by $1.22 billion in 2030, equal to $56.98 per ton of avoided CO2. After a $15/ton carbon tax is applied, this is equivalent to $898.85 million or $41.98 per ton avoided in 2030.

Solar Farms & Community Solar

Electric Vehicle

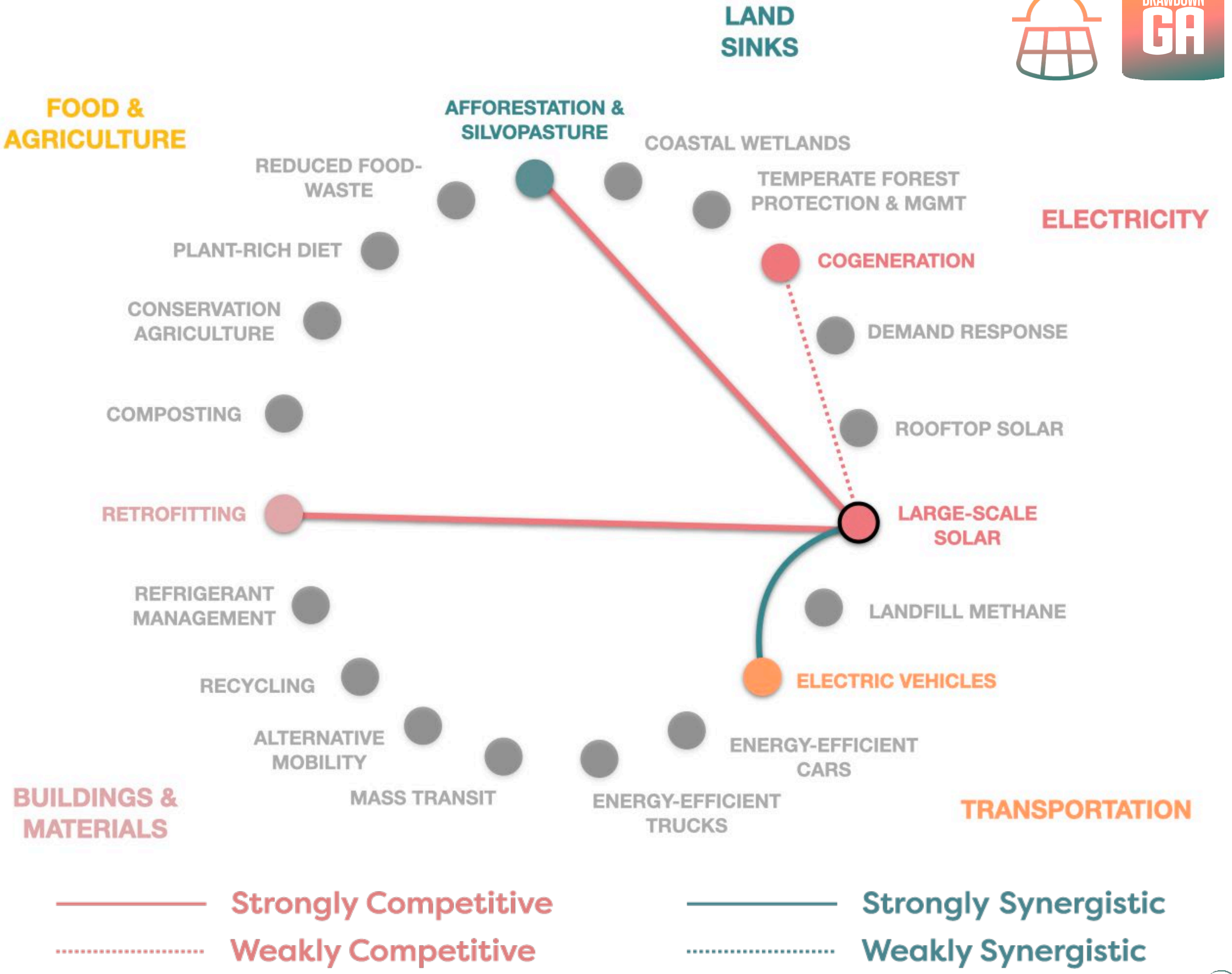
- Solar fields enable EVs to lower their CO_2 emissions.

Retrofitting

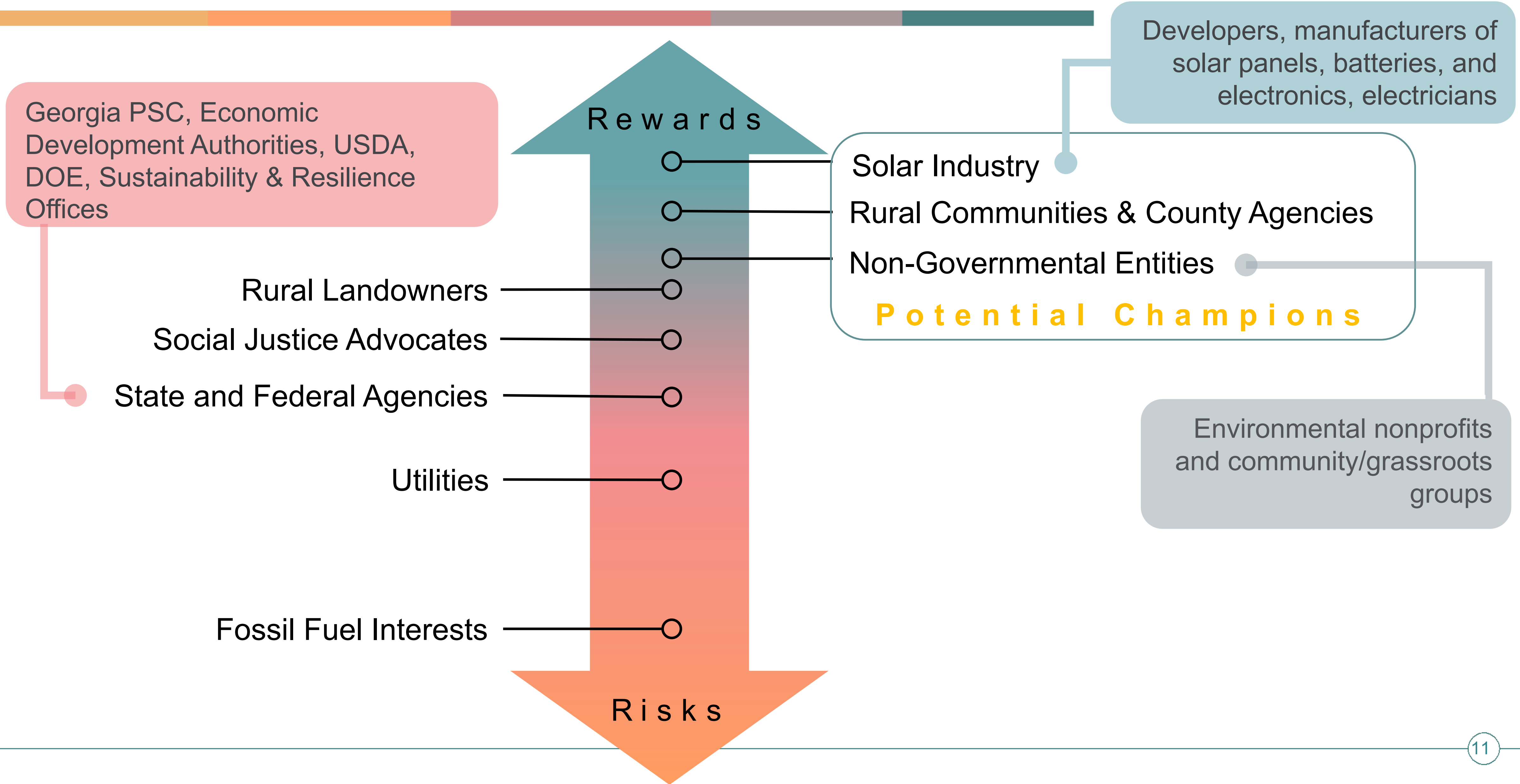
- With lots of solar fields, retrofitting buildings saves less carbon.

Afforestation & Silvopasture

- New solar fields would occupy lands that otherwise could be used for growing trees or crops.



Stakeholder Analysis of Lage-Scale Solar



Challenges and Possible Initiatives for Lage-Scale Solar in Georgia

Barriers & Challenges	Possible Initiatives	Tools & Accelerants
PV Waste Adverse Land Impacts	**Market and Policy Innovations**	End-of-Life Recycling Expedited Development of Low-Impact Sites Infrastructural Integration
Unpriced Pollution: CO_2, SO_2, NOx, PM2.5,… Overbuilt Electricity Capacity	**Initiatives that Price Air Pollution**	Clean Electricity Goals & Standards Carbon Pricing Investment Tax Credits
High Energy Burden of Low-Income Households Shortage of Trained and Diverse Workforce	**Workforce Training & Social Equity Programs**	Low-Income Community Solar Programs Training Programs for Diverse Workforce

CONCLUSIONS

- Solar farms and community solar have the potential to significantly reduce CO_2 emissions in Georgia by 2030
- Realizing the potential for utility solar could provide needed jobs and wealth to Georgia communities
- Air quality throughout the state would be improved, with significant associated public health benefits
- Ecosystem impacts of large solar fields need to be addressed appropriately to ensure prime agricultural land is not occupied

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