



EPA Recommended Metrics and Normalization Methods for Use in State and Local Building Performance Standards

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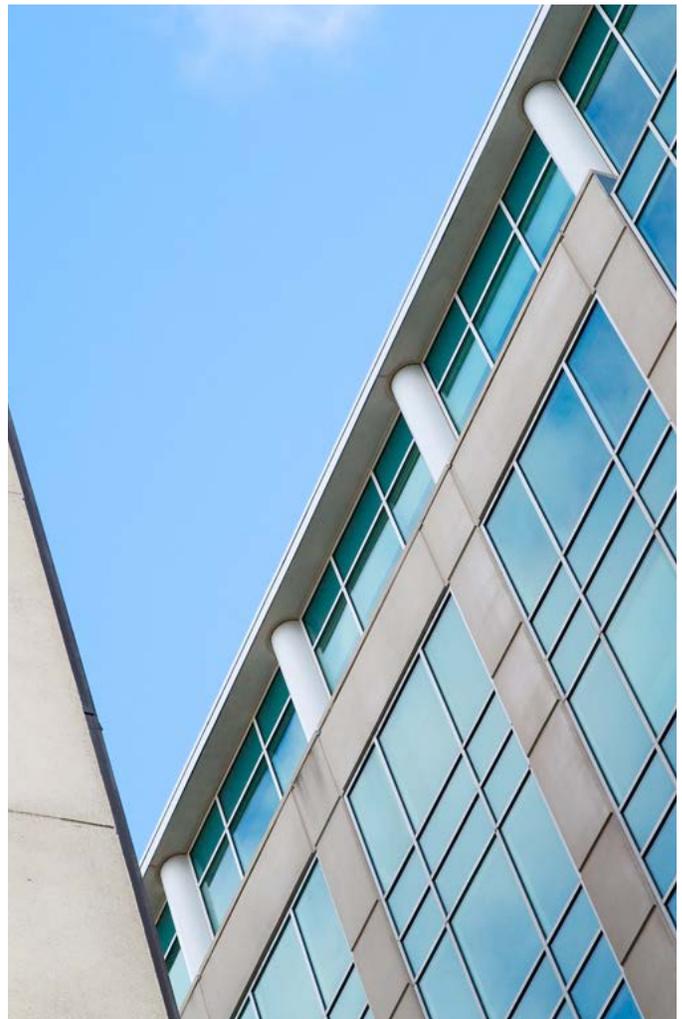
Summary of Recommendations

Based on analysis and input from policymakers, building owners, and other stakeholders concerning appropriate metrics and methods to ensure equitable Building Performance Standard (BPS) targets, EPA recommends that jurisdictions developing state or local BPS policies adopt the following metrics:

- To reduce energy use: Site Energy Use Intensity (EUI)
- To reduce onsite greenhouse gas emissions (GHG) and encourage electrification:
 - Direct GHG emissions
 - or-
 - Adopt a fossil fuel phaseout schedule

A site EUI metric inherently normalizes for building size. In addition, EPA recommends that jurisdictions apply the following principles to address important variations in EUI among buildings:

- Develop targets by building type. Each type of building will have a unique range of EUI and opportunity for improvement.
- Normalize for weather. Normalizing for weather ensures that extreme year-to-year variations in weather do not impact a building's ability to meet its target.



- Evaluate benchmarking data. Consider normalizing for operating characteristics only where the data indicate it is critical to ensuring fairness. Such normalization may not be needed when analysis of benchmarking data indicates that site EUI for a particular building type has a relatively

narrow distribution and/or is not significantly impacted by operating characteristics. When the data indicate that additional normalization is needed, consider using one or both of the following approaches::

- Appeal process. Where significant differences in operating characteristics exist for some buildings of a particular type, consider whether an appeal (or other alternative) process, instead of normalization, can address outliers.
- Establish multiple targets for each building type. Where significant differences in operating characteristics exist for many buildings of a particular type, establish two or more targets for specific building types based on evaluation of key operating characteristics. (See below for more details on two approaches – one establishing targets for groups of buildings based on their values for a single operating characteristic and one using the ENERGY STAR® score to set a unique target for each building based on all of the characteristics included in each score model).

EPA believes that adopting these metrics and approach to normalization will increase the likelihood of successful policies that provide a clear and equitable path to compliance for building owners while achieving the BPS goals. The adoption of these recommendations will also support increased consistency among policies across the country, help to streamline compliance for building owners with regional or national portfolios, and support evaluation across jurisdictions.¹



EPA Statement on the Use of Net Energy Metrics in Building Performance Standards

September 2017

What is a Net Energy Metric?

Net energy metrics are calculated by subtracting a building's on-site renewable energy production from its total energy consumption. This approach is used to determine a building's net energy consumption, which is then compared to a target net energy consumption value to determine the building's net energy performance.

EPA Recommendations against the Use of Net Energy Metrics in BPS

EPA strongly recommends against the use of net energy metrics in BPS. Instead, the site EUI metric should include all energy used to operate the building, including renewable energy generated onsite, in order to accurately reflect the overall efficiency of the building. For more on EPA's position concerning net metrics, including alternative recommendations, read EPA's full [Statement on the Use of Net Energy Metrics](#).

¹ BPS policies affect existing buildings only. To ensure that new buildings are designed and constructed to meet performance targets once in operation, policy-makers may want to adopt new construction policies that establish whole building targets aligned with their BPS policies.

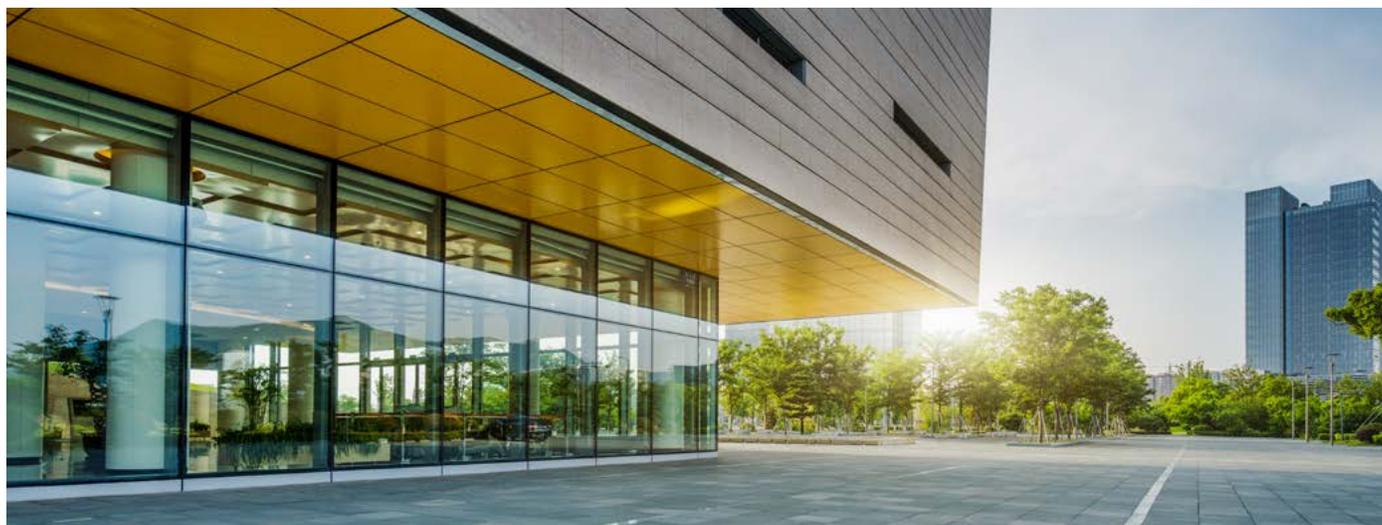
Background

As of May 2022, over 40 jurisdictions have enacted BPS and/or benchmarking policies to reduce GHG emissions from existing commercial and multifamily buildings. BPS policies require buildings to meet a specific energy use or GHG emissions performance target. The choice of metrics is a critical and challenging step for cities, counties, and states considering BPS policies.

To help local and state governments identify the best metrics for use in BPS policies, EPA developed a [white paper](#) and hosted a two-day workshop in June 2021 attended by over 90 policymakers, building owners, and other stakeholders. Eighty percent of workshop participants agreed that BPS policies

should include an energy efficiency metric. Over sixty percent favored a site energy use per square foot metric, and of these two-thirds preferred it be normalized for operating characteristics. As there is not one standardized method to normalize site energy use for operating characteristics, EPA identified the need for further exploration and discussion.

In December 2021, EPA convened building owners who participated in the June 2021 workshop to explore options for normalizing site EUI for operating characteristics. The preferred method among participants was creation of site EUI targets based on building type and key operating characteristic(s).



EPA Recommendations

Recommended Metrics for Use in a BPS

Based on extensive discussions with stakeholders and evaluation of multiple options, EPA recommends that jurisdictions pursuing a BPS policy adopt site EUI as the primary metric and, where encouraging electrification is a key goal, adopt a secondary metric more specifically designed to drive accelerated electrification. This secondary metric should be direct GHG emissions. Or alternatively, instead of a secondary metric, jurisdictions could establish a phaseout schedule for the use of fossil fuels in buildings. These approaches advance two very important goals that buildings must achieve to move toward zero carbon operations: energy efficiency and electrification.

As noted above, site EUI was, by far, the energy efficiency metric most favored by participants in the workshop hosted by EPA with policymakers and building owners to discuss BPS metrics. Advantages of site EUI include the following:

- Clear and easy to understand for building owners.
- Does not rely on the application of factors that may change over time.
- Controllable by building owners and occupants
- Incentivizes efficient electrification because a switch from natural gas heating to efficient electric heating will result in a lower site EUI.

Coupling site EUI with a metric that targets direct greenhouse gas emissions signals buildings to electrify efficiently and avoids making building owners responsible for GHG emissions from the electric grid (something over which they have relatively little control as those emissions depend on the fuel mix used to generate electricity). Including two distinct metrics adds complexity, however, and each jurisdiction will need to assess the benefits specific to their covered buildings.

An alternative to a separate direct GHG emissions metric would be a published phaseout schedule for the use of fossil fuels in existing buildings. This schedule could consist of a single date (e.g., by 2045, no fossil fuel use will be allowed in any building) or could specify several dates based on different uses (e.g., no new fossil fuel consuming equipment may be installed after 2026, and no fossil fuel use allowed for cooking by 2030, water heating by 2035, and all other uses by 2045). The use of a phaseout schedule may be simpler to implement than a direct GHG emissions metric, which requires additional reporting and tracking and that direct GHG emissions levels be set by building type. It also may provide more certainty for building owners and allow them to better plan for costly and difficult equipment replacement to eliminate the use of fossil fuels onsite.

Recommended Method for Normalizing Site EUI in a BPS

EPA recommends as the first step in normalizing site EUI that jurisdictions set separate targets for each building type. In addition, to ensure that extreme year-to-year weather does not impact their ability to meet the targets, EPA recommends that jurisdictions use buildings' weather-normalized site EUI to determine compliance.

Determining if and how to further normalize site EUI to account for operating characteristics is more complex. For each type of building, it is important to weigh the value of normalization against the added complexity that it entails. In many cases, normalization for operating characteristics may not be necessary, and therefore doesn't warrant the added complexity. This will be the case for building types whose operating characteristics don't vary widely and/or don't significantly impact the energy use of the building. An example might be police or fire stations. These buildings typically operate 24 hours a day, 7 days a week, making operating hours irrelevant in assessing energy use. Similarly, the density of workers (the number of workers per 1,000 ft²) is not likely to differ significantly among these buildings within a single jurisdiction; and even if it does, the impact on site EUI is likely to be relatively small. As a result, such normalization may not be warranted.

EPA recommends that jurisdictions evaluate benchmarking data and limit additional normalization for operating characteristics to those building types for which the data indicate it is critical to ensuring fairness. For example, such normalization may not be needed when site EUI for a particular building type has a relatively narrow distribution and/or is not significantly impacted by operating characteristics. Minimizing the use of

normalization will make the BPS requirements simpler and easier for building owners to understand and will make tracking and compliance monitoring easier for policymakers. It will also eliminate the difficulties associated with addressing changes in operating characteristics in specific buildings over time and how those impact compliance. Further, when the data indicate that a particular building type has a relatively small number of buildings with EUI and/or operating characteristics outside the norm, a jurisdiction may be able to address these buildings more easily through an appeals process.

However, additional normalization may be important for some types of buildings for which operating characteristics vary substantially and have a significant impact on the building's energy use, making it hard to determine if a building is operating efficiently based solely on its unnormalized site EUI. In cases where normalization for a building type is determined to be necessary, EPA recommends establishing site EUI targets according to differing levels of key operating characteristics, as described below.

Binning Method

For each building type, there would be two or more targets based on a range of operating activity level. For example, the target site EUI for an office could depend on how many hours per week it operates, with a higher EUI allowed for those with longer operating hours. Buildings of a single type would be placed into "bins" based on their level of activity, with unique site EUI targets for each bin.



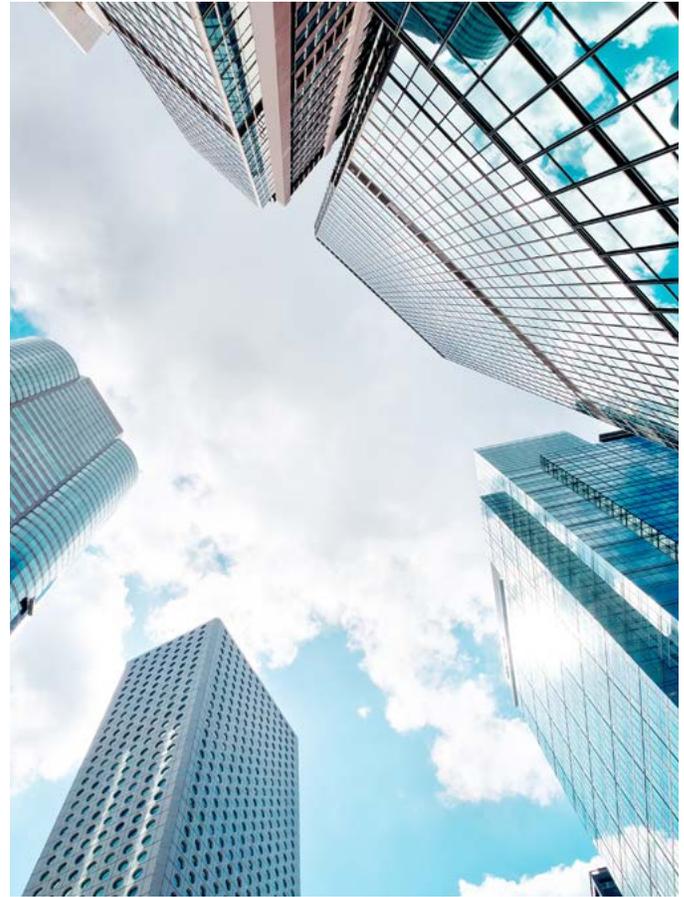
The following is an example of how this method would work for offices in a city:

- The city compiles benchmarking data submitted by all offices for the prior year and creates a distribution of their number of operating hours.
- The analysis shows that the operating hours of the offices range from 30 hours per week to 168 hours per week, with over 60% in the range of 50-70 hours per week.
- The analysis further shows that the median site EUI for those with fewer than 50 operating hours is 40 kBtu/ft² and the median for those in the 50-70 hours per week range is 56 kBtu/ft².
- Based on an analysis of the amount of energy reduction that will be required to meet the city's goals, the targets for the year 2030 are set as follows for offices:

OPERATING HOURS PER WEEK	2030 TARGET SITE EUI (KBTU/FT ²)
Less than 50	32 kBtu/ft ²
50 – 70	46 kBtu/ft ²
71 – 100	52 kBtu/ft ²
101 or more	60 kBtu/ft ²

The primary advantages of the binning method over others considered by EPA are:

- It is very easy for building owners to understand and to identify their target.
- It creates targets that reflect key differences in building operations.
- Buildings whose operations change can easily see their new target without the need for new calculations.
- The jurisdiction can identify the key building characteristic through analysis of benchmarking data (subject to limitation described below).

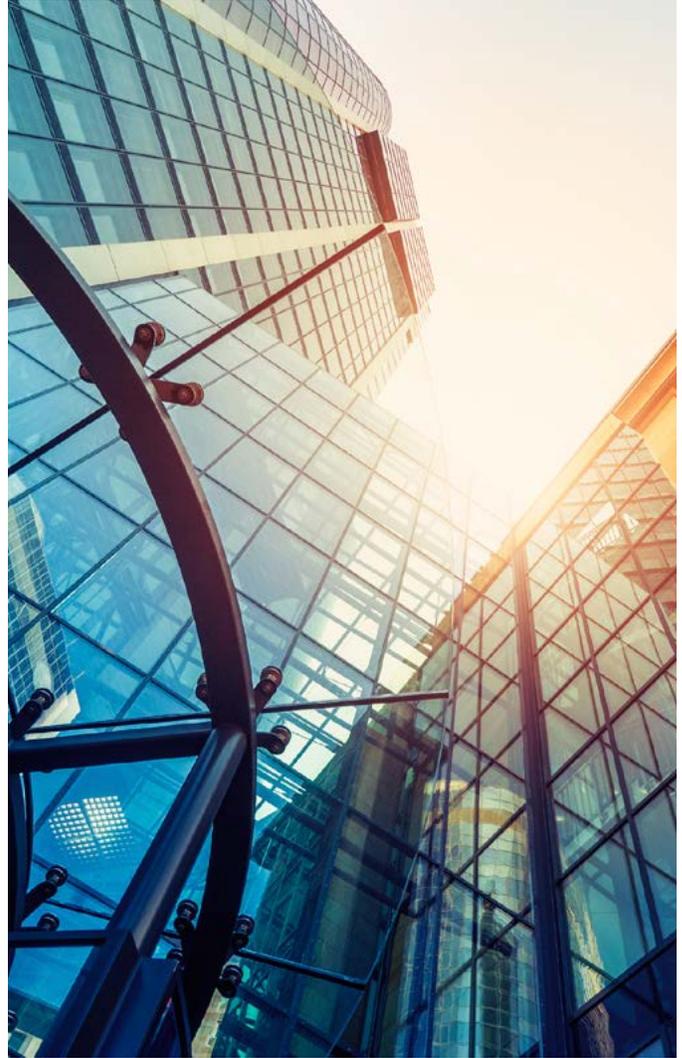


Important considerations associated with this method include:

- Because the bins can only account for discreet levels of operating activity, buildings with similar but slightly different operating characteristics may have substantially different targets.
- Operating characteristics available for use in creating bins are limited to those collected from building owners (in Portfolio Manager®, these include operating hours, number of workers, and number of computers for most property types that can't receive an ENERGY STAR score), though a jurisdiction could undertake an additional data collection if there is a desire to use different characteristics.
- Analysis will be required to determine which operating characteristics are most appropriate to use in creating the bins and to set the break points for the bins. In most cases, it will be difficult to include more than one operating characteristic in developing the bins.

Alternative Approach: ENERGY STAR Score Method

As an alternative method in cases where normalization is determined to be necessary, jurisdictions might want to consider a more complex, but robust, method that relies on the use of EPA's 1-100 ENERGY STAR scores for those building types eligible to receive a score. This approach addresses several of the considerations described above by normalizing each building based on its unique mix of operating characteristics. ENERGY STAR scores apply a statistical methodology to allow for normalization of multiple key operating characteristics so that the energy performance of buildings of a similar type can be equitably compared against each other. This alternative method involves establishing building-specific site EUI targets using the Portfolio Manager goals feature, and each building would receive a unique site EUI target that reflects normalization for all operating characteristics that are part of the calculation of the building's ENERGY STAR score. While this method produces a target using a more robust normalization method, it is more complex for both the building owner (who must perform additional calculations to receive their target) and the jurisdiction (which must record and track a unique target for each building).² A full description of how this method would work is provided in Appendix A.



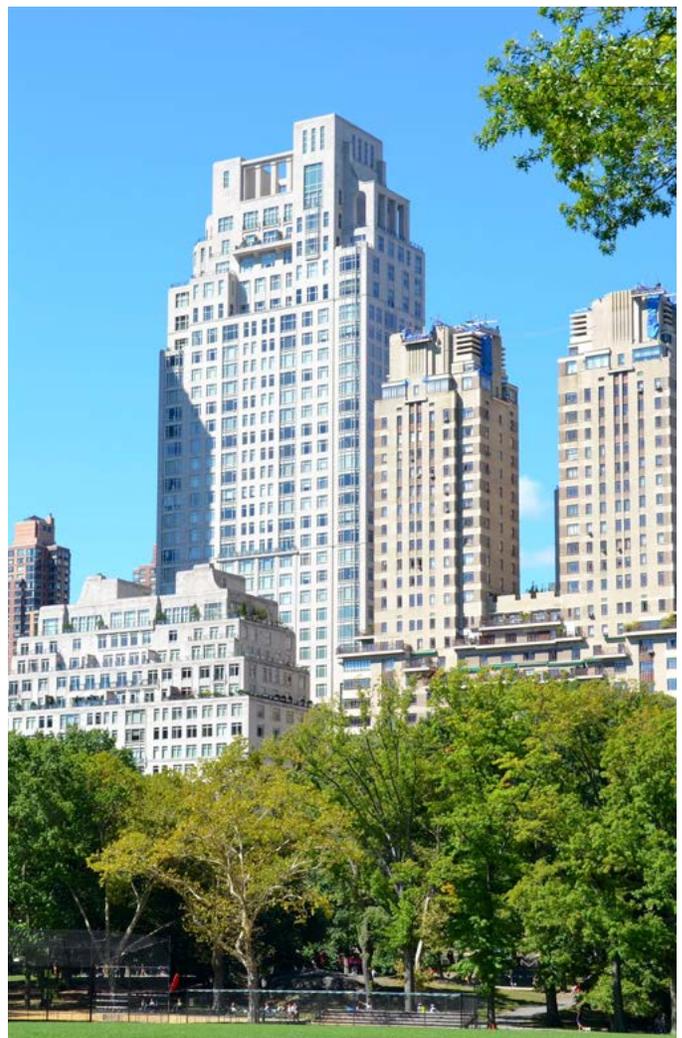
² If a jurisdiction is using Portfolio Manager sharing to collect data from building owners, it may be possible for the jurisdiction to calculate the target for each building, thereby removing the burden from building owners.

EPA Next Steps

To further aid jurisdictions, EPA plans to offer additional guidance related to these recommendations in the coming months. This guidance is likely to address the following topics:

- How to determine if normalization is needed for specific property types, and which operating characteristic to use in these cases
- How to define bins when setting targets based on the level of key operating characteristics, leveraging data and analytic methods used to develop the ENERGY STAR score for various building types
- Considerations for developing and implementing direct GHG emissions targets and fossil fuel phaseout schedules

If you have suggestions for additional EPA guidance related to BPS, or questions about how to implement the recommendations described in this document, please contact us at statelocal@energystar.gov.



Appendix A

Alternative Normalization Method for Buildings Eligible to Receive a 1-100 ENERGY STAR Score

This method takes advantage of the well-established ENERGY STAR score models, which normalize for a set of key operating characteristics for many of the building types likely to be subject to BPS policies. It translates a specific ENERGY STAR score into a site EUI target for each building based on its unique mix of operating characteristics.

How It Would Work

For each building type, the jurisdiction would require all buildings of that type to perform at a level equivalent to a certain ENERGY STAR score. Entering the score in Portfolio Manager's goal-setting feature provides the exact site EUI corresponding

to that score, accounting for that building's current, unique operating characteristics. This site EUI value would represent the target for that building under the BPS. To implement this method, the jurisdiction could collect the site EUI target via the data collection template used in Portfolio Manager to comply with benchmarking laws, or it could view the target directly if the properties are shared with the jurisdiction. Once the target is reported to the jurisdiction, it would remain unchanged for the duration of the first compliance period, even if the ENERGY STAR scoring model is updated during that period. For future compliance periods, the jurisdiction and building owners would follow the same process to set updated normalized site EUI targets for each building.



The following is an example of how this method would work for an office building which begins as a relatively poor performer with a current ENERGY STAR score of 28:

- The city sets a target that all offices must achieve energy performance equivalent to an ENERGY STAR score of 80 by the year 2030 using today’s ENERGY STAR scoring model.
- The building owner uses the goal-setting feature in Portfolio Manager to set a target ENERGY STAR score of 80.

Energy Target

Energy Target Metric: Target ENERGY STAR Score

Energy Target Value: 80 1-100 value

[Save & Calculate Other Metrics](#)

* Select "Calculate Other Metrics" to refresh the table after making changes to "Target Metric" and "Target Value"

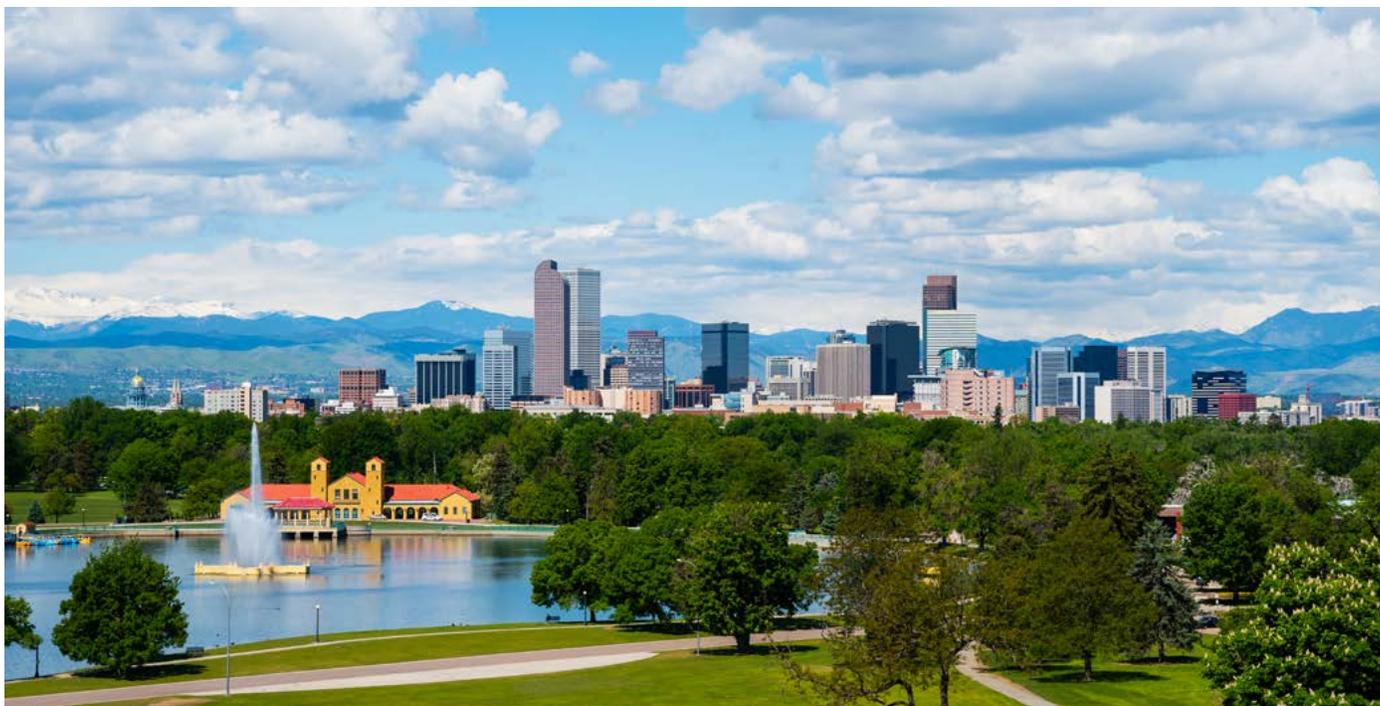
- Portfolio Manager displays the following table.

Metric	Dec 31 2019 (Energy Baseline)	Feb 28/29 2022 (Energy Current)	Target*	Median Property*
ENERGY STAR score(1-100)	31	28	80	50
Source EUI(kBtu/ft²)	250.1	256.7	122.7	194.4
Site EUI(kBtu/ft²)	107.7	112.3	53.7	85.1
Source Energy Use(kBtu)	68763838.6	70585958.1	33752590.0	53469266.9
Site Energy Use(kBtu)	29608585.3	30880466.4	14766332.8	23392130.6
Energy Cost(\$)	Not Available	Not Available	Not Set	Not Available
Total GHG Emissions(Metric Tons CO2e)	2372.8	2450.7	1171.9	1856.4

- This table shows that the building has a current site EUI of 112.3 kBtu/ft². Its target site EUI for BPS compliance, normalized for the current operating characteristics of the building, is 53.7 kBtu/ft² (corresponding to the score of 80 which was set by the city for all office buildings).
- The target site EUI of 53.7 kBtu/ft² would be reported to the city and stored as the building’s target site EUI for 2030 to comply with the BPS. If in the future the ENERGY STAR score for offices is updated, while the value in this table would change for the user, the target for BPS compliance would remain as the value originally reported to the city.³



³ Note that the site EUI target will vary based on not only a building’s operating characteristics, but also its current fuel mix. In practice, this means that an all-electric building will have lower current and target site EUI values than a similar building that uses a mix of electricity and natural gas. While this encourages electrification, as the building using a mix of fuels will find that transitioning to efficient electricity helps it reach its target, the use of interim targets could be employed to allow recalibration over time for changing fuel mix as well as operating characteristics.



The primary advantages of this method over others considered by EPA are:

- It provides the most comprehensive normalization possible because the site EUI target is set based on a target ENERGY STAR score, which reflects multiple operating characteristics using a statistical modeling approach.⁴
- The operating characteristics requiring normalization have already been determined through the ENERGY STAR score development process, thereby reducing the amount of work that must be done by the jurisdiction.
- Even if there are changes to the ENERGY STAR score model or to the site-source energy conversion factors used in Portfolio Manager, the building's target site EUI will remain fixed at the value reported to the jurisdiction, thus providing certainty to owners to facilitate planning to meet their goals.

But, as with all methods, there are some important considerations that a jurisdiction should be aware of:

- Determining at what level to set the target ENERGY STAR score for each property type to ensure that the jurisdiction meets its desired goals under the BPS will require detailed analysis.
- Only those buildings eligible for a 1–100 ENERGY STAR score can use this method; therefore, another method is needed for all other buildings.
- If buildings change their operating characteristics in a manner that would increase energy use (such as increasing operating hours), it will be harder for them to meet their target. This may require an adjustment to their target, which could be facilitated through the exemption or adjustment process that most BPS include to deal with buildings that are outside of the norm.
- As new buildings fall under the BPS, they may have targets that are normalized using an updated ENERGY STAR score model.

⁴ For example, the office example presented here will include normalization for square footage, operating hours, worker density, computer density, and weather.