

## GHG Emissions Reduction Calculations

|  |  |
|--|--|
| <b>144,660</b>   | <b>1,079,151</b>   |
| <b>Total MTCO<sub>2</sub>e Reduced<br/>for 2025-2030</b> | <b>Total MTCO<sub>2</sub>e Reduced<br/>for 2025-2050</b> |

While land use regulations and processes can impact many emissions sources, the GHG emissions reduction values estimated for this applications include five key elements.

1. Orienting for increased solar photovoltaic potential
2. Electric vehicle charging
3. Orienting buildings for thermal system energy reduction
4. Electrification of HVAC systems
5. Tree planting

The calculations are intended to reflect new residential development based on historic average housing permit data. It was recognized that some of these elements can overlap and attempts were made to avoid double counting emissions reductions. Data sources and assumptions used to calculate the reductions are detailed within this appendix.

[input] **Number of municipalities participating**

50.00 (municipalities)

[value] **Average annual housing permits in WestCOG region**

(housing permits  
85.40 /year/municipality)

*Average number of housing permits per town  
per year based on WestoCOG municipalities  
from 1990-2022 CT Dept. Economic and  
Community Development annual housing permit*

[calc] **Average annual housing permits for specified number of municipalities**

4,270.00 (housing permits/year)

[value] **Solar system sizing**

10.00 (kW/house)

*Assumption: High end of range from Eversource  
"Systems rated between 5 and 10 kW are  
generally sufficient to meet the power needs of  
most homes."*

[calc] **Solar capacity for specified number of housing units**

42,700.00 (kW)

*If all future housing was oriented to maximize  
solar potential*

[value] **Annual solar electricity generation**

16,000,000 (kWh/year)

*Quantity that displaces fossil fuel generation  
over one year for every 10,000 kW of capacity,  
based EPA AVERT*

[calc] 68,320,000 (kWh/year)

[value] **Emissions factor**

0.0002467 (MTCO<sub>2</sub>e/kWh)

*NEWE eGrid 2021 Emissions Factor from EPA  
Emissions Factor Hub (released Feb 2023)*

[calc] **Annual emissions avoided from solar generation**

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16,851.71 (MTCO<sub>2</sub>e/year)

*Estimated emissions reduction from solar compared to grid supplied electricity. As the grid becomes more saturated with renewables over time, the emissions factor will decrease and the annual emissions avoided will also decrease.*

[input] **Number of electric vehicles per housing unit**

1.00 (vehicle/housing unit)

*Access to charging can increase EV ownership so 1 EV per housing unit was assumed*

[value] **Annual emissions associated with a passenger vehicle**

4.60 (MTCO<sub>2</sub>/vehicle/year)

*From EPA Greenhouse Gas Emissions from a Typical Passenger Vehicle*

[calc] **Annual emissions avoided from electric vehicles**

19,642.00 (MTCO<sub>2</sub>e/year)

*Electricity from charging assumed to be from renewable sources, such as on-site solar and therefore no increase in electricity is included in this calculation.*

[value] **Building orientation thermal energy savings**

25% (percent)

*Source: Union of Concerned Scientist, What's in an Environmentally Responsible Building? From increasing windows on south facing side and using shading overhang*

[value] **Average space heating consumption per household**

51.50 (MMBtu/year/household)

*Source: EIA Residential Energy Consumption Survey (RECS) Dashboard for CT for 2020*

[calc] **Building orientation heating fuel consumption savings**

12.88 (MMBtu/year)

[value] **Natural gas emissions factor**

0.05311 (MTCO<sub>2</sub>e/MMBtu)

*Source: EPA 2023 GHG Emissions Factor Hub*

[calc] **Annual emissions avoided from building orientation**

2,920.05 (MTCO<sub>2</sub>e/year)

*Based on annual average housing permits specified above*

Estimated natural gas consumption

164,928.75 (MMBtu/year)

*Assuming the buildings were oriented to maximize thermal energy savings, using annual average housing permits specified above. Assuming all natural gas.*

[calc] **Annual emissions avoided from electrification of heating systems**

8,760.16 (MTCO<sub>2</sub>e/year)

*Calculation demonstrates the elimination of space heating with natural gas in future residential development through the use of various technologies such as heat pumps. Assuming electricity comes from renewable sources and therefore no increase in electricity is included in this calculation.*

## GHG Emissions Reduction Calculations

[calc] Carbon sequestration from tree planting

*It was assumed that 1 tree would be planted for each housing permit. It was also assumed that tree planting would not occur until year 3 to enable time for project development and adoption by municipalities. The approach for the calculation was developed by referencing the EPA Greenhouse Gases Equivalencies calculations for the number of urban tree seedlings grown for 10 years (<https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>). A key source used in that calculation was the Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings report published in 1998 by the U.S. Department of Energy Information Administration (<https://www3.epa.gov/climatechange/Downloads/method-calculating-carbon-sequestration-trees-urban-and-suburban-settings.pdf>). This report provides Annual Sequestration Rates by Tree Type and Growth Rate. The lbs. carbon/tree/year values for hardwood trees with a moderate growth rate were used to determine the total carbon sequestered by this project. It was assumed that the trees planted in this project will have been grown for 1 year in a nursery, consistent with the EPA's assumption in the equivalency calculations. The full carbon sequestration calculations that show the increasing carbon sequestration as the trees mature is shown in the accompanying spreadsheet.*

### Summary of carbon sequestration from tree planting

| Year             | lbs carbon/year   | MTCO2/year    |
|------------------|-------------------|---------------|
| Year 1           | 0                 | 0             |
| Year 2           | 0                 | 0             |
| Year 3           | 11,529            | 19            |
| Year 4           | 26,474            | 44            |
| Year 5           | 44,835            | 75            |
| <b>2025-2030</b> | <b>82,838</b>     | <b>138</b>    |
| Year 6           | 67,039            | 111           |
| Year 7           | 93,086            | 155           |
| Year 8           | 123,403           | 205           |
| Year 9           | 157,990           | 263           |
| Year 10          | 196,847           | 327           |
| Year 11          | 240,401           | 400           |
| Year 12          | 288,225           | 479           |
| Year 13          | 340,746           | 567           |
| Year 14          | 398,391           | 663           |
| Year 15          | 460,733           | 766           |
| Year 16          | 528,199           | 878           |
| Year 17          | 600,362           | 999           |
| Year 18          | 677,649           | 1127          |
| Year 19          | 760,487           | 1265          |
| Year 20          | 848,449           | 1411          |
| Year 21          | 941,962           | 1567          |
| Year 22          | 1,041,026         | 1731          |
| Year 23          | 1,145,214         | 1905          |
| Year 24          | 1,255,380         | 2088          |
| Year 25          | 1,371,097         | 2280          |
| <b>2025-2050</b> | <b>11,619,524</b> | <b>19,325</b> |

## GHG Emissions Reduction Calculations

[value] **Number of years**

3 (years)

*Assumption: program in place in 2027,  
emissions reductions from 2027-2030*

[value] **Number of years**

22 (years)

*Assumption: program in place in 2027,  
emissions reductions from 2027-2050*

[calc] **Emissions avoided annually**

48,173.92 (MTCO<sub>2</sub>e/year)

*Sum of above calculations excluding carbon  
sequestration from tree planting*

[FINAL] **Total avoided emissions for 2025-2030**

144,660 (MTCO<sub>2</sub>e)

*(Emissions avoided/year \* number of years) +  
carbon sequestration*

[FINAL] **Total avoided emissions for 2025-2050**

1,079,151 (MTCO<sub>2</sub>e)

*(Emissions avoided/year \* number of years) +  
carbon sequestration*

### Links to data sources:

CT Department of Economic and Community Development

[https://portal.ct.gov/DECD/Content/About\\_DECD/Research-and-Publications/01\\_Access-Research/Exports-and-Housing-and-Income-Data](https://portal.ct.gov/DECD/Content/About_DECD/Research-and-Publications/01_Access-Research/Exports-and-Housing-and-Income-Data)

Eversource Solar

<https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/solar-energy/installing-solar/solar-sizing>

EPA AVERT

<https://www.epa.gov/avert/avert-web-edition>

Section D Distributed rooftop entry : 10 MW

Results: "This load profile will displace 16 GWh of regional fossil fuel generation over the course of a year. For reference, this equals the annual electricity consumed by 1,357 average homes in the United States."

EPA GHG Emissions Factor Hub

<https://www.epa.gov/climateleadership/ghg-emission-factors-hub>

EPA GHG Emissions from a Typical Passenger Vehicle

<https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100U8YT.pdf>

Union of Concerned Scientists

<https://perma.cc/72TS-H9S8>

EIA Residential Energy Consumption Survey (RECS) Dashboard

[https://experience.arcgis.com/experience/cbf6875974554a74823232f84f563253?src=%E2%80%B9%20Consumption%20%20%20%20Residential%20Energy%20Consumption%20Survey%](https://experience.arcgis.com/experience/cbf6875974554a74823232f84f563253?src=%E2%80%B9%20Consumption%20%20%20%20Residential%20Energy%20Consumption%20Survey%20)