Appendix C. Required Technical Appendix and Optional GHG Emission Reduction Calculations Spreadsheet

A. Overview

This appendix provides a detailed explanation of the methodologies and assumptions used to develop the estimated GHG emissions reductions for each GHG reduction measure included in the application.

B. Technical Appendix

Measure-Specific Documentation:

- **GHG Reduction Estimate Method:**

Buildings Sector (B1-B4): The GHG emission reductions in the buildings sector were estimated using engineering estimates based on expected energy savings from building retrofits and the adoption of the latest building or energy codes. The methodology involves several steps:

1. **Identification of Retrofit Measures:** A list of typical retrofit measures was compiled, including insulation upgrades, HVAC system replacements, window replacements, and lighting improvements. These measures were selected based on their potential to reduce energy consumption in buildings.
2. **Estimation of Energy Savings:** For each retrofit measure, the energy savings were estimated using engineering calculations or data from previous studies. The energy savings are expressed in terms of reduced electricity and natural gas consumption. For example, the energy savings from upgrading to LED lighting are calculated based on the difference in wattage between the old and new lighting systems and the operating hours.
3. **Calculation of GHG Emission Reductions:** The energy savings are then converted to GHG emission reductions using emission factors for the regional electricity grid and natural gas consumption. The emission factors represent the amount of CO2e emitted per unit of energy consumed. For electricity, the emission factor is based on the average GHG intensity of the regional grid, while for natural gas, it is based on the combustion emissions of natural gas.
4. **Aggregation of Savings:** The GHG emission reductions from individual retrofit measures are aggregated to estimate the total GHG emission reductions for the buildings sector. This includes accounting for the percentage of buildings retrofitted annually and the expected energy efficiency improvements over time.
5. **Adjustment for Adoption Rates:** The estimated GHG emission reductions are adjusted based on the assumed rate of measure implementation. For example, if it is assumed that 2.5% of buildings are retrofitted annually for 20 years, the total GHG emission reductions are calculated accordingly.
6. **Consideration of Code Adoption:** For measures related to the adoption of the latest building or energy codes (B4), the GHG emission reductions are estimated based on the difference in energy performance between the current codes and the proposed new codes. This involves analyzing the energy efficiency requirements of the codes and estimating the impact on building energy use.
7. **Cumulative Impact:** The cumulative impact of the buildings sector measures (B1-B4) on GHG emission reductions is assessed over the specified time periods (2025 through 2030, and 2025 through 2050). This involves summing the annual GHG emission reductions over the years to estimate the total cumulative impact.

Energy Sector (E1-E3): The GHG emission reductions in the energy sector were estimated using modeling techniques that consider the amount of renewable energy generated (760 MW solar installed over 10 years) and the shift from fossil fuels to low-carbon energy sources at port facilities and industrial locations. The methodology involves several steps:

1. **Renewable Energy Generation (E1):** For measures related to the incorporation of solar and energy storage at public facilities, the GHG emission reductions were calculated based on the amount of electricity generated by the installed solar panels. This involves using solar energy generation models

to estimate the annual electricity production in MWh. The GHG emission reductions are then calculated by multiplying the electricity generated by the emission factor for the regional grid, representing the emissions avoided by displacing grid electricity with solar energy.

2. **Shift to Low-Carbon Energy Sources (E2-E3):** For measures related to demand-side management (E2) and the shift from fossil fuels to low-carbon energy sources at port facilities and industrial locations (E3), the GHG emission reductions were estimated based on the reduction in fossil fuel consumption and the corresponding decrease in GHG emissions. This involves using energy consumption models to estimate the reduction in natural gas usage due to the implementation of energy efficiency measures and the adoption of low-carbon energy technologies. The GHG emission reductions are calculated using the emission factor for natural gas combustion.
3. **Modeling Assumptions:** The models used for estimating GHG emission reductions in the energy sector are based on key assumptions such as solar panel efficiency, capacity factor for solar installations, energy efficiency improvement rates, and the penetration of low-carbon technologies. These assumptions are critical for accurately estimating the potential GHG emission reductions from the energy sector measures.
4. **Cumulative Impact:** The cumulative impact of the energy sector measures (E1-E3) on GHG emission reductions is assessed over the specified time periods (2025 through 2030, and 2025 through 2050). This involves summing the annual GHG emission reductions from renewable energy generation and the shift to low-carbon energy sources to estimate the total cumulative impact.

Transportation Sector (T1-T6): The GHG emission reductions in the transportation sector were estimated using a combination of modeling and engineering estimates based on the anticipated increase in the use of alternative transportation modes, the adoption of low and zero-emission vehicles (30% by 2030), and improvements in multimodal and active transportation infrastructure. The methodology involves several steps:

1. **Commute Reduction Programs (T1):** For measures related to providing incentives to regional small businesses to incorporate commute reduction programs, the GHG emission reductions were estimated based on the expected reduction in vehicle miles traveled (VMT) due to the implementation of carpooling, telecommuting, and other alternative commute options. The GHG emission reductions are calculated using the average emission factor for passenger vehicles, taking into account the reduced VMT.
2. **Public Transit and Micro Transit Options (T2):** For measures related to investing in partnerships to encourage van pools, vehicle sharing, and other micro transit options for rural and disadvantaged communities, the GHG emission reductions were estimated based on the anticipated shift from single-occupancy vehicle trips to shared or public transit options. The GHG emission reductions are calculated based on the difference in emissions between the modes of transportation and the expected increase in public transit and micro transit ridership.
3. **Low and Zero-Emission Vehicles (T3, T4):** For measures related to increasing the adoption of low and zero-emission vehicles and installing electric vehicle charging infrastructure, the GHG emission reductions were estimated based on the expected increase in the number of electric and low-emission vehicles in the region. The GHG emission reductions are calculated based on the difference in emissions between conventional vehicles and low or zero-emission vehicles, taking into account the projected adoption rates.
4. **Active Transportation Infrastructure (T5, T6):** For measures related to improving bike and pedestrian infrastructure and incentivizing multimodal improvements in capital construction projects, the GHG emission reductions were estimated based on the expected increase in walking and biking trips as a result of improved infrastructure and incentives. The GHG emission reductions are calculated based on the reduction in VMT and the corresponding decrease in vehicle emissions.

5. **Modeling Assumptions:** The models used for estimating GHG emission reductions in the transportation sector are based on key assumptions such as average vehicle occupancy, emission factors for different vehicle types, fuel efficiency improvements, and the impact of infrastructure improvements on mode choice. These assumptions are critical for accurately estimating the potential GHG emission reductions from the transportation sector measures.
6. **Cumulative Impact:** The cumulative impact of the transportation sector measures (T1-T6) on GHG emission reductions is assessed over the specified time periods (2025 through 2030, and 2025 through 2050). This involves summing the annual GHG emission reductions from commute reduction programs, public transit and micro transit options, low and zero-emission vehicles, and active transportation infrastructure to estimate the total cumulative impact.

Agriculture (Urban) Sector (AU1-AU4): The GHG emission reductions in the urban agriculture sector were estimated using modeling techniques that consider the increase in carbon storage from land restoration, greenspace enhancement, and urban tree planting programs. The methodology involves several steps:

1. **Native Landscaping and Irrigation Avoidance (AU1):** For measures related to promoting the use of native, drought-tolerant, low-maintenance landscaping, the GHG emission reductions were estimated based on the expected reduction in irrigation water usage and the corresponding decrease in energy consumption for water treatment and distribution. The GHG emission reductions are calculated using the emission factor for electricity consumption associated with irrigation.
2. **Land Restoration and Greenspace Enhancement (AU2, AU3):** For measures related to restoring degraded lands and enhancing greenspace to increase carbon storage, the GHG emission reductions were estimated based on the carbon sequestration potential of restored lands and enhanced greenspaces. The GHG emission reductions are calculated using carbon sequestration rates for different types of vegetation and land use changes.
3. **Urban Tree Planting Programs (AU4):** For measures related to expanding urban tree planting programs, the GHG emission reductions were estimated based on the increase in tree canopy cover and the corresponding increase in carbon sequestration. The GHG emission reductions are calculated using average carbon sequestration rates for urban trees and the projected increase in tree canopy coverage.
4. **Modeling Assumptions:** The models used for estimating GHG emission reductions in the urban agriculture sector are based on key assumptions such as the carbon sequestration potential of different vegetation types, the rate of land restoration and greenspace enhancement, and the survival and growth rates of planted trees. These assumptions are critical for accurately estimating the potential GHG emission reductions from the urban agriculture sector measures.
5. **Cumulative Impact:** The cumulative impact of the urban agriculture sector measures (AU1-AU4) on GHG emission reductions is assessed over the specified time periods (2025 through 2030, and 2025 through 2050). This involves summing the annual GHG emission reductions from native landscaping, land restoration, greenspace enhancement, and urban tree planting programs to estimate the total cumulative impact.

Materials Management (Waste) Sector (MM1): The GHG emission reductions in the materials management (waste) sector were estimated using engineering estimates based on expected reductions in landfill waste due to the promotion of recycling, composting, and other waste reduction programs. The methodology involves several steps:

1. **Waste Reduction Programs:** For measures related to promoting and incentivizing recycling, composting, and other voluntary waste reduction programs, the GHG emission reductions were estimated based on the expected reduction in the amount of waste sent to landfills. The GHG emission reductions are calculated using the emission factor for methane generation from landfills, taking into account the reduced organic waste disposal.

2. **Methane Emissions Avoidance:** The GHG emission reductions from reduced landfill waste are primarily due to the avoidance of methane emissions, which is a potent greenhouse gas. The calculation involves estimating the amount of organic waste diverted from landfills and the corresponding reduction in methane generation.
3. **Recycling and Composting Benefits:** The GHG emission reductions from recycling and composting are calculated based on the lifecycle benefits of these waste management practices, including the energy savings from recycling materials and the carbon sequestration potential of compost applied to land.
4. **Modeling Assumptions:** The estimates are based on key assumptions such as the percentage reduction in landfill waste due to the implementation of waste reduction programs, the composition of waste diverted from landfills, and the methane generation potential of organic waste in landfills.
5. **Cumulative Impact:** The cumulative impact of the materials management (waste) sector measure (MM1) on GHG emission reductions is assessed over the specified time periods (2025 through 2030, and 2025 through 2050). This involves calculating the annual GHG emission reductions from waste reduction programs and summing them over the years to estimate the total cumulative impact.

- **Models/Tools Used:**

The GHG emission reductions were estimated using ICLEI's ClearPath tool for the overall GHG inventory and sector-specific models and calculators for the individual GHG reduction measures. Specific versions of the models and tools used are documented in the technical appendix. In estimating GHG emission reductions across various sectors, a range of models and tools were employed. These tools vary in complexity and are chosen based on their suitability for the specific measures being evaluated. Below is a detailed description of the models and tools used for each sector:

Buildings Sector (B1-B4):

- **EnergyPlus:** A comprehensive building energy simulation tool developed by the U.S. Department of Energy. It is used to model energy consumption for heating, cooling, ventilation, lighting, and other energy flows in buildings.
- **eQUEST:** A user-friendly interface for the DOE-2 building energy simulation tool, used to analyze the energy performance of both new and existing buildings.
- **RETScreen:** A clean energy management software tool that helps in evaluating energy efficiency, renewable energy, and cogeneration project potentials. It is used for assessing the energy savings and GHG emission reductions from various building retrofit measures.

Energy Sector (E1-E3):

- **System Advisor Model (SAM):** Developed by the National Renewable Energy Laboratory (NREL), SAM is used to estimate the performance and financial feasibility of renewable energy systems, including solar photovoltaic installations.
- **HOMER:** A microgrid optimization tool that evaluates the economic and technical feasibility of different energy resource combinations, including renewable energy sources and storage.
- **EnergyPRO:** A modeling tool used for complex thermal and electrical energy systems, including cogeneration and district heating systems. It is employed to assess the GHG emission reductions from the shift to low-carbon energy sources at industrial locations.

Transportation Sector (T1-T6):

- **MOVES (Motor Vehicle Emission Simulator):** Developed by the U.S. Environmental Protection Agency, MOVES is used to estimate emissions from on-road vehicles, including greenhouse gases, based on various parameters such as vehicle type, fuel type, and driving conditions.
- **TRANSIMS (Transportation Analysis and Simulation System):** An integrated system of travel forecasting models used to analyze regional transportation systems and evaluate the impacts of transportation policies on GHG emissions.

Agriculture (Urban) Sector (AU1-AU4):

- **CO2FIX:** A dynamic model used to estimate carbon sequestration in forest and agroforestry systems. It is employed to assess the GHG emission reductions from urban tree planting programs and greenspace enhancement.
- **Urban Forest Effects (UFORE) Model:** Developed by the USDA Forest Service, this model is used to quantify the structure of urban forests and their environmental effects, including carbon storage and sequestration.

Materials Management (Waste) Sector (MM1):

– **WARM (Waste Reduction Model):** Developed by the U.S. Environmental Protection Agency, WARM is used to compare the GHG emissions of different waste management practices, including recycling, composting, and landfilling.

– **LandGEM (Landfill Gas Emissions Model):** A tool used to estimate the emissions of methane and other gases from landfills. It is used to assess the GHG emission reductions from reduced landfilling of organic waste.

- **Measure Implementation Assumptions:**

Below is a detailed description of the measure implementation assumptions for each sector:

Buildings Sector (B1-B4):

– **Adoption Rate:** It is assumed that 2.5% of existing buildings will undergo energy efficiency retrofits annually over a 20-year period.

– **Retrofit Lifespan:** The lifespan of retrofit measures such as insulation upgrades, HVAC system replacements, and lighting improvements is assumed to be 20 years.

– **Cost Assumptions:** Capital and operational costs for retrofit measures are based on industry averages, and financial incentives such as rebates or tax credits are considered in the economic analysis.

Energy Sector (E1-E3):

– **Solar Installation Rate:** It is assumed that a total of 760 MW of solar capacity will be installed over a 10-year period, with an even distribution of installations each year.

– **System Lifespan:** The lifespan of solar PV systems is assumed to be 25 years.

– **Energy Efficiency Improvements:** For demand-side management programs, it is assumed that there will be an annual energy efficiency improvement rate of 1-2% in industrial and commercial sectors.

– **Fuel Switching:** For the shift from fossil fuels to low-carbon energy sources at port facilities and industrial locations, it is assumed that a certain percentage of energy consumption will transition to renewable or low-carbon sources over a specified period.

Transportation Sector (T1-T6):

– **Vehicle Adoption Rates:** It is assumed that 30% of passenger and light-duty vehicles will be converted to electric or low-emission vehicles by 2030.

– **Infrastructure Development:** For measures related to active transportation and public transit, it is assumed that there will be a 10% increase in infrastructure such as bike lanes, pedestrian paths, and public transit routes over a 10-year period.

– **Mode Shift:** For commute reduction programs, it is assumed that there will be a 20% reduction in single-occupancy vehicle trips due to the adoption of alternative commuting options.

Agriculture (Urban) Sector (AU1-AU4):

– **Tree Planting Rate:** It is assumed that the urban tree canopy will increase by 50% by 2050 through the planting of new trees and the natural growth of existing trees.

– **Land Restoration:** For land restoration measures, it is assumed that a certain percentage of degraded land will be restored to green space or agricultural use each year.

Materials Management (Waste) Sector (MM1):

- **Waste Diversion Goals:** It is assumed that 50% of solid waste will be diverted from landfills to recycling or composting facilities by 2050.
- **Program Participation:** For recycling and composting programs, it is assumed that there will be a certain level of participation by households and businesses, influenced by education and outreach efforts.

- **GHG Reduction Estimate Assumptions:**

Below is a detailed description of the GHG reduction estimate assumptions for each sector:

Buildings Sector (B1-B4):

- **Emission Factors:** Emission factors for electricity and natural gas are based on regional averages and are sourced from reputable databases such as the U.S. Environmental Protection Agency's eGRID for electricity and the Intergovernmental Panel on Climate Change (IPCC) guidelines for natural gas.
- **Energy Prices:** Assumptions about energy prices are based on historical trends and projections from sources like the U.S. Energy Information Administration (EIA). These prices are used to evaluate the cost-effectiveness of energy efficiency measures.

Energy Sector (E1-E3):

- **Renewable Energy Output:** For solar installations, the assumed output is based on factors such as solar panel efficiency, geographic location, and average sunlight hours.
- **Displacement of Grid Electricity:** The assumption that renewable energy generated displaces an equivalent amount of grid electricity, thereby reducing GHG emissions associated with conventional electricity generation.

Transportation Sector (T1-T6):

- **Vehicle Emission Factors:** Emission factors for different types of vehicles (conventional, electric, hybrid) are based on data from sources like the U.S. EPA's MOVES model and manufacturer specifications.
- **Electricity Emission Factor for EVs:** For electric vehicles, the emission factor for electricity used for charging is based on the regional grid mix and is subject to change as the grid becomes cleaner over time.

Agriculture (Urban) Sector (AU1-AU4):

- **Carbon Sequestration Rates:** Assumptions about the carbon sequestration rates of different types of vegetation, such as trees and grasslands, are based on scientific studies and literature.
- Lifespan of Trees**:** The average lifespan of urban trees is assumed to be a certain number of years, which affects the calculation of long-term carbon sequestration.

Materials Management (Waste) Sector (MM1):

- **Methane Generation Potential:** Assumptions about the methane generation potential of organic waste in landfills are based on factors such as waste composition, landfill conditions, and the effectiveness of landfill gas capture systems.
- **Recycling Emission Factors:** Emission factors for recycling processes are based on lifecycle assessments that account for the energy and emissions associated with collecting, processing, and manufacturing recycled materials.

- **Reference Case Scenario (GHG Emissions or Activity Level):**

The reference scenario is based on projected “business as usual” (BAU) GHG emissions, which align with the timeframe for quantified emission reduction estimates. Below is a detailed description of the reference case scenario assumptions for each sector:

Buildings Sector (B1-B4):

- **Current Energy Efficiency Levels:** The reference case scenario assumes that buildings maintain their current energy efficiency levels without any retrofits or upgrades. This scenario is based on existing building codes and average energy consumption data for the region.
- **Business-as-Usual (BAU) Energy Consumption Growth:** The scenario assumes a BAU growth in energy consumption based on historical trends and projected population and economic growth in the region.

Energy Sector (E1-E3):

- **BAU Energy Mix:** The reference case scenario for the energy sector assumes a BAU energy mix based on current energy policies and the projected growth of renewable and non-renewable energy sources.
- **Fossil Fuel Dependency:** The scenario assumes continued dependency on fossil fuels for energy generation in the absence of measures to increase renewable energy adoption and improve energy efficiency.

Transportation Sector (T1-T6):

- **Vehicle Fleet Composition:** The reference case scenario assumes that the composition of the vehicle fleet (conventional, electric, hybrid) remains unchanged from current levels, without any significant increase in the adoption of low and zero-emission vehicles.
- **VMT Growth:** The scenario assumes a BAU growth in vehicle miles traveled (VMT) based on historical trends and projected population and economic growth in the region.

Agriculture (Urban) Sector (AU1-AU4):

- **Current Land Use Practices:** The reference case scenario assumes that current land use practices, including the extent of green spaces and urban forestry, remain unchanged without any additional land restoration or tree planting efforts.
- **Carbon Sequestration Rates:** The scenario assumes that carbon sequestration rates in urban areas remain constant at current levels, without any enhancements from increased vegetation cover.

Materials Management (Waste) Sector (MM1):

- **Waste Generation and Management Practices:** The reference case scenario assumes that waste generation rates and management practices (landfilling, recycling, composting) remain unchanged from current levels, without any additional waste reduction measures.
- **Methane Emissions from Landfills:** The scenario assumes that methane emissions from landfills continue at current rates, without any reductions from decreased organic waste disposal or improved landfill gas capture systems.

C. Calculating GHG emissions reduction for each project:

- **Port Houston's MicroGrid**

Starting emissions: Port Houston's emissions are 259,134 metric tons CO2e from ships and 174,000 metric tons of CO2eq from port activities. Target year for net-zero emissions is 2050. assuming the plan starts in 2023.

Number of years to reach net-zero: 2050 - 2025 = 25 years

Annual CO2eq reduction required: 260,000 CO2eq + 174,000 CO2eq = 434,000 metric tons of CO2eq

Annual CO2eq reduction: 434,000 million metric tons of CO2eq / 25 years = 17,360 metric tons of CO2eq per year

- **Port Houston's Zero Emission Cargo Handling Equipment**

PHA’s Operated and PHA Tenant Operated emissions from Cargo Handling Equipment (CHE) contributed in 2019, 72,121 metric tons CO2eq. The goal of PHA is to replace all diesel CHE with Zero Emission (ZE) Equipment.

- **Port Houston's High Voltage Shore Power**

Average CO2eq reduction per ship at berth using shore power: 29.89 tons of CO2e
Annual CO2eq emissions from ships at Port Houston: 259,134 tons of CO2e
Number of ships expected to use shore power: This number will depend on the capacity of the shore power infrastructure and the number of ships that are shore power compliant. For this estimate, let's assume that 10% of the ships that visit Port Houston annually will use shore power in the initial years of implementation.
Number of large ships using shore power annually: Assuming 10% of 8,300 large ships = 830 ships
Total annual CO2eq reduction from shore power for large ships: 830 ships * 29.89 tons of CO2e/ship = 24,809 tons of CO2e

- **The Clear Air Renewable Energy & Storage (CARES):**

Capacity of the solar and battery storage system: 100 kW (kilowatts)
Average annual solar power generation per kW in Texas: 1,400 kWh (kilowatt-hours)
Total annual solar power generation: 100 kW * 1,400 kWh/kW = 140,000 kWh
Emission factor for grid electricity in Texas: 0.4 kg CO2eq/kWh (This value can vary based on the specific grid mix and should be updated with the most accurate regional data.)
Annual CO2eq reduction from solar power generation: 140,000 kWh * 0.4 kg CO2eq/kWh = 56,000 kg CO2eq = 56 metric tons CO2eq

- **Solar and Storage Microgrids and Energy Efficiency Improvements**

Energy efficiency improvements: Let's assume the energy efficiency improvements result in a 20% reduction in energy use for the buildings.
Average energy use of municipal buildings: Assuming an average energy use of 200 kWh per square meter per year for municipal buildings.
Total area of buildings being improved: Assume 50,000 square meters of buildings are being improved.
Total energy savings from efficiency improvements: 50,000 m^2 * 200 kWh/m^2/year * 20% = 2,000,000 kWh/year
Emission factor for grid electricity in Houston: Assume 0.4 kg CO2eq/kWh (This value can vary based on the specific grid mix and should be updated with the most accurate regional data.)
Annual CO2eq reduction from energy efficiency improvements: 2,000,000 kWh/year * 0.4 kg CO2eq/kWh = 800,000 kg CO2eq/year = 800 metric tons CO2eq/year
For the microgrids:
Capacity of the solar and storage system: Assume a total capacity of 1 MW (1,000 kW) for the solar component of the microgrids.
Average annual solar power generation per kW in Houston: Assume 1,400 kWh/kW/year.
Total annual solar power generation: 1,000 kW * 1,400 kWh/kW/year = 1,400,000 kWh/year
Annual CO2eq reduction from solar power generation: 1,400,000 kWh/year * 0.4 kg CO2eq/kWh = 560,000 kg CO2eq/year = 560 metric tons CO2eq/year
Combining the reductions from energy efficiency improvements and solar power generation, the total estimated annual CO2eq reduction for this project is:
Total annual CO2eq reduction: 800 metric tons CO2eq/year + 560 metric tons CO2eq/year = 1,360 metric tons CO2eq/year

- **The City of Houston's (City) Regional and Municipal Fleet Electrification project**

Number of electric vehicles (EVs) to be added to the municipal fleet: Assume 200 EVs as an average between 185 and 222.
Average annual miles driven per vehicle: Assume 12,000 miles per year.
Average fuel efficiency of conventional vehicles being replaced: Assume 25 miles per gallon (mpg).
Average emissions factor for gasoline: Assume 8.89 kg CO2eq/gallon.
Emission factor for grid electricity in Houston: Assume 0.4 kg CO2eq/kWh (This value can vary based on the specific grid mix and should be updated with the most accurate regional data.)

Average energy consumption of EVs: Assume 0.3 kWh/mile.
Annual CO2eq reduction from replacing conventional vehicles with EVs:
Annual gasoline consumption avoided: 200 vehicles * 12,000 miles/year / 25 mpg = 96,000 gallons/year
Annual CO2eq emissions avoided from gasoline: 96,000 gallons/year * 8.89 kg CO2eq/gallon = 853,440 kg CO2eq/year = 853 metric tons CO2eq/year
Annual CO2eq emissions from EVs:
Annual electricity consumption of EVs: 200 vehicles * 12,000 miles/year * 0.3 kWh/mile = 720,000 kWh/year
Annual CO2eq emissions from EV electricity use: 720,000 kWh/year * 0.4 kg CO2eq/kWh = 288,000 kg CO2eq/year = 288 metric tons CO2eq/year
Net annual CO2eq reduction:
Net annual CO2eq reduction: 853 metric tons CO2eq/year - 288 metric tons CO2eq/year = 565 metric tons CO2eq/year

- **Brownfields to Brightfields project**

Capacity of the solar farm: 50 megawatts (MW)
Energy generation: Enough to power 5,000 homes
GHG emissions offset: 120 million pounds (54,431 metric tons) of GHG emissions per year
Assuming similar performance for the Brownfields to Brightfields project, we can estimate the CO2eq reduction as follows:
Annual CO2eq reduction: 54,431 metric tons CO2eq

- **the City of Houston's expanded Repair Café program**

To estimate the CO2eq reduction for the City of Houston's expanded Repair Café program, we need to consider the following factors:
Average weight of items repaired: Assume an average weight of 5 kg per repaired item.
Average GHG emissions from manufacturing a new item: Assume 50 kg CO2eq per item (This value can vary based on the type of item and should be updated with more specific data.)
Average GHG emissions from landfilling: Assume 0.5 kg CO2eq per kg of waste.
Number of items repaired per year: Assume an expansion of the program allows for an additional 2,000 items to be repaired annually.
Annual CO2eq reduction from avoiding new product consumption:
GHG emissions avoided from not buying new items: 2,000 items * 50 kg CO2eq/item = 100,000 kg CO2eq/year = 100 metric tons CO2eq/year
Annual CO2eq reduction from avoiding landfill waste:
GHG emissions avoided from not landfilling: 2,000 items * 5 kg/item * 0.5 kg CO2eq/kg = 5,000 kg CO2eq/year = 5 metric tons CO2eq/year
Total annual CO2eq reduction:
Total annual CO2eq reduction: 100 metric tons CO2eq/year + 5 metric tons CO2eq/year = 105 metric tons CO2eq/year

- **The ForUsTree project**

Number of additional trees planted: Assume 10,000 trees.
Average carbon sequestration rate per tree: Different tree species have varying sequestration rates, but a commonly used average is about 22 kg of CO2 per tree per year.
Project lifespan: Assume the trees will be actively sequestering carbon for 40 years.
Total CO2eq sequestration over the project lifespan:
Annual CO2eq sequestration: 10,000 trees * 22 kg CO2/tree/year = 220,000 kg CO2/year = 220 metric tons CO2eq/year
Total CO2eq sequestration over 40 years: 220 metric tons CO2eq/year * 40 years = 8,800 metric tons CO2eq

- **Building Infrastructure program by Fort Bend County**

Number of buildings targeted: Assume 100 buildings (mix of residential, commercial, and county buildings).
Average energy use reduction per building: Assume a 20% reduction in energy use through the implemented measures.
Average energy use of buildings: Assume 200 kWh per square meter per year.
Average area of buildings: Assume 1,000 square meters per building.
Emission factor for grid electricity in Ft. Bend County: Assume 0.4 kg CO2eq/kWh (This value can vary based on the specific grid mix and should be updated with the most accurate regional data.)
Annual CO2eq reduction from the Building Infrastructure program:
Total energy use reduction: 100 buildings * 1,000 m^2/building * 200 kWh/m^2/year * 20% = 4,000,000 kWh/year
Annual CO2eq reduction: 4,000,000 kWh/year * 0.4 kg CO2eq/kWh = 1,600,000 kg CO2eq/year = 1,600 metric tons CO2eq/year

- **Transportation Demand Management Program and Regional Small Business Energy Efficiency Loan Program.**

The GHG reduction potential scenarios estimated using ICLEI's ClearPath tool as reported in the submitted PCAP.