

Vermont Building Energy Code Collaborative

Summary of Discussions and Areas for Further Consideration

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The Code Collaborative Team would like to thank all of the stakeholders who participated in the Code Collaborative meetings and contributed to the discussions.

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Executive Summary

The Vermont Building Energy Code Collaborative was an effort by the Vermont Department of Public Service and a team of consultants to give Vermont building stakeholders an opportunity to discuss issues that arose during the last building energy code update process, some of which aren't directly related to the code update and/or needed more in-depth discussion and consideration than was allowed for in the update process timeline. The Code Collaborative was intended for stakeholders to share perspectives and viewpoints on a range of issues but there was no expectation that the group would reach consensus. Rather, it was an effort to hear from stakeholders, with the ultimate goal of gathering feedback and input to inform future decisions regarding the Residential Building Energy Standards (RBES) and Commercial Building Energy Standards (CBES) (collectively the “energy code” or the “code”) by the Vermont Department of Public Service.

The conversations at the Code Collaborative meetings covered a number of important topics relevant to the next series of code updates and beyond, including the following:

- What the goals of the building energy codes should be. A key takeaway is that it will be important to define goals with consistent terminology and to be clear about the measures needed to reach those goals.
- Stakeholders are interested in having discussions around Net Zero Ready, including what it means, how that goal could be defined in Vermont, what specific measures would be needed to achieve that goal, and if this is even a goal for which the code should be striving.
- Compliance and pathways that Vermont could take to achieve better compliance, and the consequences for Vermont builders when code is not enforced.
- Embodied carbon, including a proposal from stakeholders to include points for embodied carbon in the energy code.
- Issues specific to multifamily buildings, including how best to structure multifamily requirements in RBES and CBES.
- Measure-specific recommendations including windows, ventilation, insulation, and heating and cooling issues, among others.

The viewpoints and feedback from stakeholders on these and other topics that participants raised during the Code Collaborative process can be used to inform the next series of building energy code updates and long-term thinking about how the Vermont building energy code can best serve stakeholders and the goals of the state.

Code Collaborative Process

The Code Collaborative team began the process by creating four committees: the Cross Cutting (to discuss issues that span building sectors), Residential, Commercial and Industrial (C&I), and Multifamily. There were eight Committee meetings: two Cross Cutting, two Residential, three C&I, and one Multifamily meeting.

The Code Collaborative team reached out to 340 Vermont building stakeholders from a database of contacts resulting from the 2020 Code Update process. These stakeholders were invited to fill out a

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survey to indicate which Committee(s) they would like to participate in. They were also asked to identify issues they would like to see discussed at meetings in order to inform the conversations and preparations for those discussions. Survey results were compiled and shared at the meetings and incorporated into the discussion at subsequent meetings.

Stakeholders were then invited to the Code Collaborative meetings, which were held in May and June of 2021 and took place virtually via Microsoft Teams. While there were 340 stakeholders invited to participate in the meetings, 58 unique individuals ended up participating in at least one of the meetings. Based on the initial survey sent to stakeholders, meeting participants represented the following professional backgrounds: Consultant, Building/General Contractor, Energy Efficiency Utility, Architect, Building Energy Modeler, Home Performance Contractor, Other Energy Efficiency, Electric Designer, Other Utility- electric, gas, Lighting Designer, Commissioning, Mechanical Designer, and Public Interest Advocate. Although many professional background types were represented at the meetings, discussions may still not completely represent the full range of Vermonters with an interest in the building energy code and/or the opinions within various professions.

The meetings included a presentation of background information, any relevant survey information, and a moderated discussion of chosen topics. The discussion included an opportunity to speak as well as several live polling questions which were available for everyone to answer and guide subsequent discussion. The Code Collaborative team took notes at each meeting and notes were attributed to the individuals making comments. Meeting participants were given the chance to review and edit the notes for accuracy and the notes were then posted on the Department of Public Service's website.¹

This memo presents a summary of findings from the eight Code Collaborative meetings. The stakeholder views presented in this document are not necessarily the views of the Department of Public Service or the Code Collaborative Team.

Summary of Discussions by Issue

Net Zero Ready

While the Department does not intend on creating a Net Zero goal at this time, a discussion of what "Net Zero Ready" would mean for Vermont Building Energy Code and how "Net Zero" and "Net Zero Ready/Design" could be defined was held at a high level at the Cross Cutting meeting, and more specific discussions took place at the Residential and C&I meetings.

Net Zero Definition

It is evident that there are a range of viewpoints on the issue of "Net Zero" and that it will be important to clearly define the terminology of any goal that the state may consider ("Net Zero" vs "Net Zero Ready" vs "Net Zero by Design"). There may be confusion among stakeholders about what each phrase means and what the goal, if any, the Department would consider. While the State's net zero goal is for a

¹ <https://publicservice.vermont.gov/content/energy-code-collaborative>

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building that is “designed” or “ready” for renewables but does not go so far as requiring them, there were some stakeholders who felt the code should end up there. A few participants also raised the point at different meetings that a goal should not be “Net Zero Energy”, but rather “Net Zero Carbon”, which would take into account the issues of carbon content of fuels used by the building and of embodied carbon in building materials and would clearly express the intent of the goal, which in the case of “Net Zero Carbon”, would be to address climate change. Concerns of the embodied carbon of building insulation materials were mentioned as reasons to support the goal of net zero carbon.

At the Cross Cutting #2 meeting, 12 (out of 18) participants answered the poll question, how efficient should Vermont homes and buildings be required to be to be considered “net zero design” in the next three code cycles? The most popular answer (which was chosen by seven people) was “Architecture 2030 net zero energy targets.” Architecture 2030 net zero energy targets include a target for “all new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type. The fossil fuel reduction standard for all new buildings and major renovations shall be increased to 80% in 2020, 90% in 2025, and carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).”²

A potential definition for Net Zero Ready was discussed at both the Residential and C&I meetings: “A highly efficient and cost-effective building, designed and constructed so that renewable energy could offset all or most of its annual energy consumption. A building that achieves an EUI of X is considered a “highly efficient” building.” X is yet to be defined, but it would vary by at least building type and perhaps by building size.”

An area for further consideration could be instead of an EUI goal or requirement, one stakeholder proposed a percent reduction applied to all different types of buildings. This would still require a known baseline for buildings but could be determined using references like COMCheck, a resource from ASHRAE or by modeling a standard building.

Net Zero Concerns

One concern that came out of the Residential meeting is how renewable energy fits into the definition. One stakeholder was concerned if we set a rigid or prescriptive EUI requirement, it may not take into consideration the future cost effectiveness of renewable energy systems. A suggestion was to include renewables as a part of the analysis that sets the EUI, if that becomes the target for compliance, as is currently done with the Home Energy Rating System (HERS) approach. In both cases, consideration and balancing of building efficiency and renewable energy production is important is establishing the standards to ensure that an inefficient building is not offset with a high level of renewables. Another suggestion was that prescriptive requirements are already at their limit and that we consider transitioning away from a prescriptive approach in order to achieve net zero. However, not everyone was in agreement with this sentiment since the prescriptive approach has been widely used and is seen as a preferable compliance approach by many. The general message from stakeholders seemed to be to

² https://architecture2030.org/2030_challenges/2030-challenge/

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make sure to balance renewables and efficiency appropriately and provide multiple options for compliance.

In a poll of 18 people at the Residential meeting (in which people could choose multiple options) on “which construction costs are you most concerned about in making Vermont residential buildings ‘net zero ready’ in the next code cycle”: eight said increased window efficiency, seven said electrification, six said upgraded electrical service (for solar/storage/EV) and other, and five said increased insulation levels and (separately) increased air sealing. For “other”, two people said costs associated with the need for increased HERS compliance and two people said balanced ventilation with heat/energy recovery. Another person said getting properties ready for EV charging. Another person said backup heat when power goes out.

In a poll of seven people at a C&I meeting, people are most concerned about increased window efficiency and electrification/no fossil fuels, followed by increased insulation levels. The challenges of creating a Net Zero Ready goal were discussed. For example, one stakeholder said that defining an EUI requirement or goal of a building under CBES may be difficult because of the variability of the buildings. Another stakeholder was concerned about any building electrification requirement or goal because the equipment needed to electrify C&I buildings may not be available or may be very expensive.

One stakeholder wants to encourage thinking about source energy, including energy production associated with a building that doesn’t have renewables on-site and still be considered within “Net Zero”. This stakeholder suggested, instead of code encouraging sprawl development, we would ideally be including commuting and transport energy in our considerations. They also suggested we need options for urban infill sites that would allow them to be called net zero buildings.

Compliance

The importance of code compliance and enforcement was raised at every meeting. Proposed solutions were discussed in some depth during the conversations as well as a survey sent out to all 340 stakeholders after the first Cross Cutting Committee meeting.

Stakeholders were concerned that no matter how much the code is advanced over the coming code cycles, the lack of compliance and enforcement will be a hindrance to reaching our 2030 goals. On top of that, many stakeholders expressed concern that a lack of compliance results in an unlevel playing field for builders who do build to code and that this unlevel playing field will get worse as the code becomes more stringent over time. A few stakeholders also expressed doubt of the past compliance study findings that show high compliance rates. In the Residential meeting, some participants expressed that we need to figure out how to get more builders to build to code.

A few areas for further consideration from discussions of compliance included several people suggesting more resources or training for builders who are just building to code. Another stakeholder suggested that we need an “authority having jurisdiction” or an office in charge, even if a small percent of buildings get checked as the mere presence of an energy code official in the state and the threat of an inspection could drive more compliance. “Even a small amount of enforcement would be better than nothing”, stated one stakeholder.

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The builder registry bill, H. 157 in the Vermont Statehouse, was brought up in several meetings, including at the Residential #2 meeting, at which Representative Scott Campbell gave an update as to the bill's status. The bill did not pass this Session though it has another chance to pass next year.

Based on the level of interest in compliance at the Cross Cutting #1 meeting, the Code Team created a follow up survey regarding builder registry, certification, and licensure. From the follow-up survey (which was sent to all 340 stakeholders), 19 people answered the survey questions on registry, certification and licensure. Of these, 17 people said they were in support of a builder registry. The reasons most cited as why stakeholders were in support: accountability and consumer protection. Others mentioned that this would be a good way to help enforcement, promote training, level the playing field for builders, and professionalize the building industry.

Regarding certification, 11 people, or 58% of the respondents, answered that they would support builder certification. They again cited accountability as a main reason, but many also emphasized the potential certification held as an opportunity for training and continuing education for builders. Some respondents were in support of certification but had reservations, including that they thought it is not as palatable as a registry in Vermont or that it should not be mandatory. Those who said they were not in support worried about creating a barrier to entry into being a builder.

The number of respondents in support of licensure were identical to those who supported certification at 11 people, or 58% of respondents. While people continued to cite accountability and oversight as a main reason they would support licensure, others were not certain that it would be politically feasible in Vermont or that now is the right time for it. Those not in favor were concerned about the extra burden it would put on builders, both time and resources, and the lack of political will in Vermont to require licensure.

In a C&I meeting, in a poll regarding strategies for compliance, five people responded that statewide code officials and five people responded that statewide code assistance (i.e. a Help Desk) would be most helpful to achieve more compliance. Other ideas included a registry for builders and certification requirements for all builders. Training on Energy Cost Budget and training on Appendix G received no support of the people who took the poll, but training on COMCheck was mentioned by one stakeholder. Stakeholders are again concerned about an unlevel playing field generated when some builders strive to build to code and others do not.

A recommendation from a stakeholder was that next time the code book is published, compliance process and certifications could be printed in the first 10 pages of the book so people know the requirements right up front.

Compliance Pathways

In the Residential meeting (with a total of 14 participants), in a poll about which compliance method they are using, four out of eight respondents answered Package-Plus-Points, three answered HERS Compliance Method, and one answered REScheck Software Compliance Method. Regarding Package-Plus-Points, one stakeholder would like points for passive measures for heating and cooling, but others

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are concerned about having points for measures that are too variable and unproven. Another participant said using the Package-Plus-Points system is not efficient and that they have to reinvent the wheel every time they use it.

A concern that was raised in several meetings was the availability of HERS raters in the state. Several stakeholders are concerned that there is only one entity in the state that regularly offers HERS ratings-Efficiency Vermont- and that this may be lapsing as Efficiency Vermont revamps their new construction offerings in the future. There was the question of how to transition HERS rater capacity with Efficiency Vermont no longer providing HERS services in the state. Stakeholders seem to agree that this is an important question that needs to be addressed. Some stakeholders think there should be an effort to create a non-Efficiency Vermont HERS market. Efficiency Vermont seemed to hear about the need for HERS services and was going to consider these requests in their new construction program planning efforts going forward.

The Code Collaborative Team reached out to Steve Spatz at Efficiency Vermont for Efficiency Vermont's response to the need for HERS services in the state. Their response:

"Efficiency Vermont is in the process of redesigning the delivery of its Residential New Construction (RNC) program, including the role of energy ratings. For the remainder of 2021 and through 2022, the RNC program will continue to provide a RESNET certified HERS rating for every successful new home completed in our RNC program. This rating can be used to help market new homes and as a method of compliance for VT RBES (energy code) performance requirements. As energy code baselines continue to increase Efficiency Vermont is developing pathways to maintain the program's cost effectiveness. Current plans include:

- Continuing to provide planning and technical support for our new construction program, while transitioning the energy rating component (including field data collection) to independent/3rd party HERS raters. An RFP will be issued this fall seeking RESNET Rating Providers interested in providing energy ratings in Vermont. Efficiency Vermont knows of several Rating Providers either currently working in Vermont, and/or adjacent to Vermont and interested in expanding their work in our state.
- For those projects where Efficiency Vermont staff are not providing rating services, costs of third party ratings will be **subsidized** by Efficiency Vermont through **at least the end of 2022**.
- Technical support for new construction projects will still be provided to contractors and partners who participate in Efficiency Vermont's EEN trade group with an Account Management approach taken to supporting their business and technical development. Measure based incentives will also still be offered based on individual savings opportunities identified on a project by project basis.
- We intend to expand the potential capacity of more RESNET certified raters in VT by offering and expanding on existing training pathways to become a rater. 2021 has proven to be a big year for new construction, so there stands to be a significant market opportunity for HERS raters to begin to work or expand their services in Vermont.

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As plans develop, it's expected that additional training, support, and incentives will be offered to builders in the Efficiency Excellence Network to continue collaboration and partnership."³

The C&I survey had only six respondents: four responded that they comply with CBES through the prescriptive method (COMCheck) and two more used this method as their second pathway. Appendix G (modeling) was the first choice of two participants and the second choice of two more participants. Efficiency Vermont stated that they receive a significant number of questions of documentation needed to show CBES compliance. As stated above, having this process described in the beginning of the code, with links to the Department's web page, would be very helpful.

Embodied Carbon

Embodied carbon was another topic raised at many meetings, including at Residential #2 and C&I #3, where Jacob Racusin of New Frameworks presented his proposal for incorporating embodied carbon into the energy code point system.

The proposal is to include optional points for considering embodied carbon in building materials. The process would be to create a table with a calculation to determine Global Warming Potential per square footage of the building. You would get one point for doing the calculation, which aims to increase the literacy surrounding embodied carbon and would allow buildings and designers to come up with an emissions balance for any given project. A building could be awarded two or three points depending on the result of the calculations. The aim of this approach is to get a whole building sense of what the embodied carbon is in a building.

Reactions to the proposal were generally positive from the meeting participants. At the Residential #2 meeting, poll results of 19 people showed that 16 people were in favor of including points for calculating embodied carbon in the Package-Plus-Points options and three people were not in favor. One stakeholder suggested adding an automatic point for using a building that is more than 50 years old to address the lower embodied emissions of retrofitting an existing building.

At a C&I meeting of the 10 participants, four people indicated support of including points for embodied carbon in Additional Efficiency Packages code section C406, and two people indicated they were not in support. There was concern that embodied carbon in slab insulation could be counterproductive to carbon reduction goals. It was suggested by one stakeholder to first optimize energy efficiency and then select materials based on their embodied carbon. It was noted that there is not a good alternative for sub-slab insulation, but that by choosing extruded polystyrene instead of expanded polystyrene your embodied carbon would be reduced.

In addition, the follow-up survey to the Cross Cutting meeting included questions regarding embodied carbon. Out of a survey of 21 people, 15 people said we should be considering the embodied carbon of

³ Email communications on August 24, 2021, with Steve Spatz of Efficiency Vermont.

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materials in both RBES and CBES and six people said we should not. Out of 19 people who answered the follow-up question, nine said the approach should include insulation embodied carbon as optional points, while eight said they were open to it, and two said no. The follow up question to that was, if yes, does it make sense to start with insulation products only? Out of the 15 people who answered, 10 people said “no, start with more than just insulation products” and five people said “yes, start with insulation products only.” Survey responses to other materials that should be considered included several people saying all materials or the whole house, several others said concrete, mass timber, steel, refrigeration, roofing materials, aluminum, plastics/ PVC, and two mentioned the chain of processing and transportation.

Stakeholders offered suggestions to address embodied carbon in the survey, including several suggestions to start small, potentially with insulation and other materials readily available with low embodied carbon options, then include more materials in future iterations of the code. One stakeholder suggested that an approach to embodied carbon could be phased in incrementally to deal with potential resistance from builders. There were also a few concerns about the availability of a database with values for embodied carbon and the accuracy of ratings for materials.

In addition, a stakeholder shared a white paper that can be used as a resource for considering greenhouse gas emissions from residential building materials from Efficiency Vermont.⁴

Multifamily

Multifamily-specific code issues were discussed at the Cross Cutting #1 meeting as well as a dedicated Multifamily Committee meeting. The Multifamily Committee included a discussion of balancing affordable housing priorities with climate and energy efficiency goals, how best to approach and structure multifamily code, and technical issues associated with multifamily buildings.

The conversation began with a discussion of balancing affordable housing priorities with climate and energy efficiency goals. Cost-effectiveness was an important part of the discussion. A poll illustrated that when asked how Vermont should prioritize housing and energy policy for a given budget, seven out of 15 people preferred the option of “trade off fewer housing units built to higher energy efficiency standards (such as VHCB/ VHFA)”, rather than maximizing the number of housing units or maximizing energy efficiency standards.

There was a discussion of focusing efforts on the building envelope over advancing mechanical systems. Some people were in favor of focusing the code on envelope measures such as insulation, windows, and air tightness over mechanical heating, hot water, ventilation, and renewables systems that have a shorter lifespan, whose technology is quickly evolving, and which will be replaced multiple times over the lifespan of an efficient building. As with the efficiency versus renewables discussion above, getting

⁴ <https://www.efficiencyvermont.com/news-blog/whitepapers/the-high-greenhouse-as-price-tag-on-residential-building-materials>

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the right balance between the building efficiency levels and the mechanical systems in the building is important.

One stakeholder raised the issue of Act 250 building designation within the realm of multifamily buildings. There is confusion since residential Act 250 buildings⁵ have to follow RBES stretch code, but it is unclear for commercial Act 250 multifamily buildings. There is currently no CBES stretch guidelines, but CBES says to follow RBES ventilation requirements for multifamily apartments. Would then RBES stretch code be invoked for ACT 250 commercial multifamily buildings? Additionally, there is confusion around priority and downtown projects. The Department clarified that downtown buildings are not exempt from ACT 250 energy requirements and a participant clarified that priority projects need to follow stretch code.⁶

A takeaway for consideration of multifamily buildings in energy code came from the discussion of how to structure and approach multifamily buildings. Multifamily buildings can fall into either RBES and CBES, depending on the height of the building; a building under four stories is considered a residential building and the code requirements of the building components differ from a four-story+ building that falls under CBES. While the idea of developing a dedicated multifamily code seemed to be popular in the Cross Cutting #1 meeting, the Department reminded stakeholders that this would require a change in the enabling legislation that defines building applicability by height. One stakeholder added that Vermont codes should differ from the national codes as little as possible as there is an added cost and complexity when builders and suppliers come into Vermont and have to re-learn local requirements. In the Multifamily meeting, the discussion instead centered on how to structure code to best incorporate multifamily buildings.

Out of a poll of 15 people, the most popular option for structuring multifamily code (with six people selecting this option) is developing new multifamily chapters in both RBES and CBES that are the same. Other responses to the poll: four said create a new standalone multifamily handbook and two said include multifamily specifics throughout each relevant section in both RBES and CBES. This is an area requiring further consideration.

A few other areas for further consideration in multifamily issues were discussed. One stakeholder raised the need to reach out to others in the architect community who were unable to make these calls and ask to ask their opinions of how best to structure multifamily code. Another was to include collecting data in the next market assessment study on compliance rates specific to multifamily buildings. And there were specific measures in which standards should be aligned for multifamily purposes- this includes aligning window standards for multifamily buildings regardless of building height. Other

⁵ In Vermont Energy code, multifamily buildings with three or less stories are considered residential, while multifamily with 4 or more stories are commercial.

⁶30 V.S.A. § 55 states that a priority housing project as defined in 10 V.S.A. § 6001 shall meet or exceed the stretch codes.

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measures specific to multifamily buildings are discussed in the “Summary of Discussions by Specific Measures” section.

Cost Effectiveness

At the Residential meeting, two stakeholders presented an analysis of cost effectiveness for variations on a building. A typical modular home was priced out and modeled in terms of annual energy costs in four different configurations: 1) 2020 energy code level, 2) 2020 energy code level but tightened to 1 ACH50, 3) Efficiency Vermont’s Certified Base level, and 4) Efficiency Vermont’s High Performance Home Level. The incremental cost above the 2020 energy code level home for configuration 2 was \$5,500, configuration 3 was \$14,200 and the High Performance Home was almost \$33,000. Assuming the incremental costs were financed in a 30-year mortgage, configurations 2 and 4 generated positive cash flow (i.e., energy savings greater than incremental cost), while configuration 4 cost more than \$530/year more than it saved in energy. After the analysis was presented, a poll was presented: what is the best approach to considering the additional cost and the energy cost savings from code updates? Out of 15 people, nine people answered, “Cash flow assuming mortgage financing (e.g., monthly payments increase vs monthly savings)”, three said other (those who responded “other” did not write in a response), two said “return on investment (e.g., annual savings/total cost)”, and one said simple payback “(e.g., total cost/annual savings)”.

Solar-Ready/ EV Chargers

The idea of a solar-ready requirement was discussed at a C&I meeting. In a poll, four people said solar-ready zones should be required in code, and one said they should not. One stakeholder suggested having a requirement that the building plans specify that the structural design incorporates the load of a future solar array so that a code official or solar installer could know that the building is solar-ready.

In a separate poll at the C&I meeting, which asked if there should be a solar or on-site renewables requirement (with exceptions) for roof areas over 50,000 SF, three participants said no and two participants said yes. One said it would be good for both grid and building resilience for buildings to have solar plus battery storage. One was questioning why the example requirement would have a threshold of 50,000 SF and was also wondering if there were any resources on which we could model this requirement. A counterpoint to this was a participant who felt the 50,000 SF was a defensible size, with some exceptions, as there should be plenty of extra space on the roof for solar to cover most or all of the electric load if the building meets code. Another participant was worried about the payback period of solar, but they noted that it was still better than other alternatives.

An EV charging requirement was also discussed at this C&I meeting. In a poll regarding the right level of charging state requirements, five participants said to keep the EV requirement unchanged, and one said to increase the EV requirement. No one said to remove all requirements or reduce the number required. In the conversation that followed, one stakeholder said that the real value of an EV requirement is to bring up the conversation with the building owner. This stakeholder they would not recommend increasing the number of charging station spots due to future uncertainties. One stakeholder voiced concern to the cost of EV charging equipment. While an EV charger where the electricity is paid by the

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building owner is fairly inexpensive, there is a substantial price increase for integrating with a system where the EV owner pays for the electricity.

Existing Buildings

The importance of energy codes addressing existing buildings was raised at several of the meetings. Stakeholders brought up the fact that existing buildings comprise a large percent of Vermont's building stock, that so many of them will have to be weatherized, and the fact that they are key to meeting any climate goal we may set because they will have lower embodied carbon emissions than new buildings. A stakeholder suggested that there needs to be a way to alter, repair and improve existing buildings on a large scale without tying it to our new building standards.⁷

At the Residential meeting, one person said it's hard to interpret the existing homes chapter of the code. Filling out the RBES Certificate for existing homes is difficult. It is hard to mesh what's called out in Chapter 5 versus what's called out in Chapter 4 of the Handbook.

As part of the conversation around existing buildings at a C&I meeting, the determination of compliance was an issue for existing buildings. One participant said that there is a lack of clarity when you have a range of impacts on an existing building. At what threshold do you need to meet existing building requirements? For example, for additions, a blower door test won't tell you how well the addition was built, and it is up to professional judgement to tell clients what they have to do. An area for future consideration is to provide more clarity around air testing and what is actually required for any new part of the thermal shell.

One C&I stakeholder had a concern involving the lack of clarity for air leakage requirements for existing buildings, especially if the thermal shell is only minorly altered.

Building Codes

A stakeholder brought up the integration of energy code and building code, with the concern that as energy codes become more stringent, then builders can be building dangerous assemblies. For example, it is important that buildings are constructed structurally safe for the addition of solar panels or that wall assemblies are built so that do not cause moisture problems or rot. We could look to neighboring states to dovetail into what the neighboring states are using (they used Massachusetts as an example).

Summary of Discussions by Specific Measure

Windows

There was discussion in several of the meetings of triple-glazed windows. Some stakeholders were in support of a requirement for triple-glazed windows. One stakeholder raised that anything above a U-

⁷ RBES includes separate requirements for new construction vs. existing building in the [RBES Handbook](#) Chapter 4: Existing Homes: Additions, Alterations, and Repairs.

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value of 0.17 is not adequate for Vermont in terms of energy efficiency, comfort, and condensation, while another suggested a U-value of at least 0.14 or 0.11 and have it be triple-glazed. In a Residential meeting, there was a discussion of availability and cost of triple-glazed windows. Some stakeholders say they are readily available, made in the US, and cost competitive with double-glazed windows, while others did not agree that triple-glazed windows are cost competitive or should be required.⁸

Others have concerns about window replacements in historic buildings. Two stakeholders said that for historic buildings, it makes more sense to preserve old windows, restore or repair them, and add storm windows than it does to add in new triple-glazed windows.⁹ One of these stakeholders advocates for a balance of maintenance and replacement of windows through education and options.

In the Multifamily meeting, the issue was raised of the disparity in code requirements for windows of different storied buildings. A stakeholder said that for four-story buildings, you have to follow CBES, which has a window requirement of 0.37. But for a three-story building, you have to follow the RBES 0.28 window requirement. The stakeholder who raised this said that the four-story building should be using 0.28 windows. An area for further consideration is to align window standards between RBES and CBES for multifamily buildings.

One stakeholder noted that percent of wall fenestration should be part of the window discussion since the insulation is so different between windows and opaque walls.

Lighting

Lighting Power Density (LPD) was discussed at the C&I and Multifamily meetings. A poll regarding LPD at the C&I meeting asked, “Assuming the next code will strive for higher-efficiency, what should we do with LPD?” Of 14 people, 11 said “moderately stricter LPD allowances, make LPD proportionally more difficult as other sections of the code” and three said “stricter LPD allowances, LPD has more potential savings than other sections of the code”. No one selected “leave LPD alone or loosen LPD allowances”.

A stakeholder was concerned with people “fudging” the results, especially with screw-in fixtures. Screw-in fixtures should count as the maximum wattage lamp the fixture will accept, not the wattage of the initial lamp installed.

Also at that meeting, a stakeholder suggested that we could consider exterior solar lighting as a requirement or could consider giving points for renewables to power exterior lights.

Multifamily buildings have LPD requirements that differ for buildings of different stories, an issue of particular concern. A stakeholder raised the concern that for multifamily buildings that are big but not

⁸ Double-hung triple-glazed windows are more expensive and not readily available at this time. However, the market for triple-glazed windows is evolving and should be monitored to determine availability of the various styles and configurations across the different manufacturers and costs.

⁹ Note that RBES does not require triple-glazed windows.

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over three stories, there is no LPD requirement. There is a lack of standards for LPD in Residential code. An area for further consideration is to consider how to incorporate LPD requirement into multifamily buildings. One consideration would be to develop a LPD standard for Residential code for use in multifamily buildings. Another would be to align RBES and CBES for multifamily buildings.

Ventilation

The topic of balanced ventilation was discussed for residential, C&I and multifamily buildings. Several stakeholders at the Multifamily and Residential meetings think that balanced ventilation should be mandatory for all buildings. One participant said that ASHRAE's new Multifamily Design Guide specifically discourages unbalanced ventilation in multifamily buildings. From the Multifamily meeting, one stakeholder said the base code allows for extract-only ventilation, which they say will not help with energy efficiency or sanitary ventilation.

Attendees at the Residential meeting agreed that balanced ventilation and tighter air sealing go hand in hand. One participant mentioned they use balanced ventilation for heat distribution. A key area for further consideration is a balanced ventilation standard or requirement in code. A few participants raised the idea that with balanced ventilation, it's important to specify the efficiency of the system because not all efficiencies are equal. Therefore, another area for future consideration is the efficiency of ventilation systems.

In the C&I meeting, one stakeholder expressed the significant gains that can be realized by highly efficient energy and heat recovery ventilators. They also noted that in passive house, there is a more stringent way of testing ventilator equipment.

Heat Pumps and Electric Resistance Heat

Heat pumps paired with electric resistance heat for backup during the coldest periods or for certain building spaces came up a number of times. Electric resistance heat came up in the Multifamily and C&I meetings. One stakeholder commented that it was a good addition to code to allow electric resistance heat as a backup in high performing, low load buildings that want to go all electric, as the code currently allows. However, some were not in favor of using electric resistance as the only heat source.¹⁰ One of the stated benefits voiced by some stakeholders stems mainly from the desire for cooling, which is bundled with heat pumps but is absent with resistance heat. An issue that was raised with electric resistance heating only systems is that buildings wouldn't have air conditioning which opens up the possibility that people may install inefficient window air conditioners and increase their electric load relative to more efficient cooling capacity with heat pumps.

Meeting participants voiced some concerns about heat pumps. Some were concerned that they do not

¹⁰ RBES and CBES allow primary electric resistance heat in very low-load multifamily buildings. The current CBES restricts any other use of electric-resistance heat to specific applications such as back-up heat, remote areas, and areas requiring special consideration.

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provide adequate comfort or efficiency at very low temperatures or in buildings that do not have a good envelope. This is because a heat pump's heating capacity is significantly reduced at very low outdoor air temperatures and, if the unit was not sized properly, it could be insufficient to meet the heating load during very cold periods. Additionally, the efficiency of a heat pump at such low temperatures is almost the same as electric resistance heat.

Another concern with cold climate heat pumps is that they have refrigerants that have emissions with high global warming potential, raising the concern that refrigerant leakage from these heat pumps would be counter to any climate goal we may be trying to achieve.

A stakeholder in the Multifamily meeting mentioned that, for fossil-fuel water heaters, the energy used to heat water is lost into the building shell, which increases the building cooling load. Due to confined spaces too small for heat pump water heaters, some said electric resistance tanks aren't always a bad idea. Another stakeholder pointed out that heat pump water heaters are also advantageous, as they will reduce the building's cooling load.

Refrigerants

At a C&I meeting, one participant raised the concern that there is a significant occurrence of refrigerant leakage at installation and over the lifetime of heat pump equipment. A recommendation that came out of this concern is that code could include a testing requirement at installation.¹¹

Air Sealing/Air Leakage

In a conversation at the Residential meeting, two stakeholders suggested we go down to 0.6 ACH50. Some thought air sealing was the most important place to make buildings efficient.

The Code Team also posed the question at the C&I meeting of whether we could lower the current air sealing requirement of 0.3 CFM/SF at 75 Pa and a six-sided area. One participant said we should aim for the passive house standard of 0.06 CFM/SF. Multiple participants said there was not a need for the lower 0.4 CFM/SF requirement once corrective actions are taken, instead suggesting that setting one standard number is a good idea.

At the C&I meeting a poll was conducted asking which air sealing compliance path they generally use, or if they comply with air sealing at all. Most abstained, with only three participating in the poll. Two said they use the air barrier performance testing about half the time and the prescriptive approach with air barrier commissioning the other half. The other poll respondent said they always use air barrier performance testing. One stakeholder had skepticism on compliance rates for the entire air sealing

¹¹ ASHRAE 228, Standard Method of Evaluating Zero Net Energy and Zero Net Carbon Building Performance, has accounting methodology for projects that account for refrigerant leakage. It should also be referenced in the C407 maintenance information so that building owners can be prepared for ongoing testing.

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section. Another stakeholder added that there are few contractors or builders who are aware of blower door testing requirements.¹²

Insulation and Wall Assemblies

There was discussion at all sector meetings about where the EUI should end up, how much more insulation should be required after a next code requirement of continuous insulation, and the building science concerns about ensuring that walls are allowed to dry out in order to prevent rotting.

One stakeholder at the Residential meeting said that they thought the foundation insulation is very weak in the code.

One recommendation from a Cross Cutting meeting is to add a building science section on wall assemblies in RBES Energy Code Handbook.

In the C&I poll for building shell insulation stakeholders were asked where the issues are for shell insulation. Three indicated floors and slabs, two chose below grade walls, and one voted for the Building Above-Grade Performance Alternative that was added in 2020 CBES.

One C&I stakeholder expressed the concern that was shared by other meeting participants regarding under slab insulation. Concerns include:

- Issues around the slab edge condition and detailing thermal bridging, in passive house skirt or vertical insulation is used to avoid thermal bridging,
- How effective is R-10 continuous for large slabs, say 80,000 SF or larger, and should we consider perimeter insulation of 10 or 20 feet instead?
- Does foam insulation make sense when considering embodied carbon?

Multiple stakeholders noted the high cost of R-10 continuous. This makes larger footprint building seriously consider modeling so there is more flexibility on the slab insulation. It would be helpful to provide more guidance on continuous insulation in order to determine what is compliant/non-compliant. People appear to have been interpreting this differently.

Mechanical Equipment and Controls

There were various discussions concerning the CBES mechanical equipment and controls. Specifically:

1. Ventilation - One stakeholder recommended Vermont adopt the Internal Mechanical Code which specifies ventilation rates for commercial building types. Other stakeholders noted that all buildings should be required to have mechanical ventilation as natural ventilation is

¹² In subsequent meeting discussions, this issue was determined to be of minimal concern.

insufficient in the tighter buildings. A number of stakeholders asked for more clarification on ERV/HRV, economizer, and ventilation requirements.

2. Controls – Some stakeholders suggest that code control sequences do not get overly complex, as they are difficult to support by facilities owners. Complexity equals difficulty in supporting without sufficient staff.
3. As an architect, one stakeholder noted the desire to retain flexibility to have operable windows without adding controls due to their cost and complexity.
4. In addition, there was concern around different temperature control requirements for vestibules compared to the rest of the existing system. A stakeholder was concerned that code is not aligned with what clients would like to do with vestibules. A potential solution may be educational outreach.

Section C406

The discussion on Section C406, Additional Efficiency Package Options began with the Code Collaborative Team presenting background information.

- A brief overview of Section C406 requirements was given including the table of points earned by building type.
- It was mentioned that, while 2020 CBES went beyond what 2018 IECC required by having a point system by building type, 2021 IECC has an updated version of the points table used in 2020 CBES.
- A paper¹³ was circulated to the stakeholders which explained how the points are determined.

A poll was given asking, “What should the next revision of C406 look like?” Of the 11 respondents, five people said defer to 2021 IECC C406, three said continue down the path we are currently on with points and multiple options, two people chose to simplify to core sections of the code, while two voted to eliminate Section C406, even though it would mean other sections of the code would have to be more stringent.

There was considerable discussion around how to make Section C406 more apparent even though in 2020 CBES each major section begins with a reference to C406 and mentions that enhancements may be required due to Section C406. One stakeholder mentioned that some people are still missing this section, possibly intentionally. Two stakeholders mentioned they are skeptical of claimed CBES compliance rates particularly because they do not believe there is high compliance of Section C406. Suggestions to improve the awareness of Section C406 included moving C406 to the beginning of the code; adding a footnote or additional column directly in the tables that are modified by C406; or improving the CBES certificate to better align where points come from in the certificate.

¹³ Hart, R. et al. December 2018. “Relative Credits for Extra Efficiency Code Measures”. U.S. Department of Energy. <https://www.osti.gov/biblio/1489162-relative-credits-extra-efficiency-code-measures>

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Other discussion items included one stakeholder advocating for code to differ as little as possible from IECC model code citing added cost and complexity when builders or suppliers come from out of state. One stakeholder asked if we could incorporate additional incentives for integrated lighting and HVAC controls. Another stakeholder noted that while customers are initially challenged by Section C406, they are not getting feedback that we should remove C406.

Maintenance Information/ Systems Commissioning C407

Section C407. Maintenance and System Commissioning was discussed in the first CBES meeting. The poll asked participants to rank the issues with this section and the main issues were regarding cost, owner pushback, calculation of heating/cooling/DHW loads, and commissioning contractor availability.

In the discussion, stakeholders mentioned commissioning requirements are challenging to explain to owners early in the process as an architect doesn't have a good sense early on that we will hit the (equipment size) threshold nor what it will cost the owner. Architects don't consistently see engineers stepping in and telling owners that they need to incur commissioning expenses or an estimate of what that entails. There is an educational component required to address the in-between size building where there is uncertainty if the equipment threshold will be reached early in the process.

An issue several stakeholders addressed is the insufficient number of certified blower door testing contractors in Vermont. Efficiency Vermont does have a list of qualified contractors; however, the search on their website is not the most intuitive and people felt there were not enough for the demand in Vermont.

Errors in Code

Stakeholders alerted the Team to the following errors in the code:

1. Performance cost index target- the change in 2020 CBES put the parentheses in the wrong place with regard to the unregulated codes; this has had unintended consequences.
2. The IECC and ASHRAE 90.1 definition of *Ventilation Air* reads, "That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space." This is incorrect, as Ventilation Air is only the portion of supply air that comes from outside (outdoors), not any portion of recirculated air. The definition in the current codes is correct for 'Supply Air' or 'Air Systems', not 'Ventilation Air'.
3. Section C403.7.4 Energy Recovery Ventilation Systems was changed its verbiage from "Ventilation Systems" to "Air Systems" in the 2020 CBES; however, there is currently no definition of 'Air Systems' in the code. To avoid confusion with the definition in the current code, this section's verbiage should have remained as 'Ventilation Air' as the systems described meet this definition (they encompass both outdoor air and recirculate building air). We might opt to keep the definition consistent with IECC and ASHRAE 90.1, even though it is wrong, and revert this section back to using 'Ventilation Air' instead of 'Air Systems'. However, we could also opt to add the definition of 'Air Systems' In subsequent versions of the code (this would be the current definition of 'Ventilation Air') and 'Ventilation Air' could be corrected to include only outdoor air.

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Conclusion

The eight Code Collaborative meetings provided over 15 hours of engaged dialogue and interaction with Vermont stakeholders on topics relevant to RBES and CBES. Instead of relying on the next code update process to raise and discuss these issues, the Code Collaborative has provided a jump-start to that process and has covered some good ground to allow building off the discussions documented in this memo. This should save some time during the update process and allow for a more advanced conversation with stakeholders.

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