BEUDO Procedures

Information and data contained in this document is in support of regulations pertaining to the Ordinance entitled "Building Energy Use," Chapter 8.67 of the Municipal Code of the City of Cambridge.

This document shall be amended as needed to include information required to comply with BEUDO.

I. Emissions Factors

A. Emissions Factor Methodology

- Emissions Factors for **Grid Electricity** will be published for each compliance period by January 1 of the year prior to the start of each compliance period. These factors will be developed and published by the City using data published by ISO New England, NEPOOL, and any other relevant governmental sources as well as forecasted load and electricity generation. A residual methodology calculation method will be applied in order to account for Massachusetts renewable portfolio standards.

- Emissions Factors for **natural gas, propane, fuel oil, diesel oil, and kerosene** will be published for each compliance period by January 1 of the year prior to the start of each compliance period. These factors will be based on the standard scientific values utilized by Energy Star Portfolio Manager at the time of publication.

- Emissions Factors for energy produced by **local Generation Facilities** (or District Energy Systems [DES]) will be determined annually using the efficiency method of the World Resources Institute.

B. Emissions Factors

Compliance Period 1: 2026-2029

Energy Source	Units	Emissions Factors and Multipliers			
		2026	2027	2028	2029
Electricity					
Electric Grid Residual Factor	Kg CO2e/MWh	418	427	435	444
Annual RPS Minimum	%	30	33	36	39
RPS-only electricity Emissions Factor (for buildings with no additional Renewable Electricity purchases)	Kg CO2e/MWh	294	288	282	268
Other Fuel sources					
Natural Gas	Kg CO2e/MMBtu	53.11	53.11	53.11	53.11
Propane	Kg CO2e/MMBtu	61.95	61.95	61.95	61.95
Fuel Oil (No. 1)	Kg CO2e/MMBtu	73.49	73.49	73.49	73.49
Fuel Oil (No. 2)	Kg CO2e/MMBtu	74.20	74.20	74.20	74.20
Fuel Oil (No. 4)	Kg CO2e/MMBtu	75.28	75.28	75.28	75.28
Fuel Oil (No. 5 & No. 6)	Kg CO2e/MMBtu	74.26	74.26	74.26	74.26
Diesel	Kg CO2e/MMBtu	75.16	75.16	75.16	75.16
Kerosene	Kg CO2e/MMBtu	75.44	75.44	75.44	75.44
Generating Facilities					
District Steam (Vicinity)					
Steam (MIT)					
Hot Water (MIT)					
Chilled Water (MIT)					
Electricity (MIT)					
Steam (Harvard)					
Hot Water (Harvard)					
Chilled Water (Harvard)					
Electricity (Harvard)					
Steam (Biogen)					
Hot Water (Biogen)					
Chilled Water (Biogen)					
Electricity (Biogen)					

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	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Indirect GHG Emissions																
Electric Grid Residual Factor (kgCO2e/MWh)	443	399	365	353	366	392	377	379	379	334	372	405	401	429	409	412
Annual RPS Minimum	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	16%	18%	20%	22%	24%	27%
RPS-only Electric Emissions Factor (kgCO2e/MWh)	418	376	344	322	337	351	338	334	331	284	311	328	320	335	312	299
Direct GHG Emissions																
Natural Gas	53.07	53.07	53.07	53.07	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11
Propane	61.50	61.50	61.50	61.50	61.50	64.25	64.25	64.25	64.25	64.25	64.25	64.25	61.95	61.95	61.95	61.95
Fuel Oil (No. 1)	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.50	73.49	73.49	73.49	73.49
Fuel Oil (No. 2)	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.20	74.20	74.20	74.20
Fuel Oil (No. 4)	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.29	75.28	75.28	75.28	75.28
Fuel Oil (No. 5 & No. 6)	75.35	75.35	75.35	75.35	75.35	75.35	75.35	75.35	75.35	75.35	75.35	75.35	74.26	74.26	74.26	74.26
Diesel	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	74.21	75.16	75.16	75.16	75.16
Kerosene	77.69	77.69	77.69	77.69	77.69	77.69	77.69	77.69	77.69	77.69	77.69	77.69	75.44	75.44	75.44	75.44
Locally Generated Outputs																
District Steam (Vicinity)																
Steam (MIT)																
Hot Water (MIT)																
Chilled Water (MIT)																
Electricity (MIT)																
Steam (Harvard)																
Hot Water (Harvard)																
Chilled Water (Harvard)																
Electricity (Harvard)																
Steam (Biogen)																
Hot Water (Biogen)																
Chilled Water (Biogen)																
Electricity (Biogen)																

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C. Calculating Emissions

Electricity

For a covered property **with no qualifying additional Renewable Electricity purchases**:

Electric Emissions [kg CO2e]	=	(	Electricity consumed from the grid [MWh]	x	[100% - Annual RPS Minimum Requirement]	)	x	Electric Grid Residual Factor [kg CO2e/MWh]

To simplify calculations, we have provided the RPS-only electric emission factor in the table above, resulting in the following equation:

Electric Emissions [kg CO2e]	=	Electricity consumed from the grid [MWh]	x	RPS-only electric Emissions Factor [kg CO2e/MWh]

For a covered property that **does purchase additional qualifying Renewable Electricity** to apply to their emissions:

Electric Emissions [kg CO2e]	=	[	(	Electricity consumed from the grid [MWh]	x	[100% - Annual RPS Minimum Requirement]	)	-	voluntary RE purchases [MWh]	]	x	Electric Grid Residual Factor [kg CO2e/MWh]

Other Fuels

Fuel Source Emissions [metric tons CO2e]	=	Energy consumed [MMBTU]	x	Fuel Source Emissions Factor

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D. Time of Use Methodology

The following steps describe how Covered Properties that choose to use a time-of-use electricity emissions factor may do so:

1. Identify the total amount of residual generation from unclaimed non-emitting and unclaimed emitting generators for the year, by resource type.
    - Source: NEPOOL (New England Power Pool) GIS residual mix by fuel report
    - Notes: Although NEPOOL GIS publishes some data on a quarterly basis, the residual mix by fuel report is only displayed at the end of Q4. This is because RPS-eligible and zero-emissions certificates are banked during Q1 to Q3. To see the total annual amount of unclaimed generation, pull the report from Q1 to Q4 of the given year.
2. Download the hourly generation profile for all resources in each hour of the year, by resource type.

- Source: U.S. Energy Information Administration (EIA), Form 930
- Notes: EIA collects hourly data from ISO New England's (ISO-NE) API and publishes it via its Form 930. Users can click "Download Data" and select "New England" from the Balancing Authority/Region Files tab to retrieve hourly generation data dating back to 2015.

3. Calculate the hourly residual generation profile from unclaimed non-emitting and unclaimed emitting generators, by resource type. For each resource type with unclaimed generation reported by NEPOOL GIS, calculate the ratio of unclaimed to total generation by dividing the annual unclaimed generation reported by NEPOOL GIS by the annual total generation reported by EIA Form 930. Multiply this ratio by the corresponding resource type's hourly generation timeseries (downloaded in Step 2). The sum of this new hourly generation profile should equal NEPOOL GIS's reported annual unclaimed generation. The sum of the hourly generation across unclaimed emitting resources and unclaimed, non-emitting resources is the total hourly residual generation.
    - Sources: NEPOOL GIS, EIA Form 930
    - Notes: For the NEPOOL GIS resource types for which ISO-NE does not report hourly generation profiles (such as wood and biomass), use the hourly generation profile called "Other."
4. For each resource type, multiply the hourly residual generation profile with the associated emissions rate (zero for non-emitting resources). Sum up the hourly emissions across all resource types to estimate the unclaimed ("residual") emissions for that hour.
5. Account for imports. New England currently relies on imports for 15–20 percent of energy needs. To account for this:
    - Identify the total annual residual imported energy and associated residual CO_2 emissions from NEPOOL GIS.
        - Divide the Carbon Dioxide column by the percent of the residual mix made up by the Import System Mix row to get the residual CO_2 emissions rate from imports in pounds per MWh. Multiply the result by the number of certificates assigned to the Import System mix row to get the total residual CO_2 emissions in pounds from imports. This number purely represents CO_2 emissions, so further calculations would be needed to calculate a CO_{2eq} rate, such as scaling the CO_2 emission rate based on a national or grid-region-specific ratio of CO_{2eq} to CO_2 emissions.
    - Identify the hourly CO_2 emissions imported column from the EIA 930 data.
    - Distribute the annual CO_2 emissions on an hourly basis using the CO_2 emissions imported hourly shape from EIA 930.
    - Add the hourly residual import system mix generation to the results of step 3. Then, add the hourly residual CO_2 emissions from imports to the result of step 4.

- Note: This methodology does not need to account for exports. It needs to account for imports because the calculations are performed on a per-MWh basis and the import mix in a given hour is much different than the ISO-NE mix. By contrast, the export mix from ISO-NE should approximately match the native generation mix staying in New England.

6. For each hour, divide the residual emissions by the residual generation to calculate the final residual emissions rate.

    - Note: The result should be in kg/kWh or similar units.

7. Apply the resulting residual time-of-use emission rate to individual buildings' time-of-use energy consumption after accounting for any BEUDO-qualified purchased renewables. To account for hourly profile of renewable generation:

        - Known generation profile: If the Property Owner can provide the hourly generation profile for any qualified renewables they purchase, first subtract that generation profile from the buildings' time-of-use energy consumption.

        - Unknown generation profile: If the Property Owner purchased additional qualified renewables for which they do not have the hourly generation profile, sum the annual generation from these resources with purchases by the supplier and any allowable banked excess hourly renewables. Subtract this sum from the total remaining grid electricity use. Scale the building's remaining time-of-use energy consumption by the following ratio: total non-qualified grid electricity use divided by total grid electricity use.

E. Comparison of Grid to DES Electricity production [This section intentionally left blank]

II. Renewable Electricity

A. Additional Approved Procurement Types

i. Renewable Electricity procurement structures which are not described in the BEUDO Regulations may be submitted to the City pursuant to BEUDO Regulations IX.B.iii.3.

ii. To submit a procurement type for approval, information must be submitted prior to any applicable contract signing and at least 90 calendar days prior to the intended use of the resulting Renewable Electricity for compliance.