

**RESNET**  
RESIDENTIAL ENERGY SERVICES NETWORK



INTO THE FUTURE

Austin, TX  
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# RESNET's Climate Initiative

## The New CO<sub>2</sub>e Index

Philip Fairey, FSEC Energy Research Center

# IPCC Sixth Assessment Report

Potential for “irreversible change”



# What is RESNET Doing about Climate Change?

- RESNET has created a CO<sub>2</sub>e Index to accompany its Energy Rating Index (ERI / HERS Index)
- The CO<sub>2</sub>e Index provides a mechanism for Home Energy Raters to evaluate the long-term CO<sub>2</sub>e emissions of a dwelling unit
- What is CO<sub>2</sub>e?
  - CO<sub>2</sub>e is an expression of the impact of all Green House Gasses (GHGs) expressed in terms of their Carbon Dioxide equivalent
- What are the other GHGs considered?
  - Methane (CH<sub>4</sub> from natural gas): 29.8 times the equivalent of CO<sub>2</sub>
  - Nitrous Oxide (N<sub>2</sub>O): 273 times the equivalent of CO<sub>2</sub>
- Both upstream (pre-combustion) and combustion emissions are accounted by RESNET's CO<sub>2</sub>e Index.

# What CO<sub>2</sub>e Emission Rates are Used?

- For electricity, RESNET uses the levelized, hourly, Long-Run Marginal CO<sub>2</sub>e Emission Rates (LRMER) for the low, renewable-energy cost scenario from the 2021 Cambium database with the following constraints
  - Combined pre-combustion plus combustion CO<sub>2</sub>e emissions
  - Emission rates levelized over 2025-2050 time frame
  - 100-year global warming potential (GWP) time horizon
  - 3% social discount rate (out-year emissions count less than near term emissions)
- For household combustion fuels, RESNET uses the combined pre-combustion plus combustion CO<sub>2</sub>e emission rates from ASHRAE Standard 189.1 Appendix J for the 100-year GWP time horizon.

# What is the 2021 Cambium Database?

- Extensive database with projected hourly electric-sector generation and emissions data for years 2022 through 2050
- Multiple scenarios (e.g. BAU, 95% decarbonized by 2050, etc.)
- Data for 134 regions covering the contiguous United States
- Virtual replication of EPA eGRID sub regions
- Several emissions metrics: Average, short-run marginal, and long-run marginal
- Available GHG emissions: CO<sub>2</sub> and CO<sub>2</sub>e (CO<sub>2</sub> + CH<sub>4</sub> + N<sub>2</sub>O)
- Combustion and pre-combustion emissions data
- Busbar and end use load data

# Importance of Forward-Looking Grid Data

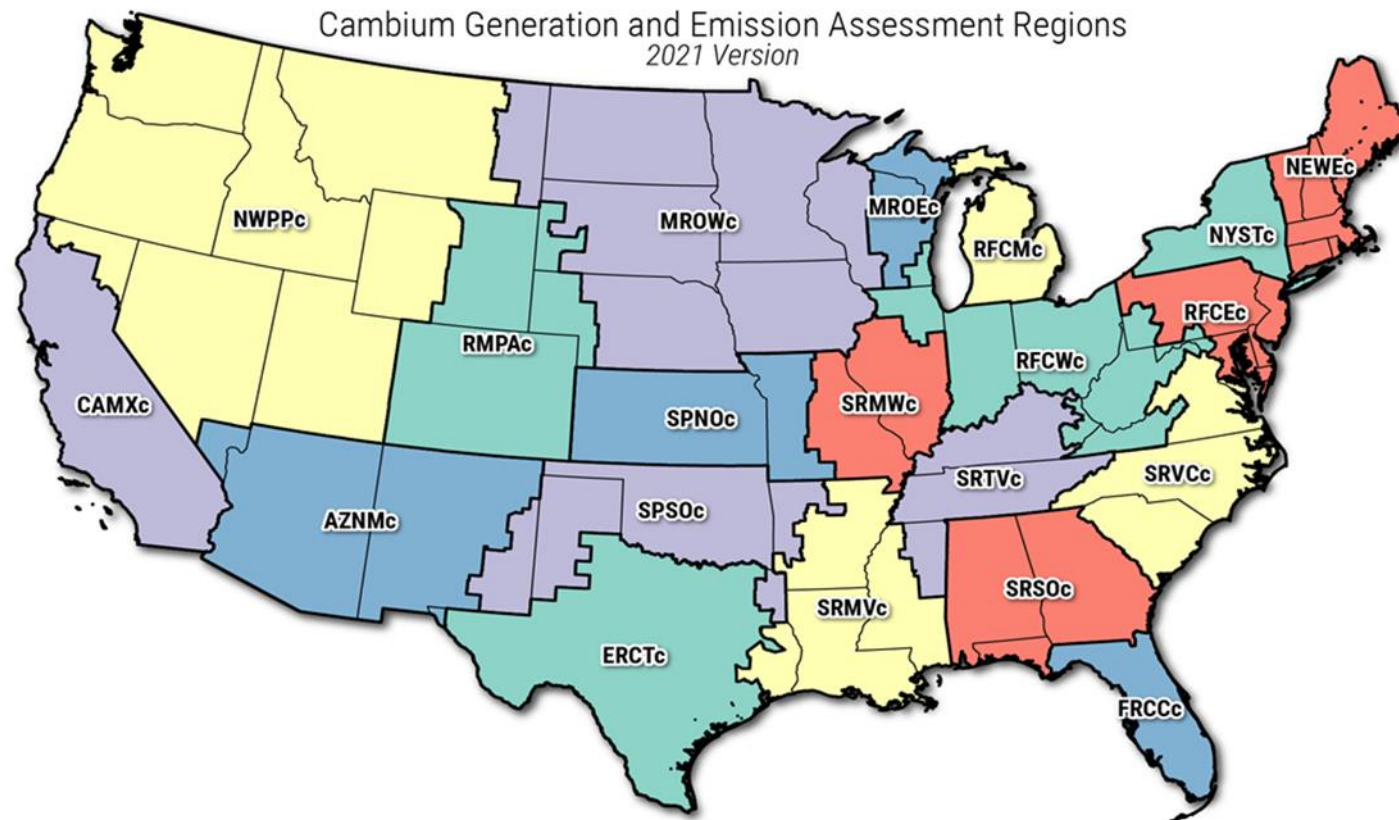
- The electric grid is changing in response to increasing cost of fossil fuels coupled with decreasing cost of renewable energy
- Estimating CO<sub>2</sub>e emissions from an operational-only short-run perspective neglects how new electric loads can be served in part by building new non-emitting generators
- Utility scale photovoltaic generation is now less costly than combined cycle natural gas generation
- Wind generation is rapidly growing in areas with good wind resources
- More coal and oil-fired generation plants are closing or being reconfigured to use natural gas in response to relative cost increases and green house gas reduction initiatives
- Failing to account for these grid changes into the future would over estimate both the long-term CO<sub>2</sub>e emissions and the long-term CO<sub>2</sub>e savings with respect to electricity generation.

# Levelized Long-Run Marginal Emission Rates

- Very similar to annualized life-cycle cost calculations
  - Uses Cambium Grid and Emission Assessment (GEA) region CO<sub>2</sub>e long-run marginal emission rates (lrmr\_co2e)
  - NREL calculation spreadsheet tool is available here:  
<https://data.nrel.gov/submissions/183>
  - RESNET calculation specifications:
    - Start year = 2025
    - Evaluation period = 25 years
    - Discount rate\* = 3%
    - Emissions calculated = combustion & pre-combustion CO<sub>2</sub>e
- \* Discount rate is a societal discount rate that provides greater value for CO<sub>2</sub>e emission savings that occur earlier in the evaluation period than for those that occur later in the evaluation period.

# What are the Geographic Regions?

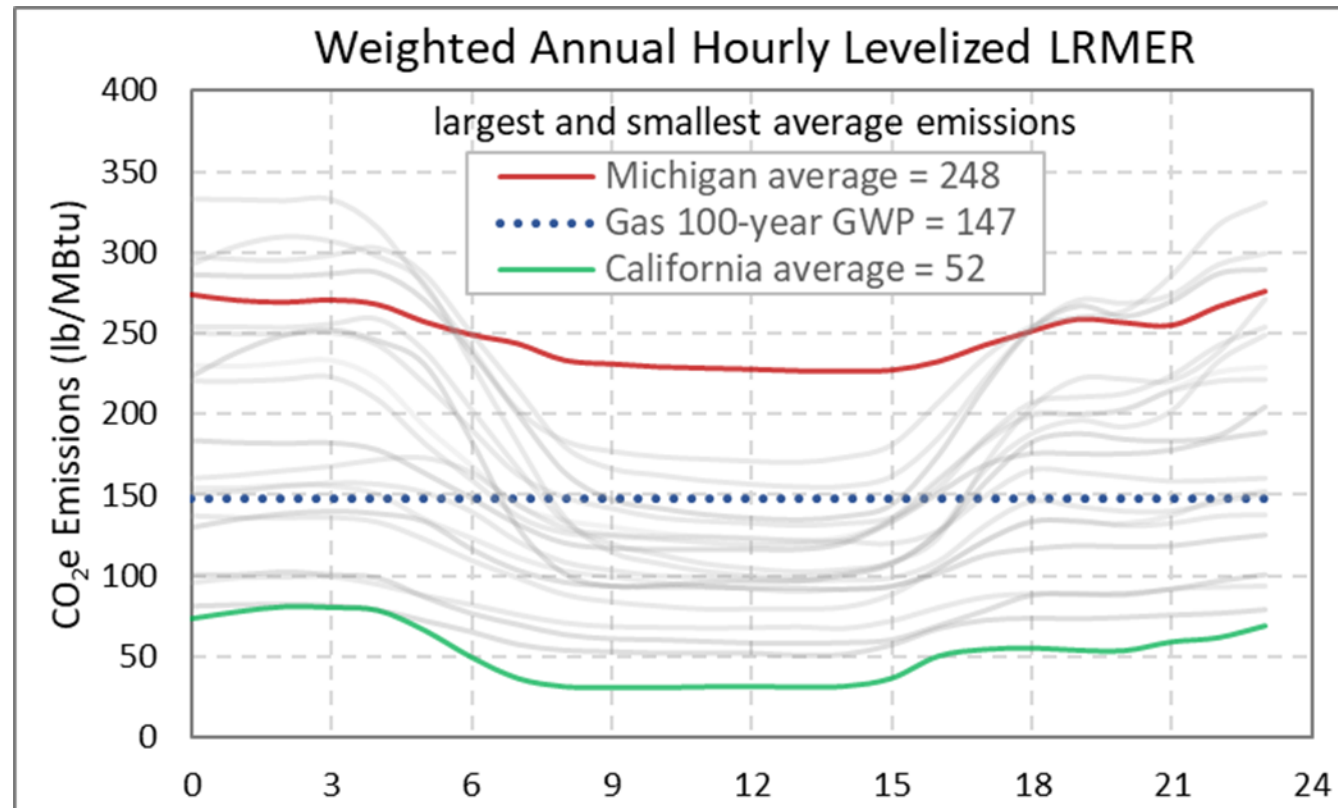
Cambium Generation and Emission Assessment (GEA) regions are almost identical to the EPA eGRID sub-regions. Cambium data are hourly, forward-looking projections while eGRID data are annual, retrospective empirical data.





# What do the Emission Rate Data Look Like?

The largest annual average electric CO<sub>2</sub>e emission rate is in Michigan. The smallest is in California. The average of these two is 150 lb/MBtu, which is very close to the natural gas emission rate of 147 lb/MBtu.



# How is the CO<sub>2</sub>e Index Calculated?

$$\text{CO}_2\text{e Index} = \text{ACO2} / (\text{ARCO2} * \text{IAF}_{\text{RH}}) * 100$$

where:

ACO2 = annual hourly CO<sub>2</sub>e emissions from Rated Home

ARCO2 = annual hourly CO<sub>2</sub>e emissions from CO<sub>2</sub>e Index Reference Home

IAF<sub>RH</sub> = Index Adjustment Factor for Reference Home

- For all electric homes, a CO<sub>2</sub>e Index of 100 would represent the same thing as HERS Index of 100. In other words, the home has the same level of CO<sub>2</sub>e emissions as an all electric home configured to the 2006 IECC minimum requirements with 2006 vintage minimum standard equipment, lighting and appliances
- For a mixed-fuel homes configured to these 2006 standards, the CO<sub>2</sub>e Index will be greater than 100.

# CO<sub>2</sub>e Index Summary

- Calculate the **CO<sub>2</sub>e Index** using the 2021 Cambium low RE cost scenario, levelized, Long-Run Marginal Emission Rates (LRMER) for CO<sub>2</sub>e applied to Rated Home energy end uses compared against the size adjusted CO<sub>2</sub>e emissions for the CO<sub>2</sub>e Index Reference Home energy end uses
- Calculate **CO<sub>2</sub>e savings** using the same 2021 Cambium Low RE Cost Scenario Levelized LRMER for CO<sub>2</sub>e applied against Rated Home energy end uses subtracted from the CO<sub>2</sub>e emissions for the CO<sub>2</sub>e Index Reference Home energy end uses
- Configure the **CO<sub>2</sub>e Index Reference Home** identically to Energy Rating Reference Home **except** using electricity for all energy end uses
- **No changes** to the calculation of the **HERS Index/ERI**.

# References

- [RESNET MINHERS Standard Addendum 66f, PDS-02](#)
- [BSR/RESNET/ICC 301-2022, Addendum B-202x, PDS-01](#)
- Cambium Online Database:  
<https://cambium.nrel.gov/>
- Cambium Documentation:  
Gagnon, Pieter; Frazier, Will; Hale, Elaine, Cole, Wesley (2022):  
Long-run Marginal Emission Rates for Electricity -  
Workbooks for 2021 Cambium Data. National Renewable  
Energy Laboratory, Golden, CO.  
<https://data.nrel.gov/submissions/183>

**THANK YOU**