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# *Comparing Energy Savings: C-PACE versus Connecticut Utility PSD*

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# Overview

- "Energy Savings" terminology
- Why Determine "Energy Savings"
- "Energy Savings" in the Eversource/UI PSD
- "Energy Savings" in C-PACE
- Illustrative Examples
- Conclusions

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# “Energy Savings” Terminology

- “Energy savings” means different things to different people
- “Energy cost savings” vs. “energy consumption savings”
- “Energy consumption savings” may be based on:
  - Whole building energy consumption
  - Energy source consumption (i.e., electricity, fuel)
  - End use energy consumption (e.g., heating, cooling, lighting,
  - ECM energy consumption
  - First year vs lifetime energy consumption savings
- A “% energy savings” that does not identify its basis is meaningless
- In the energy efficiency world, determining “energy savings” is challenging because it unfortunately can’t be directly measured

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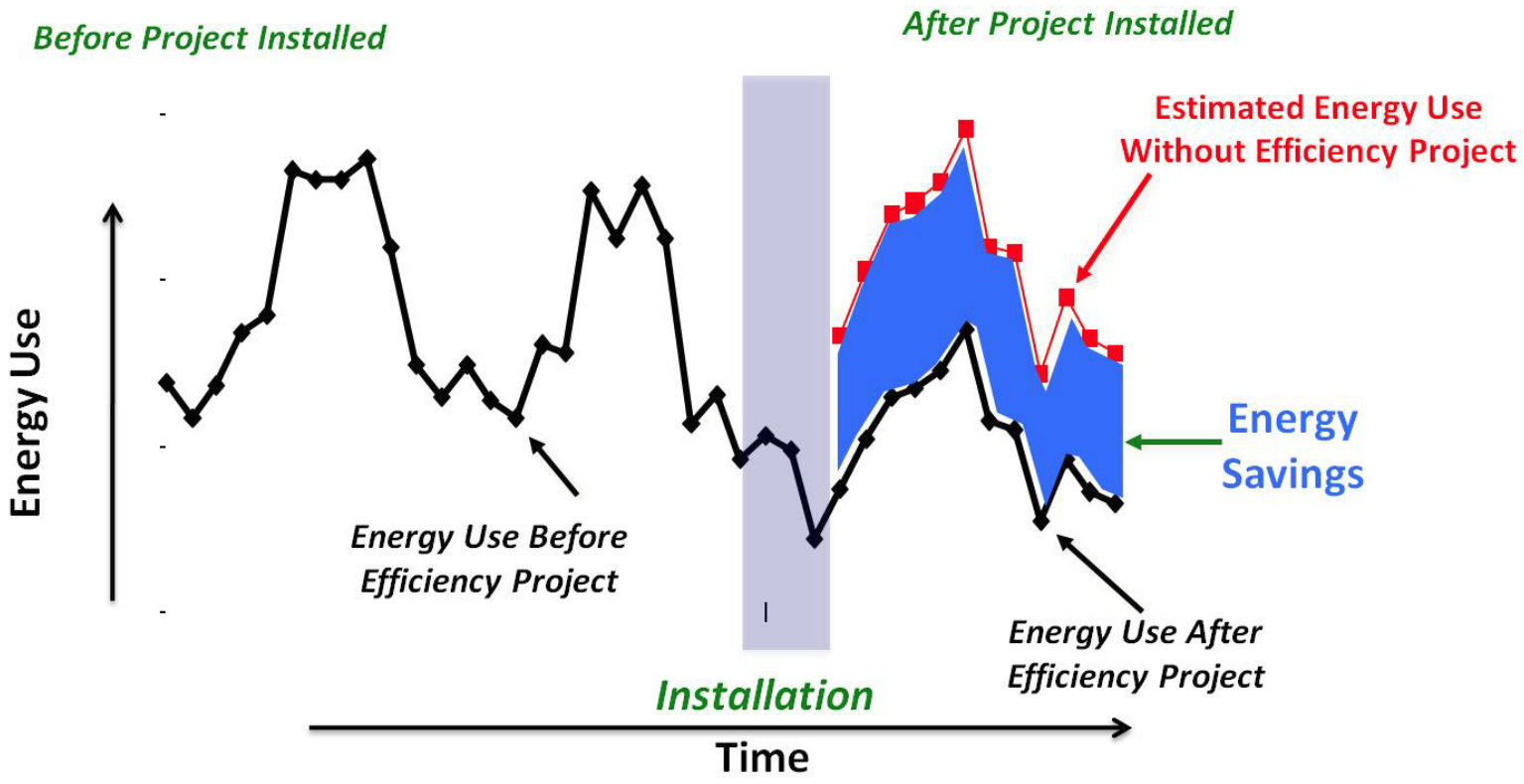
# Graphical Representation of Energy Savings




**Energy Consumption Before, During And After Project Is Installed**

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# “Energy Savings” Terminology cont'd

- The key to determining “energy savings” is the requirement to identify baseline energy consumption
- **Baseline period selected must be “representative”**
- To insure baseline data collected is representative, the industry developed and published ASTM E2797*, Building Energy Performance Assessment (BEPA) Standard* (most recent revision in 2015)

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# ASTM E 2797-15

- Standardizes the collection, compilation, review and analysis of building energy use information
- Standardizes timeframe over which information must be collected: 3 years or back to last "major renovation" if less than 3 years, with a minimum of 1 year
  - *"Major renovation" is defined as involving expansion (or reduction) of a building's gross floor area by 10% or more, or any renovation impacting total building energy use by more than 10%)*
- No "major renovation" allowed in baseline period *(be especially aware if major equipment or space use (e.g., data center) has been added/removed or ECMs (e.g., lighting upgrade) have been added)*

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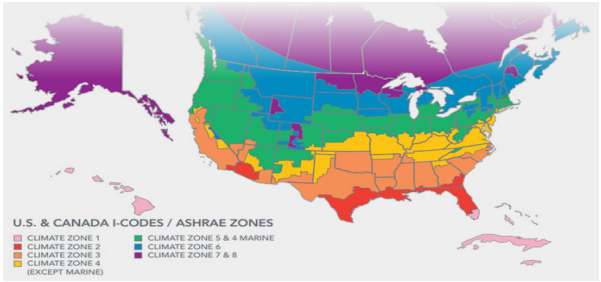
# ASTM E 2797-15 cont'd

- Identify major independent variables that can impact building energy use, e.g.,
  - Weather (e.g., HDD, CDD)
  - Occupancy
  - Operating hours




- Develop building baseline energy use equation(s)
  - Regression analysis of energy use data
  - Equations relate baseline energy use (whole building, electricity, fuel) to independent variables
- Baseline can be "normalized" using "normal" values for the independent variables (e.g., "average" or "typical" HDD and CDD)

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# Why weather normalize?

- Weather normalized energy is the energy a building would have used under average conditions (referred to as “climate normals”)
- Weather in a given year may be much warmer or colder than the building’s normal climate – weather normalization accounts for this difference
- ECM energy use projections will typically be based on “normalized” weather data

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# Why weather normalize?

- Projecting building energy use without ECMs must be based on “normalized” weather data - not actual weather data in the base year(s)
- Energy savings will be the difference between building energy use under “normalized” conditions without ECMs and with ECMs
- ASHRAE weather bin data, TMY data, “average” data all have been used to normalize – the key is  to use it for both projecting baseline energy use without ECMs and then projecting building energy use with ECMs

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# ASTM E 2797-15 cont'd

- To determine the energy consumption savings in a reporting period after the ECMs have been installed following the E2797 standard:
  - Collect actual energy use in the reporting period
  - Collect the actual independent variables in the reporting period
  - Substitute actual independent variables in the reporting period into building energy use equation(s) to estimate energy use had the ECMs not been installed
  - Energy savings in the reporting period is difference between the projected energy use without ECMs and the actual energy use

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# Reasons for C-PACE/Utility Determining "Energy Savings"

- Energy savings provide justification for investment in an energy efficiency upgrade
- Select utility energy efficiency incentives are based upon the energy savings
- C-PACE financing for an energy improvement project requires that the savings-to-investment ratio (SIR) be greater than 1
- Property owner making an energy efficiency investment desires to have it payback

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# Eversource-UI Incentives

- **Prescriptive incentives** (existing buildings installing high efficiency equipment), e.g.,
  - Lighting Upgrades ($ per fixture/lamp/occupancy sensor)
  - Air Conditioning/Heat Pump Systems ($/ton, $ for dual enthalpy economizer control and DCV)
  - Gas Heating Systems ($/input MBH; IR heaters: $/unit)
  - Solar PV (ZRECs, $/REC)
- **Performance-based incentives** (energy savings)
  - Air compressor heat recovery
  - High performance overhead doors
  - High performance windows
  - Comprehensive bonus (multiple ECMs)

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# Eversource-UI Program Savings Document (PSD)

- *PSD, 11th Edition: Technical Reference Manual for 2016 Program Year*
- Two types of energy savings:
  - **"Early Retirement" savings**
    - When replacing less efficient measures with a new measure that complies ("baseline") with the energy code
    - Where the energy savings are credited up to the remaining useful life of the measure
  - **"Lost opportunity" savings**
    - For installed measures that are more efficient than would be under the "baseline" energy code
    - Where energy savings above the "baseline" are credited over the measure's entire useful life

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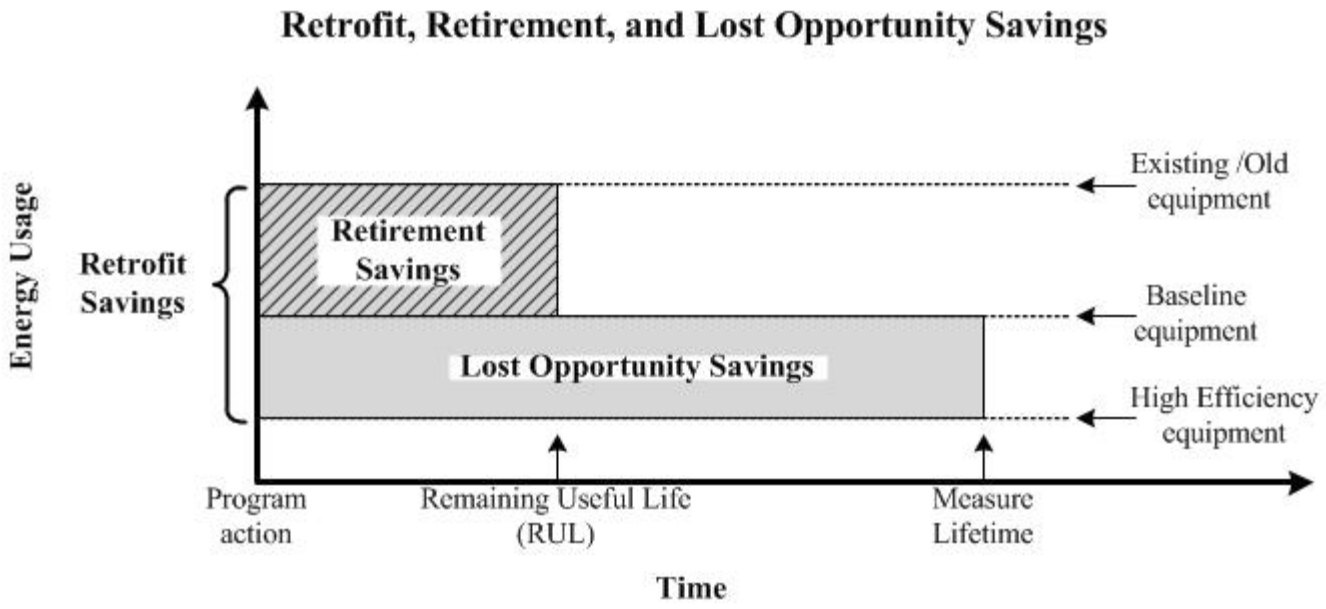
# Eversource-UI Program Savings Document (PSD)



# PSD Energy Savings Example

- Existing equipment:
  - Age: 13 years
  - Efficiency: Low
  - RUL*: 5 years


- Proposed replacement equipment (ECM)
  - Age: New
  - Efficiency: High (“above code”)
  - EUL*: 18 years

* *RUL – remaining useful life; EUL – estimated useful life*

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# PSD Energy Savings Example cont'd

- The projected lifetime energy savings would be:

  [(existing unit energy consumption for 5 years) minus
  (projected energy consumption of the new ECM for a period of 5 years)]

  plus

  [(projected energy consumption of new ECM for 13 years had it been designed to just meet the current building energy code) minus
  (projected energy consumption of the new ECM for a period of 13 years)]

- *If the new ECM being installed was only designed to meet the current building energy code, the lifetime energy savings would be the difference between the energy consumption of the existing ECM less the energy consumption of the new ECM for a period of 5 years*

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# C-PACE Energy Savings

- Lifetime energy savings is used to evaluate the SIR and eligibility for C-PACE financing for project
- C-PACE legislation requires that the SIR > 1
- "S" is determined as follows:
  - Energy savings in the first year escalated annually over the EUL (or weighted EUL for multiple measures) reflecting:
    - Projected increase in utility energy costs (e.g., 3% per year)
    - Projected annual performance degradation (e.g., 1% per year)
- "I" is the total investment (project total installed cost, cost of financing over the financing term, upfront expenses such as the cost of the energy audit, etc.)

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# C-PACE Energy Savings cont'd

- Projected energy savings calculation:
  - Projected first year energy savings =

    (existing equipment first year energy consumption - baseline)

    minus

    (projected first year energy consumption of more efficient equipment)
  - Projected lifetime energy savings = first year energy savings x EUL, reflecting
    - annual energy cost escalation (assume 3% per year)
    - annual performance degradation (typ. 0.5-1% per year)

*Note to Remember: Energy consumption of the existing equipment in the baseline should be normalized assuming energy savings for the new measure is determined under normalized conditions (to assure "apples-to-apples")*

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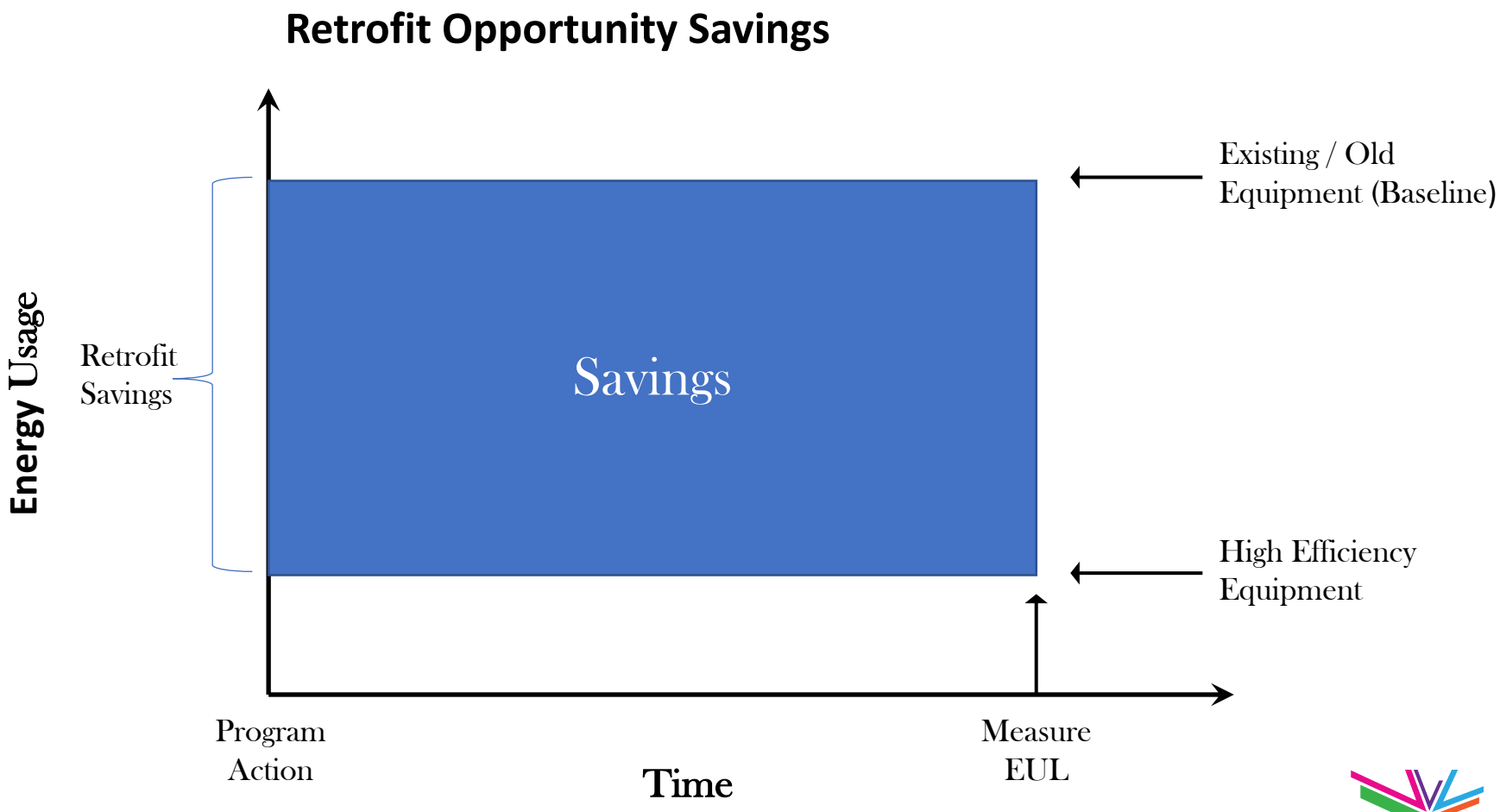
# C-PACE Energy Savings

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# C-PACE Energy Savings Example

- Existing equipment:
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# C-PACE Energy Savings Example cont'd

- The energy savings will consist of:
  - Existing system energy consumption (baseline, normalized)
  - Less the energy consumption (normalized) of the new ECM
  - Projected over 18 years, assuming an annual inflation factor for energy cost and an annual system performance degradation factor

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# Eligible Measures

- C-PACE energy improvement and renewable energy measures to be eligible must be “permanently fixed” to the building
- Utility incentives may also be applied to “non-permanently fixed” measures such as:
  - Low flow spray valves
  - Vending machine controls
  - EnergyStar appliances such as
    - Dishwashers
    - Refrigerators
    - Washing machines
    - Low-flow shower heads
    - Faucet aerators

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# C-PACE Energy Savings Third Party review

- **C-PACE Technical Administrator Reviews:**
  - Representativeness of baseline (ASTM E2797-15 standard)
  - Energy consumption in baseline (existing, pre-ECM)
  - Assumptions
  - Weather data utilized
  - Projected energy use with the planned ECMs
  - "Apples-to-apples" comparison – pre and post ECMs (normalization)
  - Energy savings (with planned ECMs over baseline without ECMs)

- **C-PACE Technical Administrator Also Determines:**
  - SIR (Project Finance Report™) – must be >1
  - Performance Risk (SIR Risk Rating™)

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# Conclusions

- **There are differences in the way utilities and C-PACE view energy savings** *(PACE allows for greater savings accounting regardless of equipment RUL)*
- **Utilities take remaining useful life and energy code requirements into account** *(when calculating applicable incentives)*
- **C-PACE only considers energy consumption in the baseline and energy consumption post-ECM installation** *(based upon actual operating performance of existing systems versus proposed)*
- **Utility incentives and C-PACE are NOT mutually exclusive, but rather totally compatible**
- **Most C-PACE financed projects have incorporated utility incentives**

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# Q&A

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