U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Benchmarking & Transparency Policy and Program Impact Evaluation Handbook

May 2015

Prepared for the U.S. Department of Energy by
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Acknowledgments

The authors wish to thank and acknowledge several organizations and individuals for their contributions to this impact evaluation handbook.

Thanks are due to the following staff members of New York City's Office of Long-term Planning and Sustainability and the Seattle Office of Sustainability and Environment, who provided the critical data, information, and assistance needed to develop the key handbook policy and program impacts evaluations approaches and examples.

- Rebecca Baker, City of Seattle
- Nicole Ballinger, City of Seattle
- John Lee, New York City
- Donna Hope, New York City, Institute of Market Transformation

Also, thanks to the many reviewers who offered valuable input and insight to this study by providing subject-related materials, in-depth discussion, and constructive review of survey instruments, analyses, and draft versions of this document:

- Scott Dimetrosky, Apex Analytics
- Amy Jewel, Chicago, City Advisor, City Energy Project
- Alex Dews, City of Philadelphia
- Katrina Managan, Denver, City Advisor, City Energy Project
- Liz Babcock, Denver, City Advisor, City Energy Project
- Sonrisa Lucero, Denver, Mayor's Office
- Nate Wilairat, EMI Consulting
- Laura Schauer, Illume Advising
- Cliff Majersik, Institute for Market Transformation
- Hilary Beber, Institute for Market Transformation
- Jayson Antonoff, Institute for Market Transformation
- Jessica Lawrence, Institute for Market Transformation
- Julie Hughes, Institute for Market Transformation
- Andrew Burr, Institute for Market Transformation
- Hilary Firestone, Los Angeles, City Advisor, City Energy Project
- Constantine E. Kontokosta, New York University
- Elizabeth Titus, Northeast Energy Efficiency Partnerships
- Christopher Frye, Northwest Energy Efficiency Alliance
- Stan Price, Northwest Energy Efficiency Council
- Marjorie McCrae, Research Into Action, Inc.

- Karen Palmer, Resources for the Future
- Adam Hinge, Sustainable Energy Partnerships
- Pam Rathbun, Tetra Tech
- Rich Hasselman, Tetra Tech
- Teri Lutz, Tetra Tech
- Michael Li, U.S. Department of Energy
- Cody Taylor, U.S. Department of Energy
- Sarah Zaleski, U.S. Department of Energy
- Elena Alschuler, U.S. Department of Energy
- Cindy Jacobs, U.S. Environmental Protection Agency
- David Hsu, University of Pennsylvania
- Bob Wirtshafter, Wirtshafter Associates

Finally, many thanks to the Navigant and Steven Winter Associates handbook project team for the many hours of work in developing and completing the document:

- Ken Seiden, Navigant
- Jay Luboff, Navigant
- Dan Chwastyk, Navigant
- Emily Merchant, Navigant
- Robert Russell, Navigant
- Sonrisa Cooper, Navigant
- Adam Szlachetka, Steven Winter Associates
- Maria Rode, Steven Winter Associates

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Executive Summary

This handbook[1] provides both a strategic planning framework and standard methodologies to determine the energy and non-energy benefits of benchmarking and transparency (B&T) policies and programs that have recently begun to proliferate in jurisdictions across the United States. The intent of this handbook is to provide a simple "how-to-guide" with very clear steps and data requirements for the primary analysis methods recommended for use by local jurisdictions wishing or needing to assess the impacts of their B&T policies. This handbook also recognizes that other stakeholders and interested parties such as industry organizations, utilities and real estate professionals may have a keen interest in evaluating B&T policy outcomes and that some of these entities have more resources to devote to B&T policy evaluation. Therefore, more advanced— and generally more expensive —evaluation methods are included in this Handbook as supplementary approaches to guide those researchers who wish to go beyond the basic, primary evaluation methods recommended for jurisdictions implementing B&T policies.

Mandatory B&T policies require annual energy benchmarking of commercial and multifamily buildings[2]—and may include an additional mandate for widespread energy use transparency (Philadelphia; New York; Berkeley, CA; Boston; Minneapolis; Montgomery County, MD; San Francisco; Cambridge, MA; Chicago; Portland, OR; Atlanta, GA; Washington, DC) or a more limited disclosure mandate of a policy-affected building's efficiency status (Austin, Seattle and Washington State; California). Voluntary benchmarking programs are similar in most respects, with the exception that there is no benchmarking requirement, per se. Rather, building owners and managers are encouraged to go through the process, understand their building's energy consumption characteristics, how they compare to similar buildings, and learn more about opportunities to reduce energy consumption. To distinguish B&T efforts from other utility energy efficiency programs, this handbook refers to mandatory B&T policies and voluntary benchmarking programs as "B&T Policies."

The B&T policies currently being implemented vary in multiple details, most notably the requirements regarding what building segments must comply, what building sizes must comply, and transparency requirements. However, they all have the same intent: to advance energy performance in commercial buildings by providing energy consumption information to market decision makers and the public.

General Approach

This handbook is designed to outline methodologies for assessing the progress of B&T policy associated market transformation towards higher states of efficiency, and to assist jurisdictions in quantifying energy and non-energy policy impacts within the context of the policy's or program's strategic goals. It is meant to be user friendly in that an overview accompanies each methodology discussed, along with a list of steps one would take to execute the methodology and an example calculation.

Initial sections of this handbook provide the B&T evaluation planning framework in the form of a sample B&T policy logic model and related market transformation indicators (MTIs).[3] These two framework elements combine to provide B&T jurisdictional staff a planning structure with which to understand and track the ongoing market transformation progress and energy and non-energy impacts of the policy or program. The framework places both the policy and impacts within longer-term perspectives by considering the intended outcomes of the policy, and the evaluation of ongoing B&T policy impacts over the course of its implementation.

More specifically, the evaluation planning aspects of the handbook serve two important functions:

a. Provide jurisdictions a *roadmap for tracking the progress* of the policy by specifying examples of the barriers to energy efficiency (EE) the policy intends to overcome, the activities undertaken by implementing

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[1] *The Department of Energy Benchmarking & Transparency Policy Impact Evaluation Handbook ("the Handbook").*

[2] *This handbook refers to B&T policies affecting commercial buildings, but this is just definitional. The term "commercial" includes all commercial and multifamily buildings subject to the B&T policy.*

[3] *MTIs are market indicators of how well the B&T policy's market transforming goals (of energy transparency and savings in the commercial/multifamily buildings sector) are being met over time – with a special focus on how well the policy is meeting its goal of helping market "push-pull" forces become a major driver of enhanced energy efficiency in the commercial buildings sector(s).*

the B&T policy, and the expected outcomes of those activities. The focus here is on providing the means for jurisdictions to monitor progress towards meeting the jurisdiction's market transformation goals.

b. Develop a B&T logic model and associated MTIs that, when combined with recommended data gathering approaches, provides jurisdictions a valuable evaluation method for assessing the degree to which the policy is: a) changing market perceptions, structures and operations related to energy efficiency, and b) motivating market actors towards increased energy efficiency in the overall market.

The second part of this handbook describes specific methods for evaluating B&T policy impacts in the following areas:[4]

- Market transformation progress
- Gross and net energy impacts
- Non-energy impacts

For each of these categories, there are two types of methodologies provided: primary methodologies and supplementary methodologies. The primary methodologies are relatively simple and require minimal data collection efforts beyond what the jurisdictions are already implementing. These recommended approaches appeal to those who wish to perform a very basic assessment of the B&T policy or program, and match the evaluation resources available in most jurisdictions. The supplementary methodologies are more sophisticated and rooted in traditional utility energy-efficiency program evaluation methodologies. Supplementary methodologies are intended to be used by jurisdictions who wish to invest greater effort in order to obtain results that are more robust.

The following themes can be seen across the primary evaluation approaches for defining leading indicators of future B&T policy impacts, estimating gross energy savings, estimating net energy savings, and estimating non-energy impacts:

- Using data already collected through the B&T policies, particularly the inputs and outputs from the ENERGY STAR Portfolio Manager® tool;
- Relying on background and historical documents that are in the public domain; and
- Obtaining feedback from key stakeholders and partners on the application of the primary approaches and the assumptions employed.

The recommended approaches also require the following:

- Expert judgment on basic assumptions;
- Decisions about specific evaluation issues related to, for instance, which MTIs should be used for future evaluation metrics; and
- A determination of what the best approach is for assessing and allocating net savings to various market actors, or for assessing the impacts of non-energy benefits within the overall evaluation effort.

In these instances, the handbook recommends creating a structured panel of experts—generally composed of stakeholders and partners—to provide input and decision-making direction. These panels[5] improve the accuracy of the decisions made, and provide legitimacy to the overall evaluation process by ensuring that local stakeholders and experts have provided decision-making input to the questions at hand.

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[4] *It should be noted that the Department has published a companion example study that applies these Handbook B&T policy or program impact evaluation methods to real-world data in the New York City Benchmarking and Transparency Policy Impact Evaluation Report.*

[5] *An expert panel consists of a group of experts and structured communication techniques designed to provide as a systematic and interactive forecast or assessment of potential event outcomes. Experts answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments – eventually resulting an expert group forecast on the topic or group of topics at hand.*

A Holistic Framework for Assessing B&T Policies

As noted above, this handbook's planning framework serves as a strategic policy planning tool, and as a method for assessing the leading indicators of the market transformation progress of the policy.[6] In combination with the handbook's analytical methodologies for determining the gross and net energy benefits, as well as the non-energy benefits of B&T policies, this handbook provides jurisdictions a holistic framework for strategic planning, tracking, and evaluating the progress of the B&T policy effort along the way.

Figure ES-1 provides an overview of the how these elements work together to create this framework for assessing the day-to-day workings of B&T policies. A brief discussion of each of the key areas follows.

[6] *In this context, the logic model component of the B&T policy's planning framework provides jurisdictions a standard methodology for specifying the goals they wish to achieve with the policy, the barriers needing to be overcome on the road to success, the activities the jurisdiction will take over time to ameliorate the impacts of the barrier(s), and the expected outcomes of these policy implementation activities.*

Figure ES-1. B&T Handbook Market Transformation Planning Framework and Evaluation Methodologies, Activities and Approaches

B&T Policy Planning Framework and Impact Evaluation Handbook	Activity Description	Approach (*Primary or **Supplemental Method)
Handbook Section 1 & 2 **B&T market transformation planning framework**	B&T policy theory and strategic logic model development	*Primary method* • Identify barriers to energy efficiency • Select activities to overcome barriers • Target expected outcomes
Leading indicators of market impacts	Market transformation indicators (MTI) development to identify the progress of expected outcomes over time	*Primary method* • Analyze market infrastructure and market actor changes • Analyze sustainability of policy impacts over time Identify key milestones indicating policy success • Analyze MTIs using market actor interviews and surveys
Handbook Section 3 **Gross energy impacts**	Portfolio Manager data analysis to identify energy impacts	*Primary method* • Analyze iterative energy use intensities (EUIs) *Supplemental method* • Augmented analysis of iterative EUI outputs
Net energy impacts	Attribution of savings across various energy efficiency policies and programs that target the same buildings market	*Primary method* • Develop historical tracing • Structured expert judgment panel (intermediate & long-term) *Supplemental method* • Quasi-experimental design to estimate net impacts from regression approaches
Handbook Section 4 **Non-energy impacts**	• Greenhouse gas (GHG) reductions • Net job creation • Real estate value enhancement assessment	*Primary method* • Calculate GHG benefits • Calculate direct, indirect and induced jobs • Real Estate comparative sales analysis *Supplemental method* • Real estate – hedonic regression modelling

* Primary methods are relatively simple and require minimal data collection efforts beyond what the jurisdictions are already implementing. These recommended approaches appeal to those who wish to perform a very basic assessment of the B&T policy, and match the evaluation resources available in most jurisdictions.

** Supplementary methods are more sophisticated and rooted in traditional utility energy-efficiency program evaluation approaches. Supplementary methodologies are intended to be used by jurisdictions who wish to invest greater effort to obtain results that are more robust.

Addressing Barriers to Improved Energy Performance in Commercial Real Estate

B&T policies are designed to address certain barriers to enhanced energy efficiency in commercial real estate. In this context, "barriers" are defined as factors that inhibit both the efficient use of energy and/or proactive market actor activities to saving energy. B&T policies and programs are designed to help remove some of these key barriers and provide a tool for understanding and measuring progress — with a specific focus on the following:

a. Raising the knowledge base of building owners about energy usage in their property(s) thereby enabling enhancement of building energy performance;

b. Providing market transparency on energy efficiency to tenants, investors, and underwriters in real estate market transactions; and

c. Providing market data to allow for enhanced deployment of efficiency efforts on the part of the relevant agencies.

In this way, the B&T policy goals encourage incorporation of energy performance information into market actor decision making, and by extension, yield energy savings, greenhouse gas reductions, and other non-energy impacts.

Logic of Benchmarking and Transparency Policies

An evaluation of the progress and the impacts of the B&T policy initiative should try to quantify the energy and non-energy impacts that occurred subsequent to policy implementation. To gain an early understanding of the likelihood of these long-term policy induced impacts occurring, evaluators must examine, among other things, the immediate and short-term indicators of market transformation that may precede actual energy savings and non-energy benefits. These indicators provide evidence of the policy's progress in meeting its stated goals.

The approach, called logic modeling, provides both a roadmap for answering questions of "who," "what," "when," "where," and "how," as well as the data necessary to evaluate the progress and effectiveness of the policy effort. As noted, this function includes a review of barriers, activities, and expected outcomes to the success of the B&T policy. In particular, an important component of the overall impact of the B&T policy is the identification of key MTIs that will be used over the life of the policy (i.e., short, intermediate, and long term) as metrics to measure policy progress towards reaching its goals. Section 1 provides discussion of a workable B&T policy logic model and MTIs that jurisdictions may choose to use, as well as illustrative examples of both.

Measuring the Market Transforming Progress of B&T Policy Implementation Over Time

Beyond the basic "barriers to outcomes" logic model elements noted above, the model also incorporates a time component that captures the expected impacts of the B&T since its enactment and initial implementation. Measuring the policy's impact at different times and over the entire period of its presence in the local market can provide local jurisdictions with a solid foundation for measuring the program's progress and effectiveness in saving energy.

"Expected outcomes" are the changes in market structure[7] or market actor behavior that the B&T policy achieves with the support of legislative and regulatory policies. In general, *immediate outcomes* relate to increased awareness of energy use by building owners and increased market actor awareness of energy; *short-term outcomes* focus on the initial effects of the policy upon awareness[8] and on early energy savings[9] due to the policy. *Intermediate outcomes* focus on continued enhancement of building energy performance and on intended change

[7] The use of the term "market structure" varies from classic economics use of the term in that the market transformation focus on the use of the term relates to changes in the supply and demand relationship and related infrastructure relative to the pre-policy or energy efficiency program state.

[8] An immediate or short-term expression of awareness might be simple familiarity with benchmarking terms. Intermediate-term or longer-term indicators of awareness might be better gauged in terms of understanding.

[9] It should be noted that beyond "energy savings," the key goal of the B&T policy or program is "awareness"—an important means to the primary goal. Additionally, a third key policy goal is to provide basic market information to program administrator and other efficiency program organization to inform enhanced program design.

to market structure or market actor behavior in support of the policy goals (which might reasonably be expected to take four to six years after program start).[10] *Long-term outcomes* are the intended market effects that follow the erosion or elimination of all barriers to the B&T policy's goals (reasonably assumed to be within seven to ten years).[11]

Market Transformation Indicators

A critical first step in the process of assessing market transformation due to the B&T policy is to develop MTIs that evaluate the extent to which market barriers have been eroded over time. These market indicators answer key questions about the policy's progress in meeting its goals, and indicate whether barriers, activities, and expected outcomes the logic model identified are present in the marketplace. In particular, B&T policy market indicators should focus on three key barriers in the commercial marketplace the policy is meant to overcome:

- ***Internal Barriers:*** Lack of owner or property manager visibility or focus into the building's energy use[12]
- ***Market Barriers:*** Lack of transparency about energy performance among real estate professionals, tenants, investors, and underwriters[13]
- ***External Barriers:*** Lack of market data for to support non-B&T program and policy design[14]

Market actor interviews and online surveys of key actors (i.e., policy-affected building owners and property managers) can provide the most cogent information available as to the policy's real progress in meeting its goals (during each of the implementation periods). Interview responses, when measured against the appropriate MTIs, provide implementing jurisdictions the data they need to assess their B&T policies ongoing impact on the market.

Section 2 provides an illustrative example of the handbook recommended method for using MTIs and interview responses to assess a B&T policy's market transformation progress.

Benchmarking and Transparency Ordinances as Foundational Policy

A key handbook focus is on the energy and non-energy benefits of jurisdictional B&T policies and the indicators that can be used to identify if these benefits can be expected and are present in the market. However, another important benefit of B&T policies, less quantifiable, but just as real, is the fact that these policies serve as foundations for other supporting activities to take place. By *foundational policy*, we mean that the data collected via jurisdictional B&T policies can be used to support other efficiency policies and activities in cities implementing such ordinances. With these data now available, utility and other efficiency program managers now have underlying knowledge about building energy usage (on an annual basis) in their service areas and can thus target new programs aimed at supporting building owners with utility program offerings that enhance program efficiency – and thus speed market transformation. Additionally, and of equal import, the policy enables relevant efficiency administrators to establish a baseline of "where the market is" and measure performance over time, relative to the impact of the policy against the baseline as well as the impacts of other energy efficiency programs that use B&T to support enhancements to their own program efforts. Though this B&T policy aspect is not the subject of the market progress or evaluation impacts methods presented in this report, it is nonetheless an important benefit that should be acknowledged.[15]

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[10] *A review of recent NEEA MT initiative examples show ranges from four to nine years for initiatives; with, for example the NEEA desktop computer supply initiative lasting approximately nine- years, the Energy Efficient TVs initiative lasting four years , and the Residential New Construction to Code initiative lasting five-years.*

[11] *While this may be a reasonably assumption, depending on the market and barriers, this may take longer than the ten years noted.*

[12] *These are barriers to energy efficiency that are internal to the building owner and operator.*

[13] *These are barriers to energy efficiency that are due to how the real estate market performs i.e., information about energy use among real estate professionals, tenants, investors, and underwriters.*

[14] *These are barriers external to building operations and the real estate market that affect other potential policies and programs that can impact the effectiveness of potential market interventions such as utility program designs, updates to building codes, etc.).*

[15] *Several examples of the use of the B&T policy as foundational include: (1) the use of the B&T information by utilities or other efficiency program administrators to target low performing building types for commercial sector efficiency programs, or (2) governmental tax credit or other incentive policy to encourage the upgrading of B&T affected buildings to certain efficiency levels.*

Gross and Net Energy Impacts

The primary recommended evaluation approaches used in this report are derived from the International Performance Measurement and Verification Protocol (IPMVP) and the Uniform Methods Project (UMP).[16] In this report, gross energy impacts of the B&T policy are defined as the change in buildings' energy usage inclusive of actions taken to reduce energy consumption and participation in other energy-efficiency activities or programs. Net energy impacts are the subset of measured energy changes attributable to the B&T policy. That is, the net savings after taking into account natural market forces and impacts from other local, state, federal, and utility energy-efficiency program and tax credit initiatives.

Gross energy impacts are estimated through what IPMVP and UMP call *Whole-Facility Analysis*.[17] This is a very efficient and cost-effective approach because B&T policies generally require benchmarking to be conducted via the ENERGY STAR Portfolio Manager® tool. Portfolio Manager meets the software requirements of the Whole-Facility Analysis approach. The recommended approach also recognizes that Portfolio Manager-based impact analyses capture all of the changes in energy use resulting from a host of factors, including other energy efficiency policies and programs, relative to the baseline. Source energy should be used for all gross energy impact calculations, as compared to site energy, because source energy takes into account the raw amount of fuel required to operate a building, including the amount of energy lost through transmission, distribution, and production losses.

Net savings from the B&T policy itself are then derived from a technique known as *historical tracing,* a structured process for attributing gross savings across the various market interventions, programs, and legislations, including the B&T policy. Historical tracing may be accompanied by *structured expert judgment,* which provides additional guidance and feedback on the historical tracing impact attribution process. The methodological approach for assessing gross and net energy impacts is presented in further detail in Section 3 of this report.

Non-Energy Impacts of B&T Policies and Programs

Non-energy impacts refer to benefits potentially resulting from the B&T policy in three areas: greenhouse gas (GHG) emissions, job creation and economic growth, and real estate values. GHG reductions are calculated from the reduction in energy usage following the B&T policy implementation. The U.S. Environmental Protection Agency's (EPA's) ENERGY STAR® Portfolio Manager calculates GHG emissions from site energy for each building.

Job creation and economic growth from the B&T policy result from the labor required to organize and submit the benchmarking data to the jurisdiction, as well as direct, indirect, and induced impacts required to achieve energy savings. Direct impacts are derived from building owners and managers hiring staff necessary to meet B&T requirements. Indirect impacts are generated from any subsequent investment in energy-saving measures and technologies and are tied to the net energy savings resulting from the B&T policy. Induced impacts are derived from economic "multipliers" that draw on the interrelationships between job creation, economic growth, and energy efficiency.

Changes in real estate value resulting from B&T impacts on energy efficiency are derived from standard real estate appraisal practices and other methods designed to isolate energy efficiency from other building features. The focus here is on how publicly reported energy use data from the B&T policy can result in changes to the strength of the relationship between energy efficiency and building value. Section 4 presents a detailed discussion of the methodological approaches for assessing each of the key *non-energy impact areas*: GHG emissions reductions, job creation, and real estate valuation.

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[16] *Information on IPMVP can be found at* ***http://www.evo-world.org****; Information on The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures can be found at* ***http://www.energy.gov/eere/downloads/uniform-methods-project-methods-determining-energy-efficiency-savings-specific****, and other draft protocols are available at* ***http://www.nrel.gov/extranet/ump/draft_protocols.html****.*

[17] *The type of analysis includes all energy use within a given building rather than the replacement of an isolated piece of equipment.*

1 Introduction

This handbook provides detailed methodologies to determine the energy and non-energy impacts of benchmarking and transparency (B&T) policies and programs, which have recently begun to proliferate in jurisdictions across the United States. The intent is to provide a "how-to-guide" with clear, standard steps and data requirements so that any interested party – government staff, consultants, researches, or other – can assess the polices in a consistent manner.

1.1 Summary of B&T Policies

B&T policies mandate energy benchmarking of buildings and are accompanied with either a mandate for widespread public disclosure or a more limited disclosure of the efficiency of the buildings. The B&T policies currently being implemented vary in multiple details, most notably the requirements regarding what building segments are covered, the minimum building size that is covered, and disclosure requirements. The Institute of Market Transformation (IMT) provides and maintains a good overview of every current policy.[18]

The intended value of these policies is two-fold. First, B&T policies have the potential for encouraging enhanced energy savings, reductions in GHG emissions, and improved ties between buildings energy consumption and its value. The simple logic (more detail on this in Section 1.1) is that through access to building energy consumption information, decision makers can properly account for it in their investment decisions. Second, B&T policies serve as a foundational policy: the energy consumption data that are collected can be used to help enhance the effectiveness of other efforts that target commercial buildings energy savings.[19] As depicted in Table 1-1, this handbook is designed to help jurisdictions quantify the magnitude of only the first value statement.

Table 1-1. Value Statement of B&T Policies[20]

Interview Guide	Quantifiable?	Addressed?
Market Impacts: energy savings, GHG reductions, improved link between energy consumption and real estate valuation, jobs?	✓	✓
Foundational: energy consumption data that are collected can be used to enhance other program design efforts that target reducing commercial buildings energy consumptions	X	X

Figure 1-1 shows a summary of the existing B&T policies by location and square footage of buildings required to benchmark.[21] New York City's B&T policy affects the largest total gross square footage, accounting for 47% or more of the total gross square footage required to be benchmarked across the United States in 2013 (IMT, 2015). In addition to the jurisdictions depicted in Figure 1-1, there are a significant number of governments currently proceeding with legislation to enact a B&T policy.[22]

[18] These overviews may be found at: http://www.buildingrating.org/.

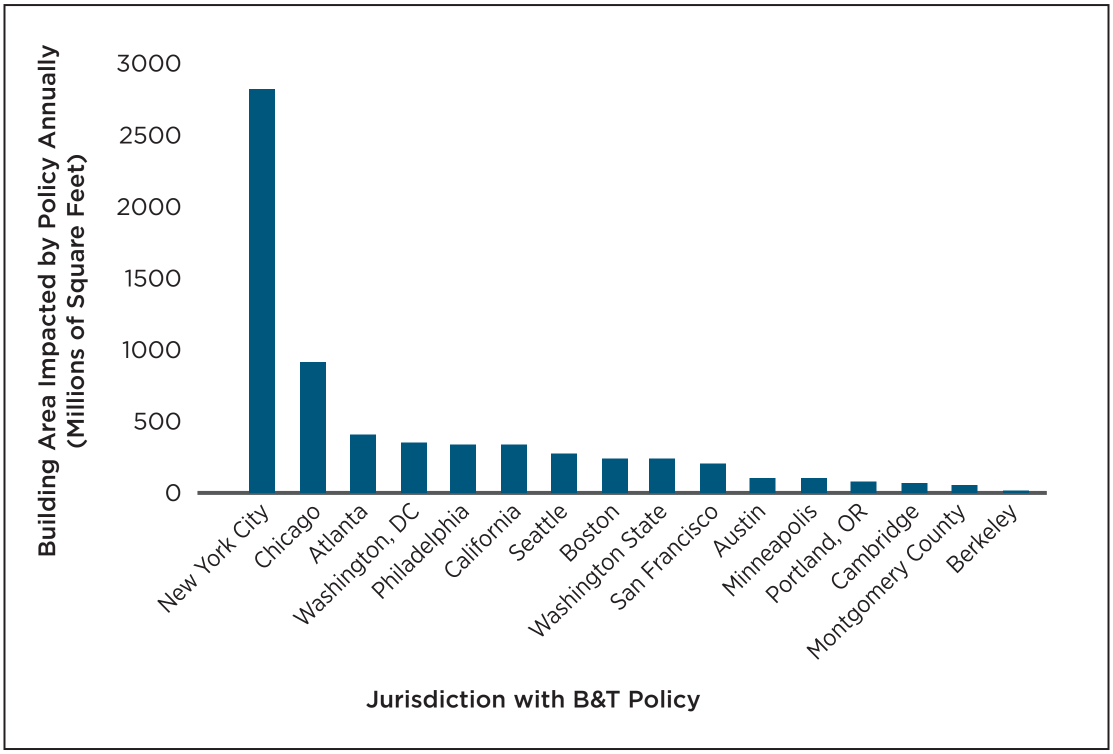
[19] See Section 2 for a detailed discussion of how these impacts become a major focus of and are incorporated into the handbook's B&T policy or program planning framework — and the related framework logic model component presented there.

[20] At the early stages of the B&T policy, foundational linkages to policy benefits are likely to be difficult to discern. However, in intermediate and long-term stages, jurisdictional foundational partners may support evaluation of program effects that do quantify these benefits.

[21] IMT maintains information on the jurisdictions that have and are considering enacting B&T policies, available at: http://www.buildingrating.org/.

[22] Since the time of the creation of this graph several other cities are considering adopting B&T policies. As noted, in addition to cities with mandated policies, several jurisdictions are encouraging building owners to benchmark their energy use through voluntary benchmarking and transparency programs. Examples of this approach include city programs in Ft. Worth, TX and Milwaukee, WI.

Figure 1-1. Cities and States Across the U.S. with B&T policies (IMT 2015)[23]



1.2 Structure and How to Use this Handbook

This handbook is meant to be user friendly and very much a practical evaluation manual. Included in the handbook is a B&T policy planning framework and three categories of methodologies included, as outlined below:

- **Section 2** presents both a comprehensive B&T policy planning framework that includes an illustrative logic model and related market transformation indicators (MTIs)[24] and a methodology for assessing a jurisdiction's market transformation (MT) progress. These planning and progress evaluation elements help an adopting jurisdiction place its policy into a longer-term perspective providing support for: a) explaining the intended outcomes of the policy; b) tracking the impacts of the policy over time during each of its market transforming implementation phases; c) assessing the market progress of the policy.

- **Section 3** discusses methodologies for calculating the impacts on the jurisdictions buildings' energy use of the policy. The energy impact methodologies provide means of estimating overall energy savings in commercial buildings over time and, in the long term, the energy impacts directly attributable to the B&T policy.

- **Section 4** discusses methodologies for calculating the potential non-energy impacts of the policy. Non-energy impacts are categorized as GHG emissions impacts, jobs impacts, and real estate valuation impacts.

For each of the methods presented above, there are two types of methodologies provided: primary methodologies and supplementary methodologies. The primary methodologies are relatively simple – they use data typically collected through the B&T policies, rely on documents that are in the public domain, and require little feedback from stakeholders. They are intended to appeal to those who wish to perform a basic assessment of the B&T

[23] *Both Washington State and Seattle have B&T policies. However, these policies differ somewhat, hence, both policies are noted separately in the figure. Similarly, California's benchmarking policy differs from jurisdictional B&T policies in San Francisco (and Berkeley) and is also listed separately.*

[24] *MTIs are market indicators of how well the B&T policy's market transforming goals (of energy transparency and savings in the commercial/multifamily buildings sector) are being met over time. They have a special focus on how well the policy is meeting its goal of helping market "push-pull" forces become the major driver of enhanced energy efficiency in the commercial buildings sector(s). MTIs are related directly to evaluation of the policy's progress in overcoming the barriers to energy efficiency identified in the logic model. The MTIs may be seen as "markers" of the policy logic and theory progress over time.*

policy, and require little to no expertise in policy evaluation to conduct. The supplementary methodologies are more sophisticated and rooted in traditional utility energy efficiency (EE) program evaluation methodologies. Supplementary methodologies are intended to be used by evaluators who wish to invest greater effort in order to obtain results that are more robust.[25]

Accompanying each methodology discussed is an overview, a list of steps one would take to execute the methodology, and an example calculation. The jurisdiction presented in the example calculation is fictitious, although much of the data used in the examples is drawn from real-world scenarios. Figure 1-2 provides an overview of the framework and recommended B&T policy evaluation methodologies along with associated activities, followed by a general description of each of the methodologies.

Figure 1 2. B&T Handbook Market Transformation Planning Framework and Evaluation Methodologies, Activities and Approaches

B&T Policy Planning Framework and Impact Evaluation Handbook	Activity Description	Approach (*Primary or **Supplemental Method)
Handbook Section 1 & 2 B&T market transformation planning framework	B&T policy theory and strategic logic model development	*Primary method* • Identify barriers to energy efficiency • Select activities to overcome barriers • Target expected outcomes
Leading indicators of market impacts	Market transformation indicators (MTI) development to identify the progress of expected outcomes over time	*Primary method* • Analyze market infrastructure and market actor changes • Analyze sustainability of policy impacts over time Identify key milestones indicating policy success • Analyze MTIs using market actor interviews and surveys
Handbook Section 3 Gross energy impacts	Portfolio Manager data analysis to identify energy impacts	*Primary method* • Analyze iterative energy use intensities (EUIs) *Supplemental method* • Augmented analysis of iterative EUI outputs
Net energy impacts	Attribution of savings across various energy efficiency policies and programs that target the same buildings market	*Primary method* • Develop historical tracing • Structured expert judgment panel (intermediate & long-term) *Supplemental method* • Quasi-experimental design to estimate net impacts from regression approaches
Handbook Section 4 Non-energy impacts	• Greenhouse gas (GHG) reductions • Net job creation • Real estate value enhancement assessment	*Primary method* • Calculate GHG benefits • Calculate direct, indirect and induced jobs • Real Estate comparative sales analysis *Supplemental method* • Real estate – hedonic regression modelling

[25] *All of the primary and supplementary methodologies discussed have been developed and reviewed by experts in the field of energy efficiency program evaluation as well as B&T policies. Many of the supplementary methodologies should be conducted by parties with significant experience performing energy efficiency program and policy evaluations.*

1.3 B&T Policy Planning Framework Elements

The B&T policy strategic framework is a planning structure that allows policy planners and implementers to clearly state their goals and the activities and outcomes that the policy is meant to achieve in the short, intermediate, and long-term. Table 1-2 provides an overview of the elements of the handbook's B&T policy framework. These elements provide the basis for assessing policy progress.

Table 1-2. The B&T Policy Planning Framework

Key Elements of a Planning Framework for Implementing B&T Policies	
Identify Barriers to Policy Success	Understand the key barriers that are being addressed by B&T policy implementation
Activities to Overcome Barriers	Identify the activities the B&T policy will undertake to overcome the barriers
Expected or Intended Outcomes	Policy activities lead to expected outcomes (e.g., enhanced building energy performance, market awareness, and other desired outcomes) that need to be identified and incorporated into the program logic framework
B&T Logic Model Development	Develop a complete "roadmap" or "logic model" that shows what barriers are intended to be overcome, activities implemented and outcomes expected
MTI Development	Develop a comprehensive set of milestones of progress indictors (i.e., market indicators of the policy's progress) that can be measured in the marketplace to evaluate the progress and impact of the policy on intended outcomes over time

1.4 The Logic of B&T Policies

Before endeavoring to employ any methodologies to evaluate the impact of B&T policies, it is wise to discuss the behavioral theory of how they work. In theory, in any open market, access to better information by both "buyers" and "sellers" allows them to make more efficient market choices. B&T policies mandate the type and form of information as well as the process by which it is shared with tenants ("buyers"), building owners ("sellers"), and other market actors such as underwriters, investors, or real estate professionals. In this manner, the policies transform both the market actor behaviors as well as the structure of the market itself.

This transformation does not occur instantaneously. After the initiation of a B&T policy, four stages occur prior to improved and persistent energy performance that are attributable to the policy. In the immediate stage, typically in the first year after implementation of a B&T policy, information flows from building owners to jurisdictions or prospective tenants depending on the policy language. In this stage and the next one, still in the short term, this information must flow to decision makers who can use it effectively. After, in the intermediate term, the decision makers must actually make a choice to use the information to make better-informed decisions. Long-term, persistent improvements in building energy performance serves as the foundation for measurable savings that can be associated with an implemented policy.[26]

An evaluation of the impacts of B&T policies should try to quantify the energy and non-energy impacts that occurred subsequent to implementation. To gain an early understanding of the likely long-term impacts of these policies, evaluators must examine the immediate and short-term indicators of market transformation that may

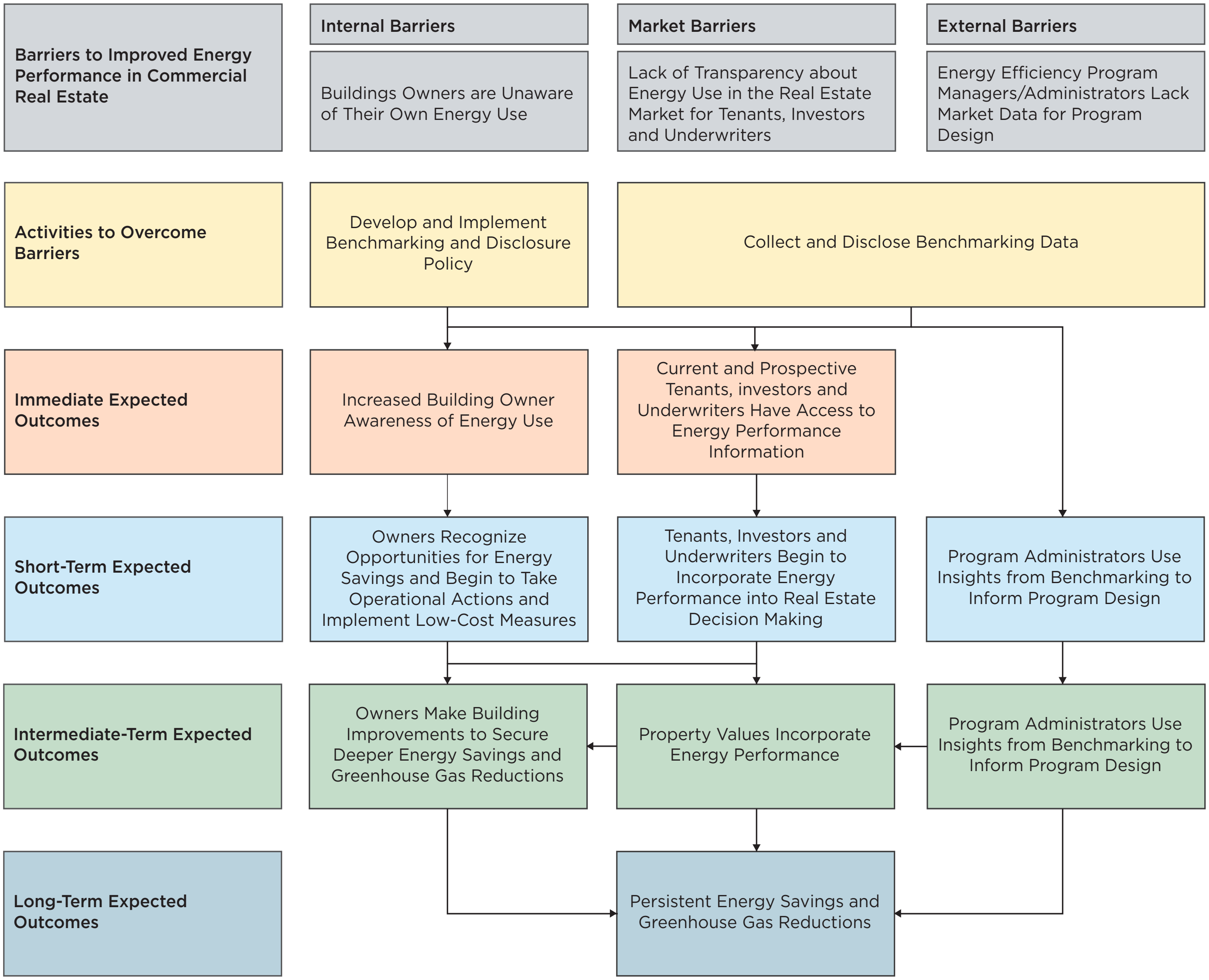
[26] This is not to imply that energy savings from the policy are not present in the earlier periods of policy implementation, because they often are. The focus here is on the growing awareness and concomitant energy savings actions of a major share of owners within the B&T market who, affected by the policy, make investment decisions toward energy efficiency that change the structural "shape" of the market over time – thus transforming the very fabric of thinking and decision making about energy efficiency within the B&T policy's jurisdictional boundaries.

precede actual energy savings. Progress assessment efforts to monitor the expected outcomes of each stage should begin soon after policy implementation so that jurisdictions can ascertain whether the theory is working as intended.

Mapping out this approach in a B&T policy "logic model," provides both a roadmap for answering questions of "who," "what," "when," "where," and "how," as well as the data necessary to evaluate the progress and effectiveness of the policy effort. As noted, this function includes a review of barriers, activities, and expected outcomes of the successfully implemented B&T policy. In particular, an important component of the overall impact of the B&T policy is the identification of key MTIs that will be used in measuring the progress of the policy towards reaching its goals at various stages of implementation.

In Figure 1-3, we present an illustrative example of a B&T policy logic model that graphically shows linkages among: a) the barriers the B&T policy is intended to overcome, b) the activities the implementing jurisdiction is taking (at the current time and planned into the future) to overcome those barriers, and c) the anticipated outcomes of the policy related to market transformation, energy, and non-energy impacts.

Figure 1-3. Illustrative Benchmarking and Transparency Policy Logic Model Diagram[27]



In this generic timeline of B&T market transformation, the focus of the first several years' evaluation should be upon leading indicators of market transformation progress, such as owners' actions to save energy, the changing awareness among market actors and enforcement authorities, and the value of B&T information to efficiency program administrators to help inform enhancements to program design. Specifics regarding which leading indicators may be monitored and how to do so are provided in the next section.[28]

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27 *In this table, the term program administrator applies to organizations or entities operating energy efficiency savings focused programs and/or activities in the market, rather than to B&T policy implementers.*

28 *Ideally, the B&T jurisdiction will have conducted a market characterization study before passage of the policy, from which early policy activities may be measured in terms of progress against this baseline.*

2 Assessing Market Transformation Progress

This section discusses leading MTIs, which provide market oriented milestones along the path of policy implementation. These are directly linked to the B&T policy logic model. The following sections provide detailed explanations and examples of these two core elements of assessing market transformation progress: the policy logic theory and model and the MTIs.

2.1 The Power of "Push-Pull" Market Transforming Effects

Once B&T information begins to inform transaction decisions, the enforcement of mandates becomes less important. For instance, tenants' reliance on B&T-policy-provided information when selecting properties to consider leasing will tend to motivate, or "pull," building owners towards enhanced energy-efficiency solutions. Upon recognizing this demand, building owners will tend to be motivated to consistently "push" towards more energy-efficient buildings to compete in the marketplace. In the ideal, as the availability of benchmarking data become commonplace and an expectation in transactions, building owners may be forced to enhance the efficiency of their inefficient buildings so that the inefficiency does not present a detriment the building value.[29] As such, the B&T policy is expected to have a significant "market defining" impacts on the markets in which the policy is implemented.[30]

This push-pull of market actor activity relating to increased market transparency (brought about by the B&T policy) is a fundamental market process that assumes that consumers (tenants and buyers) and sellers (owners) ascribe value to knowing the energy-efficiency status of buildings they are selling, leasing, buying, or renting. Market experience in the growth of LEED (Leadership in Energy and Environmental Design) and U.S. Environmental Protection Agency (EPA) ENERGY STAR certified buildings, for instance, has shown that consumers and sellers value energy-efficiency and other green aspects within important commercial buildings markets.[31]

In Figure 2-1, we present a simple diagrammatic view of push-pull market impacts over the lifetime of a B&T policy as market actor awareness, sophistication, and knowledge of energy-efficiency increases across the three (example) policy implementation timeframes.[32]

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[29] *U.S. Department of Energy, by Waypoint, "Energy Efficiency & Financial Performance: A Review of Studies In The Market" March 2014.*

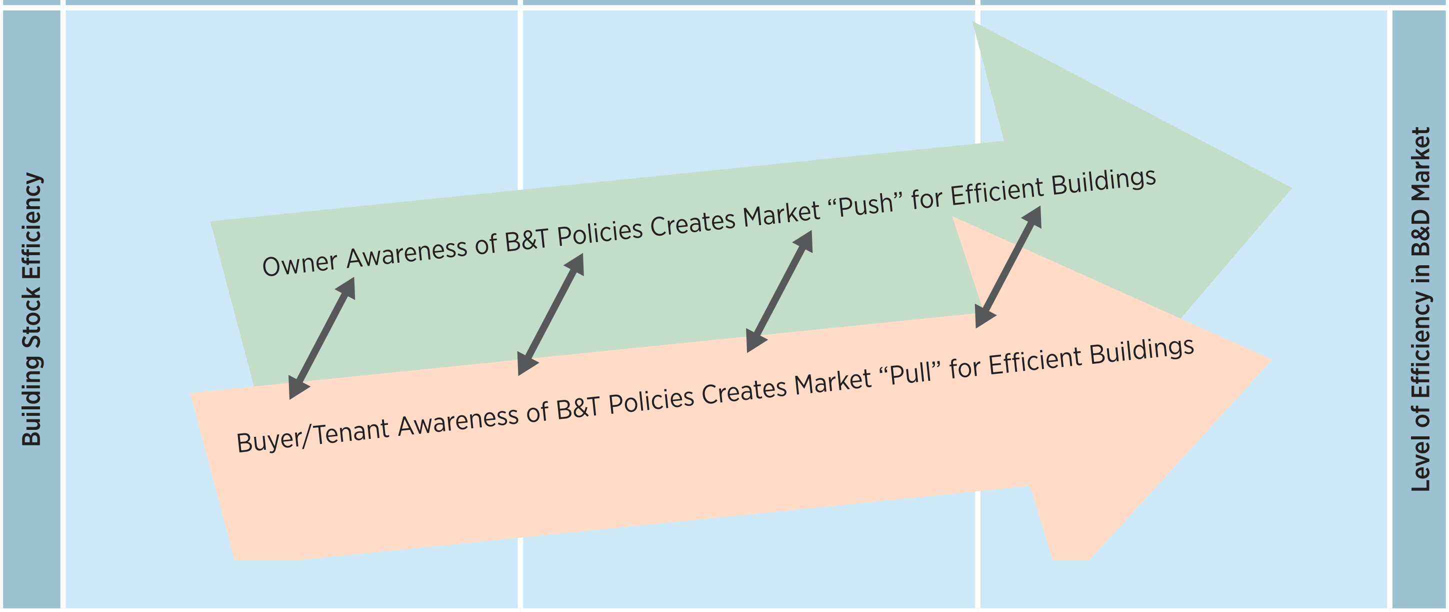
[30] *It should be noted that even with this market defining situation, it is likely that mandatory B&T policy implementation will be needed to continue momentum of policy impacts.*

[31] *Ibid.*

[32] *These policy timeframes are notional and will vary in each jurisdiction, but are presented here to provide general guidance for B&T policy implementers.*

Figure 2-1. Illustrative Example of the Push-Pull of the B&T Market Space

	Short-Term Implementation (1 to 3 Years)	Intermediate-Term Implementation (4 to 6 Years)	Long-Term Implementation (7 to 10 Years and Beyond)



	Short-Term Implementation (1 to 3 Years)	Intermediate-Term Implementation (4 to 6 Years)	Long-Term Implementation (7 to 10 Years and Beyond)
Expected Market Status	• Tenants and owners are able to access/become aware of relative energy efficiency status of buildings • Savvy tenants begin to request efficiency information when making purchase choices • Innovative owners use efficiency to position their buildings as Class A real estate; including making early efficiency improvements	• Owners are pursuing lower cost operational measures, to increase efficiency • Savvy tenants use energy efficiency information when making building lease choices and in lease negotiations • Innovative owners invest in energy efficient retrofits to improve customer comfort and reduce costs	• Mainstream owners recognize that efficiency improvements create lasting value in their properties, and invest in energy savings accordingly • Premiums are paid for high-efficiency buildings and lower efficiency buildings are associated with lower rents, higher vacancy • Information transparency has allowed the market to operate efficiently by incorporating energy into decision-making and valuation

The greatest impact of this push-pull dynamic on B&T-policy-implementing markets will likely be related to the speed in which B&T markets will move towards higher efficiency. Markets with no B&T policies, and thus less market transparency about the energy-efficiency status of the market commercial and/or multifamily building stock, will likely be slower to shift to higher efficiency buildings. This assumes that the knowledge of the B&T policy is widespread and that the various market participants value the information – encouraging owners to supply more efficient buildings, and tenants to demand them.

2.2 Typical Market Transformation Indicators

A critical first step in the process of assessing the status at any given time of market transformation due to the B&T policy is to develop MTIs that assess the extent to which market barriers have been eroded. As identified in the

NYC logic model (presented in Section 3), the following three key barriers are being addressed in NYC's B&T policy:[33]

- ***Internal Barriers:*** Lack of owner or property manager visibility or focus into the building's energy use [34]
- ***Market Barriers:*** Lack of transparency about energy performance among real estate professionals, tenants, investors, and underwriters[35]
- ***External Barriers***: Lack of market data to support non-B&T program and policy design[36]

These key barriers link back to B&T policy logic (Figure 1 3) and are the foundation for developing the primary MTIs that are used in this report to evaluate progress in transforming the commercial building market towards the policy goals.

Tables 2-1 through 2-3 provide examples of short, intermediate and long-terms MTIs associated with overcoming these barriers, as well as primary data sources, supplemental data collection methods and potential actions in case of absent or partially present MTIs.

Table 2-1. Building Owner Awareness Market Transformation Indicators

Immediate/ Short-Term MTI (1 to 3 Years)	Intermediate-Term MTI (4 to 6 Years)	Long-Term MTI (7 to 10 Years)	Primary Data Sources	Supplemental Data Collection Methods	Potential Actions in the Case of Absent or Partially Absent Indicator
Building owners are aware of annual energy performance per building or leased space for all fuels	Building owners are increasing aware of annual energy performance trends for all fuels	Building owners incorporate B&T data into energy management decisions as a matter of standard practice	Interviews and surveys of building owners and property managers	Secondary research of trade periodicals	The absence or partial absence of this indicator would justify additional educational outreach to building owners
Building owners can identify specific energy performance opportunities in their own buildings	Building owners include energy performance as a component of retrofit/ renovation planning	Building owners increasingly incorporate energy performance in to expansion and retrofit design and construction practices	ENERGY STAR Portfolio Manager inputs and outputs	Surveys of utility account representatives	The absence or partial absence of this indicator would justify additional educational outreach to building owners by both the B&T program sponsor (local municipality) as well as local utilities

[33] *Other barriers may exist, but these three key barriers present the structure for city implementation actions.*

[34] *These are barriers to energy efficiency that are internal to the building owner and operator.*

[35] *These are barriers to energy efficiency that are due to how the real estate market performs i.e., information about energy use among real estate professionals, tenants, investors, and underwriters.*

[36] *These are barriers external to building operations and the real estate market that affect other potential policies and programs that can impact the effectiveness of potential market interventions such as utility program designs, updates to building codes, etc.*

Table 2-2. Transparency of Energy Use in the Real Estate Market

Immediate/ Short-Term MTI (1 to 3 Years)	Intermediate-Term MTI (4 to 6 Years)	Long-Term MTI (7 to 10 Years)	Primary Data Sources	Supplemental Data Collection Methods	Potential Actions in the Case of Absent or Partially Absent Indicator
Tenants are increasingly aware of energy performance information and their understanding of this information increases over time	Tenants incorporate disclosure information into lease negotiations	Tenants expect improving energy performance as a standard practice by building owners	Interviews with real estate professionals; Lease contract documents	Survey of tenants; survey of commercial real estate brokers	If tenants are unaware or uncertain of the value of benchmarking disclosure information, their transition from awareness to understanding to incorporation of the information into real estate decisions will stagnate or cease.
Investors and underwriters are increasingly aware of energy performance information	Investors and underwriters begin to include disclosure information as a valuation criteria	Investors and underwriters include improving energy performance as a standard valuation metric	Interviews with real estate professionals; Lease contract documents	Survey of tenants; survey of commercial real estate brokers	If investors or underwriters do not incorporate benchmarking and transparency information into their valuation process, it may mean that they have not observed sufficient demand for buildings with improved energy performance or that they lack a methodology to monetize any demand that they do observe. Programs that demonstrate tenant demand and/or valuation techniques to quantify this demand would be viable options to address these challenges.

Table 2-3. Availability of Market Data for Energy-Efficiency Program Design

Immediate/Short-Term MTI (1 to 3 Years)	Intermediate and Long-Term MTI (4 to 10 Years)	Primary Data Sources	Supplemental Data Collection Methods	Potential Actions in the Case of Absent or Partially Absent Indicator
Energy-Efficiency Program Administrators begin to include data resulting from B&T policies in their new program designs and as input to EM&V	Energy-Efficiency Program Administrators increasingly include benchmarking and transparency information as a standard input to their current and future program designs	Interviews with program administrators; publicly available program designs	Secondary research on public testimony from energy-efficiency program administrators on links to B&T policy	If energy-efficiency program designs do not include insights from benchmarking and transparency market data, a mitigation technique is facilitated dialog between policy makers and program administrators

These MTIs act as signposts by which evaluators assess the extent to which a jurisdiction's B&T policy has transformed, and potentially will continue to transform, the commercial real estate market, including, where applicable, the larger multifamily housing market. Because this transformation happens slowly, significant energy impacts from market transformation typically are not immediately apparent. In this context, quantifying the early progress of market transformation efforts may rely upon qualitative changes in market structure or market actor behavior as evidence that the eventual, intended energy savings outcomes are likely to take place.

2.3 Evaluation Activities to Assess Market Transformation Indicators

The focus of this section is on providing jurisdictions a set of recommended early evaluation activities designed to assess the immediate and short-term impacts of the B&T policy. These activities are intended to be low-cost while providing jurisdictional staff the key market data needed to assess policy impacts and progress. These data include information focused on the following:

- **Market awareness** and use of the B&T data in decision making (e.g., tenant lease choices, market valuation issues, etc.)
- **Program design adjustments** by energy-efficiency organizations based on B&T data that indicate any market response to energy performance information
- **Non-energy benefits** related to the persistence of energy savings, and for example, greenhouse gas emission reductions

Evaluation methods recommended during this period of early program evaluation are:

- **Interviews** with key market actors and program staff
- **Online Surveys** with building owners and property managers[37]
- **Structured Expert Panels (Delphi Panels)** to support evaluation information assessment goals as noted above (i.e., energy savings, market awareness, use of data to inform program design, non-energy benefits assessment)

Table 2-4 and Table 2-5 provide an overview of recommended activities for early and longer-term assessment of the B&T policy. These evaluation methods are intended to provide administrators with the impact assessment information they need throughout the various stages of the B&T policy market transformation effort.[38]

[37] *The discussion in this section focuses primarily on interview instruments and illustrative responses. Appendix B provides a sample owner survey instrument that may be used (or modified) by jurisdictions to complement interview approaches.*

[38] *There are other evaluation activities that do not fit within the market transformation/logic model paradigm that are also important, and they are recognized as such in this handbook. These non-energy impacts include employment, environmental and other economic impacts.*

Table 2-4. Evaluation Activities to Assess Immediate and Short-Term Outcomes

	Building owner awareness of energy use	Building owners take operational and energy efficiency actions due to benchmarking	Tenants/ Investors/ Underwriters have access to energy use and cost information	Tenants/ Investors/ Underwriters incorporation energy performance into real estate decision making	Program Administrators is insights from benchmarking to inform program design
Interviews					
Building Owners	X				
Real Estate Professionals		X	X		
Program Administrators				X	X
Online Survey	X	X			
Perform ENERGY STAR Portfolio Manager Energy and GHG Impact Analysis		X			

Table 2-5. Evaluation Activities to Assess Intermediate and Long-Term Outcomes

	Owners make building improvements that secure deeper energy savings and greenhouse gas reductions	Property values incorporate energy performance	Program Administrators use insights from benchmarking to inform program design	Persistent energy savings and greenhouse gas reductions	Program Administrators is insights from benchmarking to inform program design
Interviews					
Building Owners and Managers	X				
Real Estate Professionals		X			
Program Administrators			X		X
Expert Panel	X	X	X	X	
Perform ENERGY STAR Portfolio Manager Energy and GHG Impact Analysis	X			X	
Econometric Analysis of Real Estate Data		X			

2.4 Methodological Approach for Assessing Market Transformation Progress

In general, assessment of B&T policy market transformation progress is based on the presence in a jurisdiction's marketplace of the MTIs noted above (or other MTIs developed by an implementing jurisdiction) as compared with market actor interview results. These interviews provide the leading data collection technique used to identify evidence or non-evidence of the presence of the indicator.

As noted, the generic logic model identifies three barriers:

- Building owner *lack of awareness* of their own energy use
- *Lack of transparency* about energy performance in the real estate market for tenants, investors and underwriters
- Energy-efficiency program managers/administrators *lack market data* for program design

Identification of these policy barriers-to-success serves as an intermediary step to identifying both appropriate MTIs and related *interview questions* that are then used to compare findings from market actor interviews to the expected logic model outcomes and related MTIs – and thus assess the degree of market transformation progress and the likelihood of its (eventual) success/sustainability. The MTIs identified in Section 2.2 above were classified as internal, market, or external MTIs. Each market indicator should be developed and assigned an expected timeframe (immediate/short-term, intermediate-term, long-term) in which the market would be expected to show *evidence of "completion" (or progress) in meeting the policy indicator goal*, or "non-completion" (or lack of market movement towards progress) in meeting these milestones.

Table 2-7 shows a sample matrix — derived from the logic model — that can be used to assess the progress of the B&T policy towards market transformation and sustainability. The matrix compares findings from market actor interviews to the expected outcomes and MTIs over specific periods of policy implementation.

In general, three types of market actor interviews can provide the key data needed to assess policy progress: building owners and property managers, real estate professionals, and energy-efficiency program administrators. Appendix C provides illustrative interview guides for each of these groups of market actors. Each interview guide asked tailored questions designed to understand the presence of various MTIs for interviewees as a means of assessing their progress in the market transformation process, as well as in determining the relative impact of the B&T policy in the jurisdiction's market to date.

Lists of potential interviewees should be created from key market actor groups based on the jurisdiction's assessment of the need for diversity in the interviewee population – which in turn is based on the specifics of the jurisdiction's B&T policy (i.e., whether the policy refers to larger and smaller commercial buildings, multifamily buildings or other). Below we identify audiences that should be interviewed.[39]

- Building owners and property managers
- Real estate professionals (brokers, investors, appraisers, lenders)
- Energy efficiency program administrators

The data a jurisdiction collects during the interviews becomes the basis for qualitatively analyzing and comparing the expected outcomes and MTIs identified through the logic model.

2.4.1 Assessing Results of Market Actor Interviews to Determine Market Transformation Progress

Table 2-7 provides an illustrative example of a comparison of MTIs to market interviewee responses for a Building Owner and Manager set of interviews — with a summary of interview findings in the last column of each table.[40] These responses were derived from a limited sample of interviewees conducted in an early phase of B&T policy implementation.[41]

[39] *Interview guides for each audience are presented in Appendix C.*

[40] *Appendix C provides similar example tables for Real Estate Professional and Energy Efficiency Agency/Entity interviews that compare MTIs to interviewee responses to determine the level of market progress, or not, during a particular timeframe example (immediate and short-term, in this case) upon which these examples are focused.*

[41] *For detailed EM&V efforts, a broader sample of interviewees would be necessary.*

Table 2-7. Market Transformation Progress Assessment: Illustrative Table of Building Owner and Property Manager Interview Findings with Comparison to MTIs (Immediate and Short-Term Policy Implementation Period)

	Outcome	Internal MTIs	Market MTIs	External MTIs	Interview Findings
Immediate	Increased building owner awareness of energy use.	Building owners are aware of annual energy spent per building or leased space for all fuels.	N/A	N/A	There is a high level of awareness among building owners and managers. All eight owners interviewed were tracking before the policy, and five out of eight were already benchmarking. For four interviewees, the policy improved their understanding of energy use, while for others it had no impact other than changing their behavior to meet the law.
Short Term	Owners recognize opportunities for energy savings and begin to take operational actions and implement low-cost measures. Tenants, investors, and underwriters begin to incorporate energy performance into real estate decision making.	Building owners can identify specific energy savings opportunities in their own buildings. Building owners can describe implementation of specific low-cost measures within their own buildings.	Tenants are increasingly aware of benchmarking disclosure information and their understanding of this information increases over time. Investors and underwriters are increasingly aware of benchmarking and disclosure information.	N/A	Six of the nine interviewees were already participating in utility programs before the enactment of the policy. The B&T policy was not a strong influence in building owners' decisions to participate in energy efficiency programs, but tenants, investors, and underwriters are beginning to request energy data more often.
Intermediate Term	Owners make building improvements to secure deeper energy savings and greenhouse gas reductions. Property values incorporate energy performance.	Building owners are increasingly aware of annual energy spend trends for all fuels. Building owners include energy savings as a component of retrofit/renovation planning.	Tenants incorporate disclosure information into lease negotiations. Investors and underwriters begin to include disclosure information as valuation criteria.	N/A	For eight out of nine building owners and property managers, the policy did not influence their decision to make energy efficiency improvements. All interviewees said that they were "very likely" to invest in energy efficiency upgrades, though not necessarily due to the B&T policy. Demand for efficient or green-labeled buildings has increased, and building owners expect to see more investors requesting benchmarking data in the future. For most owners and managers, compliance with the ordinance was the most influential reason for benchmarking.
Long Term	Persistent energy savings and greenhouse gas reductions.	Building owners increasingly incorporate B&T data into energy management decisions. Building owners increasingly incorporate kWh and therm costs into expansion and retrofit design and construction practices. Building owners deliberately strive toward improved energy performance as a management metric.	Tenants require consistent energy improvements as a standard lease offering. Investors and underwriters include improving energy performance as a standard valuation metric.	N/A	Most interviewees have hired full-time staff or consultants dedicated to energy efficiency in their buildings, but have not quantified the benefits of their energy management efforts to date. Energy efficiency is not a large draw for tenants, but those that have drawn new tenants cited cost savings and public image as drivers.

This example of the comparison method of market actors to MTI focuses on the immediate and short-term period after a policy has been implemented. From a market transformation progress methodology point of view, interviews with all three sets of actors should be undertaken periodically during each of the other market transformation phases of policy implementation: intermediate and long term, as a means of assessing the deepening progress of the B&T policy initiative in the marketplace.

Table 2-8 provides an example of interview timelines when it might be appropriate to re-interview the various market actor groups, to determine ongoing policy MT Progress. Note that the example provides a hypothetical number of years; the actual number of years will vary across various jurisdictions implementing B&T policies.

Table 2-8. Illustrative Example of Possible Timing for Initial and Re-Interviews to Determine MT Progress[42]

Market Progress Interview #	Market Transformation Period	Interview Timing Rationale
1	Immediate and Short-Term (1-4 years)	Early-market transformation interviews provide market actors perspectives and progress indications after the first couple of years of implementation
2	Intermediate-Term (4-7 years)	Mid-market transformation implementation interviews provide progress indication of the deepening (or not) of the B&T policy on the market and market actors
3	Long-Term (>7 years)	Late market implementation interviews provide confirmation that policy has met or begun to meet its primary goals of market transparency and owner savings actions, tenant and investor awareness and use of the policy and other energy-efficiency administrators using the B&T policy information to enhance program design

2.4.2 Example Report-out of Results of the Market Transformation Progress Assessment

Below we provide a generic outline and tables showing how a summary market transformation progress report might look, once interviews and MTI comparisons are completed (per Table 2-9 and D examples). This example is for a report of summary findings from immediate and short-term policy implementation period interviews.

Example Immediate Outcomes and MTIs Report-out

> *Of the (x) building owners and managers interviewed, all were aware of issues of energy management, and some noted that many large properties have sophisticated building management systems to monitor energy use in real time. The B&T policy resulted in publicity for some large commercial clients, causing them to pay closer attention to energy usage. Additionally, the requirement for building owners to comply with the policy has led to a better understanding of tracking energy usage and the various metrics involved in normalizing data to allow for comparisons and benchmarking. While the policy has not explicitly affected owners' views about energy efficiency in most cases, there is a growing understanding that issues of energy efficiency and sustainable management are now standard in the building management industry.*

[42] *The issue of timing for market progress interviews is a critical one that should be decided by jurisdictions at the outset of using this Handbook framework. For example, some jurisdictions may choose to interview market participants each year in the early stages of the policy implementation, while others may choose alternative approaches.*

Outcome	MTI	MTI Present?
Increased building owner awareness of energy use	Building owners are aware of annual energy spent per building or leased space for all fuels.	Yes

Example Short-Term Outcomes and MTIs Report-out

Building Owner and Property Manager Findings

Some interviewees (x number) were already taking advantage of existing energy-efficiency programs prior to passage of the B&T policy; others were not and had to come up to speed quickly to understand the intent of the policy and what they needed to do; compliance seems to have interested some owners into thinking more about energy use than prior to ordinance passage. While some respondents were likely or planning to invest in energy-efficiency upgrades within the next year, the B&T policy was not necessarily the driver in all cases. Rather, these building owners and managers frequently chose to undertake energy-efficiency upgrades for financial savings and other internal reasons. Regarding the role of the B&T policy in real estate decision making, the limited number of interviews undertaken suggests that tenants and investors are growing in their awareness and attention to energy use, although it seems early to make a broad statement about the policy's effect. Several real estate professionals noted, however, having already begun to see an increase in tenant and investor requests for data, and expect this to continue growing over the next three years.

Energy-Efficiency Administrators

Energy-efficiency program administrators interviewed are actively working the jurisdiction to provide needed data to customers to benchmark their buildings. All of the entities interviewed were in the process of determining how best to incorporate B&T policy data into their longer-term program processes and strategies, with one having begun to incorporate this information into their sales and program strategies and others being in earlier stages of implementation.

Real Estate Professionals and Efficiency Administrator Illustrative Findings

Outcome	MTI	MTI Present?
Owners recognize opportunities for energy savings and begin to take operational actions and implement low-cost measures.	Building owners can identify specific energy savings opportunities in their own buildings.	Yes, but not necessarily due to policy
	Building owners can describe implementation of specific low-cost measures within their own buildings.	Yes, but not necessarily due to policy
Tenants, investors, and underwriters begin to incorporate energy performance into real estate decision making.	Tenants are increasingly aware of benchmarking information and their understanding of this information increases over time.	Yes
	Investors and underwriters are increasingly aware of benchmarking and transparency information.	Yes
Program administrators use insights from benchmarking to inform program design.	Energy-efficiency program administrators begin to include benchmarking and transparency information in their new program design.	Yes

Example Intermediate- and Long-Term Outcomes

MTIs associated with intermediate- and long-term outcomes are not yet present in the current real estate market in Jurisdiction A. LEED and ENERGY STAR buildings do see slightly higher demand among large corporate tenants but not on a consistent basis. Building owners are not yet making capital improvements for deeper energy savings, and property values do not reflect a building's energy performance.

3 Estimating Energy Impacts from B&T Policies

The primary energy impact analysis methods recommended in this handbook are designed to:

1. Be relatively simple and inexpensive to implement,
2. Require minimal data collection efforts beyond what the data jurisdictions already collect through the B&T policy, and
3. Meet basic, industry accepted impact evaluation techniques.

The recommended set of approaches for estimating the energy impacts from B&T policies include:

- **Analysis of Energy Use Intensity (EUI) Outputs from Portfolio Manager**, which as discussed in Section 3.1 provides a gross estimate of energy consumption changes in policy-affected buildings over time without differentiating among the various factors such as policies, market forces, and energy-efficiency programs that may be contributing to the energy consumption changes.
- **Applying Historical Tracing and Structured Expert Judgment**, which as discussed in Section 3.1 provide a way to ascribe the share of gross savings that can be reasonably attributed to the B&T policy.

The remainder of this section discusses the methods available to estimate the energy impacts from B&T policies.[43] It begins with basic concepts and definitions, followed by an overview of potentially applicable energy impact analysis methodologies, both primary and supplementary. Additional details for the recommended methodologies are provided at the end of the section, and details for supplementary approaches are contained in Appendix A.

3.1 Basic Concepts and Definitions

The Baseline or Counterfactual Scenario

In theory, the actual energy savings achieved by a B&T policy should be equal to the difference between the amount of energy used by buildings subject to the policy relative to the amount of energy they would have used had the policy not been adopted. This baseline is called the “counterfactual” scenario, what would have happened if the B&T policy was not implemented. As the counterfactual scenario cannot be directly measured, defining an approach that approximates it represents the fundamental concept—and the greatest challenge—to estimating the energy savings and documenting the benefits of B&T policies.

Gross and Net Energy Impacts

The principal energy impact metrics are known as gross energy impacts and net energy impacts. The U.S. Department of Energy’s (DOE’s) Uniform Methods Project (Haeri, 2013; Violette and Rathbun, 2014) provides definitions of gross energy and net energy impacts for energy-efficiency policies and programs that are widely accepted by the industry. The following are adapted for B&T policies:

- ***Gross Impacts:*** The change in buildings’ energy usage over time inclusive of actions taken to improve their Portfolio Manager scores or reduce energy consumption, as well as their participation in other energy-efficiency activities or programs.
- ***Net Impacts***: The subset of measured gross energy changes attributable to the B&T policy. That is, the net savings after taking into account natural market forces and the impacts from other local, state, federal, and utility energy-efficiency program and tax credit initiatives.

[43] *This section draws heavily from recent energy efficiency program impact evaluation manuals including the SEEAction Energy Efficiency Program Impact Evaluation Guide (SEEAction, 2012) and DOE’s Uniform Methods Project (Haeri, 2013; Violette and Rathbun, 2014). These documents should be reviewed by readers interested in additional theoretical discussion of the merits of the various energy impact approaches discussed in this Handbook.*

Baselines and Net Savings

The definition of the counterfactual is intertwined with net savings through this question about the correct baseline: *What would have occurred in the absence of the policy?* Attribution is the extent to which the B&T policy may be seen as directly or indirectly responsible for the measured energy and non-energy impacts. The definition of attribution in this context is the acknowledgement that the impacts can be attributed to one or more policies, programs, or market forces that theoretically could be responsible for the measured result.[44]

As discussed later in this section, this handbook's recommended approach to estimating gross energy savings—comparing within jurisdiction Portfolio Manager outputs—reflects energy consumption and efficiency practices as of the moment the B&T policy was implemented, and the impacts over time of all policies and programs from the agencies and utilities seeking to reduce energy consumption in the targeted buildings.

Additionally, the concept of attribution is particularly relevant when multiple programs, policies, and regulations are targeting the same audience, which is typically the situation faced with local B&T policies. Furthermore, the foundational aspects of B&T policies, which essentially means that they are designed to facilitate participation in other energy-efficiency programs, suggests that attribution analysis may not be necessary. Some industry professionals argue that in these instances, it is nearly impossible to isolate the impacts from the various programs. They contend that, at best, we should either ignore the net impacts issue or proportionately allocate gross savings by expenditures or some other metric representing relative effort across programs.[45]

3.2 Overview of Energy Impact Evaluation Approaches Applicable to B&T Policies

The energy impact evaluation approaches potentially applicable to B&T policies can be grouped into two conceptual frameworks: control group approaches and non-control group approaches. Control group approaches utilize energy consumption data from buildings that are subject to the policy and those who are not. A "comparison" group's energy use is compared with that of "treatment" buildings—policy participants—to provide an estimate of net savings. In this context, the isolation of treatment and comparison group buildings directly isolates B&T savings from other agency or utility EE programs, so it is not be necessary to conduct further attribution analysis among the various policies and programs.

In non-control group approaches, pre-policy baseline energy use estimates are developed for participants, and this baseline is compared to post-policy energy use estimates. In general, these non-control group approaches as applied to EE programs generate estimates of gross savings, and require further adjustments to provide net savings estimates.

Control Group Approaches

Within the general control group approach, there are two broad sub-categories of methods recognized by practitioners: randomized controlled trials (RCT) and quasi-experimental methods. In an RCT, a study population (e.g., commercial buildings over 100,000 square feet) is defined and randomly assigned to either the treatment group or the control group. However, for a mandatory policy, which applies to all buildings, there is no "treatment" group that is different from a "control group." There are no potential "non-participants" from which an RCT can be developed, so an RCT cannot be designed for B&T policy impact evaluation.[46] In the context of a B&T policy evaluation, quasi-experimental methods assign "similar" buildings that are not subject to the policy to a control group.

The implementation of these quasi-experimental approaches typically involves performing econometric or statistical analyses using energy use data or other important independent variable data (e.g., weather, demographic,

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[44] *Readers interested in understanding both the theory and practice of net energy impacts estimation across policies, regulations, and energy efficiency programs and technologies should refer to Violette and Rathbun (2014) as that Uniform Methods Project Chapter includes several methodologies that are not specifically relevant to B&T policies.*

[45] *This is the approach taken by DOE to attribute savings to the American Recovery and Reinvestment Act of 2009 (ARRA) program efforts: "The effects of jointly funded initiatives, such as when SEP Recovery Act funds are combined with funds from other programs or financial offerings, will be allocated to the Recovery Act in proportion to the percentage of those funds in relation to total program or project funding" (DOE, 2010).*

[46] *However, there are still possibilities for an RCT for an "enhanced" B&T policy. For example, if there are different types of reporting or audit requirements that are being implementing randomly in a jurisdiction, the impacts of these enhancements could be studied directly through an RCT.*

or firm-specific variables) for those in the control and treatment groups. The remainder of this section describes the potential quasi-experimental design approaches applicable to B&T policies: pre-post analysis, regression discontinuity analysis, comparison city analysis, and matched controls.

Pre-Post Energy Usage Regression Analysis

One of the most common quasi-experimental methods compares the energy use of participants in the treatment group after they were enrolled in the program to the same participants' historical energy use prior to program enrollment. In effect, this means that each participant in the treatment group is its own nonrandom control group. The challenge in using this "pre-post" method is that there are many other factors that may influence energy use before, during, and after the program that are not captured with this method, resulting in biased savings estimates. To minimize bias when using the pre-post calculation method, it may be necessary to control for the impact of other influences such as economic activity, energy prices, and other variables in the regression analysis.

Regression Discontinuity Analysis

Regression discontinuity analysis explicitly recognizes that B&T policy square footage threshold requirements can be used to develop a control group. For example, if the B&T requirement threshold applies to buildings over 50,000 square feet, then one might reasonably expect that the only difference in consumption per square foot between buildings ranging from 40,000 to 50,000 square feet and those ranging from 50,000 to 60,000 square feet is the policy. The former group serves as a control group for the latter, treatment group. Another way to do this is by jurisdiction within the metropolitan area. If City X borders City Y, and X has a B&T policy and Y does not, then regression discontinuity analysis can be done along the border, with geography replacing building size in the regression discontinuity set up and analysis.

The regression discontinuity approach requires that the monthly energy consumption data be available for a large sample of buildings (e.g., several hundred or more) both above and below the threshold, before and after the implementation of the policy, and the assumption that B&T energy impacts for larger buildings are identical to those just above the threshold. Although square footage thresholds or geographic boundaries may appear to provide, on the surface, access to a representative control group, note that the reasonableness of this assumption is not assured merely by using the approach. It is possible that the nature of the real estate will differ, which would lead to biased impact estimates. Additional real estate market information, as well as the statistical techniques that can lead to a better, matched control group, should be considered prior to implementing regression discontinuity approaches. In conjunction with matching methods (discussed below), regression discontinuity will likely yield the most unbiased estimate of energy savings among the quasi-experimental methods, but it is also the most complicated method, requiring advanced knowledge of econometric modeling in addition to substantial data requirements.

Comparison City Analysis

Comparison city analysis relies on the use of a similar city, without a B&T policy, to serve as the control group. This is similar to the approach above, with the comparison city analysis distinguished by situations where the cities are not adjacent to one another. This approach also requires both pre- and post-B&T policy adoption energy consumption information from the treatment and comparison city. It also requires variables that can distinguish between economic and other city-specific influences on consumption. For example, if buildings in the comparison city have more options to participate in energy-efficiency incentive programs, that distinction would need to be addressed in the regression model. As with regression discontinuity analysis, the comparison city approach is complicated and requires advanced knowledge of econometric modeling.

Matched Controls

As noted above, simply selecting regression discontinuity boundaries or thresholds can potentially lead to biased impact estimates if control group buildings are not well-matched to treatment buildings. One way to mitigate such concerns is to "match" pre-policy energy consumption and other characteristics across treatment and control buildings. For example, matching would go beyond simple random sampling of treatment and control groups within the regression discontinuity approach by matching each treatment building with a comparison area "best match" based on the observable characteristics of customers.[47] Matching methods are now common in the economics literature—and the energy industry—for policy and program evaluations conducted with observational, rather than experimental, data.[48]

Non-Control Group Approaches

Within the general non-control group approach there are two sub-categories of gross energy savings approaches, Measurement and verification (M&V) and deemed savings:

- ***M&V*** is the process of using measurements to reliably determine gross energy savings created within an individual facility. The IPMVP and UMP define several options for estimating gross savings.

- ***Deemed savings*** are based on stipulated values, which come from prior year impact evaluation estimates using M&V or control group methods. The basic idea is that technical evaluation may not be necessary every year if prior analyses are relevant and there have been no changes warranting additional research.

The deemed savings approach is not applicable at this time to B&T policies since these efforts are in their infancy, and few evaluations have been done to date. Furthermore, the B&T logic model suggests that energy impacts will change over time, which indicates that individual jurisdictions may not be in position to deem energy savings.[49]

Whole-Facility Analysis Using Portfolio Manager Outputs

The IPMVP and UMP discusses four primary methods for calculating gross energy impacts from energy-efficiency improvements, which include:[50]

- Option A—Retrofit Isolation: Key Parameter Measurement
- Option B—Retrofit Isolation: All Parameter Measurement
- Option C—Whole-Facility Analysis
- Option D—Calibrated Simulation Modeling

Option C, Whole-Facility Analysis, is relevant to the evaluation of B&T programs because building owners are required to run their buildings through Portfolio Manager. Portfolio Manager aggregates monthly energy consumption for all energy sources of the building and effectively assesses energy usage – and changes in energy usage over time – at the whole-facility level.

3.3 Recommended Primary Impact Evaluation Approach

The primary gross energy impact analysis method recommended in this handbook is whole-facility analysis using Portfolio Manager output data contained in B&T policy tracking systems. The supplementary methodologies are more sophisticated and rooted in traditional utility energy-efficiency program evaluation methodologies, including those in the various guides cited previously. We are not suggesting that the supplementary methods never be applied. Rather, we are suggesting that they be used if resources and data permit, and when the leading indicators identified in Section 2 suggest that the intermediate / long run time period has been reached. More specifically, this handbook recommends pursuing quasi-experimental design approaches such as regression discontinuity, matching, or comparison city analysis when researchers are confident that intermediate or long-run outcomes have occurred, and more precise net savings estimates are desired or required.

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[47] *A recent report authored at Lawrence Berkeley National Laboratory cites matching methods as a reasonable alternative to establishing baseline conditions when RCTs are not an option. Please see State and Local Energy Efficiency Action Network. 2012. Evaluation, Measurement and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory.*

[48] *See, for instance, Cameron, A. Colin, and P.K. Trivedi, Microeconometrics: Methods and Applications, Cambridge University Press, 2005.*

[49] *However, jurisdictions that adopt B&T policies after there is a body of impact evaluations from those who previously adopted policies may be in position to use other jurisdictions' savings estimates as deemed in their evaluations.*

[50] *See Appendix A for more information on the IPMVP methods.*

In addition to whole facility analysis, the recommended set of approaches includes two complementary techniques for attributing gross energy impacts to B&T policies:

- Historical Tracing
- Structured Expert Judgment

These primary methods are summarized in Table 3-2 and explained in more detail below.

Table 3-2. Primary Recommended Energy Impact Estimation Approach

Recommended Component	Approach Summary
Analysis of Iterative EUI Outputs from Portfolio Manager	This approach relies on direct measurement of the year-to-year changes in Portfolio Manager energy consumption inputs by fuel type, and by further breakouts by building segment, size, or year built to derive energy impacts. The average energy usage from the initial set of Portfolio Manager outputs disclosed to the jurisdiction in the first year of the policy's implementation is interpreted to represent the state of the marketplace in terms of energy consumption at the time the policy went into effect. This interpretation is consistent with the notion that awareness and understanding of energy use, and subsequent energy-saving actions, likely do not occur until after first year benchmarks are conducted.
Historical Tracing	Historical tracing involves reconstructing the events (such as the launch of a product or the passage of legislation) that led to the outcome of interest. An example of this would be developing a "weight of evidence" conclusion regarding the specific influence or role of the program in question on the outcome. Although this qualitative analysis method has rarely been applied to energy-efficiency programs, it is well suited to an attribution analysis of major events, such as adoption of B&T policies. It is also well suited to attribution given multiple, overlapping energy-efficiency programs and policies.
Structured Expert Judgment	Structured expert judgment involves assembling a panel of "experts" who understand the markets, buildings, end-uses, and technologies being influenced by energy-efficiency programs or policies. For example, an expert panel weighing in on B&T policy impacts might include building owners/facility managers, energy-efficiency contractors, local/state policy analysts, and utility representatives. In practice, expert panels generally augment the analyses from other attribution approaches (e.g., historical tracing in this context) and use that information to reach consensus.

3.3.1 Analysis of Iterative EUI Outputs from Portfolio Manager

The primary recommendation for quantifying gross energy impacts is analysis of iterative EUI outputs from Portfolio Manager, and is intended to be a streamlined approach that requires minor adjustments from the processes that jurisdictions are already using in their data collection efforts.

Below is a high level overview of how the gross energy impacts are calculated:

1. Isolate buildings that complied in both years being compared (e.g. Year 1 & Year 2).
2. Remove outliers from the data.
3. Calculate the change in source EUI between Year 1 & Year 2 for each building.
4. Multiply the change in source EUI by the building square footage for each building.
5. Sum the source energy savings for all of the buildings (Savings = Δ Source EUI x Building Square Footage).

The gross energy impacts are calculated using the following basic formula in Equation 3-1, which is expanded later on in Equation 3-2 through Equation 3-4, which show how to apply weights to the EUIs when breaking out the EUIs into different segments, such as by building types or by building vintages.

Equation 3-1. Basic Equation for Calculating Gross Energy Impacts

$$Gross\ Energy\ Savings\ =\ Baseline\ Energy\ Use - Reporting\ Period\ Energy\ Use$$

$$= (EUI_{Year\ 1} - EUI_{Year\ 2}) * Gross\ Floor\ Area$$

The two primary factors that this method requires are the source EUI (an output from Portfolio Manager, units of kBtu/ft^2) and Gross Floor Area (an input to Portfolio Manager, units of ft^2). Source energy will be used to assess gross energy impacts, as opposed to site energy.[51] In addition, it is preferable to use weather-normalized EUI whenever it is available. If weather-normalized EUIs are not available, then non-weather-normalized EUIs will suffice.

The population of buildings that comply with the B&T policy each year will vary, which is why both the primary and supplementary recommendations will use an iterative approach. The basic concept is that for any given two-year period being evaluated (e.g., Year 1 and Year 2) the same population of buildings will be compared. For example, if four buildings comply in Year 1 and five buildings comply in Year 2 then only the buildings that complied in both Year 1 and Year 2 will be evaluated. The savings between Year 2 and Year 3 will be evaluated in a similar way, in other words, only the buildings that complied in both Year 2 and Year 3 will be evaluated.

Energy Impact Adjustments

In addition to reducing energy consumption through behavioral changes and efficiency improvements, other building energy usage factors that should not be counted towards gross energy impacts must be taken into consideration. The following adjustments should be considered when calculating the gross energy impacts:

- ***Building Mix:*** It is important to account for the variation in the buildings that comply (which is referred to as a building "segment," such as the size, vintage, type, or a combination of these characteristics) year to year because the mix of buildings may change over time. This would provide a misrepresentation of the overall gross energy impacts, which is why it is important to make sure the same group of buildings is compared between the baseline year and the year in question. This can be accomplished by making sure the same set of Portfolio Manager Property IDs, tax Parcel IDs or other property identifiers are being used in the two years being compared.
- ***Variation in Gross Floor Area by Building Segment:*** In order to accurately represent the contribution of the building segment to the overall gross energy impacts it is important to calculate an average EUI for each building segment for each of the years being compared. This can be accomplished by doing a weighted average by gross square footage for all unique buildings within each of the building segments. This ensures that the buildings with the larger gross floor area have a higher influence on the gross energy impacts than the smaller buildings.
- ***Weather Adjustment:*** The fluctuation in weather year to year can have an impact on the energy usage in a building, which is why the weather-normalized site EUI should be used instead of the non-weather-normalized site EUI if available.

Energy Impact Calculation Algorithm

The steps for calculating the gross energy impacts are as follows:

1. **Identify the baseline year and the reporting period. The baseline year is the initial year from which energy changes are measured.** The reporting period is any time in the future for which gross energy impacts will be calculated. In the algorithms below, "z" represents the baseline year and "z+1" represents

[51] *It should be noted that some jurisdictions might prefer to use site energy rather than source energy for analysis and reporting purposes. This Handbook acknowledges that the preferred metrics differ across jurisdictions, and that the energy impact methods recommended here will work for both site and source energy definitions. In addition, it is preferable to use weather-normalized EUI whenever it is available. If it is not available, the non-weather-normalized values will suffice.*

the reporting period. It is preferable if the baseline is comprised of data from a couple years before the policy went into effect.

2. **Determine the population of buildings being used in the baseline year and the reporting period, which should be the same between the two years being compared.** This can be accomplished by making sure that the list of Portfolio Manager Property IDs is the same between the two years being compared. This will ensure that the total gross floor area remains constant between the two years being analyzed. It is important to note that the gross floor area could still change year to year, for example if a building owner completes an addition or sells a portion of their space. Another important consideration to take into account is that the primary building function could change over time. For example, a warehouse could be converted to a retail space.

3. **Calculate the average EUI by building segment for both the baseline year and the reporting period.** The equation is as follows for building segment x in Year z, where "i" represents a unique building (i.e., Portfolio Manager Property ID), "z" represents the year, and "x" represents the building segment. Examples of building segments include: building type, building vintage, and building floor area bins. If the analyst is grouping the buildings by building type then an example of building segment x would be Office.

Equation 3-2. Average EUI for Building Segment "x" in Year "z"

$$EUI_{Avg,Building\ Segment\ x,Year\ z} = \sum_{i=1}^{n}\left(EUI_{Building\ i,Year\ z} * \frac{Gross\ Floor\ Area_{Building\ i,Year\ z}}{Total\ Gross\ Floor\ Area_{Building\ Segment\ x}}\right)$$

4. **Calculate the total gross impacts for all of building segments for all years through a weighted average of the individual building segment estimates.** The equation is as follows, with each building segment "x" a member of the set of all building segments "X." For each building segment, subtract the average EUI in Year "z+1" from the average EUI in Year "z" then "weigh" that building segment by multiplying it by its share of the populations' square footage.

Equation 3-3. Average of Gross Energy Impacts for All Building Segments between Year "z" and Year "z+1"

$$Gross\ Energy\ Impacts = \sum_{x=1}^{X}\left[\left(EUI_{Avg,Building\ Segment\ x,Year\ z} - EUI_{Avg,Building\ Segment\ x,Year\ z+1}\right) * \frac{Total\ Gross\ Floor\ Area_{Building\ Segment\ x}}{Total\ Gross\ Floor\ Area_{All\ Building\ Segments\ X}}\right]$$

5. **Repeat Steps 1-4 for the next annual increment.** For example, if the gross energy impacts were calculated for Year 1 and Year 2, to calculate the third year impacts the analyst should compare Year 2 and Year 3. This procedure is repeated for each year of disclosure data. As noted in (2) above, it is important to ensure that the population of buildings is the same between the two years being compared.

6. **Sum together the gross energy impacts for each time increment to calculate the average gross energy impacts over the period being evaluated.**[52] For example, if the intent is to calculate the gross energy impacts between Year 1 and Year 3 the equation would be as follows:

Equation 3-4. Average of Gross Impacts over Period Being Evaluated

$$\begin{aligned} &Gross\ Energy\ Impacts_{Year\ 1-Year\ 3} \\ &\quad = Gross\ Energy\ Impacts_{Year\ 1-Year\ 2} + Gross\ Energy\ Impacts_{Year\ 2-Year\ 3} \end{aligned}$$

7. **Develop analysis categories.** Combine the buildings in segment categories as desired for analysis. Suggested categories include building type, building vintage geographic region, property value percentile, EUI percentile, combinations of the previous, and any others of interest to the evaluator. The benefit to breaking out the data into multiple different ways is to see which types of building have exhibited the highest energy savings over recent years or which building types have exhibited the highest potential for decreasing their energy usage. This can help inform energy-efficiency program design so that programs can be tailored more effectively to specific customer segments.

Portfolio Manager Data Collection Requirements

The intent of the primary method, Analysis of Iterative EUI Outputs from Portfolio Manager, is to require only the data that the jurisdictions are already collecting. The gross energy impacts are calculated using the Weather-Normalized EUIs that are outputted from Portfolio Manager, as well as the gross floor area. The jurisdictions should not have to collect any additional data beyond what they are already collecting. The only additional effort this method requires is sorting through the data by building segments and applying the algorithms described above.

How to Summarize Gross Energy Impact Data

There are a variety of different ways to aggregate the findings from the gross energy impacts analysis. The graphs and tables below are just a few possible ways to highlight the gross energy impacts due to B&T policies. They are the product of multiple iterations of data cleaning, which include these key steps before summarizing the data and findings:

1. Create a dataset of buildings that appear in both years of data and have the same building type and floor area in each year being compared.

2. Remove all buildings with gross floor areas that were zero or blank.

3. Remove all building with building types that were zero or blank.

4. Remove all buildings with EUIs outside of a reasonable range. For example, New York City only includes buildings with EUIs between 5 kBtu/ft^2 and 1,000 kBtu/ft^2.[53]

5. Remove all buildings with abnormal changes in EUIs between the two years being compared. Specifically, buildings that had EUIs that increase or decrease more than 50% should be removed.[54]

6. Determine which buildings appeared in both years being compared (e.g., Year 1 and Year 2). The savings should only be attributed to buildings that complied in both years; otherwise, buildings that were not

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[52] It is important to note that each of the years being compared will have unique sets of buildings as the dataset will change with each comparison period, depending on which buildings complied each year and which buildings meet the data cleaning requirements. For example, Building A could have data in Year 1 & Year 2; therefore they will be included in the Year 1-Year 2 savings analysis. However, if they did not comply in Year 3, then they will not appear in the Year 2-Year 3 savings analysis.

[53] These bounds were taken from the data cleaning steps used in the New York City Benchmarking Reports (NYC, 2013).

[54] Buildings that have a greater than 50% increase or less than 50% decrease in EUIs between the two years being compared should be removed because changes beyond these thresholds are likely due to reasons other than the B&T policy or program (change in occupancy, erroneous data entry, change in space usage, etc.).

impacted by the policy may sway the savings. In order for a building to be included, the gross floor area and the building type should be the same between the two years being compared.[55]

7. Remove all duplicate entries.

After cleaning the data, the next step is to determine how best to aggregate the data and present results—ultimately, each jurisdiction will make its own determination. Figure 3-1 through Figure 3-3 summarize the energy impacts based on building type, building floor area bins, and building vintage.[56] Other possible ways to slice the data include geography, primary fuel, counties, etc. The bins were created based on histograms of the data to see where cutting the energy savings data made sense. Weather-normalized source energy savings are preferred when available; however, it ultimately depends on the jurisdiction and what date is available. For additional information on how to clean data from Portfolio Manager and how to calculate the savings, see the *Energy & Non-Energy Impacts Analysis Tool* spreadsheet in the Appendix.

[55] Occupancy is an important driver of energy use but the ability to control this depends on the extent to which building owners update this information in Portfolio Manager, which doesn't often happen. For this reason it should not be included in the data cleaning, unless there is reliable data that shows it should be accounted for.

[56] The graphs presented in this section are based on the Source EUI outputs from Portfolio Manager. It should be noted that some jurisdictions might prefer to use site energy rather than source energy for analysis and reporting purposes. This Handbook acknowledges that the preferred metrics differ across jurisdictions, and that the energy impact methods recommended here will work for both site and source energy definitions.

Figure 3-1. Example Weather-Normalized Source Energy Impacts by Building Type (All Fuels)

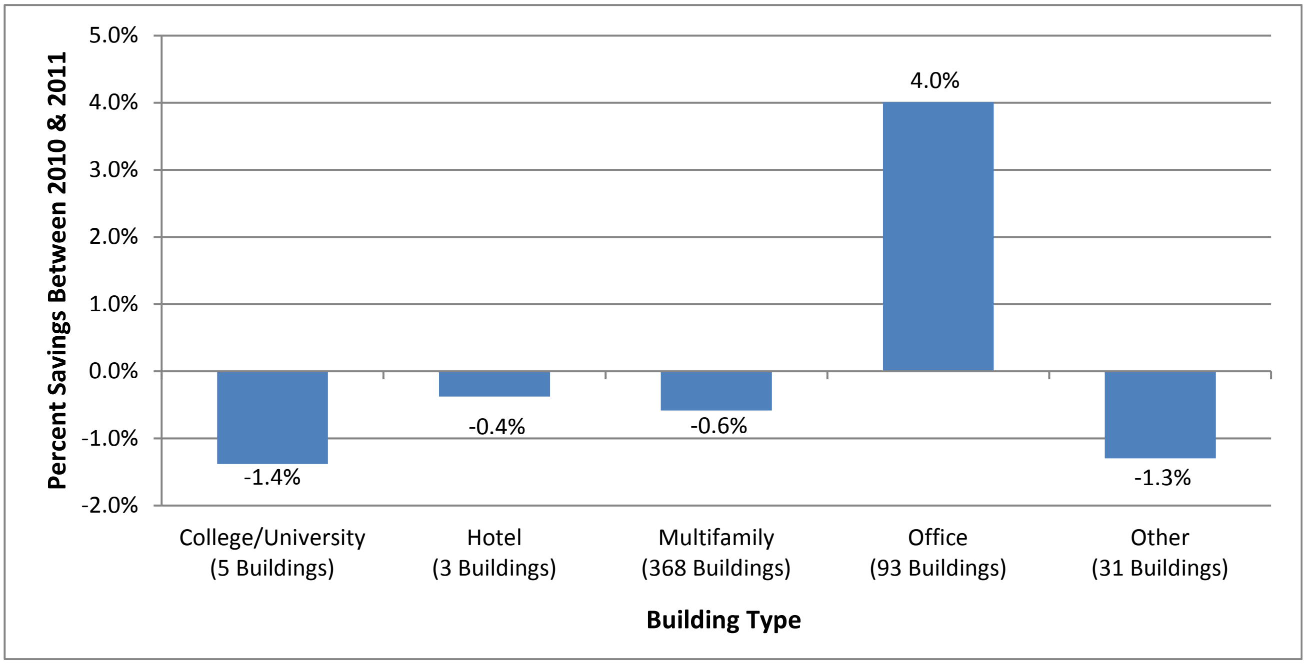


Figure 3-2. Example Weather-Normalized Source Energy Impacts by Building Vintage Bin (All Fuels)

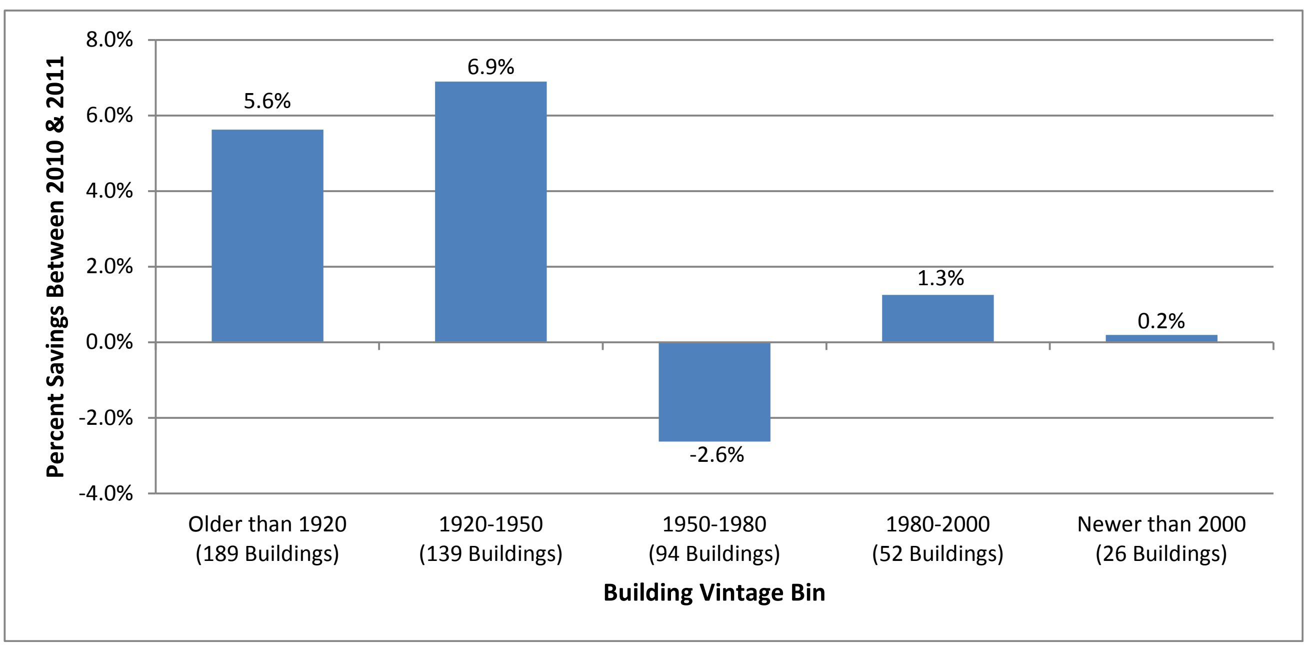


Figure 3-3. Example Weather-Normalized Source Energy Impacts by Building Floor Area Bin (All Fuels)

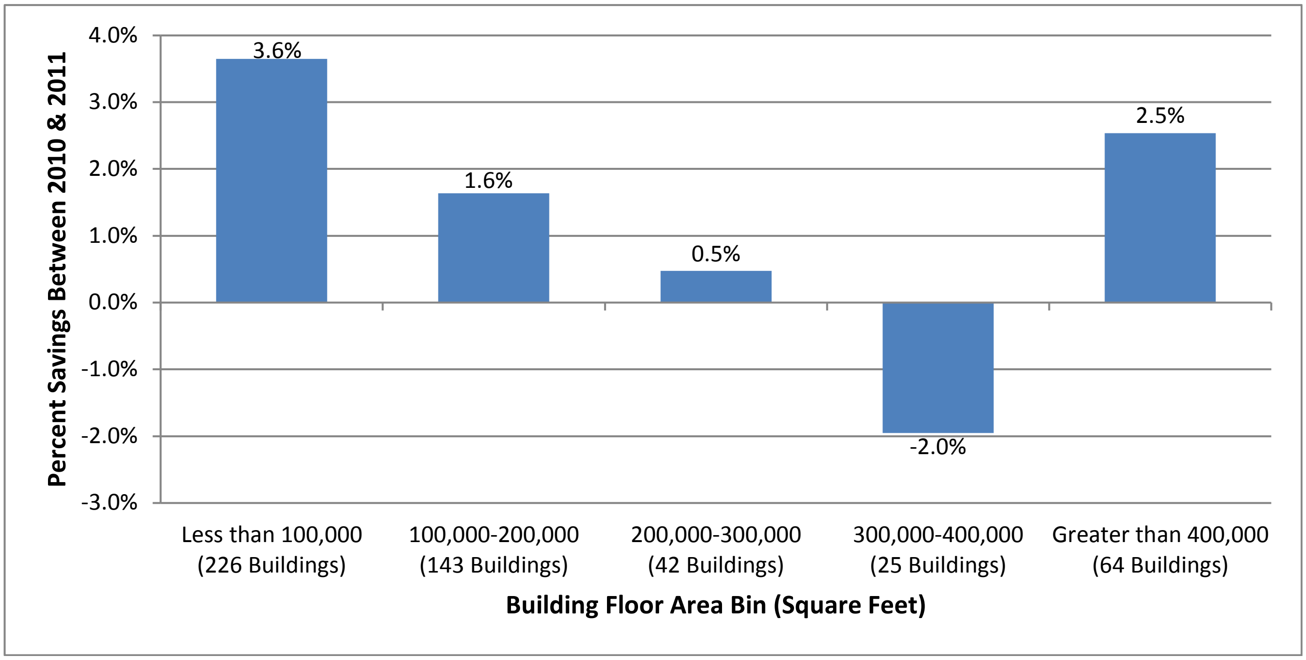


Table 3-3 and Table 3-4 below provide an additional example of how to summarize the gross energy impacts in tabular form. Table 3-3 differentiates the gross energy impacts and the weighted average EUIs between site and source energy. Source energy should be used when quantifying the gross energy impacts; however site energy is shown below for comparison purposes. Site energy is the amount of energy consumed by a building and source energy is the raw amount of fuel required to operate a building, including the amount of energy lost through transmission, distribution, and production losses. Table 3-4 breaks out the weather normalized source energy by fuel type. The percent savings were calculated by subtracting the weighted average EUI in 2011 from the weight average EUI in 2010 and dividing by the weighted average EUI in 2010.

Table 3-3. Example Gross Energy Impacts

Category	Savings *(Million BTUs)* 2010 to 2011	Weighted Average EUI *(kBtu/ft^2)* 2010	Weighted Average EUI *(kBtu/ft^2)* 2011	% Savings 2010 to 2011
Site Energy *(Weather-Normalized)*	148,988	97.6	96.2	1.5%
Source Energy *(Weather-Normalized)*	421,545	204.8	200.7	2.0%

Table 3-4. Example Gross Energy Impacts by Fuel Type (Source Energy)

Fuel Type	2010 to 2011 Savings	2010 to 2011 % Savings
Electricity *(kWh)*	60,906,641	4.5%
Natural Gas *(therms)*	-346,002	-1.7%
District Steam *(MMBTU)*	699	0.0%
Oil #2 *(MMBTU)*	-10,116	-6.1%
Oil #4 *(MMBTU)*	14,062	6.5%
Oil #5&6 *(MMBTU)*	92,782	7.6%
Diesel *(MMBTU)*	-9	-9.7%

3.3.2 Analysis of Energy Savings by Fuel Type from Portfolio Manager and Dollar Savings

The corresponding dollar savings that result from energy savings can be based on the gross energy impacts by fuel type as shown in Table 3-4 above.

The brief following steps can estimate the dollar savings tied to reduced energy expenditures.

1. Gather average cost of each fuel for the year in question, specific to the jurisdiction. Average utility rates by fuel type can be taken from the local utility provider, state energy efficiency authority, or the jurisdiction itself. Another source of information can be benchmarking consultants who already manage large sets of utility data and can document historic rates. It is important that the rates be specific to the jurisdiction in question, not state-wide figures, for example, which will differ.

2. Reconcile reported units of energy usage by fuel type with available rates per unit. The manner in which fuel usage is reported in Portfolio Manager may not match the unit of measurement found within the historic rate information. For example, natural gas usage by building may be entered as therms, but average rates in the jurisdiction may be reported as thousands of cubic feet.

3. Determine if Fuel Usage by Type is Weather Normalized. Portfolio Manager's reporting output can display site fuel usage as reported usage, or weather normalized. Portfolio Manager uses a calculation of average weather conditions to estimate how much energy usage results from changes in temperature. The resulting weather normalized figure represents the expected energy usage under average weather conditions. It is recommended to use the weather normalized figures when possible to better account for variations in temperature. Fuel usage Portfolio Manager's technical guidance on the weather normalization process is available here: ***https://portfoliomanager.energystar.gov/pdf/reference/Climate%20and%20Weather.pdf***

4. Multiply utility rates by the appropriate fuel type. The resulting dollar amounts, both increases and decreases in costs, can be summed together. Comparing these changes year to year requires that the same sets of buildings are compared between the two years to account for the resulting changes.

Table 3-5 below carries over the fuel calculations from table 3-4 and includes utility rate information.

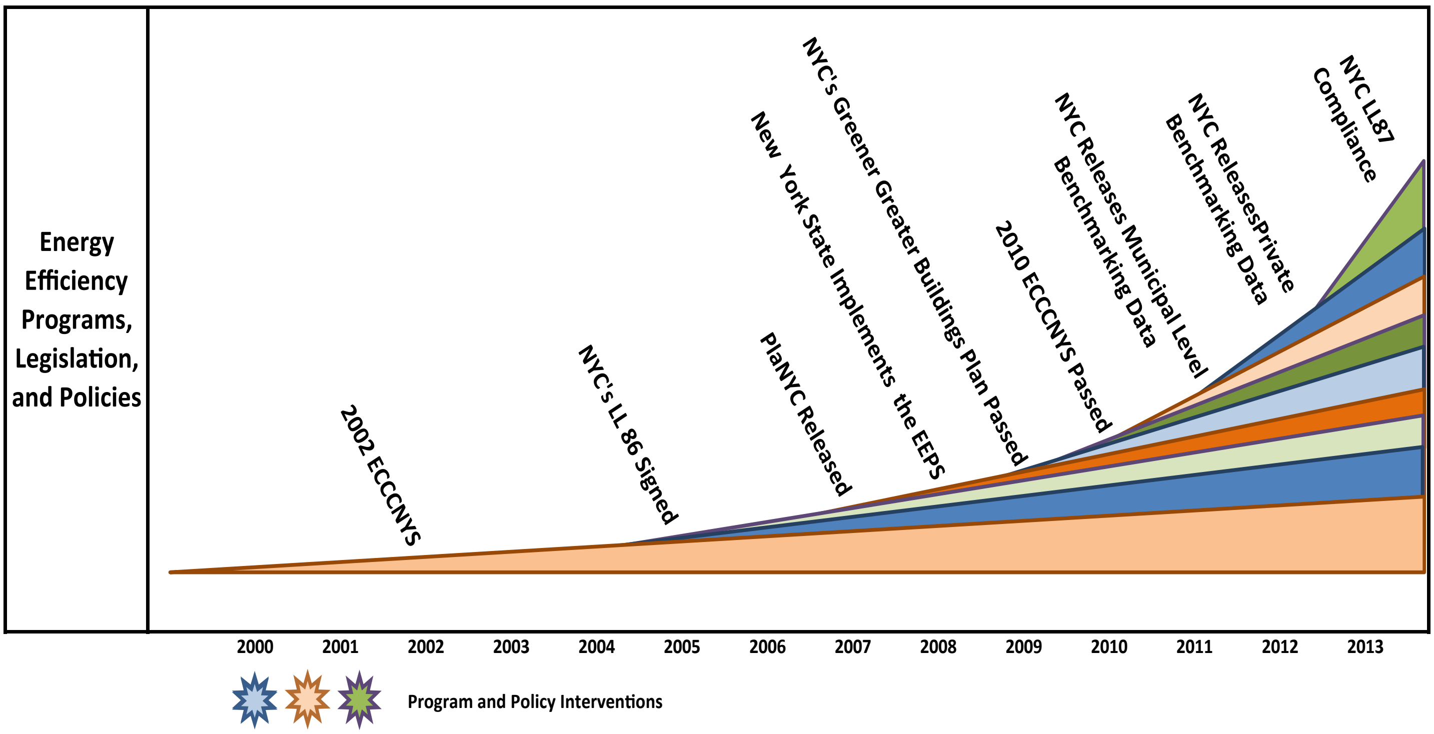
Table 3-5. Example Gross Cost Impacts by Fuel Type (Source Energy)

Fuel Type	2010 to 2011 Savings	Fuel Cost Per Unit	Fuel Converted to Cost Units	Cost Savings
Electricity *(kWh)*	60,906,641	$0.15 (kWh)	60,906,641 kWh	**$9,135,996**
Natural Gas *(therms)*	-346,002	$7.91 (mcf)	-33,625 mcf	**-$265,975**
District Steam *(MMBTU)*	699	$33.73 (mlbs)	1 mlbs	**$20**
Oil #2 *(MMBTU)*	-10,116	$2.75 (gallon)	-72,941 gallons	**-$200,587**
Oil #4 *(MMBTU)*	14,062	$2.75 (gallon)	101,392 gallons	**$278,827**
Oil #5&6 *(MMBTU)*	92,782	$2.75 (gallon)	668,989 gallons	**$1,839,721**
Diesel *(MMBTU)*	-9	$3.98 (gallon)	-65 gallons	**-$260**
Total	-	-	-	**$10,787,741**

3.3.3 Attributing B&T Energy Impacts through Historical Tracing

The second recommended analysis component, historical tracing, should be viewed as a structured process for attributing the Portfolio Manager-based energy savings estimates to the various market interventions if the jurisdiction is interested in attributing impacts from foundational B&T policies. The historical tracing process is shown in Figure 3-7, which depicts an illustrative set of utility energy-efficiency programs; city, state and federal tax credit and other interventions; and B&T related policies – and the overall growth and relative share of each market intervention over time.

Figure 3-7. Illustrative Example of Historical Tracing of Energy-Efficiency Programs and Policies



Historical Tracing, which is also called the case study approach, is a qualitative approach to attribution that involves reconstructing the historical record following the implementation of a program or policy. In application to B&T programs, this involves a process of tracking actual occurrences over time, and tracking the impacts of those events related to: 1) the program logic and theory and related market transformation indicators, and to b) broader market trends and other programs focused on influencing the same customer markets.

1. **Historical Tracing of Program Logic and Expected Outcomes.** As noted in Sections 1 and 2, a set of MTIs and associated expected outcomes are established through the development of a B&T logic model. The logic model tells us what the barriers are that the policy is addressing, the activities to overcome those barriers and the expected outcomes. The market indicators, i.e., MTIs, tell us how the policy is doing in meeting the expected goals in the marketplace. In conducting a historical tracing analysis, the logic model and MTIs become major inputs to the tracing process by identifying the real market impacts of the policy through market interviews and surveys that can: a) identify the presence of market indicators, and b) be then able to attribute these impacts to that which policy designers intended to happen in implementing the program (as identified in the logic model). As such, one of the two key components of a historical tracing analysis is the MTI evaluation, which can tell us whether market effects that are identified are indeed related to the policy's original intent. If a linkage can be made between the logic model intent and the MTI evaluation, then historical tracing analysis can begin to assume that at least some part of the recorded market change (i.e., market structure changes, market actor behavior changes, and/or energy savings) may likely be attributable to the program. For example, if the logic model has an expected outcome that tenants

and owners incorporate B&T information into their valuation of commercial space at least three years after policy implementation, then a finding after three years that the market indicator for this expected outcome exists would tend to support the notion that at least part of that outcome can be attributed to the B&T policy.

2. **Historical Tracing of the Broader Target Market and Associated Programs.** The second major component of a historical tracing analysis relates to the need for evaluators to have a firm understanding of other energy-efficiency related programs targeting the same market and barriers, and the relationships among those programs. For example, if commercial facilities facing B&T requirements also participate in state, local or utility-run energy-efficiency programs, then the outcomes and impacts from these other influences on energy consumption need to be considered in historical tracing.[57] More specifically, the evaluator should build a broad market understanding that identifies:

    - Existing market demand and supply value chains
    - Influential actors and the relationships between various actor groups
    - Market barriers and opportunities
    - How each energy-efficiency program or policy is designed to affect the market
    - How each program overlaps or complements other programs
    - Incorporates (where data is available) savings impacts of each effort

[57] *One key caution in this area relates to the need to ensure that savings from efficiency program administrator programs and B&T related efforts are not double-counted in the historical tracing analysis. Historical tracing information is typically used as background information to a structured expert judgement panel. Because of this, even though historical tracing is a qualitative method, evaluators will need to pay special attention to this issue to ensure the highest quality of this information.*

Table 3-6 presents the key steps in the historical tracing process.

Table 3-6. Steps to Developing a Historical Tracing Diagram of the B&T Policy and Related Energy Efficiency Programs

Step #	Name	Description
1	Primary Research — Information Gathering Interviews	Using an understanding of the general categories of energy-efficiency market interventions — energy-efficiency utility and agency programs, regulatory and governmental policies, tax credits, etc. — conduct primary market research interviews with key market actors and efficiency program administrators and agencies to identify key historical data on market interventions that have influence on the B&T policy marketplace
2	Secondary Research — Additional Market Influences	Undertake secondary research to identify other influential policies or EE programs that may not have been identified in interviews
3	Secondary Research — Savings Estimations (hi level) from Interventions	Use interview information and conduct secondary research to identify, where possible, energy savings estimations from the policies identified as active in the B&T policy or other programs
4	Apportion Identified Intervention Savings	Create savings graph from market influences at the high-level (when possible) for each program market intervention (per the illustration in Figure 3-7, above) to assess intervention relative impacts: a) on the overall market and b) related to each program as compared to each other
5	Common Graphic Incorporating Savings and Policy and Program Influences	Combine savings graph with policy and program influences from research above into a graphic representation of the jurisdiction's B&T historical market place as a means of beginning to assess the relative impacts and influences of the B&T policy as compared to other policy and program influences on the market
6	Use Graphic to Inform Decision Attribution of Impacts	Use the diagram in structured expert panel meeting(s) to assess the relative impact of the B&T policy in relationship to other energy-efficiency policies and programs active where the B&T policy applies

Historical Tracing Data Collection Requirements

The implementation of the historical tracing method requires the following to develop the narrative:

- Logic models describing the logical linkages among B&T resources, activities, outputs, customers reached, and immediate, short, intermediate, and longer-term outcomes or market model diagrams that may predate the evaluation. This includes changes to the logic model that may have occurred since the enactment of the policy as part of market transformation evaluation activities. (See Section 2)
- Documents and data for utility, state and regional energy-efficiency programs, building codes and equipment standards, and other external factors affecting energy usage in the buildings affected by the

B&T policy. This information is necessary to develop an understanding of the market and the various forces potentially affecting energy in the buildings subject to B&T policy.

Box 1. Summary Historical Tracing Data Collection Approach

1. **Goal of Historical Tracing:** Support expert judgement panel attribution of savings to specific energy-efficiency influencing policies, programs, standards, financial policies, and other influences that will "compete" with the B&T policy in claims of attribution of savings to those efforts.

2. **Timeframe:** Establish timeframe for research on historical analysis period to be reviewed (e.g., 2001 through 2014).
   - Criteria for selection of timeframe: In general, go back to policies that began in previous decades and still have impacts that influence the state of energy efficiency in the current market

3. **Identifying the Policies That Matter:** Typically, there are three or four key categories of policies, programs, etc. that will, along with the B&T policy, have market influence in encouraging energy-efficiency savings and will share their "piece-of-the-attribution-pie" with the B&T policy. These market influences include the following:
   - Utility and other state and federal agency program offerings
   - Federal, state, and local codes and standards
   - Federal, state, and local tax and other financial policies
   - State and local energy-efficiency and green supporting legislation, ordinances, and policies
   - Market certification programs such as LEED and ENERGY STAR

4. **Data Collection:** Use primary and secondary research, available utility evaluation measurement and verification (EM&V) and other market studies, and real estate market information to develop historical tracing "research scenarios" of possible attribution of savings to each "influencer" in the market, including the B&T policy's influence.

3.3.4 Structured Expert Judgment

Structured expert judgment recognizes that a jurisdiction's own estimates of B&T contributions to net energy impacts should include the perceptions of key stakeholders and other experts. These individuals effectively weigh in on historical tracing assumptions, and whether the historical tracing process performed by the jurisdiction is complete.

Energy-efficiency program evaluators have successfully applied the historical tracing approach in conjunction with this method to estimate net impacts. For example, Keneipp, et al. (2011) used historical tracing in conjunction with expert panels to develop net energy impacts for a residential new construction program. The authors relied on historical tracing spanning 14 years of program and regulatory documents, along with interviews with individuals involved with the program, to describe the various market influences and interventions on energy consumption and energy-efficiency actions. This information was then shared with the expert panels to estimate the total impacts and determine the program's specific contribution and net savings.

This handbook recommends similar processes for B&T policies, but with these caveats:

1. The experts chosen to review historical tracing attribution should include staff from the jurisdiction responsible for implementing and evaluating the B&T policy, other entities implementing energy-efficiency programs and policies targeting the same buildings, and independent experts.

2. This should not take place until there are indications that the external MTI's have reached the intermediate-/long-term status reflecting other agencies' use of B&T information and integration with their energy-efficiency programs. An attribution discussion with these other stakeholders can be conducted when

the B&T policy is broadly seen as contributing to energy savings in the jurisdiction and when energy consumption becomes an integral component of commercial real estate rental and sales transactions.

These expert panels improve the accuracy of the decisions made and provide legitimacy to the overall evaluation process by ensuring that local stakeholders and experts have provided decision-making input. Expert panels have been used since the 1950's[58] to provide structured judgment on a variety of questions and in a variety of forums. Specifically, the panel involves experts providing their input in two or more rounds of decision making. "Voting" for each round is anonymous, with a facilitator providing a summary of the expert's opinions from each round and the reasons for the variety of expert views. Subsequent rounds are aimed at coalescing, if possible, expert views towards a consensus on the decision at hand. The text box below illustrates the steps to effectively develop and incorporate expert input into B&T evaluation analysis.[59]

[58] Originally developed by Rand Corporation in the 1950s as a forecasting method relying on a panel of experts, the use of this structured "expert judgment" method has expanded to other areas of focus.

[59] Expertise relevant to the topic at hand is a key criterion for selection of expert panel members. Because of this, a panel of experts relevant for one area of inquiry, for instance, energy savings attribution, may not be the appropriate group for another topic (e.g., identifying the most important market transformation indicators for the effort). Additional reference materials and tools that can be used to execute recommended methodologies – such as panel discussion guides and impact analysis spreadsheets – are included in the listed appendices.

Box 2. Overview of the Structured Expert Panel Decision-Making Process

1. **Focus:** Clearly state the question at hand and the focus of expert opinion/judgment sought. For B&T policies, the goal is to confirm both the inputs to and the results of the historical tracing process. For example, do we have enough evidence to show that the B&T policy is affecting the marketplace in the way intended by the policy logic and theory? If so, what evidence do we have that might also allow us to estimate the impacts of non-policy programs and activities that may also be contributing influences to the changes we see in the market? Such information provided in the form of the historical tracing activity becomes the basis for informed decision making on the part of the expert panel in attributing savings influences to the multiple policy and program influences attendant in the market.

2. **Expert Selection:** Identify a list of potential Expert Panel members with expertise relevant to the topic. This would likely include staff responsible for implementing and evaluating B&T and other local policies, utility energy-efficiency programs, other entities' energy-efficiency programs targeted to the same buildings, and independent knowledge experts such as large property owners and managers that have taken the energy-saving actions measured by the iterative Portfolio Manager output analyses.

3. **Support Research:** Develop the background information — including the technical or social assumptions used to assess that information. The basis for expert panel decision making tends to revolve around: a) a common baseline; b) research that provides the decision makers with as relevant and accurate information as possible about the possible influences of each of the various programs, policies and other market factors, including exogenous factors such as whether, price, availability of the product or service; and, c) as appropriate, other information such as baseline forecast scenarios that can help the expert panel come to as knowledgeable and close to consensus decisions on key panel issues.

4. **Choose Format:** Determine whether the Expert Panel will be held online or in a face-to-face meeting format.

5. **Pre-Meeting:** Determine whether to provide the background information (or parts of that information) to Expert Panel members before the meeting or at the meeting. The need to have informed and open minded discussion at the panel. These issues needs to be determined by the panel facilitator and address: a) the need for panel members to have some background information before the structured expert panel discussions, but not so much that might encourage members to have pre-meeting fixed views prior to the formal meeting.

6. **During the Meeting:** Clearly define the structured voting process and outputs facilitation prior to the meeting, including potential options for follow-up inputs, if necessary.

7. **Voting Structure:** Hold the meeting, providing two or more rounds of anonymous voting, with a facilitator sharing the results and expert reasoning for their votes between rounds.

Finally, jurisdictions should recognize that utilities and other energy-efficiency program administrators often rely on survey-based approaches to determine net impacts. Under this approach, the self-reported actions and behavior of participants, nonparticipants, and other market actors (e.g., commercial retrofit and heating, ventilation, and air-conditioning [HVAC] firms) are utilized to determine energy-efficiency program free ridership, spillover, and market effects in determining net impacts. Although these approaches to determining net savings from utility and state programs are outside the scope of this handbook, as a stakeholder in these entities' evaluation processes local jurisdictions can provide feedback and ensure that B&T policies are recognized and appropriately considered in impact attribution.

3.4 Supplementary Methods for Estimating Net Energy Impacts of B&T Policies

This section provides additional information on the supplementary methods for estimating B&T policy energy impacts.

3.4.1 Augmented Analysis of Iterative EUI Outputs

This supplementary recommendation for quantifying gross energy impacts, Augmented Analysis of EUI Outputs from Portfolio Manager, is an extension of the primary recommendation described in Section 3.3.1. The gross energy impacts are calculated in the same way; however, there is an additional step to crosscheck the inputs entered into Portfolio Manager. The method involves selecting a statistically significant, random sample of buildings to conduct a desk review and/or an on-site visit to verify the inputs that are entered into Portfolio Manager. Statistical significance is based on desired confidence and precision levels. For example, if the jurisdiction wants to achieve 90% confidence with a 10% error margin or precision, the random sample would include approximately 70 buildings. Based on the results of the audit, an adjustment factor is generated for each building segment.

Below is an outline of what this process would look like. The benefit to going through this process would be higher accuracy in the estimated gross energy impacts than relying on what the building owners submitted in ENERGY STAR Portfolio Manager.

1. Select a statistically significant number of buildings (e.g., 90% confidence, 10% precision) to review based on the total number of buildings that complied.
2. Review the inputs to ENERGY STAR Portfolio Manager for each building and each year being reviewed, such as:
    a. **Occupancy Rate.** *Potential Method:* Interview the building manager about what percent of their building is occupied and if it has changed between Year 1 and Year 2.
    b. **Building Square Footage.** *Potential Method:* Request the floor plans from the city and calculate the building square footage.
    c. **Building Vintage.** *Potential Method:* Determine the building age from city records.
    d. **Building Type:** *Potential Method:* Interview the building manager about the primary use of the building.
    e. **Energy Consumption Data:** *Potential Method:* Request the billing data from the local utility.
3. Rerun Portfolio Manager with the revised inputs for both Year 1 and Year 2 for all the buildings selected in the sample.
4. Calculate the revised ("verified") savings numbers for each building.
5. Compare the revised savings with the reported savings for each building and come up with an adjustment factor.

$$(AF_{Audit,Building\ x} = \frac{Revised\ Savings_{Building\ x}}{Reported\ Savings_{Building\ x}})$$

6. Calculate an overall adjustment factor and apply it to the reported savings for all the buildings that complied in Year 1 and Year 2.

$$(AF_{Audit,All\ Buildings} = \sum \frac{Revised\ Savings_{Building\ x}}{Reported\ Savings_{Building\ x}})$$

7. If more than two years are being compared then a separate adjustment factor will be calculated for each two year period being compared, e.g. Year 1 and Year 2 will result in a different adjustment factor than Year 2 and Year 3.

This method uses the same algorithms as the primary recommendation, with an additional adjustment factor added to the third step. The adjustment factor, denoted as AF_{Audit}, should be calculated using the steps above. If the buildings that are separated into different building segments for reporting purposes, such as by building type or by building vintage, then a separate adjustment factor would be calculated for each building segment.

See Appendix B.1.2 for an example of the types of inputs required for the building type "Office" that could be crosschecked through desk reviews and/or on-site visits as part of the supplementary methodology.

The steps for calculating the gross energy impacts are the same as the primary method, with one additional step, which is multiplying by an adjustment factor. This changes Step 5 of the gross savings impact algorithm as follows:

5. Calculate the total gross impacts for all of the building segments through a weighted average of the individual building segment estimates. The equation is as follows, with each building segment "x" a member of the set of all building segments "X." For each building segment, subtract the average EUI in Year "z+1" from the average EUI in Year "z" then "weigh" that building segment by its share of the populations' gross floor area.

Equation 3-5. Average of Gross Energy Impacts for All Building Segments between Year "z" and Year "z+1" (with Adjustment Factor)

$$Gross\ Energy\ Impacts = \sum_{x=1}^{X}\left[\left(EUI_{Building\ Segemt\ x, Year\ z} - EUI_{Avg, Building\ Segment\ x, Year\ z+1}\right) * \frac{Total\ Gross\ Floor\ Area_{Building\ Segment\ x}}{Total\ Gross\ Floor\ Area_{All\ Building\ Segments\ X}} * AF_{Audit, Building\ Segment\ X}\right]$$

3.4.2 Recommended Supplemental Quasi-Experimental Design Approaches

As described earlier in this section, Regression Discontinuity, Comparison City, and Matching approaches offer the potential to fully isolate and attribute B&T policy impacts. These approaches require training in advanced econometrics, as well as energy consumption and building characteristics data for B&T and control group buildings.

4 Estimating Non-Energy Impacts from B&T Policies

This section describes methodologies for calculating non-energy impacts that may result from the B&T policy - greenhouse gas (GHG) emissions, job creation, and real estate values.

GHG reductions are a direct result of any reduction in source energy usage following the B&T policy implementation. The methods for converting energy savings to GHG reductions are well documented with precedent set in a number of municipalities and states.

Job creation estimates can be derived from the economic activity generated due to the B&T policy. Existing studies on job creation and utilization of standard economic modeling provide methodologies to project B&T policy impact. Guidance on supplemental approaches through surveys and interviews is also provided.

Lastly, this section describes an approach to evaluating the impact of publicly reported energy usage data on changes in real estate values.

4.1 GHG Emissions

Many jurisdictions have developed GHG reduction goals to help mitigate the potential impacts of climate change. Commercial buildings are a major contributor to GHG emissions, both through direct emissions – those created by fuel combustion in a given building – and through indirect emissions – those released because of electricity and steam generation at a power plant. The EPA estimates that commercial and residential buildings comprise 12% of all U.S. GHG emissions (EPA, 2015). This section examines several methods that can be used to estimate the effect of the policy on emissions.

4.1.1 Estimating GHG Emissions Impacts

GHG emissions from an individual building can be calculated based on energy usage of each fuel type given in MMBtu. A simple emissions factor is applied for each type of fuel burned on-site. This factor is a physical constant related to the chemical composition of the fuel, so the factors do not change over time. Calculating indirect emissions released during electricity generation requires an additional step; a location factor is assigned to each building that accounts for the fuel mix used at power plants in the region to generate electricity. Data required to calculate this location factor comes from the EPA's eGRID (Emissions & Generation Resource Integrated Database), which uses regional data to compute GHG emissions at the source of electricity generation.[60] eGRID also includes a grid loss factor for power plants, which accounts for indirect fugitive emissions. This emissions factor is subject to change from year to year.

Portfolio Manager uses reported energy consumption data to calculate GHG emissions in three different categories: direct emissions, indirect emissions, and total emissions.[61] Total emissions are the sum of direct and indirect emissions.

GHG reductions can be pulled directly from Portfolio Manager. GHG emissions should be calculated after energy impacts have been calculated. The same set of buildings should be used in the energy impact analysis and the GHG emissions analysis.

- **Collect emissions data from Portfolio Manager for baseline year and current year.** For simplicity, it is recommended that the user only collect the Total GHG Emissions output produced by the tool for each building for each year being considered in the analysis period. Buildings with at least two full years' worth of data should be included. The dataset should include energy consumption information, square footage, property type, and GHG emissions for each building.

[60] *More information eGRID is available at: http://www.epa.gov/cleanenergy/energy-resources/egrid/.*

[61] *A fourth emissions category, biomass emissions, is also calculated by Portfolio Manager. Biomass emissions are generally not included in total emissions.*

- **Normalize emission data by building area for each year.** This is necessary to ensure calculations account for changes in the building stock. The buildings emissions baseline should be adjusted each year to account for any changes in gross floor area throughout the city. Adjusting the emissions baseline allows for an analysis of the change in emissions due to changes in energy use, not changes in overall square footage in a jurisdiction's building stock. The equations are shown below:

$$Normalized\ GHG\ emissions \left(\frac{MtCO2e}{sq.ft.}\right) = \frac{Citywide\ GHG\ emissions}{Citywide\ gross\ floor\ area}$$

$$Adjusted\ building\ emissions\ baseline(MtCO2e) = [Normalized\ GHG\ emissions_{Year\ 0}] \times [Citywide\ gross\ floor\ area_{Year\ x}]$$

- **Calculate difference.** The final step requires calculating the difference between the emissions data for the baseline year and the analysis year.

4.1.2 How to Summarize GHG Reductions Data

The resulting emissions changes should be documented in the same manner as the gross energy impact data, as the analysis is built off the same information. Charts organized into the same groupings of building characteristics can highlight changes in GHG emissions.

Figure 4-1. Example Gross GHG Emissions Reductions by Building Type

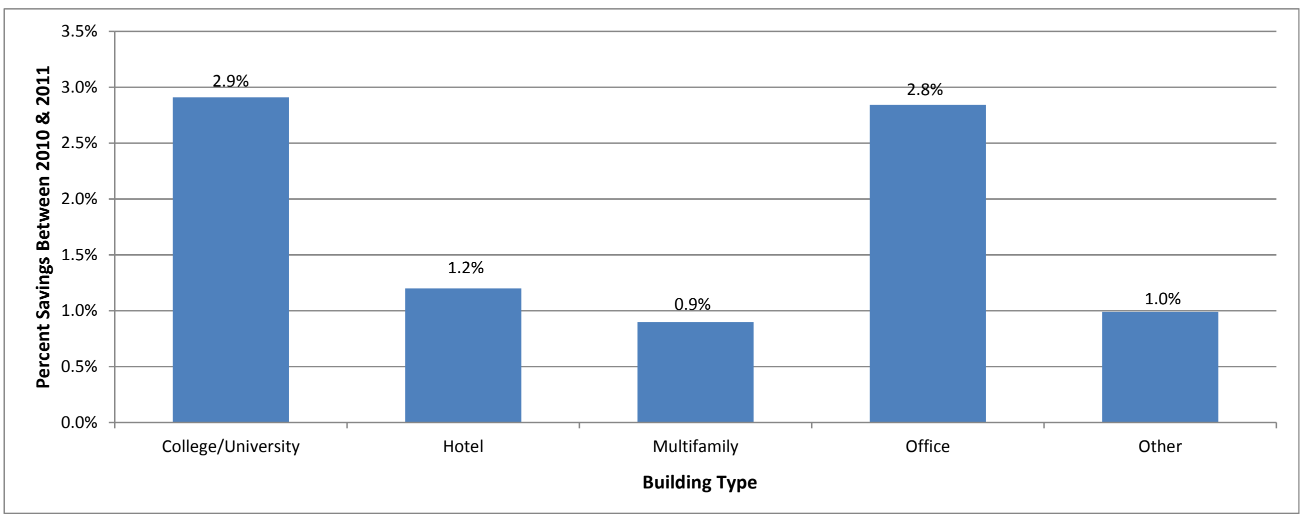


Figure 4-2. Example Gross GHG Emissions Reductions by Building Vintage

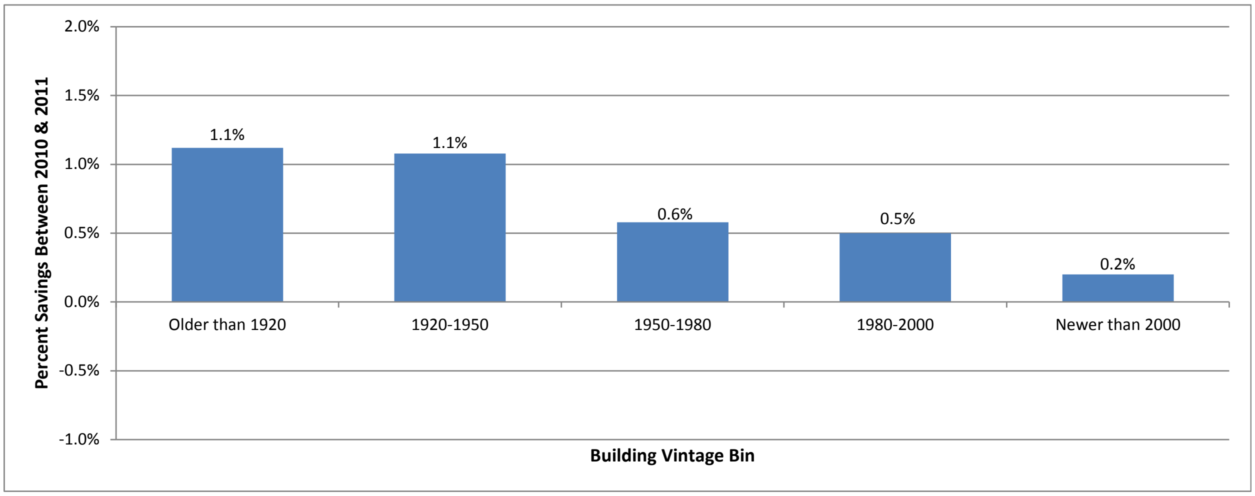


Figure 4-3. Example GHG Emissions Reductions by Building Floor Area

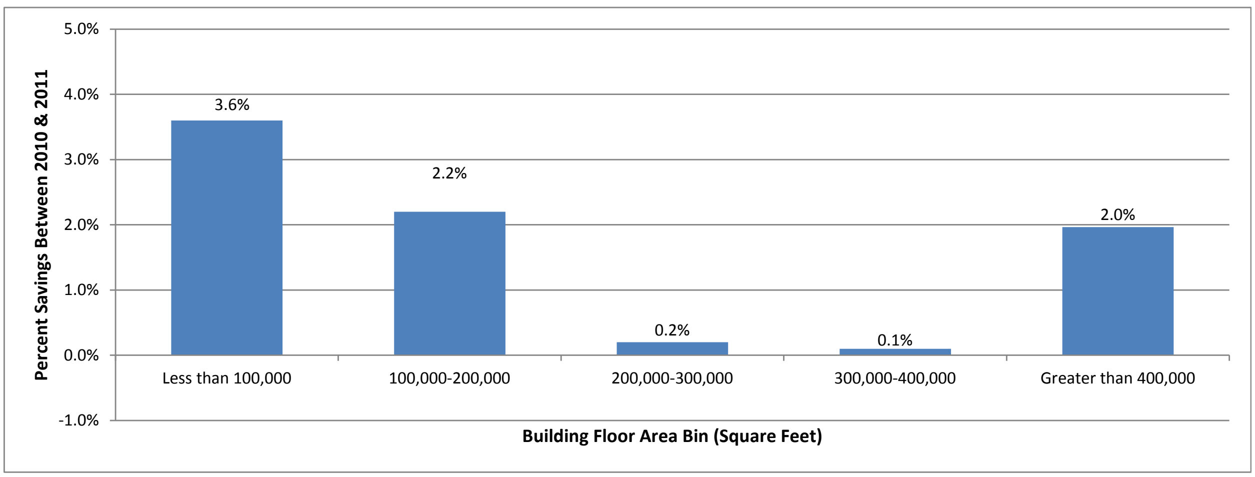


Table 4-1 shows the changes in GHG emissions as compared to the source energy changes. A negative value indicates an increase in emissions; a positive value indicates a reduction in emissions.

Table 4-1. Gross Energy Impacts and GHG Emissions Summary

Category	Gross Impacts
Source Energy *(Weather-Normalized)*	421,544 MMBtu 2.0%
GHG Reductions	-10,147 MtCO2e -1.3%

4.2 Jobs and Economic Growth Methodologies

This section outlines methods to estimate the impacts of a B&T policy on job creation and economic growth. In accordance with the structure of this handbook, this section provides recommendations for calculating both net jobs and economic growth and gross jobs and economic growth. The methods limit their scope to measuring only two categories of jobs: the first method, *Calculating Employment from Benchmarking*, examines direct jobs that result out of the need for experts to perform benchmarking; while the second method, *Calculating Employment from Efficiency Actions – Input-Output Modeling*, examines indirect jobs that result from increased construction activity that is induced by the B&T policy, as well as jobs that may be generated through the spending of money saved via reduced energy bills. Combining the results from both methods provides an estimate of total jobs created.

4.2.1 Calculating Employment from Benchmarking

The first category of jobs resulting from a B&T policy is a function of the labor required to benchmark the properties. The process of benchmarking the buildings will be done either in-house by property owners and managers or by third party consultants. Note that jurisdictions with automated benchmarking services from utilities have negligible jobs created due to the act of benchmarking and should not use this calculation. The recommended method for calculating these jobs does not vary per gross or net analysis.

- **Identify number of buildings benchmarked.** The figure can be derived from the number of buildings that comply with the B&T policy each year.

- **Determine time needed to benchmark a building.** The act of benchmarking involves several steps: gathering building data, compiling utility data, entering it into Portfolio Manager, and releasing it to the city. This process takes time. Six hours of work is suggested as the default value to use, based on input from consultants that perform benchmarking. The total of six hours per building consists of three hours to gather the information (physical building characteristics, utility bills), and three hours for inputting the data into Portfolio Manager. If the jurisdiction desires, they can conduct interviews with building owners to determine how, quantitatively, to adjust the default value to account for the effects of the size and complexity of a building and if the building has been benchmarked previously. The actual hours may fluctuate between more complex commercial buildings and simpler buildings with only one meters or space.

- **Calculate Full-Time Equivalent (FTE).** The following equation summarizes how this information is translated into jobs on a FTE basis. Note that FTE are not cumulative. For example, if in the first year of a policy the result is 20 FTE, and the second year the result is 25, there were 20 jobs added in the first year and five, not 25, added in the second year.

Equation 4-1 summarizes how this information is translated into jobs on a FTE basis.

Equation 4-1. Basic Equation for Calculating Jobs from Benchmarking

$$\mathit{Direct\ Benchmarking\ FTE} = \frac{(\mathit{Number\ of\ Buildings\ Benchmarked} * \mathit{Y\ Hours\ of\ Benchmarking\ per\ Building}}{2080 - \mathit{Hours\ Unavailable\ for\ Analysis}\ (e.g., \mathit{holidays, vacation, sick\ time, administrative\ time})}$$

4.2.2 Calculating Employment from Efficiency Actions – Input-Output Modeling

The second approach is to use input-output analysis (I-O modeling) to determine the direct and indirect economic impact of building energy-efficiency upgrades. The concept is that a B&T policy can lead to related public sector initiatives and market responses and additional energy-efficiency improvements.

The I-O model estimates how economic activity in one sector affects other sectors in a region or nation, analyzing between industries and consumers. This type of model takes into account how industries can produce goods and services that drive demand for other goods and services.

Two related studies, *Analysis of Job Creation and Energy Cost Savings from Building Energy Rating and Disclosure Policy* (Garret-Peltier and Burr, 2012) and *Employment Estimates for Energy-Efficiency Retrofits of Commercial Buildings* (Garrett-Peltier, 2011), took into account a wide range of economic and survey data to determine appropriate job creation multipliers in regards to building energy-efficiency. These studies' methodologies are used for the I-O modeling.

The studies' job creation multipliers predict the number of jobs that result from the energy-efficiency expenditure activities, and include three types of job creation:[62]

- *Direct Jobs:* Jobs generated from a change in spending patterns resulting from an expenditure or effort (e.g., construction jobs for an energy-efficiency retrofit project)
- *Indirect Jobs:* Jobs generated in the supply chain and supporting industries of an industry that is directly impacted by an expenditure or effort (e.g., the production components in mechanical equipment or trucking of materials)
- *Induced Jobs:* Jobs generated by the spending of received income resulting from direct and indirect job creation in the affected region (e.g., money spent in the economy on housing, retail goods, etc. by workers added in the direct and indirect job categories)

The previously listed three types of job creation result from three categories of multipliers:

- *Operational Expenditures and Improvements:* Job growth multipliers for this category result from improved building operations through facility support services and environmental controls.
- *Capital Upgrades:* Much of the energy savings in buildings is expected to result from capital upgrades. These upgrades to lighting, HVAC, envelope, and appliances carry their own job impacts.
- *Spending Shifts from Energy to Non-Energy Goods and Services:* Additional job creation results as owners' spending shifts away from energy costs to non-energy goods and services.

[62] *These types of job creation from increased energy-efficiency are further detailed in an American Council for an Energy-Efficient Economy white paper, available here:* **http://www.aceee.org/files/pdf/white-paper/energy-efficiency-job-creation.pdf**.

Figure 4-4 provides a high-level overview of key elements of the jobs analysis process.

Figure 4-4. Job Creation Categories

B&T Policy Job Generation Paths	The need for buildings to be benchmarked creates:	The increase in energy efficiency actions (operational improvements, capital upgrades, energy savings) that result from B&T policies creates:		
Types of Jobs	BENCHMARKING JOBS Jobs to conduct benchmarking	DIRECT EFFICIENCY JOBS Jobs to physically execute efficiency action	INDIRECT EFFICIENCY JOBS Jobs in industries supporting the execution of the efficiency action	INDUCED JOBS Jobs resulting from the increased spending in other areas of the economy
Methods in this Handbook to Calculate Job Types	Benchmarking Full Time Equivalent Equation	Input / Output Modelling or Using Multipliers		

The job creation from O&M improvements and capital upgrades are calculated separately as they require different types of labor, spending, and support industries. As such, they have different multipliers.

The IMT/PERI and Garrett-Peltier studies calculate this job creation potential by estimating the total impacted square footage of buildings that save energy. The studies then estimate a distribution of energy savings across multifamily and commercial properties, sum the square footage of each building type that saves energy within this distribution, multiply the square footage by estimated costs per square foot to achieve these savings, then multiply the dollar amounts by multipliers to result in jobs figures.

Calculate I-O Model Job Creation – O&M and Capital Upgrade Impacts

Following are the steps required to calculate job growth. Further details and charts are located in Appendix A.

- **Compile the square footages of buildings achieving energy savings by percentage energy saved.** Using the same data from Section 3, sum the square footage of properties saving weather-normalized source EUI energy, organized by property type: multifamily, commercial properties up to 100,000 sq. ft., and commercial properties over 100,000 sq. ft.. Each type of property has its own specific multipliers. Annual energy savings per building are grouped by percentages in buckets, ranging from 1% savings to 50% savings. A chart of these groupings is found in the appendix.

- **Assign energy savings due to O&M or capital upgrade improvements.** As noted, job creation figures from O&M improvements and capital upgrades use different cost per square foot figures and different multipliers for direct, indirect, and induced jobs. Thus, the compiled square footages must be split in some way to O&M or capital upgrades. For the purposes of this job analysis, it is assumed on average for the buildings that saved energy, the first 12.5% of energy savings was accomplished through O&M. National research suggests that savings between 5-20% are common for O&M improvements, and given their typical lower cost O&M improvements are likely to be pursued before capital upgrades. (FEMP, 2010; ENERGY STAR; PNNL, 2002). For buildings saving more than 12.5%, it is assumed on average the balance is accomplished through capital upgrades.

- **Multiply square footages against cost per square foot figures for O&M and capital upgrade economic activity.** The model uses assumed, nation-wide cost per square foot figures for achieving levels of energy savings through O&M and capital upgrades, by property type. Square footages are multiplied against these figures, and the total economic activity is summed by property type.

- **Multiply the resulting dollar amounts against job creation multipliers.** The total project cost estimates for each property type are applied against standard multipliers. The dollar amounts from the two groups of commercial properties are combined and used with the same multipliers. This process results in direct, indirect, and induced job creation per property type.

Calculate I-O Model Job Creation – Spending Shifts from Energy to Non-Energy Spending

Lastly, multipliers exist for further job creation estimates due to the net change in spending away from energy to more labor-intensive uses. This category is calculated differently than the O&M and capital upgrade categories: the dollar savings by fuel type are used with corresponding multipliers for direct, indirect, and induced job creation.

- **Calculate Dollar Energy Savings by Fuel Type.** This analysis is outlined in Section 3. The data are only useful for job creation calculations if it is weather normalized. Non-weather-normalized data may not reflect savings appropriately. This analysis requires an average cost of each fuel type for the jurisdiction for the period in question.
- **Multiply the Dollar Amounts Against Multipliers.** The resulting energy savings figures are then applied to the I-O multipliers to estimate net job creation resulting from shifting energy expenses from energy supply industries to the energy efficiency industry. The multipliers to calculate energy savings are found in the appendix.

4.2.3 How to Summarize Job Creation Figures

The resulting job creation figures should be summarized by type and sector to paint a clear picture of the drivers of growth. Sample tables are as follows.

Table 4-2. Example Summary Table of FTE Calculations for Benchmarking Labor

Calculation	Reporting Year 1	Reporting Year 2	Total
Number of Buildings	500	500	1,000
Benchmarking Jobs	1.5	1.5	1.5

Table 4-3. Example Summary Table of Estimated Job Created, I-O Modeling

Input-Output Analysis	Direct	Indirect	Induced	Total
Jobs from Operational Improvements – Multifamily	5	3	3	**12**
Jobs from Operational Improvements – Commercial	6	4	4	**13**
Jobs from Capital Upgrades - Multifamily	9	7	6	**21**
Jobs from Capital Upgrades - Commercial	42	34	31	**107**
Jobs from Energy Savings - Multifamily	8	1	4	**12**
Jobs from Energy Savings - Commercial	56	10	26	**93**
Total	**125**	**59**	**74**	**258**

4.3 Real Estate Value Analysis Methodologies

A considerable amount of existing research has gone towards recognizing the value of energy efficiency in real estate appraisal and to quantify the financial impact of building energy efficiency. This research has found that buildings with LEED and ENERGY STAR certifications can have higher rental rates, higher occupancy rate, lower utility costs, increased sale prices, and low construction cost premiums (DOE; 2014).

This analysis is based on publicly reported weather normalized source EUI, as well as actual sales data, rental data, vacancy data, other factors available through multiple public and private real estate data sources. This section provides guidance on understanding how the increased transparency in energy usage data resulting from the B&T policy can affect the relationship between energy efficiency and building value. This attempts to show if the availability of public energy data leads to increased value of energy efficient properties. The goal here is to provide recommendations for data analysis to see if the strength of the relationship between real estate values and the energy efficiency of properties increases over time as the result of a B&T policy.

4.3.1 Primary Recommendation for Analyzing Changes in Building Valuation: Simple Linear Regression Model

Real estate valuations commonly apply a qualitative sales comparison approach to valuing buildings based on individual building and local jurisdictional characteristics such as distance to the city center, construction attributes, building size, occupancy rate, building class, lease type, and other characteristics that are typically used qualitatively in real estate sales comparison analysis. In areas where energy consumption and efficiency are seen as important, this qualitative approach will potentially take this into account, but it may prove difficult if all buildings are subject to the same policy.

Another way to isolate changes in real estate valuations is to analyze available data to determine if the public energy usage data released by the B&T policy is positively impacting real estate values and market demand. This handbook calls this approach the simple linear regression method.

A simple, bivariate linear regression model shows the influence of an independent variable on the dependent variable. The independent variable in this situation is the weather-normalized source EUI, and the dependent variable is an indicator of real estate value. This figure can be rental rates, appraised value per square foot, or another indicator that is normalized by building size.

Finally, comparing the relationship over time, starting from before the implementation of the B&T policy and continuing afterwards as data are released annually, may shed light on any changes in the relationship. The goal should be to see if the strength of the relationship between energy efficiency and value increases with the public availability of energy performance data.

Data Collection and Organization

First, buildings should be separated into categories to best compare similar properties, as many factors affect value and demand. It is up to the jurisdiction to determine how many sub-groups to analyze, but it is recommended to organize, at a minimum, the buildings based on available data reported in Portfolio Manager:

- Separate between commercial and multifamily properties.
- Separate commercial properties by sub-type where possible.
- Separate both multifamily and commercial properties by geographic area. Sub-markets or neighborhoods are examples. Zip codes are used here for simplicity.
- Separate both multifamily and commercial properties by eras based on year built. The jurisdiction can decide which groupings are logical based on the existing building stock.

Secondly, data are compiled for each category of buildings. This includes:

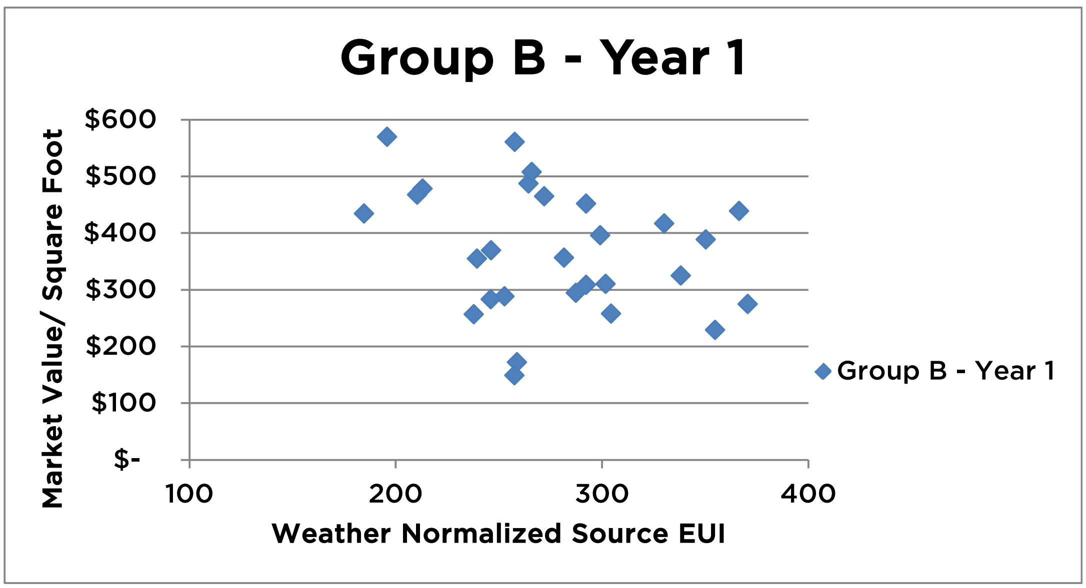
- Weather-normalized source EUI

- Indicator of value, normalized by square footage
    - Rental rates per square foot
    - Appraised value per square foot

A random sample of properties should be selected for each sample set. This can help assist in not picking solely efficient or inefficient properties. It is recommended that the municipality analyze a minimum of 10% of each subgroup type for a representative sample.

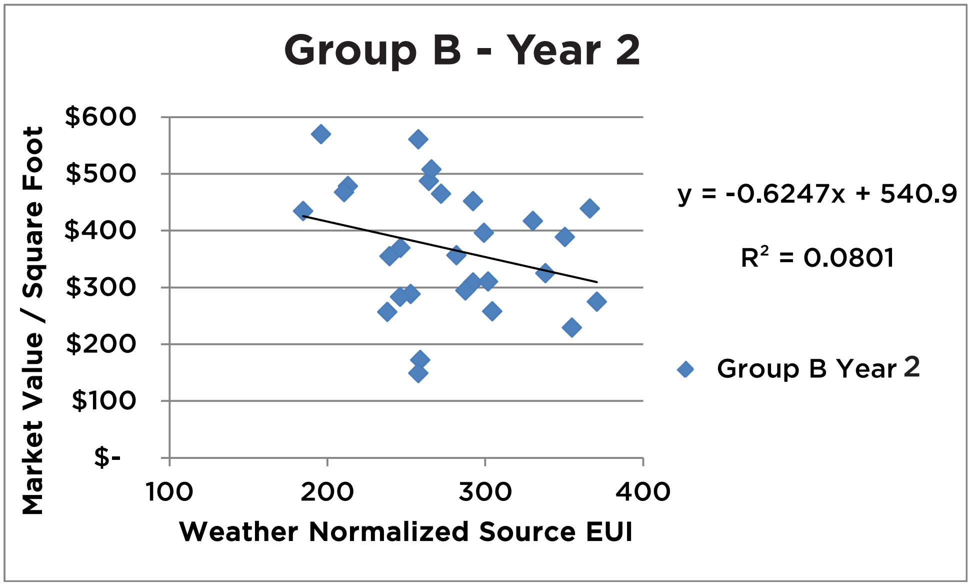
Third, the data are then plotted on a scatterplot as shown in Figure 4-5, which follows the usual bivariate regression model approach by having the dependent variable (market value per square foot on the vertical axis, and the independent variable weather normalized source EUI on the horizontal axis). Each point in the graph represents one property. As is shown in the generic example below, the data may or may not result in a discernible pattern or relationship (e.g., a negative relationship between the EUI and the valuation).

Figure 4-5. Example of Weather Normalized Source EUI/Market Value per Square Foot Scatterplot



Calculating a regression line visually shows the trend of the data. The line can be derived from the least-squares method, which takes the difference between the data and the line, then squaring the difference and adding the values together. The line can also be calculated easily enough with desktop spreadsheet software. A regression line is shown in Figure 4-6.

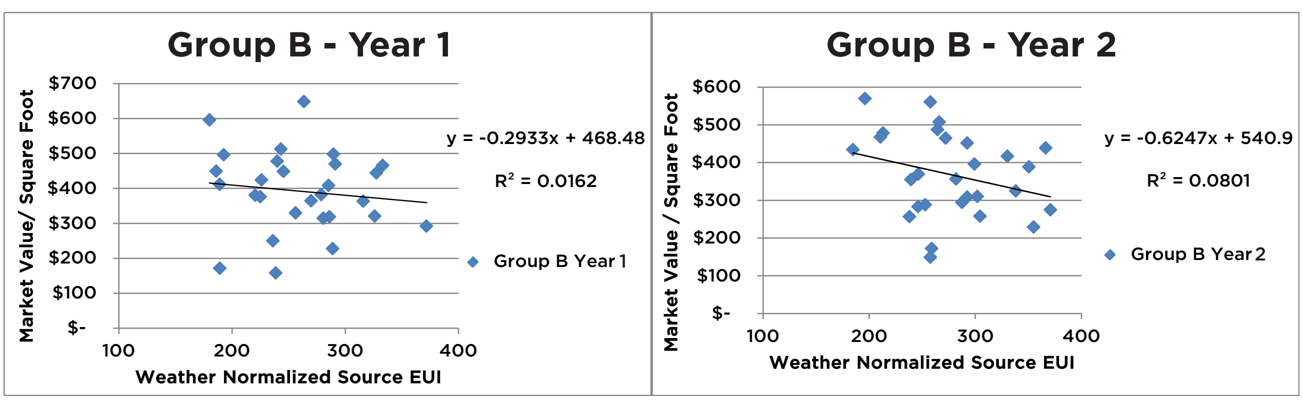
Figure 4-6. Example of Weather Normalized Source EUI / Building Market Value per Square Foot Regression



Lastly, each year, the same group of buildings should be plotted. The intent is to see as time goes on, year after year, with the same buildings, if the strength of the relationship between value and publicly released energy usage figures improves. An increase in the strength of the relationship over time could point to a growing public awareness.

Below are examples of the same buildings compared at two consecutive years.

Figure 4-7. Example of Weather Normalized Source EUI / Building Market Value per Square Foot Regression – Year 1 vs. Year 2



First, the direction of the slope should be noted. A negative slope would appear when lower weather normalized source EUIs correspond to higher values.

R-squared values, in the simplest sense, explain how closely the data matches the regression line. The buildings shown have very low R-values; however, this is as much of a function of a simple test with incomplete data as any real relationship between energy-efficiency and value. Separately, the focus is on the change in the value from year to year. In the example above, the R-squared value increased between the two years, indicating that the strength of the relationship between building energy performance and value is increasing.

4.3.2 Supplementary Recommendation for Analyzing Changes in Building Valuation: Hedonic Regression Analysis

As noted above, real estate valuations commonly apply a qualitative sales comparison approach to valuing buildings based on individual building and local jurisdictional characteristics. Hedonic regression analysis provides a quantitative way to isolate these and other attributes on the value of properties. In the context of the non-energy impacts of B&T policies, the hedonic regression model is a supplementary method that may be employed to measure the impacts of the policy on the change in real estate valuations over time. More information on the hedonic approach is provided in Appendix B.4.

Box 3. Valuing Energy Efficiency and Green Building

A major topic of analysis due to the increase of importance in energy efficiency in green buildings is the impact that efficiency has on appraisal and real estate values. Real estate appraisal is focused primarily on economic aspects, the amount for which a property can be sold or rented, but may not fully recognize the increased value due to energy efficiency or other green aspects (Chappell and Corps, 2009). While this guidebook focuses solely on energy efficiency, and no other green benefits, an understanding of the literature around this issue is still useful.

DOE – Better Building's Research

DOE's Better Building's program conducted a comprehensive survey of this research to analyze findings and pinpoint areas in need of further investigation: ***eere.energy.gov/alliance/activities/market-solutions-teams/appraisals-valuation/green-labels***

The Appraisal Institute "All Things Green"

The Appraisal Institute has taken steps to address energy-efficiency and green building. The "Residential Green and Energy Efficiency Addendum" was released in 2011, Form 820.04, to assist appraisers with valuing buildings with energy-efficiency or green features (AI, 2013a). The form was recently updated to recognize renewable energy and other green aspects even better. Fannie Mae, Freddie Mac, and the Federal Housing Administration use the new Form 1004 (AI, 2013b).

The Vancouver Valuation Accord

The Vancouver Valuation Accord is a not-for-profit association established to address the increasing importance of sustainability and the need for it to be understood in valuations and appraisals (VVA). More information can be found at: ***http://vancouveraccord.org/***.

The Green Building Finance Consortium

The Green Building Finance Consortium is a research and education effort founded in 2006 to help private investors underwrite sustainable property from a financial perspective. Alongside a large online library, the book Value Beyond Cost Savings is available free of charge on the website. More information and the book are available here: ***http://www.greenbuildingfc.com/***.

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Appendix A
Glossary

This glossary defines and explains terms used in this handbook. In cases where B&T terminology coincides with those used in the evaluation, measurement, and verification (EM&V) of energy-efficiency programs, the glossary borrow liberally from the glossary contained in SEE Action (2012). At the same time, many traditional energy-efficiency evaluation terms have been modified to more precisely define their role in B&T policy evaluation.

Activities: Actions taken or planned to be taken to address and overcome barriers identified to the policy's or program's success. In the context of the B&T policy, specified activities are designed to encourage deeper actions to save energy on the part of policy identified commercial and multi-family building owners. Specified activities to reach this goal are a component of the policy or program logic model.

Attribution: The extent to which a B&T policy may be seen as directly or indirectly responsible for measured energy and non-energy impacts. The definition of attribution in this context is the acknowledgement that the impacts can be attributed to one or more policies, programs, or market forces that theoretically could be responsible for the measured results.

Barriers: Barriers are defined as factors that inhibit the efficient use of a product, service or application of a policy outcome. In this context, the B&T policy focuses on barriers to energy efficiency and/or proactive market actor activities to saving energy. B&T policies and programs are designed to help remove some of these key barriers and are incorporated into the policy or program logic model.

Baseline: Market and building conditions, including energy consumption and associated operational and equipment purchase practices, which would have occurred without the implementation of a B&T policy, government standard, or energy-efficiency program. Baseline conditions are sometimes referred to as "business-as-usual" conditions and are used to calculate energy and non-energy impacts.

Benchmarking: The measurement of a building's energy use and comparisons of that building to the average for similar buildings, usually on an average per square foot basis.

Benchmarking & Transparency Market Transformation Evaluation Planning Framework: A set of policy planning tools available to jurisdictional staff to help clarify short- and long-term policy goals and provide a structure for future market transformation progress evaluation activities. The planning framework includes the B&T policy logic model and related market transformation indicators, which will later be used by B&T policy staff as a guide to evaluating the progress of the policy's intended effects in the market.

Benchmarking & Transparency Policy: Local laws, ordinances, or regulations that mandate energy benchmarking of buildings, accompanied by either a mandate for widespread public disclosure or a more limited disclosure of the energy performance of the buildings.

Benchmarking & Transparency Program: Local laws, ordinances, or regulations that provide processes for voluntary energy benchmarking of buildings, accompanied by either widespread public disclosure or a more limited disclosure of the efficiency of the buildings who participate in the program.

Bias: The extent to which a measurement or an analysis method, such as the various supplementary regression-based energy impact analyses approaches described in this handbook, systematically underestimates or overestimates the true value of a parameter of interest such as the randomness of a control group or the energy impact of a B&T policy.

Billing Data: Energy consumption data obtained from electric or gas meters that are used to invoice the customer for energy used in a particular billing period. For B&T policy implementation, billing data also refers to customer billing records across all affected customers over time, and for evaluation purposes may also include billing records of customer in the jurisdiction or outside the jurisdiction who are not subject to the policy.

Common Practice: In the context of building energy use, refers to generally accepted or average practices affecting energy consumption of equipment in the building including energy-efficiency, operations and maintenance, and occupant behavior. Common practices are often used to define a baseline.

Comparison Group: As noted below for control group, a comparison group represents a group of buildings not subject to a B&T policy that can be used to isolate and measure the impacts of buildings subject to the policy. Although this handbook uses the terms comparison group and control group synonymously, some researchers refer to control groups as being derived only from randomized control trials. In this restrictive definition, a comparison group is different because the buildings are identified after policy implementation through quasi-experimental designs.

Control Group: In a randomized control trial or experiment customers are randomly assigned to treatment or control groups. The control group is identical in all respected to the treatment group except they don't receive treatment, which allows the impacts of treatment to be isolated and estimated. In the context of B&T impact evaluation, the control group refers to the quasi-experimental design / regression analysis approaches where suitable control buildings are identified after the implementation of the policy.

Deemed Savings: An agreed upon or stipulated approach to estimating the energy savings from an energy efficiency measure, program, or policy.

Economic Multiplier: Parameters from input-output (I-O) modeling that mathematically describe how a change or intervention in one part of the economy will affect the entire economy. In estimating the non-energy benefits of B&T policies in terms of job creation, this handbook focuses on the net job creation multipliers resulting from reducing energy consumption / increasing energy-efficiency.

Energy Conservation: Actions taken in a building that reduce energy consumption which reflect a reduction in the service being provided by the use of energy. For example, the reduction in cooling loads from increasing the thermostat temperature level is a form of energy conservation.

Energy Efficiency: Actions taken in a building that reduce energy consumption which do not negatively impact the service being provided by the use of energy such as a reduction in cooling loads from more efficient cooling systems or better maintenance practices.

Energy Impact: The impact on energy consumption, usually but not always in terms of energy savings, resulting from an energy efficiency program or policy. The energy impact is generally expressed as the change in a building's site usage (e.g., kilowatt-hours for electricity or therms for natural gas), or in or in fossil fuel use in thermal unit(s).

ENERGY STAR Portfolio Manager®: An engineering tool developed by the EPA that is designed to provide performance data on building energy use, water use, and emissions.

ENERGY STAR Score: An output of Portfolio Manager, expressed as a number on 1 to 100 scale, which describes the relative performance of buildings on a percentile basis. For example, buildings with a score of 50 perform better than 50% of their peers, and buildings earning a score of 75 or higher are in the top quartile of energy performance.

Engineering Model: A model where engineering equations are used to calculate energy use or savings. These models can take the form of simple spreadsheet calculations to more sophisticated tools such as the ENERGY STAR Portfolio Manager® tool to advanced building simulation models such as the DOE's DOE-2 and EnergyPlus models.

Evaluation: The conduct of any of a wide range of assessment studies and other activities aimed at determining the effects and impacts of a policy or program. This includes understanding or documenting policy or program performance in terms of energy impacts, market operations, and other intended and unintended consequences of the policy or program.

Expected Outcomes: These are identified objectives in the B&T logic model that specify anticipated results of taking actions to overcome the identified policy barriers. Progress in meeting these expected outcomes is tracked through evaluation of the presence of market transformation indicator developed as part of the B&T policy market transformation evaluation planning framework.

External Barrier: A barrier to the efficient use of energy in buildings that is external to building operations and management, as well as the real estate market, which influences potential changes to energy usage in buildings. Examples include a lack of market and energy use data influencing the scope of building codes or the design of energy efficiency programs by utilities and program administrators.

Free Rider: For an energy efficiency program, free riders refer to those participants who would have taken the same energy-efficiency actions regardless of whether the program was implemented. In energy efficiency program evaluation, the share of these customers is often measured to ensure they are not double-counted. A free rider is very limited in the context of a mandatory B&T policy as nearly all "participants" are mandated to do so. Although it can be argued that some building managers and owners may be benchmarking their buildings and taking actions without the policy, the effect is likely to be small given the breadth of mandates. Furthermore, the approach to measuring gross savings, whole facility analysis using Portfolio Manager, implicitly captures buildings already benefiting from benchmarking as reflected through higher ENERGY STAR scores in the first year of the policy.

Greenhouse Gas (GHG) Emissions: A component of non-energy benefits that may be associated with B&T policies. Developed from Portfolio Manager outputs, the change in total emissions over time is used to estimate this impact. Total emissions is derived in Portfolio Manager from two components: direct emissions from a primary fuel source that is directly burned on site in the building (e.g., natural gas) and indirect emissions, which are associated with the emissions from secondary fuel sources such as utility-generated electricity or district steam.

Gross Impacts: In the energy efficiency evaluation literature this refers to the change in energy consumption resulting from policy or program-related actions taken by participants, regardless of why they participated. In the context of B&T policies, gross impacts are more broadly defined as the change in buildings' energy usage over time, inclusive of all actions taken to improve building energy performance and reduce consumption. This estimate of gross savings recognizes the foundational aspects of the B&T policy in affecting energy consumption over time, which may indirectly assist in inducting participation in other energy-efficiency activities or programs.

Hedonic Regression Model: Real estate valuations commonly apply a qualitative sales comparison approach to valuing buildings based on individual building and local jurisdictional characteristics such as distance to the city center, construction attributes, building size, occupancy rate, building class, lease type, and other characteristics that are typically used qualitatively in real estate sales comparison analysis. A hedonic regression model provides a model to isolate these and other attributes on the value of properties. In the context of the non-energy impacts of B&T policies, the hedonic regression model is a supplementary method that may be employed to measure the impacts of the policy on the change in real estate valuations over time.

Historical Tracing: A structured process for attributing energy savings from various market interventions, programs, and legislation, and policies affecting a group of buildings energy use. For example, buildings in a given jurisdiction may be targeted by B&T policies, other jurisdictional energy conservation and energy efficiency programs, federal and state energy efficiency codes and standards, and / or utility energy efficiency programs. Historical tracing may be accompanied by structured expert judgment, which provides additional guidance and feedback on the historical tracing attribution process.

Impact Evaluation: The evaluation of policy- or program-specific changes directly or indirection due to the policy or program. For a B&T policy impact evaluation may include market effects, energy impacts, and non-energy impacts.

Input-Output (IO) Model: A model that estimates how economic activity in one sector affects other sectors in a region or nation. This type of model takes into account how industries can produce goods and services that drive demand for other goods and services.

Internal Barrier: A market barrier to the efficient use of energy in a building that is internal to building operations and management because it reflects a building manager's or owner's lack of awareness about their building's energy use.

International Performance Measurement and Verification Protocol (IPMVP): A guidance document with a framework and definitions describing four M&V approaches used in energy-efficiency program evaluation; a product of the Efficiency Valuation Organization (***www.evo-world.org***).

Job Impacts: The net number of jobs resulting from the energy efficiency expenditure activities, which include three types of job creation: *Direct Jobs*, which are those jobs generated from a change in spending patterns resulting from the B&T policy itself such as performing building benchmarking, changing building operations, or investing in and energy efficiency retrofit project; *Indirect Jobs*, which are generated in the supply chain and supporting industries directly impacted by energy efficiency expenditures such as the production components in mechanical equipment or the trucking of materials; and *Induced Jobs*, which are generated by the spending of income resulting from direct and indirect job creation, for example money spent on housing, retail goods, etc. by workers added in the direct and indirect job categories.

Jurisdiction: The governmental entity adopting and implementing a B&T policy. This includes cities, counties, or states that have adopted or may adopt a B&T policy.

Logic Model: The graphical representation of a program theory showing the connections between the market barriers a policy or program is intended to overcome, the specific activities implemented through the policy or program, and the expected short-term, intermediate, and long-term outcomes of the activities.

Market Actor: The types of organizations or individuals participating in a market. For B&T policies, the market refers to commercial and multifamily real estate markets where the actors are building managers, owners, tenants, real estate professionals, investors, and underwriters.

Market Barrier: A type of barrier to the efficient use of energy in buildings that goes beyond internal building operations and management, and reflects the lack of transparency about energy use among and across the various market actors in the real estate market including real estate professionals, tenants, investors, and underwriters.

Market Effect: In traditional utility energy efficiency program evaluation, market effects are defined as other influences not already captured in free ridership and spillover that reflect changes in market structure or the behavior of market actors due to the program. As with spillover, the market effects of B&T policies are inherently part of the policy design and logic model, and represent the foundational aspects of the policy. Additionally, the primary evaluation technique recommended by this handbook to attribute net savings to B&T policies—historical tracing combined with expert panel judgment—is designed to estimate net effects without isolating traditional components of net effects such as free ridership, spillover and other market effects.

Market Transformation: A reduction in market barriers resulting from a market intervention, such as an energy efficiency policy or program, where there is a set of measured market effects that is likely to last after the intervention has been altered or eliminated.

Market Transformation Indicator (MTI): A metric or milestone indicative of progress in the market. MTIs are needed, particularly in the early stages of policy or program implementation, to evaluate the progress and impact of the policy on intended outcomes. For example, if a B&T policy is designed to reduce internal barriers around building energy performance and consumption, then an MTI will measure changes in that barrier over time.

Net Energy Impacts: The subset of measured energy changes attributable to an energy efficiency policy or program. In the context of utility-sponsored, voluntary energy efficiency programs, the isolation of net energy impacts from gross energy impacts typically involves taking into account free ridership, spillover, and market effects. However, for mandatory B&T policy evaluation the attribution of net savings as a primary evaluation technique refers to disaggregating the effects of various utility programs and government policies, including the B&T policy, through historical tracing and expert judgment. Note that the supplementary, quasi-experimental design approaches to developing net energy savings from B&T policies are used frequently for assessing the net energy savings for some utility energy efficiency programs. Finally, both primary and supplementary methods recommended in this handbook are derived directly from the UMP's net savings chapter. ***http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf***

Non-Energy Impacts: The non-energy impacts that may result from B&T Policies include changes in greenhouse gas (GHG) emissions, job creation, and real estate valuations.

Primary Evaluation Approaches: The recommended approaches for jurisdictions to evaluation the market, energy, and non-energy impacts of B&T policies. These approaches are a subset of the impact evaluation methods applicable to B&T polices, and generally reflect the basic or minimum requirements necessary to perform an evaluation, as well as the evaluation resources available in most jurisdictions.

Quasi-Experimental Design: A structured process for assigning customers to a control or comparison group for impact evaluation purposes after customers have already opted into or were mandated to be part of a treatment group. Quasi-experimental designs are generally used when a randomized control trial is neither feasible nor practical, such as the case of B&T policies.

Regression Analysis: Analysis of the relationship between a dependent variable (response variable) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation. In energy efficiency policy and program evaluation the dependent variable is energy consumption, and the independent variables must include a variable or variables representing the policy or program.

Regression Discontinuity Analysis: A supplementary impact analysis technique in this handbook that uses mandatory B&T thresholds (called discontinuities in treatment) to estimate energy impacts. A form of quasi-experimental design, regression discontinuity analysis relies on comparisons between treatment and control group customers who are very close to their respective sides of the thresholds.

Site Energy: Reflects the energy delivered to a building either as primary or secondary energy, usually reflected in the end metered value. Primary energy is the raw fuel that is burned to create heat and electricity, such as natural gas or fuel oil used in onsite generation, and secondary energy is the energy product (e.g., electricity or steam) created from a raw fuel.

Source Energy: Reflects the conversion of all primary and secondary energy consumed by a building into equivalent units of raw fuel consumed to generate each unit of energy consumed on-site. For primary energy consumed on site, Portfolio Manager's conversion to source energy accounts for losses that are incurred in the storage, transport, and delivery of fuel to the building. When secondary energy is consumed on site, the conversion accounts for the mix of raw fuels used in producing the secondary energy, and losses incurred in the production, transmission, and delivery of the energy to the site. Source energy is the preferred metric to use for evaluation, because it accounts for the total raw fuel consumed by the building.

Spillover: In the context of utility energy efficiency programs spillover is seen as additional energy savings beyond the program-related gross savings of the participants and without financial or technical assistance from the program. For example, spillover might be other measures installed due to participants becoming more educated about their energy usage, or non-participants installing program measures because they learned about them through the program but for whatever reason don't want to apply for incentives. However, the foundational aspects of B&T policies anticipate these and similar market effects, and they are properly seen as part of the intended outcome rather than spillover, which is a positive but not necessarily an intended outcome. Additionally, the primary evaluation technique recommended by this handbook to attribute net savings to B&T policies—historical tracing combined with expert panel judgment—is designed to estimate net effects without isolating traditional components of net effects such as free ridership, spillover and other market effects.

Supplementary Evaluation Approach: The subset of impact evaluation methods applicable to B&T policies that are not included in the recommended, primary evaluation approaches. Supplementary methodologies are, in general, more sophisticated and rooted in traditional utility energy efficiency program evaluation methodologies. Supplementary methodologies are intended to be used by jurisdictions or other organization who wish to invest greater effort in order to obtain findings that are more robust than may be obtained with the primary approaches.

Uniform Methods Project (UMP): A set of protocols developed by the DOE for evaluating impacts from energy efficiency measures and programs. The protocols provide a straightforward method for evaluating gross energy savings for residential, commercial, and industrial measures commonly offered in ratepayer-funded programs in the United Sates. The protocols are based on specific International Performance Verification and Measurement Protocol (IPMVP) options, but provide a more detailed set of evaluation approaches. Additionally, in certain areas such as the evaluation of net savings from energy efficiency programs, the UMP has relied on information sources, techniques, and expertise in developing protocols and recommendations. ***http://energy.gov/eere/about-us/ump-protocols***.

Whole-Facility Analysis: This is Option C of the IPMVP protocols, and also noted by the UMP as a recommended approach for evaluating energy efficiency programs targeted to an entire building rather than a single end-use or system. This approach is the primary approach recommended in this handbook because B&T policies or programs generally require benchmarking to be conducted via the ENERGY STAR Portfolio Manager® tool, and the data provided through the policy also meet the requirements of the Whole-Facility Analysis approach. This recommended approach also recognizes that Portfolio Manager-based impact analyses capture all of the changes in energy use over time resulting from a host of factors, including the B&T policy and other energy efficiency policies and programs, relative to baseline or common practices before the policy.

Appendix B
Additional Methodological Information

B.1 Methodologies for Quantifying Energy Impacts

B.1.1 Additional Information on IPMVP Measurement and Verification Approaches (Section 3.2.2)

The IPMVP discusses four primary methods for calculating gross energy impacts from energy-efficiency improvements, which include:

- Option A—Retrofit Isolation: Key Parameter Measurement
- Option B—Retrofit Isolation: All Parameter Measurement
- Option C—Whole Facility
- Option D—Calibrated Simulation

Table B-1 is an abbreviated version of the table included in the IPMVP, and provides a brief summary of each of the four methods accepted by the industry for determining gross energy impacts.

Table B-1. IPMVP Impact Evaluation Options

IPMVP Option	How Impacts are Calculated	Typical Applications
A. Retrofit Isolation: Key Parameter Measurement • Impacts are determined by measuring key performance parameters. • Measurement duration ranges from short-term to continuous, depending on variations in the parameter and the reporting period. • Parameters that are not metered are estimated.	Engineering calculations of baseline and reporting period energy from: • Short-term or continual measurement of key operating parameters; estimated values; and • Routine and non-routine adjustments as required.	Lighting retrofits—estimating power draw by determining operating hours of lights through building schedules.
B. Retrofit Isolation: All Parameter Measurement • Impacts are estimated by measuring the energy use of the system affected by the efficiency project. • Measurement duration ranges from short-term to continuous, depending on variations in the parameter and the reporting period.	Short-term or continuous measurement of baseline and reporting period energy, and/or engineering calculations using measurements of proxies of energy use. Routine and non-routine adjustments are required.	Installing a variable-speed drive and controls to a motor to adjust pump flow. Measuring electric power with a kW meter before and after the project is completed.
C. Whole Facility • Impacts are determined by measuring the energy use at the whole-facility or sub-facility level. • Continuous measurements of the entire facility's energy use are taken throughout the reporting period.	Analysis of whole-facility baseline and reporting period meter data. Routine adjustments as required, such as using a regression analysis. Non-routine adjustments as required.	Multifaceted energy management program affecting many systems in a facility. Measure energy use with gas and electric utility meters.
D. Calibrated Simulation • Impacts are determined through simulation of the energy use of the whole-facility or sub-facility. • Simulation routines are demonstrated to model actual energy performance measured at the facility. • Calibrated simulation is required.	Energy use simulation, calibrated with hourly or monthly utility billing data.	Multifaceted energy management program where no meter existed in baseline period.

B.1.2 Additional Information on using Portfolio Manager to Estimate Energy Savings (Section 3.3.1)

The types of inputs that are required depend on the primary function of the building (e.g., an office has different required inputs than a hotel). For example, the following is a list of the inputs that are required to be entered into Portfolio Manager for a building with the primary function listed as "Office," along with some possible ways to verify the inputs through a desk review. Note that a majority of the inputs have an option to use a default input instead of manually entering a value. The inputs that have this option are specified below. The inputs below provide an example of the type of inputs to Portfolio Manager that could be crosschecked through desk reviews and/or on-site visits through the Supplementary Method mentioned in Section 3.4.1.

Table B-2. Input Requirements for a Building Entered as "Office" in Portfolio Manager

Input into Portfolio Manager	Description	Possible Methods for Verifying Input through a Desk Review
Primary Function (Building Segment)	There are over 80 property types to choose from in Portfolio Manager and the intent is to select the option that best represents the primary use of the property. Only 19 of the 80 options are eligible to receive the 1-100 ENERGY STAR score, which is a measure of how well a property performs relative to similar properties after normalizing for climate and operational characteristics. The other 61 property types can still be benchmarked in Portfolio Manager; however, they cannot receive an ENERGY STAR score.	• Verify through city records, tax documents, or construction documents • Verify through a phone interview with the building owner to see how the building is operated
Number of Buildings	This is the number of physical buildings that the building manager considers as part of their property.	Same as above
Year Built	The year that the building was constructed.	Same as above
Address	The building manager is required to enter the name of the building, country, street address, city/municipality, state/province, and postal code.	• Verify through city records, tax documents, or online resources, such as Google Earth • Verify through a phone interview with the customer
Gross Floor Area	Total square footage of all areas inside the building.	Verify through city records, tax documents, construction documents, or online resources, such as Google Earth.
Occupancy	The percentage of the property that is occupied and operational.	Verify through a phone interview with the customer
Weekly Operating Hours	The total number of hours that the property is occupied by a majority of the employees per week (default available).	• Verify through a phone interview with the customer • Verify through the website for the building to see if they list their business hours
Number of Computers	The total number of desktop computers, laptops, and data servers at the property (default available).	Verify through a phone interview with the customer
Number of Workers on Main Shift	The total number of workers on the primary shift (default available).	Same as above

% That Can Be Heated	The total percentage of the property that can be heated by mechanical heating equipment (default available).	Same as above
% That Can Be Cooled	The total percentage of the property that can be cooled by mechanical cooling equipment (default available).	Same as above
At Least 12 Months of Energy Meter Data	A minimum of 12 months of monthly energy consumption data for the entire property is required in order to populate an energy score.	Request the billing data from the utility and crosscheck the inputs with what went into Portfolio Manager
At Least 12 Months of Water Meter Data	A minimum of 12 months of monthly water consumption data for the entire property is required in order to populate an energy score.	Request the billing data from the utility and crosscheck the inputs with what went into Portfolio Manager

Source: Adapted from the ENERGY STAR Portfolio Manager Glossary

B.1.3 Additional Information on Structured Expert Judgment Panels (Section 3.3.4)

The structured expert judgment approach involves assembling a panel of experts to review the attribution and net impacts findings of others and develop final estimates, or develop their own estimates. In practice, most energy-efficiency evaluations that apply this method use it to complement another approach, and it is in this context that it is recommended as a supplementary approach to attributing B&T policies in the face of multiple programs and efforts targeting the same facilities.

This process is widely known and applied across energy-efficiency program evaluations (NMR and Research Into Action, 2010). Using this process, each panelist is asked to make a judgment on the topic—based on the provided information, including the historical tracing estimates, and on their experience—and submit the information back to the evaluators. The evaluators compile the information from the panelists and resend it to the panelists for another review. The panelists are asked whether they stand by their original judgments or whether the assessments of their peers have caused them to alter their judgments. At least two rounds of judgment are required for an Expert Panel, although more rounds can be used. The advantages of augmenting historical tracing with the expert panel are the following:

- It is a relatively low-cost approach to obtaining a systematic review of the historical tracing findings before they are finalized. In practice, this process may result in sound updates to the historical tracing estimates after the initial set of findings.
- It is a useful tool for consolidating results from multiple methods to develop a consensus estimate. For instance, if a jurisdiction decides to use historical tracing and survey-based approaches, an expert panel would likely be necessary to resolve likely differences in their findings.

B.2 Input-Output Modeling: Additional Details

Input-output modeling must be based on work done by the very buildings impacted by the policy. The real task will be to quantify the spending in these industries within the buildings, and to be able to separate it from other activity related to energy efficiency in the economy.

It is important to keep in mind that, as noted in the logic modeling discussion of Section 2, actual data will likely not be able to be collected until a few years after implementation of the policy, when building owners have had the opportunity to act upon the public release of benchmarking data.

B.2.1 Estimate Economic Activity

An estimate of the said economic activity can be taken based on the size of the building stock impacted and the energy-efficiency reductions.

Spending on operations and maintenance (O&M) and energy-efficiency upgrades require the following steps:

- Calculate the square footage of the following property types covered by the B&T policy:
  - Total multifamily property square footage
  - Total square footage of commercial properties between 25,000-100,000 sq ft
  - Total square footage of commercial properties above 100,000 sq ft
- Tabulate the square footage of each property type that achieves energy savings, falling with in ranges of percentages.
- Determine which savings are attributable to O&M and which to capital upgrades
  - The "Gross Energy Savings" column contains ranges of gross energy savings. The "Multifamily," "Medium Commercial," and "Large Commercial" columns show how many square feet of each building category achieved these savings, along with the percentage of each range of all buildings that saved energy. The 25-29% and 25-50% ranges differ between the property types for later calculations. The "Multifamily" and "Medium Commercial" categories use the 25-29% range and 30-50% range, while the "Large Commercial uses the 25-50% range, to mimic the methodology used in the IMT/PERI and Garrett-Peltier studies. Buildings with savings exceeding 50% in one year are not included in the analysis, because these high percentage savings are assumed to be the result of data errors or major changes in building program or occupancy.

Table B-3. Energy Savings Distributions by Property Type

Gross Energy Savings	Multifamily		Medium Commercial*		Large Commercial**	
	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending
1-4%	7,829,691	42%	308,604	54%	7,963,311	32%
5-9%	6,327,282	34%	0	0%	5,857,888	24%
10-14%	2,609,626	14%	144,167	25%	4,575,603	18%
15-19%	931,247	5%	71,000	12%	1,879,562	8%
20-24%	328,671	2%	51,849	9%	389,059	2%
25-29%	27,600	0%	0	0%	n/a	n/a
25-50%	n/a	n/a	n/a	n/a	2,990,505	12%
30- 50%	443,510	2%	0	0%	n/a	n/a
50% + (Excluded)	247,495	1%	0	0%	1,091,747	4%
Total ft^2 of Buildings Saving Energy	**18,745,122**	**100%**	**575,620**	**100%**	**24,747,675**	**100%**

** Commercial buildings between 50,000 to 100,000 square feet in size*

*** Commercial buildings over 100,000 square feet in size*

- Assign square footages to energy savings due to O&M or capital upgrade improvements.
  - As noted, job creation figures from O&M improvements and capital upgrades use different cost per square foot figures and different multipliers for direct, indirect, and induced jobs. Thus, the square footages above must be split in some way to attribute job growth between O&M and capital upgrades. For the purposes of this job analysis, it is assumed on average for the buildings that saved energy, the first 12.5% of energy savings was accomplished through O&M. National research suggests that savings between 5-20% are common for O&M improvements, and O&M improvements are likely to be pursued before capital upgrades given their lower cost typically (FEMP, 2010; ENERGY STAR; PNNL, 2002). For buildings saving more than 12.5%, it is assumed on average the balance is accomplished through capital upgrades. For example, the total square footage of properties which save 19% source energy must be divided between O&M and capital upgrade attribution. In this case, 12.5% savings is attributable to O&M and the remaining 6.5% savings belong to capital upgrades. The corresponding cost per square foot value for O&M savings is applied to 66% of the square footage (as 12.5 is 66% of 19) and the remaining 34% of square footage is multiplied against the corresponding capital cost per square foot value. These dollar amounts are then summed in this manner for every percentage level of savings, and finally used with the appropriate multipliers.
- Multiply square footages against cost per square foot figures for O&M and capital upgrade job creation.
  - The distribution of energy savings by property type from Table 6-3 are applied to assumed cost per square foot figures. The methodology of assigning 12.5% energy savings to O&M and marginal savings beyond that to capital upgrades is also applied here. As shown in Table B-4, higher energy savings assumes a higher cost per square foot. Again, the 25-29% and 30-50% ranges are used for "Multifamily" and "Medium Commercial" while the 25-50% range is used for "Large Commercial."

Table B-4. Project Cost Estimates for Operational Improvements

Gross Energy Savings	Multifamily		Medium Commercial*		Large Commercial**	
	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending
1-4%	$0.01	$132,888	$0.01	$5,546	$0.01	$95,192
5-9%	$0.04	$253,091	$0.04	$-	$0.03	$191,265
10-14%	$0.10	$257,018	$0.10	$13,431	$0.07	$320,292
15-19%	$0.10	$70,855	$0.10	$4,671	$0.07	$103,071
20-24%	$0.10	$19,066	$0.10	$3,241	$0.07	$14,184
25-29%	$0.10	$1,255	$0.10	$ -	n/a	n/a
25-50%	n/a	n/a	n/a	n/a	$0.07	$71,705
30- 50%	$0.10	$14,234	$0.10	$-	n/a	n/a
Total	-	**$748,407**	-	**$26,889**	-	**$795,709**

** Commercial buildings between 50,000 to 100,000 square feet in size*

*** Commercial buildings over 100,000 square feet in size*

The same process is carried out for economic activity from capital upgrades: the impacted square footages are multiplied against dollar per square foot costs and complementary multipliers.

Table B-5. Project Cost Estimates for Capital Upgrades

Gross Energy Savings	Multifamily		Medium Commercial*		Large Commercial**	
	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending	Cost/Sq Ft	Spending
1-9%	$1.00	$-	$1.00	$-	$1.00	$-
10-14%	$1.50	$39,444	$1.50	$9,857	$1.50	$-
15-19%	$2.75	$222,700	$2.75	$24,289	$2.75	$407,125
20-24%	$3.25	$185,352	$3.25	$19,443	$3.25	$279,636
25-29%	$3.75	$41,389	$3.75	$-	$3.75	$1,841,460
30-34%	$4.25	$31,688	$4.25	$-	$4.25	$957,791
35-39%	$4.75	$344,922	$4.75	$-	$4.75	$-
40%-50%	$6.00	$726,178	$6.00	$-	$6.00	$4,758,625
Total		**$1,591,673**		**$53,590**		**$8,244,636**

** Commercial buildings between 50,000 to 100,000 square feet in size*

*** Commercial buildings over 100,000 square feet in size*

- Multiply the resulting dollar amounts against job creation multipliers.
  - The total project cost estimate dollar amounts for each property type are applied against standard multipliers. The dollar amounts from the two groups of commercial properties are combined and used with the same multipliers.

Table B-6. Project Cost Estimates and Multipliers for Operational Improvements

Annual Spending	Direct Jobs per $1 Million (Multiplier)	Calculated Direct Jobs	Indirect Jobs per $1 Million (Multiplier)	Calculated Indirect Jobs	Induced Jobs per $1 Million (Multiplier)	Calculated Induced Jobs	Total Jobs
Multifamily							
$748,407	6.92	**5**	4.32	**3**	4.5	**3**	12
Commercial							
$822,598	6.92	**6**	4.32	**4**	4.5	**4**	13
Total Jobs	-	11	-	7	-	7	25

Table B-7. Project Cost Estimates and Multipliers for Capital Upgrades

Annual Spending	Direct Jobs per $1 Million (Multiplier)	Calculated Direct Jobs	Indirect Jobs per $1 Million (Multiplier)	Calculated Indirect Jobs	Induced Jobs per $1 Million (Multiplier)	Calculated Induced Jobs	Total Jobs
Multifamily							
$1,591,673	5.36	**9**	4.22	**7**	3.83	**6**	21
Commercial							
$8,298,226	5.12	**42**	4.12	**34**	3.69	**31**	107
Total Jobs	**-**	**51**	**-**	**41**	**-**	**37**	**128**

B.2.2 Estimate Economic Activity – Changes in Spending from Energy to Non-Energy

Lastly, multipliers exist for further job creation estimates due to the change in spending away from energy to more labor-intensive uses. This category is calculated differently than the O&M and capital upgrades categories: the dollar savings by fuel type are used with corresponding multipliers for direct, indirect, and induced job creation.

- Calculate Dollar Energy Savings by Fuel Type.
  - This analysis is outlined in Section 3. The data are only useful for job creation calculations if weather normalized. Non-weather-normalized data may not reflect savings appropriately. This analysis requires an average cost of each fuel type for the jurisdiction for the period in question.

Table B-8. Example Gross Cost Impacts by Fuel Type (Source Energy)

Fuel Type	2010 to 2011 Savings	Fuel Cost Per Unit	Fuel Converted to Cost Units	Cost Savings
Electricity *(kWh)*	60,906,641	$0.15 (kWh)	60,906,641 kWh	**$9,135,996**
Natural Gas *(therms)*	-346,002	$7.91 (mcf)	-33,625 mcf	**-$265,975**
District Steam *(MMBTU)*	699	$33.73 (mlbs)	1 mlbs	**$20**
Oil #2 *(MMBTU)*	-10,116	$2.75 (gallon)	-72,941 gallons	**-$200,587**
Oil #4 *(MMBTU)*	14,062	$2.75 (gallon)	101,392 gallons	**$278,827**
Oil #5&6 *(MMBTU)*	92,782	$2.75 (gallon)	668,989 gallons	**$1,839,721**
Diesel *(MMBTU)*	-9	$3.98 (gallon)	-65 gallons	**-$260**
Total	-	-	-	**$10,787,741**

- Multiply the Dollar Amounts Against Multipliers.
    - The resulting energy savings figures are then used against the net multipliers to estimate job creation resulting away from energy expenses to more labor-intensive industries, as shown in Table B-9.

Table B-9. Estimated Energy Savings and Multipliers

Energy Savings $	Direct Jobs per $1 Million	Direct Jobs	Indirect Jobs per $1 Million	Indirect Jobs	Induced Jobs per $1 Million	Induced Jobs
Multifamily						
$1,244,171	6.11	**8**	0.95	**1**	2.82	**4**
Commercial						
$9,543,831	5.85	**56**	1.08	**10**	2.77	**26**
Total Jobs	-	**63**	-	**11**	-	**30**

B.2.3 Sample Calculations

Below restates the steps above:

Operational Job Creation = Total Square Footage of Properties by Type and Range of Energy Savings x $ per square foot costs for comparable energy savings x corresponding job multiplier

Capital Upgrade Job Creation = Total Square Footage of Properties by Type and Range of Energy Savings x $ per square foot costs for comparable energy savings x corresponding job multiplier

Energy Savings Job Creation = Total dollar amount of weather-normalized energy savings by fuel type and by property type x corresponding job multiplier

B.3 Supplementary Method for Calculating Economic Activity: Surveys

This approach adds more real-world value to the previous research by requesting direct feedback from the job creators themselves – the firms and building owners who have a direct stake in the results of B&T policies. The questions can relate to growth or staffing in preparation of the policy. Job growth for consultants or property owner may happen immediately for the staffing required to conduct the actual benchmarking.

Ultimately, the questions should be directed towards financial figures related to the I-O model. It is likely that job growth and/ or spending on energy-efficiency may not take place for one to three years after the initial round of benchmarking. As such, interviews should continue on a periodic basis to capture the true activity of the marketplace.

Questioning in expert panels and surveys should relate as much as possible to ensure that all data collected from any method can be compiled to paint a larger picture.

Surveys can include questions on:

- The interviewees' primary business function, grouped by the North American Industry Classification System (NAICS) code (*NMR, 2013*)

- Ranked responses to the impact of a firm's energy management resulting from the B&T policy, broken down by activity (NMR and *OEI, 2012a and 2012b*)

Questioning should be directed on the hiring of staff because of the B&T policy (*Washington State Employment Security Department, 2012*).

B.4 Supplementary Method for Analyzing Changes in Building Valuation: Hedonic Regression Analysis

A more thorough analysis of building energy consumption and real estate market data goes beyond the simple bivariate linear regression model described in Section 4.3.1. The hedonic regression model utilizes more of the data and variables employed in qualitative comparison sales approaches. Although the hedonic technique is relatively sophisticated, it has been used extensively in real estate economics.[63] For example, as noted below similar analyses have been used in published studies on the relationship between green buildings and real estate valuations.[64]

The data necessary for hedonic modeling can be collected without the assistance of a professional appraiser. In fact, the initial data gathering process can begin before the implementation of the B&T policy. However, results from the policy may take years to quantify as owners make energy efficiency improvements to their buildings, or as the market begins to use the public data. For example, buildings with LEED certification or ENERGY STAR labels may also be newer, larger buildings, or real estate demand may increase in a growing neighborhood. The data and information shown in Table B-10 are necessary for hedonic regression analysis.

Table B-10. Data Collection Basic Categories

Category	Source	Notes
Market Data		
Property Value	Property Value: Assessor's Office/ Department of Taxation	Collect data for before and after B&T policy
	Property Value: Appraisals shared by Property Owners	Collect data for before and after B&T policy
	Sale Price: Commercial real estate data sources; Public land records when available	Collect data for before and after B&T policy
	Monthly Rent: Commercial real estate data sources	$/sq. ft., Collect data for before and after B&T policy
Occupancy Rate	Commercial real estate data sources	Leased Space/Available Space, Collect data for before and after B&T policy
Building Class	Commercial real estate data sources	Note class A, B, C, or F, Collect data for before and after B&T policy
Lease Type	Commercial real estate data sources	Variables: 1 = net, 0 = gross, Collect data for before and after B&T policy

63 Hedonic regression modeling is the standard methodology for examining price determinants in real estate research. In studies measuring the impact of variables on property rents, hedonic modeling recognizes a range of building characteristics impact a dependent variable. In this case, the dependent variable is the change in real estate value from before and after the B&T policy. (Fuerst, McAllister, 2009)

64 Previous research has used a similar approach to measure the impact of LEED and ENERGY STAR labeling on occupancy rates (Fuerst, McAllister, 2009), and energy-efficiency on office building value. (Eichholtz et al., 2009)

Comp Group Data		
Facility Type	Portfolio Manager	Commercial, office, multifamily, etc.
Square Footage	Portfolio Manager	
Lot Area	Assessor's Office/Department of Taxation	
Age	Portfolio Manager	
# of Units	Portfolio Manager	
Stories	Portfolio Manager	
Location	TBD by jurisdiction	Latitude/Longitude coordinates
Energy/ Expense Data		
Labeling	USGBC, ENERGY STAR sites	LEED, ENERGY STAR, etc.
ENERGY STAR Score	Portfolio Manager	If applicable
Weather-Normalized Source EUI	Portfolio Manager	kBtu/sq. ft.

The Analysis

The change in value will be a function of the above listed data inputs and is expressed as follows:

CV = f(Property Value, Occupancy Rate, Building Class, Lease Type, Facility Type, Square Footage, Lot Area, Age, # of Units, Stories, Location, Labeling, ES Rating, EUI)

On step further, the equation will take into account not only the categories (X), but also the weights assigned to them to gauge their importance (a).

$$V = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + \ldots a_kX_k$$

Appendix C
Sample Interview Guides

Benchmarking and Transparency Policy Interview Guide – Energy Efficiency Agencies and Entities

Interview Initiation

These questions are only to develop rapport with the respondent and create a conversational tone. Other questions may be substituted individual respondents as appropriate. If the interviewer has a relationship with the respondent, these questions may be revised or omitted.

Intro*: Hello, my name is < >. Thanks for taking time with us today. I’m calling from* <Organization Name>*, and am conducting research on the topic of energy performance in commercial real estate and multifamily buildings. In particular, we want to gather information on your views of the benchmarking and transparency policy recently passed and implemented by the City/State/County. We are seeking input from* <Organization Name> *to better understand not only your perspective on the ordinances impact on commercial real estate in the city/state/county, but also any ways that you might be considering using the information gathered and revealed through the policy’s implementation process in improving and/or enhancing current commercial and larger multifamily programs, or developing new programmatic offerings based on the existence of the policy. To get started:*

Q1. *We are interested in hearing your views on < Jurisdiction A’s > benchmarking and transparency policy. Are you familiar with of this policy and how it works?*

(If “yes” continue, if “no”, ask ***Q1a****: Is there someone else in at* <Organization Name> *who is knowledgeable about the policy and how they may relate to your energy efficiency program offerings? Say thank you after obtaining the contact information and terminate the interview.*

Q2. *What is your current position at* <Organization Name>*?*

Q3. *How long have you been in that role, and how long have you been with* <Organization Name>*?*

Q4. *What responsibilities do you have in your day-to-day job?*

Programming and Activities

These questions identify the commercial and multifamily sector programs offered by the interviewee's organization in the B&T jurisdiction area influence as a pre-B&T policy influenced baseline for future comparison.

RR1. *What programs does your organization offer in the energy-efficiency in commercial real estate sector in the City/State/County including, large multifamily buildings?*

RR2. *Can you tell us a bit about the specific program offerings that your organization undertakes to promote greater energy performance in commercial real estate?*

Expected Outcomes of Interviewee Organization's Programs

These questions focus on outcomes that the respondent's organization planned to achieve as well as the path to those outcomes – with a focus on establishing a current "baseline" understanding of the organization's goals from which we can compare future integration and use of the B&T policy, if any, into the utility/organization's goals.

EO1. *Do the programs you described above have specific energy-efficiency market transformation or resource savings goals (short, intermediate and long-term)?*

EO2. *Can you tell us a bit about the milestones you are targeting to achieve over these implementation periods?* ***[Probe for specific events, deliverables, and contracted outputs]***

Barriers to Interviewee's Program Success

These questions focus on barriers that impede the interviewee's programs from improving energy performance in commercial real estate – once again as a baseline from which to compare future integration of B&T concepts and impacts in improved program design.

BA1. *What market characteristics prevent the improvement of energy performance of commercial real estate in your service area? i.e., What barriers are your programs targeted to overcome?*

BA2. *How do you address this challenge?*

BA3. *Are there institutional, regulatory or other barriers that exist in the commercial real estate market that prevent the improvement of energy performance of commercial real estate in your service area and have caused challenges for your program offerings to overcome?* ***[Probe for the names of organizations, types of challenges and other relevent information e.g., timesline if relevant]***

BA4. *How did you address these challenges?*

Market Change Since Enactment of B&T Policy

These questions probe deeper into both observed impacts of the policy in markets where the EE organizations offer programs, and any energy conservation and efficiency actions taken with these entities since the enactment of the policy that would identify immediate or planned program improvement impacts from the policy.

E1. *In your view, how has the B&T policy affected the commercial real estate market in < Jurisdiction A >?*

E2. *In relationship to the B&T policy, have your program folks seen any changes in management of commercial building energy use in < Jurisdiction A > since passage of the policy?*

E3. How has this affected the market's response to your program offerings?

B&T Policy Influence on Interviewee's Programs

These questions focus on the effect of the B&T policy on the interviewee's program design.

PI1. *Did the implementation of the B&T policy change your programs' goals, strategies, or tactics?*

PI2. *If so, in what ways? How has your organization adapted or modified your program designs, financial incentives, marketing and outreach, and other aspects of program delivery?*

PI3. *I would now like to read a series of FIVE statements regarding* <Organization Name>*'s programming as it relates to < Jurisdiction A >'s benchmarking and transparency policies. Please let me know which ONE of these statements most accurately represents your organization.*

1. *We are aware of < Jurisdiction A>'s policy but this does not affect planning or implementation of programs.*
2. *We are in the process of determining how to best incorporate benchmarking and transparency inputs and outputs into our current and future programs.*
3. *We have begun to plan programs for future implementation that include benchmarking and transparency inputs and outputs.*
4. *We have revised existing programs for the commercial building sector to incorporate benchmarking and transparency inputs and outputs.*
5. *We work cooperatively with the City/State/County to include benchmarking and transparency policies in both our current program implementation and future program design.*

Closing

These questions allow the interviewee to learn more about this project and provide an opportunity for the interviewer to ask more questions in the future.

Thank you for your time.

CC1. *Are there any questions that you have for me?*

CC2. *If we have more questions, may I contact you again?*

Benchmarking and Transparency Interview Guide – Building Owners and Property Managers

Interview Initiation

These questions are only to develop rapport with the respondent and create a conversational tone. Other questions may be substituted individual respondents as appropriate. If the interviewer has a relationship with the respondent, these questions may be revised or omitted.

Intro: *Hello, my name is < >. I'm calling from* <Organization Name>*, and am conducting research on behalf of the < Jurisdiction A > to help them better understand how the City's/State's/County's energy benchmarking and transparency policies are affecting building owners and property managers. This is not a sales call, nor will I be asking for contributions or donations.*

Q1. <Organization name> *listed you as the person responsible for submitting the benchmarking data for the < building information from database (type, location)>. Are you the person most knowledgeable about the B&T policies?* ***[If yes, continue. If no, ask for another contact.]***

Q2. *How long have your been in your current position at* <Organization Name>*?*

Q3. *What other responsibilities do you have in your day-to-day job?*

General Energy Use Awareness Questions

These questions identify and quantify any jobs created among building owners, building managers and benchmarking consultants.

G1. *Thinking back to before the City/State/County enacted the B&T policy, were you aware of this building's annual energy use and costs? On a scale of 1 to 5, where 1 means "not at all aware" and 5 means "extremely aware," how would you gauge your level of awareness?*

G2. *What about other buildings you own or manage?*

G3. *What techniques did you use to monitor energy performance in your building(s)?*

G4. *Were you performing benchmarking at that time? If so, what tools did you use? If not, what was it that prevented you from benchmarking?*

G5. *How did the enactment of the City's/State's/County's B&T policy affect your knowledge of energy consumption and energy savings opportunities?*

G6. *Did you participate in utility, state, or city energy-efficiency programs, or take advantage of tax credits, prior to the enactment of the B&T policy? If so, which ones?*

G7. *Did you participate in utility, state, or city energy-efficiency programs, or take advantage of tax credits, after the enactment of the B&T policy? If so, which ones? Did the B&T policy influence your decision to participate, and if so, how?*

> ***G7a.*** *Following on the previous question, specifically, has the B&T policy's provision for energy transparency to prospective tenants or investors influenced your thinking about energy-efficiency in the buildings you own?*

G8. [If the responded answers in the negative to any of G4 - G7, ask]*What prevented you or your organization from taking part/pursuing <benchmarking, energy savings opportunities, energy-efficiency programs, etc.>?*

How Energy Use Has Changed Since the B&T Policy Was Enacted

These questions probe deeper into the energy conservation and efficiency actions taken by building owners and building managers since the enactment of the B&T policy.

E1. *Has your organization/firm changed how it manages energy since the implementation of the B&T policy?*

E2. *How has the management of building energy use changed?*

The following lists potential interview prompts:

a. More frequent monitoring (of controls, thermostats, buildings, electrical/steam usage)

b. Identify areas or buildings for reducing energy use

c. Installing energy-efficient lighting/lighting upgrades

d. Reduce energy use

e. HVAC upgrades

f. More awareness in managers/organization as a whole

g. Benchmarking Implemented automated controls

h. Changes in business practices/energy-efficiency policy

i. Retrofits/upgrades to maintain Energy Star requirements

j. Lack of staff/personnel to continue monitoring

k. Other

E3. *On a scale of 1 to 5, where 1 means "extremely unlikely" and 5 means "extremely likely," how likely is your organization to invest in operational or energy-efficiency upgrades.?* ***[Probe how the policy influenced this.]***

E4. *I am going to read a list of seven equipment and operations & maintenance improvements. Would you please tell me which, if any, you plan to undertake in the next 12 months? Please answer "yes" or "no" to each:*

a. Provide training to facility managers on ways they can save energy in our building

b. Lighting upgrades

c. Heating, ventilation, and air-conditioning (HVAC) upgrades *d. Water heating upgrades*

e. New motors and drives for building energy systems

f. Office equipment upgrades

g. Environmental controls

h. Building envelope improvements

E5. [Ask for each item in E4 to which the Interviewee responded "yes"] *On a scale of 1 to 5, where 1 means "no influence at all" and 5 means "significantly influential," how influential was the B&T policy on your organization's decision to implement these/this improvement?*

E6. *Have you been able to quantify the benefits of your energy management efforts to date? If so, would you share this with me?*

E7. *Have you hired staff directly related to the EE and O&M process?*

a. If so, how many and are these part time or full-time jobs?

b. When did you hire these staff?

c. What are their duties related to energy-efficiency and/or operations & maintenance?

E8. *Have you attracted new tenants as a result of a property being more energy efficient?*

B&T Effects upon Real Estate Values, Tenant Occupancy and Price

These questions assess the effect of energy-efficiency and B&T upon real estate values.

RE1. *How much does the energy use or energy efficiency of a property play a role in your real estate investment decisions?* ***[Probe on both]***

RE2. *To what extent do more efficient properties see improved value in the marketplace?*

RE2a. *Do you see a relationship between increased occupancy and energy-efficient properties?*

RE3. *In what ways has the policy in your jurisdiction impacted real estate transactions?*

RE4. *What role does labeling, such as ENERGY STAR or LEED, or other "green" features play in driving demand for a property, separate from transparency of energy usage data?*

RE5. *To what extent has your organization attempted to isolate energy-efficiency of a property as a driver of value or demand, separate from other factors such as location, age, etc.?*

RE6. *I would now like to read five statements to you regarding benchmarking your building and I would like you to rate them on a scale of 1 to 5 where 1 indicates "this was not an influential reason for benchmarking" and 5 indicates "this was a very influential reason for benchmarking:"*

- *Compliance with New York ordinances*
- *Improving building energy performance*
- *Creating information of value to tenants, real estate professionals, investors and underwriters*
- *Creating added value to your building*
- *Increasing operating revenues*

Interviewee Advice

These questions attempt to capture any final thoughts from the respondent that might inform our understanding of their organization and how B&T policies influences it.

AA1. *What advice would you have for the City/State/County or other jurisdictions in implementing a successful benchmarking and transparency program?*

AA2. *What advice do you have for building owners/building managers in jurisdictions that are about to implement benchmarking and transparency policies?*

Closing

These questions allow the interviewee to learn more about this project and provide an opportunity for the interviewer to ask more questions in the future.

Thank you for your time.

CC1. *Are there any questions that you have for me?*

CC2. *If we have more questions, may I contact you again?*

Benchmarking and Transparency Interview Guide – Real Estate Brokers and Investors

Interview Initiation

These questions are only to develop rapport with the respondent and create a conversational tone. Other questions may be substituted individual respondents as appropriate. If the interviewer has a relationship with the respondent, these questions may be revised or omitted.

Intro*: Hello, my name is < >. I'm calling from* <Organization Name> *and am conducting research on behalf of the city/state/county to help them better understand how the City's/State's/County's energy benchmarking and transparency policies are affecting building owners and property managers. We are seeking the perspective of select real estate professions regarding the effect of these policies on the market. This is not a sales call, nor will I be asking for contributions or donations.*

Q1. *We are interested in hearing your views on < Jurisdiction A >'s benchmarking and transparency policy. Are you familiar with of this policy and how it works?*

> ***If "yes" continue, if "no", ask Q1a:*** *Is there someone else in at* <Organization Name> *who is knowledgeable about B&T policies and how they may relate to your EE program offerings? Say thank you after obtaining the contact information and terminate the interview.*

Q2. *How many years of experience do you have as a real estate professional?*

Q3. *How long have you been in that role, and how long have you been with* <Organization Name>*?*

Q4. *What responsibilities do you have in your day-to-day job?*

How Energy Use Has Changed Since the B&T Policy Was Enacted

These questions probe deeper into the energy conservation and efficiency actions taken by building owners and building managers since the enactment of the B&T policy.

E1. *Are you aware of any building owners or managers who changed how they manage energy since the implementation of the B&T policy?* ***[If "no," skip to E3]***

E2. *What prevents building owners and managers from doing more to improve the energy performance of their buildings?*

B&T Effects upon Real Estate Values

These questions assess the effect of energy-efficiency and B&T upon real estate values.

RE1. *How much does the energy use or energy efficiency of a property play a role in your real estate investment decisions?* ***[Probe on both]***

RE2. *To what extent do more energy-efficient properties see improved value in the marketplace?*

> ***R2a.*** *What reasons that energy-efficient properties may not see improved value?*

RE3. *In what ways has B&T policy impacted real estate transactions in your jurisdiction?*

RE4. *What role does labeling, such as ENERGY STAR or LEED, or other "green" features play in driving demand for a property, separate from transparency of energy usage data?*

RE5. *To what extent has there been an attempt to isolate energy-efficiency of a property as a driver of value or demand, separate from other factors such as location, age, etc.?*

RE6. *Do tenants, investors and underwriters have acess to building energy performance information?*

> ***R6a.*** *What prevents access to this information?*

RE7. *To what extent have tenants, investors or underwriters expressed awareness of or interest in building energy performance in selecting a property?*

> ***R7a.*** *What prevents greater awareness of building energy performance?*

RE8. *I would now like to ask about the use of benchmarking data by tenants, investors and underwriters. On a scale of 1 to 5, where 1 indicates "this information is never used" an 5 indicates "this information is always used,"*

> ***RE8a.*** *How often do tenants in < Jurisdiction A > use benchmarking data in their leasing decisions?*
>
> ***RE8b***. *Do you expect tenants' use of benchmarking data to be more, less or about the same in the next three years?*
>
> ***RE8c***. *How often do investors in < Jurisdiction A > use benchmarking data in their funding decisions to purchase or retrofit a building?*
>
> ***RE8d.*** *Do you expect investors' use of benchmarking data to be more, less or about the same in the next three years?*
>
> ***RE8e.*** *How often do underwriters in < Jurisdiction A > use benchmarking data in their decision-making process?*
>
> ***RE8f.*** *Do you expect underwriters' use of benchmarking data to be more, less or about the same in the next three years?*

Interviewee Advice

These questions attempt to capture any final thoughts from the respondent that might inform our understanding of their organization and its response to B&T policy.

AA1. *What advice would you have for the City/State/County or other jurisdictions in implementing a successful benchmarking and transparency program?*

AA2. *What advice do you have for building owners/building managers in jurisdictions that are about to implement benchmarking and transparency policies?*

Closing

These questions allow the interviewee to learn more about this project and provide an opportunity for the interviewer to ask more questions in the future.

Thank you for your time.

CC1. *Are there any questions that you have for me?*

CC2. *If we have more questions, may I contact you again?*

Benchmarking and Disclosure (B&T) Policy Survey Instrument for Building Owners, Property Managers

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Primary Information Objective:

- Determine if and how the Benchmarking and Development (B&T) policy influenced or impacted the owner's energy efficiency actions

Secondary Information Objectives:

- Determine owner's energy efficiency inclinations and actions prior to policy passage e.g., was the owner/manager already benchmarking and taking EE actions
- Determine owner's energy efficiency inclinations and actions post-policy passage and implementation e.g., did the owner take new energy efficiency actions due to the passage of the B&T policy

Research Questions:

Pre- Policy Awareness and Energy Efficiency Actions	PRP1 – PRP4
Post - Policy Awareness and Energy Efficiency Actions	POP5 – POP7
Perspectives on the Benefits and Challenges of Increased Awareness of Energy Efficiency due to the passage of the B&T policy	PBC8 – PBC10
Closing: A Big Thank You!	CC1 – CC2

Pre-Policy Awareness and Energy Efficiency Actions

PRP1. Prior to passage of the < local policy name > were you undertaking benchmarking type activities related to awareness of energy usage in your building?

□ Yes □ No

PRP 2. If yes, what types of benchmarking activities did you take?

□ a. Monitored monthly energy performance

□ b. Compared my building to others in terms of energy performance

□ c. Shared energy performance data with current and prospective tenants

□ d. Other ____

PRP3. Did you take any energy efficiency upgrade actions prior to passage of the City's/State's/County's B&T policy?

□ Yes □ No

PRP4. If yes, please check those actions that apply:

□ a. Provided training to facility managers on ways they can save energy in our building

- ☐ b. Lighting upgrades
- ☐ c. Heating, Ventilation, and Air Conditioning (HVAC) upgrades
- ☐ d. Water heating upgrades
- ☐ e. New motor upgrades and drives for building energy systems
- ☐ f. Upgraded office equipment
- ☐ g. Installed environmental controls
- ☐ h. Building envelope improvements
- ☐ i. Increased involvement in energy management planning
- ☐ j. Daily operational and maintenance improvements approaches
- ☐ k. Other ____

Post - Policy Awareness and Energy Efficiency Actions

POP5. Now that the B&T policy is in place, how much has the policy impacted your awareness of energy performance in your building?

☐ Greatly ☐ Somewhat ☐ Not at All

POP6. If the answer above is "Somewhat" or "Greatly," please tell us the areas most impacted in your thinking by passage and implementation of the B&T policy. Please check all items that apply.

Since the B&T policy was implemented I am now more likely to…

POP7. Beyond the basic benchmarking requirement of the City's/State's/County's policies, which of the following energy efficiency actions have you implemented or begun implementing due to passage of the B&T policy. Please check all item that apply.

Since the B&T policy was implemented I am currently/have begun…

- ☐ a. Training for facility managers on ways they can save energy in our building
- ☐ b. Lighting upgrades
- ☐ c. Heating, Ventilation, and Air Conditioning (HVAC) upgrades
- ☐ d. Water heating upgrades
- ☐ e. New motor upgrades and drives for building energy systems
- ☐ f. Upgraded office equipment
- ☐ g. Installed environmental controls
- ☐ h. Building envelope improvements
- ☐ i. Increased involvement in energy management planning
- ☐ j. Daily operational and maintenance improvements approaches
- ☐ k. Other ____

Benefits and Challenges of B&T Policy Passage

PBC8. Now that you've had time to work with the B&T policy, as a building owner, what would you say are the benefits of the policy?

- □ a. Continued to support already existing (pre-B&T policy) focus on energy efficiency in my building(s)
- □ b. Brought me in touch with new thinking about meeting the policy benchmarking requirements
- □ c. Increased my knowledge of the enhanced energy efficiency opportunities existing within my building(s)
- □ d. Led me to begin developing approaches and plans for increasing energy savings in my building(s)
- □ e. The policy did not add to my existing practice or focus on energy efficiency in my building(s)
- □ f. Other ____

PBC9. Now that you've had time to work with the B&T policy, as a building owner, can you tell us about the challenges you faced associated with the policy's implementation?

- □ a. I've been very interested in Energy Efficiency and I've done all I thought was economically feasible, and now I have to rethink my approach
- □ b. The policy is too costly for me to implement.
- □ c. It requires me to hire new staff or contractors to fill out the forms
- □ d. I am concerned that my building will look less attractive to potential tenants based on my disclosed energy performance.
- □ e. This puts my building under public scrutiny and forces me to decide how I will position my building in the market place
- □ f. I do not like the City/State/County telling me that I have to tell others about the energy efficiency status of my building(s)
- □ g. Other ____

PBC10. Do you have any suggestions or insights that can help the City/State/Cunty enhance the policy's implementation efforts? If so, please note them below.

Closing: A Big Thank You!

CC1. The City/State/County is very interested in your responses and we very much appreciates your time in filling in this brief survey. With your input, we can know best how to continue improving the program for all.

CC2. If you have further comments, please feel free to note them below.

Appendix D
Market Transformation Progress Examples

Illustrative Examples of Real Estate Professional and Energy Efficiency Program Administrator MT Responses

Table 9-1. Sample Real Estate Professional Interview Findings and Comparison with MTIs

	Outcome	Internal MTIs	Market MTIs	External MTIs	Interview Findings
Immediate	Increased building owner awareness of energy use. Current and prospective tenants, investors, and underwriters have access to energy performance information.	Building owners are aware of annual energy spent per building or leased space for all fuels.	N/A	N/A	Tenants and investors rarely request information regarding energy performance, and while they have access to building energy performance data, it is not easily located or necessarily analyzed in depth. Reasons that prevent building owners and managers from improving energy performance include a low return on investment, reluctance to engage with public administration, staffing, money, and tenants with high-energy consumption.
Short Term	Owners recognize opportunities for energy savings and begin to take operational actions and implement low-cost measures. Tenants, investors, and underwriters begin to incorporate energy performance into real estate decision making.	Building owners can identify specific energy savings opportunities in their own buildings. Building owners can describe implementation of specific low-cost measures within their own buildings.	Tenants, investors, and underwriters are increasingly aware of benchmarking disclosure information and their understanding of this information increases over time.	N/A	Three out of six real estate professionals said building owners changed their behavior due to the B&T policy, and one said benchmarking consultants became popular. Tenants, investors, and underwriters ask for benchmarking data infrequently, but real estate professionals expect this to increase over time.
Intermediate Term	Property values incorporate energy performance.	N/A	Tenants incorporate disclosure information into lease negotiations. Investors and underwriters begin to include disclosure information as valuation criteria.	N/A	Real estate professionals vary in their assessment of the marketplace value of efficient properties. Some identify corporate sustainability policies and energy savings opportunities as drivers of value, while others note that the cost of the buildings in their area eliminates efficiency as a factor. Investors may use the ENERGY STAR score as part of the building valuation checklist.
Long Term	N/A	N/A	N/A	N/A	N/A

Table 9-2. Sample Energy-Efficiency Administrator Findings and Comparison with MTIs

	Outcome	Internal MTIs	Market MTIs	External MTIs	Interview Findings
Immediate	N/A	N/A	N/A	N/A	N/A
Short Term	Program administrators use insights from benchmarking to inform program design.	N/A	N/A	Energy efficiency program administrators begin to include benchmarking and disclosure information in their new program design.	Energy efficiency entities offer a variety of short- and long-term programs including prescriptive measures, systems improvements, and sector-specific programs. Barriers include staff resources, funding constraints, and approval process.
Intermediate Term	Owners make building improvements to secure deeper energy savings and greenhouse gas reductions. Property values incorporate energy performance. Program administrators use insights from benchmarking to inform program design.	Building owners are increasingly aware of annual energy spend trends for all fuels. Building owners include energy savings as a component of retrofit/renovation planning. Retrofits and renovations preserve and expand upon previously installed measures.	Tenants incorporate disclosure information into lease negotiations. Investors and underwriters begin to include disclosure information as valuation criteria.	Energy efficiency program administrators increasingly include benchmarking as a standard input to their current and future program design.	Energy efficiency entities who work with commercial customers use the B&T policy to increase awareness and sales of energy efficiency programs. Energy efficiency entities are working with governments to improve programs for customers, and developing voluntary B&T policies for other jurisdictions. All three interviewees are still in the process of determining how to incorporate the benchmarking and disclosure policy into their programming, and are actively working with other entities to incorporate and implement B&T.
Long Term	N/A	N/A	N/A	N/A	N/A

U.S. DEPARTMENT OF
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For more information, visit: energy.gov/eere

DOE/EE-1220 • May 2015