

MEMORANDUM

To: Meghan O'Connor, Eversource; Massachusetts Program Administrators; Massachusetts Energy Efficiency Advisory Council

From: Ari Stern, Khadija Holder, DNV; Matt Woundy, NMR

Cc: Ben Crosby, DNV; Monica Nevius, NMR

Date: October 31, 2023

Re: MA23X13-E-CICPSA Code Promulgation Gross Savings Update for 2024 and 2025

Section 1 Executive Summary

This memorandum was prepared for the Massachusetts Program Administrators (PAs) and the Energy Efficiency Advisory Council (EEAC) consultants by the Massachusetts Cross-Cutting Research Area evaluation team, led by NMR Group. The work was carried out under the Codes and Standards evaluation contract and was conducted by DNV and NMR (throughout referred to as “the Team”).

This quick-hit study estimates the 2024 and 2025 energy savings attributable to the Program Administrators’ (PAs) 2018 commercial energy-efficiency code advocacy efforts in Massachusetts. The PAs developed three commercial lighting code provisions and two residential code provisions that were ultimately adopted into the Massachusetts state-level building code in 2020. The provisions generate savings by making the code more efficient than it would have been without the PAs’ efforts. Savings are realized once buildings permitted under the code are completed.

The first evaluation of savings from these amendments was the Code Promulgation Attribution study (19X07-B-CDPROMATT), completed in 2020, which determined an attribution factor of 90% and an initial estimate of savings.¹ The 19X07-B-CDPROMATT study required assumptions on new construction activity, industry standard practice (ISP), and code compliance in later years and thus recommended future quick-hit studies to update key assumptions. The first quick-hit study, MA21X23-B-CPROMSA, conducted in 2022, reassessed ISP and compliance assumptions and updated the square footage impacted by the code provisions to estimate savings that accrued in 2023.² This study iteration updates the square footage impacted by the commercial code provisions to estimate savings that will accrue in 2024 and 2025. The study

¹ https://ma-eeac.org/wp-content/uploads/MA19X07-B-CDPROMATT_OverallReport_Final_2020.09.15.pdf

² https://ma-eeac.org/wp-content/uploads/MA21X23-B-CPROMSA_CS-Promulgation-Savings-Update-Report_Final_2022.11.01.pdf

uses the same methods as previous studies; however, it uses updated estimates of new construction and renovation activity and adjusts other model inputs that have more recent data.

1.1 FINDINGS

The Team estimated savings for new construction (including additions) and renovations. In 2024 and 2025, savings will only accrue for the commercial amendments since all homes built under the PAs’ residential amendments will be completed in 2023. Therefore, the Team only estimated savings resulting from the commercial amendments:

- C1.2021 – Lower interior lighting power density (LPD) to slightly below Massachusetts ISP
- C2.2021 – Additional 10% exterior LPD reduction
- C3.2021 – Expansion of daylight-responsive controls requirement

1.1.1 2024 Results

Table 1 shows the gross technical potential (GTP) savings for 2024 assuming full compliance with the code provisions. The GTP savings estimates include adjustments for industry standard practice. Only kWh savings are shown in Table 1; however, the C1 interior lighting amendment also results in negative GTP gas savings of 4,916 therms due to interactive effects with heating loads.

Table 1: GTP Savings for 2024 (Full Compliance)

Amendment	Applicable ft ²	New Construction Savings (kWh)	Renovation Savings (kWh)	Total GTP Savings (kWh)
C1	27,197,110	839,132	549,812	1,388,943
C2	26,935,838	32,727	22,115	54,842
C3	4,103,803	53,933	25,157	79,090
Total	--	925,792	597,083	1,522,875

Savings will not accrue for projects that do not comply with code, and therefore this study accounted for the expected code compliance rate. Table 2 shows the estimated actual 2024 GTP savings, accounting for partial compliance with the three code provisions.

Table 2: GTP Savings for 2024 (Partial Compliance)

Amendment	New Construction Savings (kWh)	Renovation Savings (kWh)	Total GTP Savings (kWh)
C1	813,958	533,317	1,347,275
C2	25,527	17,249	42,777
C3	27,506	12,830	40,336
Total	866,991	563,397	1,430,388

Table 3 shows the total net kWh savings resulting from the three commercial amendments after applying the 90% attribution factor established in the 19X07-B-CDPROMATT study to the savings from Table 2. Table 4 shows the negative 4,292 therms of gas savings resulting from interactive effects between the C1 amendment and heating loads. Table 5 shows the total MMBtu savings for 2024 accounting for both kWh savings and negative therm savings.

Table 3: Net Savings for 2024 (kWh)

Amendment	New Construction Savings	Renovation Savings	Total Net Savings
C1	732,562	479,986	1,212,548
C2	22,975	15,524	38,499
C3	24,755	11,547	36,302
Total	780,292	507,057	1,287,349

Table 4: Net Savings for 2024 (therms)

Amendment	New Construction Savings	Renovation Savings	Total Net Savings
C1	-2,593	-1,699	-4,292
C2	-	-	-
C3	-	-	-
Total	-2,593	-1,699	-4,292

Table 5: Net Savings for 2024 (MMBtu)

Amendment	New Construction Savings	Renovation Savings	Total Net Savings
C1	2,240.37	1,467.93	3,708.30
C2	78.39	52.97	131.36
C3	84.47	39.40	123.87
Total	2,403.23	1,560.30	3,963.53

1.1.2 2025 Results

Table 6 shows the GTP kWh savings estimates for 2025. Note that there are no renovation savings because the renovation analysis assumes a one-year lag, and therefore all renovation square footage built under the code provisions would be completed by 2024. As noted above, the C1 interior lighting amendment results in negative GTP gas savings. For 2025, there are 1,957 therms of negative GTP gas savings.

Table 6: GTP Savings for 2025 (Full Compliance)

Amendment	Applicable ft ² or Complete	New Construction Savings (kWh)	Renovation Savings (kWh)	Total GTP Savings (kWh)
C1	9,879,161	552,841	-	552,841
C2	9,814,575	20,906	-	20,906
C3	1,840,362	35,468	-	35,468
Total	--	609,216	-	609,216

Table 7 shows the GTP savings after accounting for partial compliance. There are also 1,898 therms of negative gas savings after accounting for partial compliance.

Table 7: GTP Savings for 2025 (Partial Compliance)

Amendment	New Construction Savings (kWh)	Renovation Savings (kWh)	Total GTP Savings (kWh)
C1	536,256	-	536,256
C2	16,307	-	16,307
C3	18,089	-	18,089
Total	570,651	-	570,651

Table 8 shows the total net kWh savings resulting from the three commercial amendments after applying the 90% attribution factor established in the 19X07-B-CDPROMATT study to the savings from Table 7. Table 9 shows the negative 1,708 therms of gas savings resulting from interactive effects between the C1 amendment and heating loads. Table 10 shows the total MMBtu savings for 2024 accounting for both kWh savings and negative therm savings.

Table 8: Net Savings for 2025 (kWh)

Amendment	New Construction Savings (kWh)	Renovation Savings (kWh)	Total Net Savings (kWh)
C1	482,630	-	482,630
C2	14,676	-	14,676
C3	16,280	-	16,280
Total	513,586	-	513,586

Table 9: Net Savings for 2025 (therms)

Amendment	New Construction Savings	Renovation Savings	Total Net Savings
C1	-1,708	-	-1,708
C2	-	-	-
C3	-	-	-
Total	-1,708	-	-1,708

Table 10: Net Savings for 2025 (MMBtu)

Amendment	New Construction Savings (MMBtu)	Renovation Savings (MMBtu)	Total Net Savings (MMBtu)
C1	1,476.01	-	1,476.01
C2	50.08	-	50.08
C3	55.55	-	55.55
Total	1,581.64	-	1,581.64

1.2 COMPARISON TO ORIGINAL ESTIMATES

1.2.1 New Construction Activity

The MA19X07-B-CDPROMATT study estimated savings for 2023 – 2026 using forecasted construction activity data developed before the COVID-19 pandemic. Given the pandemic’s impact on construction activity the original MA19X07-B-CDPROMATT overestimated the square feet of buildings that would be completed in 2024 and 2025 subject to the PAs’ code provisions. Using actual data on project starts from 2021 – 2023, this study estimated an area of applicable new construction and renovations completed in 2024 that is about 21% less than originally forecasted in the MA19X07-B-CDPROMATT study. For 2025, this study estimates an area of applicable new construction and renovations completed in to 2025 that is 54% less than originally estimated in MA19X07-B-CDPROMATT study. The sharp reduction for 2025 is the result of the code going out of effect one year earlier than expected, reducing the applicable new construction completed area in 2025 and eliminating the area of renovations.

While the construction activity estimated in this study is less than estimated in the original study, the new construction activity for 2024 and 2025 are higher than estimated in MA21X23-B-CPROMSA for 2023. This signifies that construction activity increased as time passed after the biggest interruptions from the COVID-19 pandemic in the construction market.

1.2.2 Industry Standard Practice

A major difference between this study and the MA19X07-B-CDPROMATT study are the assumptions surrounding ISP for the C1 amendment. The MA19X07-B-CDPROMATT study conducted in 2020 assumed an ISP of 50% for 2024, meaning that 50% of the square footage completed in 2024 would comply with the C1 amendment even if it did not exist. Given the forward-looking nature of that assumption, the MA19X07-B-CDPROMATT study recommended revising ISP assumptions in future years. The MA21X23-B-CPROMSA study revisited the ISP assumptions for 2023. This study followed the same methodology for 2024, resulting in an ISP assumption of 90% for the C1 amendment. In other words, this study assumes that in 2024, 90% of completed square footage would comply with the C1 amendment even if it were not required. This results in a substantial decrease in savings estimates for the C1 amendment in 2024 and 2025 relative to the estimates in the MA19X07-B-CDPROMATT study.

1.3 RECOMMENDATIONS AND CONSIDERATIONS

Recommendation. The PAs should adopt the updated net savings values for 2024 and 2025 presented in [Table 5](#) and [Table 10](#), respectively. These values reflect more up-to-date assumptions than the MA19X07-B-CDPROMATT study for all measures.

Consideration. The PAs should consider updating the gross savings estimates associated with these amendments in 2025 for 2026. At that time, a currently ongoing commercial market evaluation will be completed that can inform industry standard practice assumptions. Additionally, construction activity data will more accurately reflect 2026 completions than the current data does.

Section 2 Background and Methods

In 2018 through 2020, the PAs developed and advocated for five building energy code amendments that were ultimately adopted into the Massachusetts Building Energy Code. That code went into effect in November 2020 and is referred to as the “2020 code” for the rest of this study. The amendments that were adopted into the 2020 code include the following commercial amendments (C1 through C3) and residential amendments (R1 and R2):

- C1.2021 – Lower interior lighting power density (LPD) to slightly below Massachusetts Industry Standard Practice (ISP)
- C2.2021 – Additional 10% exterior LPD reduction
- C3.2021 – Expansion of daylight-responsive controls requirement
- R1.2021 – Requirement for one additional efficiency option: high-efficiency HVAC, heat recovery ventilator, or high-efficiency domestic hot water for some projects
- R2.2021 – Specifying Grade I insulation installation as standard

The PAs published the Code Promulgation Attribution study (19X07-B-CDPROMATT) in September 2020. In that study, the evaluation team, led by NMR Group, developed frameworks for estimating savings for each of the five amendments and estimated an attribution factor of 90%. As part of the 19X07-B-CDPROMATT study, the evaluation team included a consideration that the PAs conduct additional research to increase the accuracy of the Gross Technical Potential (GTP) savings estimates for the 2022 – 2026 program years relative to the estimates produced in the 19X07-B-CDPROMATT study. The 19X07-B-CDPROMATT study represents the upper bounds of potential energy savings from the code amendments the PAs developed and promoted, given that it assumed 100% energy code compliance and was based on previous baseline conditions and forecasts of new construction activity.

As mentioned above, the first follow-up study, MA21X23-B-CPROMSA, was conducted in 2022 and provided updated estimates for 2023 savings based on updated new construction activity estimates. This current study serves as the second update study and provides updated estimates for 2024 and 2025 using the latest new construction activity data.

Note, while the MA21X23-B-CPROMSA study included savings estimates for both residential and commercial amendments, this study only includes estimates resulting from commercial amendments. The residential framework developed in the 19X07-B-CDPROMATT study

assumed a one-year lag between project permitting and completion. Therefore, residential savings could only accrue, at most, for one year after the 2020 code stopped being in effect, since that is the latest point in time that homes permitted under the 2020 code would be completed. The residential provisions of the 2020 code were superseded on January 1, 2023, and therefore the framework dictates that no new residential savings can accrue in 2024 or beyond.

In contrast, the commercial amendment framework developed in the 19X07-B-CDPROMATT study assumed a one- to three-year lag between permitting and completion. Additionally, the commercial provisions of the 2020 code were superseded later than the residential provisions (July 1, 2023). Therefore, savings from the commercial amendments can accrue until July 1, 2026, assuming the biggest commercial projects permitted in 2023 take three years to complete.

2.1 METHODS

During study plan development, the PAs and EEAC agreed that this study would focus on commercial amendments only and should follow the original methodology from the 19X07-B-CDPROMATT study. The PAs and EEAC also required that the study account for renovation square footage as part of total construction volume impacted by the code amendments.³

The previous update study accounted for ISP by analyzing ISP trends from published reports. During a conference call on March 2, 2023, the Team, PAs, and EEAC decided that given the relatively high degree of confidence that lighting ISP and code compliance will continue to trend toward greater efficiency, as well as the expected rate of change and its tight timeline, this study should not attempt to collect ISP or code compliance data. The Team, PAs, and EEAC also decided that a low-effort qualitative assessment of ISP through in-depth interviews (IDIs) would be too imprecise and have little influence on the outcome. As a result, this study will use the assumptions and methods from the MA21X23-B-CPROMSA study to account for lighting ISP and code compliance. The Team conducted a literature review to see if any new information could inform the ISP and code compliance trend assumptions. The literature review revealed no new ISP or code compliance data or sources published since the MA21X23-B-CPROMSA study. Therefore, the Team used the same ISP and code compliance assumptions as used in the MA21X23-B-CPROMSA study.

The rest of this section details the methods used for estimating new construction square feet completed in 2024 and 2025 for new construction and renovations. Once the Team estimated new construction and renovation square feet, we followed the methodology used in the MA21X23-B-CPROMSA to estimate GTP and net savings. [Section 2.2](#) describes the extent to which the Team updated assumptions from the MA21X23-B-CPROMSA study for the current analysis. For the full methodology see Section 2 in the MA21X23-B-CPROMSA study.⁴

³ The MA21X23-B-CPROMSA study did not include renovation square footage in the initial net savings estimate and while there was consensus that it should be included, an updated number could not be developed in time for end of year reporting deadlines.

⁴ https://ma-eeac.org/wp-content/uploads/MA21X23-B-CDPROMSA_CS-Promulgation-Savings-Update-Report_Final_2022.11.01.pdf

2.1.1 Calculating Updated Square Footage Estimates For 2024 & 2025

This section presents a detailed overview of the methods used to collect data, derive square foot estimates, and forecast completed construction to calculate updated square footage estimates for 2024 and 2025.

The Team collected data from ConstructConnect, a trusted provider of historical construction project data and industry forecasts. ConstructConnect served as the basis of new construction activity for both previous iterations of this analysis. The database includes the reported annual value (USD) and/or area (square foot) of project starts, for development type “new and addition,” split into 26 building types⁵. Additionally, the database includes annual values for “renovation and alteration” development type project starts, split by the same 26 building types. Given the lack of square footage data for “renovations and alterations,” the Team required two separate approaches for estimating the completed square footage subject to the commercial code amendments:

- **New and Additions approach:** Assumes a three-year lag between project starts and completions and maps square footage of project starts to a given completion year.
- **Renovation approach:** Assumes a one-year lag between project starts and completions but leverages dollar per square foot values by building type derived from the new and addition data to back-out renovations and alteration square footage based on renovation and alteration annual value.

Following the methodologies of the previous studies, both approaches include an adjustment to multifamily square footage to account only for the area that is in common areas (i.e., not residential space) in buildings with four stories or more.

2.1.2 Estimating New and Addition Square Footage

The ConstructConnect database includes three development types for New and Addition:

- **New:** Historical data on construction of new buildings or infrastructure on a vacant or previously undeveloped site.
- **Addition:** Historical data on construction projects that involve expanding an existing building or structure by adding new components or annexes (e.g., rooms, floors, sections, or wings).
- **New and Addition:** A forecast of construction projects that include new buildings or infrastructure and/or additions to an existing structure. For years prior to 2023

⁵ The 26 subcategories tracked by ConstructConnect include: Amusement; College / University; Courthouses; Elementary / Pre School; Fire and Police Stations; Government Offices; Hospitals / Clinics; Hotels; Industrial Labs / Labs / School Labs; Jr / Sr High School; Libraries / Museums; Manufacturing; Medical Misc.; Military; Multi-Family; Nursing Homes; Offices; Parking Garages; Prisons; Religious; Retail Misc.; Shopping; Special / Vocational; Sports Arenas / Convention Centers; Transportation Terminals; Warehouses.

the forecast data matches closely to the sum of the new and addition historical data, but for 2023, historical data is not always available.

Like previous iterations, the Team assumed that projects take up to three years to complete, and therefore determined that only value and square footage data dating back to 2021 and 2022 was relevant to estimates for 2024 and 2025, respectively. However, before the Team could map project starts to completion years, the Team had to address a gap in the additions data: the ConstructConnect data did not have square footage data for additions for the year 2023.

For the year 2023, only forecasted dollar value data was available for additions and there was no square footage data. Furthermore, this addition dollar value data was combined with the value of new development projects. The Team estimated the portion of the combined 2023 new/addition forecast data that was from additions by subtracting historical dollar values for new construction in 2023, which was available in the database. Since the analysis only relies on the first six months of 2023, the Team felt it appropriate to use this historical 2023 data even though 2023 had not ended.

Once the 2023 addition value was isolated, the Team calculated dollar per square foot values for additions to back-out addition square footage. The Team used historic square foot and value data by building type for 2022 and 2021 to calculate a dollar per square foot for additions by building type. For building types that did not have any square footage in 2021 or 2022 but did in 2023, the Team used the average dollar per square foot across all building types. We then divided the isolated 2023 addition values by these dollar per square foot factors to get 2023 addition square feet by building type.

Lastly, the Team adjusted multifamily square footage to account only for the area in common spaces in buildings with four stories or more using two factors consistent with the MA19X07-B-CDPROMATT study:

- **Share of multifamily area in buildings with four stories or more:** Before making calculations to update square footage estimates for 2024 and 2025, The Team created estimates for the multifamily subcategory. Like previous iterations of this study, the commercial code only applies to buildings with four stories or more. The Team assumed 73% of multifamily area was in buildings with four stories or more based on data described in [Section 2.2](#) below.
- **Share of non-residential area in multifamily buildings:** Within a multifamily building, only the non-residential use areas, such as lobbies, hallways, and common rooms, are subject to the commercial LPD allowances. The Team assumed 20% of multifamily area was non-residential based on data described in [Section 2.2](#).

2.1.3 Estimating Renovation and Addition Square Footage

The ConstructConnect database includes three development types for Renovations and Alterations:

- **Renovations:** Historical data on projects that make significant changes and improvements to an existing building or structure through updates, upgrades, or

modernization to a building’s interior or exterior, typically via major overhauls of spaces, systems, and finishes, while often preserving its fundamental structure.

- **Alterations:** Historical data on projects that make slight modifications or changes to an existing building or structure, typically to adapt a space to meet new requirements or purposes without completely overhauling it.
- **Renovation/Alteration:** A forecast of construction projects that include renovations or alterations. For years before 2023, the forecast data closely matches the sum of the renovation and alteration historical data, but for 2023, historical data is not always available.

The Team excluded alterations from the analysis, assuming alteration projects would be unlikely to trigger code requirements.

The renovation data only had dollar values and had no square footage data. To compute the square footage for Renovations and Alterations, the Team used dollar per square foot values from new and additions as a proxy for dollar per square foot for renovations. This approach relied on the following assumptions:

- Expenses (e.g., cost of labor and materials) for each subcategory each year would remain relatively similar across New and Addition projects and Renovation projects, leading to similar or consistent pricing per square foot for both new and addition construction and renovation and alteration projects.
- New and addition construction and renovation construction projects are likely to have closely aligned costs per square foot because they both involve a complete overhaul of an existing space, including structural changes and high-end finishes.

The Team divided the renovation dollar values per year by building type by the dollar per square foot to get values for renovation square footage.

2.1.4 Mapping Construction Starts to Completion Year

The ConstructConnect data provides project starts but savings can only accrue when buildings are completed. This study followed the same methodology as the previous studies in assuming that commercial buildings take one to three years to complete. Therefore, one-third of the construction square footage in each year is assumed completed in each of the three following years. One exception in this study involves construction starts in the year 2023. Since the code was only in effect for the first half of 2023, the analysis assumes only one-sixth of the construction starts in 2023 would be completed in each of the three following years. Lastly, for renovations, this study assumes projects take only one year to complete since they are of a smaller scale than new construction projects.

2.1.5 Uncertainty and Study Limitations

While the highlighted approach provides applicable insights, there may be room for error. First, using calculated value per square foot from one development type (New and Additions) to estimate square footage for another development type (Renovations) may not account for differences in work scopes, materials, and labor requirements, or market variations (i.e., instances

where New and Additions projects were skewed towards locations with significantly varied construction costs from Renovations and Alterations). Second, because value per square foot from prior years may not account for cost changes due to economic fluctuations, there are limitations to using 2021 and 2022 averages to estimate 2023 square foot data.

2.2 LITERATURE REVIEW

The Team conducted a literature review to identify any sources that could be used to update assumptions or inputs in the savings analysis. As noted above, the savings analysis uses the same methodology as used in the MA21X23-B-CPROMSA study. The Team made no changes to inputs based solely on code provisions (e.g., the difference between amended maximum allowable LPD and unamended maximum allowable LPD) because those inputs would remain constant throughout the effective period of the code. The rest of this section is organized by amendment, detailing how the conclusions from the literature review were applied to each input for each amendment.

2.2.1 C1 Amendment Review

In addition to new construction and renovation square footage data, the C1 Amendment uses the following assumptions and inputs:

- **Lighting hours of use (HOU) by building type:** The previous studies used values from the Massachusetts TRM for 2022 through 2024.⁶ The Team used the same HOU values for 2024 since they would still be in effect through 2024. The HOU values that were used for 2024 were also applied to 2025.
- **Share of multifamily area in building with four stories or more:** The ConstructConnect data for multifamily building square footage includes all types of multifamily buildings; however, the commercial code only applies to buildings that are four stories or more. The previous studies used data from the Characteristics of New Housing Data from the U.S. Census to estimate a share of new multifamily square footage that is in buildings with four stories or more (70%). For this study, we used the same method with updated data from the same source, resulting in an updated value of 73%.
- **Share of non-residential area in multifamily buildings:** Within a multifamily building, only the non-residential use areas, such as lobbies, hallways, and common rooms, are subject to the commercial LPD allowances. The previous study used the Massachusetts Commercial Energy Code Compliance and Baseline for IECC 2012 study, published in 2018, to assume that 20% of the area in four-plus story multifamily buildings is non-residential.⁷ We conducted a review to identify updated sources, including the Massachusetts NRNC Market Characterization Study published in 2021 that was a follow-up study to the previous source.⁸ We identified no more recent estimate of the share of

⁶ <https://www.masssavedata.com/TRL/Technical%20Reference%20Manual%202022-2024%20Final.pdf>

⁷ <https://ma-eeac.org/wp-content/uploads/MA-CIEC-stage-5-report-P70-Code-Compliance-and-Baseline-FINAL.pdf>

⁸ <https://ma-eeac.org/wp-content/uploads/MA19C08-B-NRNCMKT-NRNC-Market-Characterization-Study-Final-Report.pdf>

multifamily building floor space that is non-residential use and thus used the same assumption as the previous study (20%). DNV is currently initiating an updated market characterization study that may provide an updated value, but that study will not conclude until midway through 2024.

- **Industry standard practice:** The previous study used the Massachusetts Commercial Energy Code Compliance and Baseline for IECC 2012 study and the Massachusetts NRNC Market Characterization Study to develop a trend to estimate ISP. The study concluded that only 10% of square footage would be available for savings since 90% would comply with code provisions as standard practice. The Team found no other sources for ISP but notes that the PAs and EEAC decided to use the same assumptions specifically for ISP and code compliance as used in the previous study to avoid introducing false precision. For this study we used the same ISP assumption as used in the previous study.
- **Code compliance:** Like ISP, the previous study based the code compliance adjustment on the findings of the Massachusetts NRNC Market Characterization Study from 2021. That study found that 97% of square footage was compliant with the applicable code. The study reduced the applicable square footage by 3% to account for square footage that would not comply with code provisions. Since there is no more recent source, this study used the same 3% penalty.

2.2.2 C2 Amendment Assumption Review

The C2 amendment savings analysis is based largely on an approach used in the 2019 California Building Energy Standards Codes and Standards Enhancement (CASE) cycle report.⁹ The Team reviewed more recent CASE cycle reports to see if any could be used to update inputs to the C2 analysis. Only the 2022 CASE cycle reports included analysis for outdoor lighting.¹⁰ However, the reclassification of lighting zones during the 2022 CASE cycle made the data available in the report not directly comparable to the methods used in the C2 amendment savings analysis for the MA21X23-B-CPROMSA and MA19X07-B-CDPROMATT. Therefore, the Team used all the same assumptions as used in the previous studies without any alterations.

Code compliance and ISP adjustments were previously sourced from the NRNC Market Characterization Study. As noted above, there is no more recent source for ISP and code compliance, so the Team used the same ISP assumptions as used in the previous study.

2.2.3 C3 Amendment Assumption Review

The C3 amendment methodology had no inputs that necessitated review besides the ISP and code compliance adjustments. Again, these were based on the NRNC Market Characterization Study and so were not revised.

⁹ Codes and Standards Enhancement (CASE) Initiative: 2019 California Building Energy Efficiency Standards Outdoor Lighting Power Allowances. Accessible at

<https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-BSTD-03>

¹⁰ <https://title24stakeholders.com/2022-cycle-case-reports/>