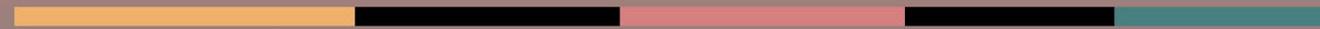


**DRAWDOWN
GA**

Refrigerants: A high impact solution for reducing carbon emissions in Georgia



Refrigerants

- Refrigerants are gases used as coolants in commercial refrigeration and AC systems
- Refrigeration equipment is prone to leaking, releasing harmful chemicals into the air
- CFCs were phased out by the Montreal Protocol to protect the depleted ozone layer
- HFCs have replaced them, but they often have extremely high global warming potential
- The EPA currently regulates the sale and usage of refrigerants
- 2016 Kigali Amendment to the Montreal Protocol calls for an 80% reduction in HFCs by 2047
- This could prevent up to 0.4 C of global warming, but the U.S. has not ratified it
- U.S. efforts to switch to low-GWP alternative refrigerants would reduce GHG emissions

Potential for Carbon Reduction Estimation

Market penetration scenarios:

1. **“Low achievable” potential:** The grocery store average CO₂e equivalent leakage rate is reduced to 13% per year
2. **“High achievable” potential:** Low achievable potential and 20% of residential air conditioners transition to SNAP-approved low-GWP alternatives
3. **Technical potential:** estimated considering the commercial refrigerant average CO₂e leakage rate is reduced to 0% per year and 50% of commercial air conditioners transition to 0-GWP alternative refrigerant systems.

Methodology:

1. Extrapolated from EPA SIP Tool and CA emissions data to estimate GA 2030 baseline emissions
2. Based low achievable potential on EPA GreenChill certified grocery store leakage rate of 13%
3. EPA’s SNAP has identified 5 low-GWP refrigerant alternatives for residential air conditioning
4. Advanced CO₂ commercial refrigerant systems have 0% leakage, though they are expensive

Private Costs and Benefits Estimation - Achievable Potential

Assumptions

- Baseline forecast for 2030 is extrapolated using existing trends and forecast population growth
- Changes in existing technology and regulations as of 2020 are factored in to 2030 baseline
- The low-GWP refrigerant market is projected to more than double from 2017 to 2025
- Cost of retrofit is estimated in the 2016 Clean Air Act update as an average figure
- Retrofitted stores will save money on annual refrigerant and operational/service costs
- Savings are modeled on the installation of a CO2 refrigerant system; savings in other cases vary

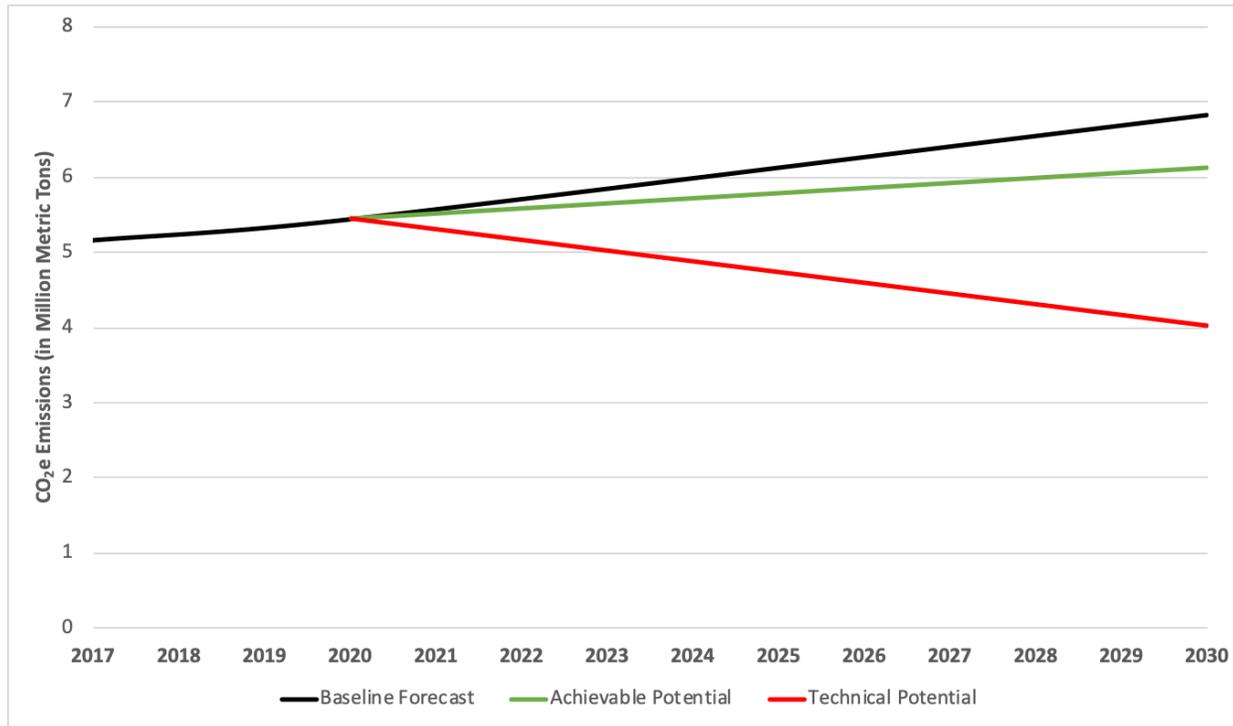
Results

PV Private Costs	PV Private Benefits
\$15,538,719	\$10,132,815 annually

Current State of Refrigerants in Georgia

- While the EPA requires some record-keeping for operators of refrigerant systems, there is no statewide or nationwide system to account for refrigerants purchased or emitted by sector
- The 2016 Clean Air Act Update called for HFCs to be subject to reporting, inspections, and leakage limits just like CFCs, but it was rescinded in 2018 under the Trump administration
- High-GWP refrigerants like R-134 and R-404 are being phased out in favor of alternatives
- Several new low-GWP SNAP refrigerant alternatives were proposed in May 2020
- EPA's GreenChill partnership has demonstrated that the grocery store average refrigerant leakage rate of 25% per year can be significantly reduced through maintenance and retrofitting
- More comprehensive refrigerant accounting requirements would reveal more detailed information about sector-specific refrigerant losses to tailor emissions solutions

Refrigerants Drawdown potential in Georgia in 2030



Baseline = From 5.44 MtCO₂e in 2020 for ozone-depleting substance substitute gases (primarily refrigerants, excluding SF₆), projecting EPA's GHG State Inventory yields 6.83 MtCO₂e in GA in 2030.

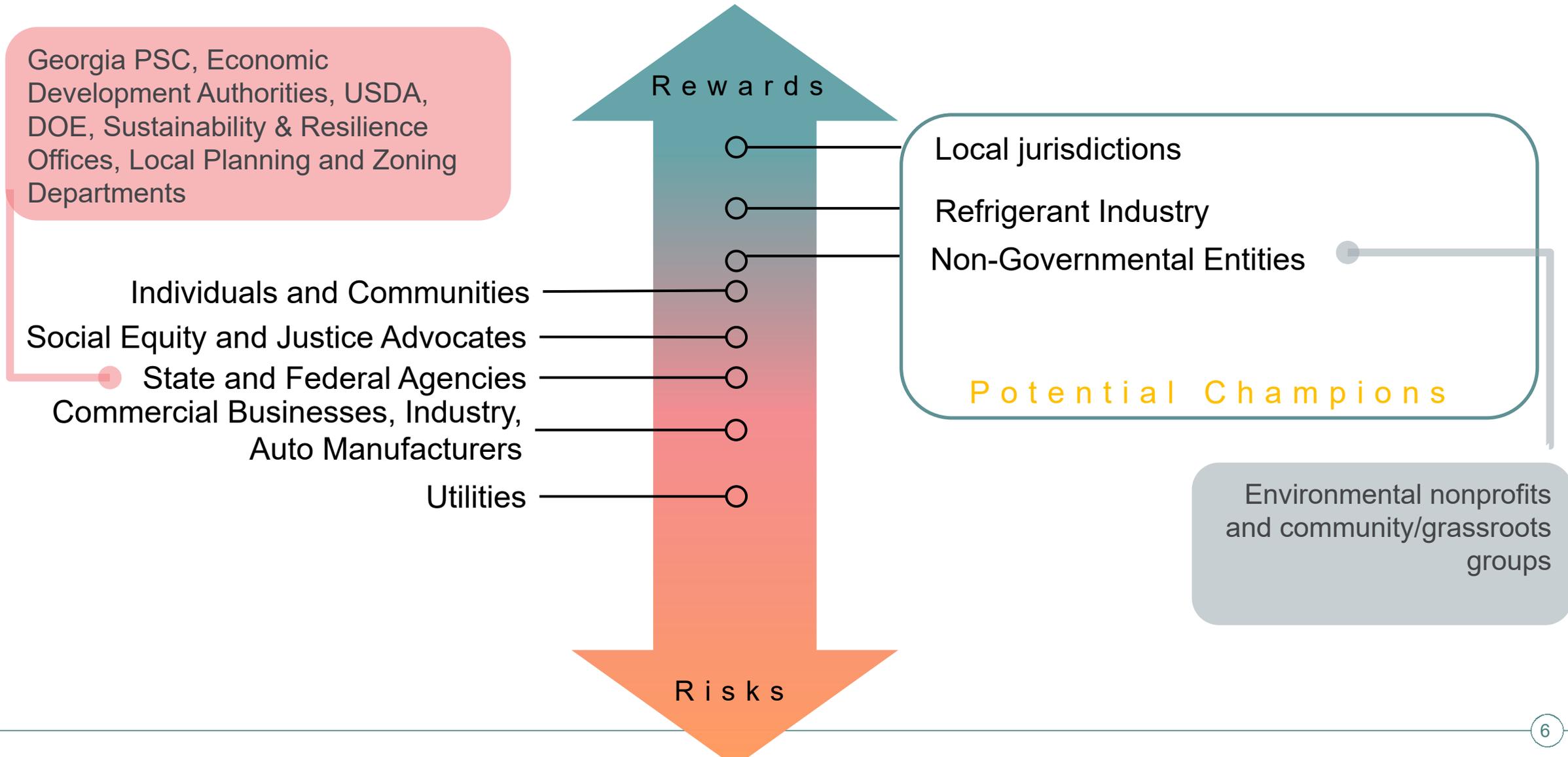
Achievable Potential = Reduction of 0.71 MtCO₂e in 2030, considering the commercial refrigerant average leakage rate is reduced to 13% per year by 2030.

Technical Potential = Reduction of 2.84 MtCO₂e in 2030, considering the commercial refrigerant average leakage rate is reduced to 0% per year and 50% of commercial air conditioners transition to 0-GWP ammonia systems by 2030.

1 MtCO₂e solution in 2030 = Retrofitting refrigeration systems in all Georgia grocery stores (around 958 stores) to achieve an industry average refrigerant leakage rate of 8%.

- +Less air pollution
- +Local jobs
- +Public health benefits
- +Less energy burden
- High upfront cost

Stakeholder Analysis of Refrigerants

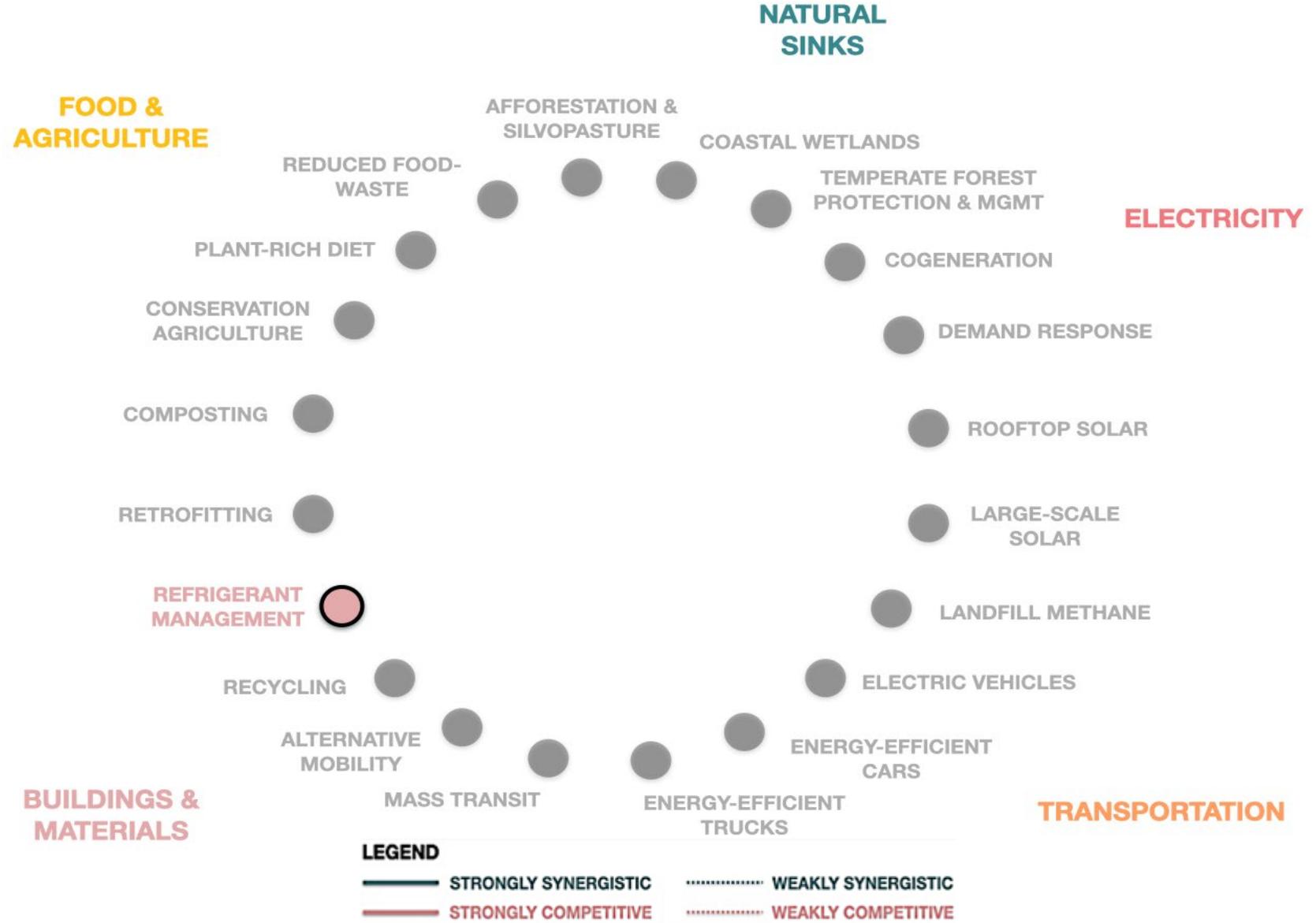


Interactions with other solutions

Retrofitting

- Alternative refrigerants must often be run through a refrigerant system at higher pressures than their traditional counterparts. This requires marginally more energy.
- Improved installation and retrofits resulting from replacing the refrigerant would make the system more energy efficient, and less AC use would result.

The full effects of these phenomena have not yet been observed so they are not included in this analysis.



Other considerations

Challenges

- Refrigerants are poorly regulated in the US
- Lack of robust data on refrigerant usage and leakage by sector
- Low reporting requirements
- Tradeoff between flammability, toxicity, and GWP
- Increasing system complexity for low-GWP refrigerants

Promising Policies

- EPA policy: 2016 Section 608 of the Clean Air Act update
- Tightening regulation on HFC refrigerants (requiring leak inspections for equipment exceeding the threshold leakage rate, lowering leakage rate thresholds recordkeeping and reporting requirements for large systems, and sales restrictions on refrigerant products)
- Improving public data on refrigerant emissions leakage



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