APPENDIX B - TECHNICAL APPENDIX

1 GHG Reduction Estimate Method & Tools Used

The following sections are intended to provide insight into the assumptions and modeling used to generate greenhouse gas (GHG) emission reduction estimates for the Southeast Florida Regional Climate Change Compact's (Compact or Project Team) proposed measures for U.S. EPA's Climate Pollution Reduction Grant Implementation Grant application (Project). The measures proposed in this Project include Residential Energy Efficiency Program (REEP), Solar Rebate Program (SRP), and Electric Vehicle New Incentives for Charging Equipment (EV-NICE). This technical appendix is intended to supplement the Compact's Workplan.

1.1 REEP & SRP - GHG Reduction Estimate Method & Tools Used

The methods used for REEP and SRP measure-related outputs and GHG emission reduction estimates included publicly available tools and datasets. Rewiring America was contracted to develop REEP and SRP measure estimates. These estimates were built upon Rewiring America's Personal Electrification Planner[1], and follows the methodology outlined on their website[2]. To summarize, the GHG reduction estimates were generated, first, using the ResStock[3] tool from the National Renewable Energy Laboratory (NREL), to determine residential building characteristics specific to homes in Florida in 2021 International Energy Conservation Code (IECC) climate zone 1A, as well as energy saving estimates under a variety of upgrade scenarios, or interventions. To convert energy savings estimates into GHG reduction estimates, we use two sets of emissions factors. For fossil fuel site emissions - including propane, natural gas, or fuel oil - we use the appropriate emissions factors from the U.S. EPA's AP-42: Compilation of Air Emissions Factors from Stationary Sources[4]. For estimating the emissions from electric loads, NREL's energy analysis data sets on Cambium[5] were used to forecast long-run marginal emissions rates.

Solar production for SRP was modeled using NREL's PVWatts tool[6]. The modeled system size was 10 kW based on community input received from local solar installers and Solar United Neighbors, a solar advocacy organization.

One exception to this methodology is estimates from the lighting upgrade (LED replacements) intervention incorporated into the REEP measure. The Personal Electrification Planner was not equipped to estimate savings from lighting upgrade interventions, so engineering estimates were used instead. The calculations and assumptions were based on Northeast Energy Efficiency Partnerships (NEEP) produced Maryland/Mid-Atlantic Technical Reference Manual (TRM), version 10[7], to produce electric consumption savings (kWh), which was then used to determine GHG emission reductions and participant cost savings based on Southeast Florida-specific grid emission factors and energy prices.

1.2 EV-NICE - GHG Reduction Estimate Method & Tools Used

Emissions reductions for the EV-NICE program were modeled using the amount of vehicle miles traveled (VMTs) associated with an increase in electric vehicle (EV) sales brought on by the measures' increased availability of public EV charging infrastructure. The amount of VMTs that become electrified is compared to the emissions that would have come from combustion vehicles to arrive at an annual emissions reduction figure. The extra emissions from electricity usage are calculated using an average EV

[1] https://homes.rewiringamerica.org/
[2] https://homes.rewiringamerica.org/data-methodology
[3] https://www.nrel.gov/buildings/resstock.html
[4] https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors-stationary-sources
[5] https://www.nrel.gov/analysis/cambium.html
[6] https://pvwatts.nrel.gov/
[7] https://neep.org/mid-atlantic-technical-reference-manual-trm-v10

battery efficiency and forecasted grid emission factors, which are then subtracted to find the total annual emissions impact from the program overall.

Greenlink Analytics was contracted to create the model for emissions reductions, which was then tested and revised for local conditions of the Compact partners. Greenlink used their proprietary model, ATHENIA[8], to model Florida Power & Lights (FPL) grid emission intensities to determine emission factors through 2050. The model used input data from publicly available resources.

Source data were derived from a combination of federal government agencies, research institutes, a regional transportation planning council, and industry-related websites. The following list provides a detailed overview of the publicly available information used for the analysis by source:

- The International Council on Clean Transportation (ICCT)
    - Expanding the Electric Vehicle Market in U.S. Cities (2017) by Peter Slowik[9]
        - Elasticity of Electric Vehicle Supply Equipment (EVSEs) to EV sales
    - Evaluating Electric Vehicle Market Growth Across U.S. Cities (2021) by Anh Bui[10]
        - Continued support of above
- U.S. DOE's Electric Vehicle Infrastructure Projection (EVI-Pro) Lite tool[11]
    - Charging infrastructure needs projections
- NREL: The 2023 National Charging Network[12]
    - EV adoption projections (12% in 2030)
- U.S. Energy Information Administration (EIA) Annual Energy Outlook (AEO) 2023[13]
    - Average ICE car emissions
- Southeast Florida Regional Transportation Plan 2045 (adopted 2020)[14]
    - Growth in population vs VMTs in the future
- Kelley Blue Book[15]
    - Average FL VMTs per year
- Car and Driver[16], Electrek[17], Driving Electric[18] websites
    - Average EV battery efficiency and average EV lifetime

2 Measure Implementation Assumptions

2.1 Assumed Rate of Measure Implementation

Assumed rates of measure implementation for all measures were determined by Compact partners' internal evaluations synthesizing factors including internal capacity, past performance, community demand, and existing workforce to ultimately approximate how many rebates each partner could process over a five-year period. From there, a distribution model was developed to reflect the following annual anticipated performance of the Project:

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8 https://www.greenlinkanalytics.org/our-expertise
9 https://theicct.org/publication/expanding-the-electric-vehicle-market-in-u-s-cities/
10 https://theicct.org/publication/evaluating-electric-vehicle-market-growth-across-u-s-cities/
11 https://afdc.energy.gov/evi-x-toolbox#/evi-pro-ports
12 https://www.nrel.gov/docs/fy23osti/85654.pdf
13 https://www.eia.gov/outlooks/aeo/
14 https://www.seftc.org/2045rtp
15 https://www.kbb.com
16 https://www.caranddriver.com/
17 https://electrek.co/
18 https://www.drivingelectric.com/

Program Year	Anticipated Production (% of Total)	Description
Year 1 - 2025	10% of total production	Ramp-up year
Year 2 - 2026	30% of total production	Peak performance year
Year 3 - 2027	30% o f total production	Peak performance year
Year 4 - 2028	20% of total production	Post-peak throttle-down year
Year 5 - 2029	10% of total production	Ramp-down and closeout year

Table 2.1 - Assumed Rate of Measure Implementation

2.2 Measure Lifetimes

Measure	PCAP Measure Code	Category	Intervention	Durability (Years)
REEP	RC-01	Envelope	Basic Enclosure	13.0
REEP	RC-03	HVAC	Medium Efficiency A/C	14.0
REEP	RC-03	HVAC	Medium Efficiency Heat Pump	14.0
REEP	RC-04	DHW	Heat Pump Water Heater	10.0
REEP	R-01	Appliance	Induction Range	14.0
REEP	R-01	Appliance	Heat Pump Dryer	13.0
REEP	RC-05	Lighting	LED Replacements	16.3
SRP	R-02	Solar	Solar Photovoltaics	30.0
EV-NICE	T-03	EV	Level 2 Charger	24.0
EV-NICE	T-03	EV	DC Fast Charger	24.0

Table 2.2 - Summary of Measure Intervention Lifetimes

REEP intervention-level durability was determined based on GHG reduction estimate methodology used. For interventions modeled by Rewiring America, measure durability was derived from InterNACHI's Standard Estimated Life Expectancy Chart for Homes[19]. For lighting upgrade interventions, measure durability was derived from the TRM. REEP intervention lifetimes range from 10.0 years for heat pump water heaters to 16.3 years for LED replacements.

Solar panel durability was determined based on information published by U.S. DOE's Solar Energy Technologies Office on End-of-Life Management for Solar Photovoltaics[20].

Because EV chargers do not inherently generate GHG reductions, but incentivize the purchase of GHG reducing EVs, the durability listed for both types of EV chargers are more accurately represented by the durability of the EVs they are incentivizing. The durability of the additional EVs the measure incentivizes, which will impact future emissions, is calculated to be a total of 24 years. This figure was calculated using an average 12-year expected lifespan for light-duty vehicles[21] and applying a linear decay model. This modeling method assumes for all vehicles placed into service in year 1, exactly half of the vehicles are off the road at year 12, and the remaining vehicles are off the road by year 24.

[19] https://www.nachi.org/life-expectancy.htm
[20] https://www.energy.gov/eere/solar/end-life-management-solar-photovoltaics
[21] https://www.spglobal.com/mobility/en/research-analysis/average-age-of-vehicles-in-the-us-increases-to-122-years.html

2.3 Capital Cost Assumptions

2.3.1 REEP & SRP Capital Cost Assumptions

Capital costs for both REEP and SRP measures follow the methodology on Rewiring America's website[2]. This methodology includes the upfront costs of electrification upgrades like heat pumps, heat pump water heaters, solar panels, insulation, stoves, and dryers which are estimated using datasets from programs and research such as the Massachusetts Residential Air-Source Heat Pump Program, TECH Clean California, and reports from Lawrence Berkeley National Laboratory (LBNL). Solar costs, specifically, were derived from datasets published in LBNL's "Tracking the Sun" report[22]. Additionally, weatherization costs were adapted from the U.S. DOE Office of Scientific and Technical Information's "The Cost of Decarbonizing and Energy Upgrade Retrofits for US Homes" report[23]. These costs were then adjusted for factors like square footage, climate zone, and efficiency. Costs are further adjusted for inflation using a Construction Price Index and for location using RS Means materials and labor cost factors, representing total installed costs. For induction ranges and heat pump dryers, costs are estimated using online prices, providing a lower bound on potential expenditure.

Additionally, all costs for interventions are designed for current regulatory conditions involving refrigerants. The refrigerant regulatory changes expected in 2025 to reduce hydrofluorocarbon-based refrigerants in exchange for those with lower global warming potential could not be modeled in due to unknown market implications as of the submission of this application.

One deviation from Rewiring America's methodology is that upfront costs for LED replacements were estimated based on an existing low-income energy efficiency rebate program. Rebates offered in 2024 for lighting upgrades in the program were used and then adjusted for inflation over the proposed period of performance. These methodologies ensure a comprehensive and adjustable approach to predicting upfront costs for various electrification upgrades.

2.3.2 EV-NICE Capital Cost Assumptions

Capital costs were based on estimates provided to Miami-Dade County by local contractors in early 2023 to install Level 2 and DCFC infrastructure for their county fleet. Capital costs are to be assumed by the applicant with a 50% rebate (capped at $100,000 for Level 2 installations and $500,000 for DCFC installations) to be provided by the EV-NICE measure. These costs include project planning, site improvements, installation, operation, maintenance, and project administration. The EV-NICE program leverages public and private sector financing to ensure maximum benefit from the grant funding.

2.4 Operation and Maintenance Cost Assumptions

2.4.1 REEP & SRP Operation and Maintenance Cost Assumptions

All operation and maintenance costs are to be assumed by the participant. However, because LIDAC households are often characterized by poor-quality, less energy efficient buildings with existing deferred maintenance, the installation of new, high-quality, more energy-efficient interventions through REEP are assumed to lower operating costs, supported by energy savings calculations, and alleviate maintenance needs for participants[24]. Similarly, the installation of on-site electricity production solar photovoltaic panels through SRP is assumed to lower operating costs, supported by energy generation calculations. Maintenance costs for solar photovoltaic systems vary so community education and engagement will be an essential component for qualifying households to decide if SRP is appropriate for their individual considerations.

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[22] https://emp.lbl.gov/tracking-the-sun
[23] https://www.osti.gov/biblio/1834578/
[24] https://www.nrel.gov/docs/fy23osti/83173.pdf

2.4.2 EV-NICE Operation and Maintenance Cost Assumptions

Operation and maintenance costs are to be assumed by the applicant.

3 GHG Reduction Estimate Assumptions

While most GHG reduction estimate assumptions are driven by the methodology used in the analysis, one assumption applies to REEP, SRP, and EV-NICE calculations. FPL serves the majority of the region, with Florida Keys Electric Cooperative (FKEC) and Key Energy Services (KES) both serving portions of Monroe County, comprising the Florida Keys. The assumption was made that the GHG grid emissions factors identified for FPL would be appropriate to apply for FKEC and KES.

3.1 REEP & SRP GHG Reduction Estimate Assumptions

For REEP and SRP, when utilizing Cambium to forecast grid emissions, we used the Cambium grid decarbonization scenario assuming 95% of the grid is decarbonized by 2050, starting in 2025. This is intended to be a more conservative estimate than the predominant electric utility serving the region, FPL's Real Zero goal to completely eliminate carbon emissions in Florida no later than 2045.

Additionally, the emissions projected for REEP and SRP were levelized over 15 years (2025-2040) because Rewiring America's models are designed to quantify emissions impacts over the lifetime of an appliance, typically averaging about 15 years. This suggests a higher probability of an overestimation of emissions savings between 2025-2030 and an underestimation of emissions savings between 2025-2030.

As stated in the Workplan, as REEP measure interventions expire approximately 10-16 years after installation, this analysis assumes they will be replaced by interventions with greater than or equal to efficiency ratings of interventions installed by this Project over the period of performance. This assumption is informed by regular trends in updates to energy efficiency codes and equipment standards, as well as technological advancements.

For REEP interventions replacing HVAC equipment, efficiency of existing heat pumps of A/C units have a lower SEER (10-15 SEER) than the retrofit equipment (16+ SEER). Additionally, the assumption was made that medium efficiency straight air-conditioners and heat pumps would be most appropriate for REEP participants all residing within climate zone 1A. The incremental cost increase for higher efficiency heat pumps, for instance, was determined to not be a prudent investment due to the unique 1:100 ratio of heating degree days to cooling degree days for the region, and medium efficiency systems would better support increased dehumidification for healthier indoor air quality.

Similar to cost assumptions, all GHG reduction estimates for REEP interventions are designed for current regulatory conditions involving refrigerants. The refrigerant regulatory changes expected in 2025 to reduce hydrofluorocarbon-based refrigerants in exchange for those with lower global warming potential could not be modeled in due to unknown impacts on equipment performance and subsequent energy consumption, as of the submission of this application.

As stated in the Workplan, local solar installers and Florida Solar United Neighbors recommended using 10 kW for the modeled average system size. All solar arrays installed in the period of performance are also assumed to be operational throughout the 2025-2050 period for the analysis.

IECC climate zone 1A includes Broward, Miami-Dade, and Monroe Counties. While Palm Beach County falls in climate zone 2A, for purposes of modeling REEP and SRP for this application, we assumed all participants were located in climate zone 1A.

High income households defined as having annual incomes exceeding 150% of local area median income, mobile homes, and vacant homes were excluded from the baseline case scenario modeling.

3.2 EV-NICE GHG Reduction Estimate Assumptions

Based on the U.S. DOE's Electric Vehicle Infrastructure Projection (EVI-Pro) Lite tool, 1.3% of light-duty vehicles (LDVs) are EVs in 2022, which will grow to 12% by 2030, based on NREL projections. The NREL projections for EV counts by year in Florida were localized by average daily vehicle miles traveled (DVMTs) from Florida Department of Transportation to arrive at a number of EVs in just the four-county area. Then the EVI-Pro Lite tool was used to determine the necessary amount of public EVSEs on a yearly basis.

The EV-NICE measure build out schedule was then used to determine the amount of incremental additional EVSEs to be installed during each of the 5 years of the program. The amount of EVSEs was converted to a percentage of additional EVSEs, which informed the amount of new EV registrations per year attributed to the program. These additional EV registrations were based on the assumption that each additional 1% of public EVSEs installed leads to 3% more EV registrations in the following year[9].

These excess EVs are assumed to be replacing internal combustion engine (ICE) vehicles and the number of EVs is multiplied by the expected emissions reductions per VMT from the electric transition. Florida VMT averages are taken from Kelley Blue Book and are assumed to grow at 1/2 the expected population growth rate based on the Southeast Florida Regional Transportation Plan 2045 (adopted 2020), due to plans for density and expanded public transportation. Average emissions from ICE vehicles are taken from the U.S. EIA's Annual Energy Outlook 2023 and assumed to decrease over time as fuel efficiency increases. Average emissions from EVs are created by assuming the average battery efficiency of 4.1 miles/kWh, backed up by efficiency numbers from top selling EVs according to Car and Driver, Electrek, and Driving Electric. Electric grid related emissions from the increased EV usage is calculated using FPL's grid emission factors, also assumed to be greening over time in accordance with plans for increased renewables in the generation portfolio.

Overall VMTs converted to EVs and the associated emissions savings on a yearly basis are then subject to an assumed 12-year average lifespan, again backed up by Car and Driver, Electrek, and Driving Electric. This lifespan is converted to a linear decay and allows the gathering of yearly emissions reduction estimates out to the year 2050.

4 Reference Case Scenario (GHG Emissions or Activity Level)

4.1 REEP & SRP Reference Case Scenarios

The reference case used for REEP and SRP modeling largely follows the same methodology outlined in 1.1, using a baseline housing stock modeled by NREL's ResStock for residential building stock in Florida, climate zone 1A, for household incomes not exceeding 150% of the local area median income [25].

"Business as usual" (BAU) projections do not include the effect of non-CPRG federal incentives because the Governor of Florida rejected formula funds through the Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL). Formula funds Florida has received for programs like the Weatherization Assistance Program (WAP) will have limited reach among regional LIDACs. Additionally, considering the target market segment are low-income and disadvantaged communities (LIDACs), we do not expect participants to carry the tax liability needed to leverage other tax credit and rebate programs.

4.2 EV-NICE Reference Case Scenario

The EV-NICE measure baseline scenario includes average combustion vehicle emissions from the AEO 2023 as well as grid emissions data from Greenlink's FPL projections, as they are the utility provider for the vast majority of consumers throughout the region.

[25] https://public.tableau.com/app/profile/nrel.buildingstock/viz/shared/K9N5GPJT3

This emissions data is coupled with baseline population and driving data from the Southeast Florida Regional Transportation Plan 2045, which was adopted in August of 2020.

The final baseline assumptions come from the Department of Energy's Electric Vehicle Infrastructure Projection (EVI-Pro) Lite tool for needed charging infrastructure based on expected EV adoption, which is taken from the National Renewable Energy Laboratory 2030 projections.

5 Measure-Specific Activity Data

5.1 REEP Measure-Specific Activity Data

The activity data used for estimating GHG reductions for REEP includes:

- Quantity of basic enclosure upgrades installed
- Quantity of medium efficiency A/C installed
- Quantity of medium efficiency heat pumps installed
- Quantity of heat pump water heaters installed
- Quantity of induction ranges installed
- Quantity of heat pump dryers installed
- Quantity of LED replacements

5.2 SRP Measure-Specific Activity Data

The activity data used for estimating GHG reductions for SRP includes:

- Quantity of solar arrays installed
- Size of solar arrays installed (kW)
- Energy production of solar arrays (kWh)

5.3 EV-NICE Measure-Specific Activity Data

The activity data used for estimating GHG reductions for EV-NICE includes:

- Quantity of EVSEs installed
- Quantity of excess EV registrations
- Quantity of increased electric VMTs
- Calculation of increased grid emissions (metric tons CO_2e)
- Calculation of reduced tailpipe emissions (metric tons CO_2e)

6 GHG Emissions Reduced

REEP Measure Evaluation - Total	2025	2026	2027	2028	2029	2025-2030	2025-2050
Households Served:	836	2,509	2,509	1,673	836	8,365	8,365
Annual Bill Savings ($):	$ 376,635	$ 1,129,904	$ 1,129,904	$ 753,270	$ 376,635	$ 11,675,679	$ 87,002,642
Annual Emissions Reduction (tons CO2e):	550	1,602	1,602	1,076	550	16,665	124,257

Table 6.1 - GHG Emissions Reduced - REEP

SRP Measure Evaluation - Total	2025	2026	2027	2028	2029	2025-2030	2025-2050
Households Served:	778	2,334	2,334	1,556	778	7,782	7,782
Annual Bill Savings ($):	$ 1,456,049	$ 4,368,146	$ 4,368,146	$ 2,912,097	$ 1,456,049	$ 45,137,504	$ 336,347,206
Annual Emissions Reduction (tons CO2e):	1,882	5,645	5,645	3,763	1,882	58,332	434,670

Table 6.2 - GHG Emissions Reduced - SRP

EV-NICE Measure Evaluation - Total	2025	2026	2027	2028	2029	2025-2030	2025-2050
New EVSEs Installed:	80	241	241	160	80	802	802
New Vehicles Attributed to Program:	0	1,846	6,076	5,452	3,632	18,937	18,937
Annual Emissions Reduction (tons CO2):	6,671	28,815	48,162	58,868	61,616	204,132	768,975

Table 6.3 - GHG Emissions Reduced - EV-NICE