

The background of the entire page is a detailed architectural floor plan in white lines on a dark blue background. The plan shows various rooms, corridors, and structural elements. A prominent green horizontal band is positioned across the middle of the page, containing the title text. The floor plan continues below this band.

High Performance Building Guide

Commercial New Construction

Version 2.2

Efficiency
Vermont

Introduction

Description

This Guide is intended to be used for projects with a “Efficiency Vermont Certified: High Performance” energy efficiency goal. This High Performance goal is a whole-building efficiency approach rather than an equipment approach. Energy intensity varies significantly depending on building type, occupancy, and usage, as well as envelope, mechanical, and electrical systems used. However, the incorporation of these measures should result in a 10 – 20% energy use reduction compared to a building built to the minimum requirements of the 2015 Vermont Commercial Building Energy Standards. This guide provides a **comprehensive** list of cost-effective energy efficiency measures for commercial new construction and major renovation projects.

 Equipment Approach 5-10%* energy savings Minimum Assistance Above-Code Equipment  Yankee Farm Credit Efficiency Vermont provided financial support for efficient equipment, enabling above-code energy performance. Equipment Approach	 High Performance 10-20%* energy savings Moderate Assistance Above-Code Performance  Norwich University Supporting a comprehensive approach to energy efficiency, Efficiency Vermont helped this customer attain a high performance goal. Whole Building Approach	 Net Zero 30-45%* energy savings Extensive Assistance Best Building Performance  Northfield Savings Bank Efficiency Vermont worked closely with the project team to set a path to achieve their net zero goal. Whole Building Approach
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*Versus 2015 VT CBES
Photos: Leslie O'Halloran & Gary Hall Photography

Measure Development

The requirements listed in this guide are developed from the following sources:

- ANSI/ ASHRAE/ USGBC/ IES Standard 189.1-2014 - High-Performance Green Buildings
- Consortium for Energy Efficiency (CEE) – Air Conditioning and Heat Pump Initiatives
- Department of Energy (DOE) ENERGY STAR Program – Furnace, Boiler, Fan, and Water Heater Qualifications
- New Buildings Institute (NBI) Advanced Buildings – New Construction Guide
- Efficiency Vermont market and project experience



Get Started

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to maximize impact and incentives.

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Documentation Review & Verification

Design and Construction Documents, including all drawings and specifications, as well as equipment submittals during construction, must be submitted to Efficiency Vermont. These documents, as well as a final inspection, will be used to verify all requirements have been met.

Recognition & Marketing

Projects completing the requirements in this Guide will be recognized as achieving the ***Efficiency Vermont Certified: High Performance*** designation. Specific benefits provided by Efficiency Vermont include:

- A customized, framed certificate for display in the building
- Certificates for contributing firms on the project team
- Marketing support for creating a press release
- Inclusion in Efficiency Vermont promotions (advertising, publicity on high-performance buildings and best practices), and possibly a project case study.

Financial Assistance

Financial incentives will be provided to the owner for each measure:

- Standard equipment incentive – specific to each project. Includes all lighting, refrigeration, and mechanical efficiency upgrades as defined in Equipment Efficiency Guide.
- Custom equipment incentives – may be available for measures not included in Equipment Efficiency Guide if presented to Efficiency Vermont during early design to review.
- Air Barrier incentive – 25% of total cost
- Systems Acceptance Testing incentive – 25% of total cost

Whole Building / Design

W1 Design Intent

Conduct a design team meeting to discuss project energy goals before the schematic design phase has concluded. Complete a design narrative, which includes a general building description, owner goals, and a description of the building envelope, mechanical, and electrical systems.

W2 Vermont Commercial Building Energy Standards

Comply with all applicable minimum requirements of Vermont's energy code, the 2015 Vermont Commercial Building Energy Standards (CBES).

W3 Systems Acceptance Testing

If included in the building, perform Acceptance Testing for:

- A. Mechanical Systems – Heating, ventilation, air conditioning, and refrigeration
- B. Lighting Systems – Daylighting controls, occupancy sensing devices, automatic shut-off controls

As part of the Acceptance Testing, verify that a Systems Manual has been prepared that includes operation and maintenance documentation, full warranty information, and provides operating staff with the information needed to understand and optimally operate building systems.

W4 Energy Monitoring

Create an ENERGY STAR Portfolio Manager account for the building. Commit to monitoring and recording annual electric and fuel consumption for five years of operation.

Envelope

Code Reminder

CBES includes minimum thermal resistance requirements for opaque assemblies and elements, and fenestration. For fenestration, maximum areas and maximum solar heat gain coefficients are also specified, in addition to minimum skylight areas. See sections 402.1, 402.2, and 402.3 for details.

E1 Air Barrier

To ensure building envelope air tightness, either:

- A. Conduct whole building air leakage testing upon construction completion and achieve 0.25 cfm or less per square foot of above-grade surface area at 50 Pa pressure, - or -
- B. Complete air barrier commissioning, consisting of both a design review to assess the air-barrier system and material documentation, and an incremental field inspection and testing of air barrier components.

Plumbing

Code Reminder

CBES requires efficient hot water supply piping design, and certain controls for hot water circulation and temperature maintenance systems. See sections 404.5 and 404.6 for details.

P1 Domestic Hot Water Heating

Meet the water heating equipment efficiency requirements listed in Table P1.

P2 Plumbing Fixtures

Meet the fixture flow / flush rate requirements listed in Table P2.

Mechanical

Code Reminder

CBES requires minimum HVAC equipment efficiencies, controls for certain types of HVAC equipment and systems, and maximum fan powers depending on the application.

- A. HVAC Equipment – Included are air conditioners, heat pumps, furnaces, boilers, chillers, and heat rejection equipment. See section 403.2.3 for details.
- B. HVAC Controls – Included are thermostatic, off-hour, snow- and ice-melt, economizer, hot and chilled water temperature reset, demand control ventilation, parking garage ventilation, energy recovery ventilation, kitchen exhaust, variable air volume, static pressure reset, fan speed, and supply air temperature reset controls. See sections 403.2.4 and 403.4 for details.
- C. HVAC Fans – Included are fan power and fan efficiency. See 403.2.12 for details.

M1 Ventilation Design

Design and operate the building to meet or exceed ANSI/ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality, including:

- Design and implement a 62.1-compliant outdoor air control technique
- Develop and implement an IAQ Construction Management Plan
- Flush the building with 100% of the scheduled quantity of outdoor air prior to occupancy and after the punch list is complete.
- Develop and implement an IAQ Operations Management Plan for building operation

M2 Thermal Comfort Design

Employ best practice design techniques to improve system performance and meet ANSI/ASHRAE Standard 55-2013 – Thermal Environmental Conditions for Human Occupancy, including:

- When sizing heating and cooling equipment, perform load calculations using building shell and interior load assumptions that are consistent with the individual building. Include accurate characterization of lighting, solar loads, glazing performance, occupancy and ventilation loads.
- When sizing the fan and air distribution systems, document fan-sizing calculations with zone-by-zone load calculations. Perform calculations to determine critical path supply duct pressure loss.
- Perform a second set of calculations using part-load conditions. Include benchmark data, average daytime temperatures, non-peak solar gain, and diversity factors for interior loads. Describe the system operation at these conditions and describe features of the design that will facilitate efficient operation at these part load conditions.

Mechanical (continued)

M3 Mechanical Equipment

Meet the minimum efficiency requirements for mechanical equipment listed in Tables M3.1 – M3.6.

M4 Ventilation Fans

Exhaust fans with a capacity of 500 cfm or less must be ENERGY STAR labeled.

M5 Ventilation Energy Recovery

Fan systems with an airflow rate that meets or exceeds the values specified in Table M3.7 shall include an energy recovery system. The energy recovery system must have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 60% of the difference between the outdoor air and return air enthalpies, at design conditions.

M6 High Efficiency & Variable Speed Motors

- A. Fans – For single-zone systems with fractional horsepower fan motors, use high efficiency motors (e.g., BPM, ECM, ICM).
- B. Pumps – For chilled or heating hot water circulation systems, use pumps with either VFD's or high efficiency motors (e.g., BPM, ECM, ICM) with integrated variable speed control.

M7 Kitchen Exhaust Systems

For kitchen exhaust hoods with a design airflow equal to or greater than 2,000 cfm, include one of the three efficiency strategies identified in section 403.2.8 of the CBES.

Lighting

Code Reminder

CBES requires different types of interior and exterior lighting controls, depending on the application. This includes occupancy sensors, time-switch, bi-level, dimming, and daylighting controls. See section 405.2 for details.

L1 Interior Lighting

Complete a Lighting Power calculation following the space-by-space method outlined in CBES (405.4.2) and achieve a power level that is at least 25% better (lower) than the calculated code allowance. Use Efficiency Vermont's LPD Calculation Tool. To achieve a low power level, use LED fixtures either qualified by Design Lights Consortium, or labeled by ENERGY STAR.

L2 Exterior Lighting

Complete a Lighting Power calculation following the method outlined in CBES (405.5.1) and achieve a power level that is at least 50% better (lower) than the calculated code allowance. To achieve a low power level, use LED fixtures either qualified by Design Lights Consortium, or labeled by ENERGY STAR.

Building Type - Specific

Code Reminder

CBES requires minimum thermal resistance levels for walk-in cooler, walk-in freezer, and refrigerated warehouse spaces, in addition to minimum efficiencies of certain refrigeration equipment. See sections 403.2.14 and 403.2.15 for details.

B1 Kitchen Equipment

- A. The following equipment must be ENERGY STAR labeled: dishwashers, ice machines, fryers, hot food holding cabinets, refrigerators and freezers, steam cookers, griddles, ovens.
- B. Boilerless/Connectionless Food Steamers – Consume ≤ 2.0 gal/hour in the full operational mode
- C. Combination Ovens – Consume ≤ 10 gal/hour in the full operational mode

B2 Appliances, Electronics, Office Equipment

The following equipment must be ENERGY STAR labeled:

- Appliances – Room air conditioners, clothes washers, dehumidifiers, dishwashers, refrigerators and freezers, room air cleaners, and water coolers.
- Electronics - Cordless phones, audio and video, televisions, set-top boxes
- Office Equipment - Computers, copiers, fax machines, laptops, mailing machines, monitors, multifunction devices, printers, scanners, and computer servers

B3 Refrigeration Equipment

- A. Evaporator fan motor controls – Required if system is greater than 4 fans or 250 watts total.
- B. Refrigerator and Freezer Case Lighting – Must be LED, qualified by Design Lights Consortium.

APPENDIX A – Requirements Tables

Table M3.1 – Electrically Operated Unitary Air Conditioners

Equipment Type	Size Category (Btu/h)	Subcategory or Rating Condition	Minimum Efficiency
<i>Air Conditioners, Air cooled</i>	<65,000	Split system	15.0 SEER, 12.5 EER
		Single package	15.0 SEER, 12.0 EER
	≥65,000 and <135,000	Split system and single package	13.8 IEER, 12.0 EER
	≥135,000 and <240,000		13.0 IEER, 12.0 EER
	≥240,000 and <760,000		12.1 IEER, 10.6 EER
≥760,000		11.4 IEER, 10.2 EER	

Notes

- a. Abbreviations: SEER = Seasonal Energy Efficiency Ratio, EER = Energy Efficiency Ratio, IEER = Integrated Energy Efficiency Ratio

Table M3.2 – Electrically Operated Heat Pumps

Equipment Type	Size Category (Btu/h)	Subcategory or Rating Condition	Minimum Efficiency
<i>Air Source, Heating Mode</i>	<65,000 Btu/h (Cooling Capacity)	Cold Climate Single-Zone Split	10.3 HSPF
		Cold Climate Multi-Zone Split	10.0 HSPF
		Split System	8.2 HSPF
<i>Water Source, Cooling mode</i>	<17,000 (Cooling capacity)	86 °F entering water	14.0 EER
	≥17,000 and <135,000 (Cooling capacity)	86 °F entering water	14.0 EER
<i>Water Source, Heating mode</i>	<135,000 (Cooling capacity)	68 °F entering water	4.6 COP

Notes

- a. Abbreviations: EER = Energy Efficiency Ratio, COP = Coefficient of Performance

Table M3.3 – Electrically Operated Variable Refrigerant Flow Air Conditioners

Equipment Type	Size Category Input (Btu/hr)	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency
<i>VRF Air Conditioners, Air Cooled</i>	<65,000	All	Multi-split System	15.0 SEER, 12.5 EER
	≥65,000 and <135,000	Electric Resistance (or none)		11.7 EER, 14.9 IEER
	≥135,000 and <240,000			11.7 EER, 14.4 IEER
	≥240,000			10.5 EER, 13.0 IEER

Notes

- a. Abbreviations: SEER = Seasonal Energy Efficiency Ratio, EER = Energy Efficiency Ratio, IEER = Integrated Energy Efficiency Ratio

Table M3.4 – Electrically Operated Variable Refrigerant Flow Heat Pumps

Equipment Type	Size Category Input (Btu/hr)	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency
<i>VRF, Air Cooled (cooling mode)</i>	<65,000	All	Multi-split System	15.0 SEER 12.5 EER
	≥65,000 and <135,000	Electric Resistance (or none)	Multi-split System	11.3 EER 14.2 IEER
	≥65,000 and <135,000		Multi-split System with Heat Recovery	11.1 EER 14.0 IEER
	≥135,000 and <240,000		Multi-split System	10.9 EER 13.7 IEER
	≥135,000 and <240,000		Multi-split System with Heat Recovery	10.7 EER 13.5 IEER
	≥240,000		Multi-split System	10.3 EER 12.5 IEER
	≥240,000		Multi-split System with Heat Recovery	10.1 EER 12.3 IEER
<i>VRF, Water source (cooling mode)</i>	<65,000	All	Multi-split Systems 86°F EWT	14.0 EER
	<65,000		Multi-split System with Heat Recovery 86°F EWT	13.8 EER
	≥65,000 and <135,000		Multi-split Systems 86°F EWT	14.0 EER
	≥65,000 and <135,000		Multi-split System with Heat Recovery 86°F EWT	13.8 EER
	≥135,000		Multi-split Systems 86°F EWT	11.6 EER
	≥135,000		Multi-split System with Heat Recovery 86°F EWT	11.2 EER
<i>VRF Air Cooled (heating mode)</i>	<65,000 (cooling capacity)	-	Multi-split System	9.0 HSPF
	≥65,000 and <135,000 (cooling capacity)		Multi-split System 47°F db/43°F wb OAT	3.4 COP
	≥135,000 (cooling capacity)		Multi-split System 17°F db/15°F wb OAT	2.4 COP
			Multi-split System 47°F db/43°F wb OAT	3.2 COP
			Multi-split System 17°F db/15°F wb OAT	2.1 COP
<i>VRF Water source (heating mode)</i>	<135,000 (cooling capacity)	-	Multi-split System 68°F EWT	4.6 COP
	≥135,000 (cooling capacity)		Multi-split System 68°F EWT	4.2 COP

Notes

- a. Abbreviations: SEER = Seasonal Energy Efficiency Ratio, EER = Energy Efficiency Ratio, IEER = Integrated Energy Efficiency Ratio

Table M3.5 – Warm Air Furnaces, Duct Furnaces and Unit Heaters, Non-Weatherized

Equipment Type	Size Category Input (Btu/h)	Minimum Efficiency
<i>Warm air furnaces, gas fired</i>	<225,000	95% AFUE
<i>Warm furnaces, oil fired</i>	<225,000	85% AFUE
<i>Warm air duct furnaces, unit heaters, gas fired</i>	All capacities	90% E _c

Notes

- a. Abbreviations: AFUE = annual fuel utilization efficiency, E_c = combustion efficiency

Table M3.6 – Boilers, Gas-, Oil-, and Wood-Fired

Equipment Type	Size Category Input (Btu/h)	Subcategory or Rating Condition	Minimum Efficiency
<i>Boilers, gas fired</i>	< 300,000	Hot Water	90% AFUE
	≥300,000 and ≤2,500,000		90% E _t
	>2,500,000		90% E _c
<i>Boilers, oil fired</i>	<300,000	Hot Water	85% AFUE
	≥300,000 and ≤2,500,000		85% E _t
	>2,500,000		86% E _c
<i>Boilers, wood pellet fired</i>	All	Hot Water	85% HHV

Notes

- a. Abbreviations: AFUE = annual fuel utilization efficiency, E_t = thermal efficiency, E_c = combustion efficiency

Table M3.7 – Energy Recovery Equipment

Percent (%) Outdoor Air at Full Design Airflow Rate	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50%
Design Supply Fan Airflow Rate (cfm)	≥4,500	≥4,000	≥2,500	≥1,000	>0

Table P1 – Water Heating Equipment

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Performance Required
<i>Storage Water Heaters, Gas</i>	≤ 75,000 Btu/h	≥ 20 gal	EF ≥ 0.67
	> 75,000 Btu/h	< 4,000 Btu/h/gal	E _t ≥ 94%
<i>Instantaneous Water Heaters, Gas</i>	< 200,000 Btu/h	≥ 4,000 Btu/h/gal	EF ≥ 0.90
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal	E _t ≥ 94%
<i>Storage Water Heaters, Electric, Heat Pump</i>		Heat Pump	EF ≥ 2.6

Notes

- a. Abbreviations: EF = energy factor, E_t = thermal efficiency

Table P2 – Plumbing Fixtures and Fittings

Fixture Type	Minimum Efficiency
<i>Toilets</i>	1.28 gallons per flush
<i>Urinals</i>	0.50 gallons per flush
<i>Showerheads</i>	2.00 gallons per minute
<i>Lavatory Faucets, Public</i>	0.50 gallons per minute
<i>Lavatory Faucets, Private</i>	1.50 gallons per minute
<i>Kitchen Faucets</i>	1.50 gallons per minute
<i>Pre-Rinse Spray Valves</i>	1.30 gallons per minute