City of Cambridge
Office of Sustainability

BEUDO: Proposed Phase 1 Regulations

October 31, 2024

CITY OF CAMBRIDGE
Office of Sustainability

Today's Presentation

Agenda

- Overview of the BEUDO requirements
- Regulations Development Process
- Explanation of Proposed Regulations
  - Emission Factors
  - Renewable Energy
- Questions

This meeting will be recorded and posted online

Questions and Submitting Comments

- **Clarifying questions:** Please submit questions through Zoom, in the Q&A box at the bottom of the screen

- **Comments:** Submit comments for consideration in developing final regulations:
  - Via our form at www.cambridgema.gov/BEUDO, or
  - Via email BEUDOregs@cambridgema.gov, or
  - Via mail to Cambridge Office of Sustainability, 344 Broadway, Cambridge MA 02139

- Email any remaining questions to **beudoregs@cambridgema.gov**

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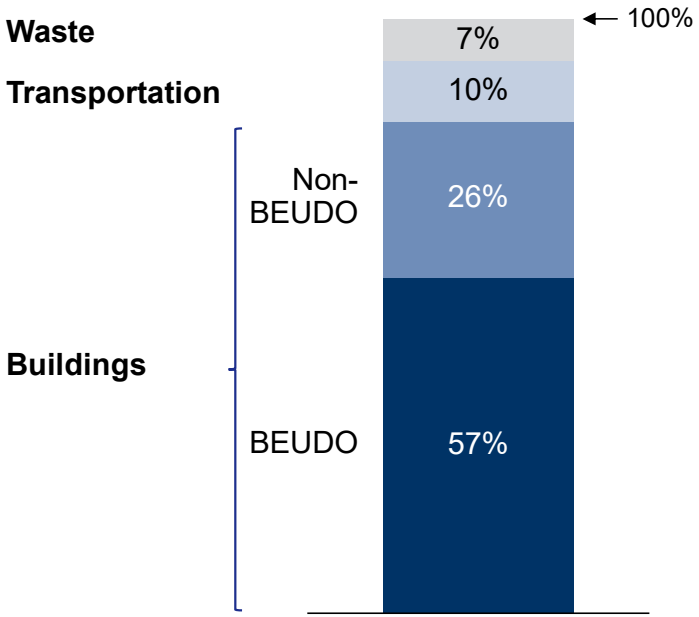
Overview of the BEUDO Requirements

The **Building Energy Use Disclosure Ordinance (BEUDO)** was enacted in 2014 as a benchmarking requirement for all buildings in Cambridge. This was a key initial measure of the **Net Zero Action Plan**, allowing Cambridge to gain a clear understanding of our building stock.

In June 2023, following a multiyear public engagement process, amendments to BEUDO were adopted which **require nonresidential buildings to reduce their greenhouse gas (GHG) emissions**

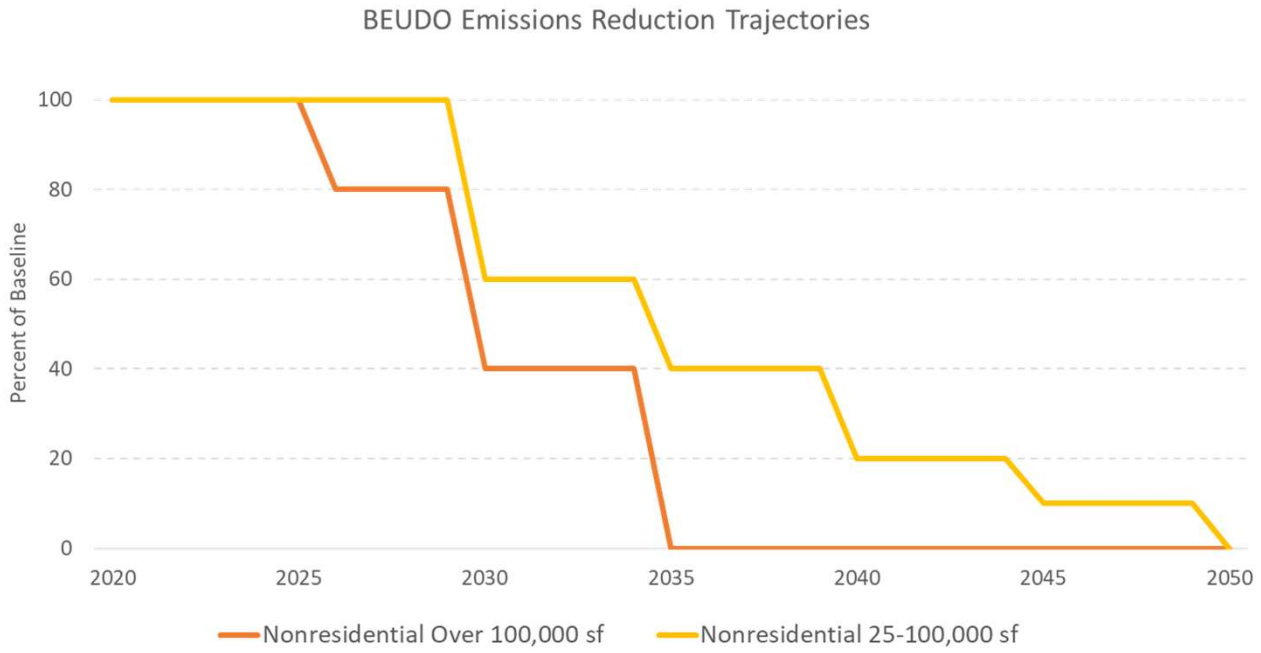
- Large nonresidential (>100,000 sq ft) must reach net zero by 2035. Reductions begin in 2026.
- Midsize nonresidential (25,000 – 99,999 sq ft) must reach net zero by 2050. Reductions begin in 2030.

Cambridge's Greenhouse Gas Emissions



- Buildings contribute 83% of Cambridge's GHG emissions
- 57% of citywide emissions come from the large buildings covered by BEUDO reporting requirements
  - Nonresidential buildings of 25,000 sq. ft. or more
  - Residential buildings of 50 units or more

Overview of the BEUDO Requirements



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Development of Regulations

Since the amendments passed, City staff have been working to plan the development and release of regulations and procedures. The proposed regulations released in October represent the first of multiple planned phases.

Phase 1: Accounting for GHG emissions of BEUDO properties

- To accurately represent the emissions resulting from energy use in Cambridge buildings, the ordinance requires the City to **develop local emission factors** (multipliers) to be used when calculating GHG emissions.
- Owners of BEUDO buildings **may purchase qualifying renewable energy (if it meets BEUDO criteria)** to reduce their electric energy emissions.

The ordinance requires the City to publish emission factors for the first compliance period by January 1, 2025.

Continued Development

The BEUDO amendments require that regulations be developed for the following topics:

- ✓ Emission factors (end of 2024)
- ✓ Review Board operating procedures (2026)
- ✓ Hardship compliance plan requests (~2026)
- ✓ Deferral compliance plan requests (~2026)
- ✓ Verified Carbon Credit requirements (end of 2028)
- ✓ Alternative Compliance Credit price for next compliance period (2029)

Phase I of the regulations will establish the emission factors as well as the process and specific criteria for voluntary purchases of renewable electricity

Phase 1 Development

Cambridge has worked closely with expert consultants to **research** these topics, **communicate** with stakeholders, and **develop** the policy language of the proposed regulations.

- In 2024, we held approximately 10 individual stakeholder meetings and 3 larger group forums.

Synapse Energy Economics will give an overview of emission factors, as well as explain the methodologies and inputs that will be used in calculating these factors every compliance period

Solventerra, LLC will present an overview of renewable energy purchasing, and the options available to BEUDO owners.

Phase 1 Development

- On October 23, the Office of Sustainability released proposed Phase I regulations.
- An accompanying BEUDO Procedures document contains the calculated values and additional calculation details.
- The comment period will be open until November 22nd, 2024.
- The City will review the comments received and examine any changes needed and promulgate final regulations in December.

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Emission Factors

- Emission factors are multipliers for each type of energy used and will be used to determine the GHG emissions of BEUDO buildings.
- We have researched emission factor options to identify the appropriate methodologies and emission factor values.
- The proposed regulations:
  - Establish emission factors for oil, gas, and other fuels.
  - Establish how emissions from grid electricity will be calculated, with owners allowed to deduct Massachusetts RPS Class I electricity
  - Establish the methodology for district energy systems. Values for district energy/cogeneration EFs are forthcoming. The City is required to finalize these factors by the end of the year, with data to be received from the plant owners
  - Provide an optional time-of-use electricity methodology

Emission Factors

Introduction to Emission Factors

- BEUDO requires energy reporting and regulates GHG emissions from energy use, including:
  - Direct emissions from combustion of fossil fuels
  - Indirect emissions from energy purchased from a utility, such as electricity or steam
- GHG emissions are calculated by multiplying the site energy for each fuel by the fuel-specific emission factor (also "emission rate" or "emission coefficient")
- Emission factors have units of mass of emissions per unit of energy/volume/mass of fuel, such as kg CO_2e per MMBtu

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"Emission Factors" shall mean the multipliers used to determine the Greenhouse Gas Emissions produced by the production or consumption of Energy

$$Emissions = Fuel\ use \times emission\ factor$$

Importance of Emission Factors

- Building owners need to know emission factors to **plan for BEUDO compliance**
- Emission factors will allow building owners to **understand their buildings' historical and estimated future emissions** and help them plan accordingly to meet BEUDO net-zero requirements
- City of Cambridge will use **emission factors to evaluate compliance and assess any penalties**

Combustion Fuel Emission Factors

- Natural gas and distillate fuel oils are the dominant fuels used in Cambridge
- BEUDO ordinance specifies that fuel emission factors will be based on scientific values
- Emission factors for combustion fuels are determined by chemical composition, which changes very little over time and location
- For transparency and simplicity, draft regulations specify using the most recently published **ENERGY STAR Portfolio Manager emission factors** for combustion fuels

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For the combustion of fuels, such as oil and gas, the emission factors will be based on standard scientific values published by federal agencies.

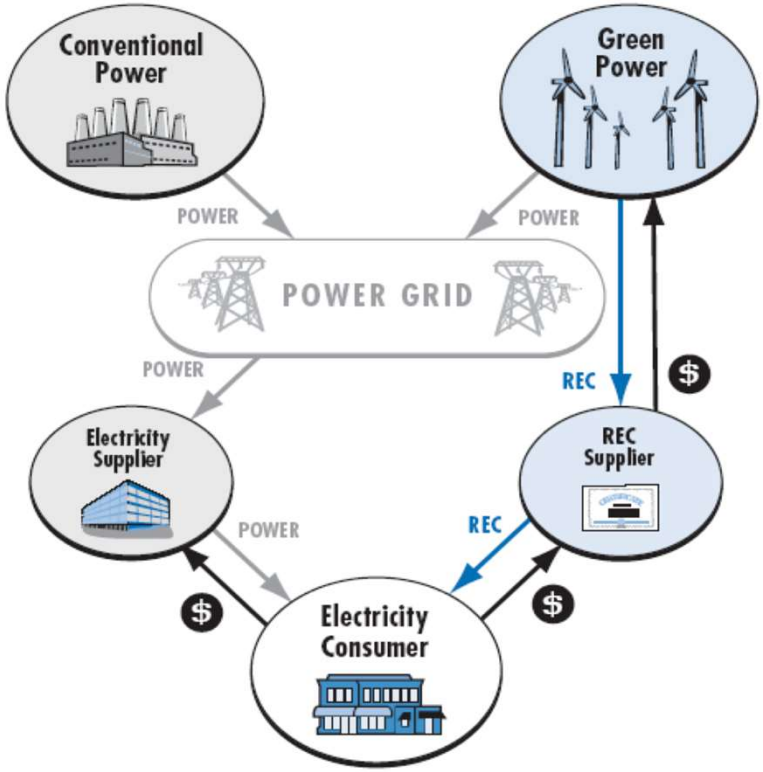
Combustion Fuel Emission Factors

Fuel	Emission Factor (kg CO_2e per MMBtu)
Natural Gas	53.11
Propane	61.95
Fuel Oil No. 1	73.49
Fuel Oil No. 2	74.20
Fuel Oil No. 4	75.28
Fuel Oil No. 5 & No. 6	74.26
Diesel	75.16
Kerosene	75.44

- This table provides relevant fuel emission factors from ENERGY STAR Portfolio Manager
  - Based on the U.S. EPA's GHG Emission Factors Hub for Greenhouse Gas Inventories and global warming potential (GWP) values from the IPCC Fourth Assessment Report
- Values do not include upstream emissions, such as methane leaks in the natural gas distribution network

Electricity Emission Factors: Background

- Massachusetts is part of a larger electric grid (ISO New England grid region)
- The grid interconnects customers to power generation from emitting and non-emitting sources
- Grid electricity used in Massachusetts cannot be traced back to specific power sources
- Renewable energy certificates (RECs) help with this
  - Used to track the supply and use of renewable electricity
  - 1 REC = 1 megawatt hour (MWh) of renewable electricity
  - RECs can be bought and sold; owner has the right to attributes
  - RECs provide an auditable record to REC owners and policymakers



Source: U.S. EPA

Electricity Emission Factors: Background

- Electricity emission factors are not constant and change with time, location, and and state policy
- BEUDO specifies that electricity emission factors should account for Massachusetts-specific context
- BEUDO leaves other specifics to rulemaking process, such as what type electricity emission factor methodology should be used
  - Options include average, marginal, and time-of-use (to be discussed)
- BEUDO regulations will provide historical and projected values for 2010-2029

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For the use of all electricity purchased from the grid other than Renewable Electricity, the Emission Factors will generally reflect the emissions intensity of electricity consumed in Massachusetts.

Types of Electricity Emission Factors

Proposed regulations

Average emissions rates reflect the total emissions divided by the total electricity supply over a specified period, typically one year

- Commonly used for building emission inventories
- **Draft regulations specify BEUDO use a type of average annual emission factor**:
  - Average regional factor based on the *residual* or unclaimed generation
  - Include accounting for building owners' renewable energy purchases

Opt-in

Time-of-use emission rates account for when electricity is consumed on a precise time scale

- Provide a more accurate depiction of emissions but are harder to implement
- Draft regulations specify providing an opt-in choice for building owners to use time-of-use emission rates

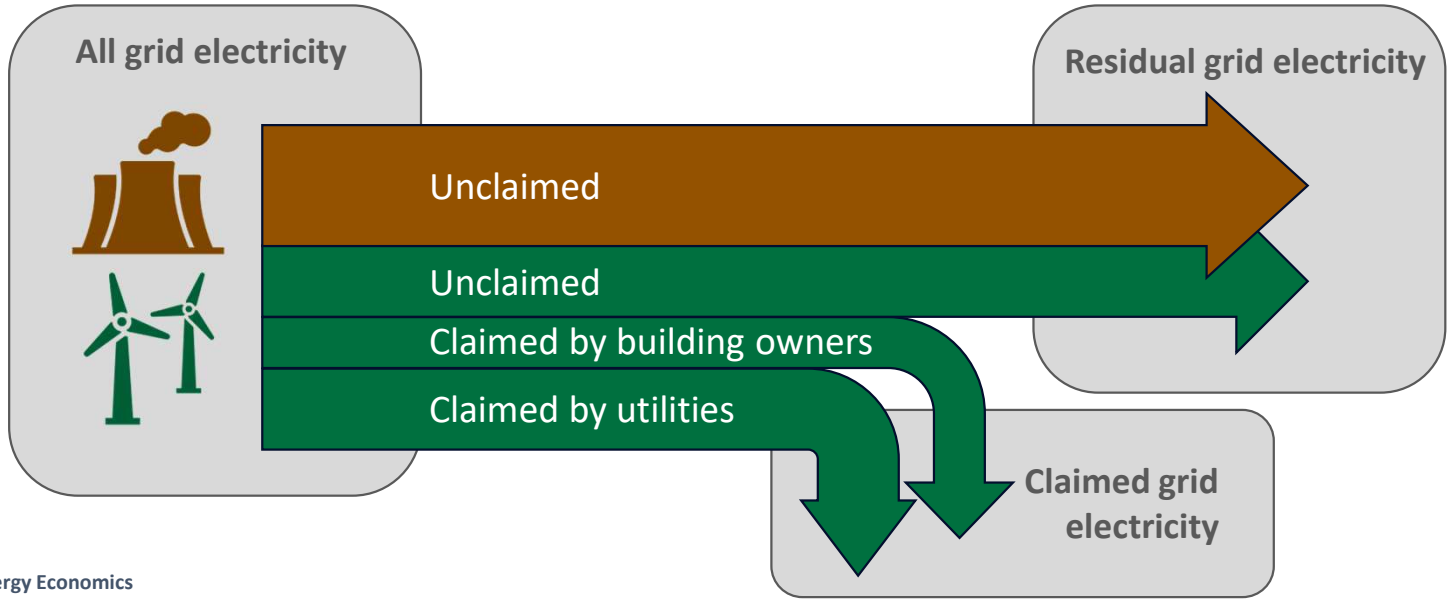
Not included

Marginal emission rates represent emission impacts of incremental changes in electricity load

- Based on *marginal resource*—the first power plant to turn on/off when there's a small change in load
- Not included in draft BEUDO regulations: (1) not appropriate for building emissions inventories, (2) buildings in Massachusetts use more than a marginal amount of electricity

Residual Electricity Emission Factors

- A residual emission factor represents emissions for unclaimed grid electricity
- Excludes non-emitting generation that has been claimed, such as purchased by building owners and utilities to comply with BEUDO or the Massachusetts RPS
- In New England this typically includes a mix of fossil fuel, nuclear, unclaimed renewable, and other miscellaneous generation



Results – Emissions

- The table on the right shows resulting residual emissions rates for New England and the renewable energy under Massachusetts RPS Class I RPS requirement
- The equation below shows how this should be applied to calculate grid emission for buildings in Cambridge

$$Building\ emissions = \left(\begin{array}{c} Total\ grid\ electricity\ use \times \\ (100\% - RPS\ Class\ I\ requirement) - \\ Qualified\ renewable\ purchases \end{array} \right) \times Residual\ rate$$

Year	Residual emissions rate (kg CO_2e/kWh)	RPS Class I requirement (%)
2010	0.44	5%
2011	0.40	6%
2012	0.37	7%
2013	0.35	8%
2014	0.37	9%
2015	0.39	10%
2016	0.38	11%
2017	0.38	12%
2018	0.38	13%
2019	0.33	14%
2020	0.37	16%
2021	0.40	18%
2022	0.40	20%
2023	0.43	22%
2024	0.41	24%
2025	0.41	27%
2026	0.42	30%
2027	0.43	33%
2028	0.44	36%
2029	0.44	39%

Residual Electricity Emission Factors

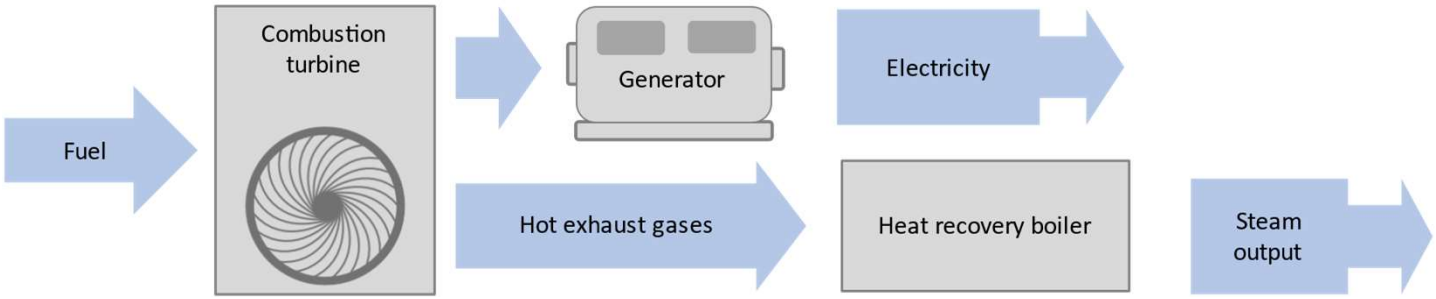
Rationale for specifying residual emission rate in draft regulations:

1. Allows consumers who are exceeding the Massachusetts' RPS requirements for renewable electricity purchases to be appropriately credited
2. Avoids double counting clean energy already claimed by other consumers
3. Aligns with leading protocols and policies:
   - Massachusetts Department of Environmental Protection (MassDEP)
   - ENERGY STAR Portfolio Manager
   - WRI Greenhouse Gas Protocol (GHGP)
   - Boston BERDO

Emission factors: Co-generation Systems

- *Co-generation ("co-gen"* or *combined heat and power)* systems generate thermal resources and electricity simultaneously
- Numerous buildings in Cambridge use steam, hot water, chilled water, and electricity provided by co-gen
  - Examples: Vicinity steam customers, Harvard, MIT, and Biogen

Common co-generation system configuration



Source: Adapted from Gillenwater et al. 2005. World Resources Institute.

Emission factors: Co-generation Systems

- For co-gen systems that produce more than one output, BEUDO requires that emissions be split among the outputs
- City of Cambridge is committed to using a consistent, transparent method to assign emissions to outputs using plant-specific data, aligned to Greenhouse Gas Protocol
- Draft regulations specified method: the efficiency method
- Currently, co-gen system owners are compiling data needed to calculate emissions
- City of Cambridge will publish co-gen emission factors

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Emission Factors for each output from the generation facility will be calculated using the Greenhouse Gas Protocol methodology…or similar methodology, using data provided by the generation facility owner.

The Efficiency Method

Allocates emissions according to the amount of fuel input used to produce electricity, steam, hot water, and/or chilled water

Steps for calculating emission factors

1. Calculate direct greenhouse gas emissions for all fuels consumed
2. Calculate the energy content of each output stream
3. Identify efficiencies of production of each output stream
4. Allocate total emissions to each output stream (using industry-standard formula)
5. Divide emissions by energy content of each output stream → emission factor

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Renewable Energy

The City conducted research and held stakeholder forums to review renewable energy (RE) purchasing processes.

The proposed regulations:

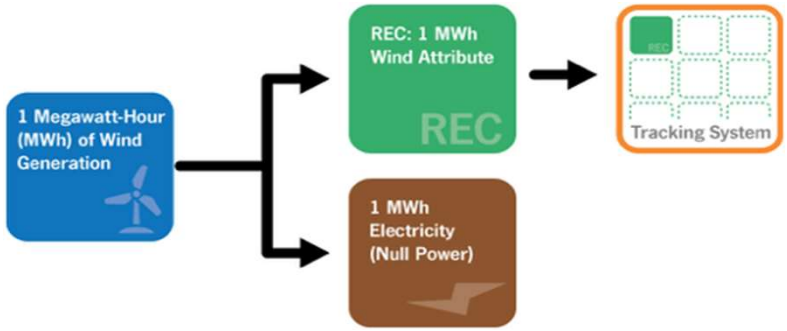
- Establish that onsite RE must retire RECs to qualify
- Clarify that property owners must submit proposed RE purchases for review and approval
- Clarify (per the Ordinance) that RE must come from new projects
- Establish options for purchases from new generating facilities:
  - ✓ Power purchase agreements and virtual power purchase agreements
  - ✓ Massachusetts Class I RECs
  - ✓ Pathway for reviewing additional RE purchase types
- Detail the requirements for tracking and assigning RE purchases used in compliance

Purchasing Renewable Energy to Meet BEUDO Obligations

- Reduce building emissions by purchasing renewable energy to offset electricity use
- Renewable energy usage is evidenced by acquisition & retirement of Renewable Energy Certificates (RECs)
- Match number of RECs with electricity emissions reduction targets

Using Renewable Energy Certificates (RECs)

- Renewable Energy Certificate (REC) is a tradeable market-based instrument that represents 1 MWh of electricity generated from a renewable energy source
- RECs are created, tracked & retired on electric transmission grid Generation Information Systems – e.g. NEPOOL GIS
- Acquisition and retirement of RECs representing renewable energy use are necessary to meet BEUDO emissions reduction obligation for both on-site and off-site projects



BEUDO Renewable Energy Project Criteria

- New Project (8.67.010(25)(a))
- Must be evidenced by RECs that are created, tracked and retired pursuant to a recognized REC tracking system
- RECs must be assigned to the Covered Property
- Approved renewable energy technology (8.67.010 (25)(c))

New Project

BEUDO Definition of New Project:

- Covered Property Owner executes renewable energy procurement contract prior to the Commercial Operation Date (COD) of the renewable energy facility 8.67.010(25)(a), including:
- New capacity **Expansions** to existing facilities; and,
- **Repowering** of an existing facility as defined by IRS (Notice 2016-31)

REC Assignment & Accounting

- RECs shall be assigned to a covered property & documentation attesting to assignment and retirement submitted annually by May 1 of the subsequent year
- Transparent REC accounting and proof of REC assignment and retirement shall be available upon request
- RECs must be registered and tracked by regional tracking system recognized by EPA
- RECs may only be subtracted from a Covered Property's electricity use for the same year in which the REC was generated

Approved RE Technologies

- Solar Photovoltaic systems (rooftop, carpark, ground mounted)
- Solar thermal power plants
- Wind turbines
- Geothermal power plants
- Small hydropower
- Other renewable energy generating sources certified by the Department

Compliance Pathways

- **On Site renewable energy generation**

  Must meet all BEUDO criteria: new project, REC tracking and retirement requirements; approved technology

- **Off-Site Renewable Energy**

  Physical Power Purchase Agreement (PPA)

  Virtual Power Purchase Agreement (vPPA)

  Unbundled New MA Class I REC purchases that meet 225 CMR 14.05

  Department Approved Project or Program

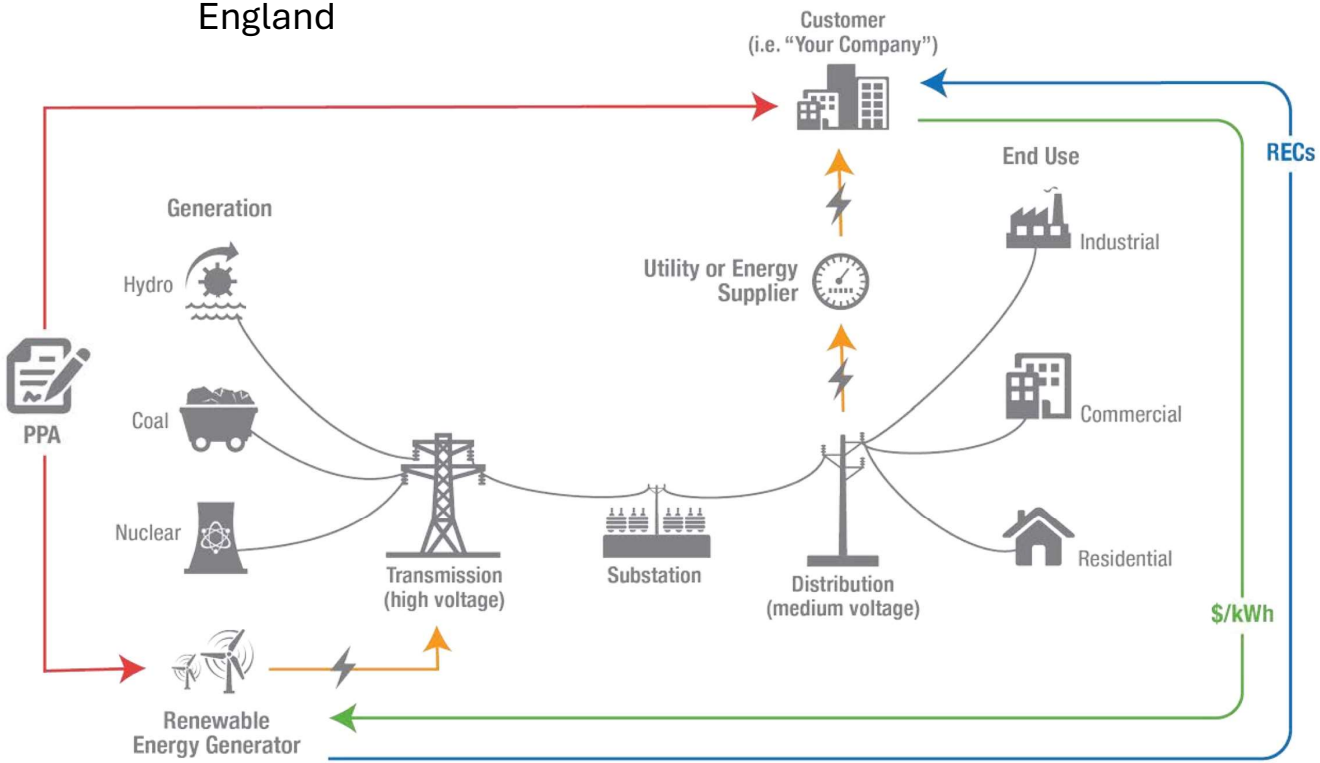
Compliance Pathways

Off-Site

PPAs

Off site renewable energy generation – PPAs

- Buyer contracts directly with a provider for traditional power purchase agreement for "Bundled" energy & RECs from a new facility
- May be from project located inside or outside of New England



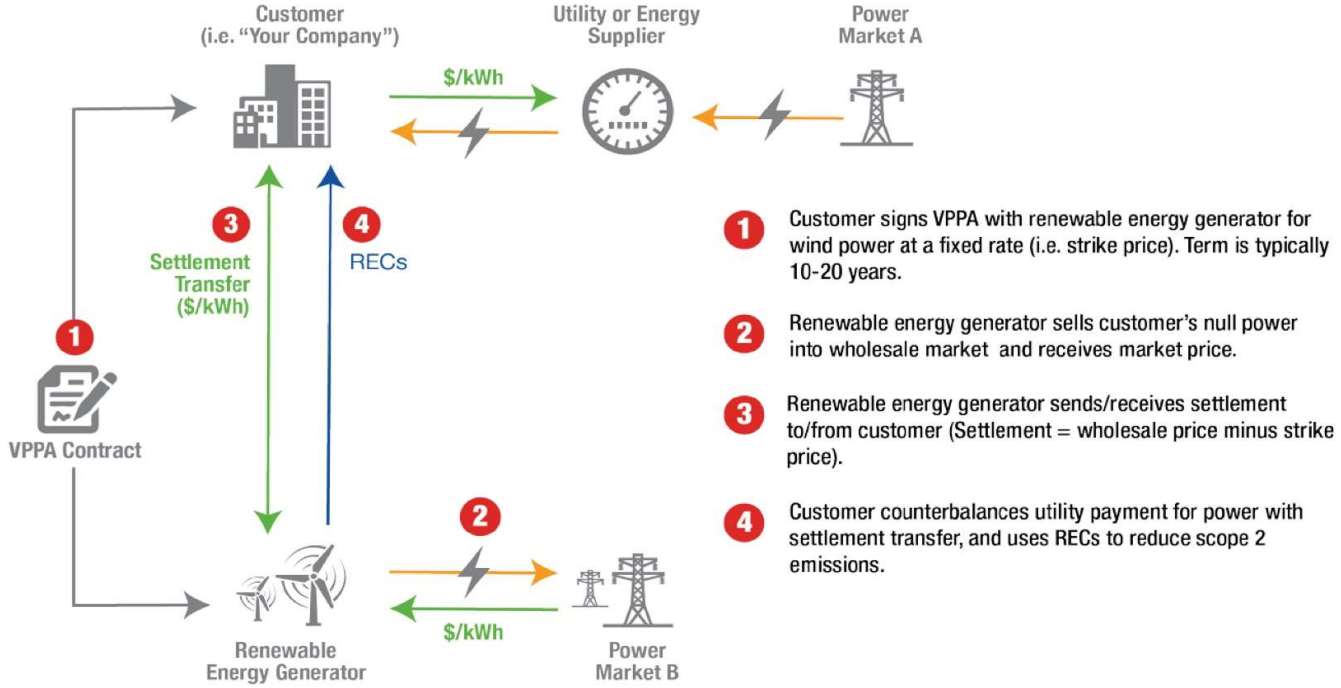
Compliance Pathways

Off-Site

vPPAs

Off site renewable energy generation – vPPAs

- Buyer acquires RECs from a new renewable energy project out of region "virtually" effectively paying for both Energy & RECs, but without taking legal title to physical energy



Compliance Pathways

Unbundled REC purchase

RECs purchased separately from physical energy (unbundled)

- Buyer acquires RECs from new renewable energy project that meet qualifications of RPS Class 1 eligibility in conformance with 225 CMR 14.05
- Typically procured from broker or renewable energy developer
- May be purchased as green tariff product from competitive supplier

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Next Steps

- ✓The 30 day comment period for the draft of Phase 1 BEUDO regulations closes **November 22nd, 2024.**

  Submit comments for consideration via **options on the website** www.cambridgema.gov/BEUDO

- ✓Phase 1 regulations are expected to be **promulgated in early December.**

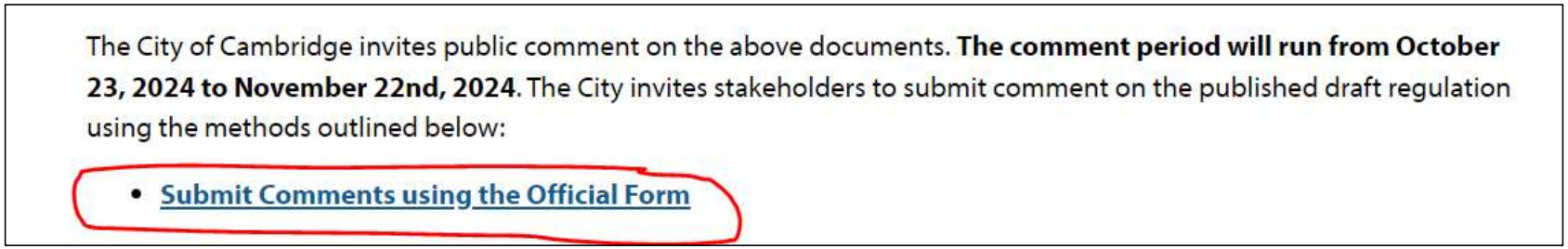
- ✓The next phase of regulations in development will contain guidance on **third party verification** and **alternative compliance requests** (deferrals and hardship extensions)

Questions/Clarifications

Please continue to email any questions to **beudoregs@cambridgema.gov**

All official comments on the proposed regulations for BEUDO should be submitted at:

www.cambridgema.gov/BEUDO



The City of Cambridge invites public comment on the above documents. **The comment period will run from October 23, 2024 to November 22nd, 2024.** The City invites stakeholders to submit comment on the published draft regulation using the methods outlined below:

- **Submit Comments using the Official Form**