

Best Practices for Energy Audits

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Joe Van Gombos, Unitil Chase Pennoyer, Resilient Buildings Group





New Hampshire Electric Co-op 🗳 Unitil

Session Efficiency Experts

Joe Van Gombos

- Senior Energy Efficiency Program Coordinator, Unitil
- Working in MA and NH Programs for the past 6 years
- Started in Administration and Compliance (Planning, EMV, Reporting)
- Now Gas and Electric Program
 Implementation

EVERS

• Retrofit, New Equipment, New Construction

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Chase Pennoyer

🌑 Unitil

- VP Operations, Resilient Buildings Group
- Energy Efficiency Consulting in MA and NH for past 5 years
- NREL Renewable and Sustainable Energy Certified
- Started work as an Energy Analyst
- Now VP Operations overseeing wide range of energy efficiency and renewable energy projects
 - Benchmarking, ASHRAE Audits, Energy Modeling Management



Presentation Overview

• Overview of Efficiency Programs

- Setting the Stage, Program Terminology and Purpose
- Goals for this Session

• Types of Energy Audits

- Turnkey Audits
- ASHRAE Audits 1, 2, & 3

• Review of the Building System

- Identifying/Documenting Existing Systems
- Opportunities for Investments in Efficiency
- Energy Audit Examples
- Next Steps for NHSaves and the NH Efficiency Workforce

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Audits in NHSaves C&I Programs

NHSaves Essential Info

NHSaves: Utilities collaborating to provide technical assistance and financial incentives for investments which conserve energy resources and upgrade facilities while improving comfort, productivity, business operations, environmental impact, etc.

Primary Program Offerings

- **1. Incentives:** project funding which reduce the cost of investments in higher efficiency equipment over baseline conditions.
- 2. Technical Assistance: funding which supports analyses of specific equipment or facility audits, intended to document key project parameters like incremental cost, energy savings, and measure life.
 - Incremental Cost: 'investment in efficiency'
 - Energy Savings: Energy or MMbtus conserved, Demand reduced
 - Measure Life: Claimable Life (in Years) for project economics







NHSaves Essential Info

Types of Efficiency Projects:

- <u>Retrofit</u>: Improve existing facility efficiency through upgrading of existing systems, installing equipment and operator controls, increasing insulation, etc.
 - Incentives generally provided against 'total cost'
 - Energy Savings calculated with existing equipment as the baseline.
- **<u>New Equipment</u>**: Investment in new 'capital' equipment including HVAC, Major Appliances, Process Systems, etc.
 - Incentives provided against 'incremental cost' (Efficient minus Baseline)
 - Energy Savings calculated as 'efficient case' over 'baseline case'
- New Construction/Major Renovation: Brand new facilities or a gut rehab of an existing building with significant project costs
 - Incentives provided against 'incremental cost' (Efficient minus Baseline)
 - Energy Savings calculated as 'efficient case' over 'baseline case'

Benefit/Cost Ratio: Key Project Evaluation Criterion assessing value of energy impacts against financial investment.







Why Dedicated Session on Energy Audits?

Energy Audits are a critical first step for energy efficiency projects.

- Documenting Existing Conditions
- Defining Proposed Conditions
- Developing inputs for benefit/cost analysis

Energy Audits are a type of technical assistance supported by NHSaves to ensure our customers, clients of your energy project consulting and implementation services, are aware of opportunities and impacts.

Session Goal:

We hope attendees will leave with a better understanding of the broad universe of types of efficiency measures that can be presented to customers, paired with available incentives that can be leveraged in selling these solutions.







Types of Energy Audits

Overview of Energy Audits

Energy Audits (Assessments) are the natural starting point for any efficiency project in an existing building.

- Benchmarking, Existing Conditions
- Documenting facility use case: weekly/annual hours of operation, behavior, building/business type, etc.

Types of Energy Audits

- Walkthrough/Turnkey Audit: gathering minimum information for a specific project like an LED retrofit. Utilities generally have vendors available to support these efforts; much interest in expanding comprehensiveness here.
- **ASHRAE Level I:** Most basic audit. High-level view of operations and energy use. Identify low-hanging fruit and determine if a deeper audit is warranted.
- ASHRAE Level II: Building on Level I Data; break down of energy by end-use, identify problem areas as key opportunities for efficiency investments. Should result in schedule of projects that can be implemented in following months-years.
- ASHRAE Level III: Most comprehensive 'investment-grade' audit that can include equipment sub-metering and in-depth engineering analysis to document more significant investment opportunities like new HVAC systems and other major building upgrades.







What warrants an Audit?

Most Common Symptoms

- Business/Operations Considerations
- High utility bills
- Occupant comfort issues
- Ice Dams
- Air quality issues
- Sustainability goals





Walkthrough/Turn-Key Audit

Goal: Install the energy efficient technologies

- Project Specific Walkthrough
- Identify opportunities for immediate retrofits
 - Lighting Improvements
 - Steam trap replacements
 - Low flow water saving devices
 - Thermostat upgrades











Level I Audit

Goal: To identify the low hanging opportunities for improving energy efficiency

- Examines:
 - Utility data
 - Benchmark building
 - Building Shell
 - Construction and insulation type
 - Mechanical System
 - Type of heating and cooling system

- Age and condition of systems
- Controls
- Electric System
 - Lighting Age and condition
 - Plug loads
- Notable Issues
 - Ice Dams
 - Safety Hazards







Level I Audit

- Report:
 - Existing Conditions
 - Safety hazards
 - Building Energy Use Intensity (EUI)
 - Energy Efficiency Measures (EEMs)

<u>Tools</u>

- Infrared camera
 - Find thermal bridging and heat loss









Level II Audit

<u>Goal</u>: To conduct deep dive into the building systems and potential EEM's

- Analyze:
 - Utility data
 - Benchmark building
 - Building Shell
 - Identify construction and insulation type
 - Problem areas
 - Mechanical System
 - Types of heating and cooling systems

- Age and condition of systems
- Controls
 - Scheduling
- Electric System
 - Lighting
 - Age and condition
 - Controls
 - Plug loads









Level II Audit

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- Reports
 - Existing Conditions
 - Safety hazards and notable issues
 - Energy Use Intensity
 - Energy Efficiency Measures
 - Financial Model



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Level II Audit Tools

<u>Tools:</u>

- Infrared Camera
 - Identify envelope weaknesses
- Anemometer
 - Measure ventilation rates
- Blower Door
 - Quantify air infiltration
- Light Meter
 - Determine lighting density
- Data Logger
 - Lighting patterns
 - Temperature fluctuations
 - Carbon Dioxide Levels (CO2)
- Energy Model
 - Equest, WUFI, or TREAT
- Financial Model









Level III Audit

Reports

- Each component of a Level I & II Audit
- Refined Analysis
 - Each energy efficiency measure
- Hourly Usage Analysis
 - A deep dive into how much energy is used when
- Power Quality and Logging Assessments



Level III Audit Tools

- Infrared Camera
 - Identify envelope weaknesses
- Anemometer
 - Measure ventilation rates
- Blower Door
 - Quantify air infiltration
- Light Meter
 - Determine lighting density
- Data Logger
 - Lighting patterns
 - Temperature fluctuations
 - Carbon Dioxide Levels (CO2)
- Power Quality Loggers









Components of Each Energy Audit

	Benchmarking	Air Infiltration Testing	Data Logging	Engineering Analysis	Energy Efficiency Measures	Financial Model
Walk- through					X	
Level I	X				X	
Level II	X	X			X	X
Level III	X	X	X	X	X	X



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The Building System & Efficiency by End Use

Facility Operations	• Building Type - Square Footage - Hours of Operation		
Envelope/Shell	Insulation - Air Sealing		
HVAC	• System Type - Age - Fuels - Controls - EMS/BMS		
Refrigeration	Controls - Motors		
Hot Water	Low-flow Fixtures - Pipe Insulation		
Process	Compressed Air - Motors/Drives/Pumps		
Lighting	Systems - Controls		
	Electric Co-op		

Energy Audit Essential Data

Energy Specialist:				Date of Assessment	
Contact Name:				Phone:	
Address: _					
City:				State:	ZIP:
Phone Number: Cell Number:		Email Address:			
Venting Cu	stem				
Beating Sy	Natural Gas	Doil	Propane		
Water Heat	ing System				
Electric	Natural Gas	□ Oil	Propane		
Electric Ac	count Number:				
Program Sp	onsor (please che	ck one):	Cape Light Compact	Eversource National Grid	🗆 Unitil
Gas Accour	nt Number:				
Program Sp ∃Berkshire	onsor (please che Gas □Columbi	ck one): a Gas of	Massachusetts 🛛 Eve	rsource 🗆 Liberty Utilities 🗆 Natior	nal Grid 🛛 Unitil
Hours of Op	peration:			Total Sq. Ft Affected by Heating a	and Lighting:
Lighting (Recommended	🗆 Inclu	ded in Proposal 🛛 Eval	uated, Not Applicable	
LED 🗌 Yes	No		iterior LED	Exterior LED	
Lighting Co	ontrols 🗆 Recom	nmended	I 🗆 Included in Propos	al 🗆 Evaluated, Not Applicable	
Locations:				Type: □ Wall Switch □ Ceiling	





Energy Audit Essential Data

		Compressed Air System Recommended Included in Proposal Evaluated, Not Applicable						
U d	t	Compressor size and cor	trol type: SCFM	HP/KW		Leak test done in the last 5 years EE improvements done in the last 5 years		
	Motors/Drivers Recommended Included in Proposal Evaluated, Not Applicable							
l Da	Ita	Applications of motor size:						
	Type: Pump Fan Updated by Vendor Other							
	VFDs Recommended Included in Proposal Evaluated, Not Applicable							
		Over 3HP motor with variable load						
		Refrigeration Recommended Included in Proposal Evaluated, Not Applicable						
		UWalk-in Cooler Reach-in Cooler Compressor Size						
	Plug Loads Recommended Included in Proposal Evaluated, Not Applicable							
	Do th	Do they have controls in place? Yes No						
	Numb	mber of personal computers: Number of vending machine sensors:						
	Kitch	chen 🛛 Recommended 🗆 Included in Proposal 🗆 Evaluated, Not Applicable						
	□Hoo	Hood Vents 🛛 Fryers 🖾 Steamers 🖾 Ovens 🖾 Griddles 🖾 Pre-Rinse Spray Valves						
	Heating System Equipment Recommended Included in Proposal Evaluated, Not Applicable							
	Furnace Boiler HVAC Unit Other							
	Model #: System Size:							
	Age/`	fear:	Efficiency, if k	nown:		Overall Condition:		
	🗆 Boil	ler Reset 🛛 Programma	ble Thermostat					
	RCE	Liberty Electric Co-op	🅼 Unitil					



Energy Audit Essential Data

Water Heating Equipment 🛛 Recommended 🗋 Included in Proposal 🗍 Evaluated, Not Applicable					
Boiler Free-standing Tank Tankless Indirect Fired On Demand Other					
Size: Temperature Setting: Age: Overall Condition:					
□ Water Restrictors □ Low Flow Shower Heads □ Hot Pipe Insulation					
Cooling Recommended Included in Proposal Evaluated, Not Applicable					
□ Whole Building or □ By Space Type: □ RTU □ Split System □ Chiller □ Condenser □ Window Unit Year Installed:					
Building Envelope Recommended Included in Proposal Evaluated, Not Applicable					
Windows: Single Pane Drafty None					
Overall Window Condition:					
Exterior Doors: Drafty Done					
Overall Door Condition:					
Insulation Recommended Included in Proposal Evaluated, Not Applicable					
□ Attic □ Ceiling □ Walls □ Basement					
Ducts and Pipes 🛛 Recommended 🗇 Included in Proposal 🔅 Evaluated, Not Applicable					
Ducts Insulated? If so: Heating Cooling Both Heating Pipes Insulated Leaks in Ducts					
Ventilation Recommended Included in Proposal Evaluated, Not Applicable					
□ Mechanical Ventilation Type: □ Air Handler □ Other □ CO₂ sensors □ Economizer					
Energy Management System (EMS)					
Do they have EMS? 🗌 Yes 🗋 No Manufacturer: Model: If yes, is it fully functional? 🗌 Yes 🗌 No Type (Pneumatic, DDC, other)					





Energy Audit Success Stories

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Level II Audit

- Benchmarking found that the building consumed 50% greater kBTUs/ft²/year than the national average
- Defined the existing conditions of the building and its systems

Audit Recommendations

- Building Envelope
 - Air sealing work
 - Insulate basement
- Mechanical System
 - Energy efficient natural gas boilers
 - Insulated domestic hot water storage tanks
 - Variable Frequency Drive pumps
 - Combined Heat and Power
- Electric System
 - LED lighting
 - Occupancy sensor controls

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Next Steps

- Define project Scope
 - Pick energy efficiency measures
 - Budget
 - Expectations
- Collect bids
 - Compare prices
 - Pick contractors
- Do the work

<u>Results</u>

- Energy usage reduction
 - 24% reduction in annual energy use
 - 39% reduction in annual energy costs
 - 90% electric load reduction with CHP system







Upper Valley Music Center

Level II Energy Audit – USDA Rural Development Program

- Benchmarking found that the building was on par with national average
 - Room for improvement
- **Defined** the existing conditions of the building and its systems

Audit Recommendations

- Building Envelope
 - Air sealing around windows and doors
 - New Storm windows
 - Insulate attic and basement
- Mechanical System
 - Air source heat pump system
- Electric System
 - LED lighting

Next Steps

- Use Audit as a Capital Improvement Plan
 - Implement each measure over time as funds become available
 - Systems reach their end of life





Looking Forward, Together

Barriers to Comprehensive Energy Audits

• Audit Investment

- Time
- Money
- Cost of Projects
 - Incentives/Financing
- Auditor Training/Experience

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 The skill and art of documenting, calculating, and proposing comprehensive project suites

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• Network of End-Use Professionals



NHSaves Solutions for Comprehensive Audits

Audit Investment

- Vendor Resources
- Technical Assistance Funding
- Cost of Projects
 - Incentives/Financing through our programs, delivered by the workforce!
- Auditor Training/Experience
 - Technical and programmatic trainings

- Program Evolution
- Continuous Improvement
 - Let's Connect to Discuss Technical Resources that will enable comprehensive projects!





Questions, Feedback

Thank you