April 2022

Connecticut Department of Energy and Environmental Protection

Attachment D: Draft Weatherization Standard

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Executive Summary

Connecticut General Statutes §16-245m[1] requires that for any Conservation and Load Management Plan to be approved, it must contain steps required to achieve the goal of weatherizing 80 percent of Connecticut's residential housing units by 2030. The statute does not define the term "weatherization," which is left at the discretion of the Department of Energy and Environmental Protection (DEEP). This document provides a definition of weatherization to be used only for measuring progress towards the statewide weatherization goal.

Background

Conn. Gen. Stat. § 16-245m, as amended by Section 33 of Public Act 11-80, requires that any Conservation and Load Management Plan (C&LM Plan) approved by the Department of Energy of Energy and Environmental Protection (DEEP) must contain steps towards the achievement of weatherizing 80 percent of Connecticut homes by 2030. The statute does not define the term "weatherization," which is left at the discretion of DEEP. In response to the Act, DEEP undertook a public process to develop a standard or definition for "weatherization."[2]

On August 22, 2012, the Energy Efficiency Board submitted to the Department of Energy and Environmental Protection (DEEP) a recommended weatherization standard for single-family homes. On November 7, 2012 DEEP issued its Draft Determination to Establish Weatherization Standards for Single-Family Dwellings in Connecticut Pursuant to Section 33 of Public Act 11-80 (Draft Determination).[3] Following issuance of the Draft Determination, DEEP conducted a Technical Meeting on December 7, 2012, where stakeholders were provided the opportunity to comment on the Draft Determination. Following the Technical Meeting, ten stakeholders submitted written comments to DEEP.[4]

These comments called on DEEP to wait for the completion of the Baseline Weatherization Study conducted by the Energy Efficiency Board before issuing a final decision on the weatherization standard. Consequently, DEEP determined that it would re-engage stakeholders on the weatherization standard

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[1] *See* Connecticut General Statutes §16-245m, *available at*: https://www.cga.ct.gov/current/pub/chap_283.htm - sec_16-245m

[2] Previous Notices, Determinations, public comments, and other materials on this matter can be found here: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/$EnergyView?OpenForm&Start=29.1&Count=30&Expand=29.1&Seq=2

[3] *See* DEEP Draft Determination to Establish Weatherization Standards for Single-Family Dwellings in Pursuant to Section 33 of Public Act 11-80, November 7, 2012, *available at*: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/c4b6caf0059e937f85257aaf005faea2/$FILE/Draft%20Determination%20for%20Weatherization%20Standards%20for%20Single-family%20Dwellings.pdf

[4] *See* DEEP Request for Additional Comments: Weatherization Standard for Single-Family Dwellings, June 28, 2013, *available at*: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/4bae084458559b7c85257b01004b7b09/$FILE/1-28-13%20Notice%20of%20Request%20for%20Additional%20Comments.pdf

when the Baseline Study was finalized. The Baseline Study was submitted to the Energy Efficiency Board on June 3, 2014.[5] On August 13, 2015, DEEP conducted another Public Information Meeting to review its weatherization definition.[6]

The previously proposed standard was not adopted for a variety of reasons, including the high technical cost of assessing homes using this standard at a large scale and its inability to account for multifamily properties, which comprise approximately 36 percent of Connecticut's housing stock.

Pursuant to Conn. Gen. Stat. § 16-245m(d)(1), the proposed 2022-2024 Conservation and Load Management Plan (the Proposed C&LM Plan) was submitted to the Department of Energy and Environmental Protection (DEEP) on November 1, 2021 by Eversource Energy (Eversource), The United Illuminating Company (UI), Connecticut Natural Gas Corporation (CNG) and The Southern Connecticut Gas Company (SCG) (collectively the Utilities), in consultation with the Energy Efficiency Board (EEB).[7]

Public comments received as part of DEEP's review of the Proposed C&LM Plan indicated a need for developing a standard of weatherization that would allow DEEP to assess progress towards its statutory goals.[8] To that end, DEEP included this Draft Weatherization Standard as an attachment to its Draft Determination on the 2022-2024 C&LM Plan. The Draft Determination and all associated attachments are subject to public comment before finalization.[9]

DEEP's Proposed Definition of Weatherization

To account for the variety in Connecticut's housing stock, DEEP is proposing three "pathways" for determining a home's weatherization status. These pathways to weatherization draw from existing programs and allow the selection of a weatherization standard that is most appropriate and feasible for a home. Under this proposed standard, a home would be considered weatherized upon completing one of the following distinct pathways:

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[5] *See* Single-family Weatherization Baseline Assessment (R5) Final Report, June 3, 2014, *available at*: https://energizect.com/sites/default/files/R5-Connecticut%20Weatherization%20Baseline%20Assessment-FINAL%2006-04-14.pdf

[6] *See* DEEP Notice of Public Information Meeting and Opportunity for Comments, Definition of "Weatherization" For Single-Family Residential Units, August 4, 2015, *available at*: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/67db1b8d9400b48a85257e9700531584/$FILE/Notice%20of%20Info%20Mtg%20081315%20%20Comments%20re%20Weatherization%20Definition%20%20FINAL.pdf

[7] *See* 2022-2024 Conservation and Load Management Plan, November 1, 22021, *available at*: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/04d115cb68d338b785258788007091c9?OpenDocument

[8] Public comments from DEEP's review of the 2022-2024 Conservation and Load Management Plan can be found here: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/$EnergyView?OpenForm&Start=1&Count=30&Expand=7.1&Seq=2

[9] For more information on DEEP's review of the 2022-2024 C&LM Plan and public comment opportunities, *see* https://portal.ct.gov/DEEP/Energy/Conservation-and-Load-Management/Conservation-and-Load-Management

1. **Home Energy Solutions (HES/HES-IE) Pathway:** A home participates in the HES or HES-IE programs, with confirmation that the core services offered in the HES visit were performed; or
2. **Prescriptive Pathway:** A home meets 5+ of the modified weatherization requirements listed in Table 2; or
3. **Flexible Pathway**: A home demonstrates an efficiency level comparable to the Prescriptive Pathway through one of the following:
    a. **Home Energy Score**: receiving a Department of Energy (DOE) Home Energy Score equal to 5 or higher;
    b. **WAP Participation**: participating in the federally funded Weatherization Assistance Program (WAP);
    c. **Construction Date:** having a construction date later than January 1, 2000; or
    d. **REM/Rate™ model**: REM/Rate™ model of the home's energy efficiency meets or exceeds the performance of a model of the same home with inputs meeting the standards outlined in the Prescriptive Pathway.

Because some of these proposed Pathways only apply to single-family homes, DEEP will continue to explore additional weatherization standards for multifamily buildings to fully satisfy §16-245m.

Pathways to Weatherization

DEEP proposes that any home that meets one of the pathways listed below be considered "weatherized" for the purpose of meeting the statutory goal.

Home Energy Solutions Pathway

A home participates in the HES or HES-IE programs with confirmation that the core services offered in the HES visit were performed.

HES/HES-IE is an appropriate proxy for weatherization because the HES and HES-IE programs are the flagship of the residential energy efficiency program offerings. The core visit delivers a basic suite of energy efficiency improvements to a home, including air sealing, installation of high efficiency light bulbs, faucet aerators, low-flow showerheads, and safety tests on furnaces and water heaters (see Table 1, below).[10] DEEP is confident that these programs provide a basic level of weatherization. The HES and HES-IE programs are familiar to Connecticut residents and the existing infrastructure around these

[10] *See* Energize CT, "Home Energy Solutions – Core Services," *available at*: https://www.energizect.com/your-home/solutions-list/home-energy-solutions-core-services

programs make them an ideal pathway for increased weatherization. In 2020, the HES and HES-IE programs have served over 41,000 Connecticut households,[11] approximately 2.8 percent of Connecticut's estimated 1.5 million housing units.[12] Since 2010, both programs have served over 576,000 Connecticut ratepayers.[13]

Table 1: Core Measures offered by the HES and HES-IE programs

Core Measures	HES	HES-IE
Energy-efficient light bulbs	✓	✓
Blower door assisted air sealing	✓	✓
Domestic hot water (DHW) conservation measures (Low flow showerheads, faucet aerators)	✓	✓
Instrumented duct sealing for central heating and cooling systems	✓	✓
Offers add-on measures	✓	✓

Homes that do not complete a HES core services visit due to a health and safety barrier would be excluded from qualifying as weatherized unless that home received the core services without having a blower door test performed.

Prescriptive Pathway

A home meets 5+ of the modified weatherization requirements listed in Table 2.

This prescriptive method for determining a home's weatherization status originates from the Single-Family Weatherization Baseline Assessment (R5)[14]. The R5 assessment considered a home weatherized if it complied with every building element on the prescriptive checklist and the discovery of a single noncompliant building element disqualified a home from being considered weatherized.

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[11] Data supplied by Eversource and UI for the 2020 Equitable Distribution Report *available at*: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/8525797c00471adb85258704004f61ea?OpenDocument

[12] U.S. Census Bureau, Population Division, Annual Estimates of Housing Units for Counties in Connecticut: April 1, 2010 to July 1, 2019 (CO-EST2019-ANNHU-09.)

[13] *See* Annual Legislative Reports of the Energy Efficiency Board, 2010-2020, *available at*: https://energizect.com/connecticut-energy-efficiency-board/about-energy-efficiency-board/annualreports

[14] *See* Single Family Weatherization Baseline Assessment (R5) Final Report, prepared for the Energy Efficiency Board by NMR Group, Inc, June 30, 2014, *available at*: https://energizect.com/sites/default/files/R5-Connecticut%20Weatherization%20Baseline%20Assessment-FINAL%2006-04-14.pdf

The R5 study concluded that only 5 percent of Connecticut single-family homes comply with all applicable prescriptive requirements. Additionally, the study suggested certain areas for improvement on the prescriptive checklist pertaining to the potential difficulty of categorizing basements as conditioned or unconditioned in addition to the near impossibility for an auditor to verify the presence, type, and R-value of slab insulation in existing homes[15]. Consequently, a pathway that requires a home to meet some, but not all, of the compliance items listed in Table 2 may be a more feasible standard.[16] Under this new prescriptive pathway, a home would only need to achieve a minimum of five of the modified weatherization requirements listed in Table 2 to meet the standard.

Table 2 Prescriptive approach to core weatherization requirements

Building Element	Prescriptive Requirements (and Performance Approach modeling inputs)
Above Grade Walls	R-11
Flat Ceilings	R-30
Cathedral Ceilings	R-19
Boundary of Frame Floor and Unconditioned Space	Frame floor which separates unconditioned space (e.g., basements, garages, crawlspaces, etc.) from conditioned space is insulated to R-13
Basements with finished interior walls	Interior walls fully insulated to R-5
Windows	U-0.50 (Double pane or single pane with storm) windows
Air Leakage	9 ACH @ 50 Pascals
Duct Leakage for Ducts Outside Conditioned Space	16 CFM @ 25 Pascals per 100 sq. ft. of conditioned space
Duct Insulation: Unconditioned Basements	R-2
Duct Insulation: Unconditioned Attics and Crawlspaces	R-4.2

[15] *See R1705 R1609 Multifamily Baseline and Weatherization Opportunity Study*, prepared for the Energy Efficiency Board by Energy & Resource Solutions, October 10, 2019, *available at*: https://energizect.com/sites/default/files/R1705-1609%20MF%20Baseline%20Weatherization%20Study_Final%20Report_10.10.19.pdf

[16] *See* Draft Definition of "Weatherization" of Residential Units in Connecticut, DEEP, August 2015, *available at*: https://portal.ct.gov/-/media/DEEP/energy/weatherization/DefinitionofWeatherizationinConnecticutAugust32015pdf.pdf

The use of a prescriptive compliance approach serves as an effective weatherization pathway because it avoids ambiguity by only inspecting building elements with pre-determined standards for compliance. Additionally, many target levels for this assessment are exceeded by Connecticut Weatherization Assistance Program (WAP guidelines, giving qualifying low-to-moderate income (LMI) households a clear path to achieving this standard upon participation in the federally funded WAP.[17]

However, DEEP points out the following reasons this criterion is not adequate on its own to determine a home's weatherization status:

1. The cost to address areas of concern can outweigh the potential energy savings and not all areas that need assessment are feasible to access.
2. The overall compliance rate for the prescriptive approach is low, especially when compared to a performance-based approach. A home that would be considered weatherized under performance-based standards could fail to qualify as weatherized under this standard alone. Ultimately, the energy performance of a home is a better measure of a weatherized home.

Flexible Pathway

A home demonstrates an efficiency level comparable to meeting 5+ of the modified weatherization requirements. This Pathway may be achieved by a home through any of the following:

1. **A home receives a Department of Energy (DOE) Home Energy Score equal to 5 or higher**;
2. **A home participates in the federally funded Weatherization Assistance Program (WAP)**;
3. **A home has a construction date later than January 1, 2000; or**
4. **A REM/Rate™ model of the home's energy efficiency meets or exceeds the performance of a model of the same home with inputs meeting the standards outlined in the Prescriptive Pathway.**

Home Energy Score – A home receives a Department of Energy (DOE) Home Energy Score equal to 5 or higher

The Home Energy Score, developed by the U.S. DOE, is an asset-based scoring system that considers a home's envelope (foundation, roof, walls, insulation R-value, and windows U-Factor) as well as its heating, ventilation, air condition, and water heating systems.[18] To generate a Home

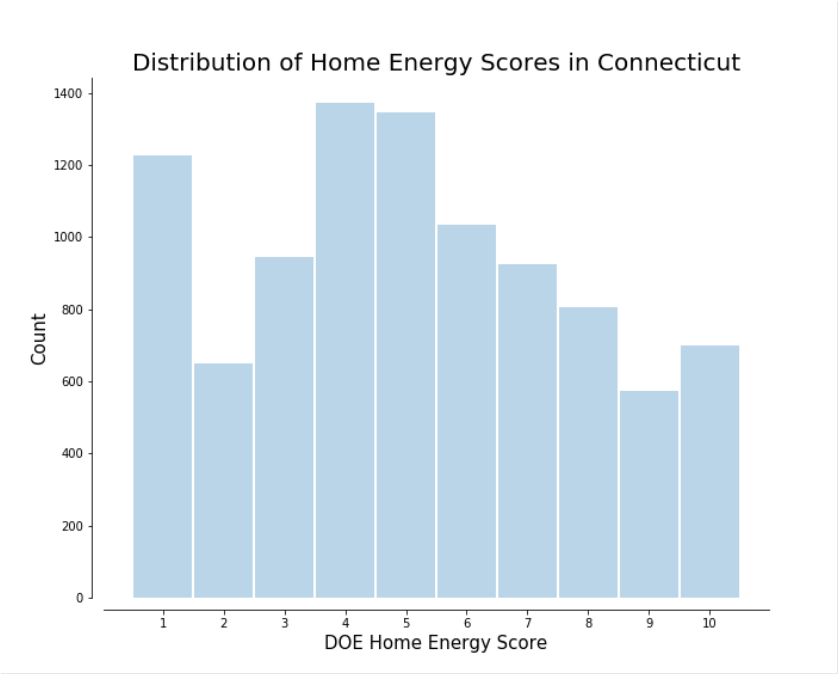
[17] *See* Connecticut Weatherization Assistance Program Operations Manual, revised May 20, 2020, *available at*: https://portal.ct.gov/-/media/DEEP/energy/weatherization/CT-WAP-OPERATIONS-MANUAL-05-22-19.pdf

[18] *See* Home Energy Score Methodology, U.S. Department of Energy, September, 2021, *available at*: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home_Energy_Score_Methodology_Paper.pdf

Energy Score, assessors collect data on these core home assets, and use it to estimate a home's energy usage. Based on the estimated annual energy usage, a house is assigned a score on a scale of 1-10, with more energy-efficient homes receiving a higher score. The scoring is normalized based on the results of the Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS)[19] from 2009.

Using the DOE scoring methodology, a score of 10 indicates that the home is in the top 10 percent of homes in the nation in terms of energy efficiency, while a house scoring a 1 is less energy efficient than 85 percent of the country's housing stock[20]. Figure 1 displays the home energy score distribution for Connecticut homes only. In addition to providing a 1-10 score to easily compare the energy efficiency of different homes, potential upgrades to the building with a payback time of 10 years or fewer are recommended along with an estimate of how the score would improve by installing the recommended upgrades.

Figure 1: The distribution of DOE Home Energy Scores in Connecticut



In terms of energy performance, a home with a score of 5 located near the Bradley International Airport weather station consumes roughly 106 MMBtu annually (see Table 3). The R5 sample

[19] *See* 2009 Residential Energy Consumption Survey (RECS) data, U.S. Energy Information Administration, *available at*: https://www.eia.gov/consumption/residential/data/2009/

[20] *See* What Does My Score Mean?, U.S. Department of Energy, *available at*: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/What%20Does%20My%20Score%20Mean%20Fact%20Sheet.pdf

determined an even higher average energy usage with the average "un-weatherized" Connecticut home using 126 MMBtu annually and the average "weatherized" home only using 100 MMBtu annually. Using the DOE scoring bins for Connecticut, the average home deemed weatherized by the R5 standards could expect to receive a Home Energy Score of 5 or 6 while the average un-weatherized home would be consistent with scores from 3 to 4. Averaging the minimum energy usage for a home that scores a 5 across all Connecticut regions results in a benchmark energy usage of 102 MMBtu annually, exceeding the average energy usage of a home deemed weatherized by the R5 study by 2 percent. This makes a score of 5 a good standard for weatherization in terms of current housing stock since it is on par with the performance of homes deemed weatherized through a more rigorous assessment of its components through the prescriptive pathway.

Table 3: DOE home energy score energy use by location.

Weather Station	Station ID	DOE Home Energy Score									
		1	2	3	4	5	6	7	8	9	10
		Annual Energy Usage by a Home above Score (MMbtu)									
Bridgeport Sikorsky Memorial	725040	146	146	131	117	102	90	80	70	60	50
Danbury Municipal	725086	147	147	132	117	103	90	81	71	61	51
Groton New London Airport	725046	140	140	126	112	98	86	77	67	58	48
Hartford Bradley Intl Airport	725080	152	152	137	121	106	93	83	73	62	52
Hartford Brainard Field	725087	143	143	129	114	100	88	78	69	59	49
New Haven Tweed Airport	725045	142	142	128	114	99	87	78	68	59	49
Oxford Awos	725029	156	156	140	125	109	96	86	75	65	54

As a well-regarded tool for comparatively assessing homes' energy performance, the Score presents other benefits, including:

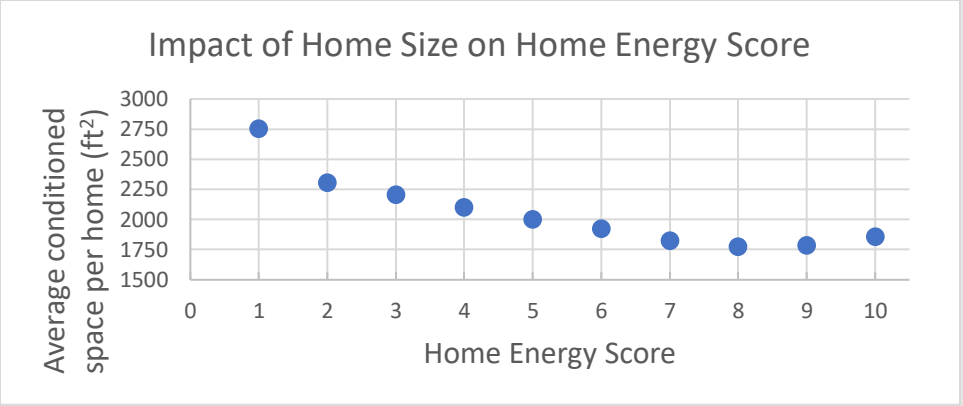
1. All homes who receive a HES visit have the option to receive a score for no charge and HES technicians are already trained and certified Home Energy Score assessors.

2. Connecticut has an existing and active database that tracks and stores data related to Home Energy Scored properties, which would allow the state to evaluate progress towards its weatherization goal. This database currently contains over 17,000 Scores.[21]
3. The scoring methodology identifies cost-effective measures that could bring a non-compliant home into compliance (or at least closer to it).

However, the Home Energy Score presents a few drawbacks:

1. DOE developed the Home Energy Score to compare homes to each other, not to determine a baseline standard for energy efficiency.
2. The score does not scale proportionally for larger homes. A larger home that would be considered weatherized by other approaches may receive a lower score than a smaller home in the same area because it will almost always require more energy than an average sized home (see Figure 2.) However, it is not impossible for a larger home to score well on a Home Energy Score.

Figure 2: Average Home Energy Score by home size



3. The average home is based on older 2009 EIA RECS survey data. If the baseline is updated with more recent survey data, the scores may need to be updated, potentially creating a tracking issue.

WAP Participation – A home participates in the federally funded Weatherization Assistance Program (WAP)

The WAP presents an opportunity for low-income residents to perform weatherization retrofits that they otherwise would not be able to afford. Income eligibility for participation is set at 60

[21] Data Retrieved on March 29, 2022 from the Northeast Energy Efficiency Partnerships (NEEP) Home Energy Labeling Information Exchange (HELIX) database. For more information, see: https://neep.org/residential-energy-labeling-and-retrofit-programs/home-energy-labeling-information-exchange-helix

percent of State Median Income. Priority is given to vulnerable applicants, "such as the elderly, persons with disabilities, families with children and high energy users[22]."

Landlords may be asked to contribute up to 20 percent of the material costs, or up to $500 per eligible unit. WAP guidelines often meet or exceed those proposed by the prescriptive approach.

As a comprehensive weatherization program, participation in WAP is a sensible method of determining a home's weatherization status for the following reasons:

1. WAP guidelines generally meet or exceed the requirements of the prescriptive compliance approach (Table 3).
2. WAP focuses on LMI and other vulnerable applicants, contributing to the more equitable distribution of weatherization benefits.
3. Multifamily units may be addressed through WAP if at least two-thirds of the tenants are income-eligible.

However, using WAP participation as a standard alone is not viable because:

1. Most homes do not qualify to participate based on income requirements.
2. Homes that have received WAP assistance since 1994 are not eligible for re-weatherization.
3. Houses currently in foreclosure cannot be weatherized through this program.

Construction Date – A home has a construction date later than January 1, 2000

The R5 study determined that 87 percent of homes built in Connecticut after 2000 comply with every applicable item on the proposed checklist; significantly more than the two-thirds of houses built in the 1990s and just under half of the houses built in the 1980s that met this same weatherization standard. However, the bulk of homes in Connecticut were built prior to the 1980s. At the time R5 was conducted, houses built after 1980 comprised only 28 percent of Connecticut's housing stock, presenting fewer opportunities for improving energy efficiency in these homes.

Connecticut adopted some energy efficiency guidelines in the 1994 state building code[23], however some requirements were not as strict as those considered in the prescriptive pathway (Table 6.) In the years 2000 and 2004, Connecticut amended its building code to adopt the 2003

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[22] *See* Weatherization Assistance Program, DEEP, *available at*: https://portal.ct.gov/DEEP/Energy/Weatherization/Weatherization-in-Connecticut

[23] *See* History of the Connecticut State Building Code, Dept. of Administrative Services, *available at*: https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/History-of-the-Connecticut-State-Building-Code

International Residential Code, 2003 International Energy Conservation Code (IECC), and 2002 National Electrical Code.[24] The 2003 IECC requirements for performance meet or exceed the performance model inputs and the prescriptive requirements listed in Table 2[25]. Considering these code adoptions, qualifying homes built after 2000 as weatherized is a sensible approach for the state because homes built under the IECC guidelines are more likely to meet weatherization standards. Automatically qualifying these homes as weatherized would help to streamline the process of determining how many Connecticut homes meet weatherization standards. This Pathway allows for the focus to be on weatherizing homes where the need is the most urgent since 78 percent of Connecticut homes were built prior to 1980, and most do not meet weatherization standards.

Table 6: Comparison of Prescriptive Requirements to 1994 Energy Efficiency Requirements.

Building Element	Prescriptive Requirements	1994 Energy Efficiency Requirements
Above Grade Wall/Side Walls	R-11	R-8
Flat Ceilings	R-30	R-33
Unheated Basements & Crawlspaces	R-13 (floor separating basement from conditioned space)	R-12.5
Slab on Grade	R-5 (four feet below grade; assume proper depth if present)	R-7 (two feet below grade)

Using a 2000 home build date as a Pathway to weatherization is grounded by the assumption that homes built after 2000 meet level of weatherization on par with the Prescriptive Pathway. This potentially results in an overestimation of the number of weatherized homes since roughly 13 percent of Connecticut homes built after 2000 did not meet the applicable items on the R5 weatherization checklist.

REM/Rate™ model – A REM/Rate™ model of the home's energy efficiency meets or exceeds the performance of a model of the same home with inputs meeting the standards outlined in the Prescriptive Pathway.

[24] *See* Id.
[25] *See* Federal Register Vol. 75, No. 171, September 2, 2010, *available at*: https://www.govinfo.gov/content/pkg/FR-2010-09-03/pdf/2010-22062.pdf.

This approach provides flexibility since a home that does not meet the prescriptive checklist standard and can still be considered weatherized after demonstrating equivalent or superior performance to one that does.

The modeling approach is also more directly tied to the goal of energy savings since it ties the weatherization standard to a thorough estimate of energy usage. However, there are limitations to the performance-based approach:

1. REM/Rate™ is proprietary software requiring licensing by home assessors. If adoption of this modeling approach is incorporated into the HES and HES-IE programs, vendors would require additional training and certification to provide homeowners with their home's Home Energy Rating System (HERS) index.
2. Potential ambiguity is introduced due to modeling only being an estimate of a home's energy efficiency.
3. Populating the model inputs is laborious and requires accurate area and volume calculations; however, HERS index ratings are generally performed on new residential developments, which does simplify the process.

Discussion of Weatherization Standard for Multifamily Buildings

Multifamily buildings comprising two or more individual units account for 36 percent of Connecticut's housing units. Multifamily housing, however, was not considered while developing the initial weatherization checklist presented in Table 2. Multifamily units are also ineligible for two of the pathways described above: REM/Rate™ modelling and Home Energy Score, due to challenges inhibiting technicians' ability to perform a reliable blower door test to locate air leaks and access building elements such as basements and rooftops.

A baseline study of multifamily weatherization opportunities concluded that half of the State's multifamily buildings would benefit from implementing at least one weatherization measure, such as above-grade wall insulation upgrades, fenestration improvements, and improved air sealing.[26] The study also recommends a supplemental study to identify weatherization opportunities in common areas of multifamily buildings. Opportunities for energy savings in multifamily units include:

[26] *See R1705 R1609 Multifamily Baseline and Weatherization Opportunity Study*, prepared for the Energy Efficiency Board by Energy & Resource Solutions, October 10, 2019, *available at*: https://energizect.com/sites/default/files/R1705-1609%20MF%20Baseline%20Weatherization%20Study_Final%20Report_10.10.19.pdf

1. Pursuing deeper penetration of low-cost measures that offer significant savings potential, including LED lighting, smart thermostats, low-flow devices, and advanced power strips.
2. Electric heating system upgrades, including replacing electric resistance baseboard heating with air source heat pumps.

These solutions are particularly applicable to multifamily units because they address upgrades to individual pieces of equipment and appliances, rather than improvements to the building envelop and fenestration, which can be difficult to accomplish in a multifamily setting. Further research into these unique energy challenges and opportunities could yield additional weatherization standards that are suited to multifamily buildings.

APPENDIX

Table 1: Prescriptive approach to weatherization core requirements

Building Element	Prescriptive Requirements (and Performance Approach modeling inputs)
Above Grade Walls	R-11
Flat Ceilings	R-30
Cathedral Ceilings	R-19
Boundary of Frame Floor and Unconditioned Space	Frame floor which separates unconditioned space (e.g., basements, garages, crawlspaces, etc.) from conditioned space is insulated to R-13
Basements with finished interior walls	Interior walls fully insulated to R-5
Windows	U-0.50 (Double pane or single pane with storm) windows
Air Leakage	9 ACH @ 50 Pascals
Duct Leakage for Ducts Outside Conditioned Space	16 CFM @ 25 Pascals per 100 sq. ft. of conditioned space
Duct Insulation: Unconditioned Basements	R-2
Duct Insulation: Unconditioned Attics and Crawlspaces	R-4.2

Table 2: Core Measures offered by the HES and HES-IE programs

Core Measures	HES	HES-IE
Energy-efficient light bulbs	✓	✓
Blower door assisted air sealing	✓	✓
Domestic hot water (DHW) conservation measures (Low flow showerheads, faucet aerators)	✓	✓
Instrumented duct sealing for central heating and cooling systems	✓	✓
Offers add-on measures	✓	✓

Building Element	Prescriptive Requirements	WAP Guidelines
Above Grade Wall/Side Walls	R-11	Cellulose insulation @ at least 3 lbs. per cubic foot. Knee-walls shall be R-11
Flat Ceilings	R-30	R-38 is considered "normal". Insulation up to R-49 is allowable
Cathedral Ceilings	R-19	Cathedral ceilings are not specifically mentioned in the WAP plan.
Unheated Basements & Crawlspaces	R-13 (floor separating basement from conditioned space)	R-19
Heated Basements & Crawlspaces	R-5 (Interior walls)	Perimeter insulation recommended but no R Value is specified. Ceiling insulation for conditioned basements is discouraged.
Slab on Grade	R-5 (four feet below grade; assume proper depth if present)	No WAP guidance
Windows	Double pane or single pane w/ storm window	Primary and Storm Window installation/repairs
Air Leakage	9 ACH @ 50 Pascals (based on HES program data)	All homes must be given a Blower Door test before and after Weatherization. However, no ACH goal is mentioned in the state WAP plan.
Duct Insulation in Unheated basements	R-2	R-5 for all ducts
Duct Insulation in Unheated attics and Crawlspaces	R-6	R-5
Pipe Insulation in Unheated Basements and Crawlspaces	R-1.6	R-3.5 for hot water pipes. R-5 for all steam pipes
Ducts outside conditioned space	16 cfm @ 25 pascals/100 sqft. of conditioned space (based on HES program data)	R-5

Table 3: Comparison of Prescriptive requirements vs Weatherization Assistance Program Guidelines

Table 4: DOE home energy score energy use by location.

Weather Station	Station ID	DOE Home Energy Score									
		1	2	3	4	5	6	7	8	9	10
		Annual Energy Usage by a Home above Score (MMbtu)									
Bridgeport Sikorsky Memorial	725040	146	146	131	117	102	90	80	70	60	50
Danbury Municipal	725086	147	147	132	117	103	90	81	71	61	51
Groton New London Airport	725046	140	140	126	112	98	86	77	67	58	48
Hartford Bradley Intl Airport	725080	152	152	137	121	106	93	83	73	62	52
Hartford Brainard Field	725087	143	143	129	114	100	88	78	69	59	49
New Haven Tweed Airport	725045	142	142	128	114	99	87	78	68	59	49
Oxford Awos	725029	156	156	140	125	109	96	86	75	65	54

Table 4 Source: Home Energy Score Scoring Tool (2018)

Year Built	Before 1939	1940-1959	1960-1979	1980-1989	1990-1999	After 2000
n	29	46	49	25	15	16
Percent in sample	16	26	27	14	8	9
Percent Statewide	18	27	27	12	8	8
Compliant (%)	7	6	16	48	67	87
Noncompliant (%)	93	94	84	52	33	13

Table 5: Sample of Connecticut housing stock meeting weatherization standard

Building Element	Prescriptive Requirements	1994 Energy Efficiency Requirements
Above Grade Wall/Side Walls	R-11	R-8
Flat Ceilings	R-30	R-33
Unheated Basements & Crawlspaces	R-13 (floor separating basement from conditioned space)	R-12.5
Slab on Grade	R-5 (four feet below grade; assume proper depth if present)	R-7 (two feet below grade)

Table 5 Source: 1994 Connecticut State Building Code

Table 6: Comparison of Prescriptive Requirements to 1994 Energy Efficiency Requirements.

Figure 3: The distribution of DOE Home Energy Scores in Connecticut

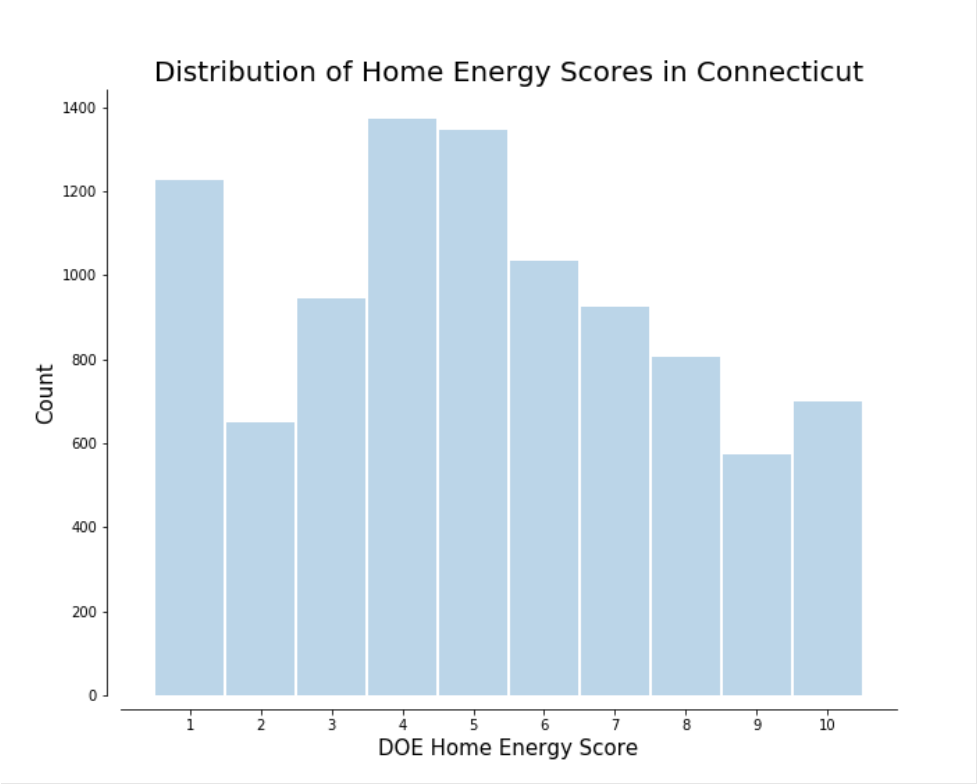

Figure 4: Larger houses will generally have lower home energy scores even if weatherization interventions occur