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UCONN's SmartBuildings CT

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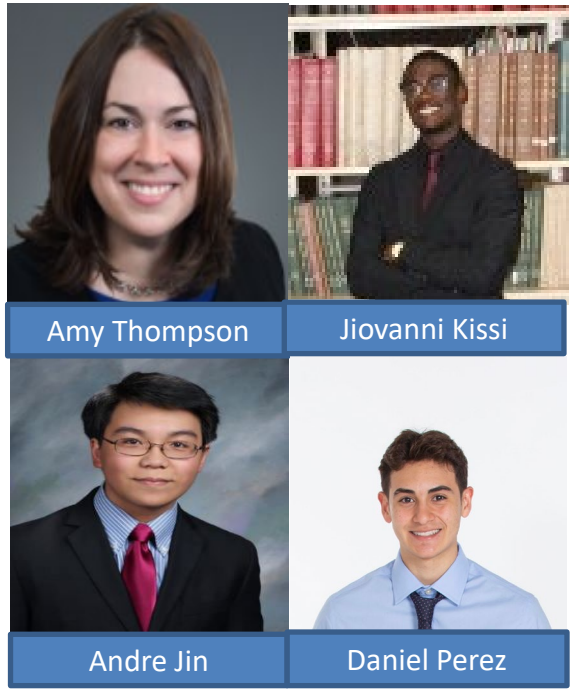


What Is SmartBuildings CT?

- We work with commercial and industrial customers in Connecticut to provide information about the operation and maintenance of buildings and their systems to help building owners and operators:
  - Lower building energy usage and costs
  - Lower carbon emissions
  - Reduce water usage
  - Improve building occupant experience
  - Upgrade building data analysis methods and technologies
- Our work is focused on implementing systems and solutions that provide better information to decision-makers for investments, operations, and maintenance of buildings.
- **Support EPA's Portfolio Manager online tool for commercial & industrial organizations in Connecticut.**
- **Help organizations setup EPA PM *automatic data exchange in their portfolios*.**
- **Provide education on building energy analytics: How to act on the data**

How to Approach Building Energy Efficiency and Energy Management – At the Community Level

Step 1. Make Commitment: Energy, Environment & Building Occupant Health

Step 2. Assess Performance

Step 3. Set Goals

Step 4. Create Action Plan – ENERGIZE CT, CT Green Bank, contractors, and energy consultants

Step 5. Implement Action Plan - Contractors, and Energy Consultants

Step 6. Evaluate Progress

Step 7. Recognize Achievements

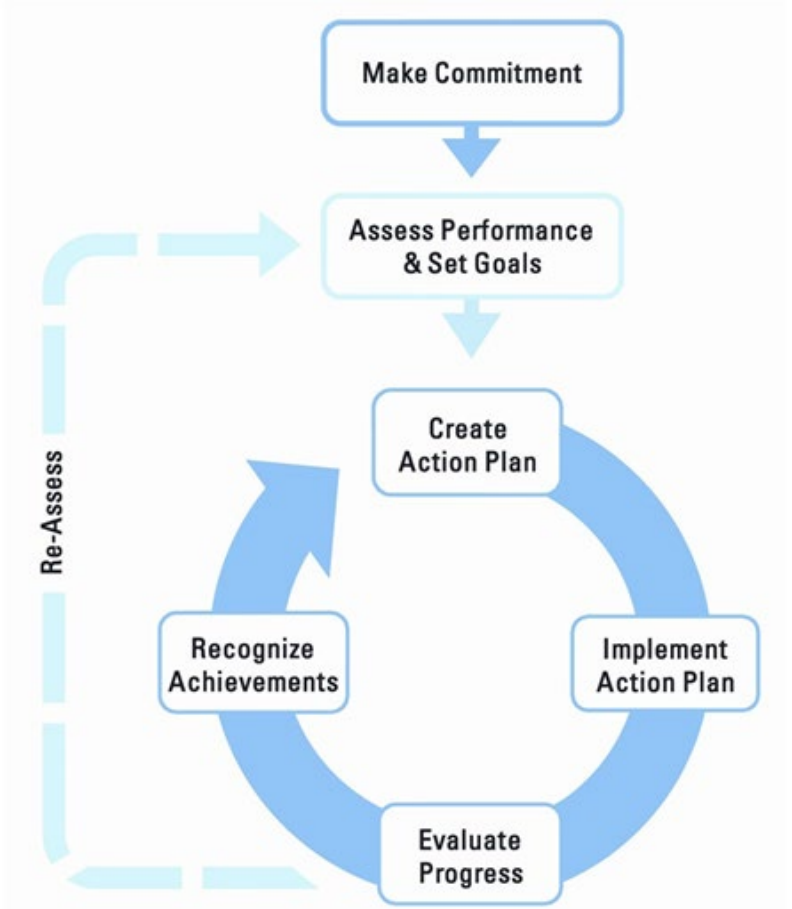


Figure 1. ENERGY STAR Guidelines for Energy Management

State-Wide Status

Connecticut

We've Supported Since 2012

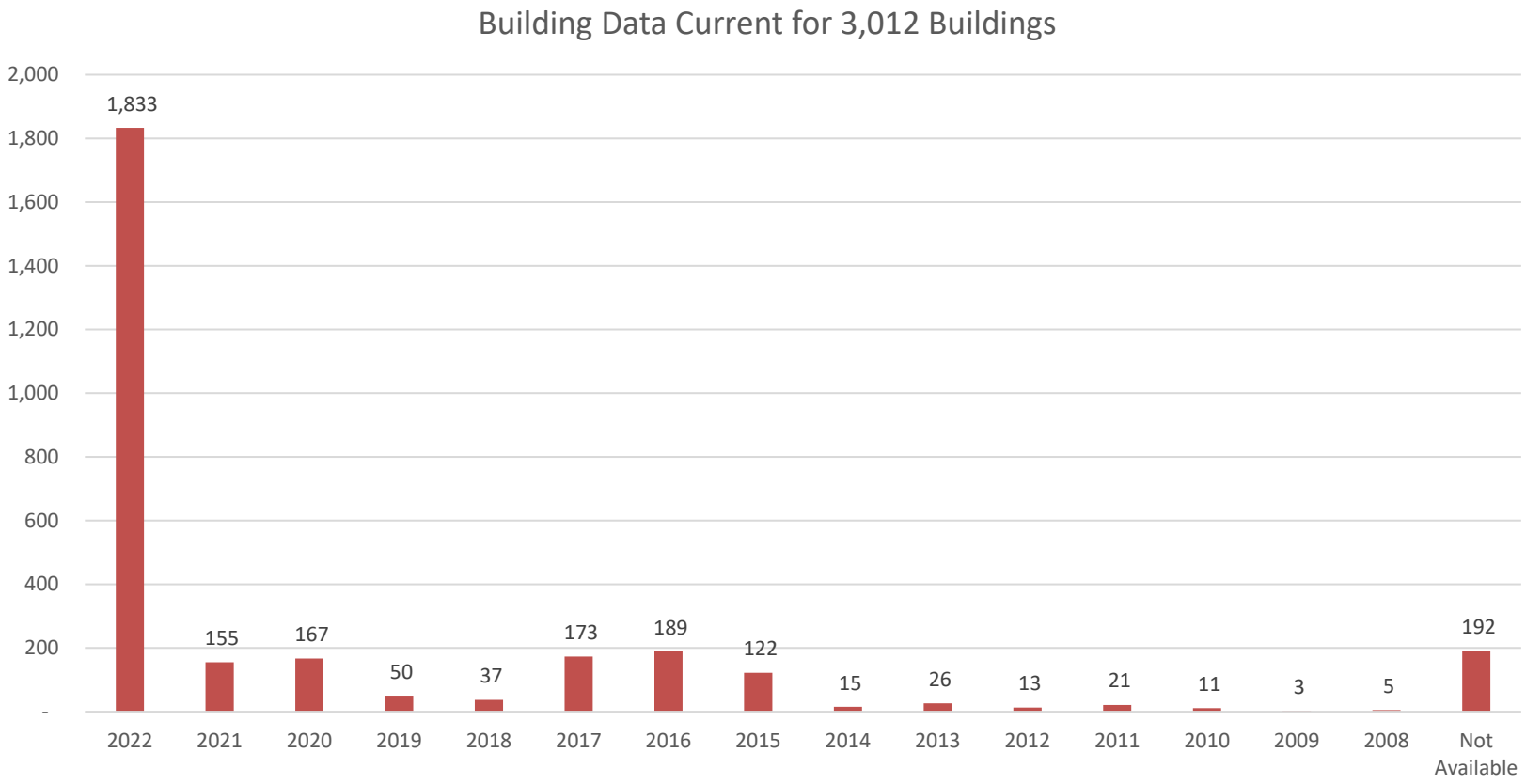
1. Andover
2. Ansonia
3. Bloomfield
4. Bolton
5. Branford
6. Bridgeport
7. Brookfield
8. Brooklyn
9. Cheshire
10. Chester
11. Clinton
12. Columbia
13. Cornwall
14. Darien
15. Deep River
16. Durham
17. East Haven
18. Easton
19. Essex
20. Fairfield
21. Greenwich
22. Glastonbury
23. Goshen
24. Granby
25. Groton
26. Guilford
27. Hamden
28. Hartford
29. Kent
30. Ledyard
31. Litchfield
32. Lyme
33. Manchester
34. Marlborough
35. Middlebury
36. Middletown
37. Mansfield
38. Milford
39. Monroe
40. New Haven
41. New Milford
42. Newtown
43. North Branford
44. Old Lyme
45. Old Saybrook
46. Orange
47. Plymouth
48. Pomfret
49. Portland
50. Putnam
51. Ridgefield
52. Rocky Hill
53. Seymour
54. Shelton
55. Somers
56. South Windsor
57. Southbury
58. Stonington
59. Stratford
60. Tolland
61. Trumbull
62. Vernon
63. Washington
64. West Hartford
65. West Haven
66. Westbrook
67. Weston
68. Westport
69. Woodbury
70. Wilton

Municipalities Supported in Attaining Sustainable CT Certifications for Energy Category (40):

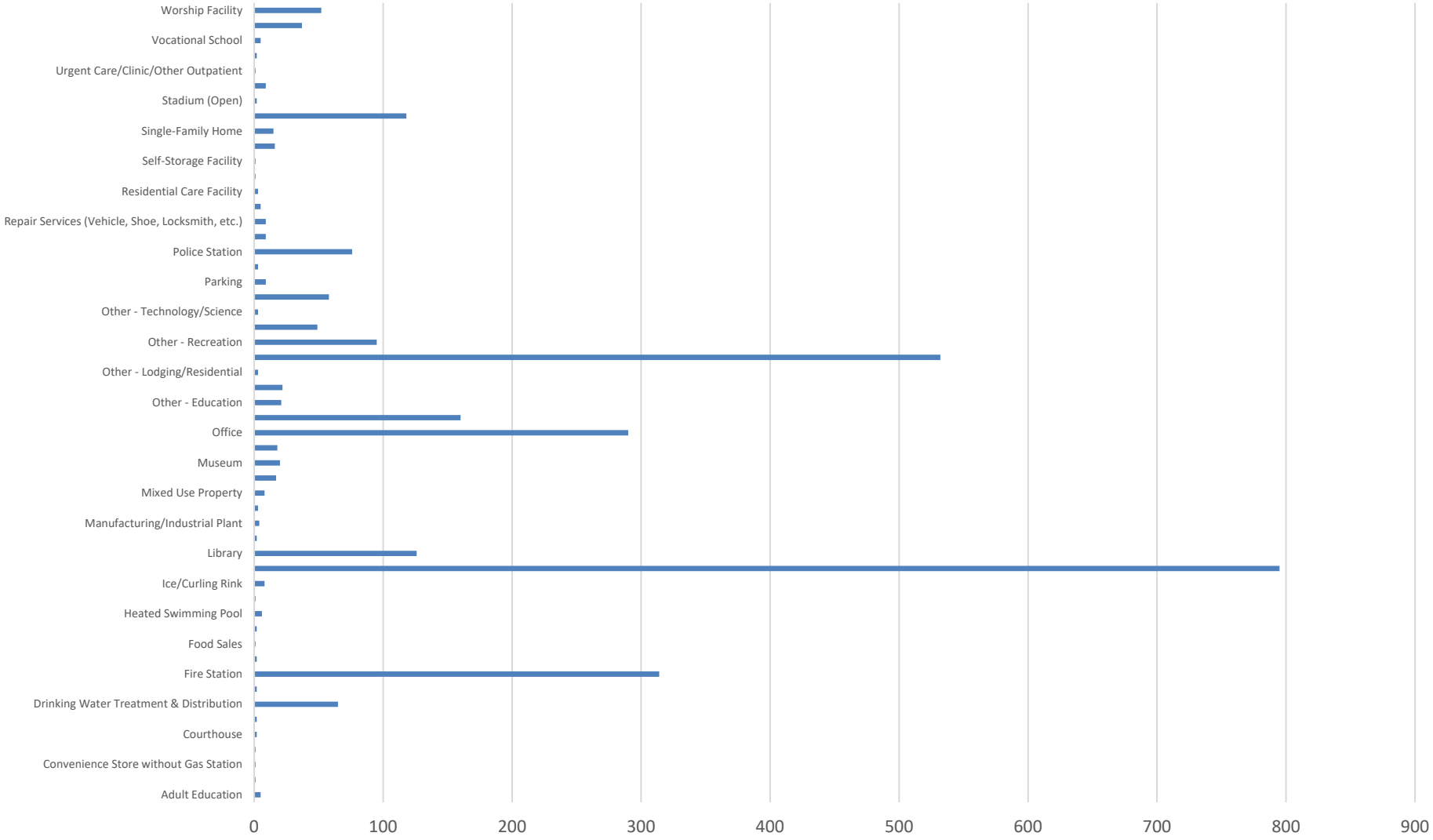
Fairfield	CLIMATE LEADER	Westport	SILVER
Glastonbury	CLIMATE LEADER	Wilton	SILVER
New Britain	CLIMATE LEADER	Bolton	BRONZE
Stratford	CLIMATE LEADER	Cheshire	BRONZE
West Hartford	CLIMATE LEADER	Chester	BRONZE
Darien	SILVER	Deep River	BRONZE
Essex	SILVER	Durham	BRONZE
Greenwich	SILVER	East Haddam	BRONZE
Guilford	SILVER	East Lyme	BRONZE
Hartford	SILVER	Goshen	BRONZE
Litchfield	SILVER	Groton	BRONZE
Manchester	SILVER	Lyme	BRONZE
Mansfield	SILVER	Pomfret	BRONZE
Milford	SILVER	Ridgefield	BRONZE
New Haven	SILVER	Rocky Hill	BRONZE
New Milford	SILVER	Southbury	BRONZE
Old Lyme	SILVER	Stonington	BRONZE
Old Saybrook	SILVER	Washington	BRONZE
Trumbull	SILVER	West Haven	BRONZE
Vernon	SILVER	Weston	BRONZE

EPA PM Benchmarking Summary

The majority of the 3,012 buildings benchmarked have current data and are up-to-date through 2022.



Types of Buildings Benchmarked



The majority of the 3,012 buildings benchmarked are municipal and K-12 schools

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Assess Performance and Set Goals

What Building Energy Benchmarking Using a Portfolio Approach Can Do for Your Community

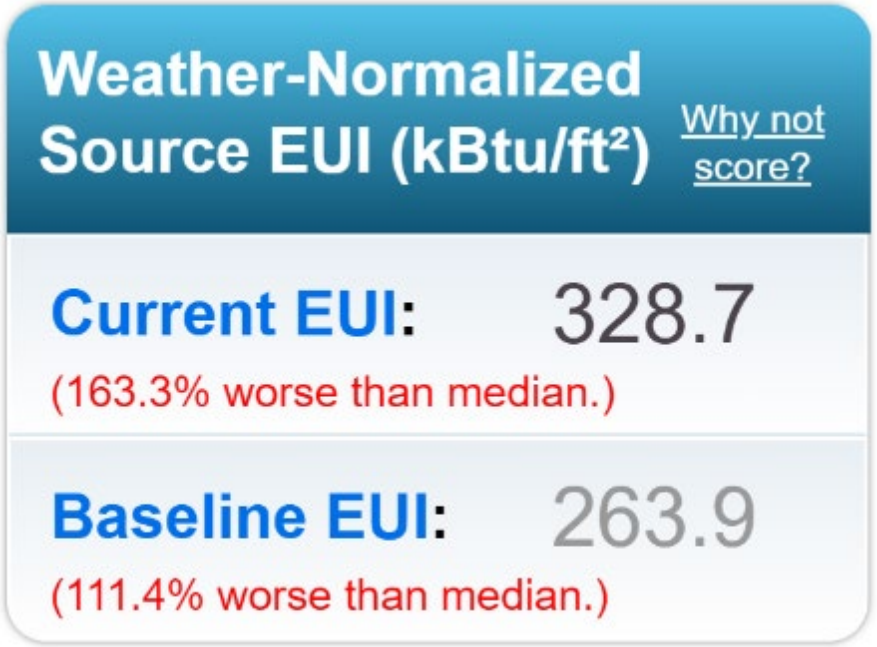
Portfolio Manager (PM) Capabilities

ENERGY STAR® Portfolio Manager®

- ENERGY TRACKING. Know how meters match to buildings. Know your total Site Energy kBtu by converting unlike units of energy usage (kWh, ccf, gallons). Know how your total building energy changes over time.
- WEATHER NORMALIZATION. Know your Weather-Normalized Site Energy in kBtu. Know if changes in Site Energy are due to weather or performance of building.
- GET YOUR BENCHMARK. Know your ENERGY STAR Rating or Energy Benchmark Comparison*
- SHARE YOUR DATA. One internal shared database for building and energy information
- STRATEGIC ENERGY MANAGEMENT SUPPORT. Select and plan projects. Correlate energy changes to projects.
- GET RECOGNIZED. Share your achievements.

Example: What you can learn

Your Benchmark



What Can I Learn?

- Do I have a high performing or low performing building?
- Is my building performance improving since my baseline year?
- Should I perform a building audit to find out why my building is performing so poorly?
- I've installed EE measures, why is my building still performing so poorly?

Example: What you can learn

Your Metrics Summary

Metrics Summary

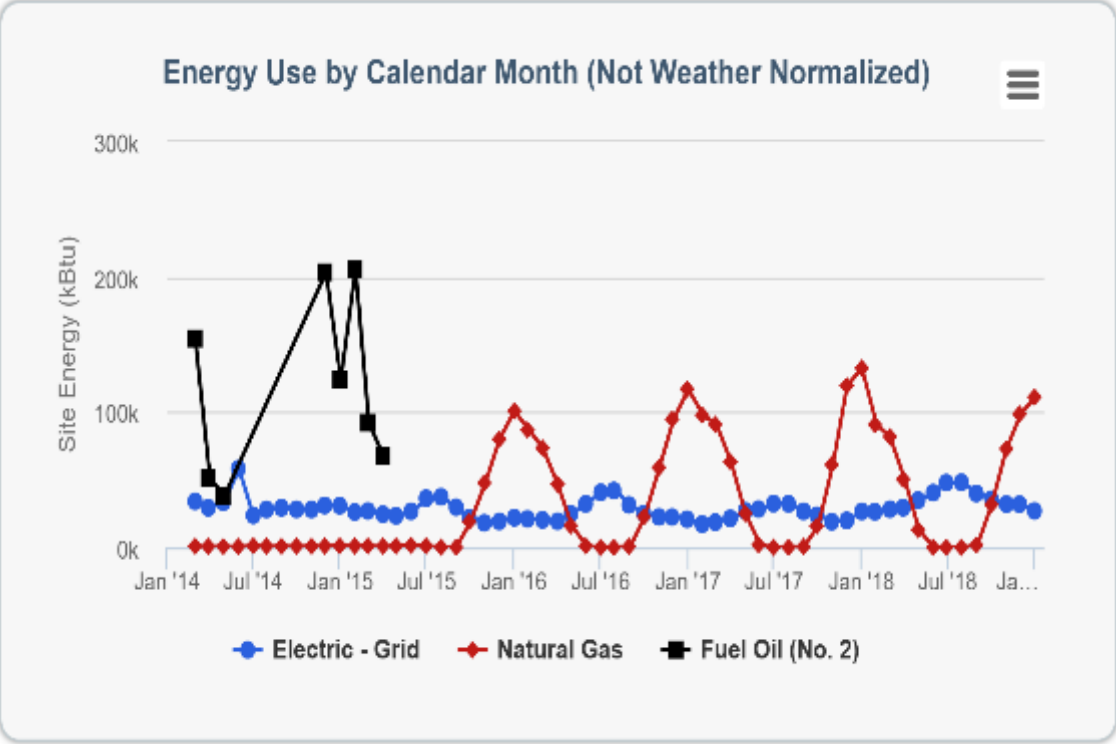
Metric	Jun 2011 (Energy Baseline)	Jan 2019 (Energy Current)	Change
ENERGY STAR Score (1-100)	43	97	54.00 (125.60%)
Source EUI (kBtu/ft²)	144.4	63.0	-81.40 (-56.40%)
Site EUI (kBtu/ft²)	75.0	26.6	-48.40 (-64.50%)
Energy Cost ($)	722,860.66	339,025.06	-383835.60 (-53.10%)
Total GHG Emissions Intensity (kgCO2e/ft²)	5.6	1.8	-3.80 (-67.90%)

What Can I Learn?

- Do I have a high performing or low performing building?
- Is my building performance improving since my baseline year?
- How much money am I saving comparing any two years?
- What is my carbon footprint, and is it improving?
- Am I lowering my water and waste usage?

Example: What you can learn

Energy Use Trend



What Can I Learn?

- What fuels are used in my building?
- Are my heating and cooling peaks increasing or decreasing over time?
- How large is my cooling peak during the summer?
- Do I have a problem with my heating system?

Example: What you can learn – Goal Setting

Understand the Benchmark and Goal Setting

Metrics Comparison for Your Property & Your Target Change Time Period

Metric	Nov 30 2013 (Energy Baseline)	Jan 31 2019 (Energy Current)	Target*	Median Property*
ENERGY STAR score(1-100)	13	11	75	50
Source EUI(kBtu/ft²)	164.5	175.0	87.3	113.5
Site EUI(kBtu/ft²)	69.0	73.0	36.5	47.4
Source Energy Use(kBtu)	8995077.9	9569423.1	4775858.3	6207423.3
Site Energy Use(kBtu)	3773766.4	3994329.5	1993469.5	2591012.6
Energy Cost($)	140799.21	154936.81	77325.07	100503.28
Total GHG Emissions(Metric Tons CO2e)	263.2	279.2	139.3	181.1

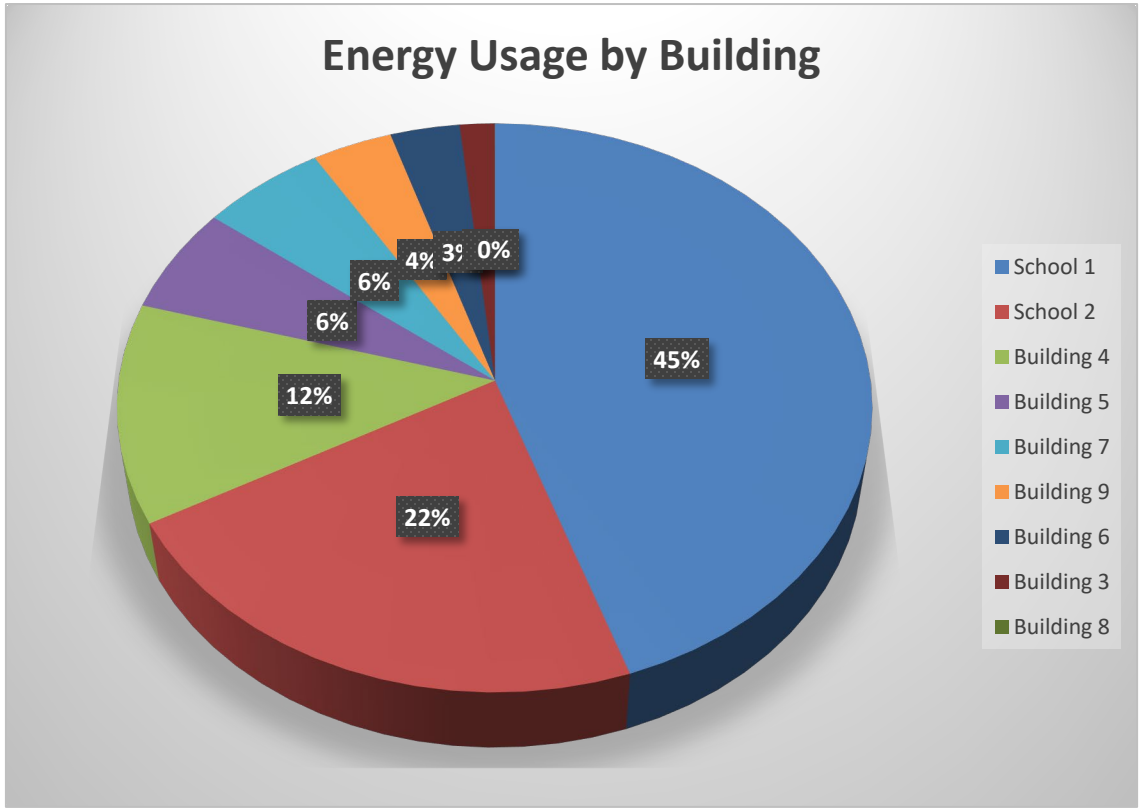
* To compute the metrics at the target and median levels of performance, we will use the fuel mix associated with your property's current energy use.

What Can I Learn?

- How can I set practical goals?
- Why is my ENERGY STAR rating so low compared to similar properties?
- How much energy do I need to save to attain ENERGY STAR certification?
- How much money could I save annually if I achieve a median rating or an ENERGY STAR rating?

Example: What you can learn

Energy Usage By Building



What Can I Learn?

- Which buildings are my highest energy users?
- Where should I focus my effort?

UConn Industrial Assessment Center

Liang Zhang, Director
Amy Thompson, Director of Operations
Ravi Gorthala, Assistant Director

University of Connecticut, Storrs

Mission of the SNE-IAC

The mission of our center is:

- To offer free and comprehensive audit and consulting services to small-to-medium manufacturers (SMMs) for saving energy, reducing water usage, minimizing industrial waste, strengthening cyber security, reducing carbon footprint, adopting renewable energy, and improving productivity;
- To train students in improving industrial energy efficiency through hands-on, real-world experience by conducting student team assessments of SMEs; and
- To provide outreach and education opportunities to nonparticipating SMEs. The proposed IAC will focus its service on the dense Southern New England/Southern NY regions, including Connecticut, Rhode Island, Long Island, New York City, and southeastern New York, and can serve a 150-mile radius from UConn campus.

Types of Energy Efficiency Measures

- 2.1321 REPLACE FOSSIL FUEL EQUIPMENT WITH ELECTRICAL EQUIPMENT
- 2.1332 CONVERT FUEL OIL COMBUSTION EQUIPMENT TO BURN NATURAL GAS
- 2.2122 INSTALL / REPAIR INSULATION ON CONDENSATE LINES
- 2.2511 INSULATE BARE EQUIPMENT
- 2.2622 REPLACE EXISTING CHILLER WITH HIGH EFFICIENCY MODEL
- 2.3141 USE BATTERY STORAGE FOR DEMAND CONTROL
- 2.3192 USE FOSSIL FUEL POWERED GENERATOR DURING PEAK DEMAND PERIODS
- 2.3415 USE A FOSSIL FUEL ENGINE TO COGENERATE ELECTRICITY OR MOTIVE POWER; AND UTILIZE HEAT
- 2.4133 USE MOST EFFICIENT TYPE OF ELECTRIC MOTORS
- 2.4146 USE ADJUSTABLE FREQUENCY DRIVE OR MULTIPLE SPEED MOTORS ON EXISTING SYSTEM
- 2.4221 INSTALL COMPRESSOR AIR INTAKES IN COOLEST LOCATIONS
- 2.4231 REDUCE THE PRESSURE OF COMPRESSED AIR TO THE MINIMUM REQUIRED
- 2.4323 USE OPTIMUM SIZE AND CAPACITY EQUIPMENT
- 2.6218 TURN OFF EQUIPMENT WHEN NOT IN USE
- 2.6231 UTILIZE CONTROLS TO OPERATE EQUIPMENT ONLY WHEN NEEDED
- 2.7134 USE PHOTOCELL CONTROLS
- 2.7135 INSTALL OCCUPANCY SENSORS
- 2.7142 UTILIZE HIGHER EFFICIENCY LAMPS AND/OR BALLASTS
- 2.7229 AIR CONDITION ONLY SPACE NECESSARY
- 2.7232 REPLACE EXISTING HVAC UNIT WITH HIGH EFFICIENCY MODEL
- 2.7234 USE HEAT PUMP FOR SPACE CONDITIONING
- 2.7493 USE DOUBLE OR TRIPLE GLAZED WINDOWS TO MAINTAIN HIGHER RELATIVE HUMIDITY AND TO REDUCE HEAT LOSSES
- 2.8114 CHANGE RATE SCHEDULES OR OTHER CHANGES IN UTILITY SERVICE
- 2.9114 USE SOLAR HEAT TO MAKE ELECTRICTY

Managing Demand and Charges

Overview and Examples

Electrical Demand

- Demand charges are based on highest rate of consumption during a billing period.
- Demand charge purpose is to charge grid capacity to customers to drive reducing grid operating costs.
- Demand charges designed to recover investments in generating plants, transmission systems (volt lines and substations), and distribution systems (distribution transformer)
- Utility Companies are required by law to maintain a "spinning reserve" to account for potential power spikes
- Lowering demand peak decreases costs for both consumers and providers (Demand Reduction-Induced Price Effects)
  - Less need for construction of new power plants and power delivery systems to meet increasing demand
  - Lessens strain on electrical grid and carbon dioxide emissions

Electrical Demand Calculations

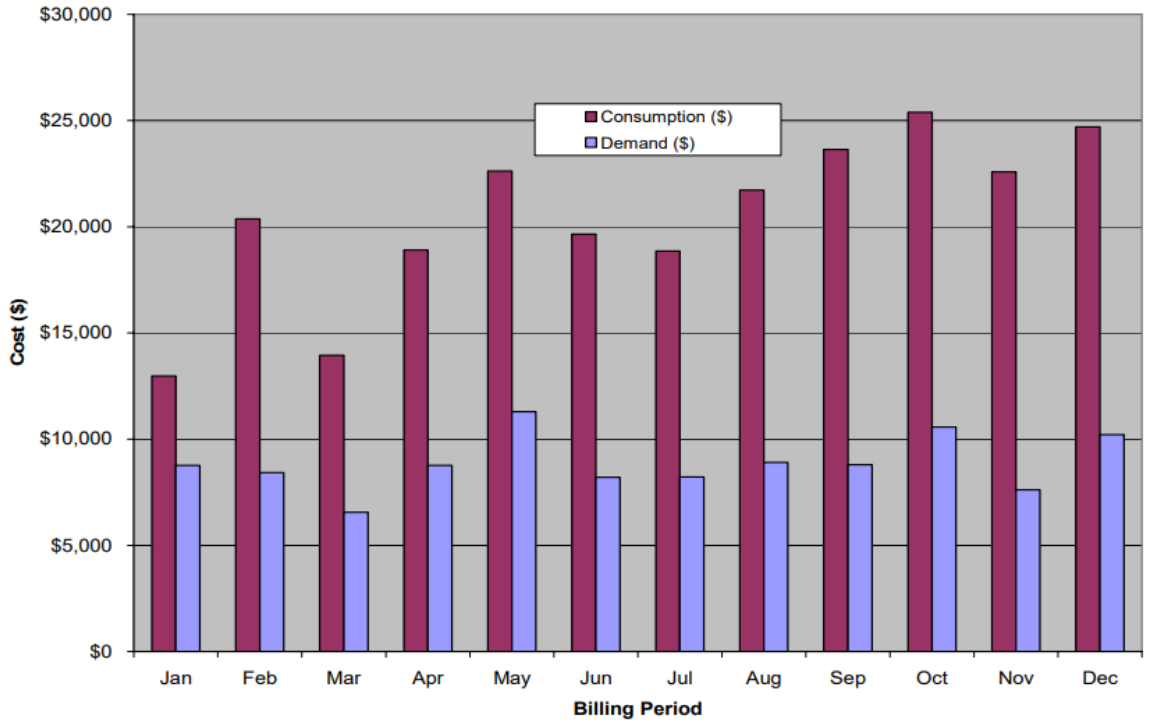
- Demand Example: Fifty 100-Watt light bulbs all turned on = 5,000 Watts and Total Demand is 5 kW
- Obtained by utility measuring energy consumed in sequential 15-minute periods throughout the billing period [2]
  - Maximum consumption converted to average rate in kilowatts (kW)
- Peak Demand multiplied by demand cost factor to obtain Demand Charge [2]
  - Demand Cost Factor can vary depending on location, supplier, and whether on-peak (daytime) or off-peak (nighttime)
- Ratchet Demand: utility charge based on highest demand billed over past 12 months

Electrical Demand

- Both customers have same electricity usage, but Customer 1 had a higher peak load and will pay a higher demand charge – will pay more for energy

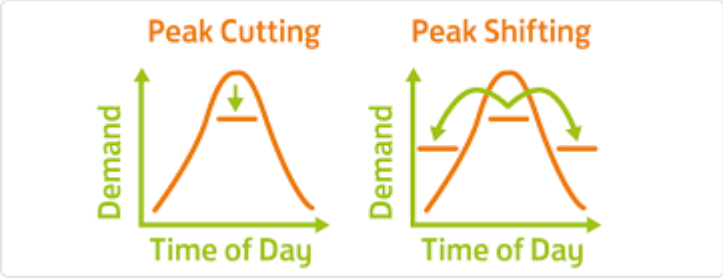
Electrical Demand

- Demand Charge added to consumption costs to obtain monthly cost [2]
  - Can often be *up to 50% of total electric bill*
- Utility Companies charge for demand to encourage reduction in power spikes



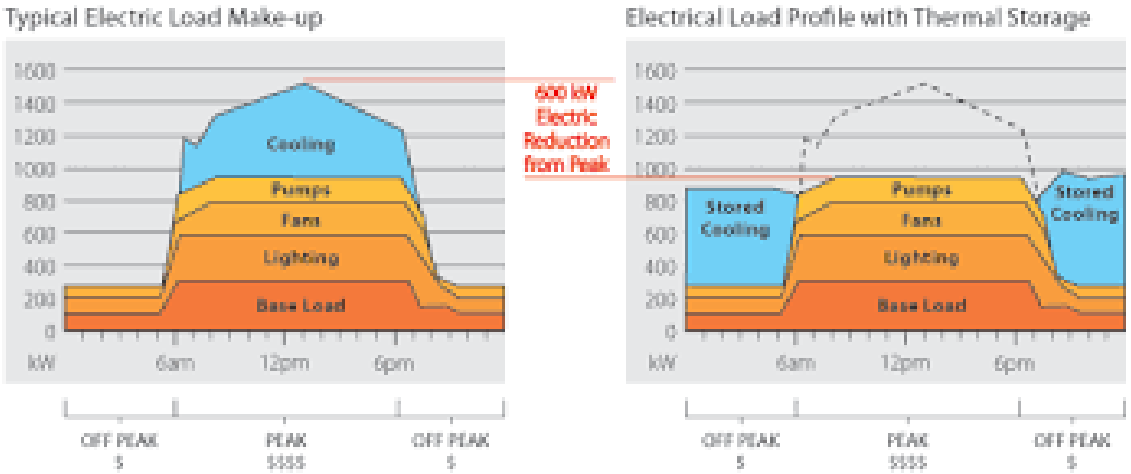
Demand Management: Cut and/or Shift

- Does the rate schedule of your buildings show a demand charge? Is there information on the bill of when the demand peak occurred?
- If the demand peak is well above the rate of consumption, monitoring and minimizing demand can reduce excess peak costs by about 15% [2]
- Want to even out peaks and valleys of energy consumption
- Active Resource: reduction that is dispatched that must respond to electric system operator during shortage event
- Passive Resource: reduction during pre-defined hours/periods



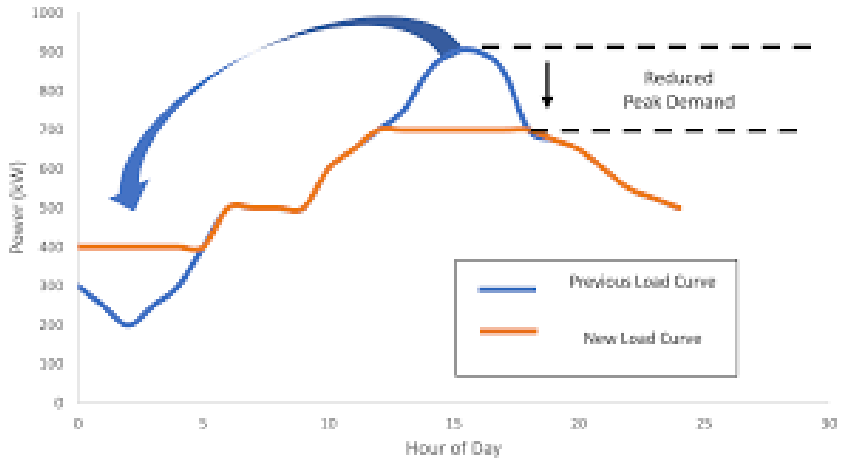
Demand Peak Reduction

- Starting of small motors are staggered and large motors are electronically controlled [2]
- Placing sequencers on air conditioning systems will prevent more than one turning on at a time [2]
- Slow start devices can help limit the current that a large motor can draw [2]
- Use thermal energy storage for off-peak rates [4]
  - Heat Water/Make Ice during off-peak hours and store for later use
- Reducing light usage/use higher efficiency bulbs [4]



Demand Peak Reduction

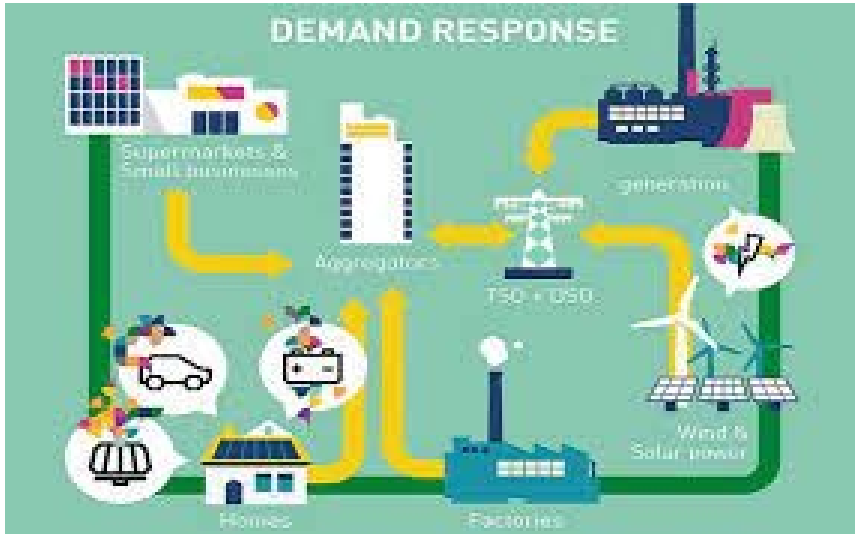
- Installation of a demand meter (about $2,500) [2]
  - With a 15% reduction in demand peak, cost of installation would quickly be covered
- Moving operations to off-peak hours [4]
  - Recharge batteries during off-peak
- Staggering shifts/breaks [2]
  - Schedule maintenance during non-operating hours
  - Overlap custodial services with normal day hours
- Use batteries for demand control and power quality issues [6]
- Use fossil fuel powered generator during peak demand periods [6]



[2]-HowToPerformAssessments-SelfAssessment
[4]-Most_Commonly_Identified_Recommendations
[6]-IAC_ARC_Codes_2019

Demand Response Programs – How They Work

- Allows utility companies to balance supply and demand and lower rates for consumers
- May offer time-of-use pricing, critical peak pricing, variable peak pricing, real time pricing, or critical peak rebates
- Direct Load Control: allows provider to cycle air conditioners and water heaters on/off during periods of peak demand in exchange for financial incentive and lower electric bills for consumers
- Grid modernization makes demand response more important and feasible
  - Example: Sensors can find peak load problems and automatic switching can divert or reduce power reducing the chance of overload and power failure



https://www.energy.gov/oe/demand-response

Demand Response Programs – Benefits

- In recent years, New England utilities have been able to reduce 300 MW of load during peak demand
- Usually reduce energy use or use energy generated and stored in a battery during high demand periods
- Option to work with curtailment service providers for demand response equipment and services
  - Incentive payment would be split with CSP if you work with them
- Residential or small business customers are eligible to enroll in smart thermostats, EV chargers, or home battery storage systems
- Industrial customers are eligible to directly enroll their battery or thermal storage system

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https://energizect.com/explore-solutions/demand-response-and-smart-devices/demand-response

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Eversource Demand Response

- Program utilizes ConnectedSolutions
  - Options include energy storage, advanced controls, and active monitoring
- Lower electricity usage via personalized solution when Eversource calls a peak demand event
  - Notification of peak demand event will be sent out 24 hours in advance
- Incentive payment based on average kilowatt reduction over the season
  - Range from $25 to $200 per average kilowatt reduction
  - No penalties for nonperformance

EVERSOURCE

UI Demand Response

- Automated Demand Response Program for businesses
- Program representative will help determine optimal load reduction strategies
- Reduction event declared up to 15 times per calendar year
- Can either reduce demand or shift to off-peak hours (automated load reduction available)
- Incentive of $50 per average kW reduced
- No penalty for nonparticipation in a reduction event

UI
An AVANGRID Company

https://uibusinessdemandresponse.com/wp-content/uploads/2022/03/United-Illuminating-Automated-Demand-Response-Brochure-032022.pdf

Closing Thoughts

- If your municipality isn't investigating building energy efficiency, *every hour of every day you are missing energy savings and lost $ in savings*
- You can use energy efficiency incentives, rebates, and tax incentives to help reduce energy and demand. *You can use these funds to upgrade your facilities.*
- With smart, energy efficient buildings, you can make your indoor air environment and air quality better for occupants and create *healthier environments.*
- *You can make your buildings more resilient to disturbances by adding alternative fuel sources and renewables.*
- *Large amount of federal $ through Bipartisan Infrastructure Law (BIL) Grant Programs*
- Connecticut has many services and support programs available to municipalities:
  - ENERGIZE CT, Eversource, United Illuminating Statewide EE Programs
  - CT Green Bank and CT DEEP
  - Non-Profits or No-Cost Resources: Sustainable CT, RCOGs, others
  - Private energy efficiency consultants and contractors
  - UConn Resources: CIRCA, SmartBuildings CT, Eversource Energy Center

Engage

Participate

Lead

Help

Find Collaborators

Reach Out

Get funded

Teach

Learn

Web: http://utc-iase.uconn.edu/

LinkedIn: https://www.linkedin.com/groups/8512041

Twitter: https://twitter.com/uconniase

Facebook: https://www.facebook.com/UTCIASE/

YouTube: https://www.youtube.com/channel/UCyIDa1nLXJE4JzvA039fmAA