# Achieving Real Transparency: Optimizing Building Energy Ratings and Disclosure in the U.S. Residential Sector

By

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Bachelor of Science in Management Science
Massachusetts Institute of Technology, 2007



Submitted to the Department of Urban Studies and Planning
in partial fulfillment of the requirements for the degree of

Master in City Planning

at the

Massachusetts Institute of Technology

June 2012



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## Abstract

Residential energy efficiency in the U.S. has the potential to generate significant energy, carbon, and financial savings. Nonetheless, the market of home energy upgrades remains fragmented, and the number of homes being retrofitted remains insignificant compared to the volume of inefficient housing stock. Providing more complete information on the energy performance of homes can enable buyers and sellers to value energy efficiency and can catalyze the delivery of residential energy efficiency. To that end, the European Union and five cities in the U.S. and Australia have implemented, in recent years, the use of residential building labeling to convey home energy performance to market stakeholders. The transparency provided through such building labeling has the potential to tear down common barriers to efficiency and to provide ways for owners, tenants, homebuyers, and lenders alike to engage in home energy efficiency.

However, there are numerous concerns surrounding the current approaches to building labeling, and the methods in use today are highly heterogeneous, leading to significant uncertainty surrounding this emerging policy tool. In particular, this thesis describes how building labeling can be optimized for the delivery of residential energy efficiency, focusing specifically on the type of rating that could be used and on the approach to disclosing home energy performance.

To achieve this, the thesis examines literature and provides case studies of four cities in the U.S. that have implemented residential energy labeling. These case studies provide insight into the shortcomings of approaches in use today, as well as a look at the beneficial methods utilized in each city. In conjunction, the thesis examines the approach the E.U. is using, the role of the private sector, and voluntary approaches in the U.S.

Based on the approaches discussed in the literature and case studies, there are several key attributes that a well-designed building labeling program should have. One key determination is that a strong labeling policy should combine asset ratings (based on an on-site assessment) and operational ratings (based on billing data) to maximize the clarity, functionality, and comparability of labels. Additionally, a well-designed labeling policy should maintain privacy while facilitating information access to the right stakeholders at the right time.

Drawing on these findings, this thesis proposes a new model of disclosing residential energy performance. The model, centered on web-enabled data analysis and access, has the potential to provide timely, consistent, and visible ratings to key market actors and, in turn, provide more complete information to residential markets on building efficiency. This approach also combines multiple data sources and requirements into a single platform, in order to streamline the rating and disclosure process. This model offers several advantages for catalyzing residential energy efficiency, as compared to existing approaches.

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## Acknowledgements

This thesis research would not have been possible without the guidance and inspiration of my advisor, Professor Harvey Michaels, and the advice and extensive support of my thesis reader, Prof. Stephen Hammer, of MIT's Department of Urban Studies and Planning.

Additionally, I would like to extend thanks to Prof. JoAnn Carmin and Lauren Lambie-Hanson, at MIT DUSP, for advice during the thesis preparation process, and to Pat Coleman for advice on writing a thesis in the field of energy efficiency. I also want to extend a thank you to the interviewees and panelists whose opinions contributed much to my research.

This thesis is part of the research being conducted by MIT's Energy Efficiency Strategies Project, a group directed by Professor Harvey Michaels. This research is made possible by a grant from the U.S. Department of Energy and National Renewable Energy Laboratory, designed to support the study of new business models to enable whole-house energy upgrades. As such, this thesis draws in part on my fall research paper for the Energy Efficiency Strategies Project, titled "A New Model for Disclosing the Energy Performance of Residential Buildings," written by myself and finalized on March 7, 2012.

## Contents

# I. Why pursue transparency of energy performance in the residential market?

## The Case for Energy Efficiency

Widespread energy efficiency in U.S. homes is a captivating ambition, a vision of people living comfortably in weatherized homes and well-insulated apartments, with draft-sealed windows and highly efficient appliances. Collectively, energy efficiency in the nation's homes would save trillions of BTUs of energy each year and obviate the need for several new power plants. In turn, of course, we would eliminate hundreds of thousands of tons of carbon dioxide emissions annually and save immensely on the nation's collective energy expenditures.

More specifically, projections of future energy use show that energy efficiency in the nation's homes represents a vast untapped resource of carbon reductions, energy savings, and financial gain. By 2020, residential buildings will consume 20% of U.S. total energy use (U.S. EIA 2011) – more than the commercial sector – and will contribute 1,350 million tons $CO_2e$ to the U.S.'s annual carbon emissions (U.S. EIA 2011, McKinsey 2009). Implementing all cost-effective energy efficiency measures in residential buildings, however, could cut primary energy use 27% and greenhouse gas emissions by 360 million tons $CO_2e$ annually (McKinsey 2009). Indeed, energy efficiency measures are some of the lowest-cost means of cutting energy use and greenhouse gas emissions, as they represent a net financial savings. For example, building insulation, lighting upgrades, and efficient water heating all have a positive net present value (NPV) per ton of greenhouse gases abated – investing in building insulation saves approximately $190 for every ton of $CO_2e$ avoided (McKinsey 2007). If all such positive-NPV efficiency measures were implemented in the U.S. residential sector, the country would stand to save $41 billion in energy expenditures, annually, by 2020 (McKinsey 2009).

## The Landscape of Residential Energy Efficiency Today

With the potential for significant cost, energy, and carbon savings, residential energy efficiency has garnered the attention and investments of both the public and private sectors. The retrofit of existing homes is of particular interest and a focus of investment as homes are typically built to have a lifetime of decades, thus making inefficiency in the existing housing stock an energy drain that will last for decades (DOE SEEAction 2011c).

On the public sector side, twenty-four states have adopted resource standards that require utility investment in energy efficiency (ACEEE 2011a), and numerous cities have also undertaken their own initiatives on residential efficiency. Many of these programs take the form of rebates or tax incentives for efficient appliances, discounted or free energy assessments, subsidized air sealing and insulation services, and technical support for homeowners. On the private sector side, numerous companies provide residential efficiency services, including home energy audits (often funded by public programs) and one-stop services that address all major upgrade needs through one contractor. In addition, residential energy service companies (ESCOs) provide the option to pay for home energy efficiency and energy use through one contracted provider. Furthermore, the private sector space of home energy efficiency has been increasingly populated by entrepreneurial firms that are seeking to provide new tools to encourage, assess, and track energy efficiency.

Yet, despite the extensive interest and investment in residential retrofits, the current landscape of residential efficiency has not spurred widespread, mainstreamed home energy upgrades. In part, investments in energy efficiency programming, while significant, remain highly fragmented, comprised of a wide variety of state, utility, and local programs with varying designs and incentives. Indeed, states, cities, utilities, and federal agencies allotted a total of $5.5 billion to energy efficiency programs and incentives in 2010 (ACEEE 2011a), but only 200,000 homes per year are retrofitted with energy improvements (Snugg 2012). In parallel, U.S. homeowners themselves spend $165 billion annually on home remodeling, but a very small fraction of this expenditure goes towards whole-home energy upgrades (DOE SEEAction 2011c). As a result, the number of retrofitted homes is small compared to the volume of inefficient housing in the country (DOE SEEAction 2011c). The focus of energy efficiency programming remains on the repair and retrofit of individual homes, and extensive interest and investments have not yet catalyzed mass-market, at-scale home energy upgrades. Indeed, the housing market stands to lose out on potential economies of scale that could be possible with widespread home upgrades (EFC 2012).

## Transparency as a Strategy for Energy Efficiency

In order to catalyze residential energy efficiency, several jurisdictions around the world have begun, in recent years, to implement transparency on building energy performance as a potential strategy for spurring building upgrades. Specifically, these cities and countries have implemented the use of mandatory building labeling, under which owners of buildings are required to obtain a rating of their property's energy use. This rating must then be disclosed to relevant stakeholders, in order to provide them with information on potential and actual energy use.

First implemented in the Australian Capital Territory and Denmark, both in 1997 (Dunsky et al. 2010, Laustsen 2005), the use of building energy labels was pioneered as a way to provide transparency on the energy efficiency of a building to new tenants, buyers, and the building owners themselves. By providing market stakeholders more complete information on building energy performance, the strategy has the potential to enable the market to value energy efficiency. As a result, the European Union, China, the City of Tokyo, the Australian Capital Territory, and several states and cities in the U.S. have implemented mandatory building labeling – mostly for large commercial and institutional buildings (BuildingRating.org 2011). On the residential side, the E.U., four cities in the U.S., and the Australian Capital Territory have requirements for building labeling, implemented largely in the past few years. Beyond the basic requirements of rating energy performance and sharing the resultant rating, the details of labeling implementation vary significantly from jurisdiction to jurisdiction.

Using building labeling to introduce transparency into the market is seen as a way to enable buyers, renters, and other stakeholders to use energy efficiency in decision-making. In turn, this can enable the fair valuation of home energy efficiency and create demand that supports investments in energy efficiency. Today, information barriers prevent market players from doing so, and, as a result, they are rarely able to take energy efficiency into account during decision-making.

Namely, renters, homebuyers, lenders, and building owners lack consistent access to information on the energy performance of a building that they may be interested in or currently live in. For example, the typical apartment hunter today lacks information on the relative energy efficiency of a prospective apartment, such as how drafty it is or how well-insulated it is. In parallel, the average homeowner today does not necessarily have information on whether their home is more efficient than similar homes, or information on which efficiency improvements to their house would be the most effective. Furthermore, at the administrative scale, most cities do not have comprehensive information on the energy retrofit needs of their housing stock.

Transparency in residential energy performance can help break down these informational barriers, enabling stakeholders to value energy efficiency. If apartment hunters and prospective home buyers can understand the relative energy efficiency of their potential next home, they have the ability to use this in their decision-making. In this way, having more complete information on energy efficiency closes a gap in the value chain of efficiency delivery: customers today that want an efficient home do not necessarily have the information to help them buy an efficient home. Furthermore, enabling building owners to have information on the retrofit needs of their property has the potential to spur the process of retrofitting. With these two mechanisms combined, residential energy labeling can potentially create a market that values both energy efficiency and the long-term cost of energy; in turn, this is a market that is enabled to demand energy efficiency and drive widespread, mainstreamed home energy upgrades.

Indeed, labeling as a strategy for spurring residential energy efficiency moves away from simply expanding upon current retrofit incentives and outreach – programming which is reliant on limited state and federal funding. Moreover, current home energy upgrade programs in the U.S., even the most successful ones, have achieved penetration rates of less than 2% due to a lack of homeowner uptake (DOE SEEAction 2011c). Many of these programs also have been largely reliant on utilities to design, implement, and operate residential efficiency initiatives. The market may benefit if utilities supported a competitive market of energy efficiency services, instead of creating and operating those services, as this could introduce creativity into the business of residential retrofits and relieve utilities of day-to-day program management. In short, transparency provides an alternative strategy to simply expanding upon existing programs, which depend on limited government funding or utilities to actively push energy efficiency to perhaps less-than-eager homeowners.

Thus, states that seek to catalyze the market for residential energy efficiency can enable the provision of more complete information through building energy labels. However, as Chapter II will detail, there is a great deal of heterogeneity in current approaches to building labeling, and there are numerous concerns over current approaches to residential energy rating and disclosure. As a result, the research focus of this thesis is: how can residential energy performance in the U.S. be best assessed and disclosed, in order to optimize the benefits for the delivery of energy efficiency? While research to date offers many insights into improving and optimizing the nascent field of building labeling, there is a particular research need in terms of asset ratings (based on on-site building assessment) vs. operational ratings (based on billing data), and in terms of the potential for new approaches to disclosure. Accordingly, this thesis will focus on these two specific aspects of optimizing residential energy labeling.

## An Overview of this Thesis

In summary, this introductory chapter has provided a look at the potential benefits of transparency in building energy performance, as a strategy for catalyzing widespread home energy upgrades. While residential energy efficiency offers numerous benefits, the current framework is characterized by fragmented programming and a failure to spur mass-market home upgrades. Instead of further reliance on outreach, limited governmental funding, or utility mandates, transparency in building energy performance can bring down informational barriers to energy efficiency, in turn enabling the market to value home energy efficiency.

The thesis explores this theme of transparency as follows:

Chapter II studies building labeling as a means of providing transparency of building energy performance, including an overview of the few examples of implementation today. The chapter enumerates the specific benefits of building labeling for each group of stakeholders in the residential market, and for the delivery of energy efficiency overall. The chapter discusses the potential of labeling to tear down common barriers to residential energy efficiency. While residential labeling has the potential to deliver major benefits for efficiency, there are numerous challenges that need to be addressed and a wide range of approaches currently in use. In this emerging field, a particular research need is identifying optimal disclosure models and rating approaches – forming the research focus of this thesis.

Chapter III examines four cases of current residential building labeling in the U.S., studying their implementation, methods, and lessons learned. The chapter also provides an overview of voluntary rating programs in the U.S, implementation of labeling in Europe, and the role of private sector entrepreneurship in the U.S. While cities and E.U. member states have utilized a number of effective ideas for building rating and disclosure, each jurisdiction has its shortcomings in terms of designing building labeling to catalyze residential efficiency.

Chapter IV provides an analysis of the case studies, identifying the problems of the current approaches to residential energy rating and disclosure. The chapter also draws on the case studies to identify the impactful methods that have been used in each jurisdiction, within the research focus of rating system and approach to disclosure.

Chapter V, drawing upon the literature and case studies, describes what the attributes of an optimal residential labeling policy would be. In order to optimize the benefits for the delivery of energy efficiency, a residential building rating policy should combine asset and operational ratings, provide easily comparable and trustworthy ratings, and connect building owners to retrofits; the approach to disclosure should also maintain privacy while providing access to the right stakeholders at the right time.

In light of these attributes, Chapter VI draws on some of the ideas identified in prior chapters and proposes a building rating and disclosure model as a potential new solution to the challenges of building labeling. By streamlining data collection, ratings, and disclosure into a single Web-based platform, coupled with timely disclosure to interested buyers and renters, this new model has several potential advantages for the delivery of energy efficiency, as compared to existing forms of labeling.

Chapter VII concludes by analyzing the impacts of a well-designed residential labeling policy, studying, as an example, the potential for statewide implementation in Massachusetts. If implemented in a way that provides real transparency to stakeholders, residential building rating and disclosure can transform the way energy efficiency is valued and delivered.

# II. Understanding Building Labeling

Providing transparency on the energy performance of residential buildings has the potential to catalyze markets to value energy efficiency: a policy of mandatory building labeling has been posited as an approach to achieve this. Offering specific benefits to each of the many stakeholders in the residential market, building labeling can break down key barriers to the delivery of energy efficiency. Nonetheless, numerous challenges in implementing residential labeling need to be addressed. This chapter will provide an overview of implementation today, examine the potential benefits of building labeling, and discuss the research need in light of the challenges in this emerging field.

## Varied Approaches to Building Labeling

The specifics of building labeling requirements vary quite a bit, as shown in Table 1. Some require a rating that is based on an assessment of the building's energy efficiency characteristics (an asset rating), while others base the rating on past energy use (an operational rating). Furthermore, the rating may be required to be disclosed solely to the owner's transactional partners – i.e., new tenants, buyers, or lenders – or the requirement may mandate a public listing of this rating (BuildingRating.org 2011). In the U.S., building labeling policies have also targeted various sizes of buildings and sectors.

In addition, the rating itself takes several forms – some jurisdictions use an A to F scale, where A is a very efficient building, while others use a 0-100 scale (BuildingRating.org 2011). Figure 1 shows a few examples of labels (among which Denmark's and the U.K.'s labels use an A-F scale and ENERGY STAR uses a 1-100 scale). Furthermore, some assessment processes may produce a list of specific retrofit needs and a guide to recommended actions. There are also jurisdictions in which the labeling requirement focuses around a benchmarking program: building owners collect data on energy use over the course of the year, creating a benchmark against which to measure future savings, and, as an 'add-on,' the benchmark is disclosed (City of New York 2012a). Overall, the numerous parameters of a building labeling requirement vary greatly from jurisdiction to jurisdiction, but common to all labeling policies is some form of assessing building energy performance, and then disclosing the rating.

**Table 1: Key variables in building labeling**

| | | | |
|---|---|---|---|
| Sector | ▪ Municipal | ▪ Commercial | ▪ Residential |
| Size Threshold | ▪ All buildings | ▪ 10,000 sq ft | ▪ 50,000 sq ft |
| Disclosure | ▪ Publicly listed | ▪ Time of sale or lease | ▪ To all interested buyers and tenants |
| Rating | ▪ Asset | ▪ Operational | ▪ Both |
| Rating Scale | ▪ Statistical | ▪ Technical absolute | |
| Recommended Actions | ▪ Attached to assessment | ▪ Not possible/not included | |

It is crucial to distinguish a building labeling policy from voluntary recognition or certification programs. These include several well-known standards, namely the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) certification, the Green Globes program, and the ENERGY STAR Homes certification. These programs typically recognize new construction or new projects (i.e. expansions and renovation) that have been built with green measures. In addition, they are voluntary standards through which builders can seek to certify the sustainability of their work.

In contrast, building labeling is a policy that requires assessing the energy performance of buildings both new and existing: it applies to all buildings at the time the policy is implemented, not just new projects. Furthermore, it is a requirement for all owners to go through the rating process, not as a voluntary recognition, but as a standardized measure of buildings both inefficient and efficient. Finally, a building label is solely about energy performance – it does not account for sustainable commuting, water use, recycling, or green construction materials, as LEED does (ASHRAE 2011).

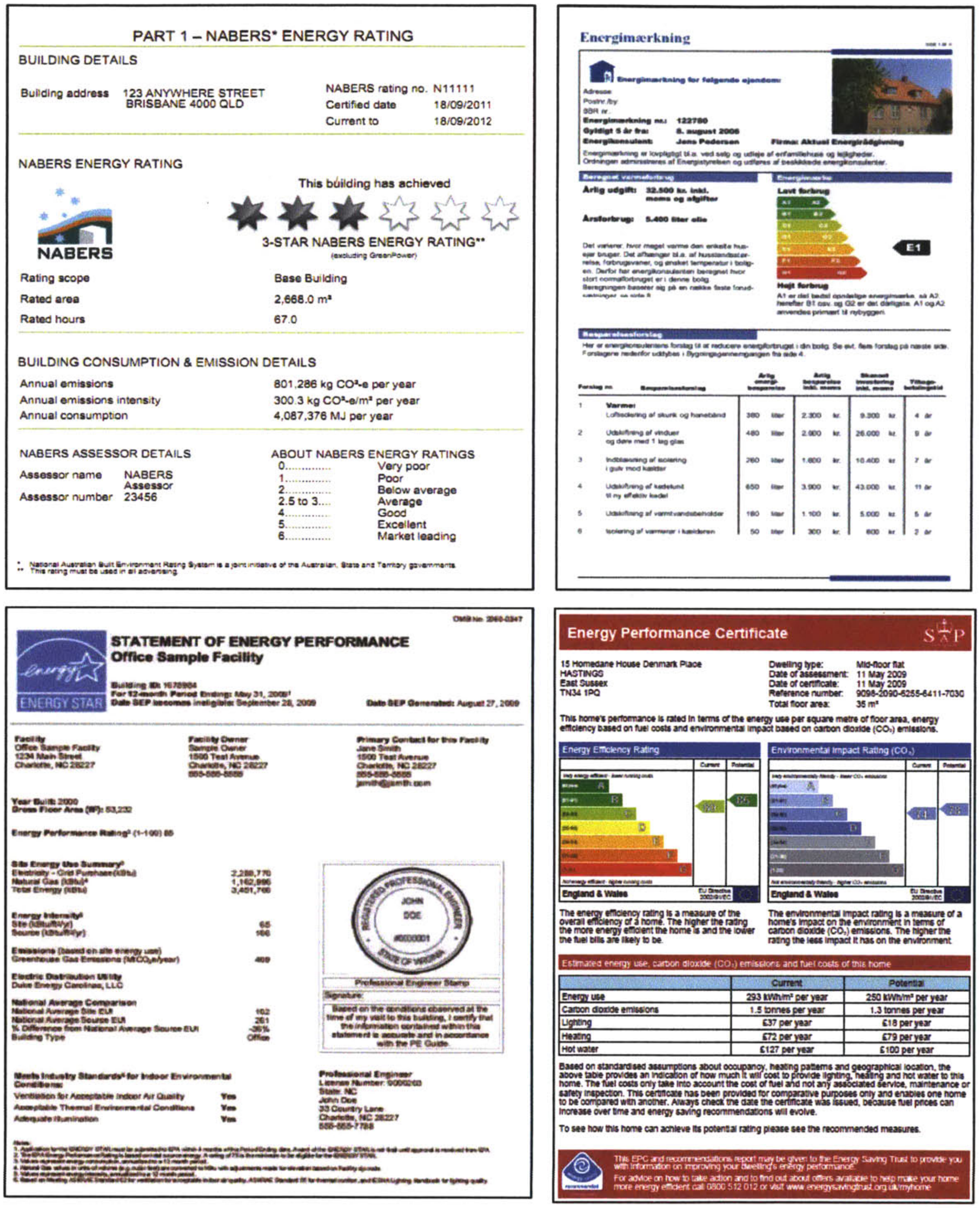



**Figure 1: Building energy labels from Australia (top left), Denmark (top right), the U.S.'s ENERGY STAR program (bottom left), and the U.K. (bottom right). Source: BuildingRating.org 2011.**

As a result, certification and recognition programs play a distinctly different role than building labeling. Indeed, while some cities have encouraged LEED-certified buildings, this does not obviate the benefits of mandatory building labeling, nor would it interfere with the implementation of labeling.

## Implementation Today

Residential building labeling has the potential to create transparency in housing markets, as discussed in the previous chapter. As a result, four U.S. cities, the European Union, and the Australian Capital Territory have implemented some form of residential building rating and disclosure to date.

### In the U.S.

Four cities in the U.S. have adopted residential labeling policies to date that are mandatory and involve a standardized rating or assessment (BuildingRating.org 2011).

New York City and Washington D.C. both have energy rating and disclosure mandates for buildings over 50,000 square feet (thus covering mostly commercial and large multifamily buildings). Under the requirements, building owners must use ENERGY STAR Portfolio Manager, a tool created by EPA, to generate a benchmark report from their utility bills. This report is then sent to the City, and each building's energy performance and rating is made publicly available on the City's website.

Seattle requires a similar use of ENERGY STAR Portfolio Manager, applicable to all residential buildings over 5 units. Building owners submit the benchmarking reports to the City, and owners must disclose an energy performance report to prospective buyers, tenants, lessees, and lenders upon request.

Austin, TX requires homeowners have a certified assessor conduct an on-site home energy assessment of their property prior to its sale. The energy assessment report must then be made available to prospective buyers, or, in the case of multifamily buildings, to prospective and current tenants. The requirements encompass nearly all homes in Austin.

The implementation and outcomes in New York, Seattle, and Austin will be explored in depth in Chapter III.

### In the European Union

The European Union requires its member states to implement widespread, mandatory building labeling under the 2002 European Energy Performance of Buildings Directive. Starting in 2009, all buildings, residential and commercial, are required to have an Energy Performance Certificate at the time of sale or lease. This applies to buildings old and new, single-family homes and skyscrapers. Beyond this, there is extensive variation from country to country in calculation methods, enforcement, administration, and overall implementation (BPIE 2010).

### Australia

Since 2010, Australia has required that all office buildings must procure an energy rating, and advertise and disclose the rating during sale or lease (CBD 2012). As part of this undertaking, Australia has developed a nationwide rating system, called NABERS (the National Australian Built Environment Rating System) that extends to all types of buildings, even though the national requirement is only for offices.

Moreover, in the residential sector, the Australian Capital Territory (i.e., Canberra and the surrounding area) requires that homeowners obtain an Energy Efficiency Rating before time of sale and disclose it to prospective buyers (ACT Government 2012). This rating is listed on a scale of zero to six stars and must be completed by an accredited energy assessor. The requirement has been in effect in some form since 1999 (Pike and Craze 2011).

It is widely expected that the Australian national government will expand home energy labeling to the whole country in 2012, with mandatory ratings for all homes being sold or rented (Pike and Craze 2011).

Beyond these cases, building labeling remains limited to commercial-only policies or voluntary programs. In the U.S., both Washington State and California have statewide building labeling requirements that apply only to commercial properties, strictly excluding residential property from the labeling mandates (BuildingRating.org 2011). China has a building labeling system in place primarily for governmental buildings, while Brazil has created a voluntary building rating program that may at some point in the future become mandatory (Leipziger 2011). Tokyo has a labeling program for non-residential buildings, requiring their owners to disclose energy ratings at time of sale or lease (IMT 2011b).

## The Benefits of Labeling for Residential Stakeholders

By providing information on the energy performance of homes, residential labeling can offer significant benefits to the stakeholders that make up the residential market.

For homebuyers, labeling allows a prospective buyer to understand the energy consumption, comfort (i.e., draftiness), and operating costs of a home he or she is considering. It allows prospective buyers to compare homes (Massachusetts DOER 2010) and enables them to understand how much work may be involved to bring the house up to a more efficient level, whether the motivation is cutting carbon, saving on energy bills, or increasing indoor comfort.

Tenants stand to benefit similarly. They can understand how much it will cost to heat and power their next apartment or house and can collect information on potential choices to compare them. While tenants are less likely than homeowners to make major investments in upgrades, the information disclosed to them through labeling can help them pick more efficient, less costly-to-operate apartments and homes – for example, an A-rated unit versus a D-rated unit (in a market with letter-grade labels).

For building owners, this creates a market-driven incentive to improve the energy performance of their buildings and advertise strong ratings (IEA 2010). Indeed, studies of building labeling in the Netherlands observe higher valuations for homes and offices with green ratings, when compared to less efficient but otherwise similar buildings (Jennen and Kok 2011, Brounen and Kok 2010). With both renters and buyers enabled to seek out energy efficient units, building owners are able to cater to the demand from those who want an efficient home. Furthermore, proactive homeowners who have taken steps on their own to retrofit their properties now have a quantitative measure of their efforts – they can state and advertise how efficient their property is. Indeed, there are some building owners, according to Duane Desiderio, Vice President at the Real Estate Roundtable, that are "using [energy ratings] as a marketing tool" (Desiderio 2012).

In addition, building owners who haven't conducted home upgrades benefit from having information on what actions can make their homes more efficient (NEEP 2009). Many homeowners are undoubtedly interested in retrofitting their home, or perhaps upgrading it prior to sale, but lack information on what steps they could take to do so. Building ratings, especially those conducted through an on-site assessment, provide information on what home energy upgrades would be beneficial and cost-effective. Owners of multiple properties are also then able to identify their worst-performing and/or most easily retrofitted buildings.

One final stakeholder group is lenders. A bill currently introduced in the U.S. Senate, the SAVE Act (S. 1737), would direct federal loan agencies to use a home's energy performance, based on a site assessment, as a cost factor in determining mortgage eligibility. Currently, mortgages backed by the Federal Housing Administration do not include the cost factors of home energy, but, under the SAVE

Act, the cost of energy and the potential for saving on energy bills in an efficient home would be taken into account (IMT 2011a). Mortgage writing under the SAVE Act would benefit from having more complete information, perhaps from labeling, thus making banks and lenders key beneficiaries of building labeling. Today, the only federal loan offering that takes energy efficiency into account is what is called an "energy efficient mortgage," or a loan to conduct home energy improvement, capped at 5% of the property value (EPA 2012b). Even without the SAVE Act, large multifamily buildings are often owned and operated with support from lenders. Energy performance ratings for such buildings – primarily if the building owner pays utility bills – could be beneficial to these lenders as well.

## Informing Policymakers and Program Managers

Cities, states, and utilities can also benefit from building labeling in making policy decisions on energy efficiency programming. Additionally, in many states, utilities design and implement home energy programming. Currently, these policymakers and program managers have access to relatively few streams of information on the housing stock; data is typically limited to property assessor reports, which encompass home size, age, and number of rooms, as well as U.S. Census data, which estimates home energy consumption at the tract level (U.S. Census 2000). Utilities have access to home energy bills as well, and, where applicable, advanced metering data. But none of these data streams paint an accurate picture of actual retrofit needs – in other words, policymakers and program managers can't use this information alone to determine what types of home efficiency incentives to provide.

Building labeling offers a new data resource that cities, states, and utilities can use to understand the energy performance, shape of building systems, and retrofit needs of local housing stock, as well as its "true energy-saving potential" (BPIE 2010). Labeling generated through on-site home assessments can provide an especially detailed look at housing retrofit needs, offering a rich dataset to work with in understanding the future of local residential energy use.

## Bringing Down Barriers to Efficiency

Building labeling also presents specific benefits that have the potential to bring down several key barriers that commonly obstruct the delivery of residential energy efficiency.

### The Landlord-Tenant Split Incentive

One common barrier in trying to get homeowners to invest in home upgrades is the landlord-tenant split incentive in rental properties. Typically, landlords are not keen on investing in energy improvements when tenants are paying the utility bills. At the same time, tenants are unlikely to make improvements to a property they may not stay in long enough to recoup their investment. Even for efficiency improvements with a very short payback period, tenants may be reluctant to make investments in a property they isn't theirs. As a result of this split incentive, the rental property often goes unimproved.

Building labeling has the potential to mitigate this split incentive barrier (Dunsky et al. 2010): landlords of inefficient apartments must disclose the energy performance of their buildings, enabling prospective tenants to seek out more efficient housing. As a result, landlords have an incentive to invest in improvements that will save energy costs for their future tenants.

### The Builder-Buyer Split Incentive

Paralleling the landlord-tenant split incentive, there is little incentive for a builder to install more efficient appliances or invest in a more efficient building envelope when the new homeowner will be paying utility bills. Indeed, the costs of these measures can drive up the builder's selling price. Building labeling, however, provides an incentive for builders to construct energy efficient homes, and a disincentive to avoid building homes that will be rated poorly (IEA 2010).

Of course, some of the new construction standards discussed earlier – LEED and ENERGY STAR Homes – can also play this role in the builder-buyer split incentive. A universal labeling system, however, provides consistency and comparability between the ratings for new homes and existing homes.

### Risk of Investment

Currently, proactive homeowners and landlords that make efficiency investments in their properties have no assurance of being rewarded for their investment through higher sale prices or rents. Labeling can help mitigate this risk by assessing and sharing the results of such investments, creating a market where owners can better recoup their investment through higher valuation or rent (Dunsky et al. 2010). In the Netherlands, Brounen and Kok (2010) find that homes with green ratings sold and rented at an average of 3% higher than homes that were otherwise identical but rated as energy inefficient.

### Inertia

Even when landlords are interested in making retrofits, the motivation it takes to actually go through with the upgrade can be an obstacle – a barrier of inertia. A residential energy label, however, can create pressure from tenants that overcomes the inertia of owners and helps spur a building retrofit (Burr et al. 2010). For example, if current tenants see that their apartment building has just been rated poorly, they may be more motivated to ask their landlord to invest in energy efficiency improvements.

## The Challenges and Uncertainties of Labeling

For all the benefits that residential building labeling potentially holds for the delivery of energy efficiency, there are major concerns as to how it has been implemented and how impactful it can actually be (Dunsky, et al. 2010). After all, residential labeling has only been implemented in five cities outside the E.U. Major concerns facing the implementation of residential labeling include the clarity and trustworthiness of ratings (Dunsky, et al. 2010), the costs of the rating process itself, the fluidity of disclosures and transactions (BPIE 2010), the quality of the rating method, and the privacy of information on home energy use (Barr et al., 2010).

At the same time, there is no uniformity in the approaches being used by cities and E.U. member states, as will be explored in Chapter III. There are significant differences in the types of rating, the requirements on owners, the building types covered, and the disclosure method, among other factors, between the different jurisdictions. Each approach has its own distinct benefits and concerns. Indeed, with most building labeling policies being enacted in the past three years, there is very little in the way of results or outcome analysis to 'prove' one approach over another. This heterogeneity of approaches, coupled with the many concerns about residential labeling, means that there is a great deal of uncertainty in this nascent field. Can building labeling be impactful in its current forms of implementation? Or could new methods offer advantages over current approaches?

As with any emerging field, there is a multitude of papers providing analysis and arguments on how building labeling should be implemented. As seen in the following section, this literature provides significant insight into improving labeling, but there remains a need to examine new ideas for the type of rating and new approaches to disclosure.

### Research into Addressing These Challenges

Much of the existing literature on building labeling establishes the potential benefits of labeling, as cited in the preceding sections of this chapter. These papers (such as Dunsky et al. 2010) focus on the potential for market transformation, correction of information imbalances, communication with stakeholders, and breaking down of common barriers to energy efficiency. In conjunction with these works, other research examines potential cross-benefits with other mechanisms of delivery energy efficiency. Mekler and Michaels (2011) discusses innovative delivery mechanisms for retrofits and observes the need for reliable tools to evaluate and verify home energy performance.

Several state governments have examined the potential for building labeling in whitepapers, studying issues that have come up in case studies and identifying the best path forward for their own state. These studies, such as Massachusetts DOER (2010) and Maine PUC (2010), take a look at some of the decision variables discussed earlier: mandatory or voluntary, minimum building size, focus on commercial vs. residential, assessment-based or not, and type of rating scale. They lay out the advantages and disadvantages of each potential choice and recommend specific decisions. These papers also lay out the case, in general, for transparency in real estate markets. Massachusetts DOER (2010) is specifically written with an eye towards the ongoing pilots in Massachusetts.

There are also papers which provide an analysis of the challenges of labeling and offer region-level strategy for labeling. The Northeast Energy Efficiency Partnerships has published its findings (NEEP 2009) on how labeling policies can be designed to have the greatest market impact, making specific recommendations about when to disclose energy ratings and about enforcement mechanisms.

Other papers, written by private organizations, advocate for a specific rating standard and identify problems with other standards. For example, the American Society of Heating, Refrigerating, and Air Conditioning Engineers advocates its BuildingEQ rating program in a position paper (ASHRAE 2011), pointing out shortcomings in commonly used rating tools in the U.S., including EPA's ENERGY STAR Portfolio Manager.

Much can also be learned from the literature on European labeling to date. As the European Union has implemented building labeling policies in 2009, there is extensive research providing observations on implementation (albeit little in the way of outcomes as of yet). Works such as ECEEE (2009) and BPIE (2010) identify best practices among the E.U. member states' labeling programs, examining successes to date and the elements of labeling that contributed to the success. Some papers also seek to recommend a plan of improvement for the E.U.'s current form of implementation. Finally, there are several papers that seek to quantify the impacts of labeling in E.U. member states on local real estate valuation and markets. These papers, such as Jennen and Kok (2011) and Brounen and Kok (2010), analyze very specific local markets; they find, indeed, statistically significant increases in market valuations for buildings with greener ratings.

## The Research Need

The current literature offers extensive insight into the emerging, evolving, and heterogeneous approaches to building labeling. The literature covers the benefits of building energy labeling in depth, and it offers numerous hypotheses on what aspects of existing programs could be improved and on how jurisdictions that don't currently require building labeling could proceed.

What is missing, however, is a close examination of how the processes of rating and disclosure itself could be reorganized to optimize the benefits for delivering residential energy efficiency. First, few papers explore the possibility of combining asset and operational ratings, and whether this would be more beneficial to spurring residential retrofits. Second, there is little research on the issues of current disclosure mechanisms and how disclosure could be improved to better drive residential energy efficiency.

Accordingly, and as stated in Chapter I, this thesis will focus on how residential energy performance can be best designed for optimizing the delivery of energy efficiency, with a specific focus on two aspects:

- the appropriateness of operational ratings vs. asset ratings vs. a combined rating, and
- the potential for alternative disclosure mechanisms for residential building energy ratings.

As this chapter has shown, residential labeling offers significant benefits for energy efficiency but, as implemented today, encompasses a wide variety of approaches and faces numerous issues, leading to the identified research need. Chapter III provides four case studies of existing residential building rating, as well as information on approaches in the E.U., voluntary programs, and the private sector. These studies, in conjunction with other literature, will help identify how rating methods and approaches to disclosure could be improved.

# III. Case Studies and Current Developments

Given the heterogeneity of labeling approaches in use today, looking at the current approaches to implementation can provide an understanding of some of the different methods used in residential labeling and how they may or may not address the concerns surrounding labeling. Indeed, current approaches to residential building labeling can provide insight into how it could be optimized for the delivery of energy efficiency to the residential sector.

To that end, this chapter examines case studies of early adoption in New York City, Seattle, and Austin, as well as pilot projects in Massachusetts. These cases were picked as there are only four cities in the U.S. with residential labeling; D.C. uses an approach that is nearly identical to New York and is a much smaller market. Finally, the chapter examines voluntary rating programs in the U.S., the European Union approach to residential building rating, and the role of the private sector in this field.

Each case study describes the background of implementation, the labeling requirements, and the outcomes to date. Moreover, each case study also describes the methods used for rating and disclosure and identifies the benefits that each method provides for residential labeling.

Finally, in order to understand how each set of methods is beneficial to the delivery of energy efficiency, each case study summarizes how the different methods address the key themes below. Based on the literature, these themes are important to the ability of building rating and disclosure to help deliver residential energy efficiency:

- usefulness of building performance information to stakeholder decision-making;
- comparability across whole residential markets;
- usefulness to policymakers;
- fostering of residential upgrades;
- ease of the rating and disclosure process;
- privacy of billing information; and
- accuracy and reliability of energy rating.

## New York's Local Law 84

### Background

New York City has implemented building benchmarking and disclosure for large buildings as part of an aggressive, broader effort to cut greenhouse gas emissions. In 2007, New York City announced the finalization of PlaNYC, a comprehensive plan for the growth of the city between 2007 and 2030, including planning for nearly one million expected new residents (City of New York 2007). PlaNYC focuses heavily on a "greener, greater New York," with numerous prescribed actions designed to cut energy use and greenhouse gas emissions.

Greener buildings are the focus of one full chapter of the plan. The plan estimates that 75% of the city's greenhouse gas emissions come from building energy use, as does 94% of the city's electricity use (City of New York 2007). Moreover, the City estimates that 85% of the building stock that will exist in 2030 has been already built; with that in mind, PlaNYC makes increasing the energy efficiency of existing buildings a key focus (City of New York 2012b).

To that end, the city's signature Greener, Greater Buildings Plan (GGBP) is a plan designed to spur energy efficiency in existing large buildings, in both the public and private sectors. It was developed with stakeholder outreach and feedback (ICLEI-IMT 2011), and, in December 2009, Mayor Michael Bloomberg signed into law the four regulations that form the core of GGBP's strategy (City of New York 2012b). These four Local Laws target the 16,000 largest buildings in the city, which collectively comprise half of the built square footage in the city. The laws include an energy code for building renovations, retro-commissioning, lighting retrofits, and benchmarking and disclosure. The regulations are coupled with new green workforce training programs and green building financing mechanisms provided by the City (ICLEI-IMT 2011).

## The Approach

The benchmarking ordinance – Local Law 84 – applies to all private buildings over 50,000 square feet, as well as City-occupied buildings over 10,000 square feet for which the City pays utility bills (City of New York 2011). Groups of buildings that are jointly operated as a condominium or that are on the same lot also fall under the purview of the law if they combine to exceed 100,000 square feet. Buildings consisting of 1 to 3 residential units are explicitly exempt, although it is unlikely they would comprise 50,000 square feet as it is.

Each year, building owners must collect data on energy and water consumption (with data compiled by calendar year). This data must then be entered into EPA's ENERGY STAR Portfolio Manager tool, along with data on occupancy and floor area. The sidebar "Using EPA's ENERGY STAR Portfolio Manager"

**Using EPA's ENERGY STAR Portfolio Manager**

The EPA has developed Portfolio Manager as an easy-to-use building benchmarking tool. Using billing data and user-provided information on occupancy, it calculates an estimate of the building's energy use intensity and GHG emissions (EPA 2012a), thus providing a benchmark of the building's energy use against which future progress can be measured. Additionally, for fifteen types of commercial buildings, such as hotels and supermarkets, Portfolio Manager compares a building's energy use intensity to a national dataset and outputs a percentile score. For example, a score of 50 for a supermarket in a given year indicates that the supermarket performed at the median of the national supermarket dataset. Scores from 75 to 100 make the owner eligible to apply for ENERGY STAR recognition for the building. Today, many building owners have adopted Portfolio Manager into their business models, with over 350,000 buildings benchmarked through it (Desiderio 2012).

provides a brief overview of the functions of Portfolio Manager. Needless to say, many of the buildings subject to Local Law 84 have multiple tenants, each with separate metering. For non-residential tenants, building owners are required to request energy use data and occupancy data from the tenants, with the request made using an official City-provided form (City of New York 2012c). If that is unavailable, the published requirements provide default values, with values provided for different types of non-residential occupants (City of New York 2011). For residential units, building owners are allowed to use the data from 10% of units to extrapolate whole-building consumption; as before, if the data for 10% of units is unavailable, the methodology provides default values. Broadcast and cell towers are exempt from a building's energy footprint.

To provide a simpler and more accurate alternative to this process, New York's utilities have worked with the City to provide access to aggregated whole-building energy consumption data (City of New York 2011). The aggregation at the building level ensures that individual tenants' billing remains confidential. ConEd and National Grid each provide a data request process for building owners, and each provides requested data by email, typically within 15 days. ConEd charges $103 for the service. Notably, even if owners obtain this whole-building data, they are still required to make the request for occupancy data from their non-residential tenants (City of New York 2012c).

The benchmarking reports generated by Portfolio Manager must then be submitted to the City; the tool generates what is termed a New York City Benchmarking Compliance Report (City of New York 2011). The building owner is also required to retain the original data, as well as copies of the information requests made of the non-residential tenants. To help building owners through the whole process, the City provides a hotline for benchmarking assistance and has connected building owners with specialized, 3 ½ hour-long training sessions (City of New York 2011).

The benchmarking requirement went into effect for the 2010 calendar year, requiring private building owners to benchmark and submit reports by May 2011 (City of New York 2011). Non-compliance with Local Law 84 is treated as a violation of the city's construction code and is assessed a $500 fee per quarter of non-compliance (DOE SEEAction 2011a).

Public disclosure for buildings that are primarily residential will begin in September 2013 for buildings: each building's energy use intensity, water use per square foot, and (if applicable) percentile rating will be posted online by the City, accessible to the public (City of New York 2011). Disclosure of reports for primarily non-residential buildings begins in September 2012, and the disclosure of reports for City-occupied buildings began in September 2011.

### Outcomes

By August 2011, two-thirds of the buildings covered by Local Law 84 had complied and submitted benchmarking reports; the City extended the deadline to December to encourage additional submissions. By March 2012, compliance was up to 80% of buildings, according to Laurie Kerr, a Senior Policy Advisor in the Mayor's Office of Long Term Planning and Sustainability (Kerr 2012). Preliminary analysis shows that residential units comprise 80% of the floor space being benchmarked. In addition, the City's analysis showed a spread of building energy use where some buildings have an energy use intensity that is fourfold that of others (Kerr 2012).

Benchmarking has also led to job and expertise creation, spurring a 'cottage industry of benchmarkers' (Kerr 2012). Compliance costs have been about $500 to $2000 per building, translating into a significant business opportunity for private sector service providers. In addition, energy service companies in New York have seen a 30% uptake in business, specifically due to benchmarking (DOE SEEAction 2011a). One company in New York that provides building energy services, Ecological, reported doubling in size and adding 400 clients since benchmarking started (Hurley and Burr undated).

Some stakeholders were concerned when ENERGY STAR Portfolio Manager was announced as the benchmarking tool, feeling that it would not accurately capture the energy performance of the building stock (ICLEI-IMT 2011). However, this experience has helped to reshape ENERGY STAR Portfolio Manager: the EPA became a partner of New York's benchmarking regulations and is undertaking steps to better represent multifamily buildings in the tool. The EPA is also working to better incorporate steam consumption in energy calculations and is working with New York and its utilities to eventually facilitate direct data upload. Kerr notes that, since other cities in the U.S. also use Portfolio Manager, there is an "impetus to improve it over time" (Kerr 2012).

## Takeaways

New York's benchmarking and disclosure requirements offer several important lessons for other cities or states, even though it is too early to quantify any impacts on the market in New York.

First, when labeling data is collected and aggregated by the City, the data is a valuable resource for the City, even before it becomes publicly available (ICLEI-IMT 2011). The Commercial Buildings Energy Consumptions Survey, a database currently used to estimate building energy use for different types of buildings in the U.S., has been a struggle and a limitation for the EPA and DOE to work with. Now, the City of New York will have a powerful dataset on building energy consumption, comprised of a large number of buildings with detailed benchmark reports. Indeed, the dataset will be the "single largest reliable population of statistics regarding energy performance for a wide variety of buildings" (ICLEI-IMT 2011). This data will help the City make policy decisions for future energy efficiency programs (ICLEI-IMT 2011).

Second, requiring building owners to use and process energy billing data can be a motivator for building energy upgrades. As observed in ICLEI-IMT (2011), just the requirement of compiling energy use numbers and having to confront them can spur building owners to finally act on energy efficiency.

Furthermore, having owners know what their rating is can be a motivator as well. Kerr notes that owners really care whether their score is "above [a score] or below that... If they knew [the energy use], or the building operators knew that, they could do something about it" (Kerr 2012).

Third, coupling operational benchmarking with energy audits presents multiple benefits. The on-site energy audits provide information on actual building retrofit possibilities, according to Kerr (ICLEI-IMT 2011), while benchmarking provides a tracking mechanism for energy use.

Fourth, involving stakeholders throughout the process can prove beneficial. The City utilized the knowledge of technical experts to shape the requirements and worked to gain the support of local stakeholders, such as those in the real estate industry (ICLEI-IMT 2011).

There are several challenges, however, that also offer valuable lessons. First, the labeling process needs to streamline the integration of energy billing data. In New York, the most significant challenge to date has been for building owners in trying to obtain whole-building energy use data from utilities (ICLEI-IMT 2011). Facilitating the data request process has been a major hurdle, and, as Desiderio notes, cities need to "first make sure there is adequate building data capture" when implementing labeling (Desiderio 2012). In New York, the possibility of directly uploading utility data to Portfolio Manager accounts – thereby streamlining the benchmarking process – remains an ongoing discussion.

Second, there was initially a great deal of confusion among building owners as to what actually needs to be done to comply with Local Law 84 (ICLEI-IMT 2011). As a result, easy-to-use checklists were prepared to guide owners through the process (along with the trainings and hotline mentioned earlier). Thus, Kerr notes that assistance is a crucial complement to any benchmarking regulation (ICLEI-IMT 2011).

Finally, compliance remains a concern, as, nearly a year after implementation, 20% of owners have not conducted benchmarking. Indeed, ICLEI-IMT (2011) identifies enforcement as a crucial component, as building owners need to be spurred into action.

Nonetheless, GGBP and its multiple components have been well-received by many residents and industry stakeholders (ICLEI-IMT 2011), and it is expected to contribute 5% towards the city's 2030 emissions reductions goal. While it will be a few years before market outcomes can be judged, New York's work demonstrates that it is logistically and technically feasible to implement comprehensive building energy efficiency benchmarking in the country's largest city (ICLEI-IMT 2011).

### Assessment

In terms of catalyzing residential energy efficiency, the methods used by New York address some of the critical issues but leave room for improvement.

**Usefulness of building performance information:** The Portfolio Manager ratings provide an easy-to-use look at past energy performance, but the absence of any asset component means that the rating does not convey any information about the potential efficiency of the building. Nonetheless, the fact that New York makes its rating information publicly available at all times means that stakeholders can access it at any point in their searching and decision-making.

**Comparability across whole residential markets:** Only the city's largest buildings must conduct benchmarking and disclosure. Thus, on the consumer-facing side, stakeholders can only compare across a small part of the housing market.

**Usefulness to policymakers**: As noted, the collection and analysis of rating data by the City will give policymakers a rich dataset to use in efficiency planning.

**Fostering residential upgrades**: Coupling benchmarking with on-site audits provides targeted upgrade recommendations. Furthermore, simply having building owners compile energy consumption data can spur upgrades.

**Ease of the rating and disclosure process**: While New York has worked to simplify the process of getting whole-building data, one wonders if it could be streamlined further, into a direct transfer of data from the utility to Portfolio Manager. After all, many building owners were confused as to how to comply with the new local law. Separately, fully public disclosure in New York means that the City handles the posting of all ratings, with no real burden of disclosure on the building owner.

**Privacy**. New York's facilitation of whole-building billing data helps avoid breaching confidentiality by aggregating numerous billing accounts in each building. Separately, fully public disclosure means that building owners do not have the choice to disclose energy performance to market stakeholders only. This is a requirement that probably could not be easily asked of single-family homeowners, if benchmarking were to encompass the whole residential market.

**Accuracy and reliability of rating**. The approach of allowing a building owner to use 10% of units as a proxy for the whole building certainly calls into question the accuracy of some benchmarks; perhaps this even allows the system to be gamed by using the data from low-consuming units. As a result, the need for easy access to whole-building data is apparent.

## Austin's Energy Conservation Audit and Disclosure Ordinance

### Background

Austin has implemented an energy rating and disclosure requirement that targets energy efficiency in all homes, whether single-family or large apartment building, exempting only mobile homes and trailers. As a result, Austin's ordinance brings transparency to approximately 317,000 residential units (U.S. Census 2005).

In February 2007, Austin released its Climate Protection Plan, and, in line with the Plan, the City Council turned to the issue of building energy efficiency soon after. The City Council sought to take aggressive action on curbing the growth in energy demand, seeking to cut 700 MW of peak hour power use by 2020 (IMT 2011c). This was especially germane to City lawmaking as Austin's electric utility is municipally owned; it is the 9th largest community-owned utility in the U.S. (Austin Energy 2012a). To address residential energy efficiency, the City Council proposed a retrofit ordinance, one that would require retrofitting homes to a minimum level of efficiency before they are sold (ABOR undated).

However, the local network of real estate agents, the Austin Board of Realtors, opposed the City's proposal, citing concerns over property rights and housing affordability, and negotiated with the City for a different requirement (ABOR undated). The Board and the City arrived at a compromise, in which transparency would be provided to the home sale process through energy audits and disclosure. The requirement for retrofits was removed for all but the most poorly performing multifamily buildings.

Thus, in November 2008, the Austin City Council approved the Energy Conservation and Disclosure Ordinance, or ECAD. ECAD requires energy benchmarking for nearly all commercial and industrial buildings, and energy auditing and disclosure for all residential buildings (IMT 2011c). In order to improve upon the initial rollout and provide more time for commercial building compliance, the Austin City Council amended ECAD on April 21, 2011, bringing it to its present state (City of Austin 2011a).

### The Approach

ECAD applies to buildings that are within the city limits of Austin and receive electricity from Austin Energy. Austin Energy does provide power to some homes outside the city, but these properties are not subject to ECAD or any other city regulations.

ECAD encompasses buildings in all sectors. First, under ECAD's non-residential regulations, any commercial, industrial, or institutional building without manufacturing is required to undergo annual energy benchmarking (Austin Energy 2012b). Owners must file their reports with the city using ENERGY STAR Portfolio Manager; these reports are not publicly disclosed. Compliance is required of buildings over 75,000 square feet by June 2012, followed by buildings over 30,000 square feet a year later, concluding with all buildings over 10,000 square feet starting in June 2014.

For the residential sector, ECAD implements rating and disclosure for all residential buildings, from single-family homes up to large apartment complexes. These residential requirements went into effect in 2009 (Austin Energy 2012d). Under the ECAD mandate, buildings with up to 4 residential units follow a required single-family homes process, while 5 units of more must follow a separate multifamily building process. For condominium buildings, the rules apply to units owned: owners of 4 units or less in a single building go through the single-family home process, while owners of 5 or more units go through the multifamily requirements. Finally, trailers and homes without foundations are not subject to ECAD (City of Austin 2011b).

For single-family homes, ECAD requires that owners complete a residential energy audit prior to selling the house (City of Austin 2011a). A copy of the audit must then be provided to prospective homebuyers three days before the end of the option period (the time during which the buyer can withdraw from the sale). A building professional certified by the Building Performance Institute or the Residential Energy Services Network must do the assessment. The assessment involves checking attic insulation, duct sealing, HVAC systems, and air sealing, in addition to a measurement of window area (Austin Energy 2012c). The resulting audit provides information on attic R-values, air leakage, HVAC efficiency and condition, fenestration, and, perhaps most importantly, the opportunities and strategies for improving the home's energy efficiency. The whole audit process typically costs $200 to $300 and takes about two hours for a home of about 1,800 square feet or less. The energy assessor submits the report to the City within 30 days, while the homeowner provides a copy to the prospective buyer; both of these steps use standardized, City-provided forms (City of Austin 2011b). The audit is good for 10 years, i.e. the same audit is valid if the house is resold within ten years.

There are several exemptions which allow a house to bypass the audit requirement (Austin Energy 2012c). First, houses less than 10 years of age are exempt from the requirement. Second, the audit can be waived if the incoming buyer signs an agreement with Austin Energy to complete weatherization within six months. Third, the ECAD requirement is waived if the purchaser commits in writing to Austin Energy that he or she will be demolishing or substantially rebuilding the home within six months (City of Austin 2011b). Finally, homeowners who upgraded their homes through Austin Energy's Home Performance with ENERGY STAR program can bypass ECAD if one of the following conditions was met: at least three of the recommended upgrades were implemented, or all recommended measures were implemented, or the homeowner received an energy efficiency rebate of $500 or greater. Austin Energy provides records of program participation if needed (Austin Energy 2012c).

Failure to comply with ECAD is a Class C misdemeanor (Austin Energy 2012c), with fines ranging from $500 to $2000 (ACEEE 2011b).

In the multifamily sector, ECAD's approach to rating and disclosure requires up-to-date energy audits independent of when the property is sold and has stringent requirements for disclosure. Owners of multifamily buildings that are over 10 years old were required to conduct an energy audit by June 2011, and buildings newer than 10 years old must undergo energy audits as they reach 10 years of age (City of Austin 2011b). Audits are thereafter required every 10 years – regardless of whether the property is being sold or not. As a result, all buildings over 10 years of age will eventually have an audit conducted within the past decade. As with single-family homes, the auditor must be BPI- or RESNET-certified. The audit consists of a check of about 10% of the unit floor plans in a building and an examination of duct leaks, attic insulation, and windows (Austin Energy 2012d). The assessor sends a copy of the audit to the City within 30 days. Furthermore, the building owner must then share the audit with current residents and post a copy of it at the property, plus he or she must share it with prospective tenants.

Similar to single-family homes, Austin multifamily buildings are exempt if they have done duct work in the past 10 years with Austin Electric's rebate program (City of Austin 2011b).

Based on the results of the audit, retrofits and additional disclosure are required for highly inefficient multifamily buildings. This applies to multifamily buildings whose energy use intensity is over 150% of the average energy use intensity of Austin-area multifamily buildings (City of Austin 2011b). To reduce energy use at these poorly performing properties, ECAD requires that the owners implement retrofits to cut energy use by 20%, with 18 months to comply; exemptions are granted if major deconstruction or HVAC replacement would be required. Until the retrofits are complete, the owners of these properties must take an extra disclosure step: they must tell tenants that the property has high energy use and that their bills would be higher than they would be at a more efficient building. It is expected that 50 of the roughly 1000 apartment buildings in Austin will fall into the category of highly inefficient (City of Austin 2011a).

To complement ECAD requirements, Austin Energy's website plugs homeowners into rebate and loan programs. Specifically, Austin Energy's Home Performance with ENERGY STAR provides rebates for duct sealing, attic insulation, window treatments, air conditioning, and air sealing work (Austin Energy 2011c). These rebates, when combined with other grants that Austin Energy provides, can cover up to 60% of the cost of improvements (ACEEE 2011b).

### Outcomes

To measure outcomes, Austin Energy has tracked the number of homes sold and the number of audits conducted. Compliance with the ECAD process was high, as measured in the year ending June 2010 (the first year of ECAD): 9,549 homes were sold, out of which 4,862 conducted an energy audit and 3,999 were determined to be exempt under the reasons discussed earlier (ACEEE 2011b). This means 688 homes failed to go through the ECAD process, for a compliance rate of 93%.

Additionally, Austin Energy tracked the number of homes implementing energy upgrades before the house is sold or within one year after sale. This would indicate, generally, that the ECAD requirements had spurred the seller to perform energy improvements, or that the new buyer, informed through the disclosure process, had implemented some of the recommendations. The target outcome was 25% of homes sold in the year ending June 2010, and 45% for the year ending June 2011 (ACEEE 2011b). Actual implementation rates, however, fell short: 12% in the year ending June 2010, and 7% in the following year.

ECAD has also spurred an 11% uptick in the number of households participating in Austin Energy's energy efficiency programming (DOE SEEAction 2011b). On the multifamily side, retrofits in recent years, spurred in part by ECAD, have achieved 2.68 megawatts of power capacity cuts (ACEEE 2011b).

Data collected from ECAD reports also reveals the collective state and retrofit needs of the homes being sold in Austin. Among single-family homes sold in Austin in the first year, 98% received one or more upgrade recommendations. ACEEE (2011b) details the breakdown, with 78% needing weatherization, 68% needing HVAC renovation and sealing, and 79% needing attic insulation. If implemented, these improvements would save 3.9 MW of power demand and eliminate nearly 5,000 metric tons $CO2_e$ of emissions annually.

### Takeaways

There are several lessons to be learned from Austin's implementation of ECAD.

First, a building labeling requirement that encompasses all buildings enables consistent and comparable energy assessments across homes of all types. Austin's ECAD requirements cover all homes, exempting only mobile and trailer homes. As a result, prospective homeowners can compare the energy efficiency of a new home to their current home (comparing between single-family homes is difficult due to disclosure only during the option period).

Second, required disclosure to all prospective tenants (of multifamily buildings) can enable comparisons during the decision-making process. As a result of ECAD, apartment hunters can view the energy performance of any unit in a multifamily building they are considering, and, in fact, are made aware if they are considering a unit in an especially inefficient building. This enables apartment hunters to consider and compare energy performance during decision-making.

Third, regarding single-family homes, a requirement to disclose to prospective buyers during the option period has its advantages but leaves room for improvement. In the initial version of ECAD, disclosure for single-family home energy audits was required simply "before the sale," which resulted in sellers disclosing the audit results during closing (ACEEE 2011b). Disclosure is needed much earlier in the home-buying process if it is to help new buyers negotiate improvements to the home. As a result, the City Council amended ECAD to move the disclosure requirement to three days before the end of the option period. However, it is important to note that this still doesn't enable comparisons between a prospective buyer's homes of interest: the prospective buyer only receives the audit results when negotiating the purchase of a house, not during the house viewing and visiting process.

Fourth, having a finite period of validity for energy audits – i.e., an expiration time – means that extremely old audits are not being used for sale or lease transactions. This provides more accurate information to prospective buyers and tenants, as it reflects any efficiency improvements or any deterioration of the building envelope up to 10 years ago.

Fifth, the utilization of on-site audits can provide tailored recommendations for home energy upgrades. The use of audits under ECAD delivers actionable recommendations to the homeowner and prospective buyer, in a way that simply calculating energy use intensity would not. This also enables the City to understand in detail the retrofit needs of the housing stock.

Sixth, providing exemptions to audit requirements for homes that will be retrofitted can potentially encourage greater uptake of retrofits and reduce the programmatic burden on homeowners. In Austin, owners are exempt from audit requirements if, among other reasons, the new buyer commits to weatherization or the seller has implemented qualifying efficiency upgrades. This may contribute to the observed 11% uptick in energy efficiency services requested of Austin Energy. These exemptions also help reduce any unnecessary burden for homeowners that are legitimately implementing or have implemented home upgrades.

Finally, collection and analysis of home energy assessments by a city enables significant insights into retrofit needs. In Austin, City officials are able to use an analysis of energy audits to determine that just 2% of homes have all recommended efficiency measures implemented. Furthermore, City officials have been able to identify attic insulation as the most common need and could, if wanted, tailor rebate programs to encourage more attic insulation upgrades. Taking this analysis to the next level, City officials are also able to quantitatively estimate the resource that home energy efficiency represents, calculating the energy that Austin could save through home efficiency.

### Assessment

Austin's ECAD uses several methods that have the potential to catalyze residential energy efficiency.

**Usefulness of building performance information**: Austin requires the disclosure of the home energy audit during sale negotiations of single-family homes. This allows house hunters to use it in their decision-making, but it is likely coming at a time when the buyer is already more or less committed to buying the house. The requirements for multifamily disclosure – to all prospective residents – allow for comparisons across all properties of interest, at a time when building performance can more likely influence decision-making.

**Comparability across the whole residential market:** ECAD applies to all homes, excepting only mobile homes. This is a unique approach out of the four case studies examined in this thesis, and it creates a uniform standard: house hunters know that any property they look at will be subject to ECAD requirements, and hence will either have an energy audit or proof of upgrade ready to view, or will require an upgrade within six months. Among multifamily properties, apartment hunters know that they can compare energy audits across all multifamily buildings.

However, Austin also does not use any type of rating scale that could enable qualitative comparisons between two buildings. In other words, there is no percentile score or efficiency rating that summarizes a home's inefficiency or efficiency. Instead, prospective homeowners and apartment hunters must read through the audit recommendations of different properties.

**Usefulness to policymakers**: Austin officials are collecting and analyzing the label results and, as seen, now have detailed insights into the retrofit needs of the housing stock.

**Fostering residential upgrades:** The use of on-site energy audits allows for tailored recommendations to be at the core of the process. In addition, being able to conduct a retrofit as a means of skipping the audit requirement encourages home upgrades. However, this method may not be suitable in a city where the goal is to have comparable numerical or letter ratings for all homes, retrofitted or not.

**Ease of the rating and disclosure process**: ECAD is designed to reduce unnecessary burdens on homeowners, by providing ways for retrofitted homes or new homes to be exempt from the process. In addition, the 10-year period of validity reduces the burden on homeowners who are selling within that timeframe.

**Privacy of billing information:** Austin's approach to home energy assessments does not use, much less share, a homeowner's energy consumption. Instead, what is being shared is a home's efficiencies and inefficiencies, and, this too, is only required at the time of sale, when the sellers will soon be leaving the house. Thus, Austin's approach offers significant protection of resident privacy.

**Accuracy**: ECAD requires the use of on-site energy audits, as a way of ensuring an on-the-ground, in-person look at home energy needs. Keeping the audits for valid for a finite period also helps ensure accuracy.

## Massachusetts's Home Asset Rating Pilots

### Background

Massachusetts has taken action in recent years to reduce energy use and greenhouse gas emissions. In 2008, Governor Deval Patrick signed into law the Global Warming Solutions Act, which established a greenhouse gas reduction goal of 10-25% below 1990 levels by 2020, facilitated in part by the Commonwealth's participation in Regional Greenhouse Gas Initiative cap-and-trade program. To cut energy use and its associated carbon emissions, Massachusetts has implemented numerous energy efficiency measures which have earned it the American Council for an Energy Efficient Economy's recognition of being the most energy efficiency-active state (ACEEE 2011a). These measures include decoupling electric utility profits from the amount of power sold. The Commonwealth has also created a ratepayer-funded energy efficiency public benefit fund and implemented a requirement for utilities to pursue cost-effective efficiency as their first fuel. In addition, Massachusetts has launched the Green

Communities Program, which incentivizes cities and towns to implement sustainability measures and also requires utilities to develop medium-term plans for energy efficiency spending. With these mandates, utilities have collaborated to provide the MassSAVE program, through which homeowners have easy access to free home energy assessments, technical assistance, and steep rebates for lighting, HVAC, air sealing, and insulation improvements (DSIRE 2011).

Massachusetts conducted research into building labeling in 2008, as part of its Zero Net Energy Buildings Task Force research, and determined that building labeling would be a highly beneficial program to pursue (Massachusetts DOER 2010). The state had also worked with the National Governors Association's Center for Best Practices to identify barriers to commercial labeling in the U.S. In 2010, Massachusetts received a $2.6 million grant from the U.S. Department on Energy to implement 'next-generation energy efficiency' retrofits (Commonwealth of Massachusetts 2010). Building on this foundation, Massachusetts is now pursuing two pilots in building rating: one is a pilot of energy ratings of office and multifamily rental buildings, a plan for which is laid out in the whitepaper "An MPG Rating for Commercial Buildings" (Massachusetts DOER 2010). The second is a residential retrofit and rating pilot supported by the 2010 Department of Energy grant.

This residential pilot program is being led by the Massachusetts Department of Energy Resources (DOER), supported by the utilities National Grid, Western Mass Electric, and Bay State Gas. The program centers on conducting deep retrofits of homes in the Greater Springfield area. The retrofitted homes will also receive home energy ratings and thermal imaging analysis (Commonwealth of Massachusetts 2010, 2011), and homeowners will have access to one-stop energy efficiency services.

## Approach

The Massachusetts pilot is focused around the energy efficiency retrofits of 2,725 homes in Springfield, Longmeadow, East Longmeadow, Hampden, Wilbraham, Palmer, and Belchertown. These retrofits are conducted within the scope of the MassSAVE program, and hence are similar to retrofits available to other homes in Massachusetts (Sherman 2012). They are expected to achieve energy savings of 20% or more in each home, reaching to 40% in some cases (Commonwealth of Massachusetts 2011).

Most relevantly, the 2,725 homes that participate in the retrofits will each receive a building energy rating. These ratings will be conducted after the retrofit is done, according to Alex Sherman, a Clean Energy Fellow at Massachusetts DOER (Sherman 2012). The home ratings, titled Energy Performance Scores, are advertised by the state as "similar to the MPG ratings for cars and trucks" that homeowners can share at time of sale (Commonwealth of Massachusetts 2011, Massachusetts EEA 2012). A draft version of the rating proposes to include the projected energy use of the home over the year, with this use being interpreted into a numerical score as well. The projected energy consumption will also be interpreted into an annual home carbon footprint. The ratings will be comparable between homes (Massachusetts EEA 2012), with the main objective being to help prospective homeowners and residents value energy efficiency in their decision-making (Sherman 2012).

As an additional component of the program, exterior thermal imaging is being used as a complement to the Energy Performance Scores (Commonwealth of Massachusetts 2011). Specifically, DOER utilized $325,000 of the federal grant to conduct thermal imaging of homes and subsequent image analysis, contracting Sagewell, Inc. for this work. Starting in March 2011, Sagewell collected images in the seven towns using vehicle-mounted thermal imaging equipment; imaging was completed over one-and-a-half months. The equipped vehicle was driven down streets between 8 PM and 6 AM, as this time of night is best for identifying temperature differences in the house envelope. The resulting thermal image analysis can be used to help determine where insulation and additional air sealing can be most effective.

Participating homeowners will be able to access an online one-stop shop for energy efficiency services, including information on contractors, available incentives, and rebates (Commonwealth of Massachusetts 2011). This website will also help homeowners understand the ratings they have received (Sherman 2012). Furthermore, the website will also provide analysis tools to help homeowners track their energy use and offer rewards for energy use reductions (Massachusetts EEA 2012).

The planning and implementation of the pilot has been conducted with extensive outreach to homeowners, contractors, and local officials (Massachusetts EEA 2012).

### Outcomes

The retrofits and ratings in Massachusetts' Greater Springfield pilot are being kicked off in the spring of 2012 (Sherman 2012). As a result, there is no hard data on retrofit needs, home energy performance, or market response just yet.

In general, many people have appreciated getting a free rating of their home's energy performance (Sherman 2012), and city officials have been largely welcoming and supportive of the pilot as well. Pushback from the real estate community was more also "muted" than it has been on the commercial rating pilots. Of course, there has been some concern from a few stakeholders. In regards to building rating and thermal imaging, Sherman notes that there was some "concern about the lack of or loss of privacy," although this was largely attributable to a small number of vocal citizens (Sherman 2012).

In these pilots, success for the Commonwealth is defined in large part by the reactions of key stakeholders to the rating process, i.e. the homeowners, city officials, and tenants. If the stakeholders can agree that the ratings are fair, Sherman notes, that would address one of the biggest hurdles to residential building rating (Sherman 2012).

In coming year, DOER will continue to work on the pilots: the commercial labeling pilot is expected to run through 2013, while the residential rating pilot will run through 2014 (Sherman 2012). The results of the pilot will help guide future direction, which could involve retooling the approach or scaling up. Massachusetts will be also be coordinating closely with federal programming on residential energy performance rating (Sherman 2012).

### Takeaways

As Massachusetts' residential energy rating program is a pilot and is very much in its early phases, the major lessons are expected in the coming months and years. Nonetheless, the development of the pilot programs has provided insight into building rating strategies, and these insights can be important ideas for other jurisdictions.

First, it is potentially valuable to combine asset and operational ratings instead of simply relying on one or the other. Asset ratings should not be treated as a "standalone," Sherman notes, but nor will operational ratings "capture the full efficiency potential of a building." Sherman opines that the two should always be paired; they serve as complementary measures of a building's performance (Sherman 2012). Massachusetts DOER (2010) also examines the two types of ratings (asset vs. operational) extensively, concluding that both should be part of a building label.

Second, thermal imaging can be a valuable tool to residential energy efficiency, but it is not yet a definitive way of determining upgrade needs. In the Greater Springfield pilot, the thermal imaging is intended to "get a visual [of] what we might be able to do," according to Sherman. It can help push homeowners towards a retrofit, but it is not intended to be the sole foundation for identifying retrofit needs. In the long term, the hope is that the use of thermal imaging can eventually bring down the costs of home energy audits (Sherman 2012).

Third, connecting homeowners to rebates, efficiency incentives, and similar programs can help spur owners into using their energy audit and implement retrofit recommendations. In the Massachusetts pilot, homeowners are plugged into the MassSAVE program as a result of the retrofit process, and also have access to a one-stop shop for efficiency services online. This has the potential to spur more homeowners into implementing additional efficiency measures.

Fourth, the disclosure of residential energy rating will likely need to take privacy concerns into account. Asked about the potential for disclosure of residential building ratings in Massachusetts, Sherman said, "I don't think [residential ratings] will be as public-facing as the commercial side of things... Residential is a bit more difficult; not something you'd see on the side of a house, [although] multifamily might fall into the commercial side of things" (Sherman 2012). As a result, residential disclosure may need to be more private than, for example, the fully public disclosure approach used for large buildings in New York.

Fifth, the collection and aggregation of labeling data by the city can be useful for program management, such as targeting rebates and incentives (Sherman 2012). Indeed, the aggregate information could help inform the future of a city's building codes. This collected information could be useful to utilities as well, helping them identify where to focus their efforts (Sherman 2012).

## Assessment

While still in the pilot phase, Massachusetts' approach to residential rating and disclosure combines several strong ideas, addressing the critical issues in a way that can drive residential retrofits.

**Usefulness of building performance information:** The proposed rating system conveys information that's easy to grasp (the projected energy use) and interesting (the carbon footprint). The potential for combining asset and operational ratings sounds promising, as it can draw on the benefits of each.

Thermal imaging is also useful in visually demonstrating building envelope inefficiencies to homeowners, perhaps engaging those who would otherwise be skeptical about home heat loss.

**Comparability:** While the pilot encompasses a finite number of homes, the rating system is designed to facilitate direct comparisons between homes – it uses a numerical energy score, presented visually.

**Usefulness to policymakers:** The Commonwealth anticipates, just as officials in New York and Austin describe, that building rating information will help identify specific retrofit needs in the housing stock. This information could be used in a number of innovative ways beyond this, such as designing future building codes.

**Ability to spur residential upgrades:** Massachusetts has taken the proactive step of connecting owners of rated homes with all the information they need to implement upgrades, such as incentives and efficiency services. This can help building ratings translate into actual retrofits.

**Ease of the rating and disclosure process**: in this pilot phase, Massachusetts has introduced exterior thermal imaging into the home energy assessment, with no additional burden for the homeowner. Adding in new streams of information similarly must avoid creating additional burden for homeowners.

**Privacy of billing information**: At this stage, no information is required to be disclosed to stakeholders. It is likely, however, that information on the energy performance for individual single-family homes cannot simply be available to the public at all times.

**Accuracy:** combining asset and operational ratings can provide a more complete, comprehensive picture of home energy performance, as it shows both the empirical performance of the home and its efficiency potential.

# Seattle's Building Energy Benchmarking and Reporting Program

## Background

Over the past decade, Seattle has taken leadership in reducing greenhouse gas emissions. In 2005, Mayor Greg Nickels established a goal of reducing Seattle's emissions to 7% below 1990 levels by 2012 (City of Seattle 2009). In conjunction, Nickels urged mayors around the country to adopt the same goal for their cities, in what was titled the Mayors' Climate Protection Agreement. By 2005, Seattle had accomplished its target, reducing emissions to 8% below 1990 levels. In cutting its greenhouse gas emissions, Seattle determined that its building stock represented a major potential source of greenhouse gas reductions and energy savings. As a result, in 2008, Nickels announced the City's intention to make Seattle the green building capital of the U.S. This initiative set a goal of increasing the efficiency of existing buildings by 20%.

With this goal in mind, Seattle's Green Building Task Force, Office of Sustainability and Environment, Department of Planning & Development, and Seattle City Light (a publicly owned utility) worked on developing policy options for energy efficiency in new and existing buildings. Their efforts produced 11 potential policies for new buildings and 14 for existing buildings. One of the options for existing buildings was the measurement and disclosure of building energy performance, as a way to "identify opportunities for energy efficiency gains, encourage voluntary upgrades, and create a mechanism for market differentiation" (City of Seattle 2009). The technical analysis of this policy option suggested a phasing-in of disclosure requirements for commercial and multifamily buildings (above 5 units), with a pilot audit program for single-family homes (i.e., up to 4 units).

Separately, in May 2009, Washington State passed SB 5854, enacting statewide building labeling for non-residential buildings over 10,000 square feet (Buildingrating.org 2011). This law requires the use of ENERGY STAR Portfolio Manager and disclosure of the resulting benchmark to all prospective buyers, commercial lessees, and lenders. It is thus important to note that Seattle's proposal would expand on an existing statewide program and reach into the residential sector.

In late 2009, working from the policy options being debated in Seattle, the Seattle City Council took up Bill 116731, an ordinance to require energy performance disclosure in commercial buildings and residential properties of 5 units or more (City of Seattle 2010). On February 4, 2010, the bill was signed into law as Ordinance 123226, creating Seattle's Building Energy Benchmarking and Reporting Program.

### The Approach

Seattle's Building Energy Benchmarking and Reporting Program applies to all buildings that are over 10,000 square feet or contain 5 or more residential units. The rule specifically excludes townhouses (defined as separate-entry buildings comprised of multiple single-family houses) (Seattle DPD 2011). For buildings that are primarily residential, compliance is required by April 1, 2012.

Under the requirements of the program, building owners use Portfolio Manager to benchmark their buildings, provide the result to the City, and disclose it to relevant stakeholders (Seattle DPD 2011). First, owners create a profile in Portfolio Manager and input information on building. Much of the information is provided in a notification letter sent out by the City as a reminder to complete benchmarking: for example, this letter lists the building's square footage and year of construction. (The City makes a point of noting that not receiving this letter is not an excuse for failing to conduct benchmarking.) The owner also enters information on building use and unit vacancy into Portfolio Manager.

The building owner then enters energy use data for the past year. Seattle and its local utilities have streamlined the upload of this billing data through what is titled Automated Benchmarking (City of Seattle 2012). Under Automated Benchmarking, a building owner selects the relevant utilities within Portfolio Manager. Then, he or she sends these utilities written authorization, using a standard form available online, that allows each utility to upload whole-building consumption data for the past 15 months into Portfolio Manager. The building owner now has their property's energy use data accessible online, and links to it using the meter number provided by the utility. Several utilities set up 'virtual meters' to aggregate whole-building data, when no single meter exists for the whole building. This Automated Benchmarking service is available from all major utilities – gas, electric, and steam. Apart from Automated Benchmarking, a building owner can also enter their data manually if they wish for whatever reason.

With benchmarking complete, the building owner authorizes the City of Seattle to download the benchmark report (Seattle DPD 2011). Each April, the City will collect the reports for all covered buildings; these reports include the building's energy use intensity, carbon footprint, percentile rating (where available), and potential eligibility for ENERGY STAR recognition. The City of Seattle does not publicly post this data, as done in New York. However, the City notes that all information received by the City, under Washington State's Public Records Act, is a public record and hence can be viewed by anyone upon request (Seattle DPD 2011). As such, Seattle's multifamily energy ratings are not actively disclosed to the public, but they cannot be considered strictly confidential.

The final component of Seattle's program is disclosure. Specifically, a building owner must provide an energy disclosure report when requested by any of the following:

- A current tenant;
- A prospective tenant, during lease negotiation,
- A prospective buyer, during purchase and sale negotiation; or
- A lender, when considering an application for financing or refinancing (City of Seattle 2011).

The disclosure report can be generated through ENERGY STAR Portfolio Manager, which creates a one-page summary of building energy performance. The owner has seven days to respond any such request, and the report must be provided prior to the signing of the contract in question (Seattle DPD 2011).

Additionally, the City of Seattle makes available numerous brochures on the process and how-to guides online, supplemented with a series of public workshops (City of Seattle 2011). The City has also set up a technical support hotline and email address to provide assistance, and has been offering drop-in support services.

Seattle's ordinance provides for enforcement by the use of penalties (City of Seattle 2011). Failing to provide a report to the City, or providing an inaccurate report, is assessed a $150 citation, after which the building owner has 15 days to come to compliance. If he or she fails to do so, there is a $150/day penalty for the first 10 days, and then a $500/day penalty for continued non-compliance. Failure to disclose the energy performance report upon request by a stakeholder also receives a $150 fine the first time, followed by $500 fines for each violation thereafter.

### Outcomes

First, the City pushed back the compliance date from April 1, 2012, to October 1, 2012. As a result, Seattle's residential energy benchmarking and disclosure is still getting off the ground – seeing the effects and market impact of the ordinance is still down the road.

As of March 2012, the City has observed a 30% compliance rate, across all commercial and multifamily buildings (Antonoff 2012). City officials note that more should be done on outreach. Additionally, fines have not yet been issued to spur compliance, so it remains to be decided when to start penalizing non-compliant building owners (Antonoff 2012).

There have been multiple obstacles in implementing Seattle's benchmarking and disclosure program. In order to launch the benchmarking program, the Seattle Department of Planning and Development first had to assemble a building database, an effort that was expected to take five months (Antonoff 2010).

Other challenges included developing reporting rules for mixed-use buildings, with the goal of being able to calculate energy use intensities for each use within the building (i.e., for the hotel section of a building vs. the apartments in the building), in addition to calculating the energy use intensity of the building as a whole (Antonoff 2010). Also, the City's rulemaking had to define buildings in a way that aligned with utility meters or groups of meters, and in a way that excluded extraneous loads.

Furthermore, the validation of owner-provided data was seen as a potential concern. Additionally, city officials noted that privacy concerns could be a challenge, requiring the aggregation of data in order to 'mask' individual energy bills (Antonoff 2010).

In regards to economic impact, the retrofits spurred by this program are expected to create 150 jobs (City of Seattle 2011).

### Takeaways

First, the automatic upload of utility data can streamline the benchmarking process significantly. The City of Seattle has worked with its utilities such that building owners only need to submit a request form to have all of their energy data for the past 15 months loaded and ready for benchmarking analysis. The use of virtual meters has also allowed this automatic upload to work in a user-friendly way, enabling building owners and utilities to compile whole-building data as if it were a normal metered account.

Second, a city can take steps to reduce the information burden for building owners. Seattle has streamlined the benchmarking process by providing reminder letters with key building information, such as square footage and year of construction, taken from the property database. While most building owners have this basic information, the City compiles all of it into one convenient letter for building owners to use.

Third, requiring disclosure of benchmark report during negotiation of a lease, a sale, or financing can help shape decision-making, while aggregation of reports by municipal government can guide policymaking. The City characterizes the purpose of its benchmarking and disclosure ordinance as creating an informed market and guiding purchase and lease decisions (City of Seattle 2011). Aggregation of the reports by the City can help track Seattle's progress on energy efficiency, guide future policymaking, and help target incentives. Indeed, Jayson Antonoff of Seattle's Department of Planning and Development (2012) notes the City can use the information "to shape our incentive policies [and] know which sector of the market is underperforming."

Fourth, the use of a single rating, as opposed to a whole audit report, can potentially spur conversations about the underlying building performance, according to Antonoff. Building owners in Seattle initially expressed concern as to whether the Portfolio Manager benchmark was an appropriate, comprehensive measure of energy performance – that "distilling everything down to one number" wouldn't capture variation in building energy efficiency (Antonoff 2012). Instead, they would have preferred to 'explain' their building's performance. However, Antonoff says the City hopes that such a dialogue between building owner and prospective tenant, for example, will happen as a result of disclosing the benchmark rating – i.e., sharing the energy performance rating would spur a discussion of the underlying efficiency characteristics and needs.

Fifth, the requirement to rate building energy performance and disclose it can spur information sharing among building owners. Antonoff (2012) notes that building owners representing 25% of downtown Seattle's floor space have formed an association that shares energy efficiency ideas, directly spurred by the benchmarking and disclosure process.

Finally, the required disclosure to existing tenants and prospective tenants may make it unnecessary to have a public disclosure or listing of building benchmarks. Antonoff (2012) observes that, if a building owner loses an existing tenant or a potential tenant over poor energy performance, it creates an incentive for the owner to perform energy upgrades. This incentive mechanism relies only on disclosure to stakeholders.

### Assessment

Seattle's approach has made the rating and disclosure process both easy and informative, but it falls short of encompassing the whole housing market or providing any asset rating component.

**Usefulness of building performance information to decision-making:** Seattle's required disclosure of the building benchmark during lease, sale, and financing negotiation is notable in that it enables more informed decision-making for apartment hunters and prospective homeowners, as opposed to just homebuyers (as in Austin). At the same time, the use of an operational rating only means that there is no information on the potential efficiency of the building.

**Comparability across whole residential market**: The use of Portfolio Manager means that ratings are easily comparable. Unfortunately, Seattle's ordinance only extends to buildings with 5 units or more, excluding a vast section of the housing market and limiting the scope of its potential usefulness for house hunters.

**Usefulness to policymakers**: As with other cities, Seattle is aggregating and analyzing benchmarking reports as a way of understanding what incentives could be provided to specific residential sectors.

**Fostering residential upgrades:** Seattle has not taken any significant steps to linking the benchmarking process with actual home upgrades, apart from providing links on the benchmarking website to utility programs. Nor does the rating process provide any sort of recommendations for home upgrades (being an operational rating), so the element of actively fostering retrofits remains missing.

**Ease of the rating and disclosure process:** Seattle has done the best at easing the rating process, among the cases studied in this chapter. The city uses its data sources to provide key building characteristics to building owners. The utility service of automatically aggregating and uploading energy consumption data seems to make the process very easy and painless for the building owner.

**Privacy of billing information:** The use of aggregation protects individual ratepayers' privacy, and the process obviates the need for building owners to request data from any resident – crucial for both ease of process and resident trust in the benchmarking program.

**Accuracy and reliability:** The use of historical billing data alone means that the rating reflects how past residents used energy, not the potential energy use intensity for future residents. Nonetheless, the use of standardized data upload means that the rating is consistently based on actual consumption, not estimates based off a small percentage of units, as allowed in New York.

## Building Energy Labels in the European Union

In 2002, the European Union passed the European Energy Performance of Buildings Directive (2002/91/EC), ushering in a requirement for all member states to implement building energy ratings and disclosure. As of 2009, all buildings in the E.U. must have an Energy Performance Certificate (EPC) at the time of construction, sale, or lease (BPIE 2010). This extends to all buildings of all types: single-family homes, apartment buildings, commercial buildings, and institutional buildings all must have an EPC for transactions. Beyond this, the E.U. gives its member states a great deal of flexibility in how building labeling is structured, including rating methods, assessor accreditation, type of label, content of label, and costs.

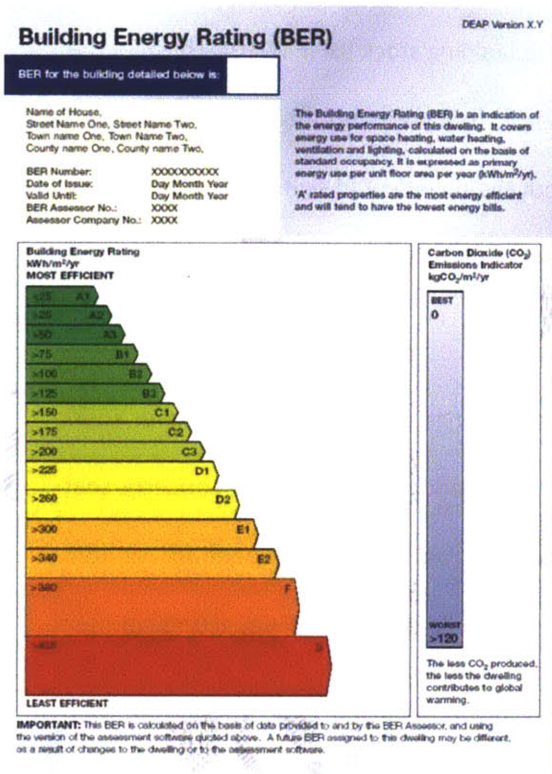



**Figure 2: Ireland's building energy label (Source: BuildingRating.org 2011)**

Ireland is a member state whose EPC program is generally recognized as a successful example (ECEEE 2009). Its rating system uses an easy-to-understand rating scale of A through G, with a clear visual display of the grade (see Figure 2). A recommendation report of appropriate building upgrades accompanies each rating.

Homeowners can find an assessor by searching a national website listing certified assessors (ECEEE 2009). The assessor then conducts an audit and enters data into the Dwelling Energy Assessment Procedure tool, from where it can be directly submitted to a national database. The homeowner receives a unique identification number for the home's certificate, which they can use to access and view it online.

A sample of a few hundred labels is automatically validated each week for quality control (ECEEE 2009). Furthermore, assessors themselves are audited regularly to ensure process quality. By October 2009, over 75,000 home energy ratings had been conducted, with 300 new ones issued every day; Irish officials report a high rate of compliance. Newly built housing typically earns a rating of 'B', while existing housing typically gets 'Ds.'

Several trends characterize building labeling in the E.U. as a whole. First, building energy rating is largely dependent on home assessment alone; operational data does not play a role. Second, most member states do not collect the ratings into a central database; as a result, local and national officials are not able to use rating data to understand the state of the building stock (BPIE 2010). Third, in the past, 'semi-mandatory' approaches to disclosure also presented a concern: until 2008, the Netherlands had residential energy label requirements at time of sale, but the buyer could sign off to waive the seller's obligation to provide one. Under this setup, only 7% of houses sold had an energy rating done (Brounen and Kok 2010).

Additionally, costs for rating single-family homes in the E.U. range from under €100 to over €500. Apartment ratings cost from under €100 per unit to €400 (Maldonado et al. 2010). The concerns that have been raised include: the need for a common methodology across the E.U., the need for random audits to ensure quality, and the challenge of ratings apartment buildings and individual units in them.

Although implementation has taken place within just the past three years, early indications are that building energy ratings are spurring some markets to value energy efficiency. In the Netherlands, Kok and Jennen (2011) find that office space with a green rating is correlated to have higher rent per square meter, at a statistically significant level. In the Netherlands' housing market, Brounen and Kok (2010) found higher valuations for that homes had an A, B, or C energy rating, versus homes that were otherwise identical but rated at a D or lower.

## Voluntary Building Energy Rating Programs

Several proposals for voluntary home energy ratings have been put forward in the U.S. The Home Energy Rating System Index (HERS) is perhaps the most well-known, with the U.S. Department of Energy ramping up pilots of a separate Home Energy Score (HES).

## The Home Energy Rating System (HERS) Index

The HERS Index was developed by the Residential Energy Services Network, a network founded by the National Association of State Energy Officials and Energy Rated Homes of America (RESNET 2012). The HERS program uses on-site home assessments to determine energy retrofit needs, including a blower-door test, air duct tests, insulation inspection, wall-to-window ration calculation, determination of solar orientation, and HVAC efficiency tests. The data is then entered into an analytical software tool that projects home energy use.

The Index itself is a scale of 0 to 150, with higher numbers indicating more energy use. As the defining reference point, a home built to 2004 International Energy Conservation Code will score a 100 (RESNET 2012). Every point below 100 indicates that the home being examined is 1% more efficient than the reference home. At a score of zero, the home in question is a net zero energy building, i.e. 100% more efficient than the reference home.

For new homes, limited information from the building's plans can be used to develop a pre-construction HERS Index, from which builders or architects can work to improve the planned energy efficiency (RESNET 2012). As such, it can be used for new/unbuilt homes as well as existing ones.

HERS can be used for all single-family homes and multifamily buildings under three stories. The resulting certificate lists the home's energy attributes, provides the actual rating, and estimates the annual energy costs (CEC 2011).

The U.S. Department of Energy is currently conducting a nationwide contest for homebuilders, inviting them to rate their new homes with HERS ratings and display this rating to new residents (DOE 2012a).

### DOE's Home Energy Score

The U.S. Department of Energy (DOE) has also proposed a rating system titled the Home Energy Score (HES). The score is a rating on a scale of 1 to 10, where 10 is a home that is highly efficient (DOE 2012b). The scoring is based on a walkthrough that involves collecting 40 specific data points, including foundation type, wall and window characteristics, roof condition, attic condition, air sealing, and heating and hot water system efficiency. The assessor also uses the walkthrough to determine opportunities for energy-saving upgrades. As an asset rating, HES assumes 'standard operation' of the home, modeling its use by a family of three with specific thermostat set points over the course of the year. Crucially, the modeled energy use translates to different scores for different climactic regions of the country: for example, a home in New England needs to use no more than 204 million BTU/year to score an 8, but a home in California must use 126 million BTU/year or less to earn the same score. The complete scorecard indicates the home's current rating, what its rating would be after improvements, and the estimated financial savings over 10 years that would result.

In November 2010, DOE launched pilots of HES use around the country. In the first year, pilots were conducted in 9 different metropolitan regions of the country, scoring anywhere from 15 to 160 homes in each location (DOE 2012b). These pilots sought to determine homeowner response, assessor training, and calibration of the tool.

In the 2012-2013 cycle, the ratings pilots are being scaled up. At over 15 locations around the country, different organizations are testing out HES, with a minimum of 200 homes per organization (DOE 2012b). Each organization is re-scoring 5% of their homes to test for quality assurance.

## Developments in the Private Sector on Residential Rating and Disclosure

The private sector of energy efficiency has been developing new solutions for rating the energy performance of buildings, as well as new ways of interfacing with information on building energy use.

The new ideas populating this field have the potential to make building energy rating an easier, less expensive, and/or more accurate process. In conjunction, new products that provide information-enabled efficiency could contribute to the building rating process and use ratings to guide consumers.

First, perhaps the company most involved with home energy assessments is Conservation Services Group (CSG), an energy efficiency services company with offices around the U.S. It primarily works with utilities and organizations to provide home energy assessments and has served over 2 million homes as of 2011 (CSG 2011a). CSG has worked primarily to design large-scale assessment and efficiency implementation programs, as well as establishing contractor networks to serve retrofit demand.

CSG has also developed the EnergyMeasure software portfolio, a set of tools for whole-home energy assessment (CSG 2011b). Homeowners can use the EnergyMeasure View tool to get a preliminary audit online, requiring about ten minutes and basic home information. EnergyMeasure Home is for energy audit professionals, providing a software platform to compile home asset characteristics and measurements, and then enter in recommendations.

Other companies are working to develop software platforms that can calculate and/or share building energy performance in new ways. Wegowise, based in Boston, is working to develop a tool that enables owners to aggregate raw billing data, from which the tool calculates a building benchmark (Wegowise 2012). Building owners can then interpret the benchmarks, understand their carbon footprint, and compare their performance to that of similar buildings. The performance can be shared with whomever the building owner wishes – "anyone else who has a WegoWise account" (Wegowise 2012). The company is also developing a Wegoscore – " a quick and easy way to understand a building's total energy use in one number."

Several companies are working to develop advanced data engines for building energy assessments. Retroficiency, a Boston-based firm, is working to provide energy assessment tools, currently for commercial buildings, as it identifies site-based assessments to be slow, expensive, and inconsistent (Retroficiency 2012). The company has developed the Building Efficiency Intelligence platform, which analyzes advanced metering data (specifically, metering data measured throughout the day) to identify retrofit options for a commercial building "without ever visiting," using data analytics instead. In a similar vein, FirstFuel of Lexington, MA has developed a Rapid Building Assessment Platform for use by utilities or commercial building owners that can provide "deep building insights with zero touch" (FirstFuel 2012). The software platform uses two pieces of information – one year's worth of hour-interval energy use and the building address – and then analyzes energy use against weather history, solar orientation, daily space use, and occupancy information (FirstFuel 2012, Fitzgerald 2012). FirstFuel's analytics are able to estimate the disaggregation of energy use into nine end uses, such as lighting, plug load, and electric heating, and then estimate the efficiency level of each system.

Both Retroficiency and FirstFuel are able to provide tailored retrofit recommendations from their analytics, while aggregating energy billing data in the process. FirstFuel's user interface estimates the cost savings and carbon savings associated with each improvement as well. For example, the Town of Lexington used FirstFuel's "no-touch" audit and will be implementing its recommendations, expected to save $90,000 per year (Fitzgerald 2012). While FirstFuel can use analytics to provide insights into building performance, it is important to note that a building professional is needed to interpret results into retrofit recommendations. Indeed, analytics like FirstFuel's platform are not expected to replace on-site audits entirely (Fitzgerald 2012) but rather provide an overview of major efficiency needs.

Cambridge-based ēssess is working to provide a different alternative to on-site assessments. Focusing on the residential sector, the company has observed that on-site energy assessments are "expensive, time-consuming, and incredibly inconvenient," and that they fail to estimate the cost of a home's inefficiency (ēssess 2012). To that end, ēssess analyzes energy inefficiencies using highresolution thermal infrared scanning from the exterior of the house, coupled with other basic building data. The company interprets the infrared imagery to determine R-values and energy loss, analyzing it to determine the 'money being lost' in each drafty door or window. For example, a home with eight windows and one door facing the street receives a picture identifying the energy loss rate and cost at each of these nine points. Using this analysis, ēssess produces a list of recommendations, provides the homeowner with an easy-to-understand energy efficiency report, and connects the owner to a one-click service platform for finding contractors.

Firms like Retroficiency, ēssess, FirstFuel, and CSG have the potential to make the rating process more streamlined and less expensive, and perhaps even more accurate. Some of the analytics in use are limited to commercial buildings, but their ability to provide no-touch audits and recommendations offers hope that residential audits could be similarly streamlined and made less expensive. Building professionals would be able to play more of an analytical role in determining retrofit recommendations, instead of having to collect data and process it.

Other companies are engaged in using energy consumption information to spur energy-saving behavior, and the use of building labeling data has the potential to connect in with these engagement platforms. OPower, based in Arlington, VA, has focused heavily on using behavioral science, sending consumers the types of messages, comparisons, social normative messaging that would get them most motivated to save energy (Laskey and Kavazovic 2010). OPower analyzes hourly energy use (where advanced metering is available) to disaggregate energy consumption into heating and cooling use, then provides targeted efficiency recommendations and compares each home to a set of 'similar neighbors.'

Similarly, Efficiency 2.0 is a three-year old company that seeks to implement energy efficiency through extensive consumer engagement (Efficiency 2.0 2012). Working with utilities, it provides ratepayers with tailored recommendations for energy efficiency by analyzing each home's basic characteristics, zip code, and area weather patterns against millions of data points. This analysis helps to identify conservation recommendations that would be most suited or well-received by the homeowner. Efficiency 2.0 then helps customers set goals and track their progress, and allows users to create a community team to collectively save energy (and earn rewards as a community). In a similar vein, the companies Simple Energy and MyEnergy each seek to motivate consumers through friendly competition with their friends on saving energy (MyEnergy 2012).

These companies, working to stimulate energy-conserving behavior through the targeted use of information, could utilize building energy labels in a number of ways. First, an asset rating indicates the potential energy performance of a home and hence could be used to set voluntary goals for residents. For example, residents could receive messaging that says that their home is rated at a B grade, but their energy consumption has been closer to what would be expected in a D-graded house. Second, home building energy ratings, asset or operational, could help inform behavioral recommendations for saving energy. For example, if an on-site assessment indicates that a home's greatest inefficiency is its heating system, targeted messaging could encourage the homeowner to lower the thermostat at night. Third, labeling programs could draw on the information collected and analyzed by these companies: the rating process could utilize the data aggregated and analyzed by these companies in order to streamline building rating.

Finally, building rating and disclosure represents a way for building owners to share a concise report about energy performance if they wish or are required to do so. Today, utilities have already started to promote the concept of portability of one's own energy use information – in other words, the ability to compile, use, and voluntarily share your energy billing data. In January 2012, in partnership with the White House, six utilities announced the launch of a Green Button program (Fehrenbacher 2012). Under Green Button, utility customers can download their billing data, either in an easy-to-read format or directly into third-party home energy websites. The key components of this initiative are the standardization in billing data format and the access to it through a secure portal for ratepayers. Standardization, in particular, can enable software providers to more readily develop universally accessible apps for energy efficiency services (Fehrenbacher 2012).

# IV. Analysis of the Case Studies

The case studies examined in Chapter III show the heterogeneity of approaches in use today, as well as some of the challenges of current approaches and the innovative methods cities are using. This chapter first assesses the shortcomings of current approaches and, second, identifies rating and disclosure methods that cities are using to expand the benefits for delivering residential energy efficiency. Table 2 provides a basic overview of the cases examined.

**Table 2: A summary of the case studies**

| Case | Launch Year | Rating Type | Approach to Disclosure |
|---|---|---|---|
| **New York** | 2011, disclosure starts in 2013 | Operational, using Portfolio Manager | Shared with City, which posts publicly on website |
| **Austin** | 2009, revised 2011 | On-site audit, with no numerical score | Single-family homes: shared with buyers during option period.<br><br>Multifamily homes: shared with prospective and current residents |
| **Massachusetts pilot** | Runs 2011-2014 | On-site audit with modeled energy use | No disclosure requirement in pilot phase |
| **Seattle** | 2012 | Operational, using Portfolio Manager | Shared with prospective buyers and renters, current tenants, and lenders |

The discussion of approaches and outcomes in each of the case studies help to illustrate that there are shortcomings in the emerging approaches to residential labeling. Specifically, there are shortcomings in both the types of ratings being used and in the approaches to disclosure.

## Issues with Current Types of Rating

Residential labeling in the U.S. uses either utility billing data (plugging it into Portfolio Manager) or an on-site home energy audit. These current forms of rating fail to capture the benefits that could potentially result from a combined rating, in which asset and operational information would complement each other.

First, operational ratings alone (as in New York and Seattle) fail to provide information on the potential for efficiency in the home, as discussed in the Massachusetts case study. After all, an operational rating is based solely on the energy use of previous residents. This can potentially undermine the trust in the rating as well: prospective tenants and buyers may view the label as a reflection of the usage patterns of the previous resident(s) and not as much about the home itself.

Second, using operational ratings alone, as in Seattle and New York, fails to provide targeted recommendations for actual home retrofits. Achieving home upgrades is a desired outcome for all of these cities, and using Portfolio Manager alone to provide a benchmark doesn't provide building owners the recommendations they need on what to do next. As Desiderio says, under current operational-data labeling, you're "simply getting aggregated data." To drive retrofit, he feels, "what you're really going to need is an [on-site] audit." Of course, entrepreneurial companies may be making progress towards using billing data to estimate some retrofit needs without an on-site assessment, as is currently available for commercial buildings with advanced metering. However, as currently implemented in New York and Seattle, the operational rating – conveying only historical energy use intensity – does not result in any recommendations to the owner on retrofit strategies.

Third, operational ratings by themselves are also failing to provide policymakers with an understanding of retrofit needs. In Austin, policymakers have a fine-grained understanding of what the typical home retrofit needs are. In contrast, Seattle's use of operational ratings alone does not provide this type of detailed insight, only showing the energy use intensities of different types of houses.

Fourth, using only operational ratings prevents the rating of very new buildings, as at least one year of operational data is required, as discussed in IEA (2010) and BMVBS (2010). In New York and Seattle, for example, new buildings must necessarily have a year of operation complete before being able to complete benchmarking, and, as a result, the building's owner and prospective buyers and tenants cannot compare the energy performance of the new building to others prior to this.

Fifth, the use of asset ratings alone does not help homeowners track progress on cutting energy use. New York and Seattle's approaches – providing benchmarking by definition – allow building owners to understand their baseline energy use and track reductions against it. In Austin, however, the labeling process does not help or encourage homeowners to track their energy use from year to year.

Sixth, conducting on-site energy assessment without any sort of rating component (as in Austin) fails to provide easy comparability between homes. On the other hand, the energy use intensity of homes in Seattle and New York can be directly compared, given that there is a numerical rating for each building.

Seventh, some forms of operational rating have not been designed in a way that avoids process burdens for building owners. In New York, the inability to directly link in utility data creates more work for building owners; in contrast, Seattle's process, with direct data upload and city-provided building information, is streamlined to the point that it creates relatively little work for the owner.

Eighth, rating processes must not neglect the potential of thermal imaging. While the technology is still in the early stages of testing and development, it has the potential to provide a visual of retrofit needs, as seen in Massachusetts.

Finally, implementing labeling for only part of the housing market, as in New York and Seattle, limits its impact. Granted, New York officials are intentionally targeting only the city's largest buildings in the Greener Greater Buildings Plan; nonetheless, in both New York and Seattle, home buyers and prospective tenants are able to understand building energy performance for only parts of the residential market. Labeling requirements for the whole residential market mean that prospective homeowners can view the building energy performance of any home. (Austin comes close, by providing transparency for the multifamily rental market and, separately, for the purchase of single-family homes.)

## Issues with Current Approaches to Disclosure

The approaches to disclosure described in the case studies vary significantly, with several shortcomings among them. Seattle's approach to disclosure is the best approach among the four case studies for delivering more complete information on energy performance to market stakeholders.

First, fully public disclosure may not be appropriate for all residential sectors. New York's fully public disclosure means that anyone who wishes to know the energy performance of a covered building can do so. This is, in effect, fully public transparency. However, it is unlikely that this approach can be extended to single-family homes or small multi-unit buildings, as discussed in the Massachusetts case study, as this would violate reasonable expectations of privacy.

Second, requirements to disclose building performance only when the transaction is nearly complete are ineffective. In Austin, the City saw the initial requirement to share the energy audit at time of closing as insufficient and improved ECAD to require disclosure during the option period.

Third, requiring disclosure to buyers only (as for Austin's single-family homes) neglects the rental market. Tenants of single-family homes in Austin (which can include buildings up to 4 units) are not granted access to any sort of energy performance information, while prospective buyers are. This is a significant shortcoming given that tenants are often responsible for utilities, and it is especially crucial in light of the landlord-tenant split incentive that poses a barrier to the upgrade of rental properties. This is better addressed in Austin's disclosure requirements for multifamily buildings, which require providing a copy of the audit to current and prospective tenants.

As a result, Seattle's disclosure policy emerges as the best among the case studies for catalyzing energy efficiency, by providing disclosure to all prospective tenants, prospective buyers, and lenders during negotiation, in addition to current tenants. This approach to disclosure provides more complete information on energy performance to all market stakeholders.

Nonetheless, all four case studies fall short of requiring disclosure when prospective tenants and buyers could actually use it to compare homes. As discussed in the Austin case, requiring disclosure during sale negotiations makes it unlikely that house hunters can compare the energy performance of multiple homes of interest (and the same is true for Seattle). For disclosure to enable the valuation of an energy efficient home over an inefficient one, it needs to be part of the home viewing and visiting process, enabling prospective renters and buyers to value efficiency when deciding on a home.

Finally, all of the cases studied here fall short of making building energy labels highly visible for prospective tenants and homebuyers. Under the current approaches to disclosure, the house hunter must request the label and wait for the seller or landlord to provide it; in the case on New York, the house hunter would need to go online to look up the property. Alternatively, requiring that the energy score or rating be provided on all home listing materials would make the rating highly visible and would be much more readily available for use in decision-making.

## Summary of Methods

The case studies discussed in Chapter III help identify the benefits of specific methods, in addition to illustrating the shortcomings. There are methods in each of the cities which have potentially enabled the labeling policy to better catalyze residential energy efficiency. These methods are summarized below in Table 3 and Table 4.

**Table 3: Summary of rating methods identified in the case studies.**

| Rating Methods | | | | | |
|---|---|---|---|---|---|
| **Method** | **N.Y.** | **Austin** | **MA pilot** | **Seattle** | **Benefits** |
| Use of operational data | • | | • | • | - Shows owners the actual energy use in the past year<br>- Enables tracking of energy use |
| Use of asset assessment | • (under separate law) | • | • | | - Provides information on building retrofit options<br>- Provides city a detailed understanding of retrofit needs<br>- Can be used for new homes<br>- Estimates energy use independent of current operation |
| Use of thermal imaging | | | • | | - Spurs homeowner interest<br>- Helps retrofit contractor identify loss of heat |
| Upload of whole-building operational data from utilities | • | | | • | - Reduces burden on owner<br>- Allows for more accurate calculations of energy use intensity and carbon footprint |
| Recommendations accompany rating | | • | • | | - Helps homeowner take action on inefficiency issues |
| Carbon footprint estimate | • | | • | • | - Provides residents information on environmental impact |
| Validity of audit for 10 years | • (under separate law) | • | | | - Avoids unnecessary audits<br>- Avoids use of very old audits which could be less trustworthy |
| Annual updates | • | | | • | - Provides an up-to-date rating<br>- Encourages tracking of building performance |
| Uniformity in rating scale | • | | • | • | - Allows buyers to compare between all homes |
| Exemptions for retrofitted buildings | | • | | | - Encourages home upgrade<br>- Reduces owner burden |

Table 4: Summary of disclosure methods identified in the case studies.

| Disclosure Methods | | | | | |
|---|---|---|---|---|---|
| **Method** | **N.Y.** | **Austin** | **MA pilot** | **Seattle** | **Benefits** |
| Applicable to all residences | | • (all fixed homes) | | | - Creates a complete market for which energy performance is transparent |
| City collects building energy reports | • | • | • | • | - Provides city a robust dataset on energy performance<br>- Allows automated label audit<br>- Allows automated audit of assessor<br>- Can assist in developing future building codes |
| Public disclosure on city website | • | | | | - Rating easy to access<br>- Ratings are visible to all stakeholders |
| Disclosure before time of sale, to potential buyers | | • (single-family) | | • | - Provides information to relevant stakeholders without publicly disclosing home-specific information<br>- Shares information when it can help decision-making |
| Ratings disclosed to current and prospective residents | | • (multi-family) | | • | - Information on energy performance could create interest among current tenants<br>- Provides transparency to help prospective tenants in decision-making |
| Website to connect users with ratings and EE programming | | • | • | | - Encourages engagement in retrofits and can simplify upgrade process |
| Online portal to view certificate | | | • | | - Allows for homeowner engagement and learning |

# V. Defining an Optimal Residential Labeling Approach: The Needs

Based on the examination in Chapter IV of the beneficial methods of existing residential labeling, as well as their shortcomings, this chapter seeks to define what attributes an optimal building labeling policy needs to have in order to optimize the benefits for the delivery of energy efficiency. These key attributes are related to, first, the type of rating and, second, the approach to disclosure.

## Type of Rating

### Combined Asset and Operational Information

A combined rating, listing both an asset rating and operational information to complement each other, can draw on the benefits of both. The resultant rating can provide a more complete, clear picture of home energy performance and serve to better catalyze residential energy efficiency.

Including an asset rating would have the specific benefits of:

- enabling comparisons between buildings irrespective of current tenant behavior;
- identifying the retrofit needs for the building owner;
- providing city, state, and utility program managers a detailed understanding of retrofit needs;
- allowing new buildings to be rated; and
- allowing comparisons of new building performance against city building codes, which are typically defined in the U.S. in terms of home envelope and systems characteristics.

Including operational information would have the benefits of:

- providing a look at actual energy use intensity in the past year;
- allowing a building owner to track energy performance over the years, especially relevant after retrofitting a home;

- being a relatively low-effort process to add valuable information to the rating, especially if whole-building billing data is automatically uploaded.

In addition, thermal imaging has the potential to be a valuable resource in the rating process. Including it would have the benefits of:

- spurring homeowner interest; and
- helping retrofit contractors identify major heat losses.

Thus, a combined rating that lists both an asset rating and operational information, along with thermal imaging when available, would provide a more comprehensive, more useful label.

Indeed, providing both operational and asset information has been identified as the most clear approach for prospective homeowners and renters (NES 2009). Jensen et al. (2007) also identifies the combined rating as the best choice on a spectrum of options for home energy assessment in Denmark: at one end, the lowest quality option is to simply add up meter data; the highest quality option, at the other end, is a computation based on both on-site assessment and meter history.

### Coverage and Comparability Across All Residential Buildings

As seen in the New York and Seattle case studies, leaving out segments of the housing market risks undermining the usefulness of the residential labeling program. After all, buyers and renters may look at residential buildings of all sizes; e.g., an apartment hunter may look at units in duplexes and high-rises. As a result, building ratings must encompass the whole residential market to provide useful transparency to market stakeholders.

Crucially, the residential energy rating needs to be directly analogous and comparable between single-family homes and larger homes, such that it provides a means of decision-making for stakeholders. The Ireland example demonstrates the use of letter-grade rating for all types of homes.

### Trustworthy Rating Methodology

The disclosure of energy ratings can have an impact on residential markets only if the stakeholders trust the information being presented – true for prospective buyers and renters, mortgage writers, cities and states, owners, and current residents. Trust in a labeling system relies on the following criteria:

- **Reproducible and consistent**. A standardized calculation tool must be used by assessors to model energy use, as in the HERS system. After all, a building should receive the same rating regardless of the assessor that conducts the visit, regardless of the time of year. Conversely, a story of a building receiving an 'A' from one assessor and a 'B' from another would be enough news to undermine trust in the system (BPIE 2010).
- **Thorough**. The assessment needs to examine all relevant aspects of the house, as in the HERS energy audit protocol, such that major home systems aren't skipped for the sake of making assessments faster and cheaper. Indeed, reducing the cost of the assessment could go too far, as a cheap rating could be seen as untrustworthy (BPIE 2010).
- **Current**. To earn the trust of prospective buyers and tenants, an energy audit needs to be relatively recent, and not allowed to be valid for decades. Instead, as in the Austin model, the audit should be allowed to be used for 10 years.
- **Regularly audited.** Cities must be able to easily and regularly audit a sample of building labels in order to ensure their accuracy, as currently done by national authorities in Ireland. Indeed, many E.U. countries lack mechanisms to register and audit building ratings, and user uptake of ratings remains a concern as a result (BPIE 2010).
- **Transparent.** In line with the overarching goal of transparency, it is crucial that the process is clear to all stakeholders. Assessment protocols, calculation methodologies, and all default values should be made available online, so that residents can understand what goes into a rating.

A building rating system with these attributes can provide information on home energy performance that market actors will trust. Otherwise, there is a risk that building rating comes to be seen as a useless bureaucracy and unnecessary intrusion of privacy (BPIE 2010).

### Designed to Reduce the Costs of Home Assessment

As seen earlier, asset-based ratings, involving a detailed check of home systems, can cost anywhere from $150 to $600, and, to date, building owners have borne the costs of the rating. Indeed, bringing costs down is identified as a need for future labeling policy in the U.S. (NEEP 2009) and in the E.U. (Maes and Vekemans 2007). Jensen et al. 2007 also notes that asset-based assessments in Denmark would be a higher-cost process than simpler ratings.

### Designed to Connect Homeowners to Retrofit Programs

In the end, the goal of a building rating program is to facilitate energy improvements to homes and apartments. As a result, the rating program needs to provide homeowners with a direct link to retrofit programming for each of the recommended upgrades. For example, the rating system could provide an online portal that provides links to insulation contractors, or the website for rebates on CFLs, whenever those recommendations are part of the assessor's report. The rating tool could perhaps provide a rough estimate of what the resulting label would be (BPIE 2010), by plugging the 'improved asset' description into the calculation methodology. For example, a label could read "if all of the recommended actions are implemented, this house will go from a B to an estimated A minus," as proposed in the HES rating.

## Approach to Disclosure

### Protection of Privacy

As seen in the case studies, the approach to disclosure needs to protect the privacy of residents in regards to their energy use and, similarly, ensure that utilities can continue to protect the confidentiality of their customers (Barr et al. 2010). Thus, labeling needs to avoid any unnecessary disclosure of private information by using whole-building aggregation. In addition, disclosure of building ratings should be limited to stakeholders, as opposed to the approach of fully public disclosure used in New York.

### Transparency to the Right Stakeholders at the Right Time

In order for labels to actually drive market valuation of energy efficiency, the labeling policy needs to provide access to appropriate stakeholders during their decision-making processes. Specifically, ratings need to be accessible to prospective homebuyers and prospective tenants at the same time that they view the property such that it enables the valuation of efficient homes over inefficient ones. Indeed, disclosure at the time of final transaction (i.e., lease signing or closing) has been observed to have little impact on decision-making (BPIE 2010, City of Austin 2011a).

### Visibility of Ratings

In order to spur the housing market into actually valuing energy efficiency, energy performance ratings needs to be highly visible and likely to be read by a potential homebuyer or tenant when considering a home. Simply providing access to an online database of ratings, for example, can result in few people taking the initiative to look up a rating, especially in high-demand 'seller's markets' (Brounen and Kok 2010).

In fact, in Germany, the seller of a building is only required to share the label upon request; perhaps as a result, only 35% of recent homebuyers reported in a survey that they read it (Amecke 2011). Similarly, in England and Wales, a survey of homebuyers in 2008 and 2009 found that only 68% recalled ever seeing the energy performance label (NES 2009) . In general, promoting the certificates is a key priority for improvement of building rating in the E.U. (BPIE 2010).

As a result, building ratings need to ideally be listed on home listing materials or rental ads, as this would allow home buyers and apartment hunters to readily use information on energy performance with no additional research.

# VI. Proposing a New Model for Building Rating and Disclosure

This thesis has examined four case studies and literature on residential building labeling, which together show that residential labeling is an emerging field comprised of a wide variety of approaches. As Chapter V shows, all of these approaches have their own problems, and these shortcomings help to define what the attributes would be of an ideal residential labeling policy.

At the same time, the analysis of these case studies in Chapter IV also provides a look at the innovative ideas being incorporated into residential labeling in order to increase the impact on energy efficiency. Could a new model for residential labeling bring these ideas together to combine their benefits? This chapter proposes a new model for rating and disclosing residential energy performance, drawing on the methods discussed, in a way that can build on their combined strengths.

## Key Elements and Structure

Cities and states that seek to introduce residential rating and disclosure should adopt a model comprised of four key elements.

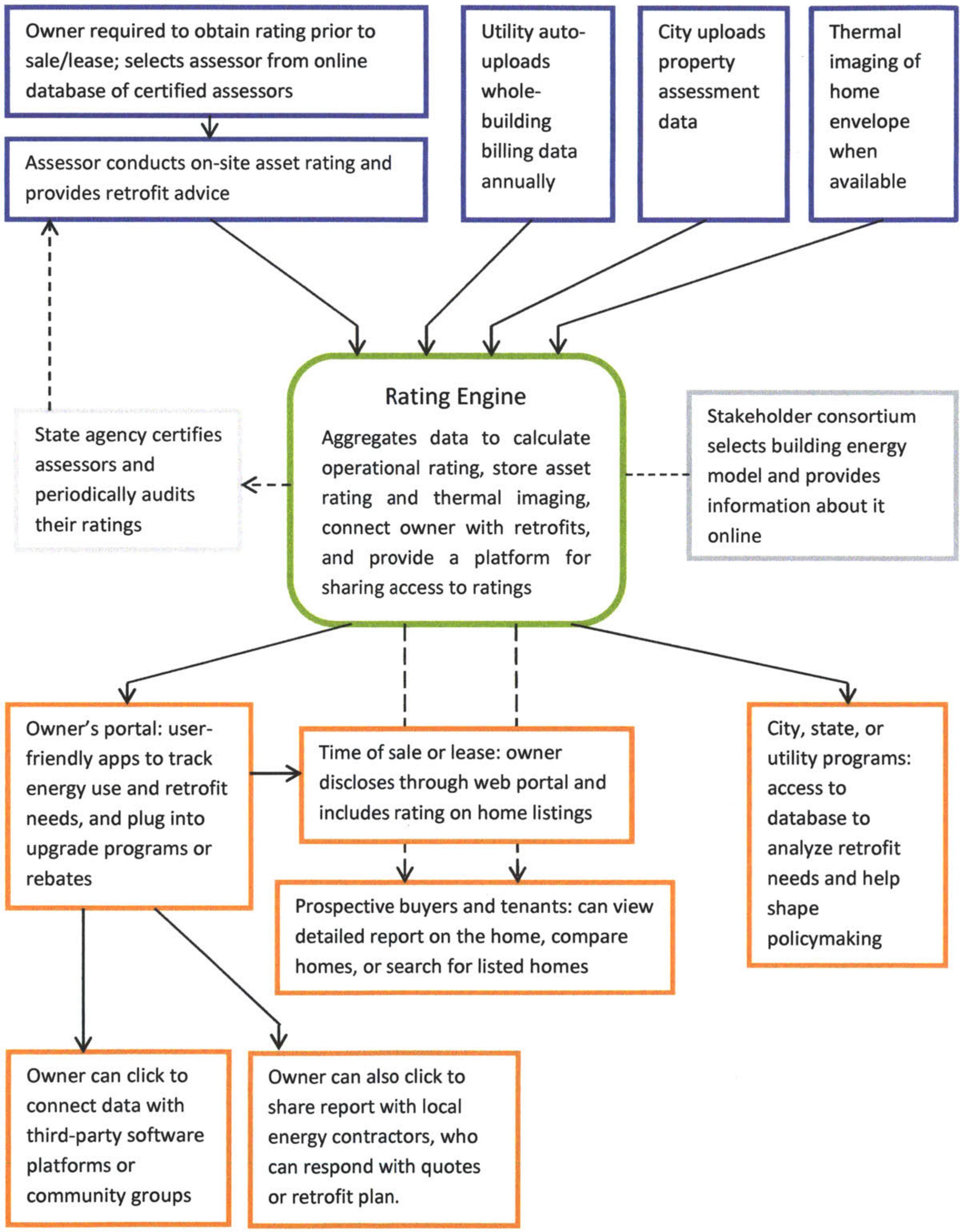
1. **A Web-based engine that brings together energy assessment data, operational information, property data, rating calculation, and information access.** A web-based database and analysis engine would collect home assessment data and auto-uploaded operational data, then calculate and store the ratings. The platform would have an interface to provide owners access to their own building performance. Owners could connect this data with third-party home energy software, or share with third parties of their choice, such as energy contractors.
2. **Required asset ratings enhanced by annual operational updates.** A requirement for homeowners to conduct an asset-based home assessment prior to the first time the unit is available for sale or rental. Home energy assessors would upload the collected data into the online engine. Utility data would be auto-uploaded into the engine to provide complementary

operational ratings annually. Thermal imaging would be uploaded when available. The asset-based rating would be valid for up to ten years.

3. **Confidentiality of ratings, with Web-enabled disclosure to all relevant stakeholders.** Building owners would have continuous access to their home's ratings online. At the time when the unit is listed for sale or lease, owners would be required to disclose a building's ratings (asset and operational) on all listings. Owners would also be required to share access to the complete report collected online. This owner would be able to make this disclosure through their online portal, by making the rating fully public at time of listing. For large multifamily buildings, this would effectively mean the rating is continually public.
4. **Periodic auditing of labels and assessors.** The relevant authority would conduct periodic audits of assessors and labels by using a sample of the aggregated labels. All certified energy assessors would be listed online, giving building owners access to a competitive market of assessor services.

The resulting process is illustrated in Figure 3 below.

Figure 3: A new model for residential rating and disclosure



## A Walkthrough

Following implementation of a residential labeling law, all residential owners would be required to complete a home energy rating before the property was up for sale or lease. As opposed to requiring audits by a specific date, this approach would have the added benefit of spreading out the number of assessments that will need to be performed by a finite number of local energy assessors.

As the first step, the homeowner consults the directory of certified home energy assessors, provided online by the state. The owner picks one to come and do an assessment, perhaps seeking out the lowest-cost provider in a competitive marketplace.

The assessor collects data on the building's envelope, fixed lighting, HVAC, hot water, and orientation. This assessment is dictated by a standardized protocol – it could be the HERS protocol or another similar measurement standard. The assessor also collects data from the owner on occupancy.

The standardized protocol also provides default values for a select few home components based on building typology, instead of requiring on-site measurement. In the E.U., the data acquisition phase of the rating process has introduced errors in the rating of up to ±20% (BPIE 2010). Using a small number of default values can reduce this measurement error, and in turn limit deviation in the final rating to ±5%. Accordingly, the protocol in this model of building rating uses default values for a limited number of house parameters, where actual measurement would be prone to error.

The assessor inputs the data into a central rating engine, operated by a state agency. A standardized calculation procedure is used to model energy consumption and develop an asset rating, either by the centralized engine or through distributed software tools. A consortium of local building technology experts, state agencies, and energy assessors is in charge of choosing the home energy model and ensuring periodically that it is serving local assessment needs. This is the practice used in Denmark, where a consortium also operates the database (Jensen et al. 2007), and it represents a way to involve stakeholders from the very launch of a rating program. The assessor provides the homeowner with their asset rating, including upgrade recommendations. The assessor additionally offers the owner the option to make their rating public – perhaps if the owner wants to showcase their green home or does not want to deal with disclosure later on.

This database also receives auto-uploaded billing data from utilities and building data from the city's property assessment office. This combined data allows the engine to calculate an operational rating each year, one that can be compared to the asset rating in place for single-family homes and small multifamily buildings. For example, a home might have the potential to be a B in energy use, but it could have been operated in the past year at a C+.

The aggregated data of the building ratings now provide a resource for the state, cities, and utilities to analyze and understand specific retrofit needs. In addition, authorities use the ratings to conduct periodic, automated audits of the assessors. Agencies can also use this data to identify homeowners who want to showcase their green homes, to support proactive building owners.

Meanwhile, the building owner is provided access to view his rating online, using a user-friendly portal. This portal helps each owner understand the ratings, describes the home's improvement needs, and compares the building to the local average (see Figure 4). Action steps accompany each retrofit need, providing information, for example, on what program to call for

**123 Commonwealth Avenue**
**Homeowner's Portal**

**Asset Rating (2007): B+**
**Operational Rating (2011): C**

**See my home's thermal image >**
**Learn more about these ratings >**
**Find a certified assessor >**

**How can I upgrade/save energy? >**

**Plug my rating into an energy app >**
**Share my rating with friends/groups >**

*Selling or renting?*
**Make my ratings public >**

**Figure 4: A suggested approach for what the homeowner portal would offer.**

insulation rebates or the link to utility retrofit programs. To improve owner uptake, the database can also provide periodic mailing (or e-mailing) of this information.

In addition, the homeowner can choose to provide the rating to third parties of his or her choice. For example, the owner can click to connect this data with third-party energy use software, such as that developed by OPower or MyEnergy. Additionally, he or she could also disclose the rating to a community group or neighborhood association that is holding an efficiency competition. Finally, the homeowner can also use the portal to share the report with local contractors, who can then respond with plans or cost estimates for addressing retrofit needs.

**Public Energy Ratings Search**

**Search for a home by address >**

**Compare a listed home to your current home >**

**Search for all currently listed properties in**
**zip code _____**
**with an asset rating of ____**
**or an operational rating of ____.**
**Go >**

**Report a home for sale/rent that does not have a rating posted >**

Figure 5: A suggested approach for the services that the public portal would provide.

When the home is ready to be rented or sold, the owner is required to list the rating (i.e., just the letter grades or numerical scores) in home listing flyers or rental marketing. The owner can use the previous asset rating as long as it was conducted within the past ten years. Additionally, the owner goes online and makes the full assessment profile public for as long as the listing is active.

The apartment hunters and homebuyers are thus presented with the asset and operational ratings on all listings. They can also go online, search for the specific house, and understand its energy performance and retrofit needs, the latter being especially important for buyers. This public portal (see Figure 5) allows users to compare buildings of interest side-by-side. Moreover, a customer in the market for a new apartment or house can go to this portal and search for all currently-listed units that meet their energy performance needs; this could be all apartments that score over a B, or could be all houses that have highly efficient HVAC.

WalkScore uses a similar method to provide an apartment search for people looking to live in a compact, walkable neighborhood (see sidebar "WalkScore's Apartment Search by Score").

This market of interested buyers and renters acts to keep disclosure enforced. If a building owner has not made his online energy rating accessible when it is listed, prospective tenants and buyers can report the violation to the enforcing agency. The agency is able to check the database to examine if in fact disclosure was not provided. Furthermore, failure to make the rating public also keeps it from being viewed by all the interested buyers and renters who are using this portal to search for properties.

**WalkScore's Apartment Search by Score**

WalkScore is a website providing users an understanding of how walkable their neighborhood is. The site uses public data on the locations of key amenities, such as grocery stores and public transit and analyzes proximities to generate a rating for any given address. The rating is on a scale of 0 to 100, where 100 is a highly mixed-use, walkable location. WalkScore then overlays these ratings with current apartment listings, allowing apartment hunters to search for homes that exceed a certain score. Users can also refine based on some of the attributes that constitute the score, such as proximity to transit. The interface uses Google Maps to visually present apartments meeting an apartment hunter's score and amenity criteria.

Source: WalkScore 2012.

## The Advantages

This model for rating and disclosing the energy performance residential buildings works to address the key needs and attributes of an optimal labeling approach, as identified previously, and can potentially provide a more effective means of residential labeling than the approaches identified in the individual case studies. In order to compare against the case studies, Table 5 below lists the advantages of this proposed model in each of the major themes discussed throughout the case studies.

Table 5: Advantages of the proposed model, as compared to the case studies.

| Key Theme | Advantages of Proposed Model |
|---|---|
| Usefulness of building performance information to stakeholder decision-making | The use of both an asset rating and operational rating, with thermal imaging when available, provides the benefits of both methodologies identified earlier. This includes increased functionality for market stakeholders, clarity on home energy performance, coverage of new buildings, and ability to track energy use reductions.<br><br>In addition, the asset and operational ratings can't be missed by apartment hunters and house hunters: these scores are required to be listed on lease ads and home listing sheets. |
| Comparability across whole residential markets | This model provides comparable ratings across all residential buildings: the same disclosure requirements apply to all residential properties. As a result, prospective home owners and renters can examine energy ratings for all of the homes they may be considering, allowing for fair comparisons during decision-making. |
| Usefulness to policymakers | The model provides efficiency program managers and officials with detailed insight into home energy performance. The use of asset and operational ratings mean that program managers can understand both the retrofit needs of the building stock and the effects of home upgrades. |
| Fostering residential upgrades | The model connects owners directly to retrofit options, in the form of recommendations from the on-site assessor and as easy-to-follow steps online for implementation. Homeowners can also use the site to share the report with contractors, streamlining the process of upgrading homes as much as possible. Providing homeowners with an estimate of what their rating could be post-improvements, and the ability to track operational ratings after retrofits, also encourages owners to be proactive once their properties have been rated. |
| Ease of the rating and disclosure process | Providing a directory of assessors eases the process of getting a rating, and the on-site audit also lets assessors to walk homeowners through the remaining steps of viewing and sharing ratings. Additionally, disclosing ratings in this model does not require homeowners to print out copies of reports, or type up complex energy use statistics. Instead, they simply disclose the basic asset and operational ratings when they list the home, and use one-click sharing on their web portal to make the detailed rating report public during this time.<br><br>Additionally, the use of a competitive marketplace for home assessors has the potential to spur assessors to offer competitive prices and discounts. The |

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| | prospect of no-touch assessments for homes, such as those currently offered for commercial buildings, could drive down costs further. Furthermore, the use of auto-uploading for utility and property data could also serve to cut process costs. |
| Privacy of billing information | This model keeps ratings and utility billing data accessible only to efficiency program administrators. The owner can access the rating, as well. At the time of sale or lease, the ratings are published in all listing materials, and the online detailed report is shared only while the home is listed. |
| Accuracy and reliability of energy rating | The use of asset ratings means that the label is unbiased by the behavior of the previous tenant, and instead represents the house's potential. A standardized protocol for home audits and a central calculation engine work to help ensure reproducibility in ratings. The disclosure of these methodologies to the public provides transparency into the process as a whole. Finally, the collection of ratings in a central database enables automated, periodic audits on labels and assessment companies. |

In short, this new model offers a way to bring together innovative practices for rating building energy performance which otherwise remain separate in the case studies. It combines insightful on-site audits with a streamlined, low-effort approach for operational updates, and potentially with thermal imaging as well, in order to provide a more comprehensive, clear rating of building energy performance than those examined in the case studies, one with greater functionality for tracking and comparing building energy efficiency. Furthermore, the data engine which serves to bring these data streams together also provides a platform for information access, enabling homeowner engagement with the rating, fostering retrofits, and making the disclosure process not only easier, but more impactful for prospective residents by providing greater comparability and visibility than any of the approaches in the case studies.

# VII. Conclusion

Residential building labeling can introduce real transparency about energy efficiency into housing markets and hence has the potential to catalyze home energy upgrades. Early results and observations from implementation in the U.S. and abroad support the belief that building labeling can enable housing markets to value energy efficiency, in turn catalyzing the delivery of energy efficiency.

Yet there are significant concerns about the way residential labeling is implemented, and, in conjunction, residential labeling has been implemented in a multitude of ways to date. As a result, there is a great deal of uncertainty in this emerging approach to energy efficiency.

The model proposed in this thesis presents one strategy to significantly improve upon residential rating and disclosure. Drawing on and combining some of the individual ideas and methods identified in the case studies, this model offers the possibility of disclosure in a way that addresses the myriad needs of privacy, transparency, and program analysis. It also seeks to provide a rating that is clear, comprehensive, and inclusive of all the benefits that operational or asset-based ratings alone each offer.

## Obstacles

Still, implementing such a model would have obstacles to overcome. First, the model requires the close collaboration of numerous organizations: utilities, city and state governments, the public, and building assessors. Implementation would require that these groups first come together to work collaboratively and then sustain a partnership to develop standards for sharing information.

In addition, implementing residential labeling has costs that must be paid, including program administration, database development, and the individual costs of rating each house. While prospective tenants and homebuyers are likely to benefit the most from disclosure, charging them for this benefit may be out of the question. The goal, after all, is to make ratings as visible as possible, and actual viewings of energy certificates remains a challenge in countries like England and Germany – where they are free to access. Thus, charging users to access rating reports may not be a good strategy.

Instead, utility ratepayer-funded retrofit programs may be in a position to contribute. An analysis of energy certificates in England and Wales finds that certificates would increase the demand for efficiency programs and cut the amount of marketing they need by £40 million annually (Olloqui 2009). As a result, the marketing funds saved for utility efficiency programs could be plowed directly back into operating the residential labeling program.

The costs of assessing and rating each home may have to be borne by homeowners, as is the case today. The burden, however, should not be overstated: conducting a one-time site assessment at $200-300, prior to selling or leasing, is a tiny fraction of typical home sale values or annual rental income.

Apart from costs, a third obstacle is working to ensure that the building ratings are understood and accepted by homeowners and residents. A building rating program that is not part of house-hunting discussions or is not useful to decision-making fails to achieve its purpose. Sherman likens the possibility of widespread building rating to nutrition facts or miles-per-gallon ratings for cars, both of which are commonly talked about and used (Sherman 2012). He comments on building labeling that "if it doesn't become part of the cultural vernacular… then we need to go back to the drawing board."

## Potential Impact on Home Retrofits

Despite the obstacles, the impacts of residential energy labeling have the potential to be significant. As an example, if Massachusetts were to implement residential labeling requirements, it would affect 2.8 million housing units statewide (U.S. Census 2010). Out of these, 54,000 homes and condos were sold in 2011 (Laczkoski 2012), and 960,000 units were rented out. Assuming the rentals require the signing of a lease each year, this translates to 1.01 million housing units in Massachusetts requiring a disclosure of energy performance, each year. Additionally, if the uptake of energy efficiency retrofits is anything like in Austin, it will mean that about 10% of homes sold will undergo an energy upgrade; perhaps a conservative assumption is that, in any given year, 1% of rental units leased will undergo an energy upgrade. This equals 15,000 homes receiving energy efficiency retrofits each year.

## Conclusions

The model proposed in this paper presents a new, improved way to implement disclosure of residential energy performance and a rating approach that offers a comprehensive and more easily understood picture of residential energy performance.

The access to more complete information provided by a well-designed strategy for residential energy labeling can transform the way stakeholders seek residential energy efficiency. In the proposed model, building owners are provided with clear information on their building's performance, through a platform that enables them to understand retrofit needs, more easily connect to retrofit opportunities, and share information with third-party organizations and applications. For prospective tenants and homeowners, this model provides easily accessible and comparable information on the energy performance of a potential new home, enabling more informed decisions and the use of energy efficiency as a decision factor. As a result, tenants and homebuyers collectively can create a market signal for more efficient homes. Cities, states, and utilities all benefit from this approach, with up-to-date, detailed information available on the performance and needs of housing stock. The result is a well-informed housing market, enabled by transparency to seek out and catalyze residential energy efficiency.

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