Footprint Fund

Technical Memo # 1. Cornerstone Apartments

10/28/2020

How did we calculate the greenhouse gas emission reductions from the Cornerstone Project?

Step 1

The first step was to estimate the avoided electricity use of installing a more efficient heating system.

MMW Architects, the architectural firm that designed the Cornerstone Apartments, used Sefaira[1] and the DOE Energy Plus[2] engine, cross referenced with their internal database, regional averages, and the US Energy Information Administration's CBECS database (Commercial Building Energy Consumption Survey), to estimate the energy use of the baseline system (electric resistance heat) and the more efficient system (air source heat pumps). This model estimated the annual energy savings of 63,021 kWh/year over a 20-year lifetime, giving a total electricity savings of 1,260,420 kWh/lifetime (1,260 MWh/lifetime). MMW also estimated the additional cost of the heat pumps to be $44,000.

Step 2

We selected a project-appropriate emission factor.

We used emission factors from the EPA Emission Factors for Greenhouse Gas Inventories (2018)[3]. These factors represent the amount of CO_2, CH_4, and N_2O produced per kWh from the U.S. electric grid (Missoula is in the NWPP subgrid). Importantly, the emission factors used were for non-baseload generation, the distinction being that peak load production (e.g. gas-fired thermoelectric plants) has a different emissions profile than baseload generation (e.g. hydroelectric)[4], and they incorporate estimates of gross grid losses. The weights of the various GHGs were converted to CO_2-equivalent using 100-year, no carbon cycle feedback global warming potentials from the IPCC Fifth Assessment report. This produced an estimated GHG intensity of 1,533 lbs CO_2e/MWh (see Appendix A, below).

Step 3

Next, the avoided energy use was converted to greenhouse gas (GHG) emissions.

Combined the lifetime savings of 877 metric tons (t) of CO_2e.

$$\frac{1{,}260\ MWh}{lifetime} \times \frac{1{,}533\ lbs\ CO_2e}{MWh} \times \frac{t}{2204.62\ lbs} = \frac{877\ t\ CO_2e}{lifetime}$$

[1] https://sefaira.com/

[2] https://energyplus.net/

[3] https://www.energystar.gov/buildings/tools-and-resources/portfolio-manager-technical-reference-greenhouse-gas-emissions

[4] https://www3.epa.gov/ttnchie1/conference/ei20/session3/adiem.pdf

Step 4

Finally, we calculated the cost of each emission reduction.

The cost of the system ($44,000) divided by the avoided GHG emissions (877 *t* CO_2e) resulted in a price of $50.19/*t* CO_2e. Clearwater Credit Union and the Missoula Housing Authority agreed that each organization would fund half of the project cost, and in return Clearwater would acquire the ecosystem service (emission reductions or offsets). This resulted in Clearwater purchasing the emission reductions from this project for $25.09/*t* CO_2e.

Clearwater plans to retire the credits over 2020-2021, exhausting them all to maintain net-zero GHG emissions.

These carbon offsets are not verified or available on the open market. Verification adds both time and cost to the project. Instead, this project relied on the high level of trust between the parties and a fully transparent calculation of the avoided GHG emissions. For the time being Climate Smart Missoula continues to be interested non-verified offsets (with full transparency) but is also exploring the steps needed for verification.

Appendix A. Emission factors and global warming potentials

The emission factors used are from the EPA Emission Factors for Greenhouse Gas Inventories (2018), NWPP subregion, non-baseload.

Greenhouse Gas	Units	Emission Factor
CO_2	lb/MWh	1,524.9
CH_4	lb/MWh	0.124
N_2O	lb/MWh	0.020

Global warming potentials are from the IPCC 5th Assessment Report, 100-year GWPs, no carbon cycle feedback[5][6].

Greenhouse Gas	Global Warming Potential
CO_2	1
CH_4	28
N_2O	265

[5] https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf
[6] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials