# Making Data-Driven Policy Decisions for the Nation's First Building Energy Performance Standards


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**ABSTRACT**

Nearly every major U.S. city has committed itself to ambitious climate action goals – for Washington, DC this means a 50 percent reduction in greenhouse gases by 2032 and carbon neutrality by 2050. In support of these goals, Washington, DC has passed one of the most aggressive and practical climate action bills in the nation—with the Clean Energy DC Omnibus Act, DC became the first city in the U.S. to adopt energy performance standards for existing buildings. DC's Building Energy Performance Standards (BEPS) require energy efficiency improvements for all commercial and multifamily buildings that do not meet a sector-specific minimum ENERGY STAR score or equivalent metric, with iterative compliance cycles every five years that will accelerate the pace of whole building retrofits.

This paper explores this revolutionary policy framework and uses two data analysis projects that DC conducted to evaluate the potential impact of the BEPS and move towards carbon neutrality. First, we analyze the potential energy savings and greenhouse gas reductions, as well as potential cost impacts, from the implementation of a BEPS policy in DC We then examine the role of BEPS in a carbon neutrality strategy, how BEPS savings iterate over time, and what additional existing building improvements will be driven by the gravitational pull of new building codes on median performance.

The paper highlights the benefits and limitations of such data-driven approaches to support policy decisions. Finally, we will review ongoing BEPS implementation, including expected policy directions, critical supportive programs, and lessons learned to date.


## Introduction

Globally, cities and buildings are a significant source of greenhouse gas emissions, but cities are also well-positioned to take a leadership role in mitigating the effects of climate change by directly governing building energy use. Recognizing this responsibility and the urgency to act, many cities across the United States, including Seattle, New York City, San Francisco, Los Angeles, and Washington DC, have set ambitious targets to become carbon neutral by 2050. For DC, building out the path to carbon neutrality has been heavily reliant on leveraging the city's robust repository of building energy data and developing unique data-driven approaches to policy making and implementation. The District of Columbia recognized that achieving carbon neutrality will require dramatic reductions in energy use in existing buildings. While benchmarking laws have helped expand awareness of energy use and yielded energy savings in the range of 5% to 14%, more work is needed (Meng 2016, Seiden 2015). If commercial buildings continue to be retrofitted at current national rates, it will take over 60 years to reach all buildings, and per-building savings would also be insufficiently modest. There is a growing consensus that meeting the challenge of climate change requires more direct regulation of existing buildings. (Nadel 2020). This paper shows how the District has able to use building energy data analysis to effectively design and implement the first such Building Energy Performance Standard (BEPS) in North America.

This paper will focus on two separate approaches to this analysis: 1) a project conducted by C40 Cities (C40) and Lawrence Berkeley National Laboratory (LBNL) to estimate the greenhouse gas and general cost impacts of BEPS and 2) a grant awarded to Integral Group & Elementa Engineering to develop a Carbon Neutrality Strategy for the District, which included an exploration of the iterative savings from the final BEPS law, and its interaction with other complementary policies. Methodologies and results for both of these projects are described below, followed by a description of how these analyses are being utilized in the District's ongoing BEPS implementation and a survey of lessons learned throughout the process.

## Local Policy Context

As context for the analysis, we first review the landscape of energy efficiency planning, policy, and support in the District. Since 2012, DC has been tracking its progress through the goals set forth in the Sustainable DC plan[1], which establishes a carbon reduction target of 50% by 2032, relative to 2006. In 2017, Mayor Bowser expanded on this goal by committing the District to carbon neutrality by 2050. With nearly 75% of its emissions coming from buildings, collecting and analyzing building energy data plays an integral part in any climate action planning that the city undertakes. Through the benchmarking and reporting mandates of the Clean and Affordable Energy Act (CAEA), the District's Department of Energy and Environment (DOEE) has been collecting building energy data for its largest commercial buildings since 2013 (Clean and Affordable Energy Act).[2] The benchmarking data has served as a foundation for building owners to better understand their energy usage, as well as allowed the District to more effectively plan and design programs and policies.

Along with the energy reporting requirements, DC has several support programs that are critical to the success of advancing building energy efficiency. The DC Sustainable Energy Utility (DCSEU) operates under a performance-based contract with the District and serves as the one-stop resource for energy efficiency and renewable energy services for District residences and businesses; additional financial assistance will be provided through the DC Green Bank, established in 2018 (DC Green Bank). To expand technical assistance, the District has funded the creation of a High Performance Building Hub, which will provide education, resources, and peer

[1] The original Sustainable DC Plan was released in 2013. Updates were made to the plan and released in 2019 under Sustainable DC 2.0. Full text for both versions can be found at: https://www.sustainabledc.org/.

[2] The Clean and Affordable Energy Act (CAEA) was passed in 2008. The benchmarking requirements within the CAEA currently apply to privately-owned buildings over 50,000 $ft^2$. The Clean Energy DC Act of 2018 amends the CAEA such that the benchmarking threshold will drop down to 25,000 $ft^2$ beginning with calendar year 2021 benchmarking data and 10,000 $ft^2$ beginning with calendar year 2023 data.

exchange, to owners, developers, builders, and designers as they seek to comply with the District's policy objectives.

In January 2019 the District enacted the Clean Energy DC Omnibus Act (CEDC Act), which established a first-of-its-kind energy performance mandate for existing buildings (Clean Energy DC Act). Starting in January 2021, the District will set an energy performance threshold no lower than the local median ENERGY STAR score (or equivalent metric) by property type. Buildings below the performance threshold will be able to choose a performance pathway, which requires that they document a 20% reduction in energy usage, follow a prescriptive list of required energy efficiency measures, or choose another pathway determined by DOEE, over a 5-year compliance period.

The major components of the CEDC Act, and specifically the provision establishing the BEPS, directly pull from the analysis that had been conducted through the development of the Clean Energy DC Plan (District of Columbia 2018). The plan's actions are modeled to achieve a 56% reduction in the District's GHG emissions relative to 2006; a fifth of those savings come from existing building policies including performance standards. With this in mind, DOEE sought to further analyze the BEPS policy, in order to fully understand the impact from a cost and energy savings impact, as well as to understand what role the BEPS will play in the District's path to carbon neutrality.

## Estimating the Impact of a Potential BEPS

As the District Government set out to propose a Building Energy Performance Standard (BEPS), the Department of Energy and Environment (DOOE) worked with C40 Cities and LBNL to estimate the potential energy and emissions savings from a hypothetical BEPS program, along with taking a high-level look at what it might cost. The study had two main objectives:

1. Determine the potential energy savings and GHG reductions from implementing a BEPS policy for a range of energy performance targets for different building types and sizes.
2. Assess the cost implications for building owners, and technology pathways to achieve BEPS targets.

### Technical approach

**Analysis Goals:** The approach started with setting various energy performance thresholds based on the ENERGY STAR system, and then analyzing the impact of requiring all buildings to meet that level of performance. Because at the time of this analysis, the Clean Energy DC Plan was not finalized and the Clean Energy DC Act had not been drafted, the analysis focused on three options for BEPS thresholds: buildings falling within the 20th, 40th, and 50th percentile ENERGY STAR scores across a range of building types and sizes. Specifically, the analysis created different subgroups of buildings by floor area (>50k sf, 25-50k sf, and 10-25k sf) and building type (education, lodging, medical, multifamily, office, and other), and computed the following metrics for each subgroup:

- the number and types of buildings affected;
- the amount they would need to improve their site and source energy use intensity (EUI) and ENERGY STAR score;

- the monetary cost required to implement the measures.

**Data Sources:** District tax data was used to represent the entirety of the commercial and multifamily building stock. Federal buildings and embassies were excluded as they would not be covered by the policy. Since the tax data did not include information on energy consumption, two additional data sources were used : 1) the District's benchmarking data for buildings larger than 50k sf, and 2) the DOE Building Performance Database (BPD) data for buildings between 10k and 50k sf (LBNL 2018). The combination of the benchmarking and BPD data was used as a representative sample of the building stock with respect to important metrics such as energy consumption, ENERGY STAR score, and others. Buildings were categorized into six major types: office, multifamily, medical, lodging, education, and other. Lastly, data from the DCSEU was used to estimate the cost of implementing various energy efficiency measures.

**Hypothetical Scores:** For each subgroup in the tax data, LBNL developed a probability distribution of ENERGY STAR scores from the corresponding subgroup in the benchmarking data (>50k sf) or BPD data (10-25k sf and 25-50k sf). This distribution was sampled from to impute hypothetical ENERGY STAR scores for each of the buildings in the tax data. This allowed LBNL to make predictions about the entire building stock, rather than just subsets (benchmarking and BPD) of the building stock. Using the hypothetical ENERGY STAR Scores, three potential BEPS thresholds were set at the $20^{th}$, $40^{th}$, and $50^{th}$ (median) percentile ENERGY STAR scores. An increase in ENERGY STAR score was predicted for each of the buildings in the tax data to meet the criteria.

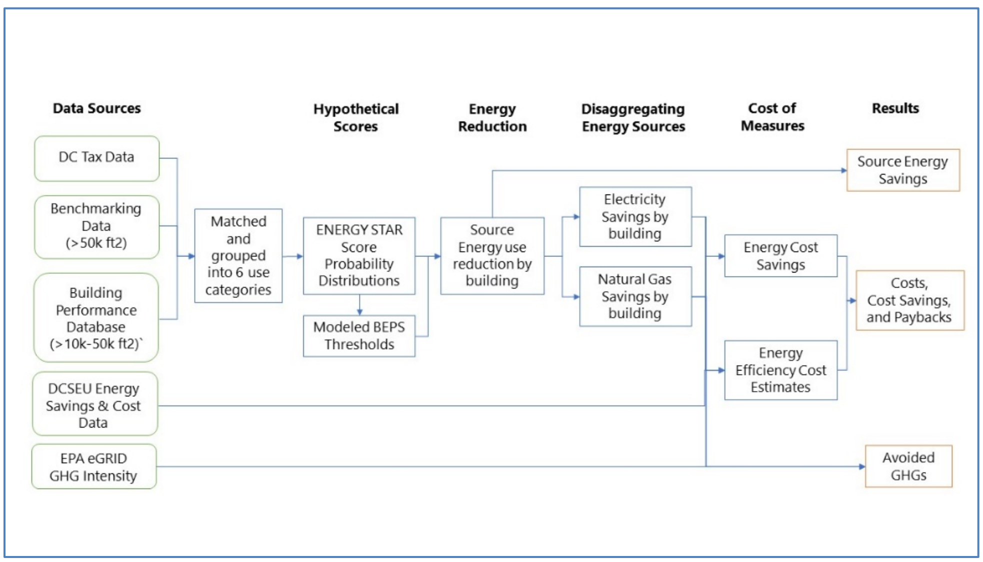


*Figure 1. Workflow for C40/LBNL Analysis*

**Energy Reduction:** In a BEPS policy based on ENERGY STAR score, the actual reductions needed for each building would vary, as the relationship between ENERGY STAR score and EUI is driven by a statistical model created by the ENERGY STAR Program. Without access to that model, a simplified approach was taken. For each subgroup, the relationship between ENERGY STAR score and source EUI was fitted to a linear regression model to the data in the corresponding subgroup in the benchmarking or BPD data. This regression model predicted the decrease in source EUI and source energy consumption that would be needed for each building to increase its ENERGY STAR score to meet the criteria. The predicted total energy savings is a time-independent snapshot, assuming all buildings met the thresholds. In reality, these reductions will play out in stages over time, as modeled later in this paper.

**Disaggregating Energy Sources:** For each subgroup, the probability distribution was calculated of the ratio of source electric energy consumption to total source energy consumption from the corresponding subgroup in the benchmarking data (>50k sf) or BPD data (10-25k sf and 25-50k sf). Hypothetical ratios for each of the buildings in the tax data was imputed from this distribution. Source energy was split into electric energy and non-electric energy using these hypothetical ratios. It was assumed that all non-electric energy is attributable to natural gas consumption, then added electric and natural gas energy to yield site energy. As a result, the model largely did not assume any fuel switching; while beneficial electrification is a policy goal of the District and is discussed further below but was not an explicit focus this analysis. Disaggregated site electric and natural gas savings were used to compute the corresponding greenhouse gas emissions reductions and cost savings. Because the analysis is a time-independent snapshot, the then-current 2016 eGRID GHG intensities for the RFC-East subregion was used.

**Cost of Measures:** In order to capture the local market for energy efficiency, data from the DC Sustainable Energy Utility's (DCSEU) operations from 2011 to 2018 was used to determine the probability distribution of the cost of reducing energy consumption. Due to data availability, this could only be done in the four larger building groups, office, multifamily, education, and other (representing over 90% of the total building stock); for lodging and medical buildings, the other distributions were sampled. For each subgroup, hypothetical values of cost of energy reduction was imputed by sampling from these distributions. Applying the resulting cost values to the energy reduction estimate helped derive the total cost and cost per floor area for each building to meet the criteria.

## Energy and GHG Savings Results

Figure 2 summarizes the source energy savings from meeting the 20th, 40th and 50th percentile criteria, broken out by floor area range and building type.

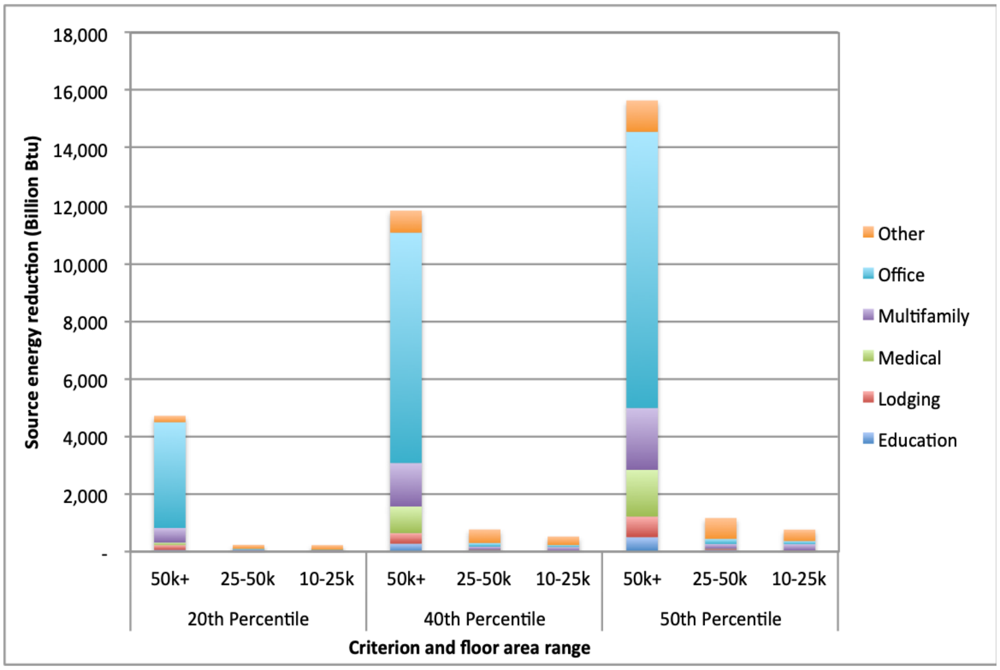


*Figure 2. Reduction in annual source energy from meeting 20th, 40th and 50th percentile criteria, by floor area range and building type.*

The most stringent policy implementation modeled, the 50th percentile (median) criteria for all buildings above 10,000 sf, could result in a total annual source energy reduction of 17,586 Billion Btu (21% of total existing building source energy use). The vast majority of this reduction (18.7% of building source energy use, and 89% of source energy savings) would come from buildings over 50k sf. Buildings in the 25k-50k sf range and 10k-25k sf range only contribute an additional reduction in source energy use of 1.4% and 1% respectively. Most of the savings come from offices, followed by multi-family housing and medical.

The total number of buildings impacted by the 50th percentile criteria is 2,746. Of these, 916 are in the >50k sf range, and 561 and 1269 in the 25-50k sf and 10-25k sf range respectively. The number of impacted buildings scales downward linearly with less stringent criteria.

We also explored the relationship between energy use intensity and building age as well as energy use intensity and size. We did not find a significant relationship between these parameters, which is consistent with other analysis of benchmarking data sets, and EPA's own findings (Kontokosta 2016, ENERGY STAR 2018, ENERGY STAR, New York City 2014). While some might reasonably expect newer buildings built to the very latest energy codes to be more efficient, they are often more energy intensive due to the presence of more services (e.g. more elevators) and amenities, and may also represent too small a portion of the data; and unlike New York City, DC has a small stock of prewar buildings. Altogether, this suggests that the policy does not necessarily need to differentiate the criteria based on building age and size.

Finally, annual CO2e GHG reductions from the annual energy savings was calculated using the eGRID subregion RFC-East non-baseload emission rates for electricity, and ICLEI U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions factors for natural gas. With the 50th percentile criteria for all buildings above 10,000 sf, total annual reduction in GHG emissions, assuming full compliance, was estimated at approximately 1.05 million tons of CO2e.

**Costs**

As is widely known, the costs to implement efficiency measures are highly context specific and can vary significantly even for the same measure and building type based on external factors such as the construction economic cycle, as well as site specific factors such as asbestos abatement, accessibility and security constraints, etc.

Building level (project level) costs and savings were analyzed using the DCSEU measure data. Table1 shows the range of project costs per unit of site energy savings ($/kBtu saved). The median values for each building type vary from 0.06-0.12 $/kBtu. Table 2 shows the simple payback at the building level, assuming utility prices in Washington DC are about $0.04/kBtu for electricity and $0.01/kBtu for gas[3]. Median values for simple payback are 3 years or less.

*Table 1. Aggregated building-level cost for DCSEU projects*

| | **Implementation cost ($/site kBtu saved)** | | | | |
|---|---|---|---|---|---|
| **Building Type** | **10th percentile** | **25th percentile** | **Median** | **75th percentile** | **90th percentile** |
| Education | 0.02 | 0.04 | 0.12 | 0.19 | 0.36 |
| Multi-family | 0.04 | 0.06 | 0.10 | 0.21 | 0.29 |
| Office | 0.01 | 0.05 | 0.10 | 0.18 | 0.49 |
| Other | 0.01 | 0.02 | 0.06 | 0.12 | 0.21 |

*Table 2. Building-level simple payback for DCSEU projects*

| | **Simple payback (years)** | | | | |
|---|---|---|---|---|---|
| **Building Type** | **10th percentile** | **25th percentile** | **Median** | **75th percentile** | **90th percentile** |
| Education | 0.37 | 1.38 | 2.99 | 4.89 | 8.80 |
| Multi-family | 1.26 | 1.83 | 3.01 | 6.88 | 13.58 |
| Office | 1.09 | 1.44 | 2.59 | 4.83 | 14.39 |
| Other | 0.34 | 0.51 | 1.54 | 3.17 | 5.46 |

[3] February 2018 data from https://www.bls.gov/regions/mid-atlantic/data/averageenergyprices_washingtondc_table.htm

Figure 3 shows the total costs and savings across the portfolio of projects implemented by the DCSEU to date. It shows a wide array of measure types. As expected, the measures vary in their cost effectiveness. For example: lighting retrofits provided 18.5% of total portfolio savings at 22.2% of total costs; space heating measures provided 32% of savings at 11% costs; and air conditioning provided 6.5% of total portfolio savings at 16% of costs.

Estimated costs for each building affected by the criteria was determined by applying the DCSEU cost intensity ($/kBtu saved) data to the reductions required for each building that was below the criteria. Significant variation was found in the range of costs for each building type and size category - with the 20th percentile at less than $1/sf and 80th percentile at more than $20/sf. These ranges were too wide to provide more specific conclusions about the costs for specific building types and sizes.

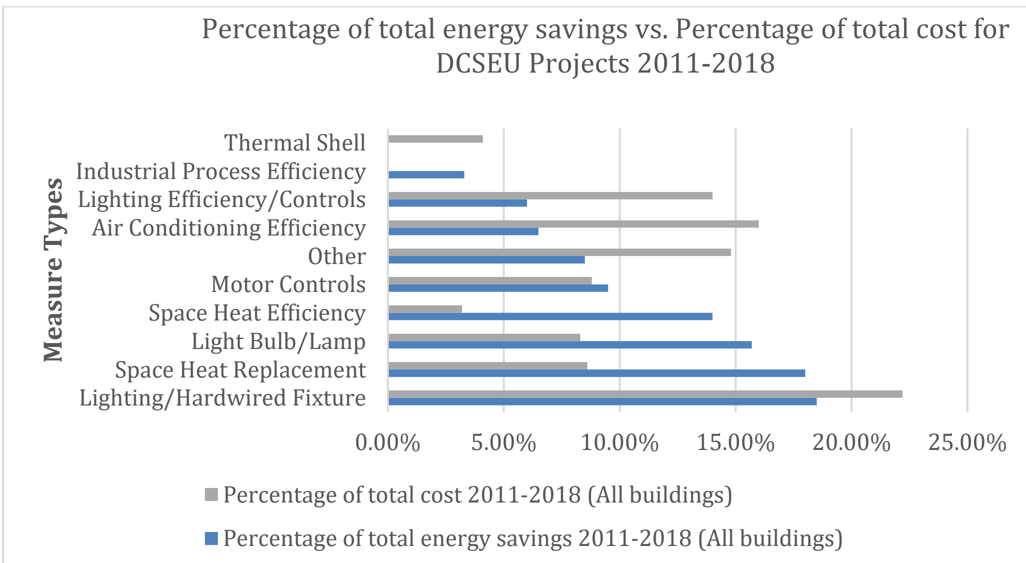


*Figure 3. Total costs and savings for portfolio of DCSEU projects*

This first analysis suggested that a BEPS policy can provide significant savings towards meeting Washington DC's climate goals. If all buildings over 10k sf were required to meet the 50th percentile criteria, it would reduce annual source energy use by more than 20%, equating to 1.05 million tons of CO2e GHG annually. However, the savings vary widely by building type and floor area range. As depicted in Figure 2 above, the vast majority of savings (89%; 18.7%/21%)) are from buildings over 50k sf. It is notable that the policy would impact 916 buildings over 50k sf and 1269 buildings in the 10-25k sf range, but with vastly different amounts of savings for those floor area ranges. It was recommended that the city should carefully consider the benefits of additional savings from smaller buildings against the transaction costs of implementing the policy for those buildings. Even if the city were to include all buildings, it may be advisable to start with buildings over 50k sf. Similarly, it was recommended that the city consider phasing the policy based on building types.

## Modeling Savings Over Time

As noted above, in 2018, DOEE published the final Clean Energy DC plan (District of Columbia 2018), along with the C40 analysis. In July 2018, the Clean Energy DC Omnibus Act was introduced in the Council of the District of Columbia to adopt many of the recommendations in the Clean Energy DC plan, including the Building Energy Performance Standard (Clean Energy DC Omnibus Act of 2018). The Act was signed into law in January 2019. [4]

Some elements of the final legislation vary from the ideas examined by C40/LBNL. For example, the C40/LBNL analysis showed that only marginal savings would come from the buildings under 50,000 $ft^2$. However, the District felt that occupants of these buildings deserve to live and work in energy efficient, healthy buildings, and thus the BEPS requirements apply to all buildings over 10,000 $ft^2$. The final BEPS is based on ENERGY STAR Score, with the standard for each building type being set at the local median ENERGY STAR score for that building type, based on the benchmarking data, or the median Source EUI if no ENERGY STAR score is available for that type; building types with less than 10 instances will use the national medians. While the primary goal of the BEPS is to reduce total energy use, the law also includes a mandate that by 2023, DOEE must undertake and publish a report assessing whether the BEPS should be revised to a standard based on greenhouse gas emissions.

Shortly after the Clean Energy DC Omnibus Act was signed into law, DOEE hired Integral Group to conduct additional research on how the City can achieve its goal of achieving carbon neutrality by 2050. This analysis aimed to build an iterative model of BEPS savings over time, using the final requirements of the CEDC Act, to examine how those savings could interact with a larger citywide energy model and other complementary actions.

### Technical Approach

One of the challenges in modeling the effect of the BEPS is understanding the relationship between ENERGY STAR score and building energy use intensity (EUI), and how that relationship might change in the future. While ENERGY STAR does publish the underlying assumptions and data for their scoring calculations, it is periodically updated every 5-10 years and is highly likely to continue to change as buildings become more efficient (ENERGY STAR 2018). Therefore, when looking at how savings build over time, it is difficult to use ENERGY STAR scores explicitly to model the impact of the BEPS, even if ENERGY STAR is the mechanism used to implement the policy. The Integral model instead uses an implicit relationship between ENERGY STAR score and building site EUI to model the impact at each BEPS compliance cycle.

Figure 4 shows the relationship between site energy use intensity and ENERGY STAR score for a sample set of multifamily buildings in the DOEE benchmarking dataset. A similar relationship exists for other program types, though the exact shape of the regression line will vary depending on the performance characteristics of buildings in the benchmarking dataset.

[4] The first compliance cycle of BEPS, beginning in January 2021, will only apply to properties over 50,000 $ft^2$, and the threshold will eventually drop down to 25,000 $ft^2$ and 10,000 $ft^2$ beginning on January 1, 2027 and January 1, 2033, respectively. Additionally, the equivalent metric for properties that cannot receive an ENERGY STAR score has yet to be determined by DOEE.

Note how the median site EUI (66 kBtu/ft$^2$-yr) and median ENERGY STAR score (55) intersects the regression line for this dataset.

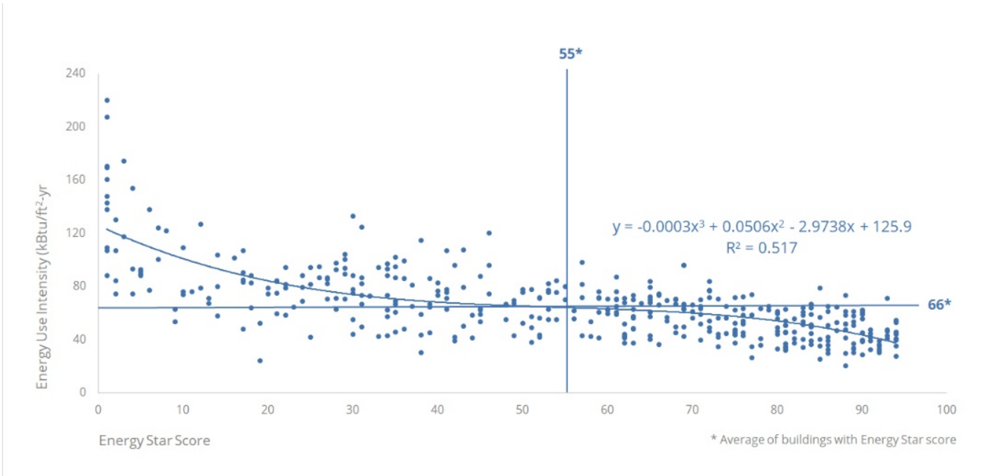


*Figure 4. Energy Use Intensity vs. ENERGY STAR Score for Multifamily Buildings in the District of Columbia*

Since the BEPS compliance standards are based on local median ENERGY STAR scores, and there is a demonstrated relationship between median ENERGY STAR score and median site EUI, the model uses the median site EUI as the BEPS compliance target for each building type. And rather than explicitly modeling the impact of the BEPS on individual buildings in the District, the model uses distribution curves to derive an average EUI for the existing building stock for each BEPS compliance cycle. Figures 5 and 6 show the distribution of site EUIs for multifamily buildings at various dates as a result of the BEPS. The shape of the curve changes over time as a result of how BEPS is designed. The worst performing buildings (represented on the right side of the graph) gradually improve with each BEPS compliance cycle, while the best performing buildings (represented on the right side of the graph) remain unchanged. As a result, the average EUI for each program type will gradually reduce over time, with the biggest reductions occurring in the first few BEPS compliance cycles. While this graph is for multifamily buildings, similar patterns exist for other building types. To enhance readability, Figure 5 includes modeled results for only every other cycle.

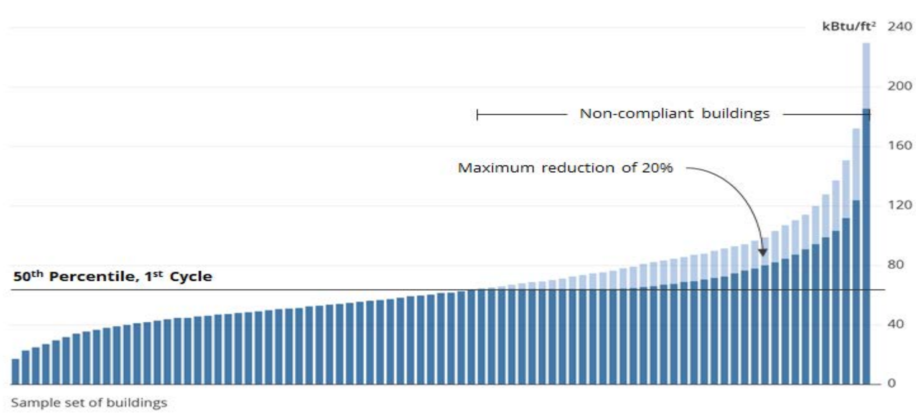

*Figure 5. BEPS savings over one compliance cycle*

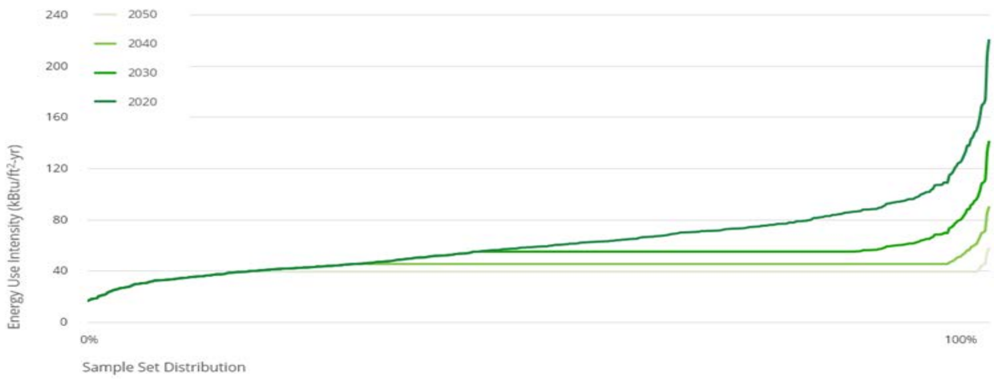


*Figure 6. Distribution of Site EUIs for Multifamily Buildings over multiple compliance cycles*

Overall, the savings estimates from the Integral analysis align with the savings estimates of the LBNL study, though there are slightly greater savings due to the iterative nature over time, and the differences between the details of the modeled policies. For most building typologies, the average site EUI for existing buildings will reduce by 30% from 2018 to 2050. The average EUI for the entire building stock, including the smaller buildings not covered by the BEPS, exempt buildings, and new buildings, would be slightly lower for each building typology. The GHG savings were also modeled and amplified by increasing renewables on the electricity grid, as discussed below.

**The Gravitational Effect of Building Codes**

While BEPS is one of the most important policy actions for existing buildings, it is not the only one, and alone will not be sufficient to achieve carbon neutrality by 2050. A whole suite of additional policy actions will be needed, which are beyond the scope of this paper. BEPS also interacts with other policies, such as energy codes for new construction, the Renewable Portfolio Standard.

The Clean Energy DC plan recommends that the District "establish a pathway toward net-zero energy performance in all residential and commercial buildings over the next 10 years, starting in 2021 with the construction of new single-family and small multifamily buildings." The Net Zero Energy (NZE) building codes should be designed to eliminate (or nearly eliminate) net emissions from new construction and major renovations in the District.

In order to meet the NZE code requirements, buildings will need to first meet aggressive energy use reduction targets and then generate or procure enough renewable energy to meet the remaining annual energy demand. Some building types, such as single-family homes, might be able to meet the NZE code requirements entirely through on-site renewable energy generation, while other building types, such as hospitals and high-rise commercial and multifamily, will need to use a combination of onsite and offsite renewable energy, preferably through long-term PPAs from new generation sources.

These codes haven't been signed into law, but the District has taken the first steps by including an optional outcome-based NZE code compliance path as "Appendix Z" in the newest city building code. In the Clean Energy DC Plan, the District set a goal for all new buildings in DC built after 2026 in DC to be NZE buildings (District of Columbia 2018).

As a result of how the law structures the BEPS, the District's energy codes for new construction will strongly influence the compliance targets for existing buildings. The new energy codes exercise a "gravitational pull" on the BEPS policy, which affect the BEPS ENERGY STAR targets in each compliance cycle. With stronger energy codes, the median Site EUI for each building type will decrease, driving up the median ENERGY STAR score for each building type, which will in turn make the compliance standards for BEPS more stringent following each code cycle. With the future creation of NZE codes, BEPS would yield an additional 3% (78,000 metric tons (MT) $CO_2e$ per year) in annual citywide GHG savings by 2050. Figure 7 shows the impact of BEPS with existing energy codes and with new (NZE) energy codes, in terms of cumulative site energy savings. Table 3 shows the projected EUIs for new buildings, considering the impact of the NZE codes.

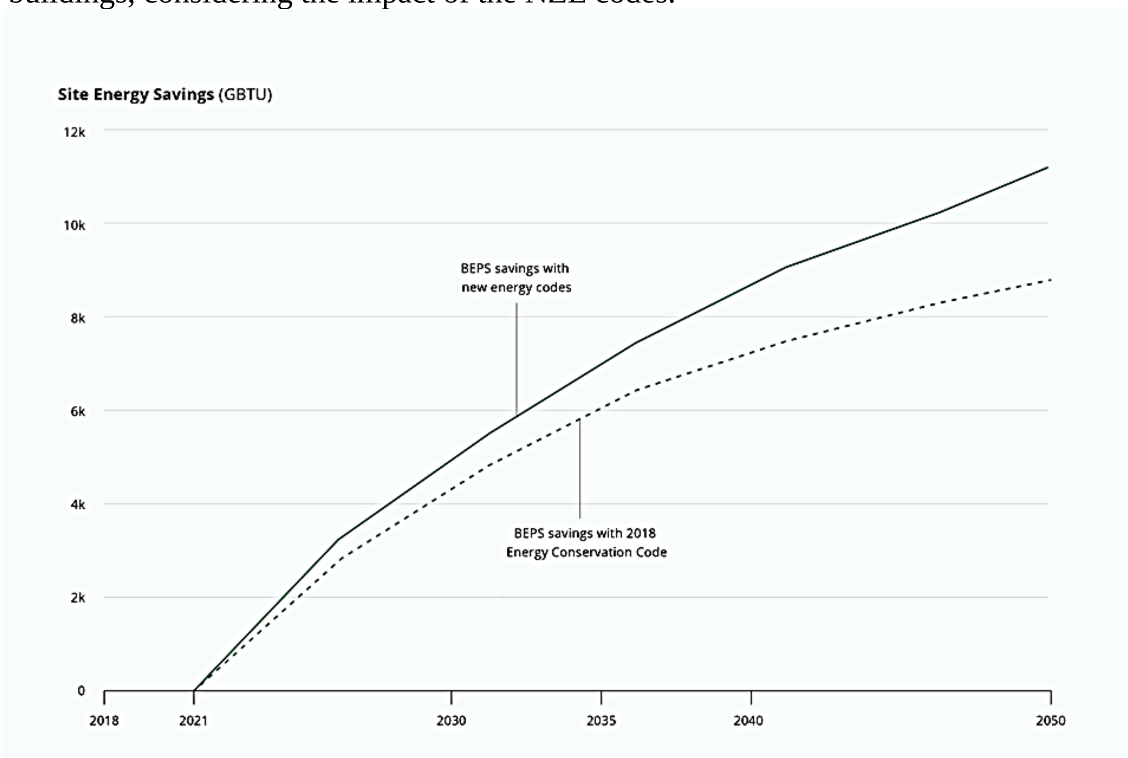


*Figure 7. Impact new Energy Conservation Codes on BEPS Site Energy over time*

*Table 3. Average Projected EUI of Existing DC Buildings as a Result of the BEPS, in kBTU/ft$^2$, accounting for impact of building codes*

| **Property Type** | **2018** | **2035** | **2050** |
|---|---|---|---|
| **Multifamily** | 81.6 | 60.6 | 48.5 |

| | | | |
|---|---|---|---|
| **Higher Education** | 137.1 | 91.8 | 63.8 |
| **Private K-12** | 84.4 | 69.2 | 58.0 |
| **Recreational** | 158.0 | 119.8 | 97.0 |
| **Cultural** | 129.4 | 95.1 | 71.0 |
| **Office** | 83.7 | 67.0 | 57.3 |
| **Hotel** | 139.6 | 107.8 | 89.5 |
| **Retail** | 103.4 | 71.5 | 59.8 |
| **Mixed Use** | 98.7 | 73.6 | 58.7 |

In addition, the CEDC Act includes requirements to increase the District's Renewable Energy Portfolio Standard (RPS) to 100% by 2032. Because not all renewable energy sources eligible for the RPS will directly impact the GHG intensity of the grid subregion, our modeling applied a range of discounts to the GHG savings from the RPS based on future PJM capacity and LBNL estimates of the impact of renewable policies (Barbose 2019). Nonetheless, the projected reduced GHG intensity of the electricity increases the total GHG savings from the buildings subject to the BEPS by 42%.

Given a move towards a 100% RPS, it is clear that beneficial electrification is a critical component of the path to carbon neutrality. Some aspects of the current RPS design, such as the fact that the performance path uses Site EUI, do incentivize electrification, and a switch towards a GHG standard might as well, depending on how the GHG intensities were calculated. While fuel switching from natural gas to electricity was not part of the BEPS-specific modeling detailed in this paper, additional modeling to look at interactions with potential electrification policies is an area of ongoing and future research.

## Current Implementation

Currently, as required under the CEDC Act, a Mayoral-appointed Task Force has been convened to assist DOEE with developing an implementation plan and the associated regulations related to BEPS. At the onset of the Task Force meetings, the District recognized the value of keeping data analysis and modeling at the forefront of its decision-making. Both the C40/LBNL and Integral analyses have provided critical context to the District's implementation of BEPS. DOEE has leveraged the information at different stages of this policy development process.

DOEE has been able to build from both these analyses to develop a BEPS modeling framework of its own. DOEE has developed multiple compliance pathway scenarios and implementation plans based on feedback and suggestions from the Task Force. Building on both the building level approach of the C40/LBNL model and the savings overtime implications of the Integral approach, DOEE was able to model the projected energy and greenhouse gas savings from these scenarios. With this information, the Task Force can make more informed decision regarding which scenarios to recommend DOEE includes in the final BEPS policy. These meetings are still ongoing, and the model is still being refined.

## Discussion

As DOEE progresses down the road of implementation and proceeds to keep data-driven decision-making at the forefront of the process, it is important to reflect on some of the lessons learned:

1. *Understand what question(s) you are trying to answer* - before undertaking any data analysis project, it is crucial to understand what the most important issues that need clarity, as well as identify any gaps in information that may affect policy decisions down the line. For example, with both analyses described in this paper, DOEE had to anticipate what concerns might arise surrounding BEPS and develop a fairly clear vision of how these projects could help provide clarity on the best path forward towards policy development. Specifically, DOEE used the first analysis to understand the floor area thresholds and median target thresholds to recommend be included in the BEPS, and the cost analysis, though preliminary, helped inform the program. (The Council has charged DOEE with commissioning an additional, more detailed cost-benefit analysis, but this project was not complete at the time of this paper.)
2. *Stakeholder engagement is key throughout the process* - Engaging with stakeholders early and often is key to any policy development process but is especially important when relying on data-driven decision-making. To fully understand where the gaps lie, what the true impact of the policy will be, and how to best address short-term and long-term concerns, it is important to identify, build relationships, and solicit regular feedback from key stakeholders. This is exemplified through the District's relationship and constant feedback loop with the BEPS Task Force, which is helping to shape many of the important details of the District's BEPS policy. The ability to use the BEPS modeling to run different scenarios for the Task Force's consideration has resulted in a much richer and more informed conversation. A critical foundation here is that, thanks in part to years of data analysis projects and data-driven planning by DOEE, stakeholders, by and large, seem to trust DOEE's analysis and findings; this precondition may not exist in all locales.
3. *Data-driven decisions may be outweighed by other factors* - In any politicized environment, it is important to keep in mind that data-driven decisions may not always be the most practical or appropriate. There may be times where the data is providing a clear path forward from a policymaker's perspective, but it is outweighed by questions of practicality, pushback from stakeholders, or concerns of equity and fairness. For example, the modeling showed that applying the BEPS to smaller buildings, and building types with fewer buildings, had marginal GHG and energy savings in a citywide context, but building occupants of those buildings also deserve healthy, efficient buildings, and so it was decided to apply the BEPS to those buildings as well.

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