Maggie McCarey
Director, Energy Efficiency Division
Massachusetts Department of Energy Resources
100 Cambridge St, #1020
Boston, MA 02114

Dear Ms. McCarey:

Phius **(Passive House Institute US)** is a non-profit 501(c)(3) organization committed to making high-performance passive building the mainstream market standard. Phius trains and certifies professionals, maintains the Phius climate-specific passive building standard, certifies and quality assures passive buildings, and conducts research to advance high-performance building**.** Buildings constructed to the Phius standard provide superior indoor air quality, resilience during power outages, and an extremely quiet, comfortable indoor environment. Project teams are increasingly adopting passive building principles and the Phius standard for single-family, multifamily, and commercial buildings to achieve Net Zero buildings, resulting in over 7,000 units certified, and totaling over 7.4 million square feet across North America.

Phius appreciates the opportunity to provide comments on the proposed Massachusetts Stretch code. Phius believes that overall, this energy code represents a substantial step forward in energy efficiency. However, Phius also believes that several issues remain. These comments will focus on the following:

1. **Phius applauds the requirement of Passive House as code for multifamily buildings.**
2. **Phius suggests changes to the wording of Section 405 to improve the enforceability of the Phius alternate compliance path.**
3. **Phius suggests amending the thermal bridge language in Section C402.7**
4. **Phius remains concerned about the TEDI limits included in Section C407 and suggests amendments to the current approach.**

1. Phius applauds the requirement of Passive House as code for multifamily buildings.

Making Phius the minimum code requirement for multifamily buildings represents the endpoint of a well-thought and comprehensive set of policies designed to make net-zero multifamily buildings the norm. This requirement will ensure that all multifamily buildings in municipalities that adopt this energy code will use significantly less energy (40-60%) than code buildings. Moreover, these buildings will be resilient and reduce the energy burden on low-income

families. Finally, the Phius certification process will ensure well-constructed projects that achieve the promised energy reductions and provide ancillary benefits such as resilience.

2. Phius suggests changes to the wording of Section R405 and C407.3 to improve the enforceability of the Phius compliance path.

Currently, there are several states/municipalities that have included an alternate compliance path for Phius. These jurisdictions deem buildings achieving the Phius standard as compliant. One of the advantages of the alternate path is that it gives enforcement agencies and Phius the chance to see how this type of code requirement works in practice. The original language for these types of requirements focused on a two-part process. First, projects need to receive a design certification from Phius before receiving a permit and second, the project needs to receive final certification before receiving the Certificate of Occupancy. This approach, unfortunately, has received pushback from project teams working on Phius projects. The main complaint rests on timing. The design certification process may take longer than developers would like, and the final certification is subject to the same issue.

There are good reasons why the Phius design certification/final certification process may take longer than developers/project teams prefer. As noted above, Phius projects go through a two-step process: design review and construction review.

PART 1:

First, Phius certification staff reviews construction drawings, product specifications, and modeling to ensure that the building energy use is below the stringent values specified in the standard. In addition to reviewing energy performance Phius evaluates the building envelope components and details for moisture and condensation performance. After identifying and resolving all issues, Phius issues a design certification.

PART 2:

After design certification, actual construction a Phius-trained Rater/Verifier reviews (on-site) and ensures that the building reflects the pre-certified plans and that it meets the criteria of the programs listed above. If changes to the design occur, Phius updates the modeling. The updated values for energy use of the building must still meet the Phius standards for certification.

Making Phius a code requirement introduces a tension between the need to maintain the high-quality standards of a building meeting the Phius standard while also accomplishing this within a period acceptable to developers (this is obviously a constant issue within the code enforcement issue in general). The proposed language in Section R405 and Section

C407.3 attempts to resolve this tension. Phius appreciates this attempt. However, Phius suggests the addition/amendment of the language for the following two reasons:

A. DOER should clarify vague language on several important points (detailed below):

Following are specific suggestions aimed at clarifying the language in Sections R405 and C407.3:

1. Make the language identical between the residential and commercial sections (except for the sections outlining compliance with electric chargers and solar ready provisions). The processes are the same for residential, multifamily, and commercial buildings.
3. Specify a blower door test result, not just test result (See R405.2 (2) (b); and specify that the Phius air-tightness threshold must be met- the inclusion of the report is not sufficient. This applies to both the commercial and residential section.
4. Amend the term "based on" to "reflect" (related to as-built conditions)
5. In the Phius process, a Phius Certified Verifier oversees construction of commercial and large multifamily. Add the term Verifier to Rater. C407.3.2.2 (3) and R405.2 (2) (b).
6. C407.3.2.2 (4) as well as R405.2 (2) (d) are amended to include additional important requirements. Phius will suggest language changes below.
7. In writing a similar provision, the City of Chicago added a grace period of 180 days to receive the final certification after the certificate of occupancy was granted. Phius suggests adding a similar provision.
8. Please change PHIUS to Phius.
9. The term Passivehouse refers to PHI. We would suggest replacing Passivehouse to "Phius or PHI," or passive house.

B. DOER should add ventilation commissioning and envelope assembly elements as specific as-built verification requirements along with blower-door test results.

After reviewing hundreds of multifamily projects across the country, Phius has found that certain issues arise repeatedly. Item 3, referring to blower door test results is one. There are two additional areas of importance:

- <u>Ventilation:</u>
    - **Achieving the minimum ventilation rates in units and common spaces:** To receive a design certification, a project must provide a complete accounting of ventilation rates to units and common spaces. Unsurprisingly, the as-built ventilation rates often do not match the design values and it is important to make sure the final commissioned rates are sufficient.

- **Ensuring that the electrical efficiency of ventilation units is within the range of design specifications are important issues to resolve.** On multiple projects, Phius has found that the measured electrical efficiency of rooftop ventilation units has often been significantly higher than the design specification. This, in turn, can adversely affect the project's source energy and possibly push it out of compliance.

- Hygrothermal performance of the opaque enclosure:
  - Phius requires projects to meet specific hygrothermal requirements for enclosure design, typically keyed on the ratio between exterior and cavity R-value. Phius has found cases where the required amount of exterior insulation which Phius approved during the design certification has changed with the as-built condition and would be flagged for hygrothermal concern during final certification review.

Phius requests adding a requirement for ventilation commissioning and confirmation of the make up of as-built insulated assemblies along with the blower door test results. Ventilation commissioning and confirming the envelope assembly (as well as addressing deficiencies identified from these activities) occur during the typical inspection process and should not affect the time frame for completing construction.

Following are the suggested amendments. (Strike out refers to deleted language and Bold/underline refers to added language).

Suggested Changes to the Proposed Code Language:

R405 ~~Passivehouse~~ Phius or PHI Building Certification Option. **This option requires compliance with Section R405.1, R405.2.**

R405.1 Scope. Projects certified as meeting the Phius CORE 2021 or Phius ZERO 2021 Passive Building Standard – North America, or newer, demonstrated using approved software by ~~PHIUS~~**Phius**, where ~~PHIUS~~ **Phius** design-certification is demonstrated by Phius; or, Projects pre-certified as meeting the Certified Passive House standard using software by the Passive House Institute (PHI), where PHI certification is demonstrated by a Certified Passive House Designer.

R405.2 Passive House Documentation

1. If using ~~PHIUS~~ **Phius** or PHI Passive House software, prior to the issuance of a building permit, the following items must be provided to the Building Official:
   a. A report which demonstrates project compliance with ~~PHIUS~~ **Phius CORE 2021 (or newer)** or PHI performance requirements.
   b. A statement that the compliant reported results ~~are~~ "~~based on~~ **reflect the** plans."

c. Evidence of ~~precertification approval~~ project registration from ~~PHIUS~~ **Phius** or PH**I**

2. Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the building official:

a Documentation of Design certification from ~~PHIUS~~ **Phius** or Pre-certification approval from a PHI certified consultant.

b. An updated report which reflects "as-built" conditions and demonstrates project compliance with ~~PHIUS~~ **Phius** or PHI performance requirements.

c. A copy of the Passive House Rater/**Verifier**'s test results **that meet the Phius requirement**.

d. A statement that the compliant reported results ~~are "based on~~ **reflect the** 'as-built' conditions, incorporating the relevant test results **including ventilation commissioning and photographic evidence that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook** and documented changes to equipment, materials, and assemblies that impact performance".

e. Compliance with R404.4, and Appendix RB: Solar Ready Provisions

f. A final certification, provided by Phius or PHI, shall be provided to the building official a maximum of 180 days after receiving a certificate of occupancy.

C407.3 ~~Passivehouse~~ Phius, PHI or passive house. This option requires compliance with Section C407.3.1, C407.3.2**.**

C407.3.1 Compliance. Buildings shall be pre-certified through Passive House Institute US (~~PHIUS~~ **Phius**) or Passive House Institute (PHI) and shall ~~have~~ an "as-built" report from a Certified Passive House Consultant (Phius CPHC) or certified Passivehouse designer demonstrating compliance with the ~~PHIUS~~ **Phius** -CORE 2021 or PHI standard. Software tools for determining Passive House certification shall be approved software tools by ~~PHIUS~~ **Phius** or PHI.

C407.3.2 Documentation. Compliance with ~~PHIUS~~ **Phius** or PHI shall be in accordance with C407.3.3.1 and C407.3.3.2

C407.3.2.1 Prior to building permit. Prior to the issuance of a building permit, the following items must be provided to the ~~rating authority~~ **building official**:

1. A WUFI or PHPP compliance report which demonstrates project compliance with ~~PHIUS~~ **Phius** CORE 2021 (or newer) or PHI performance requirements.
2. A statement that the WUFI or PHPP results ~~are "based on~~ **reflect the** plans".
3. Evidence of project registration from ~~PHIUS~~ **Phius** or PHI.

C407.3.2.2 Prior to issuance of certificate of occupancy. Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the ~~rating authority~~ **building official**:

1. Documentation of Design certification from ~~PHIUS~~ **Phius** or Pre-certification approval from a PHI certified consultant.
2. An updated WUFI Passive or PHPP compliance report which demonstrates project compliance with Design Certification through ~~PHIUS~~ **Phius CORE 2021 (or newer)** or PHI performance requirements.
3. A copy of the Passive House Rater/**Verifier**'s blower-door test results **that meet the Phius requirement**.
4. A statement that the WUFI or PHPP results ~~are "based on~~ **reflect** 'as-built' conditions, incorporating the relevant test results **including ventilation commissioning and photographic evidence that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook** and documented changes to equipment, materials, and assemblies that impact performance".
5. Compliance with C405.13, and Appendix CB
6. A final certification, provided by Phius or PHI, shall be provided to the building official a maximum of 180 days after receiving a certificate of occupancy.

~~**C407.3.3 Verification by approved agency.** Verification of compliance shall be completed by a certified Passive House consultant Phius~~.

3.Phius suggests amending the thermal bridge language in Section C402.7

While Phius appreciates the effort to include language to address thermal bridges in the commercial portion of the stretch code, we would suggest adding one additional section. One of the main concerns relative to thermal bridges is the possibility for moisture damage such as mold growth or corrosion. To prevent this situation, Phius suggests adding a requirement that ensures a minimum temperature to interior surfaces. Following is the suggested language:

C402.7.5**: Avoiding Moisture Damage at Thermal Bridges**. The thermal resistance between the interior surface and the exterior is at least R-10 (IP) everywhere, and the thermal resistance between the outboard side of any air-permeable insulation and the exterior is likewise R-10 (IP) everywhere.

4.Phius remains concerned about the TEDI limits included in Section C407 and suggests amendments to the current approach.

As noted above, Phius believes that the proposed opt-in stretch code represents a major advancement in the development, adoption, and implementation of energy codes. However, Phius continues to have concerns over the proposed TEDI targets.[1] (Please note that Phius is making these comments without knowledge of the underlying modeling assumptions that generated the TEDI targets). Specifically, Phius believes that:

[1] The comments will focus on the school TEDI targets as we do not have good data on office buildings.

1. The TEDI heating demand targets are unreasonably low.
2. The TEDI cooling demand targets appear to be unreasonably high (these two comments are interrelated).

Rational heating and cooling demand targets are both needed to provide guardrails on the design as having an overly strict heating demand target and an overly loose cooling demand target can easily skew designs. That is why Phius sets aggressive yet climate-optimized heating and cooling demand targets. The Phius standard is predicated on optimizing the balance between heating and cooling demands (even in areas known for its cooling load such as Massachusetts, it still can get hot in the summer).

Phius has data for four school projects (as per the typical Phius process, there is a target value and a modeled value): three in climate zone 5, one in climate zone 4 (although none in Massachusetts). Based on a comparison between the TEDI targets and the Phius targets (for heating demand and cooling demand), it is likely that the TEDI targets for heating demand are significantly more stringent than Phius requirements. The average heating demand targets for the projects in climate zone 5 is 8 Kbtu/ft2-yr, or over 3 times the TEDI target (the average Phius target for cooling demand is 40% of the TEDI target).

Given the ambitious level of insulation, ventilation and heating/cooling efficiency needed to meet the Phius standard— we believe that the TEDI targets will be unnecessarily difficult and costly to achieve.

Again, this comment might change once there is a chance to review the underlying modeling assumptions. However, the significant disparity that exists gives a signal that there may be future problems with the TEDI heating demand target. Table 1 shows the disparity between the Phius Targets and the TEDI target.

Table 1: Targets for Heating Demand, Cooling Demand for 4 schools Designed to the Phius Standard[2]

Project	Climate Zone	Type	Area (Sq. ft)	Heating Demand Target	Cooling Demand Target
1	4C	New	19099	4.5	3.4

[2] These are the same 6 schools from Table 1.

2	5A	Addition	7016	7.3	3.6
3	5A	Addition	7667	8.5	5.7
4	5A	New	27930	8.3	5.3
				Kbtu/ft2-yr	
TEDI Limits				2.4	12

Phius would like to propose a solution to this situation. The TEDI approach relies on absolute targets that are based on underlying assumptions. The accuracy of the approach, therefore, comes from the accuracy of the assumptions, which may not accurately reflect a given project; undermining our ability to accurately predict the actual energy use. Instead, Phius feels that structuring the requirement as relative i.e. comparing results against a baseline building will make the design process more manageable for designers. Phius believes this for the following reasons:

- Making the target project-specific gives the most nuanced performance criteria – this avoids the issue of setting up granular-enough categories of buildings, determining targets for them, and still ending up with criteria that give bad design guidance for buildings that do not fit a category well.

- Using a two-model, relative-performance target avoids some problems of sensitivity to calculation protocol. We have not had good luck when people try designing to Phius' thermal performance targets using different software. The annual heating demand is particularly sensitive to calculation details at high performance levels (low values) because it is a smaller difference of two larger numbers - heat gains and losses which requires the agency to tune the targets software-by-software and category-by-category. A two-model, relative performance regulation can get by with some general statements about simulation program capabilities, as is done in the IECC and ASHRAE codes (along with a table that lists the things to be modeling differently or the same for the two cases.

Conclusion

Thank you for the opportunity to provide these comments. As noted at the beginning of this letter, Phius strongly commends the efforts of MA DOER in proposing and adopting/implementing one of the strongest energy codes in the country. Phius hopes to continue to work with the agency to make this energy code a success in reducing energy use in Massachusetts.

Sincerely,

Isaac Elnecave
Policy Specialist
Phius

Appendix A: Clean Version of Suggested Passive House Enforcement Language

R405.1 Scope. Projects certified as meeting the Phius CORE 2021 or Phius ZERO 2021 Passive Building Standard – North America, or newer, demonstrated using approved software by **Phius**, where **Phius** design-certification is demonstrated by a Certified Passive House Consultant; or, Projects pre-certified as meeting the Certified Passive House standard using software by the Passive House Institute (PHI), where PHI certification is demonstrated by a Certified Passive House Designer.

R405.2 Passive House Documentation

1. If using **Phius** or PHI Passive House software, prior to the issuance of a building permit, the following items must be provided to the Building Official:
    a. A report which demonstrates project compliance with Phius CORE 2021 (or newer) or PHI performance requirements.
    b. A statement that the compliant reported results "reflect the plans."
    c. Evidence of ~~precertification approval~~ project registration from **Phius** or PH**I**

2. Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the building official:
    a Documentation of Design certification from **Phius** or Pre-certification approval from a PHI certified consultant.
    b. An updated report which reflects "as-built" conditions and demonstrates project compliance with **Phius** or PHI performance requirements.
    c. A copy of the Passive House Rater/**Verifier**'s test results **that meet the Phius or PHI requirement**.
    d. A statement that the compliant reported results **reflect the** 'as-built' conditions, incorporating the relevant test results **including ventilation commissioning and photographic evidence that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook** and documented changes to equipment, materials, and assemblies that impact performance".
    e. Compliance with R404.4, and Appendix RB: Solar Ready Provisions

f. A final certification, provided by Phius or PHI, shall be provided to the building official a maximum of 180 days after receiving a certificate of occupancy.

C407.3 ~~Passivehouse~~ Phius, PHI or Passive House. This option requires compliance with Section C407.3.1, C407.3.2**.**

C407.3.1 Compliance. Buildings shall be pre-certified through Passive House Institute US (~~PHIUS~~ **Phius**) or Passive House Institute (PHI) and shall have an "as-built" report from a Certified Passive House Consultant (Phius CPHC) or certified Passivehouse designer demonstrating compliance with the **Phius** -CORE 2021 or PHI standard. Software tools for determining Passive House certification shall be approved software tools by **Phius** or PHI.

C407.3.2 Documentation. Compliance with **Phius** or PHI shall be in accordance with C407.3.3.1 and C407.3.3.2

C407.3.2.1 Prior to building permit. Prior to the issuance of a building permit, the following items must be provided to the **building official**:

1. A WUFI or PHPP compliance report which demonstrates project compliance with ~~PHIUS~~ **Phius** CORE 2021 (or newer) or PHI performance requirements.
2. A statement that the WUFI or PHPP results **reflect the** plans".
3. Evidence of project registration from **Phius** or PHI.

C407.3.2.2 Prior to issuance of certificate of occupancy. Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the **building official**:

1. Documentation of Design certification from **Phius** or Pre-certification approval from a PHI certified consultant.
2. An updated WUFI Passive or PHPP compliance report which demonstrates project compliance with Design Certification through ~~PHIUS~~ **Phius CORE 2021 (or newer)** or PHI performance requirements.
3. A copy of the Passive House Rater/**Verifier**'s blower-door test results **that meet the Phius or PHI requirement**.
4. A statement that the WUFI or PHPP results **reflect** 'as-built' conditions, incorporating the relevant test results **including ventilation commissioning and photographic evidence that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook** and documented changes to equipment, materials, and assemblies that impact performance".
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