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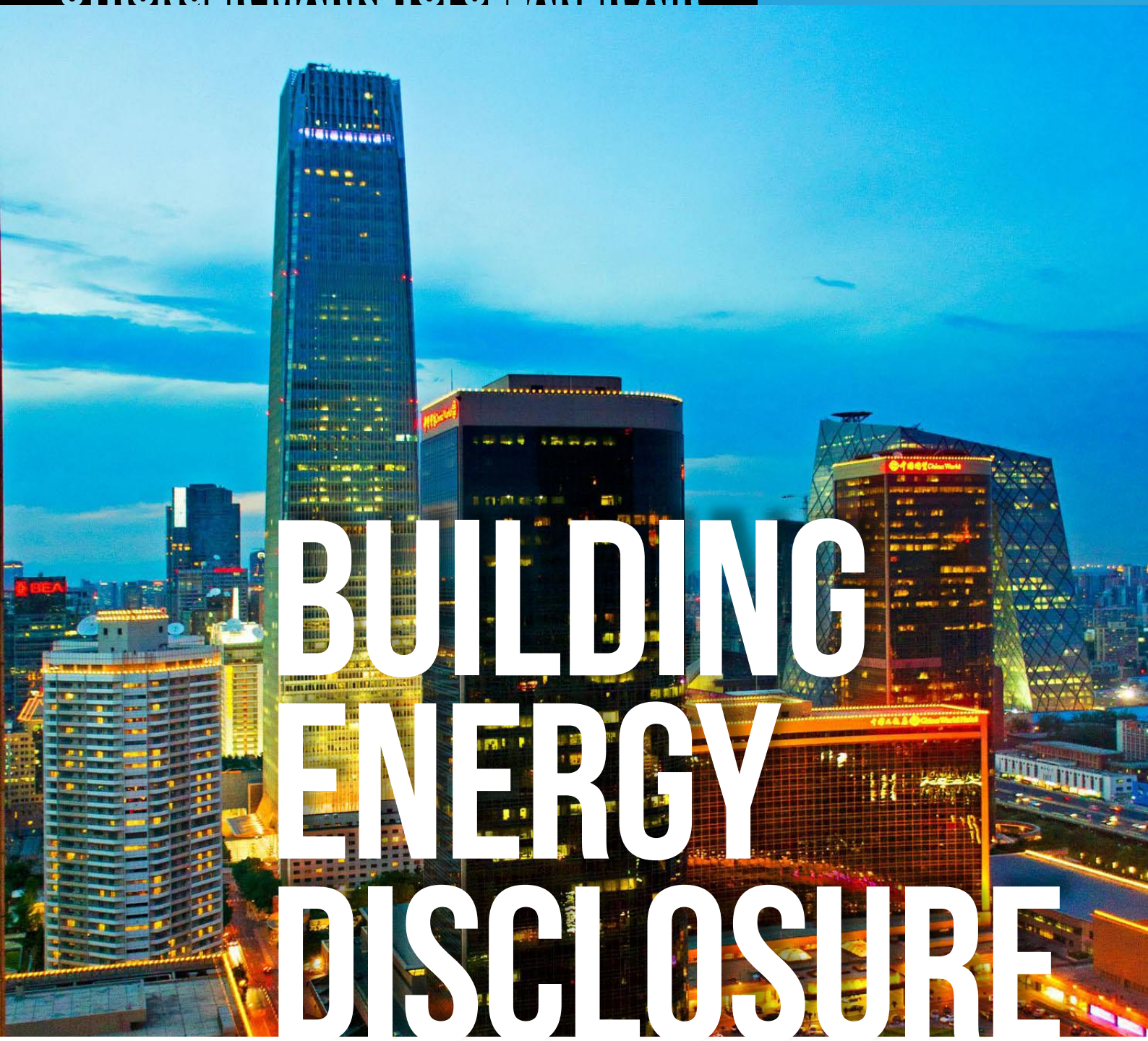

BUILDING ENERGY DISCLOSURE

How Energy Reporting for Buildings Can Reduce Costs and Improve Efficiency

September 2015

保尔森基金会
PAULSON INSTITUTE

Shanghai scene: Energy disclosure can boost demand for more efficient buildings and therefore help reduce emissions.

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The Paulson Institute is a "think and do" tank that promotes environmental protection and sustainable development in the United States and China, while advancing bilateral economic relations and cross-border investment. Established in 2011 by Henry M. Paulson, Jr., the Institute is committed to the principle that today's most pressing economic and environmental challenges can be solved only if the United States and China work in complementary ways. The non-partisan institute is headquartered at the University of Chicago with staff in Beijing, San Francisco, New York and Washington D.C. The Institute focuses on research, programs, and advocacy that promote increased economic activity to spur job creation, smart urban growth and responsible environmental policies. Our Think Tank publishes papers on the most important macroeconomic issues facing China today, energy strategies, and issues in US-China economic relations. Learn more at www.paulsoninstitute.org

About the Series: *Stronger Markets, Cleaner Air*

This paper is one in a series produced in 2015 by the Paulson Institute's Climate Change and Air Quality Program aimed at policymakers and influencers in China. The series provides recommendations on how policymakers can harness market forces to reduce emissions of both conventional pollutants and greenhouse gases that contribute to climate change. The topics covered by the series include power sector reform, electric power demand response, carbon emissions trading and building energy disclosure.

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Stronger Markets, Cleaner Air

BUILDING ENERGY DISCLOSURE

How energy reporting for buildings can reduce costs and improve efficiency

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Blue-sky thinking: The Paulson Institute held its inaugural Paulson Dialogues, exploring how policy can incentivize markets to support China's transformation to a high-innovation, low-carbon economy.

Read more about the outcomes of the Building Energy Disclosure Dialogue on page 23.

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1. INTRODUCTION

As the public gains access to 24-hour pollution data at any location via portable devices, demand for indoor air purification and masks has increased.The same disclosure model could be applied to building energy use.

Today, buildings account for about a third of China's final energy consumption and rising.[1] Given the energy consumption and carbon implications of China's rapidly expanding building floor area—2 billion square meters annually, equivalent to a fourth of the total building area in the U.S.[2] —it is critical that the government prioritizes energy efficiency. China is already encouraging building energy efficiency through new technology promotion, building codes and standards, and financial incentives. However, administrative measures and government funds are insufficient to generate needed investments. To successfully reduce emissions from the building sector, China should allow the market to play a greater role in delivering energy savings.

Building energy disclosure is a low-cost market tool that can help China achieve cost-effective improvements in building energy efficiency. Unlike codes or standards, which establish baseline efficiency requirements for buildings, energy benchmarking and disclosure raises awareness in the market by providing owners with the tools and information needed to better understand their buildings' efficiency, and making this information available to buyers, investors and tenants. When in the hands of the public, building energy data can boost demand for more efficient buildings. Specifically, when a building's energy use is transparent, building tenants are empowered to make informed purchase and rental decisions based on the estimated costs associated with the building's operation.

This paper focuses on the role of expanded energy use disclosure in constructing a stronger market for building energy efficiency. Disclosure—when combined with effective enforcement of regulations, targeted incentives, competent technical services, and access to financing—can help drive the market for investments in building efficiency. Experience in both China and the U.S. with data disclosure prove of the potentially transformational impact that policies can have on the market. In the U.S., emissions disclosure via the Toxic Releases Inventory has affected investor behavior through reduced asset prices for polluting firms; it has also moved company behavior towards decisions to reduce emissions and invest in lower-emissions activities.[3] China's real-time release of ambient PM2.5 data beginning in 2012 is driving similar changes. As the public gains access to 24-hour pollution data at any location via portable devices, demand for indoor air purification and has increased. The same disclosure model could be applied to building energy use.

China has made noteworthy progress in building energy disclosure through investments in disclosure platforms for large non-residential buildings and allocation of institutional capacity across cities for implementing disclosureegulations. But more can be achieved.

International experience with building energy disclosure provides important lessons that can be helpful to China as it improves the energy efficiency of

Definitions

For the purposes of this report, building energy benchmarking, disclosure and labeling are defined as follows:

Building energy benchmarking	The process of measuring a metered building's energy use with a standard metric to track improvements in energy efficiency over timeby comparing these metrics to the building's baseline or with other buildings of the same characteristics. Benchmarking is used to compare a metered building's energy performance over time, among peer groups, or to identify top performers.[4] Collection and use of diverse types of data such as total annual energy use, square footage, occupancy rate, operation times and climate factors, combined with training, can help improve accuracy of benchmarking results.[5]
Building energy disclosure	The process of making building energy consumption data publically available via an online platform following the annual recording of energy use data to a centralized database by building owners and electric utilities. Once owners report data via the central database, relevant government bodies assess the data for authentication and disclose data in a user-friendly manner allowing potential buyers, renters, and investors to make informed transactional decisions that take building energy performance into consideration. Disclosure also allows service providers to more easily identify and connect with communities and property owners in need of energy efficiency services.* For the purposes of this paper, building energy disclosure does not include building energy labeling.
Building energy labeling	The practice of making a building's energy consumption visible to the public through an energy rating or score, provided as a certificate, plaque, or made available online.

Note that building energy benchmarking, disclosure and labeling practices differ across countries and that definitions may vary.

its large non-residential buildings. In the past decade, Europe and large cities in the U.S. such as New York have launched new building energy disclosure laws to help incentivize building energy efficiency. This paper reviews these efforts and points at the following early lessons for China on the impact that disclosure could have:

- Building energy disclosure has been shown to provide a small but significant incentive for building owners and operators to improve energy efficiency. After three years of mandatory reporting and benchmarking for over 13,000 properties in New York City beginning in 2010 via the EPA's Energy Star Portfolio Manager benchmarking tool, energy use per building has declined citywide.[6] Data remain limited, but more evidence should be available in the next few years.
- Building energy benchmarking in the U.S. is leading to new business models that combine "big data" analytics with real estate and energy businesses like utilities and energy service contractors. As data become more easily accessible to the public through online platforms, and as

* In New York City, building owners are mandated to report energy consumption data via the U.S. Environmental Protection Agency's Energy Star Portfolio Manager – an online tool that building owners can use to measure and benchmark energy performance over time. Once this energy use data is recorded using Portfolio Manager, the city government discloses the information publically in a format that is consistent for all buildings and understandable to market players.

building codes tighten, there will be greater incentive among building owners, potential buyers and developers toinvest in energy efficiency. Benchmarking could have a much greater impact than earlier energy service company models or efforts to promote behavioral change and energy conscious investment.

- Building energy benchmarking and disclosure have the potential to help policymakers, utilities and energy service companies identify individual neighborhoods and buildings for services and financial incentives.

The value of energy efficient buildings extends far beyond cost savings and carbon reduction.

The value of energy efficient buildings extends far beyond cost savings and carbon reduction. A growing body of research suggests that buildings with higher energy performance are also likely to be of better quality and healthier for occupants.[7] A study published in the Journal of Building and Environment, for example, correlates reductions in energy use with increased occupant comfort.[8] The authors argue that low energy buildings could "achieve some of the highest levels of occupant satisfaction.[9]" Similarly, empirical data from a 2000 Lawrence Berkeley National Laboratory study shows that improved indoor environments could produce significant gains for employee productivity and health.[10] The paper cites several energy efficiency measures ranging from heat recovery to energy efficient lamps that improve indoor environmental quality, occupant health, and even performance.[11]

With its rapid rate of urbanization, China has much to gain by more aggressively pursuing energy efficiency in buildings to support development of smart and efficient urban centers of the future. Building energy disclosure can be an important market tool in achieving this goal.

2. BENCHMARKING AND DISCLOSURE ACCELERATE EMISSIONS REDUCTIONS

Building energy benchmarking and disclosure can help accelerate energy efficiency and reduce emissions from China's building stock. Experience suggests that owners and operators who benchmark their buildings' energy use, by measuring and tracking energy consumption with a standard metric to evaluate efficiency in comparison to similar buildings, are more likely to invest in energy efficiency.[12] This is partly because benchmarking allows building owners to more easily identify the most cost-effective measures for improving energy efficiency. Effectively disclosing benchmarked results to the public via online platforms and with the use of tools such as building labeling can subsequently create competition in the market and drive investment in energy saving technologies and practices.

In addition to weak building codes and standards, insufficient investment in building energy efficiency has been attributed to high costs associated with energy efficiency technologies and retrofits, and weak incentives for good performance. This overall lack of incentive has resulted in what the European Commission calls a vicious "circle of blame" in building energy efficiency.[15] In this "circle of blame," regulators are criticized for weak policy, the building industry is blamed for hindering implementation of efficiency measures, and consumers claim that they lack the information on energy efficiency needed to make informed purchases.[16] As a result, contractors, developers and builders insist that there is no incentive to invest in energy-efficient buildings or retrofits.

MARKET BARRIERS TO OPTIMIZED BUILDING ENERGY USE

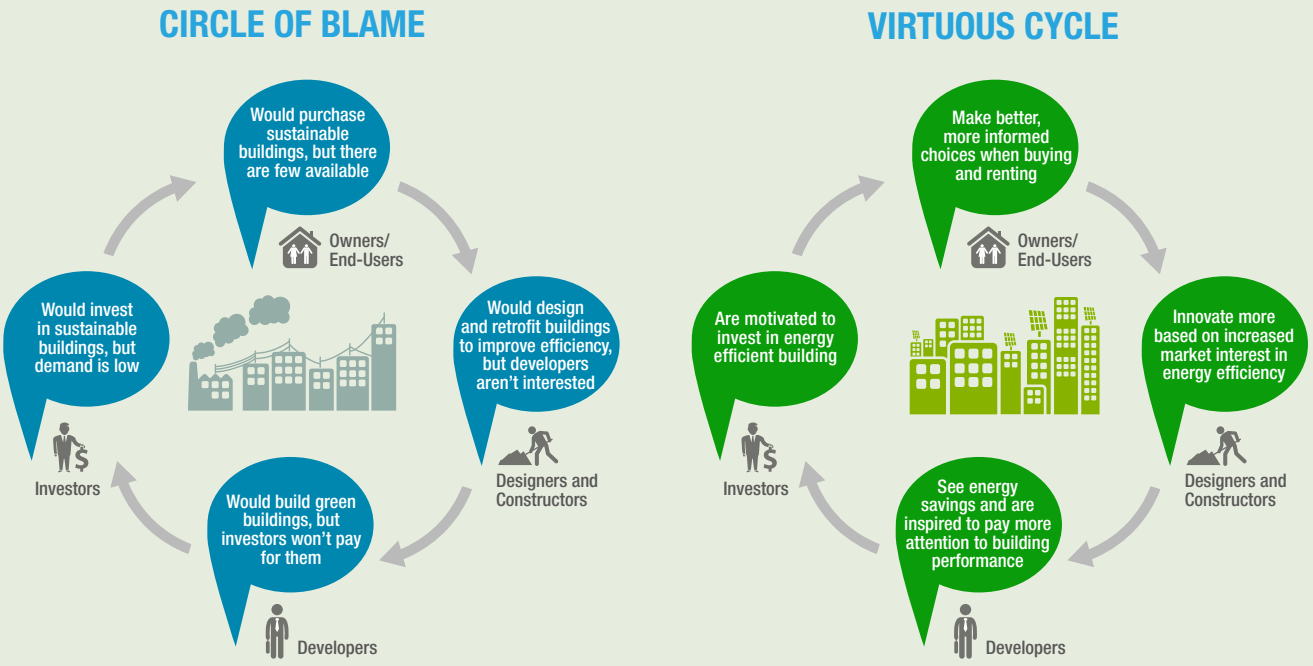
Market failures	Principal-agent (landlord-tenant) problem	If a property owner makes an investment, the tenant who pays the bills receives the benefit
	Assymetric information	The property owner is unable to credibly convey information about the value of energy efficiency improvements and cannot recoup cost of upgrades through higher rent or sales prices
	Credit constraints	The property owner may not have sufficient funds to pay upfront investment cost
Market barriers	Search costs	The property owner must spend time searching for information related to energy efficiency, paying for an energy audit and locating contractors to perform upgrades
	Uncertainty	Future cost savings are uncertain, adding risk to any energy investment
Behavioral failures	Inattention	Owners and occupants pay little attention to energy when making investment, purchase or rental decisions
	Status quo bias	Property owners defer decisions on upgrades even when they offer a large benefit

Source: Analysis Group, 2013

At each step in the cycle, market players await a behavioral change from other actors before they respectively buy, build, commission, or fund sustainable buildings.[17] A study on building energy efficiency in Norway attributed deficiencies in energy efficiency public policy, a lack of government promotion of efficiency, and far too little innovation or investment in research and development (R&D) in the building industry as responsible for slow adoption of energy efficiency.[18] According to the authors of the study, developers focus too much on reducing short-term costs and too little on recent improvements in design practices. This results in the reuse of older, less energy-efficient designs, including deployment of outdated equipment, materials and building management systems in new projects.[19]

Building energy benchmarking and disclosure can resolve some of these barriers, replacing the "circle of blame" with a virtuous cycle in which greater awareness of building performance, and the associated energy savings, catalyzes action on the part of property developers and building owners alike. Just like appliance energy labels, providing more energy information for buildings in understandable ways helps consumers make informed choices

BUILDING ENERGY DISCLOSURE CAN HELP TURN THE BUILDING ENERGY EFFICIENCY "CIRCLE OF BLAME" INTO A VIRTUOUS CYCLE



Source: RICS Research, 2008

when buying or renting. Disclosure also gives technology companies the incentive to innovate,[20] while directly encouraging building owners to invest in energy efficiency retrofits.[21] Therefore, the reporting of energy performance is as important as the collection and analysis of the data itself. Disclosure will be effective if the data on building energy performance is presented in ways that are useful for market players.

Under the most optimistic long-term scenario, building energy benchmarking and disclosure could enable a significant market transformation in the building sector by changing expectations of what customers value when renting or buying.[22] For example, there is the potential for customers to consider energy efficiency as one key indicator of overall property quality. Greater disclosure could increase the relative value of properties with higher performance, spurring demand for energy-efficient products, materials and services, but buyers currently lack methods of determining the energy efficiency characteristics of properties. Though building energy policy would continue to depend on traditional regulations such as building codes and standards, energy disclosure could help address market failures while empowering building occupants and owners to make better energy choices.

When combined, building performance and operational data can drive investment in energy efficient retrofits and practices. In the short-term, making operational data on energy used within the home—beyond overall energy consumption to include consumption by individual appliances—available to occupants and building owners is a powerful tool for encouraging needed investments in more efficient practices.[23]

Disclosure also gives technology companies the incentive to innovate, while directly encouraging building owners to invest in energy efficiency retrofits.

3. BUILDING ENERGY DATA POWERS NEW INDUSTRIES

Building energy benchmarking and disclosure are already beginning to enhance the market for services related to energy efficiency across the U.S. and EU. Benchmarking and disclosure in the U.S., for example, are creating an entirely new industry that uses the data to help building owners achieve improvements in energy performance. This type of disclosure, and the market behavior it incentivizes, can go beyond energy savings to accelerate job creation in energy efficiency auditing, data analytics, demand response, and clean energy deployment.

One of the earliest results of building energy disclosure in the U.S., together with supporting policies, was the birth of the energy service market. Energy service companies (ESCOs) in the U.S. have accelerated green building development, creating one of the most mature ESCO markets in the world.[24] Through minimal upfront investment geared at long-term savings, ESCOs have helped building owners finance efficiency investments for new buildings as well as retrofit projects.[25] In the ESCO model, building owners enter into energy savings performance contracts (ESPCs) through which service providers provide energy efficiency consulting in exchange for a percentage of the profit from savings achieved. Since the 1970s, and especially the early 1990s, there has been a dramatic increase in the number of energy service companies (ESCOs) worldwide, indicative of the growing demand for energy efficiency services.[26]

One of the earliest results of building energy disclosure in the U.S., together with supporting policies, was the birth of the energy service market.

The ESCO model has the potential to make significant contributions to China's existing building market, just as it has done in other countries.[27] However, of the over 2,000 ESCOs registered in China today, most focus primarily on relatively simple technology projects as opposed to larger, more comprehensive solutions—a challenge the U.S. also faces.[28] Unlike in the U.S., however, where ESCOs cover a variety of building sectors as well as industry, China's ESCOs started their experience in industrial processes. While its ESCOs have over the recent years ventured into the built environment, China can build on the progress made by allowing these companies to play a larger role in this market. Public building energy disclosure can help produce new leads for ESCOs, thereby opening new channels for the market to participate in building energy efficiency, and allowing new business models to flourish.

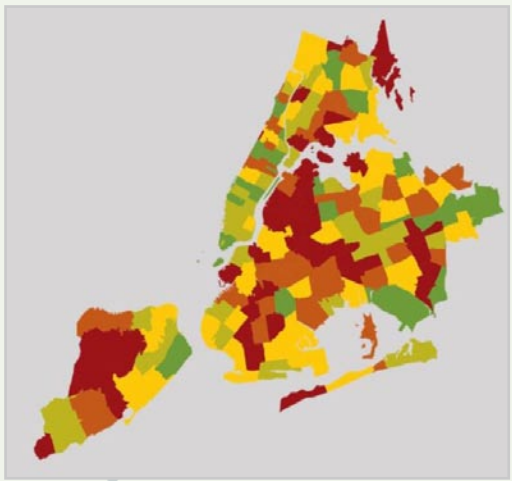
Within the past decade, startups have devised even more creative ways of collecting and distributing building energy data to facilitate energy smart decisions and efficiency investments. As utilities and private startups such as Opower have discovered, enabling building owners and energy managers to compare performance against that of their neighbors or business competitors can drive significant operational changes.[29] Opower estimates that through early 2014 its mailings and emails to building owners and utility customers—

the mailings feature bar charts and simple emoticons—have produced electricity savings of over 4 billion kWh.[30] The company's experience is in line with that of other utilities that have discovered the power of information to "nudge" customers towards lower consumption patterns.

Retroficiency is another startup using a combination of public and private data to push energy savings for buildings. The company has shown how data can be used to match city neighborhoods to energy efficiency investments. For example, Retroficiency identified New York neighborhoods that would benefit more from better insulation as opposed to better windows. The company's maps are powerful tools for policymakers and private companies looking for opportunities to reduce energy use at both the city and building levels.[31]

These new business models are an indication of a new industry that has the potential to change the way building owners, operators and investors think about efficiency.

RETROFICIENCY ANALYSIS OF NEW YORK ZIP CODES THAT WOULD BENEFIT FROM BETTER TEMPERATURE CONTROL, NEW WINDOWS

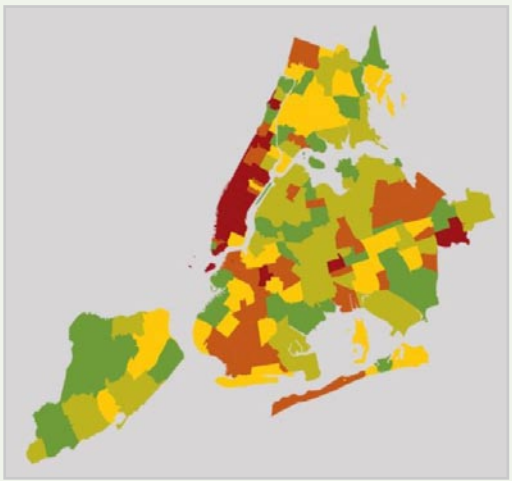


SCENARIO 1

What if every building turned the thermometer up one degree in the summer and down one degree in the winter?

Financial Savings: $145 Million

Portfolio Energy Savings (MBtu): 1.9%



SCENARIO 2

What if every building with old windows installed new, efficient ones?

Financial Savings: $227 Million

Portfolio Energy Savings (MBtu): 4.5%

KEY: Zip codes ranked by percent savings

Lower savings % — Higher savings %

Source: Retroficiency, Greentech Media

A recent MIT study highlights how building energy labels and new data can combine to assist local governments and planners as they work to create stronger policy platforms for energy efficiency:

"Under the current conditions, states, cities, and utilities have access to a few data streams: property assessor reports, home energy bills, infrared imagery (being piloted), and advanced metering data (where applicable). Building labels, especially if generated through on-site home assessments, can provide a new data stream to cities, states, and utilities that captures the housing stock's ratings, shape of building systems, and retrofit needs. Using this rich dataset in conjunction with the existing data enables these stakeholders to better identify residential efficiency potential, create more powerful building models, and develop targeted incentives for home upgrades."[32]

Building energy disclosure is a tool that can help ensure appropriate allocation of financial resources by helping banks better identify projects that should be prioritized and expanding the market for ESCOs to improve buildings that are not efficient.

Social media is even getting involved. New York-based startup Honest Buildings began collecting and posting data on over 250,000 buildings in its hometown in 2012, giving commercial properties online exposure that can spur energy-conscious decision making during the construction, maintenance and retrofitting of buildings. Within the first year of its establishment, Honest Buildings worked with companies and NGOs to expose building performance and drive energy efficiency in new and retrofit properties.[33] Despite these initial efforts, the market has been sluggish and demand for building energy consumption data is low among customers. Nevertheless, the Honest Building platform continues to provide energy service companies and contractors with a platform to locate customers and reduce project pricing through a competitive bidding process.[34]

New startups are not the only ones getting involved. As more data becomes available, tech giants like IBM, Honeywell, Siemens, and GE are joining energy companies and utilities in the search for ways to marry public and private building energy data with the services they provide. Demand-side management, energy storage, rooftop solar PV, home energy management—all of these technologies are beginning to converge with data availability to create new pathways for buildings to radically improve energy performance.

These developments have important implications for China. In January 2015, China's National Development and Reform Commission (NDRC) and the China Banking Regulatory Commission released energy efficiency credit guidelines that provide financial institutions with guidance on the types of projects eligible for energy efficiency funding.[35] Article 5 of the guidelines specifies that energy efficiency credits are available for new and existing residential, government, and other public buildings. The guidelines also state that buildings that meet national standards should get priority financing.[36] Building energy disclosure is a tool that can help ensure appropriate allocation of financial resources by helping banks better identify projects that should be prioritized and expanding the market for ESCOs to improve buildings that are not efficient. Greater involvement by financial institutions will allow new business models to develop in China.

4. CHINA IS MAKING PROGRESS IN DISCLOSURE

China is already developing a system for building energy disclosure in its large non-residential and government-owned buildings.* In fact, energy conservation and disclosure efforts for public buildings** began as early as China's 11th Five-Year Plan.[37] By 2008, several policies were in place to support building energy disclosure, such as the State Council's 2008 Regulations on Energy Performance of Civilian Buildings and Regulations on Energy Performance of Public Buildings.[38] Article 32 of the Regulations states that all government and large non-residential public buildings should be evaluated and labeled based on energy performance and that the results are to be made available to the public.[39] To date, these efforts have been focused on large non-residential buildings, which are responsible for 38% of total energy consumed by non-residential buildings, yet represent only 8.3% of the building stock.

A 2014 joint study by the National Resources Defense Council and the Energy Foundation highlights the value of disclosing building energy data to potential buyers, renters, investors and operators to drive efficiency improvements. The report notes the progress China has made in improving the energy efficiency of its large non-residential building stock through market-driven efforts to disclose energy consumption information and eventually make data accessible via online platforms.[40] Since establishing the Ministry of Housing and Urban-Rural Development's (MOHURD) building energy consumption monitoring platform for large non-residential buildings in 2007, the Central Government has collected energy use information for 3,680 buildings in 20 cities over the course of five discrete monitoring stages (as of April 2014).[41] The current disclosure system has come a long way, compared to just a few years ago in 2012, when China did not require public disclosure of data, either online nor in the building itself.[42]

One of China's more recent achievements in building energy disclosure was the launch of MOHURD's Energy Performance Benchmarking and Disclosure Program in July 2014, an initiative jointly funded by the World Bank and Global Environment Facility.[43] The Program uses a web-based benchmarking tool to measure operational energy performance in buildings and builds on the success from China's Building Energy Benchmarking Tool, which is already available in Beijing for hospitals, hotels and office spaces. The online tool models the U.S. Energy Star Portfolio Manager and borrows aspects of New York City's building energy benchmarking and disclosure policy. China plans to publically release the next version of the online tool in July 2015. The program is striving to benchmark 29 million square meters of building area by 2017 and 171 square million meters by 2025.[44]

One of China's more recent achievements in building energy disclosure was the launch of MOHURD's Energy Performance Benchmarking and Disclosure Program in July 2014, an initiative jointly funded by the World Bank and Global Environment Facility.

* Large non-residential buildings in China are defined as buildings over 20,000 square meters in area.
** Public buildings in China are broadly defined as non-residential buildings for public use including but not limited to office buildings, commercial buildings, schools and hospitals.

Beijing and Ningbo will be the first municipalities to collect city-level data and experiment with the new platform between 2015 and 2017. The program should launch nationally by 2018. The Beijing and Ningbo pilots will also integrate building energy efficiency with China's emissions trading scheme pilots in several cities, including Beijing, Shanghai and Shenzhen.[45]

Maximizing the impact of these investments will require improved data sharing among designers, financiers, developers, owners, occupants, operators, entrepreneurs and regulators. Without access to credible information on building performance, upstream investments in disclosure platforms and other effective tools would be constrained. Today, public access to data and sharing between agencies remain limited.[46]

Government leadership will be vital as China tries to fully capitalize on its investments in building energy disclosure. Public buildings, in particular, represent a huge opportunity for governments to lead by example.[47] One of the most obvious benefits of public sector leadership in driving building energy disclosure is that savings from energy efficiency improvements can help cut government costs and make public funds available for investment in other sustainability services and initiatives. According to a 2012 World Bank report, China can encourage energy efficiency in public institutions by developing reputational incentives like awards and benefit sharing for government agencies, clarifying accountability structures, building the technical capacity of energy services professionals, and diversifying financing channels.[48]

Data driven: Ningbo (pictured here) and Beijing will be the first municipalities to collect city-level data and experiment with MOHURD's Energy Performance and Benchmarking Disclosure Program.

5. GOVERNMENT LEADERSHIP CREATED A MARKET FOR EFFICIENCY IN THE U.S.

The U.S. was a pioneer on appliance energy labeling, starting with the Energy Star program launched in 1992. Energy Star, developed jointly by the U.S. Environmental Protection Agency and the Department of Energy, was applied to new homes beginning in 1995 on a voluntary basis.[49] This program hoped to build upon the success of Energy Star in fostering new energy efficient appliance supply chains. (Though Energy Star is voluntary, demand for Energy Star-rated products such as refrigerators means that the majority of such appliances meet Energy Star requirements.[50]) An important aspect of U.S. efforts is that many labeling programs focus on building operational performance, supported by energy benchmarking. Operation labeling is required under prevalent programs like Energy Star and LEED, the other main voluntary green building scheme common in the U.S. Unfortunately, these programs currently only reach a small percentage of buildings and homes.[51] For example, as of October 2013, the United States was home to over 17,000 LEED-certified projects representing a total floor area of about 234 million square meters, equivalent to just 3% of the nation's total commercial floor space in the same year.[52] Through 2013, more than 1.5 million new homes and 25,000 buildings and plants had earned the Energy Star rating, a small fraction of the total number of new homes and buildings.[53]

Together with building codes and standards, more information enables the market to work more efficiently.

In recent years, various states and cities such as California and New York City have begun to require mandatory energy labeling and disclosure in some parts of the building market.[54] In many cases these laws and regulations on mandatory building energy disclosure began as rules related to building transactions, such as sales or rentals. In 2011, Washington State enacted a transactional disclosure-based law, with disclosure required when selling or renting a building.[55] Seattle later strengthened this requirement with its annual reporting law. Early reports suggest that both laws spurred local energy efficiency and building management for benchmarking services.[56]

For many U.S. policymakers, the benefit of energy disclosure mandates is that they offer a more market-oriented approach towards promoting energy efficiency as compared to tightening building codes and standards. Together with building codes and standards, more information enables the market to work more efficiently.

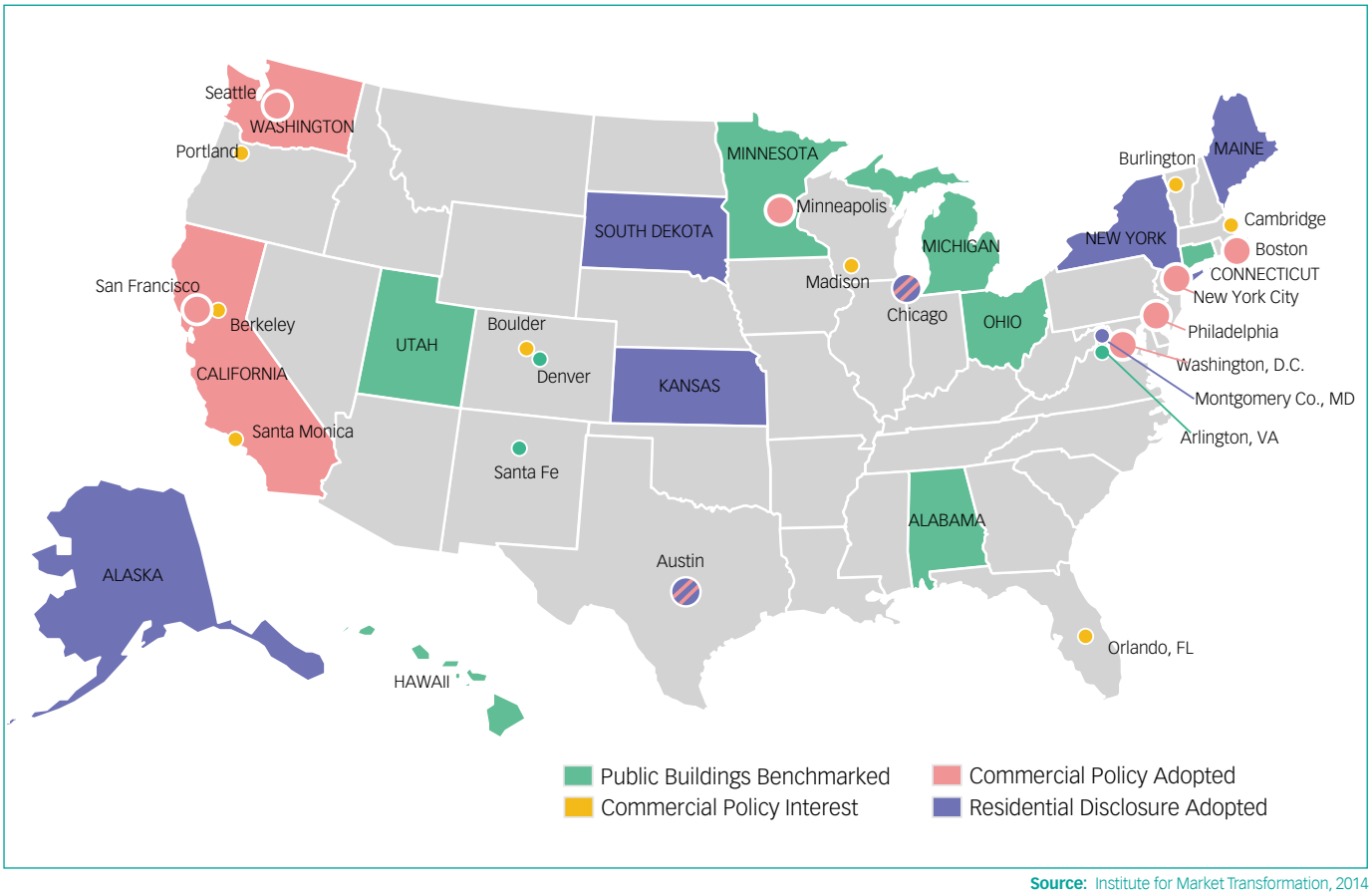
In some cities, building benchmarking information is now online, creating a wealth of new data and business opportunities. In 2012, New York City became the first city in the U.S. to make energy consumption of all large private-sector buildings available to the general public online.[57] After three full years of data collection, the city now has building data gathered through a mandatory

citywide benchmarking process collected as part of Local Law 84.[58] Beginning in May 2010, all city-owned buildings were required to benchmark energy use annually. Large private sector buildings* became subject to the same mandate as of May 1, 2011.[59]

Specifically, Local Law 84 requires public buildings over 929 square meters in area and private buildings over 4,645 square meters (or private properties with multiple buildings with a combined square footage over 9,290 square meters) to report energy use annually.[60] A total of 20,320 large private buildings and 3,097 public buildings reported energy consumption data for 2012 via the EPA's Energy Star Portfolio Manager benchmarking tool,[61] representing a total area of 239 million square meters, or about 45% of total citywide floor area in 2012.[62] New York City achieved a compliance rate of 84% by 2013, with a 92% compliance rate among building owners between years two and three.[63]

New York City's Local Law 84 also has specific clauses related to auditing that require building owners to save a copy of energy bills for at least three years.[64] New York City is also contributing its data to building energy performance analysis on a national scale, providing anonymized energy data to the Department of Energy's Building Performance Database, a visualization tool

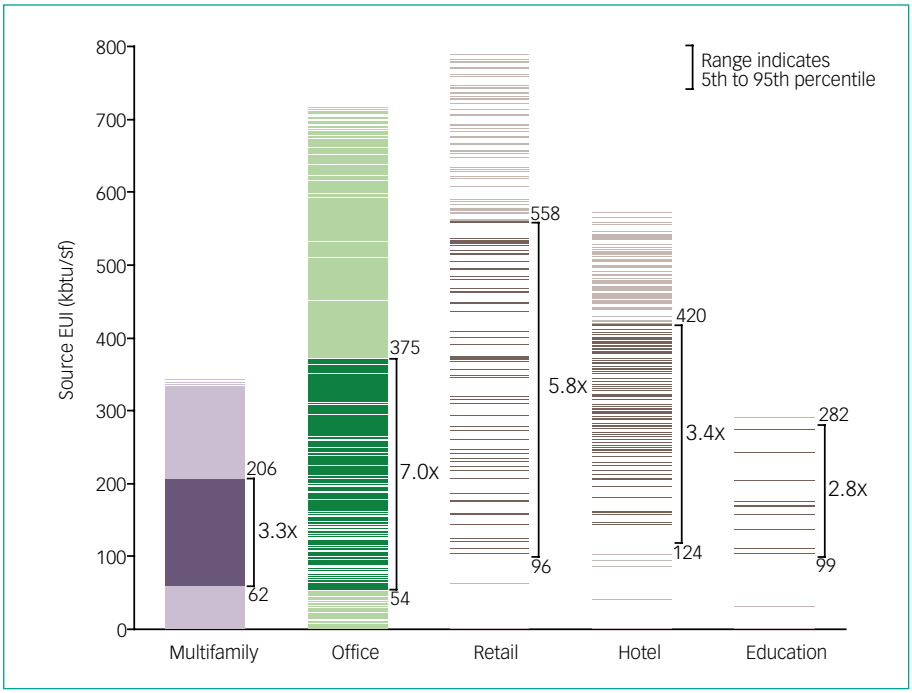
SPREAD OF DISCLOSURE LAWS IN THE U.S. AS OF 2014



Source: Institute for Market Transformation, 2014

* Local Law 84 defines a covered building (or large private sector building) as any building that is not owned by the City of New York and that exceeds 50,000 gross square feet, and "…(ii) two or more buildings on the same tax lot that together exceed 100,000 gross square feet, or (iii) two or more buildings held in the condominium form of ownership that are governed by the same board of managers and that together exceed 100,000 gross square feet."

NEW YORK ENERGY USE INTENSITY (EUI) SCORE BY SECTOR IN 2012



Source: PlaNYC Annual Benchmarking Report, September 2014

that allows for comparison of building energy performance across similar buildings.[65]

New York is already putting energy data to use in intriguing ways. The city calculates energy use intensity (EUI) scores for properties and buildings, normalizing for weather and occupancy, as well as a building Energy Star score.[66] Scores are based on a 1-100 percentile ranking and give owners and potential occupants a better understanding of the energy consumed in similar buildings and how much they could save. The data from New York reveal ample variation in building energy performance across all sectors.

Other cities have been following New York's example. Austin, Boston, Chicago, the District of Columbia, Minneapolis, Philadelphia, San Francisco, Seattle, and Montgomery County in Maryland have adopted similar benchmarking regulations.[67] As data from these locations become available—whether publicly or to building owners only—they will begin to differentiate buildings based on energy performance. Credible data that are easy to understand will be essential to stimulate a market response. Accessible and credible data also inform regulatory mandates for building energy performance, gradual tightening of energy codes, green credit promoting energy efficiency investment financing, and business models that can effectively package energy efficiency measures to customers. Finally, data can inform urban planners and designers of the building energy use impacts of various urban designs and inform policymakers of the types of regulations needed to support green building development – critical elements in designing more resource efficient and livable cities.[68]

The data from New York reveal ample variation in building energy performance across sectors.

U.S. EXAMPLES OF MANDATORY BUILDING ENERGY DISCLOSURE

Location	Applicability	Implementation	Requirements
Austin, Texas	Commercial buildings over 10,000 square feet, residential buildings over 10 years old	Phase-in between 2009 and 2014	Residential mandatory audit and disclosure to buyer/tenant; Commercial mandatory annual Energy Star Benchmarking
New York City	Public buildings over 10,000 square feet; Commercial and most Residential over 50,000 square feet	Phase-in between 2010-2011	Mandatory Energy Star benchmarking, mandatory audits every 10 years
Philadelphia, Pennsylvania	Commercial buildings over 50,000 square feet; multi-use buildings with over 50,000 square feet of commercial use	June 2013	Mandatory Energy Star benchmarking
San Francisco, California	Non-residential buildings over 10,000 square feet	Phase-in between 2011-2013	Mandatory Energy Star benchmarking for buildings over 2 years old; mandatory energy audits for buildings over 5 years old
Seattle, Washington	Non-residential and multi-family residential buildings over 20,000 square feet	Phase-in between 2012-2013	Mandatory annual Energy Star benchmarking
Washington, DC	Public buildings over 10,000 square feet, private buildings over 50,000 square feet	Phase-in between 2009-2013	Mandatory annual Energy Star benchmarking
State of California	All public buildings; private non-residential buildings over 50,000 square feet	Phase-in between 2004-2014	Mandatory annual Energy Star benchmarking (non-residential buildings)
State of Washington	Non-residential buildings over 10,000 square feet; Public buildings over 10,000 square feet	Phase-in between 2010-2012	Mandatory annual Energy Star benchmarking and disclosure prior to sale, lease, financing

Source: Analysis Group, 2013

New York's experience shows how solutions can be found even in complex building and ownership environments. The city features high-rise towers with varying building quality and ages. Many buildings include a combination of apartment owners and renters. Occupants and potential occupants can use building energy benchmarking to identify the buildings that are most energy efficient. Furthermore, benchmarking can help policymakers clarify standards and targets that designers and owners should strive towards, and create mandates for building owners to achieve those goals.

Federal agencies in the U.S. have more recently taken a leadership role in driving building energy disclosure under the U.S. Sustainability and Energy Scorecards Program. The program, launched in April 2011, evaluates federal agencies based on energy intensity, greenhouse gas pollution, and green building practices, among other indicators.[69] Since the Program's launch, 24 federal agencies and departments have released annual scorecards to disclose sustainability performance in multiple areas, including building energy use. Scorecards hold federal agencies accountable for reaching energy reduction targets and help these agencies identify opportunities for energy

efficiency improvements.[70] The Department of Defense and Department of Interior's scorecards for January 2015, for example, indicate room for improvement in building sustainability – only 0.8% and 3.1% of buildings ranked as sustainable, respectively.[71] The Department of State, on the other hand, is on track with 18.5% of its buildings receiving a high performance rating for sustainability.[72]

The building energy asset score is another tool developed by the Department of Energy that provides energy efficiency ratings for commercial and multifamily residential buildings on a scale of 1 to 10. The tool helps building owners identify opportunities for efficiency upgrades as they might relate to the building envelope, heating, ventilation and air conditioning (HVAC) system, or lighting.[73]

Growing awareness and commitment to energy savings in buildings across sectors is driving investments in efficiency. Federal leadership has been accompanied by innovation in the private sector that is creating new platforms for easy access to building energy information. The result is a growing market for services such as energy auditing, meter installation, lighting upgrades, and appliance replacements. As mandatory disclosure laws force building owners to reveal the potential operational costs associated with their properties due to structural inefficiencies, and buyers recognize the difference that an energy efficient versus inefficient building can make for lower monthly utility bills, the demand for energy efficiency services will grow. The positive impact on the economy should be significant;[74] a study by the University of Massachusetts-Amherst and the Institute for Market Transformation shows that existing building disclosure policies in the U.S. have the potential to create 59,000 new jobs through 2020 and save consumers US$ 3.8 billion.[75]

Growing awareness and commitment to energy savings in buildings across sectors is driving investments in efficiency.

Lessons from the U.S.: The availability of large quantities of public and private benchmarking data in the U.S., especially for large commercial and residential buildings, has contributed to the development of a dynamic industry that combines data analysis with building energy performance in new and exciting ways. Building energy benchmarking programs in the U.S. have led to innovative business models that have made disclosed energy data easily assessable through online platforms to building owners and contractors. Lessons from the U.S. experience that can be helpful for China include the following:

- Government leadership can help drive building disclosure and energy efficiency efforts
- Disclosure of building benchmarking information online can create a wealth of new data and business opportunities and drive development of the energy efficiency market

Big city, green city: As China expands building energy disclosure laws, it can learn from the experiences of cities like New York (pictured here), a leader in this sector in the US.

6. THE EU EXPERIENCE SUGGESTS ACCESS TO DATA CAN DRIVE EFFICIENCY

Both the U.S. and Europe offer relevant examples of how to implement disclosure based on local circumstances. In the EU, public buildings owned by the national, state or local governments have been a test bed for building energy disclosure since the 1990s. As early as 1997, Denmark required energy certification schemes for buildings.[76] Using public buildings as a testing ground for energy disclosure in the EU proved ideal given that these buildings were usually both owned and occupied by the same government agency. Fewer stakeholders resulted in simpler approval processes and easier implementation.[77]

The EU's 2002 Energy Performance of Buildings Directive (EPBD) was a game changer for building disclosure. The first collective action across 27 member states, the Directive introduced a framework for energy performance certification and required EU states to pass related legislation by 2006.[78] In practice, the first member states began implementing the energy disclosure requirements in 2009.[79] The EPBD broke new ground, requiring certification of new buildings at the time of construction as well as disclosure of energy performance certificates (EPC) for existing buildings at the time of sale or lease. The Directive also requires prominent posting of EPCs for large public buildings. And by 2010, the EU amended the EPBD to require even greater disclosure. According to the amended version (known as the "recast"), building owners are required to disclose energy information prior to property transactions such as leases or purchases.[80] The cost of the EPC is generally no more than a few hundred euros.[81]

Types of building energy labels

Asset labeling evaluates the energy performance of buildings based on the quality of the thermal envelope (such as insulation and windows), or the efficiency of the building's heating, ventilation and air conditioning (HVAC) system, irrespective of energy use. Asset labels are designed to facilitate direct comparisons of energy performance across similar buildings and are independent of occupant behavior.[82] Asset labeling helps prospective tenants and buyers make better economic choices and can encourage building owners and developers to invest in energy efficient building materials, equipment and retrofits. Nevertheless, challenges remain regarding how evaluators should record data in a standardized way that allows for fair comparison across structures.[83]

Operational labeling is based on actual energy use, such as the use reflected in a building's energy bill. Usage data reflects occupant behavior that may be unrelated to building quality, a factor that must be considered in evaluating such data for comparison purposes. Operational labeling can capture energy used by specific equipment in the home such as a television or a refrigerator.

Well-designed mandates, based on good benchmarking data, can encourage building retrofits.

European countries use both asset and operation labeling to inform buyers of a building's energy use characteristics. Most European countries require operational labels only for publicly-owned buildings, while private buildings are only required to offer asset labels to protect privacy.[84] The standards generally require an independent assessment that assigns a rating shown on the EPC. EPCs include reference values, such as current legal standards, to make it possible for consumers to compare and assess energy performance. The assessments are also accompanied by recommendations for cost-effective improvement options to raise the performance and rating of the building.[85]

So far, EPBD implementation has been slow. First, building energy labels may be poorly designed, placing too little prominence on energy costs that users say matter most (for example, in Germany the EPC displays the energy efficiency of a building by color and in kWh/m^2. This requires customers to convert information into expected utility costs, which requires expertise most buyers do not have).[86] Displays featuring energy consumption and corresponding letter grades would be more effective. Second, consumer awareness and understanding of EPC results is low. EPC results have also been shown to be inconsistent across countries, making data comparison difficult.[87] Third and perhaps most important, countries and localities differ sharply in their degree of implementation and compliance.[88]

China should take careful note of the challenges the EU has faced in promoting and implementing building energy disclosure requirements and determine how to best adapt lessons learned when designing disclosure programs domestically.

Lessons from the EU*:* When implemented in the context of supportive policies, building labeling and energy performance disclosure is a useful tool. The EU experience shows that three types of supportive policies enable disclosure to incentivize building retrofits:

- Regulatory mandates: Well-designed mandates, based on good benchmarking data, can encourage building retrofits
- Financing incentives: Government incentives should be designed to improve access to commercial financing and project services
- Market development: Training and capacity building across the supply chain and public awareness on the demand side can help increase demand for building energy efficiency

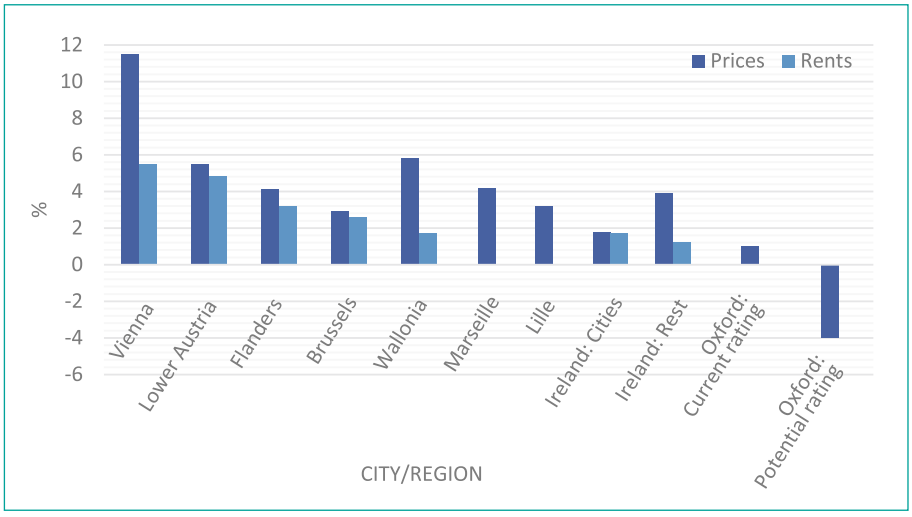
7. EU AND U.S. EXPERIENCE OFFER VALUABLE POLICY LESSONS

While there is rich international experience in measuring and disclosing building energy performance, so far few studies attempt to assess the impact of building energy disclosure laws on building energy consumption.[89] This is because energy disclosure laws are simply too new. Most EU states that have implemented the directive only started issuing energy performance certificates around 2009.[90] In the U.S., mandatory building energy benchmarking policies are similarly recent.

While few studies directly measure the impact of disclosure laws on energy consumption, research on the impact of disclosure on property value shed light onto the effectiveness of directives. The European Commission, for example, found that homebuyers must be willing to pay more for energy-efficient homes in order for energy-efficient building practices to become more prevalent.[91] The Commission's review of property value studies finds that better building energy scores are associated with higher sales prices and rental values in a variety of cities and countries. The effect holds in both warm and cold climates and for properties across the cost spectrum. For offices, buildings with the lowest energy scores yield the lowest rents.[92] Despite the useful insight they provide, the property value studies conducted so far do not necessarily address causality.

Survey-based analysis of home buying suggests mixed results for the EU program so far, partly because buyers do not place energy efficiency very high when evaluating properties.[94] Even with building energy labels, few

EFFECT OF ONE-LETTER GRADE IMPROVEMENT IN EPC RATING ON PRICE AND RENTS[93]



Source: European Commission, April 2013

homebuyers report that they considered energy efficiency when making a purchase.[95] That said, homebuyers also shared that they consider energy efficiency for both direct cost savings and as a sign of comfort.[96] Clearly, energy efficiency overlaps with other characteristics of house quality and attractiveness.

European survey-based studies on building retrofits show similarly mixed results. Building energy labels in Europe have been shown to encourage homeowners to perform energy-related retrofits and investments.[97] Yet respondents are often sheepish about admitting that the EPC label played a role in retrofit decisions.[98]

One drawback of the European studies of homeowners is their focus on individual dwellings as opposed to larger buildings or the building stock overall. The coming wave of U.S. building benchmarking data could begin to provide persuasive evidence of energy-related decisions taken in larger buildings, including large offices and apartment buildings like those typical of Manhattan and many areas of China.

Some such data is already being reported. The Energy Star program reports that of 35,000 buildings participating in its benchmarking program from 2008-2012, buildings reduced energy use intensity by 7% on average, after controlling for weather and climate effects. Buildings with the lowest initial score showed the greatest increase in absolute and percentage energy savings. If the trend continues on a linear track, the EPA noted, the buildings would collectively reduce their energy use 25% by 2020.[99] For New York, which now has the largest amount of building floor area subject to mandatory benchmarking, three years of data show declining energy use intensity for both offices and apartment buildings, but with insufficient data to call a trend.[100]

Nevertheless, with growing awareness about the contribution of buildings to carbon and conventional pollution emissions, benchmarking efforts are expected to help accelerate green building investment and efficiency upgrades in both new and retrofit projects.

Investment in building energy disclosure can drive energy savings in China, and perhaps add even greater savings as building energy efficiency is combined with demand-side management and distributed energy. As the market develops, regions that act first to provide the data to foster faster development of an energy efficiency services industry for buildings could benefit from a first-mover advantage.

Investment in building energy disclosure can drive energy savings in China, and perhaps add even greater savings as building energy efficiency is combined with demand-side management and distributed energy.

8. PAULSON DIALOGUE FINDS DISCLOSURE CREATES A MARKET FOR EFFICIENCY

China already has several years of experience with energy disclosure programs, including both mandatory and voluntary programs under the Three Star and LEED programs. China has also rapidly increased building code compliance while simultaneously developing more rigorous building codes. Nevertheless, more can be done to improve current disclosure platforms to ensure timely and effective comparison of similar buildings and subsequent building standards to drive efficiency. But in order for these efforts to be meaningful, China must simultaneously boost capacity to implement these standards.

The U.S. and EU experience with building energy benchmarking and disclosure offer several helpful lessons for China. Policymakers in China can reference these lessons as they continue to strengthen current disclosure platforms in place. Local lessons are also available. Building on China's progress, the Paulson Institute convened an expert Dialogue in June 2015 to discuss how to improve existing data collection methods, reporting processes and disclosure platforms to drive efficiency investments. The group confirmed the value of building energy disclosure in establishing a market for building energy services, and debated major obstacles that have slowed investment. Experts shared several suggestions for accelerating building energy efficiency in China:

- **Government buildings should lead by example:** Several participants highlighted the value of government buildings taking the lead in both disclosing energy use data as well as providing a framework for data collection and reporting. While current disclosure requirements target government buildings, more can be done to collect and report data consistently and on an annual basis within the same building stock to allow for effective comparison of energy use. According to experts, government leadership in data reporting frameworks can ensure that good practices are implemented across multiple levels and have a far reaching effect.
- **Engage the public to drive the market:** In order to boost demand for building energy efficiency services, greater effort should be placed on public engagement, which can be achieved through improved data availability. Data availability drives the market because it enables the private sector, including energy services companies, to employ big data techniques to assist building owners and operators identify buildings with the greatest potential for low-cost improvements. If publicly-available data remains limited, change will be slower, because efficiency investments will depend more on administrative measures and the initiative of individual building owners or operators.

According to experts, government leadership in data reporting frameworks can ensure that good practices are implemented across multiple levels and have a far reaching effect.

One of the most important takeaways from the dialogue was a generally shared confidence around the economic benefits of disclosure.

- **Provide comprehensive and enabling guidance to building owners:** As building energy disclosure platforms mature, systems must be in place to ensure that property owners are regularly informed about how their buildings compare to similar building types, aware of the resources available for improving building design and operation, and given clear guidance on the time period within which improvements must be made. Clear and comprehensive guidance will empower building owners to make the necessary improvements to properties and ensure that China benefits fully from its investments in disclosure.
- **Diversify types of building data collected:** Data collected for buildings should extend far beyond total energy use to include information such as square footage, appliances in use, insulation materials and occupancy rates, and combined with data on external factors such as climate. Taking multiple data points into account will help ensure accurate benchmarking and that the necessary energy efficiency improvements are made.
- **Strengthen building owner confidence and participation in disclosure:** Ensure that disclosure does not risk leakage of commercial secrets or personal information. When building owners and businesses are confident that energy data disclosure will not threaten commercial competiveness, they are more likely to disclosure data. Furthermore, recognizing property owners for their leadership in disclosure incentivizes ongoing participation and encourages participation by additional stakeholders.

Dialogue findings confirmed the value of energy use disclosure in creating a market for building energy efficiency. One of the most important takeaways from the dialogue was a generally shared confidence around the economic benefits of disclosure – several participants expressed the view that the economic benefits of disclosure greatly exceed the cost of implementation.

9. SUGGESTIONS AND CONCLUSIONS

Based on the outcomes of the June 2015 Paulson Dialogue on Building Energy Disclosure, and drawing upon suggestions of Chinese public policy experts and commercial leaders in the building energy field—as well as on the lessons learned from the EU and U.S. examples of building energy disclosure policies done at scale—the Paulson Institute has the following suggestions for building energy disclosure in China:

- **Expand the types of data collected** for benchmarking purposes to include information on square footage, occupancy rates, operational periods, and external factors that can impact energy use such as climate. Types of data collected and data categorization—for example, organize energy data by use type (lighting, heating, cooling,) within a single building as opposed to usage across a company's entire supply chain—should be standard for all buildings to ensure useful comparison.
- **Establish a firm legal foundation for building energy disclosure** (especially for public buildings) supported by strict and consistent implementation. While various mandates since 2008 encourage public building energy disclosure, building owners and operators report that they still lack a firm legal basis for publicly releasing building energy data or sharing it with appropriate government agencies and platforms. Several Dialogue participants specifically mentioned this obstacle as the leading factor preventing greater disclosure of energy data. A legal foundation could include specific guidance on the timing of disclosure, as well as a standardized template for energy disclosure from public buildings—such as what data should be disclosed, with what frequency, to whom, on what platform, and how it should be formatted to enable comparison between buildings.
- **Establish a timeline for expanding data disclosure to include more buildings, beginning with public buildings,** accompanied by a strong training program and incentives for disclosure. Several Dialogue participants agreed that public building energy disclosure can foster markets for building energy services where markets currently do not exist. Government offices, schools, hospitals and other public buildings are excellent starting points for these programs. But it takes time to foster understanding about the benefits of disclosure and the importance of taking action to improve building energy performance to oftentimes conservative administrators. In the U.S., public building energy scorecards took several years to develop, standardize, and implement: time was needed to get agencies onboard with the types of energy data disclosed, train building operators in data collection and formatting, and enable agencies to take initial remedial action to fix glaring energy efficiency problems prior to public data release.[101] In some cases, positive incentives, such as renovation funds that are conditional upon public release of

A significant reduction in building energy use will reduce conventional and greenhouse gas emissions from the building sector, helping China achieve its longer-term goals for air quality and climate change.

utility data—currently being tested in California as part of the "California Clean Energy Jobs Act" passed in 2012 and focused on providing funds for energy retrofits in public schools—can accelerate implementation and create a path forward for other buildings.[102] These were all important steps that took several years. With China's rapid pace of urbanization, the nation may need to accelerate development of building energy performance benchmarking and disclosure laws and practices to allow the market to deliver the billions of square meters of energy efficient buildings needed to help China achieve its carbon and energy intensity reduction goals.

While real-time building energy consumption disclosure for public buildings in China may still be sensitive is some localities, the Paulson Institute encourages the Chinese government to undertake steps to make data available, including establishing a strong legal foundation for disclosure to resolve legal concerns around data release. Although most experience suggests that concerted but gradual steps have been taken towards disclosure for various reasons, the faster legal concerns around data sharing and disclosure are overcome, the sooner the market will be able to play a more central role in driving efficiency. In cases where public disclosure is not yet an option, China can begin developing internal rating systems to compare similar public buildings, award top performers and develop improvement plans for those properties that lag behind. Over time this experience could build confidence towards public disclosure.

Equipped with credible data, the market could help deliver energy efficiency retrofits in buildings and accelerate the rate of which energy efficient designs are incorporated into new property developments. Benchmarking can also strengthen government building energy performance policies and help China achieve its low carbon city targets.[103] The Paulson Institute believes that consideration of the above suggestions, in tandem with progressively stronger building codes and enforcement, can help China achieve its goals for building energy savings. A significant reduction in building energy use will reduce conventional and greenhouse gas emissions from the building sector, helping China achieve its longer-term goals for air quality and climate change. In addition to its environmental benefits, the impact of increased demand for building energy efficiency will create jobs in service areas including energy auditing, retrofitting, and equipment upgrades. Linking the market to building energy efficiency through greater information disclosure and supporting policies is a clear win for both business and society.

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17. Nikhil Nadkarni and Harvey Michaels, "A New Model for Disclosing the Energy Performance of Residential Buildings," Massachusetts Institute of Technology, March 2012, accessed at http://web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf, "This information barrier prevents these market actors from valuing energy efficiency and the long-term costs of energy use. A customer's inability to identify efficient homes also represents a gap in the value chain of delivering energy efficiency: many customers want efficiency and cost savings, but there is a major information barrier between this demand and the number of retrofits being done by building owners."

18. Marianne Ryghaug and Knut H. Sørensen, "How energy efficiency fails in the building industry," Energy Policy, 2009, pages 984-991, accessed at http://wenku.baidu.com/view/a131f2e69b89680203d825ac.html, page 985. "Our research has identified three main obstacles to construction of energy-efficient buildings: (1) deficiencies in public policies to stimulate energy efficiency, (2) restrained government efforts to regulate the building industry, and (3) conservative practices in the building industry."

19. Marianne Ryghaug and Knut H. Sørensen, "How energy efficiency fails in the building industry," Energy Policy, 2009, pages 984-991, accessed at http://wenku.baidu.com/view/a131f2e69b89680203d825ac.html, page 988. "A number of institutional characteristics seem to generate conservatism and a lack of priority given to sustainability and energy efficiency in buildings, thus blocking the translation of energy efficiency policies into attractive avenues of action. First, the emphasis on short-term cost efficiency and the high pace in the design process result in an extensive reuse of solutions. It is therefore much more important for the firms to have an overview of earlier designs and solutions so that these can be copied than to have someone to engage with innovation and new technologies…The conditions for transfer of new knowledge from research institutions are poor. The building and construction industry in Norway is large and complex and dominated by small and medium sized enterprises that corporate on the design and construction of buildings…In Norway, the building industry scores among the lowest on investments in R&D and innovation activity."

20. "Energy Performance Certificates in Buildings and Their Impact on Transaction Prices and Rents in Selected EU Countries," European Commission (DG Energy), April 19, 2013, accessed at http://ec.europa.eu/energy/efficiency/buildings/doc/20130619energy_performance_certificates_in_buildings.pdf, "He identifies some of the common themes of the approach as the provision of information to help consumers make informed choices at the point of sale; rewards and incentives for innovation

at the best-performing end of the market; and mandatory minimum standards for performance to remove the worst performing products (Hinnells and Boardman, 2011)."

21. Nadav Malin and Tristan Roberts, "Energy Reporting: It's the Law," buildingfree.com, August 2012, accessed at http://www2.buildinggreen.com/article/energy-reporting-its-law, "Energy reporting mandates.... address existing buildings that are not otherwise being renovated, they don't ensure that the properties are managed for efficiency, and they don't encourage performance beyond the code minimum."

22. "Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries," European Commission (DG Energy), April 19, 2013, accessed at http://ec.europa.eu/energy/efficiency/buildings/doc/20130619energy_performance_certificates_in_buildings.pdf, "Labelling schemes are best understood in the context of a broader market transformation approach. As the name suggests, the approach aims to transform or shift whole markets. It grew out of product policy and has more recently been applied to the complex area of transforming property markets (Fawcett and Boardman, 2009; Killip, 2011a). Simply put, market transformation integrates policies into a strategy to ensure that the average product sold moves towards greater energy efficiency (Boardman, 2012)."

23. Leen Peeters and Matthijs De Deygere, "Impact of User Behaviour and Intelligent Control on the Energy Performance of Residential Buildings," Think E and 3E, August 20, 2014, accessed at http://www.leonardo-energy.org/sites/leonardo-energy/files/documents-and-links/he_3e_user_behaviour_20140820.pdf. "At this stage, the in home display's (IHD's) are mostly in experimental stages and applied in demonstration projects. Reported savings on household's energy consumption are in the rage of 5 to 20% using direct feedback, 10% when indirect feedback is used. Mostly, there numbers relate to experiments with limited time duration. When prolonging the experiments, different studies report lower savings rates. However, time does not undo all energy savings." "...provide a basis to discuss how these activities can be changed, taking into account the values and routines a family finds indispensable to maintain a good life."

24. Julie Osborn, Chuck Goldman, Nicole Hopper and Terry Singer, "Assessing the U.S. ESCO Industry Performance and Market Trends: Results from the NAESCO Database Project," Lawrence Berkeley National Laboratory and NAESCO, May 15, 2002, accessed at https://escholarship.org/uc/item/20r0720d.

25. Stephen Lacey, "How the ESCO Market for Efficiency can Continue Expanding," Greentech Media, September 26, 2013, accessed at http://www.greentechmedia.com/articles/read/How-the-ESCO-Market-for-Efficiency-Can-Continue-Expanding.

26. Edward Vine, "An international survey of the energy service company (ESCO) industry," Energy Policy, Volume 33, Issue 5, March 2005, accessed at http://www.sciencedirect.com/science/article/pii/S0301421503003008.

27. J.P. Painuly et al., "Promoting energy efficiency financing and ESCOs in developing countries: mechanisms and barriers," Journal of Cleaner Production, Volume 11, Issue 6, accessed at http://www.sciencedirect.com/science/article/pii/S0959652602001117.

28. Gailius Draugelis and Alberto U. Ang Co, "China: Improving Energy Efficiency in Public Institutions," World Bank, 2012, accessed at http://documents.worldbank.org/curated/en/2012/01/18481002/china-improving-energy-efficiency-public-institutions, page xvi.

29. Stephen Lacey, "Who Will Emerge as the Opower of Commercial Building Efficiency?," Greentech Media, March 17, 2014, accessed at http://www.greentechmedia.com/articles/read/Will-There-Ever-Be-an-Opower-of-Commercial-Building-Efficiency.

30. Stephen Lacey, "Who Will Emerge as the Opower of Commercial Building Efficiency?," Greentech Media, March 17, 2014, accessed at http://www.greentechmedia.com/articles/read/Will-There-Ever-Be-an-Opower-of-Commercial-Building-Efficiency.

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32. Nikhil Nadkarni and Harvey Michaels, "A New Model for Disclosing the Energy Performance of Residential Buildings," March 2012, accessed at http://web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf. "Building labeling can create a new data resource for states, cities, and utilities as they work to identify efficiency needs. Under the current conditions, states, cities, and utilities have access to a few data streams: property assessor reports (covering home size, age, etc.), home energy bills, infrared imagery (being piloted), and advanced metering data (where applicable). Building labels, especially if generated through on-site home assessments, can provide a new data stream to cities, states, and utilities that captures the housing stock's ratings, shape of building systems, and retrofit needs. Using this rich dataset in conjunction with the existing data enables these stakeholders to better identify residential efficiency potential, create more powerful building models, and develop targeted incentives for home upgrades."

33. Jeff St. John, "Honest Buildings: 250,000 New York City Buildings Online," Greentech Media, May 9, 2012, accessed at http://www.greentechmedia.com/articles/read/honest-buildings-250000-new-york-city-buildings-online.

34. Jeff St. John, "Honest Buildings: 250,000 New York City Buildings Online," Greentech Media, May 9, 2012, accessed at http://www.greentechmedia.com/articles/read/honest-buildings-250000-new-york-city-buildings-online.

35. "能效信贷指引"[Energy Efficiency Credit Guidelines], NDRC and China Banking Regulatory Commission, January 19, 2015, accessed at http://www.cbrc.gov.cn/chinese/home/docView/9B09B258DCCF4E439A9DE352051885E8.html.

36. "能效信贷指引"[Energy Efficiency Credit Guidelines], NDRC and China Banking Regulatory Commission, January 19, 2015, accessed at http://www.cbrc.gov.cn/chinese/home/docView/9B09B258DCCF4E439A9DE352051885E8.html. Article 7: "Low-energy and ultra-low-energy new energy-efficient buildings exceeding the current national standard, new 2-star and 3-star green buildings and green affordable housing projects that meet the national evaluation standard for green buildings, energy efficiency retrofitting of existing buildings, green retrofit projects, buildings utilizing renewable energy, energy efficiency retrofitting of central heating and cooling systems..."

37. Gailius Draugelis and Alberto U. Ang Co, "China: Improving Energy Efficiency in Public Institutions," World Bank, 2012, accessed at http://documents.worldbank.org/curated/en/2012/01/18481002/china-improving-energy-efficiency-public-institutions, page 136.

38. "民用建筑节能条例," [Regulations on Energy Performance of Civilian Buildings], State Council, August 1, 2008, accessed at http://www.gov.cn/flfg/2008-08/07/content_1067062.htm; "公共机构节能条例" [Regulations on Energy Performance of Public Buildings], State Council, August 1, 2008, accessed at www.gov.cn/zwgk/2008-08/11/content_1069566.htm; "民用建筑能效测评标识技术导则"[Guidance on Energy Efficiency Evaluations and Labeling for Civilian Buildings], Ministry of Housing and Urban Rural Development, July 8, 2008, accessed at http://www.mohurd.gov.cn/dfxx/200807/t20080709_175166.html.

39. "民用建筑节能条例," [Regulations on Energy Performance of Civilian Buildings], State Council, August 1, 2008, accessed at http://www.gov.cn/flfg/2008-08/07/content_1067062.htm. "县级以上地方人民政府节能工作主管部门应当会同同级建设主管部门确定本行政区域内公共建筑重点用电单位及其年度用电限额。县级以上地方人民政府建设主管部门应当对本行政区域内国家机关办公建筑和公共建筑用电情况进行调查统计和评价分析。国家机关办公建筑和大型公共建筑采暖、制冷、照明的能源消耗情况应当依照法律、行政法规和国家其他有关规定向社会公布。"

40. "用对标与公示撬动建筑节能市场-纽约等城市国际经验的启示"[Using Energy Disclosure to Pry Open the Building Energy Efficiency Market – International Case Studies Including New York], Natural Resources Defense Council, April 2014, accessed at http://www.efchina.org/Reports-zh/reports-20130514-zh.

41. "用对标与公示撬动建筑节能市场-纽约等城市国际经验的启示"[Using Energy Disclosure to Pry Open the Building Energy Efficiency Market – International Case Studies Including New York], Natural Resources Defense Council, April 2014, accessed at http://www.efchina.org/Reports-zh/reports-20130514-zh.

42. Gailius Draugelis and Alberto U. Ang Co, "China: Improving Energy Efficiency in Public Institutions," World Bank, 2012, accessed at http://documents.worldbank.org/curated/en/2012/01/18481002/china-improving-energy-efficiency-public-institutions, page 60. "In China, MOHURD has already developed a national building energy rating and labeling system and is piloting the effort in a number of provinces and municipalities. At this point, however, this building labeling system does not include recommended energy efficiency improvements and public disclosure (in the building or on the internet) is not required."

43. "China: GEF grant to support scaling-up energy efficiency and renewable energy in cities," World Bank, April 26, 2013, accessed at http://www.worldbank.org/en/news/press-release/2013/04/26/china-gef-grant-to-support-scaling-up-energy-efficiency-and-renewable-energy-in-cities; Carolyn Szum, "Research on Very Low-Energy Building Operations and Management Methods," Lawrence Berkeley National Laboratory, August 25, 2014, accessed at https://cercbee.lbl.gov/sites/all/files/attachments/Day%201-Panel%204-LowE-ICF-Carolyn.FINAL_.pdf.

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25, 2014, accessed at https://cercbee.lbl.gov/sites/all/files/attachments/Day%201-Panel%204-LowE-ICF-Carolyn.FINAL_.pdf.

45. Carolyn Szum, "Research on Very Low-Energy Building Operations and Management Methods," Lawrence Berkeley National Laboratory, August 25, 2014, accessed at https://cercbee.lbl.gov/sites/all/files/attachments/Day%201-Panel%204-LowE-ICF-Carolyn.FINAL_.pdf.

46. Paulson Institute Dialogue, Building Energy Disclosure, June 11, 2015.

47. Broader recommendations on China's green urbanization and the role of building energy efficiency, including disclosure, and providing public services in greener buildings are found in the Green Urbanization Chapter of Urban China: Toward Efficient, Inclusive and Sustainable Urbanization, a 2014 publication by the State Council's Development Research Center and the World Bank.

48. Anke Meyer, Robert Taylor, Gailius Draugelis and Alberto U. Ang Co, "China: Improving Energy Efficiency in Public Institutions," World Bank, 2012, accessed at http://documents.worldbank.org/curated/en/2012/01/18481002/china-improving-energy-efficiency-public-institutions. The report highlights the need for better coordination between government incentives and commercial financing channels as well as establishing accounting and budgeting procedures to authorize multi-year payments for Energy Performance Contracting, a key market mechanism.

49. "Energy Star Overview of 2013 Achievements," U.S. Environmental Protection Agency, 2014, accessed at http://www.energystar.gov/sites/default/uploads/about/old/files/EnergyStar_POY_4page_040414_PrintReady_508compliant.pdf?806d-7b17.

50. Tyler Wells Lynch, "Your Next Fridge Will Be More Efficient. Here's Why," Refrigerators Reviewed, September 16, 2014, accessed at http://refrigerators.reviewed.com/features/everything-you-need-to-know-about-the-new-energy-star-fridge-standards.

51. Nikhil Nadkarni and Harvey Michaels, "A New Model for Disclosing the Energy Performance of Residential Buildings," Massachusetts Institute of Technology, March 2012, accessed at http://web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf. "Indeed, the few existing standards, such as LEED and Energy Star Homes, are mostly limited to a relatively small number of new homes."

52. Infographic: LEED in the World, United States Green Building Council, May 2013, accessed at http://www.usgbc.org/articles/infographic-leed-world; Nina Khanna et al., Comparative Policy Study for Green Buildings in U.S. and China, Lawrence Berkeley National Laboratory, April 2014, accessed at https://china.lbl.gov/sites/all/files/green_buildings_policy_comparison.pdf, page 8. Total commercial building floor space in the U.S. is more than 6.7 billion square meters. The latest year of reported national statistical data on commercial buildings is 2003.

53. "Facts and Stats," Energy Star, accessed July 14, 2015, at http://www.energystar.gov/buildings/about-us/facts-and-stats.

54. Andrew Burr, Cliff Majersik and Nick Zigelbaum, "The Future of Building Energy Rating and Disclosure Mandates: What Europe can Learn from the United States," Institute for Market Transformation, 2010, accessed at http://www.imt.org/uploads/resources/files/7.5IEECBPaper33.pdf.

55. Nate Brevard, "Building Energy Disclosure Laws: The WegoWise Guide," WegoWise, December 19, 2014, accessed at http://blog.wegowise.com/2014-03-27-building-energy-disclosure-laws-the-wegowise-guide.

56. Nadav Malin and Tristan Roberts, "Energy Reporting: It's the Law," Buildinggreen.com, August 2012, accessed at http://www2.buildinggreen.com/article/energy-reporting-its-law, "The State of Washington first enacted a transactional disclosure-based law (with disclosure required only when selling or renting the building), says Baker, which Seattle was able to build on with its annual reporting law. The laws have spurred the development of a vendor community competing to gain customers for benchmarking; the vendors then can offer broader energy-efficiency and building management services."

57. Susan DeFreitas, "New York City Building Energy Benchmarking Results a First," Greentech Media, September 27, 2012, accessed at http://www.greentechmedia.com/articles/read/new-york-city-building-energy-benchmarking-results-a-first.

58. Local Laws of the City of New York for the Year 2009, Number 84, accessed at http://www.nyc.gov/html/planyc2030/downloads/pdf/ll84of2009_benchmarking.pdf. According to Local Law 84, benchmarking is "to input and submit…the total use of energy and water for a building for the previous calendar year and other descriptive information for such building as required by the benchmarking tool."

59. Local Laws of the City of New York for the Year 2009, Number 84, accessed at http://www.nyc.gov/html/planyc2030/downloads/pdf/ll84of2009_benchmarking.pdf, page 8. "The department of finance shall make information generated by the benchmarking tool available to the public on the internet no later than September 1, 2011, and no later than every September first thereafter for city buildings, no later than September 1, 2012, and no later than every September first thereafter for covered buildings whose primary use is not residential, as determined by the department of finance, and no later than September 1, 2013, and no later than every September first thereafter for covered buildings whose primary use is residential, as determined by the department of finance. Such information shall include, but need not be limited to: (i) the energy utilization index, (ii) the water use per gross square foot, (iii) where available, a rating that compares the energy and water use of the building to that of similar buildings, and (iv) a comparison of data across calendar years for any years such building was benchmarked. Information generated by the benchmarking tool for the 2009 calendar year for city buildings, for the 2010 calendar year for covered buildings, and for the 2011 calendar year for covered buildings whose primary use is residential, as determined by the department of finance, shall not be disclosed."

60. Susan DeFreitas, "New York City Building Energy Benchmarking Results a First," Greentech Media, September 27, 2012, accessed at http://www.greentechmedia.com/articles/read/new-york-city-building-energy-benchmarking-results-a-first.

61. "New York City Local Law 84 Benchmarking Report," PlaNYC, New York City, September 2014, accessed at http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf, page 12. "The square footage required to benchmark included 2.3 billion sq. ft. of private sector buildings and over 281 million square feet of public sector buildings."

62. "New York City Local Law 84 Benchmarking Report," PlaNYC, New York City, September 2014, accessed at http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf. Appendix C Endnotes, page 47. "According to the Department of Finance's (DOF) database of taxable properties and the Department of Citywide Administrative Services' (DCAS) database of City buildings, New York's citywide gross floor area is estimated to be 5.75 billion square feet. Proportionally, properties required to comply under the Greener, Greater Buildings Plan (GGBP) make up 2.58 billion sq. ft., which is 45 percent, or nearly half of citywide gross floor area."

63. "New York City Local Law 84 Benchmarking Report," PlaNYC, New York City, September 2014, accessed at http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf, page 12."

64. Local Laws of the City of New York for the Year 2009, Number 84, accessed at http://www.nyc.gov/html/planyc2030/downloads/pdf/ll84of2009_benchmarking.pdf, page 6. "Owners of covered buildings shall maintain such records as the department determines are necessary for carrying out the purposes of this article, including but not limited to energy and water bills and reports or forms received from tenants. Such records shall be preserved for a period of three years, provided that the commissioner may consent to their destruction within that period or may require that such records be preserved longer than such period. At the request of the department, such records shall be made available for inspection and audit by the department at the place of business of the owner or at the offices of the department during normal business hours."

65. "New York City Local Law 84 Benchmarking Report," PlaNYC, New York City, September 2014, accessed at http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf, page 33.

66. Benchmarking Data Disclosure and Reports, 2013 Energy and Water Data Disclosure for Local Law 84, April 28, 2015, NYC's Mayor's Office of Sustainability, accessed at http://www.nyc.gov/html/gbee/html/plan/ll84_scores.shtml; "New York City Local Law 84 Benchmarking Report," PlaNYC, New York City, September 2014, accessed at http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf, page 47.

67. "Montgomery Is First County with Benchmarking Law," Institute for Market Transformation, April 29, 2014, accessed at http://www.imt.org/news/the-current/montgomery-is-first-county-with-benchmarking-law.

68. "Urban China: Toward Efficient, Inclusive and Sustainable Urbanization," World Bank, July 2014, accessed at https://openknowledge.worldbank.org/handle/10986/18865. This World Bank report includes a comprehensive discussion of spatial planning and green urbanization policies.

69. "Office of Management and Budget Sustainability and Energy Scorecards, Council on Environmental Quality," accessed on June 18, 2015 at https://www.whitehouse.gov/administration/eop/ceq/sustainability/omb-scorecards.

70. "Leading by Example in Environmental, Energy, and Economic Performance, United States Government," accessed on June 18, 2015 at http://archive-sustainability.performance.gov/.

71. "Office of Management and Budget Scorecard on Sustainability/

Energy," Department of the Interior, January 2015, accessed at http://www.doi.gov/greening/prfm_matrix/upload/OMB-Scorecard-January-2015-2.pdf; "Office of Management and Budget Scorecard on Sustainability/Energy," Department of Defense, January 2015, accessed at http://www.denix.osd.mil/sustainability/upload/DoD-Final-Jan-2015-OMB-Scorecard-public-version.pdf.

72. "Office of Management and Budget Scorecard on Sustainability/Energy," Department of State, January 2015, accessed at http://www.state.gov/documents/organization/243530.pdf.

73. Building Energy Asset Score, Department of Energy, accessed on June 18, 2015 at http://energy.gov/eere/buildings/building-energy-asset-score.

74. Andrew C. Burr, "Energy Disclosure and the New Frontier for American Jobs, Institute for Market Transformation," March 2012, accessed at http://www.imt.org/uploads/resources/files/Energy_Disclosure_New_Frontier.pdf.

75. Andrew C. Burr, et al., "Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy," Institute for Market Transformation and University of Massachusetts-Amherst, March 2012, http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/PERI-IMT-2012-Analysis_Job_Creation.pdf.

76. Kristen Engelund Thomsen, "Denmark: Impact, Compliance, and Control of Energy Legislation, ASIEPI International Workshop," Danish Building Research Institute, Aalborg University, September 2009, accessed at http://www.asiepi.eu/fileadmin/files/WP3/18_Denmark.pdf, page 8.

77. Charles P. Ries, Joseph Jenkins, and Oliver Wise, "Improving the Energy Performance of Buildings: Learning from the European Union and Australia," RAND Environment, Energy, and Economic Development, 2009, accessed at https://books.google.com/books?hl=en&lr=&id=nX0Zt9i4FKYC&oi=fnd&pg=PP2&dq=history+of+building+energy+disclosure+in+the+european+union&ots=uBx8LfqSW-&sig=ZJF017HF_YuCEBN151OKZn_Qp4I#v=onepage&q=disclosure&f=false. Pages 26 and 37.

78. Mark Levine et al., "Building Energy-Efficiency Best Practice Policies and Policy Packages," Lawrence Berkeley National Laboratory, American Council for Energy Efficient Economy and Sustainability Consulting, October 2012, accessed at https://escholarship.org/uc/item/5206n1xr#page-71. Page 44.

79. "Energy Performance Certificates in Buildings and Their Impact on Transaction Prices and Rents in Selected EU Countries," European Commission (DG Energy), April 19, 2013, accessed at http://ec.europa.eu/energy/efficiency/buildings/doc/20130619-energy_performance_certificates_in_buildings.pdf. "Directive 2002/91/EC required Member States to bring into force the necessary laws, regulations and administrative provisions by 4 January 2006 at the latest…Bring the necessary laws, regulations and administrative provisions into force by 4 January 2006, or if extended by 4 January 2009."

80. "Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries," European Commission (DG Energy), April 19, 2013, accessed at http://ec.europa.eu/energy/efficiency/buildings/doc/20130619-energy_performance_certificates_in_buildings.pdf. "it strengthened the role of EPCs in raising awareness of better energy performance of buildings by demanding publication of the energy performance indicator of the EPC at the time of advertising a building for sale or rental rather than only at the time of signing a purchase agreement or rental contract."

81. Eduardo Maldonado et al., "Executive summary report on the interim conclusions of the concerted action supporting transposition and implementation of the Directive 2002/91/EC," Intelligent Energy Europe, February 2010, accessed at http://www.epbd-ca.org/Medias/Pdf/CA_Summary%20report_Feb2010.pdf. See page 5.

82. "Commercial Building Asset Rating/Labeling White Paper, Massachusetts Department of Energy Resources," January 18, 2010, accessed at http://www.mass.gov/eea/docs/doer/energy-efficiency/commercial-asset-rating-white-paper-presentationl-1-11.pdf, page 9.

83. "An MPG Rating for Commercial Buildings: Establishing a Building Energy Asset Labeling Program in Massachusetts," Massachusetts Department of Energy Resources, December 2010, accessed at http://www.mass.gov/eea/docs/doer/energy-efficiency/asset-rating-white-paper.pdf, pages 20-21.

84. Nadav Malin and Tristan Roberts, "Energy Reporting: It's the Law," August 2012, accessed at http://www2.buildinggreen.com/article/energy-reporting-its-law. "European countries use both "asset labels", which rate the predicted performance of a building based on how it's designed and built, and "operational labels," which are based on actual energy use." "Most European countries require operational labels only for publicly owned buildings, while private buildings only have to offer asset labels;" Nikhil Nadkarni and Harvey Michaels, "A New Model for Disclosing the Energy Performance of Residential Buildings," MIT Energy Efficiency Strategy Project, March 2012, accessed at http://web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf, page 1. "Yet existing approaches to disclosure are fraught with numerous issues, including a lack of connection to the retrofit process, poor visibility of ratings, and a lack of balance between transparency for stakeholders and homeowner privacy;" Nadav Malin and Tristan Roberts, "Energy Reporting: It's the Law," accessed on May 12, 2015 at https://www2.buildinggreen.com/article/energy-reporting-its-law. While operational labels can provide important information that can lead to recommendations for equipment use and behavioral changes to improve building efficiency, these labels also reveal details about occupant behavior, which has led to concerns about occupant privacy.

85. "What is the EPBD?," Ideal EPBD, Intelligent Energy Europe, accessed January 17, 2015, at http://www.ideal-epbd.eu/index.php?option=com_content&view=article&id=2&Itemid=2&lang=en.

86. Hermann Amecke, "Buildings Energy Efficiency in China, Germany, and the United States," Climate Policy Initiative, April 2013, accessed at http://climatepolicyinitiative.org/wp-content/uploads/2011/12/Effectiveness-of-Energy-Performance-Certificates.pdf. "The EPC does not show the information that purchasers want: financial implications. Results: The financial implications of energy efficiency matter most to purchasers. Yet, … in Germany, the EPC only shows the energy efficiency of a dwelling by color (green to red) and in kWh/m2. The conversion of this information into expected utility costs in EUR requires expertise that most purchasers likely do not have."

87. "The final recommendations of the ASIEPI project: How to make EPB-regulations more effective? Summary report," Intelligent Energy Europe, March 31, 2010, accessed at http://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/asiepi_access_the_results._en.pdf. See page 11.

88. Yamina Saheb and Ellina Levina, "Buildings Energy Efficiency Policies Codes, Labels and Incentive Schemes," International Energy Agency, 2012, accessed at http://www.iea.org/media/workshops/2012/buildingsrussia/saheb2.pdf. See page 13.

89. Robert N. Stavins et al., "An Economic Perspective on Building Labeling Policies," Analysis Group, March 28, 2013, accessed at http://www.boma.org/research/newsroom/press-room/Documents/An%20Economic%20Perspective%20on%20Building%20Labeling%20Policies.pdf. "Evidence on the impact of these programs on energy use is very limited. The only study we are aware of that directly addresses this question is a study of the EPC program in Denmark, which found that the introduction of EPCs did not lead to any change in residential energy use."

90. Yamina Saheb and Ellina Levina, "Buildings Energy Efficiency Policies Codes, Labels and Incentive Schemes," International Energy Agency, 2012, accessed at http://www.iea.org/media/workshops/2012/buildingsrussia/saheb2.pdf. "What is the implementation status of EPCs?"

91. "Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries," European Commission, April 19, 2013, accessed at http://ec.europa.eu/energy/efficiency/buildings/doc/20130619energy_performance_certificates_in_buildings.pdf, "The idea of the vicious circle of blame is to show how different actors in the (commercial) property market (e.g. occupiers, contractors, developers, investors) are ready to take action but depend on, or say they depend on, other actors to take action before they can respectively demand, build, commission or fund sustainable buildings. The dynamics are likely to be similar in the residential market and indeed Bloom et al. (2011) make a very similar observation about the United States residential property market: "for energy-efficient building practices to become more prevalent, it must be established that homebuyers are willing to pay more for energy-efficient homes."

92. Nils Kok and Maarten Jensson, "The impact of energy labels and accessibility on office rents," Energy Policy 46, January 2012, accessed at http://www.researchgate.net/publication/254408508_The_impact_of_energy_labels_and_accessibility_on_office_rents.

93. "Energy Performance Certificates in Buildings and Their Impact on Transaction Prices and Rents in Selected EU Countries," European Commission (DG Energy), April 19, 2013, accessed at http://ec.europa.eu/energy/sites/ener/files/documents/20130619-energy_performance_certificates_in_buildings.pdf, page 15.

94. Hermann Amecke, "Buildings Energy Efficiency in China, Germany, and the United States," Climate Policy Initiative, April 2013, accessed at http://climatepolicyinitiative.org/wp-content/uploads/2011/12/Effectiveness-of-Energy-Performance-Certificates.pdf. Purchasers do not care strongly about energy efficiency. Results: Energy efficiency is considered to be only a minor purchasing criterion, ranking 9th out of 13 criteria measured in our survey. The relevance of the EPC is likely limited by the relevance of the

purchasing criterion which it informs."

95. Julia Backhaus et al., "Key findings & policy recommendations to improve effectiveness of Energy Performance Certificates & the Energy Performance of Buildings Directive," Intelligent Energy Europe, 2011, accessed at http://www.ideal-epbd.eu/download/pap/Final_IDEAL_EPBD_result_oriented_report.pdf. "The Energy Performance Certificate played a small - if any - role in respondents' purchasing decisions."

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