

## Appendix: GHG emission reduction methodology and assumptions

This appendix and the attached spreadsheet describe the calculations and data sources used to estimate the GHG reductions and cost-effectiveness of the measure described in this application.

### GHG reduction estimate method

Metro estimated GHG reductions for this measure using the same methods and data that were used to estimate the benefits of Measure Res-2 in the Portland-Vancouver MSA's PCAP, updated to reflect new details from this application on how this measure would be implemented. Metro's method consisted of three steps:

1. Estimating the average reduction in energy use and greenhouse gas reductions that increasing funding for energy efficiency measures in new TOD program-funded affordable housing would achieve per unit.
2. Applying this average reduction to the average annual GHG emissions for a multi-family unit in the MSA (since Metro's TOD program only funds multi-family units), using data from the PCAP MSA GHG inventory and GHG reduction analysis.
3. Scaling these benefits up based on assumptions about how many units would be implemented, and when the resulting improvements would take effect.

### Measure implementation assumptions

Key implementation assumptions used in the analysis include:

*Number of housing units impacted by this project:* 3,700, based on past performance of the TOD program and the budget and strategic plan for the 2025-30 program cycle.

*Assumed rate of implementation:* The TOD program engages developers early in the development process in order to identify the most cost-effective way to achieve energy efficiency and other co-benefits for residents of affordable housing. Metro will engage developers who are building TOD-funded units throughout the grant period, and it will take a while before these units are built and begin to deliver benefits. The analysis assumes the following:

- The TOD program will engage developers at a constant rate over the first 5 years of the program (i.e., Metro will offer incentives to developers of 740 units during each of the five years over the grant period).
- It takes approximately 2 years from the initial point of engagement for a housing unit to be built and begin to deliver GHG reductions. Our GHG estimates account for the assumed date of construction, i.e., the 2025-30 GHG reduction estimates reflect the fact that only 3/5 of the housing units impacted by this program will be built prior to 2030, and that some of those units will be complete and begin producing benefits earlier than others (e.g., the 740 units impacted during the 1<sup>st</sup> year of the grant will begin to produce benefits during the 3<sup>rd</sup> year, and those impacted during the 3<sup>rd</sup> year will begin to produce benefits during the 5<sup>th</sup> year).

*Measure lifetime:* 40 years. Most of the changes to buildings resulting from this measure will be to building envelopes and to internal structures that accommodate HVAC systems and other appliances. According to [Fannie Mae](#), the estimated useful life of most of these elements is 40-50 years in multifamily properties.

*Capital and O+M cost assumptions:* Metro's [Transit-Oriented Development](#) (TOD) program has dedicated approximately \$3.5 million yearly in incentives during 2024-28 for developers of higher-density, regulated affordable housing near transit to commit to early design meetings with program partners to identify areas to increase energy efficiency. As reported by project partners, these meetings and incentives typically result in some energy efficiency gains, but partners report that less than a third of the projects in their pipeline are currently aiming to achieve at least a 15 percent reduction from the energy code baseline. Metro is seeking additional \$5 million in CPRG Implementation grant funding to provide increased incentives for developers to fully implement recommended energy efficiency measures.

If awarded funding for this additional energy efficiency incentive, projects would be required to work with a building energy efficiency consultant to model each development's forecasted energy use and then work to achieve modeled energy savings of at least 15 percent beyond the code baseline. Based on conversations with building energy efficiency consultants and Energy Trust of Oregon staff Metro believes that the additional implementation grant funding will support meeting in about 90 percent of new units funded by the TOD program. Projects not meeting this standard would not be eligible for funds from CPRG, though they could still receive funding from Metro originating from other sources.

The grant request would go toward funding capital improvements – specifically, materials, supplies and labor to implement increased energy efficiency measures in the impacted housing units, as well as Metro staff time to administer the program. There are no operations and maintenance costs associated with the grant. Some of the efficiency improvements funded through this project may need to be maintained or replaced over the lifetime of the grant, but maintenance and replacement costs for some of the elements that have shorter lifetimes that could potentially be funded through this grant, like energy-efficient HVAC systems and roofs, are generally comparable to those for the conventional, less-efficient building elements that would otherwise be included in these buildings under the reference case scenario, and which are normally accounted for as part of the development process. This application therefore does not assume any additional operations and maintenance costs due to the measure.

### **GHG reduction estimate assumptions**

*Average annual household energy consumption by fuel type:* GHG reduction estimates for this measure are based on and assumed reduction in average household energy use. During the GHG inventory for the PCAP, Metro collected data on total residential-sector energy consumption by fuel type from utilities within the MSA; see Appendix 2 of the PCAP (attached) for more information on the inventory methodology and data sources used.

*Emissions factors:* All emissions factors used for this analysis came from [EPA Emissions Factors Hub](#), using IPCC AR5 GWP values, except for the emissions factor for electricity, which was based on the electricity mix for the three counties in the Metro region (Multnomah, Clackamas, and Washington) where this strategy would be implemented. These were the same factors used in the PCAP GHG inventory except that the electricity emissions factor in the PCAP was based on the MSA-wide electricity mix. In this analysis we used them to convert average annual household energy consumption to average annual household GHG emissions.

*Average annual household energy consumption for multifamily houses:* Metro's TOD program only funds larger multifamily housing developments (i.e., typically developments of 4 stories or more) in order to meet the program's goal of locating as many housing units as possible within walking distance of high-

quality transit stations. Most housing in the MSA is single-family, and multifamily units generally use less energy than single-family units because they feature shared walls and more efficient use of interior space. In order to estimate annual energy use in the multifamily units that will be affected by this measure, we collected data from the Energy Information Administration's Residential Energy Consumption Survey (RECS), which shows housing energy consumption by fuel type for different types of structures for structures within the Western climate zone. The data are shown in the RECS CE4.5 tab of the attached spreadsheet.

According to the RECS, the typical multifamily unit in the Western US uses 44.4% of the energy of the average housing unit (26.6 million BTUs vs. 59.8 million BTUs). We applied this factor to the average annual GHG emissions across all housing units to estimate average annual GHG emissions for multifamily housing units under the reference case scenario.

*Reference case scenario:* the reference case for this measure assumes that, in the absence of any energy efficiency incentives funded either by CPRG or by Metro, the new affordable housing units funded by the TOD program would produce the same amount of GHG emissions as the average multifamily housing unit in the MSA. The information above describes how GHG emissions were estimated for the reference case scenario.

*Measure-specific activity data:* The main performance metric the TOD program will be using to evaluate projects is each project's modeled Energy Usage Intensity (EUI), or energy used per square foot per year (kBtu/sq ft/year). In particular, the TOD program looks at a project's net EUI, to allow for consideration of the amount of renewable energy exported to the grid in projects that opt to add solar panels. We estimated the GHG reductions due to this measure by assuming a minimum 15 percent reduction in energy use and GHG emissions that will be reflected in building energy models using EUI data compared to Oregon energy code baseline. The minimum efficiency that a project would need to attain to receive CPRG funds would be at least a 15 percent decrease in EUI from the code baseline, though it is likely that the range of outcomes will be in the 15-30 percent from code baseline range.

The GHG emissions per housing unit tab in the attached spreadsheet shows how Metro combined the data described in this section to estimate reference case per-unit energy use and GHG emissions for this measure.

### **GHG emission reduction calculations**

As discussed above, Metro estimated average annual per-unit GHG reductions for this measure by multiplying the average annual GHG emissions for a multifamily building by the minimum required reduction in GHG emissions demonstrated by the building energy model each developer will be required to complete. This energy model will compare the building's forecasted net EUI to the code baseline EUI and calculate the percent reduction achieved with the planned energy efficiency measures. We then scaled annual per-unit reductions to estimate total emissions reductions across all impacted units in the MSA, both for 2025-30 and 2025-2050, by applying the inputs and assumptions discussed in the Measure implementation reductions section.

Metro estimated the proportion of total GHG emissions reductions attributable to the CPRG Implementation Grant by multiplying these reductions by the percentage of project funding that would be provided by the grant. We calculated cost-effectiveness of the GHG reductions achieved with these grant dollars by dividing the estimated emissions attributable to the CPRG Implementation Grant by the amount of the grant request.

See the attached spreadsheet for more detail on how these calculations were performed.