East Boston's Opportunity for a Clean Energy Transition

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Technical Appendix: Methodology and Assumptions

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This document describes the methodology and assumptions that the Union of Concerned Scientists (UCS) and GreenRoots (GR) used for the development of the analysis *East Boston's Opportunity for a Clean Energy Transition*

METHODOLOGY

UCS and GR employed the Hybrid Optimization of Multiple Energy Resources (HOMER) Grid Version 1.6.1—an energy system optimization and financial analysis model specifically designed to analyze distributed generation and microgrids at the customer and local level—to analyze the economic feasibility of investing in behind-the-meter storage combined with solar in/on multi-family housing in East Boston, MA.

The HOMER model was originally developed by the U.S. National Renewable Energy Laboratory (NREL) and now distributed by HOMER Energy LLC as a proprietary computer software package. HOMER Grid models a power system's physical operations and its life-cycle cost, which is the total cost of installing and operating the system over its lifespan. HOMER allows users to compare many different system options based on their technical and economic benefits. The model has two optimization algorithms. The original grid search algorithm simulates all the feasible system configurations to search for the least costly system and displays a list of configurations sorted by net present cost, and then simulates hourly operation of each technology configuration (Lambert T et al. 2006; HOMER Energy LLC 2017).

We conducted additional off-model calculations to estimate adjusted payback periods given various state-specific incentives and programs. In general, payback period indicates how many years it takes to recover an investment. We calculated the adjusted payback periods for each investment option based on the size of each system, its investment cost, the annual solar power generation, the annual bill savings out of each system, and the various state incentives (listed in the next section).

We also conducted off-model calculations to identify potential rooftop solar penetration according to building characteristics in East Boston. We used data provided by the Boston Planning and Development Agency.

ASSUMPTIONS UNDERLYING THE HOMER ANALYSIS

Financial

Our financial analysis assumed that the investments would be made in 2021 and that the projects would have a 25-year lifetime. All net-present-value calculations in the HOMER analysis used a real discount rate of 6 percent.

Size of rooftop solar system for a triple-decker building

The roof area of most triple-deckers is 30 by 40 feet, which can host a solar power system with about 14 to 19 kilowatts (kW) of peak solar power (Deffenbaugh 2017).We assumed that most buildings will be able to install, at minimum, a 14kW rooftop solar system.

Electricity demand by building type

We used the Department of Energy's (DOE) Open Energy Information (OpenEI) database to identify hourly load profile of a typical single-family detached home in the East Boston area. OpenEI data provides commercial and residential hourly load profiles simulated for all typical meteorological year 3 (TMY3) locations in the United States. It contains hourly load profile data for 16 commercial building types and residential buildings based off the DOE commercial reference building models and the Building America House Simulation Protocols (DOE 2014).

- **Triple-decker apartment building.** We adjusted the scale of the load to create an assumed hourly load profile for a typical triple-decker building located in East Boston using monthly power consumption data from the Cambridge Energy Alliance for actual triple-decker buildings (Gromer 2019).

Policy assumptions

- The **Federal Solar Investment Tax Credit (ITC)** is currently a 30 percent federal tax credit against the tax liability of residential and commercial investors in solar energy property. It is scheduled to ramp down to 26 percent in 2020, and 22 percent in 2021. After 2021, the residential credit drops to zero while the commercial credit drops to a permanent 10 percent. Since this analysis assumed that the investments would be made in 2021, an investment tax credit of 22 percent was applied to the investment cost estimation.
- **Net metering program.** The net metering (NEM) program allows customers to offset their energy use and transfer energy back to their electric companies in exchange for a credit (Commonwealth of Massachusetts, 2019a). We assumed that triple-deck buildings installing rooftop solar will receive NEM services from Eversource, and that the systems classify as cap-exempt facilities (that is, not constrained by the legislative limits on total capacity from larger systems in Massachusetts) given a nameplate capacity rating of less than 25kW on a three-phase circuit (Eversource n.d.). We used Eversource East's NEM rate for Class I residential R-1 customers (Eversource 2019a).
- **Solar Massachusetts Renewable Target (SMART) Program.** The SMART program allows solar energy system owners to receive a payment from the state for their solar energy production at a fixed rate per kilowatt-hour (kWh) of solar energy produced. The compensation is calculated by subtracting the

value of solar energy from the total SMART program compensation rate to account for net metering credits. In terms of design, the SMART program is a declining block program in which the incentive levels will decline by prescribed amounts over up to eight blocks per electric distribution company (EDC) territory (CLEAResult Consulting 2018).

  - **Base incentive for solar energy:** We first reviewed the *Total Megawatts Available* for Eversource to identify the solar block status for projects smaller or equal to 25 kW. We found that Eversource East is accepting applications for blocks 3 to 8 (Clean Power Research 2019). We assumed that rooftop solar systems for triple-deckers in East Boston will be able to qualify for Block 5, and used Eversource East's fixed compensation for this block of $0.28/kWh (Commonwealth of Massachusetts 2019b).
  - **Storage adder:** Eversource East is accepting applications for block 4 of the storage adder (Clean Power Research 2019). We assumed that storage paired with rooftop solar for triple-deckers in East Boston will be able to qualify within Block 5. The storage compensation adder for a 14kW solar system with a 13.2kWh storage system is $0.039/kWh (Commonwealth of Massachusetts 2019b).

- **Residential Renewable Energy Credit.** Massachusetts offers the owner of a renewable energy system a one-time state income tax credit equal to 15 percent of the system cost, up to $1,000 (Commonwealth of Massachusetts 2019c). We used a $1,000 credit amount for each system installed in a triple-decker.

Technology cost and performance

Cost and performance assumptions for electricity-generating and storage technologies used for the HOMER modeling are shown in Tables A-1 and A-2 below.

- **Solar PV.** The cost assumptions are based on NREL's mid-case scenario of the Annual Technology Baseline (ATB) 2018 (NREL 2018).

Table A-1. Solar PV cost in 2021

Residential Solar PV	
CAPEX (2019$/kW)	2,240
O&M cost (2019$/kW/year)	13

- **Storage.** We used the technology cost and performance assumptions provided by HOMER Energy's storage technology library for a 13.2 kWh, 2-hour-duration lithium-ion battery. We also assumed that the battery price would decrease by 8 percent annually (Lazard 2018).

Table A-2. Storage cost and performance in 2021

Behind-the-meter Storage	
Technology specification	13.2 kWh lithium-ion battery (2-hr duration)
CAPEX (2019$/kWh)	428.4
Lifetime (years)	10
Lifetime throughput (kWh)	67,500

Electricity Price Tariff

We used Eversource East's summary of electric rates to determine the *delivery service charges* (Eversource 2019b). We applied the A1, A5 (Residential, R-1) rate, which is available for "all domestic uses in a single private dwelling, in an individual apartment, or in a residential condominium in which the principal means of heating the premises is not provided by permanently installed electric space heating equipment."

- Customer charge (per month): $7.00
- Distribution energy charge (per kWh): $0.06507
- Transition energy charge (credit per kWh): $0.00052
- Transmission charge (per kWh): $0.02585
- Revenue decoupling charge (credit per kWh): $0.00057
- Distributed solar charge (per kWh): $0.00088
- Energy efficiency charge (per kWh): $0.01725
- Renewable energy charge (per kWh): $0.00050

For the *supplier charges*, we applied Eversource's basic service rates for residential customers.

- January 1 through June 30 (per kWh): $0.13588
- July 1 through December 31 (per kWh): $0.10836

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