RESEARCH REPORT
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RAISING THE ROOF:
HOW TO CREATE CLIMATE WEALTH THROUGH EFFICIENT BUILDINGS

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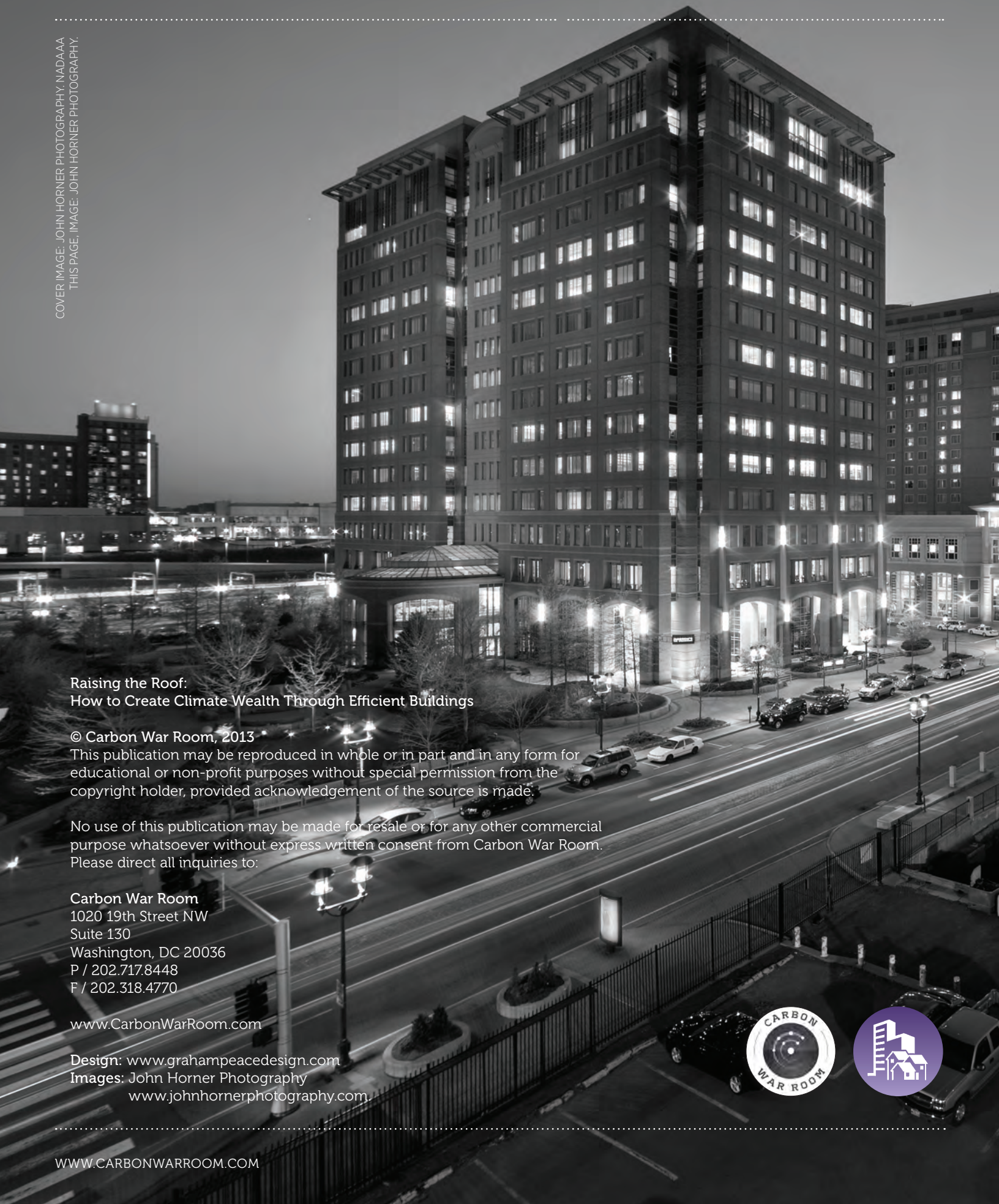

Raising the Roof:
How to Create Climate Wealth Through Efficient Buildings

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A Letter to Our Readers

Amigas y Amigos,

Climate change presents one of the greatest challenges in human history—a challenge that transcends national boundaries, income, ideology, race, and ethnicity. Overcoming that challenge will result in one of the greatest wealth creation opportunities ever—a modern industrial revolution that could radically reshape society and our planet. The world can no longer afford to be intimidated by the magnitude of the climate crisis, nor into believing that we must choose between economic prosperity and environmental security.

The Carbon War Room takes a global, sector-based approach. Our mission is to accelerate the adoption of proven clean technologies and innovative business models in order to achieve profitable, gigaton-scale reductions of carbon emissions. One sector in which the Carbon War Room is actively engaged is Energy Efficiency in the Built Environment (EEBE)—a sector with an estimated market potential of $87 billion per year, and an equally substantial opportunity to reduce greenhouse gas emissions.[1] In 2010, the Carbon War Room launched the Green Capital Global Challenge (GCGC) to help cities around the world use innovative mechanisms to support energy efficiency in their built environments, thereby bringing capital, energy technologies, and jobs to their citizens in a sustainable and profitable way. Having concluded the GCGC, we are now, with this paper, able to share the insights we gained over the course of that Challenge with cities and building management groups around the world. We hope that this information will be used to stimulate new initiatives or accelerate existing initiatives in readers' own cities.

This publication, "Raising the Roof: How to Create Climate Wealth Through Efficient Buildings", is a collection of observed global best practices as they relate to finance, technology, and policy. Whether discussing San Francisco's benchmarking ordinance, the UK's Green Deal, or Melbourne's 1200 Buildings program, this guide is meant to provide real estate owners, capital providers, entrepreneurs, and policy makers with a point of reference on how energy efficiency projects are currently working (or not) around the world. We also provide a selection of further resources to facilitate more in-depth research.

Our work on energy efficiency continues as an active project at the Carbon War Room. Please stay or get in touch with us to let us know how we can help you.

Best Regards,

José María Figueres, President, Carbon War Room

[1] Robins, Nick, Charanjit Singh, Robert Clover, Zoe Knight, and James Magness. "Sizing the Climate Economy." Rep. N.p.: HSBC Global Research. 2010.

Executive Summary

EXECUTIVE SUMMARY

The implementation of measures to achieve EEBE (Energy Efficiency in the Built Environment)—whether on a building-by-building basis or in a portfolio of buildings—is a multi-step process involving benchmarking, auditing, implementation, measurement and verification, and ongoing commissioning. While it is generally accepted that most buildings leak energy, and that most asset owners leave money on the table by not undertaking efficiency retrofits, inertia is a powerful force, causing stakeholders to stick with the status quo rather than enter the unchartered waters of EEBE projects. Compounding that inertia is a historical lack of private capital to finance retrofits, a "split-incentive" barrier, and a persistent uncertainty as to whether substantial savings will actually be realized through energy efficiency upgrades. It is thus understandable why so few projects have been completed relative to EEBE's potential to generate savings.

Implementing EEBE projects offers a myriad of benefits, including, but not limited to, direct bill savings, increased comfort, higher productivity, strong paybacks on investment, and the reduction of carbon emissions. Any attempt to demystify and otherwise help to accelerate the EEBE industry is timely. In working with 30 global cities over the past three years, the Carbon War Room has found that the current finance, technology, and policy conditions are sufficient to unlock hundreds of billions of dollars of capital for EEBE projects across the world—the challenge is working out how to get it done quickly and on a large scale.

IMAGE: JOHN HORNER PHOTOGRAPHY.

KEY INSIGHTS

The Context

- **Emissions:** Globally, buildings are responsible for 40 percent of energy consumption and 33 percent of CO_2e emissions.[2] In the wealthier cities of the industrialized world, most of that energy is used by residential and commercial buildings for lighting and temperature control.[3]

- **Market size:** HSBC estimates that the total size of the current EEBE market is $87 billion per year today, and the potential market in 2020 to be $245 billion per year.[4] The US, China, France, Germany, and UK currently account for 75 percent of the global EEBE market.[5] McKinsey forecasts potential US savings of $1.2 trillion against an investment of $520 billion by 2020. Such savings represent a reduction in energy consumption of 9.1 quadrillion BTUs, which would prevent the release of 1.1 gigatons of CO_2e emissions each year.

Key Barriers

- **Misaligned financial incentives:** A significant "split-incentive" challenge exists in buildings in which the landlord does not pay the energy bills of the property. Simply put, tenants are often unwilling and/or unable to incur the upfront capital expenditures of implementing a retrofit, as they will not necessarily capitalize on those long-term savings. At the same time, building owners are often unwilling to pay for efficiency measures given that they will not accrue a short-term benefit from the resultant lower energy bills. This split incentive is one of the single biggest obstacles to EEBE across sub-sector and geography.

- **Upfront capital costs:** Comprehensive energy efficiency retrofits that result in 20 percent or higher reductions in energy consumption often require a substantial upfront investment. Building owners might not have the ability to finance the upfront capital expenditure.

- **Associated risk:** Though upfront costs are a problem, large amounts of capital are, in fact, currently available for EEBE programs. That capital is not being accessed because many types of EEBE investments and asset classes are new to the market, so the perceived risk associated with such investments is high. The risk can be mitigated, however, through more data, innovative insurance packages, and inserting credit enhancements into the financing structures.

- **Lack of information:** Often, building owners lack the time, knowledge, and/or the capacity to differentiate between substance and noise when it comes to the available retrofit opportunities. Many building owners are not aware of the data and reports illustrating that more efficient buildings result in higher tenant occupancy rates, lower operating expenses, and lower default rates. Many building owners are not aware of the data and reports illustrating that more efficient buildings result in higher tenant occupancy rates, lower operating expenses, and lower default rates.

- **Legal/structural challenges:** Many buildings have mortgage covenants in place that prevent the incursion of further debt or changes to the structure of the building without explicit consent of the lender. Furthermore, some buildings may be unable to incur additional debt due to their being owned as Special Purpose Vehicles (SPVs), which lack additional assets that could serve as collateral.

[2] http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2124
[3] http://www.rrojasdatabank.info/statewc08093.4.pdf
[4] http://earthscience.bcsdk12.org/earthscienceiscool/media/climatechange/documents/2010%20Financing%20Energy%20Efficiency%20Building%20Retrofits.pdf
[5] http://www.pikeresearch.com/research/energy-efficient-buildings-global-outlook


PARKING

- **Undervaluing energy efficiency:** Competing priorities, such as the need to purchase new assets or to make other improvements in a building can divert available capital away from energy efficiency, since EEBE projects are not often seen as a priority compared to "core business" needs.

- **Inertia:** There is a tendency for energy efficiency measures to be deployed in a reactive manner, that is, to be only deployed when an existing piece of equipment fails. This results in a sub-optimal outcome in which substantial savings are missed, as the largest savings can be achieved when owners take a holistic, systems-wide perspective, addressing all aspects of their building at once.

- **Embryonic markets:** While energy efficiency has been widely described as "low-hanging fruit" for 30 years, the world still lacks a vibrant marketplace for funding EEBE projects, and securitization of off-balance-sheet finance has not yet taken off. Despite its immense promise, energy efficiency is still at an immature stage relative to other cleantech sectors like solar, wind, and biomass.

Key Opportunities

- **Technology:** In the last several years, a whole suite of "big data" products for EEBE have been developed and profitably deployed; these technologies range from ones that simply track how energy has been or is currently being consumed (assisting with benchmarking, retro-commissioning, and audits) to more robust measures that use analytics to optimize energy consumption patterns (optimization, demand response, etc.). Many of these software solutions often do not require any upfront hardware expenditures and can save building owners 3–15 percent of their energy costs, which represents tens of billions of dollars of savings globally.

- **Finance:** 2013/14 will be a transitional and transformative period for energy efficiency finance as several innovative schemes like PACE, on-bill, and Energy Savings Agreements (ESAs) enter post-launch phase and expand their scope and scale. The opportunity for energy efficiency to be included in Master Limited Partnerships (MLP) and designated as a Real Estate Investment Trust (REIT) could also greatly enable new pools of capital to invest into efficiency projects.

- **Policy:** While many national governments are using top-down approaches to EEBE, the Carbon War Room also found many compelling examples of local municipalities using the legal and policy levers at their disposal, as well as regional/multi-national efforts that galvanize nations to act. For example, at the national level, Singapore has recently instituted the Energy Conservation Act, Australia launched its NABERS benchmarking scheme, and the UK published its "Energy Efficiency Strategy".[6] At the sub-national level, various US states have passed "decoupling" laws, which enable utilities to obtain remuneration from alternative sources besides simply selling the most energy. On the macro level, the European Union has an upcoming Energy Efficiency Directive, which will require regular energy audits across all large businesses in the region.

- **Demand stimulation and aggregation:** The widespread adoption of energy efficiency requires aggressive marketing and outreach programs in order to both stimulate and aggregate demand—however, many proponents of EEBE seem to treat such programs as non-core activities in relation to their efforts. EEBE demand has often been treated with a "if we build it, they will come mentality" – which clearly has not worked. Strong consideration to demand aggregation needs to be strategized at the beginning of any large-scale project and implemented with sufficient resources.

- **Process improvement:** In the public sector (and parts of the private sector where EEBE would be considered non-core) buyer sophistication and time available are limited, and procurement policy can be restrictive. Process improvement that, for example, pre-approves suppliers and spells out clear action steps can yield significant and accelerated results. An example is London's RE:FIT program, which is now being rolled out nationally across the UK.[7]

The largest savings can be achieved when owners take a holistic, systems-wide perspective, addressing all aspects of their building at once

[6] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65602/6927-energy-efficiency-strategy--the-energy-efficiency.pdf
[7] http://www.refit.org.uk/

IMAGE: JOHN HORNER PHOTOGRAPHY.

Introduction

- Energy Efficiency in the Built Environment (EEBE) represents one of the most cost-effective means of combating climate change, and also one of the most significant opportunities for economic growth in the 21st century.

- EEBE projects could help buildings achieve as much as an 80 percent reduction in energy use.

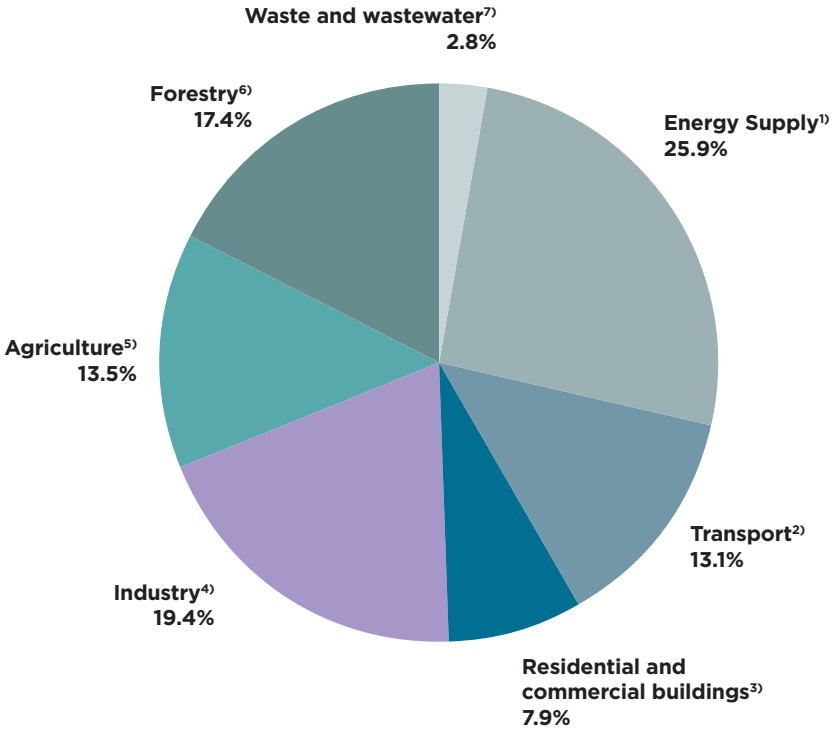
- There are many challenges that have limited the number of EEBE projects and programs around the world to date.

- Solutions to these challenges already exist and are possible to implement under current political, technological, and economic conditions.

MOTIVATION

2008 marked the first year in history that the majority of the human population lived in cities, and the pace of urbanization is only accelerating. Ensuring that the urban centers of the world minimize their environmental impacts will become increasingly central to any efforts to combat climate change. The main feature of a city is its buildings, and the buildings in which we live, work, and play are responsible globally for over nine billion tons of man-made carbon dioxide equivalent (CO_2e) emissions each year[8] (see Figure 1). This means that emissions from our residential and commercial buildings are responsible for a full 8 percent of our global CO_2e output annually.[9] Fortunately, solutions and technologies exist today that can increase the efficiency of the way those buildings consume energy (see Box 1), reduce their demand for energy, and otherwise optimize building systems. The Built Environment sector represents an important opportunity for implementing cost-effective solutions to climate change, and the implementation of EEBE has the potential to generate substantial amounts of new revenues for our cities and create millions of new jobs for their citizens.

Figure 1: Global CO_2e by Sector[10]



Source: http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter1.pdf

BOX 1

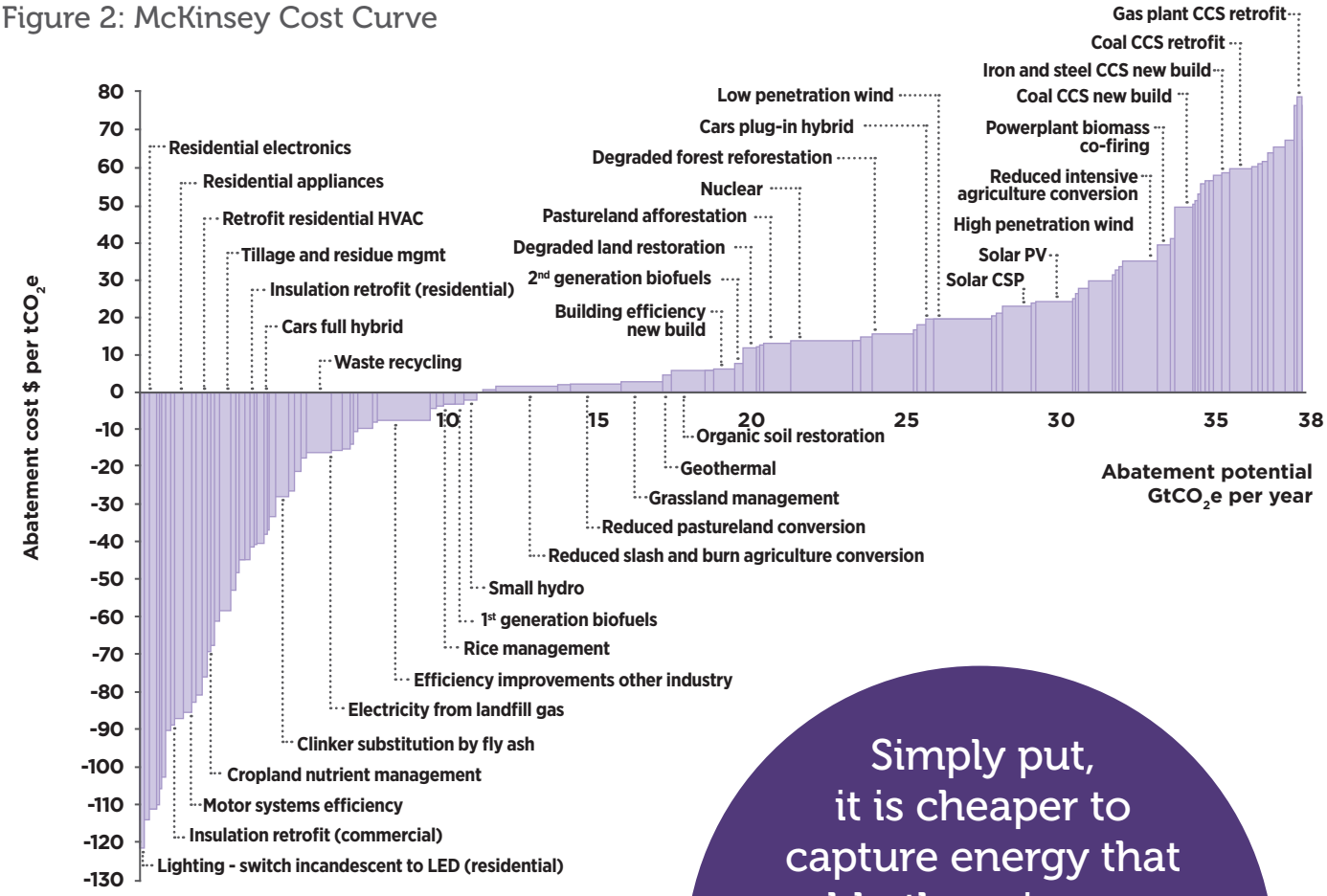
Energy Efficiency 101

ENERGY EFFICIENCY is often associated with conservation and sacrifice, but the truth is that improving energy efficiency simply means getting more benefits out of the energy that we use. Advances in building materials and technologies from the last few decades make it possible to use smaller amounts of energy while maintaining the same lifestyles and comfort levels we're used to in our buildings. And upgrading to improved, more efficient systems ultimately generates substantial monetary savings via reduced utility costs.

Energy efficiency improvements are possible in all Built Environment sub-sectors: commercial, residential, industrial, and the MUSH (municipal, university, school and hospital) market. The partners mentioned in this report have predominantly focused on retrofits and renovations for existing commercial, residential, and multi-family buildings. In commercial buildings, energy savings of up to 50 percent have been shown to be feasible with even low levels of investment, and extra savings are possible with additional investments. Since approximately 75 percent of the buildings that will exist in the large cities of the world in the year 2050 have already been built today, addressing the energy efficiency of our pre-existing building stock is an important endeavor. We cannot simply wait for new advanced new buildings to be built—we must improve the buildings that we have.

[8] Intergovernmental Panel on Climate Change.
[9] http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter1.pdf
[10] IPCC—http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter1.pdf

Figure 2: McKinsey Cost Curve



Source: McKinsey & Co.

Simply put, it is cheaper to capture energy that would otherwise escape or be wasted through inefficiency than it is to build new energy generation capacity

TRANSFORMATIONAL IMPACT

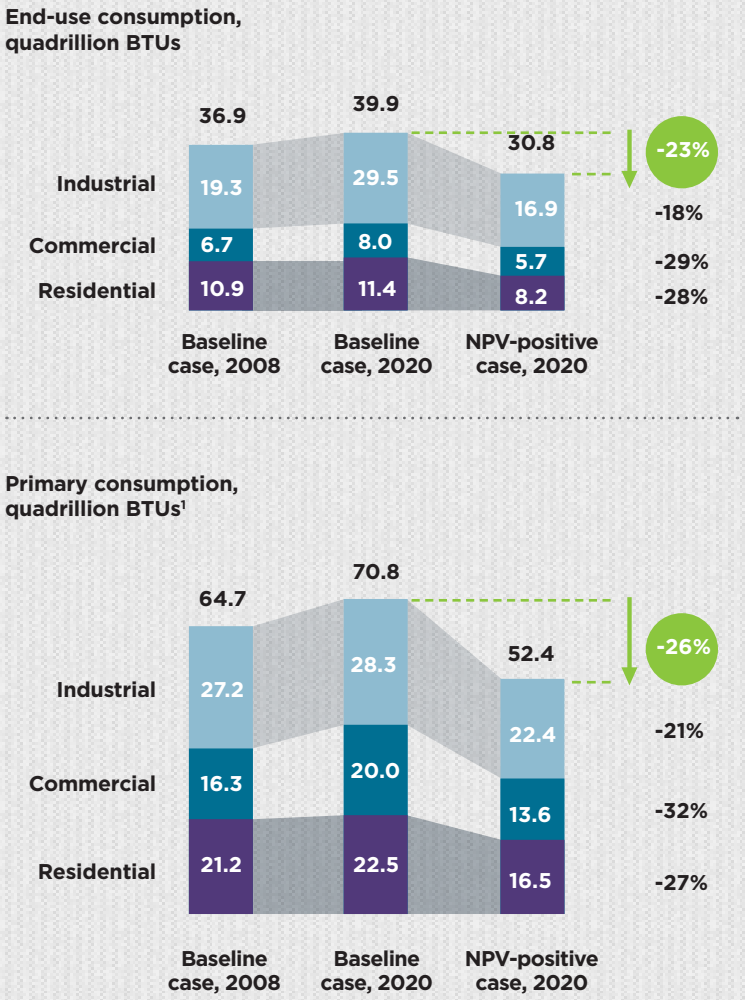
Out of all the clean technology being touted today, technologies that improve the energy efficiency of the Built Environment sector offer the most economically effective method of reducing energy costs and greenhouse gas (GHG) emissions, as they allow us to reduce our energy demand simply by upgrading and optimizing existing systems. Unlike other cleantech options, EEBE technologies do not require us to make any significant changes to our energy transmission systems, to the composition of the electricity mix, or to the comfort levels of building occupants. Simply put, it is cheaper to capture energy that would otherwise escape or be wasted through inefficiency than it is to build new energy generation capacity.

Research has shown that, through the implementation of existing, proven EEBE technologies and practices, global electricity consumption could be reduced by about 20–30 percent in the next 10–15 years. Figure 2 maps many existing clean technologies from many sectors according to their cost-effectiveness. On the left-hand side of the McKinsey Cost Curve are the technologies that are cost-negative GHG reducers—that is, they actually save money for every ton of GHG they reduce. Most notable is that many of the technologies on the left-hand side of the curve are EEBE options.[11]

In the United States, potential energy savings from efficiency measures would reduce annual electricity consumption in the residential and commercial Built Environment sector by over 695 billion kWh annually, translating to a savings of over $78 billion per year on the electricity bills of American consumers and businesses (based on electricity prices of 11 cents per kWh).[12] Thus, energy efficiency upgrades for buildings offer a relatively

[11] Hayes, Sara, Steven Nadel, Chris Granada, and Kathryn Hottel. "What Have We Learned from Energy Efficiency Financing Programs?" Rep. no. U115. Washington, DC: American Council for an Energy-Efficient Economy. 2011.
[12] Ibid.
[13] https://www.gov.uk/government/publications/energy-efficiency-opportunities-in-the-uk

Figure 3: Energy Efficiency Potential in US



Source: McKinsey & Co.

straightforward means of obtaining significant energy and cost savings, and should appeal to both municipal leaders and asset owners. In the United Kingdom, according to their recently released "Energy Efficiency Strategy", cost-effective EEBE measures would obviate the need to build 22 additional power stations.[13] (see Figure 3)

BENEFITS OF ENERGY EFFICIENCY

Asset owners, in particular, have much to gain from taking steps to increase the energy efficiency of their buildings. On top of the presumed savings that will result from their decreased energy use, efficient buildings tend to have higher rental premiums. According to a study by Nils Kok and the University of California, Berkeley, "an office building registered with LEED or ENERGY STAR® rents for a 3 percent premium, on average. Labeled buildings have effective rents that are almost 8 percent higher than those of otherwise identical nearby non-rated buildings."[14] Another recent study sponsored by the Royal Institution of Chartered Surveyors shows that "ENERGY STAR®-rated buildings command a sale premium of 16 percent on the building aggregate."[15, 16]

In addition, performing energy efficiency upgrades may reduce the frequency and cost of required maintenance, which would save asset owners money in the long term. "Reducing your facility's load allows existing systems to operate less frequently and newer systems to be designed smaller, thereby lowering operating costs."[17]

Furthermore, research has shown that by conducting efficiency upgrades asset owners are creating a more comfortable work environment for their tenants, and this can result in performance gains. "A deep retrofit that successfully addresses occupant comfort issues, primarily related to ventilation, temperature and lighting, is estimated to add $3 to $30 per square foot to the value of office space for the occupant, based on the potential for productivity gains of 1 to 5 percent."[18] Specifically, Greg Kats of Capital-E found that productivity increases in commercial buildings averaged 3.3 percent from improved indoor air quality, 5.5 percent from improved temperature control, and 3.2 percent from the installation of high-performance lighting systems.[19]

Finally, energy efficiency upgrades may confer additional soft benefits to asset owners, such as the marketing and publicity value of "greening" a building. This has the potential to provide a competitive advantage among similar asset types.

[14] Eichholtz, Piet, Nils Kok, and John M. Quigley. "The Economics of Green Building." Working paper no. W10-003. Fisher Center for Real Estate and Urban Economics & UC Berkeley. 2011.
[15] "Benefits Beyond Energy Cost Savings." Rocky Mountain Institute. 1 February, 2012. http://retrofitdepot.org/BenefitsBeyondEnergySavings
[16] http://cbey.yale.edu/uploads/Environmental%20Economics%20Seminar/EKQ%20082010%20JMQ%20(2).pdf
[17] "HVAC Systems | SBA.gov." The US Small Business Administration | SBA.gov. 1 February, 2012. http://www.sba.gov/content/hvac-systems
[18] "Benefits Beyond Energy Cost Savings." Rocky Mountain Institute. 1 February, 2012. http://retrofitdepot.org/BenefitsBeyondEnergySavings
[19] Ibid.

WHAT HAS BEEN DONE SO FAR?

Besides the cases of some forward-thinking cities, there have been few coordinated efforts to incentivize EEBE across a municipality or district. the most common policy mechanisms for EE range from rebates, grants, tax credits, accelerated depreciation allowances and energy service contracting (ESCOs). Some innovative municipalities are pursuing Property Assessed Clean Energy (PACE), and on-bill financing while others are thinking about what types of credit enhancements could be used to leverage private investment. While rebates and tax credits have made it possible for some projects to move forward, they have significant problems and restrictions. Rebates, in particular, are merely band-aid solutions that only incentivize one-off investments in specific pieces of equipment, rather than providing the impetus for a systems-wide analysis that can identify the opportunities for a comprehensive and "deep" retrofit. Moreover, both rebates and direct grants, as direct or indirect government subsidies, perpetuate the myth that carbon abatement is only profitable with government incentives, and therefore would not be profitable if those incentives were taken away. Table 1 highlights some of the popular government incentive schemes in the US in 2007.

Table 1: Types and Participation Rates of Local Incentives, United States: 2007

Types of Incentives	Percent
Incentive payment from a utility energy efficiency program	57%
Direct monetary payment from a city or county (grant, rebate or reimbursement)	52%
Expedited permit processing	36%
Marketing/publicity/awards	35%
State income tax credit	29%
Property or sales tax rebates or abatements	22%
Density bonus	21%
Access loans/loan funds	17%
Full or partial refunds for development fees	9%

Source: National Association of Industrial and Office Properties Research Foundation.

One government-led yet market-based mechanism that has been successful in helping to drive EEBE projects is that of regional cap-and-trade systems. These systems provide voluntary, market-based incentives for significant and continual improvement. However, they are difficult to administer, they sometimes allow for free-riding, and their ultimate success is dependent on policy decisions and appropriations. One of the most successful of these so far has been the New England Regional Greenhouse Gas Initiative (RGGI). On January 1, 2013, California launched its cap-and-trade scheme, which is already among the largest in the world yet does not allow EEBE projects to be counted in its compliance offset category.

While the Carbon War Room supports all such policy efforts to date, it focuses particularly on the emerging solutions for technology and finance that allow asset owners to make efficiency improvements with limited or no upfront cost and without dependency upon government grants or financial incentives. The Carbon War Room believes that the energy efficiency "stool" requires the three legs of technology, capital, and policy to stand. This paper begins with the section that enables us to peek into the soul and guts of a building: technology.

About This Paper

This guide begins with an explanation of technologies that do not require upfront hardware investments but that could yield energy savings in excess of 15 percent. Although such technologies have diverse names like optimization, retro-commissioning, and auditing, this paper attempts to sub-divide only by tangible and actionable options. These technologies enable the building owner to understand how their buildings are consuming energy, which is the basis for being able to conduct a comprehensive retrofit.

When the technology is well known, often it is sourcing the upfront capital for a retrofit that remains a significant obstacle. The following section highlights existing and emerging finance mechanisms like performance contracting, assessment finance, on-bill repayment, and Energy Savings Agreements. The last main section covers the best global policies the Carbon War Room has seen for stimulating private sector adoption and investment of energy efficiency.

The paper concludes with some remarks on demand aggregation, as well as highlighting areas where the Carbon War Room project team has gained traction and achieved impact; and equally where it has run in to obstacles—noting some of the lessons learned along the way that may be of service to others on a similar path.

It is important and obvious to note that this guide, while intending to cover much ground, does not aim to be the last word on energy efficiency policy, finance, and technology. Rather, the Carbon War Room hopes that it will stimulate ideas and provide tangible resources for you to create change at the speed and scale required in your chosen field, helping us all to realize the economic and environmental benefits of Energy Efficiency in the Built Environment.

IMAGE: JOHN HORNER PHOTOGRAPHY. OFFICE DA

Deep retrofits have been estimated to add $3 to $30 per square foot to the value of office space based on decreased operating costs and higher occupant productivity

Technology

- Each building has a unique starting position that must be assessed in order to determine the best course of action for implementing energy conservation measures.

- The process for implementing energy efficiency measures is well ordered, progressing from benchmarking to auditing, to implementation, and finally to capital upgrades.

- The savings garnered from using an ordered building optimization approach, coupled with the savings from capital retrofits, allow external financial institutions to assist with financing for deeper retrofits.

ASSESSING A BUILDING'S STARTING POSITION

There is no one-size-fits-all solution for improving a building's performance through technology upgrades. Every building has unique potential and limitations. A building owner must assess their building's "starting position", taking stock of the building's systems and operations, and assessing what, if any, energy efficiency measures have been implemented to date, as Figure 4 illustrates. Ideally, the starting position is captured as part of a "gap analysis" associated with a Strategic Facility Plan,[20] which maps the goals of a facility's use against the business objectives. These simple questions will help building owners to understand their starting positions:

1. How old is my building and when was it last upgraded?
2. How old are the control systems? Is there a building automation system (BAS[21]) and what is connected to it: major heating, ventilation and air conditioning (HVAC) systems; zone-level systems; lighting?
3. When were the building's systems last tuned?
4. What are the building's costs per square foot?

Answers to these questions will illuminate a building owner's options for energy efficiency measures and will establish the starting position from which they will be working to optimize their building's performance.

RECOGNIZING THE CHALLENGES

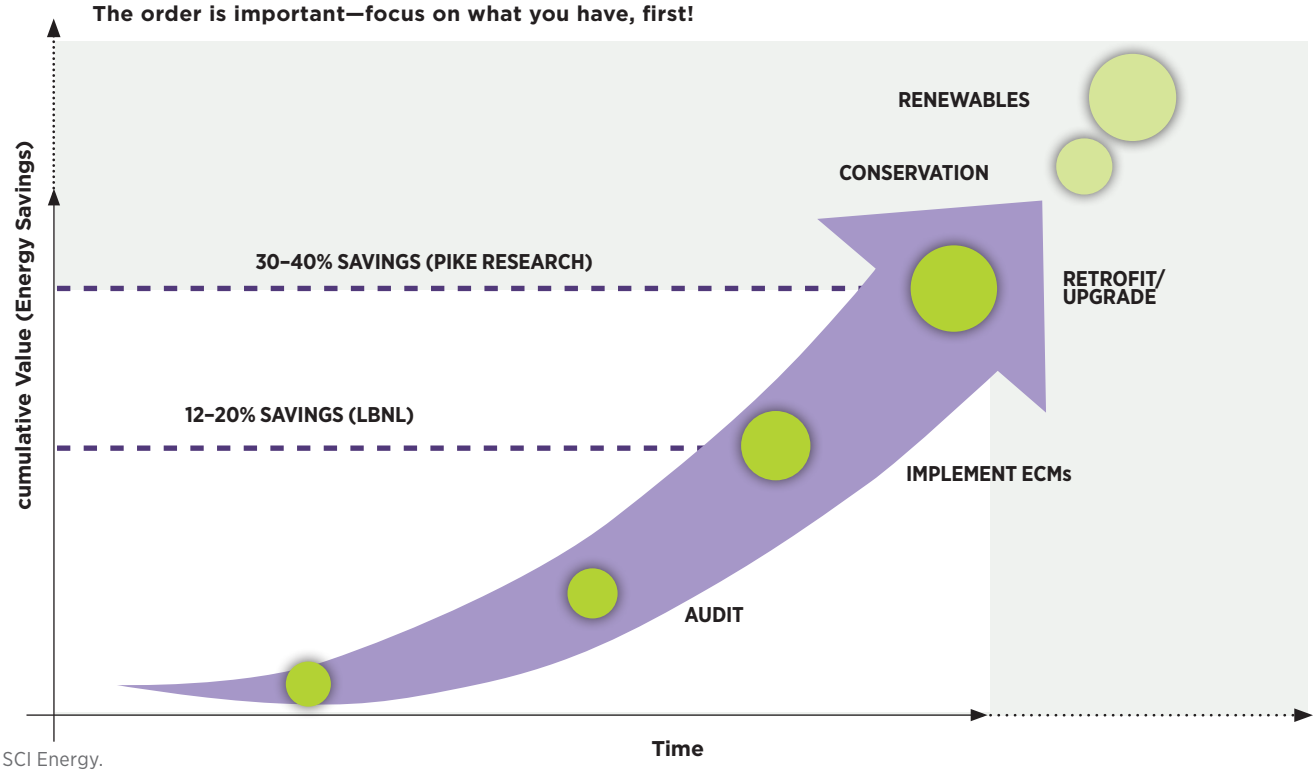
Challenges in energy efficiency projects typically hinge on economics—not because the numbers are unattractive but rather because the costs and associated benefits do not accrue to the same stakeholders, creating a situation of split incentives, wherein owners, managers, and tenants each have a different relationship to investments in energy efficiency. While the precise relationships among these stakeholders will vary from building to building, each project ought to always consider who gets what benefits, when, and how. Generally, the challenge comes down to owners who see little reason to spend money on upgrades that will only save their tenants' money on utility bills. Property and facility managers can also be part of this challenge, as they are often conservative in their assessments of the risks of any new technologies, and/or may discount the operational or behavioral benefits to be gained from improving their building's energy management. Understanding the stakeholder ecosystem of a building and how it translates to decision making on energy efficiency is fundamental to successfully prioritizing efforts and allocating resources in an attempt to implement an EEBE project.

Other challenges will be enumerated by the gap analysis or elicited by the starting position assessment questions listed above. Most of the "gap" will be found in less-automated buildings (e.g., pneumatic zones), systems-integration challenges with the current building automation system (e.g., no support for open communication protocols), lack of uniform standards for interpreting data, or lack of information about the building. Challenges also arise when facilities' staffs are ill equipped or over-tasked.

[20] http://www.ifma.org/files/resources/tools/SFP_WhitePaper.pdf

[21] BAS is another term for a building's control system—which is a computerized, intelligent network of electronic devices designed to monitor and control the mechanical, electronics, and lighting systems in a building.

Figure 4: Energy Efficiency Loading Order



Source: SCI Energy.

DETERMINING AN ECONOMIC MODEL

A crucial but oft-overlooked part of getting started with an efficiency retrofit is the development of the economic model that will support the upgrade. This economic model involves more than simply assessing the stakeholder value chain and establishing the level of investment or the budget. Decision makers must also consider the following:

- What are the decision criteria for pursuing various measures?
- What accountability mechanisms exist to ensure performance?
- Will the efficiency measures result in continual and increasing future savings or merely realize an immediate one-time gain to the bottom line?
- What is the desired ROI or payback period?How will this be measured and communicated to the stakeholders?

These questions will help guide asset owners towards solutions that offer the greatest possible benefits to their particular buildings.

Implementing the Upgrade

The Carbon War Room has worked with building technology companies to develop a step-by-step process for not only assessing a building's current performance and calculating the economic opportunities of an efficiency upgrade, but also for choosing the most appropriate technologies for a given building and determining the easiest order of implementing such changes.

Our methodology for energy efficiency improvement focuses on energy consumption, as opposed to simply energy cost savings. The latter can be achieved not only through upgrades but also through demand response programs—which are often mistakenly referred to as "energy efficiency" as well. However, such usage curtailment typically requires occupant sacrifice through pre-cooling, thermostat setbacks, and lighting changes, and these options run counter to the very notion of energy efficiency. Consumption that is seemingly reduced in peak periods by these methods is, in actuality, mostly just moved to off-peak periods. While there may be a carbon benefit of demand response, as less-efficient peak generation plants are used less frequently, this practice is not considered as being "energy efficiency" by this paper.

The recommended process for EEBE outlined here will result in true energy savings and will require no sacrifices on the part of tenants. The Carbon War Room's process, in a nutshell, emphasizes first optimizing with what you have (via energy efficiency improvements), and only then considering steps such as changing the building (via envelopes, renewables, etc.) and asking occupants for behavioral modifications.

The process for implementing energy efficiency measures is well ordered, as each step has clear prerequisites, and progressively enhances energy and systems performance. The steps are shown in Figure 5.

The building performance industry is clearly evolving to recognize the need to set carbon reduction goals, both for environmental and economic reasons. Energy efficiency—including optimization and retrofits—is the logical starting point in this process, and there are advantages to approaching the process in the order described here. Other initiatives, including conservation, renewables, and even demand response, may be implemented after these, and may also be important elements both in a company's strategy and in our global efforts to mitigate the threat of climate change.

Because the process is designed with the understanding that each building has a unique starting position, a building owner may in fact start at any step along the continuum in Figure 5. For example, a building that has already been benchmarked could begin by conducting a retro-commissioning audit, assuming that the original benchmarking data is accessible.

Figure 5.
From Commissioning to a Retrofit

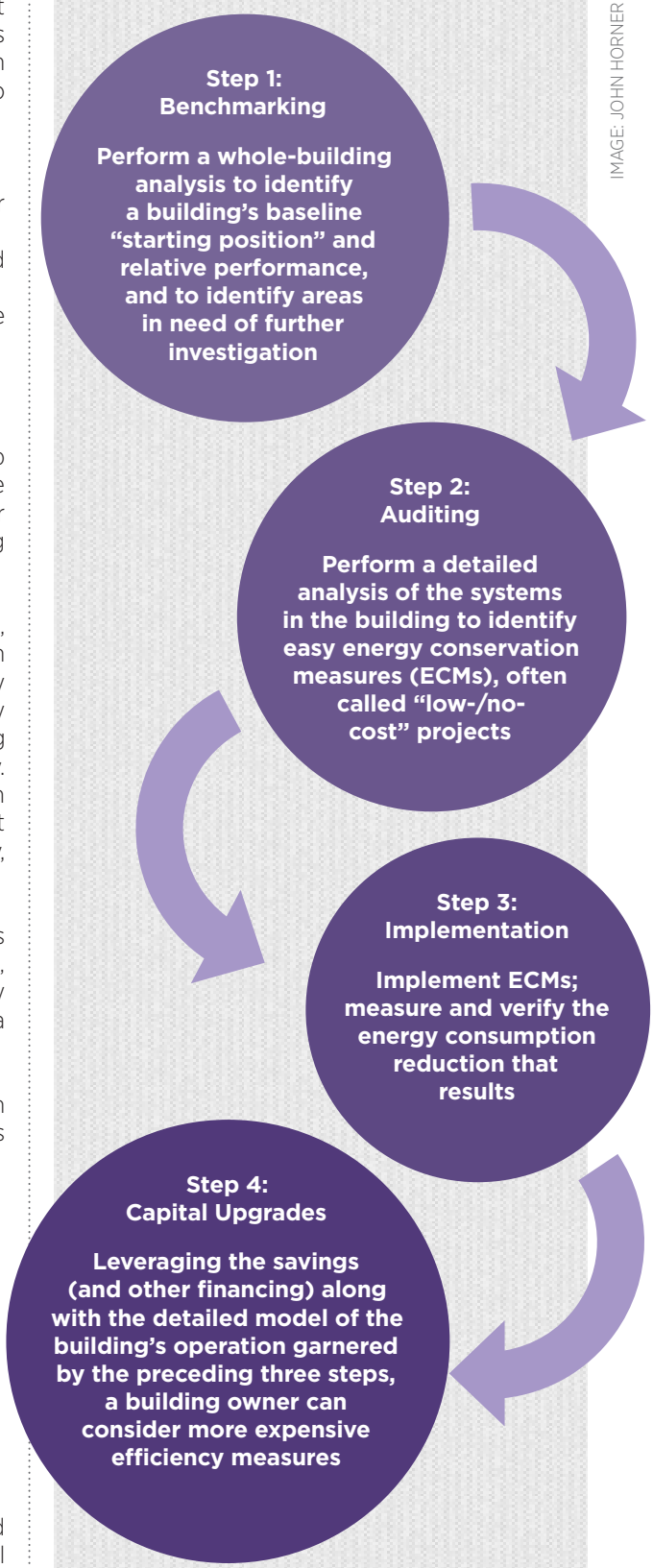


IMAGE: JOHN HORNER PHOTOGRAPHY.


PRUDENTIAL

STEP 1: BENCHMARKING

The foundation step of any energy efficiency plan is benchmarking. In the United States, a joint program between the US Department of Energy and the US Environmental Protection Agency (EPA) called ENERGY STAR® defines benchmarking as "a process that either compares the energy use of a building or group of buildings with other similar structures, or looks at how energy use varies from a baseline."[22] As a compliment to the ENERGY STAR® program, the US EPA offers a Portfolio Manager Benchmarking Tool, available at www.energystar.gov. This tool provides an energy performance score on a scale of 1 to 100, with 100 being the most energy efficient and 1 being the least. This score represents a percentile ranking compared to the overall national building stock. An ENERGY STAR® certification is awarded to buildings that score 75 or above, indicating they are in the top 25 percent of buildings across the nation.

A building's energy use represents the single largest factor in determining its overall environmental sustainability. Recognizing this, the US Green Building Council's LEED for Existing Buildings rating system (LEED-EB) incorporates the aforementioned ENERGY STAR® score as both a prerequisite and as a source of credit points for LEED green building certification. For example, a building must have a minimum ENERGY STAR® score of 69 to pursue LEED-EB. The ENERGY STAR® score can also provide up to 18 LEED credit points, making it the single largest source of potential points in the LEED rating system. Other countries and regions are beginning to implement programs similar to the LEED certification system in the United States.

However, all benchmarking efforts are not equal, particularly because they do not always mandate a certain degree of resolution in the collection of energy data. Obtaining the highest possible frequency of data collection is critical to reliably determining a building's baseline. More detailed energy data allows for a better understanding of energy load shape, and for the analysis of energy performance relative to weather, occupancy, set points, and schedules. Buildings with energy management systems or with continuous meter reporting have an advantage because they are able to automate the process of data collection. While increasing the frequency of data collection can add cost, the granularity of data is truly a key determining factor in successfully achieving and sustaining savings from an EEBE project.

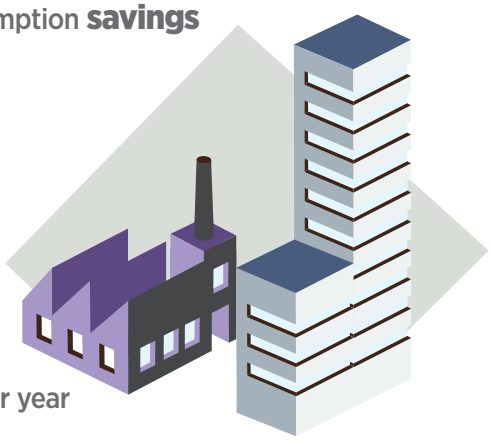
Benchmarking commercial Buildings...
can yield **5%** energy consumption **savings**

...if all commercial buildings
take this simple step

5% translates to **11%**
at coal-fired plants

We could **remove**
52 coal plants

...nearly
29 million tons GHG per year



Source: EIA Commercial Non-Mall Consumption Data
(CBECS 2003) and US EPA Clean Energy: Calculations and References

While the precise relationships among these stakeholders will vary from building to building, each project ought to always consider who gets what benefits, when, and how

[22] "ENERGY STAR® Building Manual." Chapter 2, Section 2.1. Revised April 2008. http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH2_Benchmarking
[23] FLEX YOUR POWER. http://www.fypower.org/

BOX 2

Benchmarking Tools and Market Leaders

There are a number of tools available in the marketplace that can help building operators benchmark their energy performance, implement tracking of their ongoing consumption, and even engage with their occupants on the issue of energy efficiency.

The following companies are a sample of those that offer tools—including energy monitoring/measurement and other analytic functions—for identifying coarse energy savings recommendations:

- **FirstFuel, Retroficiency®:** These two companies both offer products that use interval monitoring of energy consumption data from users, service providers, or utilities, along with building data derived from an address to provide benchmarking, monitoring, and energy savings recommendations.
- **EFT Energy, MACH Energy, Pulse Energy, SCI Energy®:** These four companies all offer products for energy management, including real-time consumption monitoring and visualization of meters and sub-meters. Their products offer varying degrees of analytic functions, custom reports, and dashboards; some of solutions they offer include automating ENERGY STAR® score calculations, and even the submission of data to the EPA's Portfolio Manager tool.
- **Lucid Design Group™:** This company provides energy- and carbon-tracking dashboards and kiosks that visualize energy consumption in ways that facilitate employee and/or guest engagement, including social networking features that compare energy performance across buildings.
- **Sustainable Real Estate Solutions™ (SRS):** This company uses its Peer Building Benchmarking database of more than 120,000 buildings, updated regularly, to facilitate the propagation of a benchmarking best practice that complements ENERGY STAR®'s nationwide rating with local building comparisons across 12 key performance indicators.

STEP 2: AUDITING

Step 1, benchmarking, preferably with highly granular information, gives the owner or operator a sense of the overall performance of their building relative to other buildings, normalized for influencing factors like weather and occupancy. Step 2, auditing, involves undertaking a study of how energy is currently being used in the building in question, along with a set of recommendations on ways to improve that building's energy efficiency and reduce energy costs.[23]

Audits can range in their levels of analysis. The least detailed audit involves simply a preliminary visual examination of a building, such as The American Society of Heating Air Conditioning and Refrigeration Engineers' (ASHRAE) Level 1 audit.

As with benchmarking, the manner and depth of data collection during an audit is highly important, as it will influence the breadth of opportunities identified. To perform a successful audit, data must be collected that describes the specifications, schedule, operating conditions and purposes of all building assets, as well as the environment in which the assets operate. Data granularity is, in fact, even more important at the audit stage than during benchmarking, as it impacts the subsequent design of the measurement and verification plan required to ensure sustainability of savings.

Building audits are valuable because they allow for the identification and prioritization of low-cost and no-cost ECMs. The shortcoming of an audit is that it reflects only a snapshot of building performance. To effectively optimize energy performance, building operators ought to perform commissioning exercises regularly.

Turn off the lights
& HVAC when unoccupied...

20% of buildings use HVAC and lighting outside scheduled hours of operation

300 Billion BTUs—
over 5 Million tons
of GHG/year

An easy **2% savings** off total energy use in commercial buildings

http://docs.lib.purdue.edu/iracc/665/
Roth, K.W. et al., "The Energy Impact of Faults in US Commercial Buildings." 2004.

BOX 3

Examples of More Detailed Audits

- **ASHRAE Level 2:** Energy Survey and Analysis—wherein the auditor will conduct in-depth interviews with operating personnel, perform a detailed analysis of energy use by asset type to quantify base loads, seasonal variation, and effective energy costs, and evaluate the environment surrounding the assets. Then, from that data, they will identify and prioritize all ECMs, and also identify promising capital projects for further review. [2–4 weeks]

- **ASHRAE Level 3:** Detailed Analysis of Capital-Intensive Modifications (Investment-grade Audit)—this audit is similar to the above but also provides the further review required to justify capital-intensive opportunities and includes a higher degree of monitoring, data collection, and engineering analysis. [8–12 weeks]

- **Traditional retro-commissioning (RCx)[24]:** This systematic method "provides an understanding of how a facility is operating and how closely it comes to operating as intended. Specifically, it helps to identify any improper equipment performance, any equipment or systems that need to be replaced, and/or any other operational strategies for improving the performance of the various building systems."[25] [4–6 months is typically required for utility programs such as these]

NOTES FROM THE FIELD
Building Energy

"Unlike most other industries, building energy management and efficiency has not yet taken full advantage of the economic, social, and environmental opportunities presented by the advent of big data and the transformative power of the Internet. For anyone working in the field of building energy efficiency it is no secret that energy data is difficult to get, and that consistent, normalized, high-quality data is extremely rare. Building data is often held in proprietary vendor silos, although this actually runs counter to the interests of building owners, managers and occupiers who bear the burden of costly and inefficient buildings as a result of the silos. Trusted data, applications, and systems are needed to enable a new market dynamic.

Our company, Building Energy, faced many obstacles when we started out with the mission to create a global, trusted network of building data and applications. Those obstacles included: lack of standards around data structures (taxonomies); the lack of methodologies and transparency on how energy data is extracted, transformed, and loaded (ETL) to meet auditability and compliance requirements; and the fact that facilities and sustainability management has not yet been integrated into the information technology infrastructure of organizations.

Building Energy is working to overcome these obstacles by developing an "Internet of Buildings" that makes trusted and secure energy data aggregation, analytics, and applications possible on a global scale. Anyone tasked with managing building assets can now use their own data to make better decisions while attracting the best technologies and vendors through a dynamic and efficient market based on high-quality data and applications. An expanding universe of energy software and service providers can find more opportunities and deliver better solutions in an ecosystem free of the friction caused by the lack of objective, trustworthy data. While many challenges remain in liberating and harmonizing data, we are confident that we will begin to see the gigaton-scale investment into retrofits that the Carbon War Room is helping to catalyze when asset owners have access to accurate and reliable data."

D. Magnus Cheifetz, CEO, Building Energy

Digital Auditing Tools and Market Leaders

Energy audits have evolved to make use of new software and data capture tools. One of the fastest growing audit types is 'retro-commissioning (RCx),' which is expected to grow from 2,000 agents who conduct it in 2010 to over 20,000 globally when the market reaches maturity.[26] These types of audits are designed to capture building data, support energy simulation and modeling, and sometimes even provide an on-going monitoring component. It is extremely important for audits to entail such monitoring of performance after the EEBE retrofit, in order to sustain identified savings. Such monitoring is often called monitoring-based commissioning, continuous commissioning,®[27] ongoing commissioning, or persistent commissioning.

[24] Retro-commissioning generally proceeds in four phases: planning, investigation, implementation and hand-off. Much like a traditional audit, at the end of Phase 2, the engineer performing the retro-commissioning will identify all energy conservation measures, prioritizing the low-/no-cost measures.
[25] "ENERGY STAR® Building Upgrade Manual," United States Environmental Protection Agency, Office of Air and Radiation, 2008 Edition.
[26] Pike Research. Energy Efficiency Retrofits in Commercial and Public Buildings. (Nock, 2010)
[27] Continuous Commissioning®, CC® and PCC® are registered trademarks of the Texas Engineering Experiment Station, a member of the Texas A&M University System, an agency of the State of Texas.

BOX 4

Technology-Based Tools to Accelerate Market Use of RCx or to Amplify Its Benefits

- **Cimetrics™, SRS, Facility Dynamics, Retroficiency®:** A thorough audit will generate a great deal of data, and these providers offer software energy models capable of interpreting it. ECMs and retrofit measures can be simulated through such modeling, and the predicted performance outcomes and ROI estimates that are also generated by the models improve evaluation and decision making.

- **ecoInsight:** This solutions provider offers mobile audit capabilities, integrated product pricing and performance information, and sales proposal-generation tools to professional auditing agents. Information about building equipment, energy use, and occupants is collected via a mobile device, making the information immediately available for use in analysis, collaboration, and/or proposal generation.

- **kWhOURS:** This tablet-based auditing tool handles the data capture and data management associated with the auditing process. With integral software, tagging, imaging/drawing, and import/annotation tools, the company claims that it can save up to 35 percent of the time required to complete an audit, along with some of the cost.

- **SCI Energy®:** Solutions offered by this provider include an automated fault detection and diagnostics tool (SCIwatch®) that uses trend data from a BAS or sensor data acquired through a gateway device. The identified faults are useful as they give RCx engineers insight into system performance, allowing them to target specific assets for deeper investigation.

STEP 3: IMPLEMENTATION

Completing Steps 1 and 2 will give a building owner a full awareness of their building's baseline energy performance and a detailed understanding of the low-/no-cost ECM options available to them. Most service providers that conduct either a simpler energy audit or the more in-depth RCx retro-commissioning process will provide a detailed written report that identifies ECMs capable of delivering 12–20 percent energy reductions.[28] Step 3 entails implementing ECMs found by the audit. By doing so, energy savings will manifest into real reductions in operating capital—that is to say, the building owner will see their utility bills decrease. Though ECMs do not require large outlays of capital, it can still sometimes be a challenge to obtain the non-monetary resources needed to undertake them, since multiple skillsets, including knowledge of energy, information technology, heating, ventilation and air conditioning HVAC, and building controls, are needed in various combinations to complete the ECM projects. Often, an external project manager helps building engineers to complete their ECMs, or an ESCO is hired to manage and implement the conservation measures.

Finally, once implemented, a building owner needs to "commission" or verify each implemented measure in order to confirm that the ECMs have brought about the desired efficiency improvements. It is imperative that a building owner establish a measurement and verification (M&V)[29] plan to ensure the measure achieves its intended energy reduction—most utility programs require this. Periodic monitoring confirms performance and ensures the sustainability of the improvement.

Retro-commissioning (RCx)
commercial buildings

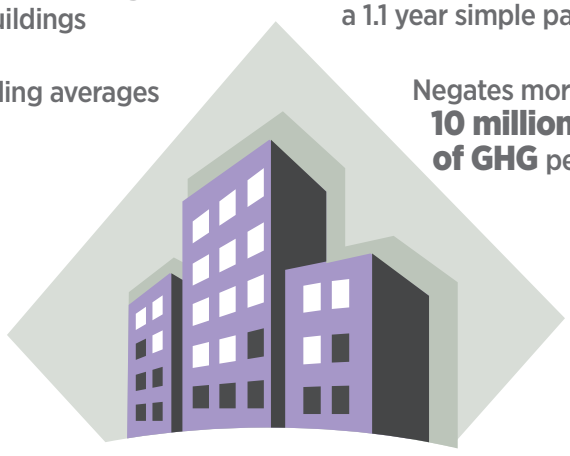
16% savings provides a 1.1 year simple payback

An office building averages **$2.17/sq ft**

Negates more than **10 million tons of GHG** per year

RCx costs **$0.30/sq ft**

25% of buildings doing RCx...



Source: "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions." Mills, LBNL. 2009.

[28] "Building Commissioning: A Golden Opportunity for Energy Costs and Greenhouse Gas Emissions." Mills, LBNL. 2009. http://cx.lbl.gov/2009-assessment.html

[29] "M&V is the process of using measurement to reliably determine actual savings created within an individual facility ... As savings cannot be directly measured, the savings can be determined by comparing measured use before and after implementation of a project, making appropriate adjustments for changes in conditions." http://mnv.lbl.gov

Integrated Tools

There are a number of firms that have combined activities from benchmarking to RCx auditing to the implementation of ECMs into a single service offering. Using technology, these firms aim to leverage the data acquired in benchmarking to be more efficient in their building audits. Such technology typically incorporates some form of monitoring and fault detection, and is also the means by which energy savings are sustained once implemented. In fact, it is now possible to use such technology to combine all three steps—benchmarking, audit and implementation—into one approach. An integrated approach saves time as well as reduces energy consumption. Accelerating the time to savings can positively change the building owner's return on their investment. For instance, an integrated approach utilizes the same team to collect and analyze energy data for the benchmarking as for the auditing of the facility, preventing any of the data from having to be collected twice. The same firm then interprets the audit or RCx findings, and manages (in some cases) the implementation of the ECMs they identified. The same team may even provide the M&V for the ECMs.

Many of the technologies mentioned as applicable to benchmarking can provide information about energy and systems performance to retro-commissioning agents before they even set foot on site. In other words, an engineer or technician doing the benchmarking step collects data that will be relevant to the RCx process, and not just for an ENERGY STAR® score or some other consumption scorecard. Additionally, the technologies put in place to monitor energy and systems performance for Steps 1 and 2 can also be used throughout the implementation step to provide M&V. Finally, and perhaps most importantly, any auditing technology that provides ongoing commissioning enables the building's engineers to sustain the savings gained from the ECMs implemented in Step 3 and to identify additional possible operational savings.

STEP 4: RETROFIT IMPLEMENTATION

In spite of the relative simplicity of these first three steps, and the substantial benefits that can be had by moving up through Step 3 and optimizing existing building systems, there is a misconception among building owners that implementing energy efficiency measures is expensive, complex, and requires a complete overhaul of a building's system. This misconception persists due to the slightly more complex, though not impossible, nature of Step 4—EEBE retrofits. In order to conduct "deep" retrofits required to obtain gigaton-scale reductions of CO_2e, the use of finance is required. Yet sourcing the capital to undertake these comprehensive retrofits remains one of the largest challenges facing asset owners. The next section of this paper discusses various methods of financing EEBE retrofits—methods that the Carbon War Room believes to be capable of achieving gigaton-scale reductions in the CO_2e emissions of the Built Environment sector.

BOX 5

A Sample of Service Providers Offering Integrated Approaches, and Their Varying Proprietary Technologies

- **BuildingIQ—The BuildingIQ System:** The BuildingIQ System offers a solution that works with BAS that has already been installed in a building to predict energy demand and HVAC system parameters in order to continuously optimize energy use. This solution improves the efficiency of energy consumption by pre-planning HVAC operations, managing set points, and continuously updating the settings of the HVAC system throughout the day in response to any changes to internal or external conditions.

- **SCI Energy—Intelligent Retro-commissioning™ (iRCx™):** The iRCx product combines energy management and fault-detection software with a modified RCx process. The company claims that it accelerates the RCx process by allowing the RCx engineer to better understand energy consumption and to even target specific underperforming assets before conducting their investigation.

- **SkyFoundry—SkySpark:** On its own, SkySpark is a technology tool for domain experts to capture their knowledge in "rules" that automatically run against collected data. Employing "semantic tagging", pattern recognition, functional rules processing, and other techniques, SkySpark's analytics engine has the ability to automatically identify issues worthy of attention.

IMAGE: JOHN HORNER PHOTOGRAPHY. OFFICE DA

To effectively optimize energy performance, building operators ought to perform commissioning exercises regularly

Finance

The US ESCO market for EEBE project installations and services exceeded $5.1 billion in 2011 and is expected toreach $16 billion by 2020

- The traditional Energy Service Company (ESCO) model of financing is both common and useful for municipal, university, school and hospital (MUSH) projects, as it provides a holistic approach to implementing efficiency upgrades and allows for the implementation of performance guarantees. However, ESCOs typically favor large projects, leaving smaller projects with no financing or risk-mitigation strategy.

- New and innovative financing mechanisms, like Energy Service Agreements (ESAs), third-party on-bill finance, and assessment financing, allow asset owners of small and large buildings alike to access low interest rate financing for deep retrofits.

- Risk mitigation strategies are crucial to the success and scalability of any EEBE financial mechanism.

The previous sections of this guide were meant to provide a foundation for the implementation of in-depth or comprehensive energy efficiency retrofits—Step 4 of the EEBE process, as outlined on page 23. It is commonly believed that such comprehensive building improvements can offer asset owners up to 80 percent reductions in energy use. Applied across a wide range of building portfolios, this represents gigaton-scale emissions reductions. However, deep retrofits require substantial capital investment. In times of economic austerity, governments often do not have sufficient capital to fund these types of projects.

The following section highlights third-party financing mechanisms that cover 100 percent of the upfront cost of the project, meaning that they neither depend upon government intervention nor do they require using an asset owner's capital. Along with explaining how each mechanism or model is generally structured, the pros and cons of each are discussed with the aim of improving the ability of asset owners to judge which mechanism might be most suited to their needs.

ENERGY SERVICES COMPANY (ESCO)

Energy Services Companies (ESCOs) are typically large companies that specialize in demand-side energy services and that have been assisting their customers with energy efficiency retrofits for decades.

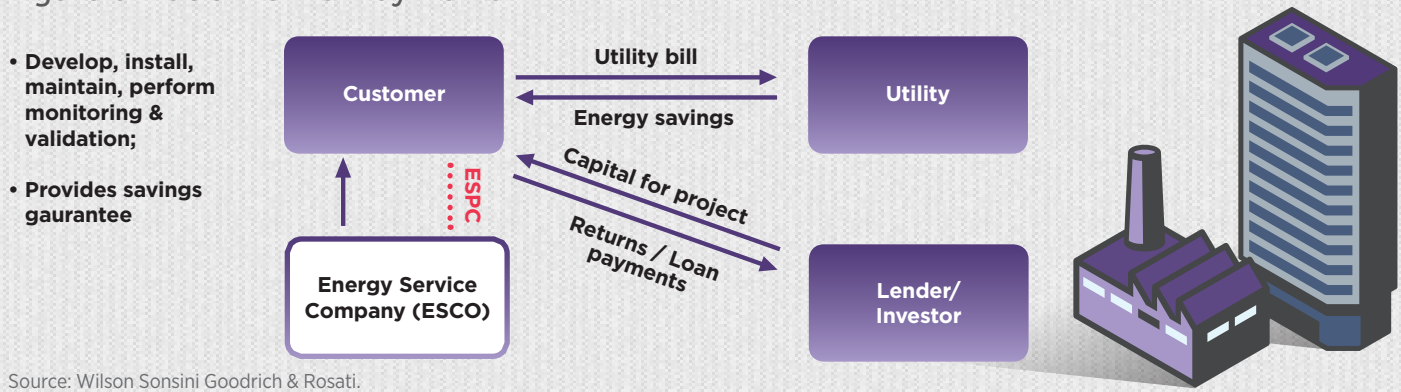
The current ESCO model for EEBE is focused on providing performance guarantees that help backstop energy efficiency upgrades, making it easier for projects to acquire financing. Typically, an ESCO will enter into a performance contract with the asset owner. In one variation of the performance contract model, the ESCO, generally through third-party finance partners, will invest all of the capital necessary to perform the retrofit. Alternatively, the asset owner may finance the project via internal capital, a tax-exempt capital lease, or bond financing through a bank. In either case, the performance contract is in place to help give the capital provider more comfort that the project will generate savings capable of offsetting the costs of the project. If the project ultimately underperforms, the ESCO makes a payment on the shortfall, as Figure 6 illustrates.

The primary advantage of performing a retrofit through a performance contract with an ESCO is that they have expertise and experience to design and implement high-quality projects, and to guarantee the savings from the projects. In some cases the ESCO may also assist the asset owner with sourcing traditional financing or other incentives by connecting them with banks or utilities with which the ESCOs have developed relationships.

The predominant disadvantage of performance contracting through major ESCOs is that, in many cases, "there must be a large savings potential before an ESCO and financier will make a commitment to an energy efficiency project, so performance contracts are generally arranged for facilities with annual energy costs above $150,000."[30] Therefore, smaller entities interested in retrofitting their buildings may not attract the large ESCOs as project partners.

Despite this disadvantage, the market for ESCO-type projects remains significant. The advantages offered by ESCOs, and their long tenure as market players in the energy efficiency industry, allows them to capture much of the deal flow for large projects. The ESCO market for EEBE project installations and services exceeded $5.1 billion in 2011 and is expected to reach $16 billion by 2020.[31] Some of the noteworthy ESCOs that the Carbon War Room has worked with include Ameresco, Johnson Controls, Lockheed Martin, SAIC, Siemens, and Trane. The Carbon War Room fully supports the ESCO model as a sensible solution for many asset owners. However, due to their preference for large projects, ESCOs tend to dominate the MUSH (municipal, university, school, and hospital) market, which leaves plenty of room for other market players to become involved in smaller commercial and residential projects. Many of these additional market solutions are described in the following sub-sections.

Figure 6: ESCO Flow of Payments



Source: Wilson Sonsini Goodrich & Rosati.

[30] Ibid.
[31] Pike Research. "The US Energy Service Company Market." 2012. Pike Research. July 15, 2012.

ENERGY SERVICE AGREEMENTS (ESAs)

Energy service agreements are energy financing mechanisms that enable building owners to obtain the benefits of retrofits without spending any upfront capital. This mechanism essentially works as a pay-for-performance financing solution. Under an ESA, the project developer sponsors 100 percent of the upfront project costs, and then owns the equipment and is responsible for any ongoing maintenance and gets repaid from the energy savings that accrue. There are several different models in the market by which the vendor recoups the capital investment from the customer. At the end of the arranged term of the agreement, the asset owner has the option to buy out the equipment from the vendor. Therefore, the major difference between ESAs and the ESCO model is that the initial capital investment is provided by a third-party investor rather than independently sought out by the asset owner, as Figure 9 illustrates.

As a whole, ESAs provide an innovative method of third-party financing that does not require sourcing a bank loan and can even be delivered off-balance sheet – depending on the specific structure of the deal. However, ESAs are not without their critics. For example, since retrofit projects using ESA structures are very complex, have long sales cycles, and occur on a building-by-building basis, there are questions regarding whether ESAs are capable of achieving gigaton-scale reductions of CO_2e emissions.

The Carbon War Room has worked with vendors offering ESAs, including SCI Energy, Metrus Energy, Abundant Power, Green Campus Partners, Cedargate Capital, and Sustainable Development Capital and is bullish about the global opportunity for this structure to retrofit large numbers of buildings.

ESAs provide an innovative method of third-party financing that does not require sourcing debt and can even be treated as off-balance sheet

NOTES FROM THE FIELD
SCI Energy

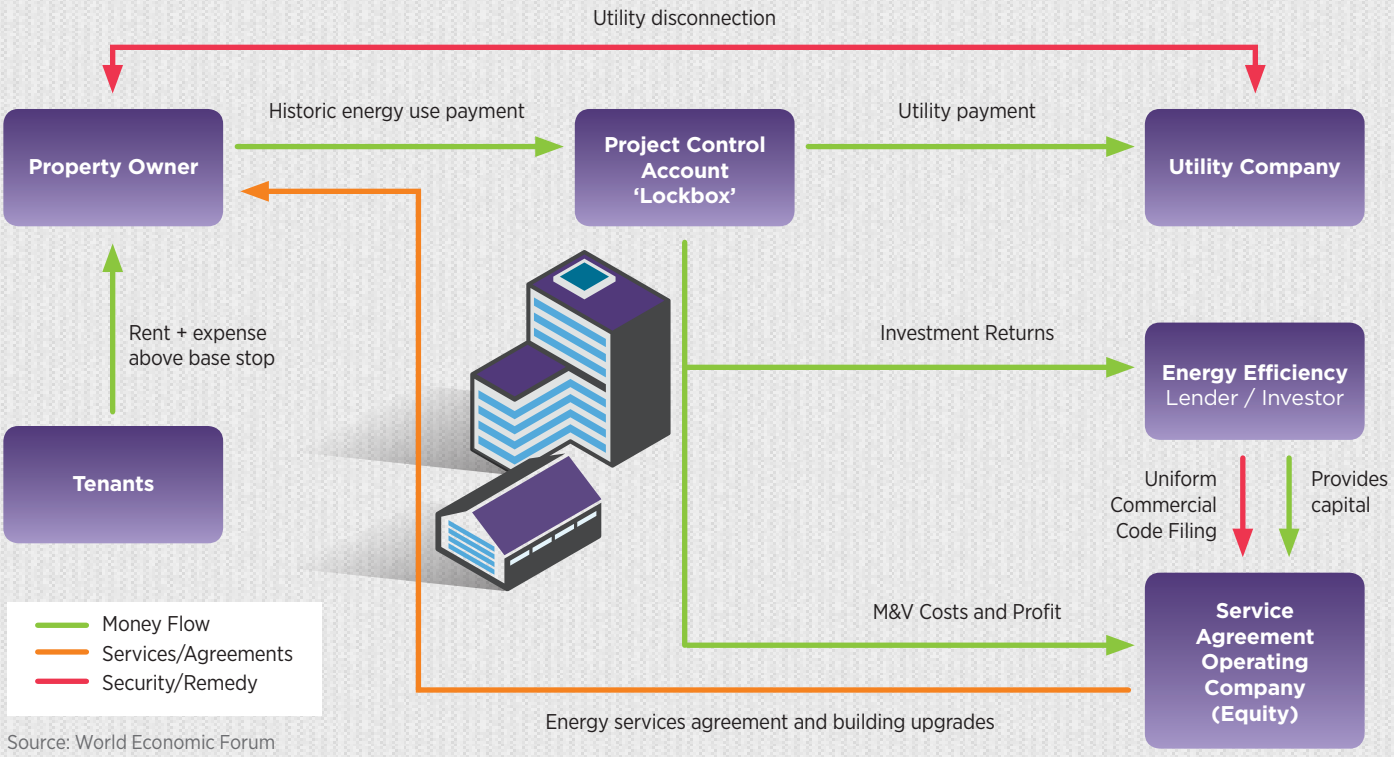
"We created the Managed Energy Services Agreement (MESA) to enable debt-constrained property—primarily commercial real estate, private hospitals, and private universities—to obtain non-debt capital that does not interfere with any lender covenants that they may have. MESA is the sale of energy efficiency as a service: buildings pay us what they used to pay for energy adjusted for weather and occupancy, and SCI Energy pays their bills. The risk of achieving savings rests entirely with us, as does the burden of designing and installing, in collaboration with the landlord, a comprehensive set of improvements that will reduce energy usage.

Simply put, we are installing comprehensive retrofits at no upfront cost to the asset owners. In our experience, we have found three significant obstacles to executing a MESA project. First, because this is a pioneering asset class, there is an element of novelty that asset owners take a while to get comfortable with. Second, for commercial real estate, MESA boosts asset yield by reducing below-the-line capital expenditure. For private universities and hospitals, it represents a non-debt option that may be a very attractive, and in some cases the only option for an EEBE project. However, we have found that in the majority of buildings, capital improvements take place only when equipment is broken beyond repair, not when it is simply inefficient. Changing this reactive process is necessary, but property managers and owners are so accustomed to working in this manner that it has almost become a culturally embedded norm and is therefore proving difficult to alter.

The third obstacle is more of a technical problem of data availability—there is often a significant lag between landlord interest in MESA and the generation of the data to confirm project feasibility, largely as a result of antiquated utility systems and misconstrued confidentiality requirements. SCI Energy is moving towards establishing a more comprehensive and immediate presence in buildings, plugging directly into systems to gather data and provide early value. All of these three issues can and are being addressed, and we are excited for the prospects of the EEBE industry in the coming years."

Sean Neil, co-creator of Managed Energy Savings Agreement (MESA) and Managing Director, SCI Energy

Figure 7: "ESA" Flow of Payments



Source: World Economic Forum

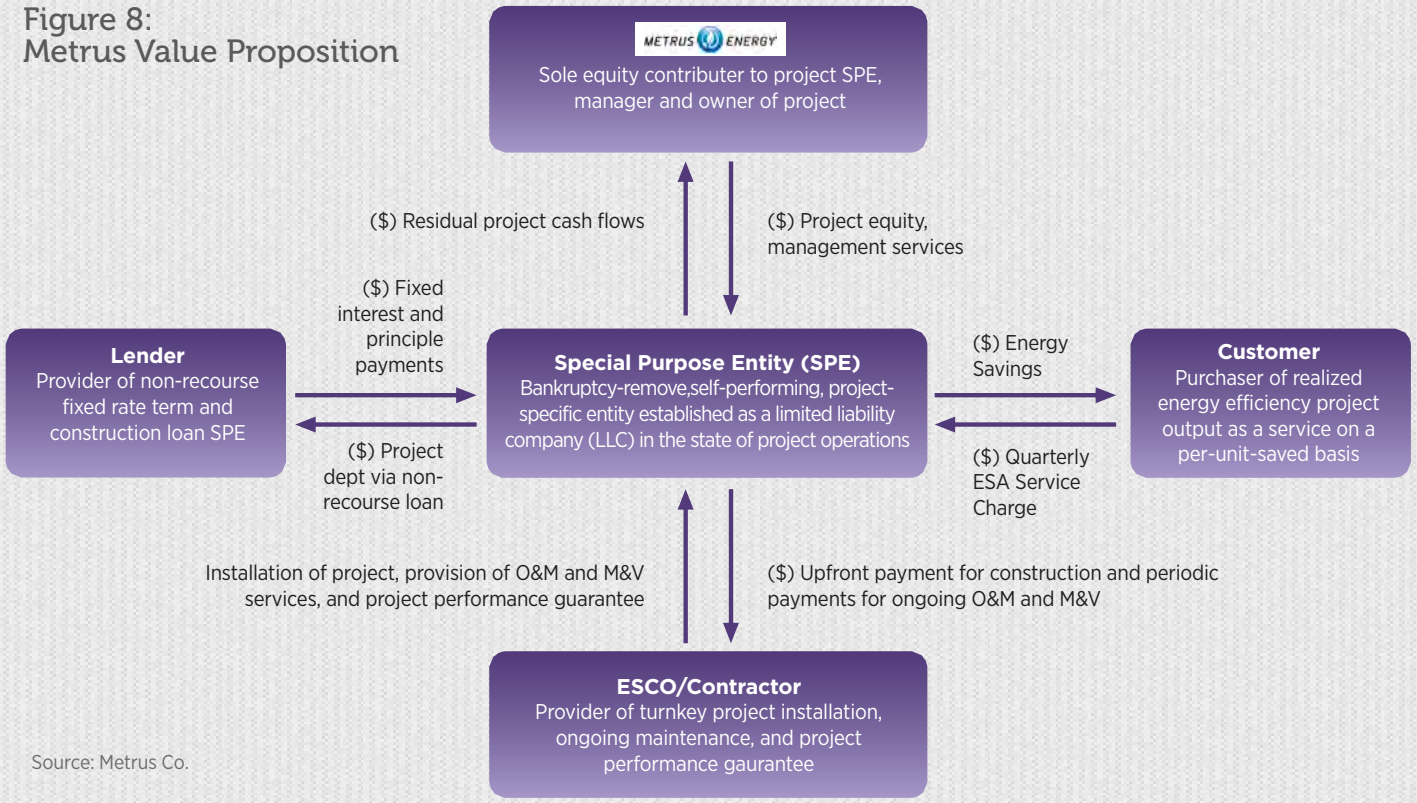
SCI Energy Model

SCI Energy has been able to implement the largest number of ESA projects to date. As the company was formed by a merger between a technology provider and a finance provider, it has a unique understanding of building retrofits, a fact that allowed it to develop and implement a particularly robust version of an ESA.

Their model, the Managed Energy Services Agreement (MESA), works to boost asset yield by decreasing the recurring capital expenditure of their client partners. SCI Energy pays the capital cost for energy efficiency upgrades, then directly charges the building owner their historic rate for electricity, assuming the responsibility for paying the property's energy bill to the utility company themselves. The more successful the building retrofits are, the more profitable they become by increasing the difference between each building's historic and current energy costs—a difference that SCI Energy pockets as a recoupment of their investment. Under MESA, commercial property owners retain control of the EEBE equipment and savings after an initial eight- to 10-year contract.

For each project, SCI Energy forms a wholly-owned special purpose entity (SPE, in the form of a Transaction LLC) to provide energy services to the building owner. The SPE finds outside financing for the project and enters into an agreement with the building owner (see Figure 7). Both the MESA contract and the loan agreement for the property improvements are held by the SPE. The SPE assumes responsibility for paying the property owner's energy expenses for the duration of the contract period, which may be up to 10 years. During that period, the building owner makes monthly payments to the SPE (via a third-party collection company) of the contractually agreed amount, which equals a measure of historical energy expenses, adjusted for energy prices, weather, and changes in energy usage and occupancy. The SPE uses the funds to pay the utilities, service the debt and ensure a return for equity investors.

Figure 8:
Metrus Value Proposition



Source: Metrus Co.

Metrus Energy Model

Metrus Energy's model is similar to SCI Energy's MESA model but is based on the concept of monetizing the avoided energy use ("negawatts"), much like an energy efficiency power purchase agreement (EEPPA). Under its model, Metrus pays for all project development and construction costs, and then, after a project is operational, the customer uses a portion of the cost savings associated with reduced energy consumption to make periodic service payments back to Metrus. "The price per unit of energy savings is a fixed, output-based charge that is set at or below a customer's existing utility price, resulting in immediate reduced operating expenses."[32] On a quarterly basis, the measurement and verification (M&V) data on the retrofit project is compiled and used as the basis for the ESA service charge. This means that the customer pays only for actual (i.e., realized, not simply expected) energy savings, and is not exposed to any technology performance risk, while avoiding all upfront capital costs or balance sheet impact.

As in all ESAs, Metrus owns the installed assets for the duration of the ESA term and pays the external contractor for any ongoing maintenance, after which the customer has the option to purchase the equipment at market value. Additionally, for each project utilizing the ESA structure, Metrus establishes a special purpose entity (project LLC). Additional third-party debt is then secured from an outside lender to supplement the equity capital that Metrus invests directly, as Figure 8 highlights.

The loan from an outside lender is made directly to the project LLC, but the particular capital structure of the project depends on the underlying economics of the project and the credit of the customer. Metrus' ESA model has been proven via multi-million dollar energy efficiency retrofit projects for a major multinational industrial corporation.

[32] Metrus Energy, Inc. Summary Issue brief. Metrus Energy. 2012.

IMAGE: JOHN HORNER PHOTOGRAPHY. NADAAA

THIRD-PARTY ON-BILL

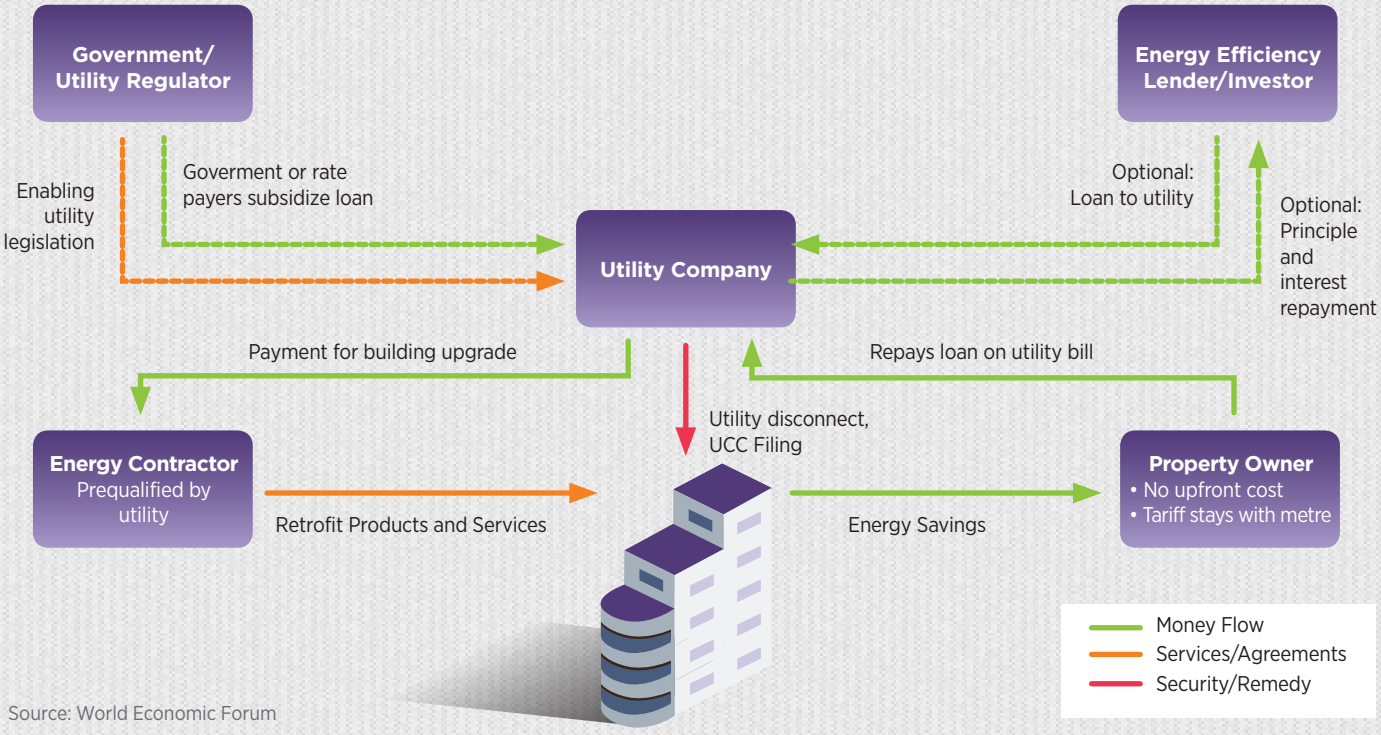
Several municipalities around the world are creating programs that tie EEBE loan repayments to the building's utility bill. Generally, on-bill payment schemes are systems through which an entity (usually either the utility or a third-party lender) pays for improvements in a home, a business, or a government facility and then recovers the costs from participating customers as an itemized finance charge on the utility bill.[33] Utility funds for such projects may come from government loans like ARRA (American Recovery and Reinvestment Act), or from revolving loan funds. The projects may alternately be funded directly by a third-party investor.

"There is no consistent 'one-size-fits-all' approach to on-bill financing. Rather, it is an innovative collection mechanism that can be utilized in a variety of ways to optimize its net benefit across a diverse array of communities."[34] The defining characteristics of this mechanism are that the EEBE projects are serviced by utilities and repaid by customers via their monthly utility bills. In many cases, the savings achieved through the retrofit are sufficient to cover the additional line-item charge of the EEBE project. Additionally, by working with the utility, other incentives can be bundled into the efficiency retrofit to reduce the cost of the project. On-bill mechanisms are often perceived as being lower-risk investments because customers already have strong relationships with their utilities, and are very unlikely to neglect payment of their utility bill, especially if the threat of discontinuation of power is real. Also, the credit quality of energy efficiency loans and other programs can be substantially improved by allowing for the investment to be repaid through the utility bill. Finally, as mentioned above, there are several different options for financing on-bill mechanisms, which makes them applicable for a wide range of buildings or situations.

The most long-standing and common model of on-bill mechanisms used to fund EEBE projects is simply the on-bill finance (OBF) model. Under the OBF model, the local utility lends capital to a ratepayer to purchase a more efficient piece of equipment. Then, once the project is finalized, the building owner allows the utility to collect repayment in future utility bills as part of the rate tariff. In OBF programs, individual projects are funded by utility ratepayers through both a loan and a rebate or other incentive. Funding is available for businesses, and is repaid through a monthly line item on the customers' utility bill with usually zero percent interest.[35]

This method is popular because it is logical and streamlined for asset owners and contractors—however, not all utilities embrace this structure. Although many utilities have established on-bill financing schemes, and initial success has been observed, uptake of this basic system has generally been low. Most utilities do not relish the idea of investing their own capital in energy efficiency projects, as they view that to be the traditional role of a bank or ESCO. In any case, the establishment of an on-bill financing mechanism often requires a directive from the state's public utilities commission.

Figure 9: On-Bill Repayment Diagram



Source: World Economic Forum

A more recently developed alternative to the OBF model, termed on-bill repayment (OBR), allows for an asset owner to solicit private or third-party capital to cover the initial investment in their energy efficiency upgrades, though the investment is still repaid via the utility bill. The utility simply collects and then passes the payments on to the capital providers, rather than serving as the actual investor themselves (See Figure 9). In a proposed OBR scheme expected to come online in California in 2013 or 2014, the utilities would receive a collection payment in exchange for serving as a facilitator of this process, thereby incentivizing them to participate in EEBE with a new income stream. As in OBF, loan default might result in meter disconnection, making it a contentious model for cold weather climates.[36]

The OBR model is particularly effective for several reasons. To begin with, the capital is provided by third parties, relieving the pressure on both asset owners and utilities to cover upfront costs, and no taxpayer or ratepayer funding is required. Additionally, the program's administration and utility costs may be recovered through fees charged to investors or developers. Another important characteristic of an OBR program is that the repayment obligation is a rate tariff that stays with the meter. In the event of a change in ownership or tenancy, the new payer of the utility bill would enjoy the savings from the project while also assuming the obligation. The tariff also continues to apply in the event of foreclosure. [37]

The design of OBR programs may also further minimize risk by requiring qualifying projects to provide an estimate of bill neutrality, meaning that the monthly repayment amount will not be greater than the energy savings from the upgrade. This ensures fairness for future tenants, owners, and current mortgage holders. Given its use of investor capital, the OBR option has greater potential for scale than the traditional OBF model—which only relies on ratepayer utility capital—and is more likely to be customizable to the needs of various property owners and vendors. Figure 11 highlights the main aspects of OBR.

NOTES FROM THE FIELD
Environmental Defense Fund

"The Environmental Defense Fund believes that on-bill repayment (OBR) programs can transform the market for energy efficiency across the United States (and potentially the world) by providing a way for commercial and residential building owners to access the private capital they need to upgrade their energy performance. In May 2012, the California Public Utility Commission (CPUC) ordered investor-owned utilities to establish OBR programs for commercial properties. Those programs are expected to be operational by mid-2013. As we have progressed from design to implementation stage with OBR, we have found that some constituents have expressed concern with the requirement that utilities treat the OBR charge as equivalent to the utility charge. However, EDF believes that this equal treatment is critical to attracting private capital at scale. This is because lenders use existing data on the historical performance of utility bill payments to evaluate credit risk, and very low historical default rates are the key value proposition for using an on-bill repayment mechanism. EDF has consistently heard this message from both banks and rating agencies. However, utilities and some consumer advocates have challenged this notion and expressed their preference for the utility and OBR obligations to be distinct with respect to collection procedures.

Increasing dialogue among stakeholders has been crucial to our success in making progress. For example, we have convened stakeholder meetings, and made introductions among lenders and utilities to facilitate discussions that allow each side to understand the other's perspective. In addition, we have listened to utilities and realized that there are alternative payment structures we can utilize to achieve the program goal of aligning utilities' and lenders' interests. It has also been critical to emphasize and clarify the strong consumer protections we advocate for being added to all OBR programs, including significant protections for vulnerable ratepayers, such as those with medical needs.

We have also looked to similar programs to better understand how they have addressed this critical issue. In New York, the Center for Working Families (CWF, a consumer advocacy organization) actively supports the state's on-bill program, which has utilities follow standard collection procedures, including disconnection. CWF believes that the utilities' collection procedures, which have been vetted over many years, provide sufficient safeguards for vulnerable populations. CWF also wrote a letter in support of EDF's proposed OBR legislation. EDF is optimistic that with the proper consumer protections in place, we will be able to meet the needs of consumer advocates, utilities, and lenders to create a well-designed and successful program."

Brad Copithorne, Energy and Financial Policy Specialist , EDF

[33] "On-Bill Financing Program (Tied-To-The-Meter) Study." Energy and Finance. Harcourt Brown & Carey. February 15, 2012. http://harcourtbrown.com/2011/01/on-bill-financing-program-tied-to-the-meter-study/

[34] Bell, Catherine J., Steven Nadel, and Sara Hayes. "On-Bill Financing for Energy Efficiency Improvements: A Review of Current Program Challenges, Opportunities, and Best Practices." Rep. no. E118. Washington, DC: American Council for an Energy Efficient Economy. 2011.

[35] Brown, Matthew, and Dave Carey. "Introduction." Proc. of CPUC Energy Financing Workshop, CPUC Auditorium, San Francisco.

[36] It should be noted that his method of mitigating risk is controversial given the dire implications of meter disconnection in cold weather climates.

[37] Copithorne, Brad. "Creating Financing Markets for Energy Efficiency Projects in Commercial Buildings." Issue brief. N.p.: Environmental Defense Fund, n.d.

The remainder of this section describes two versions of third-party on-bill mechanisms, both OBF and OBR, that are being implemented around the world. Although these programs are, in the Carbon War Room's estimation, particularly innovative, they by no means represent the only models for structuring on-bill financing mechanisms for EEBE projects.

Oregon Model

One of the first municipalities to implement a version of a wide-scale on-bill repayment scheme was Portland, Oregon, through their Clean Energy Works Portland (CEWP) program. Through this program, homeowners receive assistance conducting an audit, selecting appropriate energy conservation measures, applying for a loan, and implementing the building upgrade. The upfront financing for the projects is provided by a loan fund managed by the CDFI Enterprise Cascadia, and the homeowners repay the loan via their utility bill. The money in the fund is currently sourced from ARRA, the Portland Development Commission, the Living Cities Foundation, and other smaller funds.[38] In this particular program, interest rates vary based on applicant qualifications, and the loan cannot be transferred to a new property owner. During the preliminary implementation of the program, loans averaged about $9,000 and monthly payments averaged about $46.[39] As this program has grown out of the pilot phase, changes and improvements have been made, and the Carbon War Room is excited to learn more about the results it will achieve in coming years.

On-Bill Repayment is a potentially scalable EEBE mechanism being piloted in regions around the world

United Kingdom Model

A program similar to OBR is being delivered in the United Kingdom. Known as the Pay As You Save (PAYS) scheme, it is a financing mechanism for residential buildings created under the umbrella of the Green Deal. With PAYS, the cost of a property retrofit is spread over a long period of time—and potentially across different owners and occupiers—as the obligation to repay is tied to the meter not the tenant. The savings from the retrofit will be more than the costs of repaying that retrofit, with the requirement for Green Deal that the bill payer will be better off in the first year. If the building changes ownership and/or occupancy, the benefits of the EEBE measures, along with the obligation to pay, are transferred to the new bill payer.

With the Green Deal program, some upfront costs, such as the cost of insulating solid walls, are subsidized through energy company obligation schemes, with government incentives provided to encourage wider-scale adoption rates. The retrofit work is undertaken by an accredited company with rigorous UK government mandated standards, and the mechanism as a whole is promoted by trusted third parties, including local authorities.

The program went live in October 2012 but the finance models are only now beginning to become available. Early demand figures are encouraging, with much of the drive coming from local authorities. Major cities such as Birmingham, Newcastle, Leeds and Manchester have initiated Green Deal programs, with Birmingham in the lead. Finance for these projects will predominantly come from a new venture called The Green Deal Finance Company (TGDFC), a private sector collaboration developed by PWC. Additional partners include the newly formed UK Green Investment Bank and the UK government. Funding is also expected to come from the European Investment Bank (EIB), whose role is to provide interim finance and aggregate Green Deal projects until they can be refinanced through a investment grade bond.

TGDFC's interest rate will be set at 6.96 percent, but with associated costs this will generally be in the range of 7.5–9 percent to consumers. This rate is higher than most of the sector was hoping for, but it is generally recognized that this is be best available without significant government subsidy. How consumers will react to this one of the key unknowns, but the Carbon War Room sees great opportunities for the program to scale.

[38] Bell, Catherine J., Steven Nadel, and Sara Hayes. "On-Bill Financing for Energy Efficiency Improvements: A Review of Current Program Challenges, Opportunities, and Best Practices." Rep. no. E118. Washington, DC: American Council for an Energy Efficient Economy. 2011.
[39] Green For All. "Clean Energy Works Portland: A National Model for Energy-Efficiency Retrofits." Rep. Portland: Green For All. 2010.
[40] If you are a municipality seeking a comprehensive understanding of how to establish a PACE program, the Carbon War Room highly recommends reading the "Property Assessed Clean Energy (PACE) Replication Guidance Package for Local Governments", published by the State of California, and attached at the end of this document.
[41] Eligible measures vary by program.
[42] Carmichael, Annie. "Property Assessed Clean Energy (PACE) Enabling Legislation." Issue brief. San Francisco: Renewable Funding & Vote Solar Initiative. 2010.
[43] "PACE Program Basics." What Is PACE? Web. 14 Mar. 2012. <http://pacenow.org/blog/about-pace/>.
[44] http://issuu.com/nilskok/docs/kk_green_homes_071912/1

ASSESSMENT FINANCE

For more than 100 years in the US, municipalities have levied assessments on their constituents to pay for upgrades to roads, sewers, schools, and other common assets that benefit the public good. A special assessment district is a defined area within a community in which property owners stand to benefit from an improvement project more significantly than the community in general. Essentially, the establishment of special assessment districts allows for communities to pay for improvements proportionately, based upon the extent to which certain areas will enjoy the benefits of the improvement, as those closer to the improvement, by virtue of benefiting more substantially from it, are charged more for the project.

The idea of special assessment districts has many applications. In 2007, for example, it was adapted by the city of Berkeley, CA to apply to renewable energy projects that could result in cleaner air and the mitigation of climate change. The application of special assessment districts to EEBE upgrades represents another innovative application of assessment financing, and its potential is most clearly exemplified by programs like Property Assessed Clean Energy (PACE).[40]

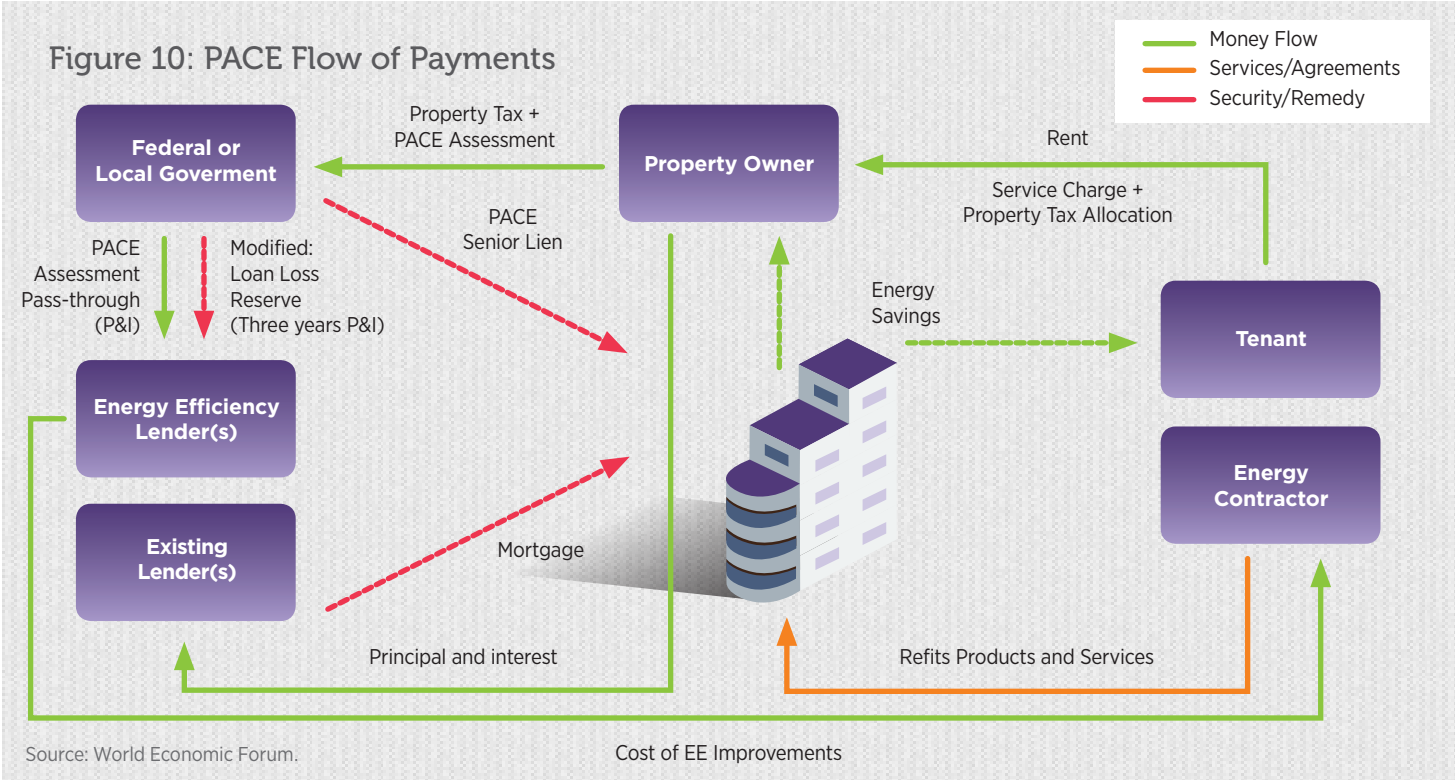
PACE is a particular type of assessment financing that establishes an assessment district to finance not only EEBE projects but also renewable energy, water conservation, or other sustainability efforts.[41] The creation of PACE financing districts is highly dependent on an individual municipality's property tax laws, and, in most cases, requires specific PACE-enabling legislation to be passed. The legislation must be built off existing financing and assessment authority of state and municipal statutes. Additionally, depending on the precise funding mechanism planned for the PACE project (many of which are discussed on page 37), steps may need to be taken to authorize the use of bonds to finance improvements, to insure that assessments are secured by liens on properties, or to authorize financing improvements on private property.[42]

Projects approved for the special assessment district are paid for either by the municipality or by a third-party capital source like a fund or bank, meaning there is zero upfront cost to building owners. The EEBE financing instead works by attaching a special tax assessment in which the repayment obligation is actually attached to the property itself and not the property owner, and transfers to the new owner with the sale of the property. The participating property owners then pay off the debt via a property tax charge collected over the course of up to 20 years, though shorter periods may be used.[43] In most programs, estimated savings must exceed the investment amount. Figure 10 illustrates how payment flows occur between a municipality, lender, contractor, and property owner.

Given that property assessments usually qualify as eligible pass-through costs, PACE helps to overcome the split incentives of tenants and owners that can occur with triple-net-lease tenant-occupied buildings, such as commercial and multi-tenant residential buildings.

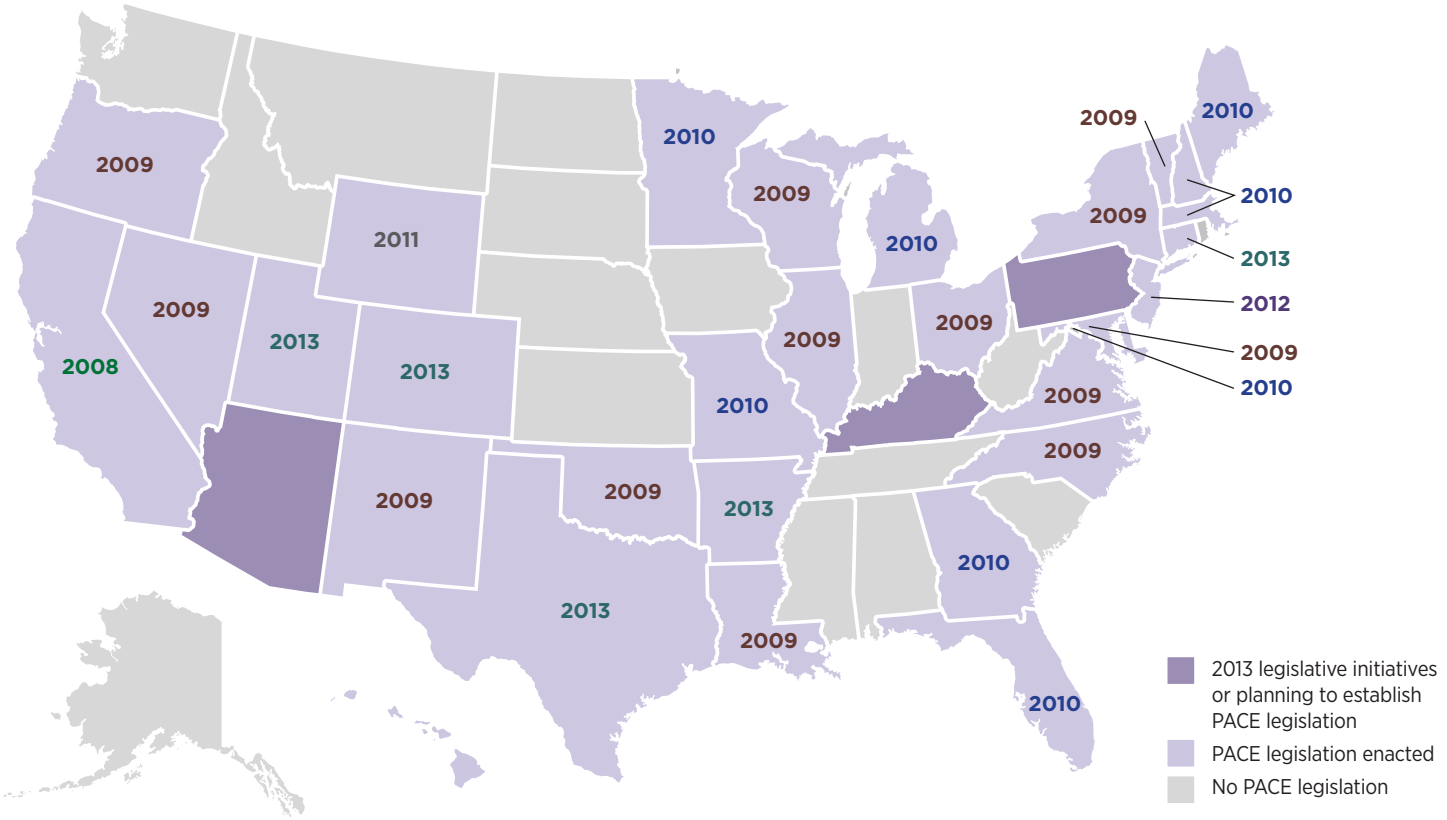
Ultimately, tenants benefit from the utility bill savings and also bear the costs of the PACE financing structure, while owners are able to monetize the soft benefits (associations with being green) and hard benefits (capitalization of energy savings) that accrue with carrying out retrofits.[44]

Figure 10: PACE Flow of Payments



Source: World Economic Forum.

Figure 11: Status of PACE Enabling Legislation and Year Enacted



Source: PACENOW.

According to a baseline forecast scenario from a report by Pike Research, PACE will be used to finance retrofits for commercial properties at a rate of $2.5 billion annually by 2015. The report estimates this investment will create 50,000 new jobs and prevent 8 million metric tons of carbon dioxide emissions. As of May 2013, approximately $33 million in PACE renewable energy and efficiency deals have been completed in six states in residential and commercial buildings with an additional current pipeline[45] of $100 million.

While some states have pursued this policy more aggressively than others, enabling legislation for PACE financing for commercial buildings has been passed in 30 states plus the District of Columbia, as Figure 11 above illustrates. Representatives Hayworth (R-Calif.), Lungren (R-N.Y.), and Thompson (D-Calif.) have also proposed federal legislation, called the PACE Assessment Protection Act of 2011, in the House of Representatives (H.R. 2599). That bill would increase the scope of PACE financing to include residential buildings by directing the Federal Housing Finance Agency (FHFA) to permit the PACE mechanism.[46] Despite these promising steps, one of the main impediments to rapid deployment has been confusion about the details of PACE.

PACE could used to finance retrofits for commercial properties at a rate of $2.5 billion annually by 2015 - according to Pike Research

[45] This pipeline is what has been reported by program administrators and has not been independently verified.
[46] "Financing Energy Efficiency Upgrades with Property Tax-based Repayment." Property Assessed Clean Energy Financing (PACE). Alliance to Save Energy. 2011. February 20, 2012. http://ase.org/resources/property-assessed-clean-energy-financing-pace
[47] For this reason, there is little, if any, standardized nomenclature for these programs. The Carbon War Room has attempted to consolidate existing literature into the most recognized names for these structures, but it should be noted that the models might have different names in other literature.

Existing PACE Structures

The following pages contain an examination of existing PACE structures and will attempt to delineate between the various models. As PACE is a relatively new financing mechanism to the market, it currently takes many different forms that depend on the legislative definitions of PACE in particular regions, and on the entities that are administering the PACE programs.[47] The Carbon War Room has chosen to try to simplify the myriad variations by defining four primary types of structures that support commercial PACE programs:

1. **Municipally Financed:** In this model of PACE, a municipality uses a large line of credit, backed by the full faith and credit of the municipality, to fund qualified projects on an as-needed basis. When sufficient project volume is reached, the portfolio can be sold through a municipal revenue bond issuance. The proceeds of the sale can replenish the line of credit and facilitate a new funding cycle. As an example, please see the description of the Palm Desert Energy Independence Program in Palm Desert, CA, later in this document.

2. **Pooled Bond:** In this model, a property owner's applications for PACE financing are approved during an aggregation period, which means that only once a sufficient number of approved applications have been assembled will the local government sell a bond to fund all of the projects at once. The ClimateSmart Loan Program in Boulder, CO is one such example.

3. **Open Market:** In this model, property owners independently secure financing for a defined project with the lender of their choice. Financing terms are negotiated independently of the municipality and are predicated upon 1) senior lien position of PACE and 2) the underlying credit of the owner/building. This model avoids the timing delays associated with the pooled bond approach but still requires the consent of mortgage holders. With owner-arranged projects, terms are most likely to be 5–20 years with an interest rate of 5–8 percent—though given the ad hoc nature of funding methods for such projects, no published standardized rate exists. The Florida Green Energy Works Program uses this approach.

4. **Owner-Preferred:** In this model, a vendor serving an active municipality pre-approves each qualifying property for assessment financing, which is usually limited to a maximum of 10 percent of the property's fair market value. The vendor either fully funds the program or pools projects before committing capital. All potential projects must meet strict underwriting guidelines. Some programs following the owner-preferred structure require the program administrator or the property owner to receive full consent from the primary lender, while others only require lender notification. Even in cases where only lender notification is required, if a mortgage holder can demonstrate that the assessment lien would violate the terms of an existing loan agreement, it may object to the assessment. In the event of a lender objection, property owners must meet additional requirements before proceeding (i.e., reversion to Open Market model). If the lender does not object, the vendor provides fixed-rate funding secured by individual PACE assessments. Amortized for terms up to 20 years, interest rates are fixed for the life of the assessment and are tied to a benchmark rate, such as US Treasuries, currently falling in the 5–6 percent range. The Clean Energy Sacramento Program in Sacramento, CA is an example of this model.

It should be noted that some PACE programs are designed with flexibility in several of the aforementioned structures. Unfortunately, describing every possible permutation of a PACE program is outside the scope of this paper. It should also be noted that none of the four structures described here have yet to show significant uptake in the market.

Generally, the Carbon War Room believes that the first three structures (Municipally Financed, Pooled Bond, and Open Market) have some important challenges to overcome. For example, both the Municipally Financed and Pooled Bond models require large numbers of projects to be aggregated for capital to be deployed, leading to long time horizons for project implementation. Open Market structures reduce the project development cycle compared to these other two. However, all three of these models typically (though not in every case) require explicit lender consent from mortgage holders. The Owner-Preferred structure, on the other hand, suffers less from these challenges. However, this model faces different challenges with respect to negotiations with mortgage holders, which will be discussed further in the Lender Consent section of this paper.

A potential advantage of the Owner-Preferred structure is that, if program administrators filter the PACE applications through a third-party vendor, and by pre-approving properties for financing, this model has the ability to easily scale to entire municipalities rather than relying on piecemeal applications retrofitting one building at a time.[48] The Carbon War Room recognizes that this perspective is not shared by all within the PACE community and therefore it is discussed in more detail in the Lender Consent section.

Table 2, overleaf, demonstrates the current (May 2013) status of commercial PACE-funded projects and those in development.

[48] For the purposes of full disclosure, the Owner-Preferred model was pioneered by the Carbon War Room-backed PACE Commercial Consortium, consisting of Ygrene Energy Fund, Hannover Re, Energi, and Lockheed Martin, with an initial $650 million commitment from Barclays for the Miami and Sacramento markets. Projects began to be funded in Sacramento in January 2013.

NOTES FROM THE FIELD
SF Commercial PACE

"We originally launched our San Francisco's PACE program (GreenFinanceSF) as a residential program in April 2010, but suspended it in July 2010 due to objections raised by mortgage regulators the Federal Housing Finance Agency (FHFA). Since commercial properties are not subject to those regulators, we pivoted our focus to a commercial-only program that uses an Open Market PACE financing approach—enabling multiple capital providers to serve the diverse commercial real estate market through a private placement bond model. The program closed its first financing transaction in October 2012 for Prologis Inc., which will install $1.4 million in lighting and HVAC improvements, and a 200 kW rooftop solar photovoltaic system.

In 2010, when the FHFA statements shut down a promising start to the San Francisco residential program (~$900,000 in applications in the first two months), it had a chilling effect in which almost all developing residential PACE programs around the country were immediately suspended. Some questioned whether commercial programs would be able to move forward. Also, since program start-up costs were being covered by federal grant funds (American Recovery and Reinvestment Act, or ARRA), timing challenges emerged with respect to strict spending deadlines; in California $30 million in ARRA funds originally designated for residential PACE also needed to be reallocated after the FHFA notices, and it was not totally clear how to commit those funds.

Considering the challenges described above, our team needed to act quickly to establish new commercial administrative and technical guidelines, update our bond authorization, and obtain legislative approvals, among other things. Additionally, the program had to identify an appropriate capital structure to finance commercial retrofit projects, which would presumably be larger in size but smaller in number. We explored our options and ultimately chose the Open Market model, as this approach would not require a new solicitation for a single finance provider, which would have been time prohibitive. Since Open Market PACE allows for flexible deployment of capital from multiple sources, we felt it was a good fit given the wide variations in the commercial real estate market and the newness of the program.

In retrospect, it is clear that marketing and outreach—which are critical to promote the program opportunity and energy efficiency in general to owners—were under-funded at the time of the program launch; new funding sources will help to increase outreach to owners, and especially contractors, who are ultimately the ones who can "sell" energy upgrades. Additionally, our first bond closing has confirmed that transaction costs can be significant. While it is generally understood that with experience and time these costs will go down, currently they may be perceived to be burdensome. To address this in the interim, we have recently identified new resources to reduce those costs for early adopters. All said and done, we are excited to see PACE gain momentum in San Francisco and throughout the country."

Rich Chien, PACE Program Manager, City and Council of San Francisco

Program Examples: Ygrene Energy Fund and Melbourne

The Carbon War Room has worked to create the PACE Commercial Consortium (PCC)—consisting of Ygrene Energy Fund, Hannover Re, Energi, and Lockheed Martin—to address the Miami and Sacramento markets. Announced in 2011, the first projects broke ground in January 2013 in Sacramento.

The following section describes the Ygrene Energy Fund model, which is an example of a PACE initiative. This model removes the pressure on property owners to acquire financing, offers an accelerated timeline for funding projects, and relies on strict underwriting criteria that include:

- An energy audit from a recognized firm that assesses the viability of various energy efficiency solutions and forecasts/models the expected savings over the life of the assessment term
- Use of a performance-guaranteeing insurance product from insurance companies like Energi
- A Savings-to-Investment Ratio (SIR) in excess of one ensuring that all projects pay for themselves
- The borrower under a PACE lien may not have filed for bankruptcy in the previous seven years
- The term of the assessment should not exceed the useful life of the improvements
- The property owner must be current on property taxes and have not been late on a payment more than once in the past three years, or since purchase if the purchase date of the property is less than three years.

It is also important to note that programs similar to PACE have been implemented in other countries as well. One example is the Environmental Upgrade Agreement program in Melbourne, Australia.

The city of Melbourne's "Zero Net Emissions by 2020" strategy focuses on the retrofit of existing commercial and residential buildings, which account for the greatest emissions in the city. In response to this emissions profile, the City of Melbourne delivers two flagship programs: 1200 Buildings and City Switch (focused on building owners and office tenancies respectively). The City of Melbourne adopted Environmental Upgrade Agreements (EUA) in 2011.

In 2012/13 the Australian Government stimulated $25 million investment from the private sector in EUAs and up to $50 million in other innovative finance mechanisms. The establishment of the new Clean Energy Finance Corporation, responsible for $10 billion, will see further investment in energy efficiency and renewable energy mechanisms and projects.
Interest in EUAs has grown significantly since Melbourne introduced the mechanism to Australia. Legislation has been changed in the state of New South Wales to enable EUAs and the mechanism will soon be available in the state of South Australia.

PACE provides financing for the upfront costs of retrofits while overcoming the split incentives that exist between tenants and owners

IMAGE: JOHN HORNER PHOTOGRAPHY. OFFICE DA

Table 2: US Commercial PACE Market – Projects Funded and in the Pipeline

Location	Name	Scope	Program Adminstrator	Funded	Pipeline
Los Angeles CA	Energy Upgrade LA PACE	LA County	Sustento Group	-	$18,000,000
Palm Desert CA	Energy Independence Program	Palm Desert	City	$575,000	-
Placer County CA	mPower Placer	Placer County	County	$742,000	$2,411,000
Sacramento CA	Clean Energy Sacramento	City of Sacramento	Ygrene Energy Fund	$1,000,000	$30,000,000
San Francisco CA	GreenFinanceSF	San Francisco	City	$1,400,000	$4,000,000
Sonoma County CA	SCEIP	Sonoma County	County	$11,000,000	$1,300,000
Statewide CA	CaliforniaFIRST	14 Counties thus far	Renewable Funding	$0	$28,500,000
Statewide CA	California PACE - FigTree	18 Counties	Fig Tree	$735,745	$2,278,000
Counties CA	HERO Program - Commercial	2 Counties	Samas Capital	$0	-
Possible statewide CA	HERO Program Residential	Possible statewide	Renovate America	$0	
Yucaipa CA	Energy Independence Program	City of Yucaipa	City	$20,252	$20,284
Boulder County CO	Climate Smart	County	Program closed	$1,520,000	-
Statewide CT	C - PACE	Statewide	CEFIA	$185,000	-
Washington DC	Green Energy DC	District Wide	Various Advisors	-	$340,000
Statewide FL	Florida Green Energy Works	any Municipality	Eco City Partners	-	$700,000
Statewide FL	Green Corridor District	any Municipality	Ygrene Energy Fund	-	-
Statewide FL	Florida PACE Funding Agency	any Municipality	SAIC	-	-
Atlanta GA	Clean Energy Atlanta	City of Ann Arbor	Ygrene Energy Fund	-	-
Ann Arbor MI	Ann Arbor PACE	any Municipality	Clean Energy Coalition	$565,000	-
Statewide MI	Lean & Green	Edina	Lean & Green	$9,500	-
Edina MN	Edina Emerald Energy Program	any Municipality	Eutectics Consulting	-	-
Other MN			Eutectics Consulting	-	-
Statewide MO	Missouri Clean Energy District		MoCEF	-	-
Statewide NY	Energize NY	Westchester County (plus)	LDC	-	-
Cleveland Vicinity OH		County District	Lake County Port Authority	$3,375,000	-
Toledo OH	Toledo-Lucas Municipal PACE	County District	Port Authority	$12,000,000	-
Milwaukee WI		Milwaukee	City		
Total				$32,552,497	$87,549,284

Source: PACENOW and Carbon War Room research.

IMAGE: JOHN HORNER PHOTOGRAPHY. NADAAA

Lender Consent Challenge

The single most polarizing aspect of PACE is the argument over whether or not the implementation of PACE projects should require the consent of mortgage lenders. Although most PACE programs share the ideology that PACE assessments should receive the same treatment as other special assessments, there are two fundamentally divergent opinions in the marketplace as to how to address the issue of lender consent.

On the one hand, PACE itself is still a new mechanism and there is a lack of empirical data on the persistence of PACE-generated savings over the long repayment term (up to 20 years), leaving banks understandably hesitant to forfeit their first lien position. Therefore, many PACE programs are predicated on the belief that there is a real risk of litigation to the property owner and the municipality if PACE assessments are done without consent from the mortgage lender. This is exacerbated by the fact that PACE assessments are voluntary rather than mandatory. Proponents of this opinion believe that the existing PACE structures function more similarly to a loan, and since most mortgages have covenants restricting additional debt, lender consent should be required. Certainly, requiring that mortgage lenders approve PACE financing reduces the risk that asset owners will be accused of violating mortgage covenants.

On the other hand, other programs are based on the confidence in the legal authority of assessment finance and, thus, only require the property owner to supply the information about the retrofit financing to the mortgage lender. Proponents of this opinion claim that lender consent should not be required, pointing to more than 100 years of statutory authority supported by court precedent that validates a municipality's intrinsic right to assess levies in the "public purpose", with wide deference for cities to define public purpose as they see fit.[49] Any such levies are repaid via property taxes and therefore are senior to any other debt placed on the property. The logic of this argument is that, since banks have not successfully raised encumbrance issues when municipalities assess levies for schools, sewers, or streetlights, there is no precedent for them to raise concerns with levies that pay for renewable energy or efficiency projects.

Many property owners are also worried about lenders' ability to foreclose based on "contract interference" or "impairment" of the mortgage under a PACE system, which may occur when the assessment supplants the property's mortgage in the first lien position. However, there has yet to be a case in which a bank has been able to legitimately claim that an egregious act has been done, or that they were substantially damaged by the implementation of a PACE tax, especially given the particular constructs of this type of assessment. In fact, under the three-part test used by courts, the Carbon War Room has concluded that the creation of PACE assessments as senior liens do not constitute an unconstitutional impairment.[50] Actually, by lowering energy costs, PACE studies clearly show that the program—unlike other charges—enhances the property owner's ability to pay their mortgage.

Given the infancy of PACE programs, it is difficult to demonstrably prove the soundness and safety of PACE liens with regards to foreclosures and defaulting. Yet the existing data is promising. For example, a recent "Energy Upgrade California" white paper on PACE concluded that in 2009–2010, the total secured tax delinquencies for the county of Somona were 3.3 percent compared to PACE assessment non-repayments of 1.19 percent. For 2010–2011, total secured tax delinquencies in Sonoma were 2.3 percent compared to PACE delinquencies of 1.8 percent.

Residential Assessment Finance

PACE financing has been developed for residential properties as well as commercial properties, and there are currently active residential PACE programs in several municpalities. While many cities had earnestly begun developing programs from 2008 to 2010, most of these programs were shut down in light of the May 2010 letters from the Federal Housing Finance Agency (FHFA) stating that under the terms of Fannie Mae/Freddie Mac, residential property owners are not allowed to obtain loans that have senior lien status to a mortgage. Furthermore, such loans would be an "unallowable encumbrance" to a property with a Fannie/Freddie-backed mortgage.

In light of the FHFA's objections, federal legislation has been proposed. The PACE Assessment Protection Act of 2011, HR 2599, was introduced into the US House of Representatives on July 20, 2011 by Congresswoman Nan Hayworth (R-NY) and is co-sponsored by a bi-partisan contingent of 51. This bill, if passed, will prevent federal residential and commercial mortgage regulators from adopting policies that conflict with or thwart established state and local PACE laws.[51]

Also in response to the FHFA's guidance to Fannie and Freddie, several states, municipalities, and NGOs filed lawsuits against the FHFA. In 2012, the District Court for the Northern District of California forced the FHFA to go through a rule-making procedure; the FHFA appealed and in March 2013, the 9th Circuit Court of Appeals vacated the order, dismissing the case. As of the publication date of this paper, it is not clear whether the plaintiffs will petition for a larger panel on the 9th Circuit to hear the case "en banc" or whether they will petition the Supreme Court to review the case.

[49] Ibid.
[50] Energy Reserves Group v. Kansas Power & Light. No. 81-1370. Supreme Court. January 24, 1983.
[51] Ibid.
[52] "Welcome to the City of Toronto Website." About Tower Renewal. N.p., n.d. December 15, 2012.
[53] http://www.vancouversun.com/technology/Vancouver+energy+efficiency+program+bombs/7907720/story.html
[54] http://www2.news.gov.bc.ca/news_releases_2009-2013/2013EMNG0072-000827.htm
[55] MacLean, John. "Structuring Loan Loss Reserve Funds for Clean Energy Finance Programs." Energy Efficiency Finance Corps. January 15, 2010. February 10, 2012.
[56] Energi, Inc. "Risk Mitigation through Insurance for New Energy Financing." Rep. N.p.: n.p. 2012.
[57] Ibid.
[58] Ibid

PROGRAM EXAMPLES: Vancouver

It should be noted that, while residential PACE is essentially on hold in the United States, it is being pursued in Canada via the Home Energy Loan Program (HELP) in Vancouver and the Tower Renewal Program in Toronto,[52] and is also being considered in New Zealand.

Vancouver City Savings Credit Union ("Vancity") made C$5 million available for up to 500 loans for residential energy efficiency retrofit measures in Vancouver's Home Energy Loan Program (HELP). Homeowners could borrow up to $10,000 for 10 years at 4.5 percent, with payments comparable to the retrofit's energy savings. The City of Vancouver and other outside parties provided a loan-loss reserve fund to reduce risk for Vancity. The function of this one-year pilot project was to demonstrate the need for, and efficacy of, retrofit loans.

The HELP program wrapped up after one year without meeting its 500-loan target. The low uptake of the program has been tentatively attributed to current low energy costs and an interest rate that is perceived as too high.[53] Although Vancouver's program did not achieve all of its goals, it did help homeowners reduce emissions and save money while also inspiring new energy efficiency financing programs across the province. The province, along with BC's utility companies, started a pilot on-utility bill financing program in Colwood and the Okanagan region in 2012. This program is scheduled to expand in January, 2014, with the potential of going province-wide.[54]

Loan loss reserve funds and loan guarantees are two ways that municipalities can enhance the credit of projects and encourage private sector participation

RISK MITIGATION

Even with innovative financing mechanisms like ESAs, on-bill financing, and PACE, loans for energy efficiency projects are not always attractive to lenders. There are a number of options that have the potential to make these loans more attractive, including additional credit enhancements that utilities and lenders may require to help mitigate the risk of default.

One very common method of reducing risk is to establish a loan loss reserve fund. A loan loss reserve fund leverages public money to cover a percentage of the total loan portfolio principle—usually 2–10 percent. Providing this guaranteed protection against losses makes loans for energy efficiency projects more attractive, and may allow lenders to apply lower interest rates with more flexible terms. It also enables public funds to have a significantly larger impact than they would if they were used to finance projects directly.[55]

Many of these innovative financial mechanisms are also considered risky because they rely so heavily on the energy savings as a means of repaying loans. In order to ameliorate this component of the risk, the property owner and/or lender will often require the contractor to offer a collateralized guarantee on medium-to-large-scale projects. Doing this mitigates the risk associated with measured energy savings by assuring fair compensation to the investor in the event that the retrofit does not generate the expected level of savings.

Another option is to add third-party performance and savings guarantees to projects to offer assurance to lenders that customers will be able to repay loans through energy savings.[56] One recent development in this option is the re-emergence of Energy Savings Insurance.[57] Energy Savings Insurance, such as that being offered by Energi, backstops contractor guarantees of system effectiveness and energy savings and increases the "bankability" of projects. If the guaranteed savings are not met and the source of the deficiency is an effect of contractor design or installation, then the system owner is reimbursed an amount equal to the output shortfall.

The application of adequate risk protections through insurance will further encourage the continued success and growth of the clean energy and energy efficiency markets. More specifically, Energy Savings Insurance is particularly beneficial because it: reduces barriers to entry for smaller ESCOs that do not always have sufficiently strong balance sheets to self-insure the savings; forces the criteria for defining energy savings to be transparent and explicit; mitigates the risk of system underperformance; and adds security of return on investment for financiers. Additionally, in many cases "the insurer provides third-party review of engineering and design and third-party involvement in ongoing measurement and verification, thereby increasing the building owner's confidence level to invest."[58] Overall, the integration of insurance products into building retrofit financing leads to higher project confidence among building owners and lenders that wish to increase the energy efficiency of their portfolio.

The combination of new finance mechanisms that enable asset owners to source new avenues of capital in tandem with risk mitigation measures has the transformative capacity to unlock hundreds of billions of dollars for energy efficiency retrofits globally. This paper's attention now turns to the role of government in creating policies that can harness and unlock the best practices of entrepreneurs.

Policy

Government can play an important role in creating a policy environment conducive for market forces to accelerate investments into energy efficiency retrofits

- Policies like utility decoupling, point-of-sale auditing, and benchmarking mandates create a framework for asset owners to understand how their buildings consume energy – a necessary condition for retrofits to occur

- Other policies exist to facilitate innovative financing structures, such as assessment finance and on-bill finance, which allow asset owners to retrofit buildings.

WHAT ROLE DOES POLICY PLAY?

In its work, the Carbon War Room is continually asked by stakeholders ranging from municipal representatives to large asset owners, "Where do we begin?"

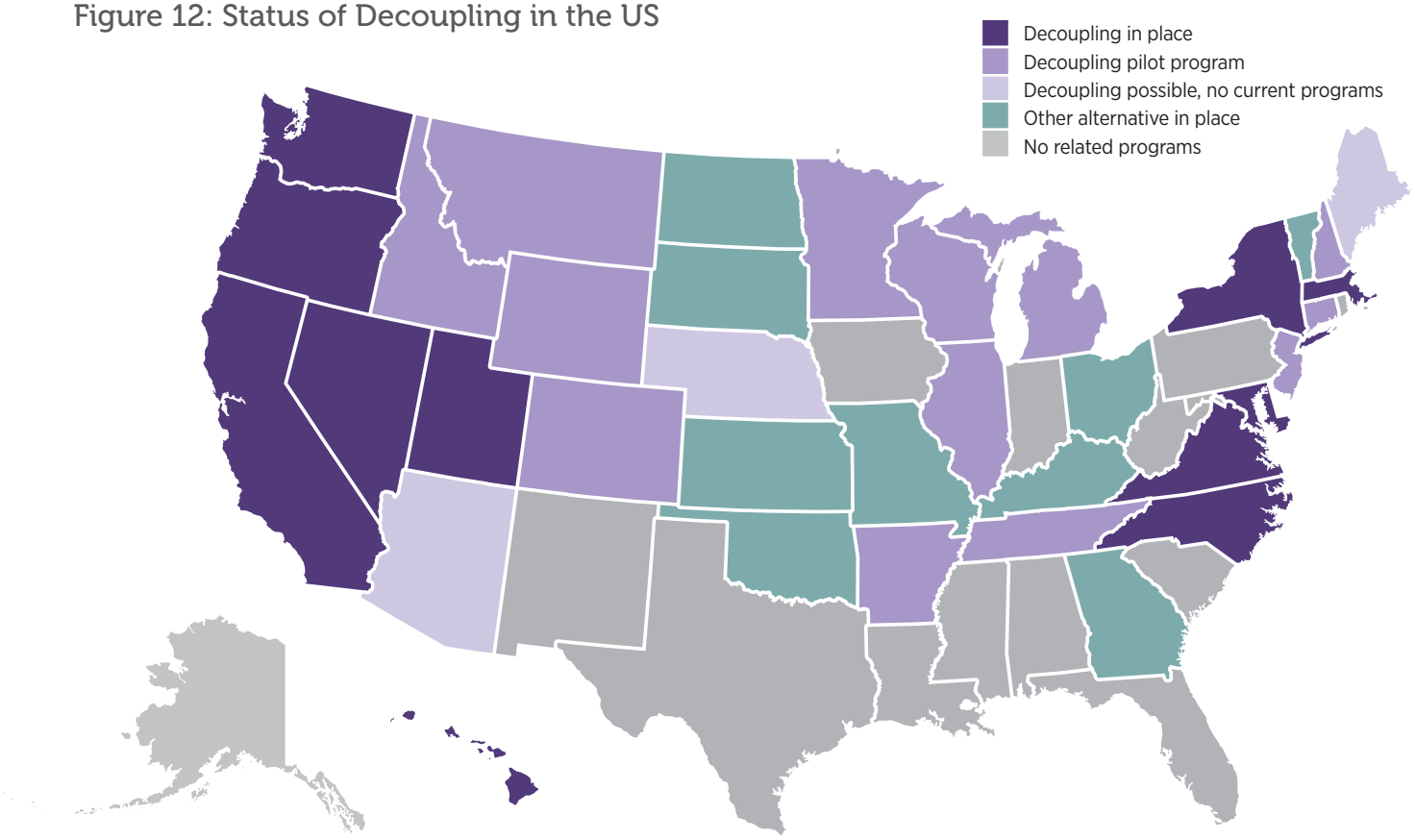
While the Carbon War Room focuses on solutions that do not require changes in policy, it recognizes that there are certain policy frameworks that are more effective at fostering entrepreneurial solutions than others. Therefore, the Carbon War Room supports the premise that government can help create environments conducive to competition, as well as that enable innovative private sector financing mechanisms to flourish. In fact, many of the financing solutions discussed previously are highly dependent upon local policies, like the creation of enabling legislation, the establishment of special districts, and the requirement for utilities to serve as a billing mechanism for EEBE repayments.

As mentioned earlier, there are several ways to incentivize efficiency upgrades, the most common being rebates, credits, and accelerated depreciation schedules. While well intentioned, these incentives have the capacity to create a myriad of problems, not least that such rebates and credits are typically only offered in small amounts and only for limited periods of time. Many of the incentives are also disjointed, with some offered by state and federal governments, some by utilities, and others by private institutions, and it is up to asset managers and homeowners to navigate this disjointed maze of incentives. Ultimately, applying for credits is a time-consuming process, and many building owners and managers simply cannot make it a priority.

How to Incentivize Upgrades Without Creating Perverse Incentives: Utility Decoupling

Investor-owned utilities traditionally operate within a structure that disincentivizes energy efficiency: they make money by selling electrons to consumers. The more electrons they sell, the more money they make. Under this system it would be illogical for utilities to promote or engage in energy-saving efforts. Therefore an effective first step for a state interested in promoting efficiency is to pass decoupling legislation that alters this rate structure for utilities. As Figure 12 illustrates, most US states have either implemented or passed utility-decoupling laws.

Figure 12: Status of Decoupling in the US

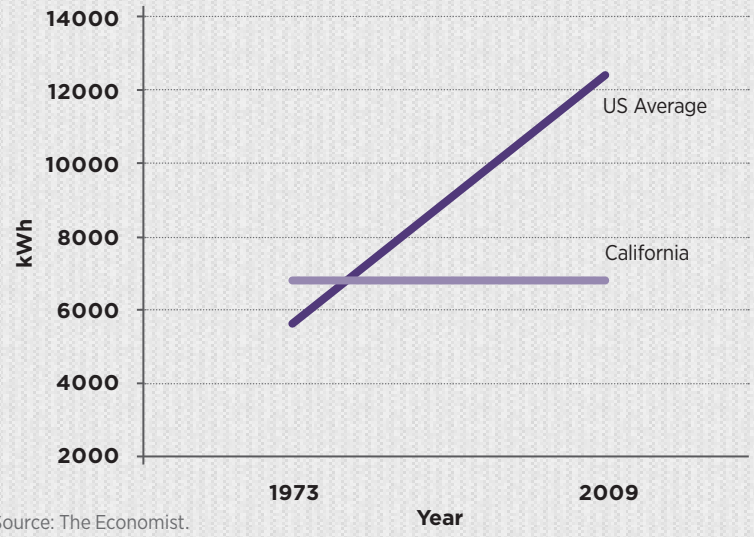


Source: The Energy Information Administration (EIA)

The most common method of decoupling requires utilities to collect a certain level of revenue, regardless of sales. Typically this entails the utility charging a fixed rate per customer instead of per unit of energy sold. These fixed rates can be altered periodically to reflect changes in the infrastructure or customer base. "Performance targets or efficiency incentives are typically also included in a decoupled compensation scheme, thereby incentivizing the reduction of energy demand by encouraging the utility to improve the efficiency of its infrastructure and employ demand-side management practices."[59]

The results of decoupling schemes have been extraordinarily successful, with California often held up as a shining example. The state applied decoupling to natural gas in 1978 and to electricity in 1982. Since the first oil shock in 1973, "per capita electricity use in the nation has increased by about 50 percent to about 12,000 kilowatt-hours annually. Meanwhile, over that same period, per capita electricity use in California has remained absolutely flat at about 7,000 kilowatt-hours per year," [60] as Figure 13 illustrates. While it is difficult to attribute all of California's energy efficiency gains to decoupling alone, it is one of the main programs that have made such gains possible.

Figure 13: California vs. US Annual Per Capital Electricity Use



Source: The Economist.

It is important to note that, "although decoupling can neutralize the disincentive to support energy efficiency programs, it doesn't create a financial incentive to save energy through investing in energy efficiency that is comparable to the financial incentives that exist for utilities to invest in capital assets such as new power plants and facilities."[61] Stronger policies, therefore, would pair decoupling with additional incentives for reducing energy use and emissions.

[59] "Decoupling In Detail." Center for Climate and Energy Solutions. C2ES. February 15, 2012. http://www.c2es.org/what_s_being_done/in_the_states/decoupling_detail
[60] Brownstein, Ronald. "The California Experiment." The Atlantic. N.p., October 2009. July 15, 2012. http://www.theatlantic.com/magazine/archive/2009/10/the-california-experiment/7666/2/
[61] "ACEEE | Decoupling Utility Profits from Sales." American Council for an Energy-Efficient Economy. ACEEE. February 15, 2012. http://aceee.org/topics/decoupling

IMAGE: JOHN HORNER PHOTOGRAPHY, OFFICE DA

NOTES FROM THE FIELD
Washington, DC's Benchmarking Program

"Given the fact that buildings account for three-quarters of the greenhouse gasses emitted in the District of Columbia, any effort to reduce energy use and carbon emissions there must begin with existing buildings. Energy benchmarking is the natural starting point for these efforts because, as the saying goes, you can't manage what you don't measure. The Clean and Affordable Energy Act of 2008 mandates that all private buildings over 50,000 square feet and all district government buildings over 10,000 gross square feet, annually benchmark and publicly disclose their energy and water consumption using ENERGY STAR® Portfolio Manager. The first deadline for data submission is April 1, 2013 for all private buildings over 100,000 square ft, moving to private buildings over 50,000 sq ft by April, 2014.

During the public outreach preceding the passage of the law, building owners and managers (via the local BOMA affiliate) argued that mandatory benchmarking was unnecessary due to the already high market penetration of ENERGY STAR® Portfolio Manager in DC. Furthermore, the real estate community was particularly opposed to the public disclosure requirement. In spite of these objections, DC Council passed the law. During the lengthy regulatory process, owners and managers of multi-family buildings voiced concern about the inclusion of residential properties. Commercial property owners and managers questioned the requirement to benchmark the whole building (including ground floor retail and restaurant spaces that were exempt under US EPA guidelines). In addition, many stakeholders were concerned about the possibility of confidential information being disclosed.

In order to reduce concerns about public disclosure, DC Council stipulated that the public disclosure requirements would begin in the second year of benchmark reporting. In addition, the program was phased in so that only the largest, most capable asset managers would have to comply initially. DDOE also made allowances in terms of what data had to be reported, especially in the initial years, and required non-residential tenants to comply with data requests from building owners. Together, these changes removed the main barriers to successful benchmarking, particularly of residential properties. DDOE also made clear that no financial data would be collected and limited the scope of the summary data that would be disclosed.

The most important lesson for other jurisdictions contemplating an energy benchmarking and disclosure program is that easy access to reliable building-level utility data is critical. If not already available, jurisdictions should work to get the local utility companies to provide aggregated whole-building data, and, ideally, to upload this data directly into the owner's ENERGY STAR® Portfolio Manager account. Where possible, the law should require utility companies to offer this service. In addition, since building owners will always have to get some data from tenants, the law should also require tenants to provide certain information to their landlord upon request, and back up this requirement with realistic fines for both owners and tenants. Finally, a widespread public outreach campaign is essential to achieving a high compliance rate."

Marshall Duer-Balkind and Dave Good, District Department of the Environment, Government of the District of Columbia

BENCHMARKING AND DISCLOSURE RULES

At a more granular level than utility decoupling, asset owners need to understand how their buildings are performing. Any party interested in improving energy efficiency in an existing building should begin by implementing a benchmarking effort in order to establish a baseline against which to compare any upgrades. Simply increasing awareness of current energy use among building occupants often results in incremental energy savings. Policies that mandate the collection and disclosure of benchmarking data are therefore another useful tool for municipal leaders looking to increase their cities' efficiency. A number of US municipalities are implementing or considering deploying benchmarking programs in the coming years—see Figures 14 and 15.

New York City is a pioneer of energy benchmarking mandates. The passage of Local Law 84 in 2009 called for the benchmarking of city buildings using the EPA's Portfolio Manager tool to begin in May 2010, with commercial, mixed-use, and residential buildings coming under the same mandate in May of 2011.[62] The city recently released its reports from the program analyzing the first year of data for both municipal and privately owned buildings. The reports show that New York City municipal buildings scored at or around the national averages for similar buildings, while energy use varied widely in privately owned buildings, even among buildings of the same type. Overall, buildings' energy use was on par with New England averages, and was lower than national averages. The city estimates that if its relatively inefficient large buildings could be improved to meet the median level of energy use in their category, New York City could reduce energy consumption by 18 percent and greenhouse gas emissions by 20 percent.[63]

San Francisco has also been working on landmark legislation (AB1103), which came into effect in 2013. In the first phase of this plan, utilities must provide energy consumption data upon request. In the second phase, non-residential buildings will be required to disclose benchmarking data for sale, lease or refinancing (discussed further below). Additionally, any building eligible for an ENERGY STAR® rating must disclose this rating, and buildings ineligible for the score must disclose the energy use intensity level (kBtu/sf-yr) of the building. Figure 17 highlights some of the US cities set to roll out benchmarking programs in the coming years.

This new piece of legislation builds off San Francisco's Building Performance Ordinance that was implemented in February 2010. In order to comply with this earlier rule, asset owners must perform annual benchmarking and disclose ENERGY STAR® ratings, energy use intensity, annual CO_2e emissions, and other basic descriptive data. They must also have energy audits performed by a qualified professional at least once every five years.[64]

Australia has taken the benchmarking and disclosure concept to the level of national policy. The government of New South Whales manages the National Australian Built Environment Rating System (NABERS), which is an intensive version of the benchmarking programs described above.

> *"NABERS is a performance-based rating system for existing buildings that rates a building on the basis of its measured operational impacts on the environment, and provides a simple indication of how well asset owners are managing these environmental impacts compared with peers and neighbors. NABERS can be used to define and set operational performance targets and measure and rate actual performance. Accredited ratings can also be used to disclose and report on performance to interested parties, establish commercial relationships for the monitoring and maintenance of performance targets, enlist professional services to improve a rating, and make decisions about priority actions or investment options."*[65]

The NABERS program has ensured that building owners take initial steps toward improving their energy efficiency by determining the initial conditions of their buildings. "Government agencies and councils, planning and housing authorities, and utilities may also be interested in the information that NABERS generates as a means of encouraging environmental improvement and providing incentives."[66] New Zealand is adopting the NABERS program as well, with plans for implementing a voluntary NABERS program in late 2013.

POINT-OF-SALE AUDITING

Another way to encourage energy efficiency improvements in the existing building stock is to implement a requirement whereby the sale of a building space triggers improvements. "Point-of-sale efficiency upgrade policies '[require] compliance with certain energy (and sometimes water) efficiency requirements before buildings can be sold, transferred from one proprietor to another, or renovated beyond a predetermined total permit value.'"[67]

This solution is not always well received by asset owners because it increases the cost and complexity of building transactions. However, there are measures that can be put in place to minimize the strain on building owners. For instance, a cap can be placed on the cost of improvements. Under these circumstances, "requirements may be satisfied once homeowners or property owners have completed upgrades that are valued up to a specified dollar amount, or that are equivalent to a certain percentage of the building's value."[68] Creating this type of mechanism will, at the very least, result in a greater understanding of building energy use and potential areas in need of improvement.

While mandating efficiency upgrades can be effective, the Carbon War Room realizes that it is not always politically optimal, or even possible. There are other ways that the government can facilitate private investment into energy efficiency without explicit requirements.

[62] February 1, 2012. http://www.nyc.gov
[63] PlaNYC. "New York City Local Law 84 Benchmarking Report." Issue brief. City of New York. August 15, 2012. http://www.nyc.gov/html/gbee/html/plan/ll84_scores.shtml
[64] Jewell, Mark, and Barry Hooper. "Benchmarking and San Francisco's Energy Ordinance." Webinar. January 13, 2012.
[65] February 1, 2012. http://www.nabers.com.au/
[66] Ibid.
[67] "HousingPolicy.org | Policy—Set Standards and Offer Incentives." Toolbox. Housing Policy & Housing Strategies from HousingPolicy.org. February 20, 2012. http://www.housingpolicy.org/toolbox/strategy/policies/standards_incentives.html?tierid=113332
[68] Ibid.

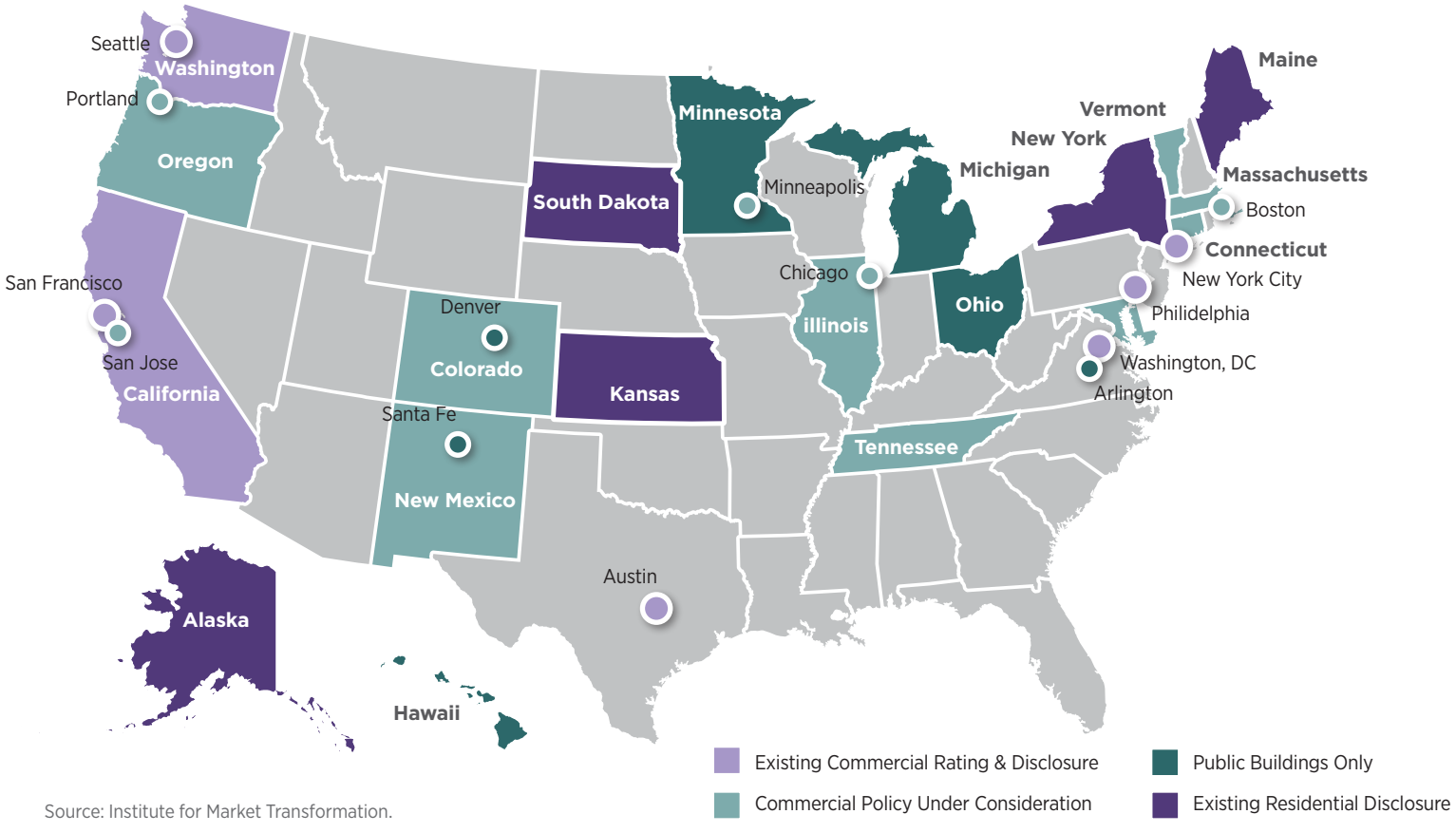
Figure 14: Benchmarking and Disclosure Policy Status

Jurisdiction	Benchmarking (Building Type and Size		Reporting	Disclosure					Audits	RCx
	Non-residential	Multi-family	To local government	On public website	To tenants	To transactional counterparties				
						Sale	Lease	Financing		
Austin	10k SF+	5+ units	✓	-	-	✓	-	-	✓	-
California	10k SF+	-	✓	-	-	✓	✓	✓	-	-
Washington, DC	50k SF+	50k SF+	✓	✓	-	-	-	-	-	-
New York City	50k SF+	50k SF+	✓	✓	-	-	-	-	✓	✓
San Francisco	10k SF+	-	✓	✓	✓	-	-	-	✓	-
Philadelphia	50k SF+	-	✓	✓	-	✓	✓	-	-	-
Seattle	10k SF+	5k SF+	✓	-	✓	✓	✓	✓	-	-
Washington State	10k SF+	-	-	-	-	✓	✓	✓	-	-

Under Consideration Boston, Boulder, Cambridge, Chicago, Minneapolis, Portland, San Jose

Source: Institute for Market Transformation

Figure 15: Benchmarking in the US



Source: Institute for Market Transformation.

Demand Aggregation

- Achieving widespread adoption of energy efficiency requires aggressive marketing and outreach programs that will help to aggregate demand, while demand aggregation can also be achieved through convenings that encourage open communication and collaboration.

- Countries or municipalities may also engage stakeholders via competitions for capital deployment, energy use reduction, or carbon emissions mitigation.

- The strategy that the Carbon War Room has applied most recently is to build consortia of companies that provide compatible services in such a way that the consortia are collectively able to offer turnkey solutions, including technology, contracting, financing, and insurance.

It is the hope of the Carbon War Room that this guide provides a city sustainability officer or asset owner with the tools to implement individual policy measures, technology improvements, or financing solutions. But in order to achieve widespread adoption of energy efficiency, it is important to also pursue aggressive marketing and outreach programs in order to help aggregate demand.

One way to do this is through targeted convenings. For example, the Carbon War Room has developed a concept called Deal Days in which a municipality partners with a large property owner and together they bring to the event commercial and municipal building owners representing a minimum of 100,000,000 square feet. The Carbon War Room offers specific and well-vetted solutions that will provide the greatest benefits to the asset owners. Vendor presentations are done without the companies' competitors in the room so that stakeholders feel comfortable speaking candidly.

Cities have also begun to adopt similar models for disseminating information to stakeholders and bolstering support for energy efficiency. Massachusetts held an event in January 2012 called Mobilize Energy Efficiency in America, which was a series of symposium-style meetings aimed at stimulating economic activity through energy efficiency by encouraging open communication and collaboration among energy efficiency stakeholders. Emphasis was placed on how attendees can participate in and utilize resources from the Department of Energy's Better Buildings Challenge.

Other cities have begun to engage building owners through challenges and competitions. An exciting example of this was Richmond, Virginia's Earth Day Energy Challenge, a project of the Richmond Region Energy Alliance (RREA). This program encouraged homeowners in the Richmond metropolitan area to take a free 22-question online evaluation to learn about their home's energy usage, which helped them to understand their home's relative performance and find out what they could do to improve its energy efficiency and lower their energy bills. RREA incentivized participation by entering each participant into a draw to win one of five free home energy assessments from an RREA-qualified contractor. This program provided a fun and interactive way for residents and neighborhoods to actively engage in energy efficiency planning for their homes.

The United States government may establish similar challenges in the commercial or municipal sectors in order to drive the market towards overcoming barriers and implementing projects. The US Department of Energy administers the Better Buildings Challenge, which "supports commercial and industrial building owners by providing technical assistance and proven solutions to energy efficiency. The program also provides a forum for matching partners and allies to enhance collaboration and problem solve in energy efficiency." Partners and allies involved in the challenge represent 2 billion square feet of committed properties, more than 300 manufacturing facilities, and $2 billion in financing through allies.[69] Over 40 municipalities are currently enrolled in the challenge, including Atlanta, Chicago, Denver, Houston, Seattle and Washington, DC.

In the United Kingdom, the government has established the Better Buildings Partnership, which "is an exclusive collaboration of London's leading commercial property owners and allied organizations, supported by the Mayor of London and the Greater London Authority". Its goal is to create solutions for the commercial sector that will allow London to meet the Mayor's target of a 60 percent reduction in CO_2 emissions by 2025.[70] Other cities throughout the world, including Toronto and Sydney, are also adopting the Better Building Partnership model.

Cities can use challenges and convenings to bolster community engagement in efficiency and sustainability

[69] US DOE Energy Efficiency and Renewable Energy. Better Buildings Challenge. US Department of Energy. July 20, 2012. http://www4.eere.energy.gov/challenge/

[70] "Cutting CO_2 in Commercial Property." Better Buildings Partnership. City of London. July 20, 2012. http://www.betterbuildingspartnership.co.uk/home/

NOTES FROM THE FIELD
Wellington, New Zealand

"New Zealand is often referred to as the land of plenty. However, one thing that we do not have in abundance is warm, energy-efficient homes. Decades of inadequate building codes resulted in an estimated 900,000 homes with substandard insulation (there are 1.6 million homes in total in New Zealand). A successful government program providing grants for insulation has made a significant dent in the problem. More than 150,000 homes have received an insulation retrofit grant since 2009. But the program only addresses ceiling and under-floor insulation and there is no guarantee it will continue past October 2013. Many Kiwi households also still struggle to understand the basics of energy efficiency.

In Wellington—the capital city of New Zealand—the City Council has developed the Home Energy Saver Program to help households cut energy bills and make their homes healthier. The program was designed to remove barriers to taking action on energy efficiency by empowering the household with information. Households—owners or renters—are eligible for a free, two-hour home assessment. During the assessment, the assessor does a complete walkthrough of the home with the occupants. The assessor looks at insulation levels, sources of moisture, shower flow rates, ventilation and heating. The assessor then compiles a simple action plan that is tailored and prioritized to the household's needs. The assessor can also supply and install small energy-efficient measures on the spot including energy-efficient lighting and low-flow shower roses.

After just over 18 months, we are extremely pleased with the results of the program. For every dollar the council spends on the program, we are leveraging three dollars of spend from government grants and the household toward energy efficiency retrofits. We have completed nearly 800 home assessments and we have received overwhelming positive feedback from customers about the program. We are finding at least 50 percent will get something done on the spot and our follow-up survey confirms that 90 percent of households took some form of action as a result of the assessor's advice.

The key to the program's success is that it directly involves the homeowner. The homeowner gets to understand the issues with their home and they are given the options and tools to take action. For the program to build on its early achievements, we will need to continue to find new and improved ways to engage the homeowner to make taking action simple and affordable."

Zach Rissel, Senior Policy Advisor, Wellington City Council

IMAGE: JOHN HORNER PHOTOGRAPHY. NADAAA

It is exciting for communities to develop these types of programs because they provide triple bottom line benefits. The programs help property owners save money, they reduce harmful greenhouse gas emissions and improve environmental quality, and they have been shown to build community and to create jobs. According to a recent report, "increased building retrofits could create more than 3.3 million new direct and indirect cumulative job years (excluding induced) in the United States economy."[71] Several cities have decided to capitalize on this by establishing employment programs to engage workers in weatherization, retrofit, and renovation projects. For instance, EMBERS Green Renovations in Vancouver is a non-profit, socially responsible business providing energy-efficient solutions and home renovations. As part of its work, the company provides job training for inner-city workers and then hires them to undertake weatherization work. This type of program can be particularly attractive to municipalities that have been hit hard by the recession and that suffer from diminishing construction industries.

[71] Baker, Jake *et al.* United States Building Energy Efficiency Retrofits. Rep. Ed. Mark Fulton. Rockefeller Foundation & DB Climate Change Advisors. 2012.

Lessons Learned

In reflecting on three years of project work, the Carbon War Room thought it would be helpful to summarize three of the biggest lessons learned along the way, with the hope that those lessons will accelerate the learning curve for other market actors.

Lesson 1: Beware of "One Size Fits All"

When the Carbon War Room launched the Green Capital Global Challenge at the Vancouver Olympics, the operation was envisaged as one that would broker private capital investment into residential Property Assessed Clean Energy (PACE) programs, initially in the US, and subsequently more globally. The Federal Housing Finance Agency letters in May 2010 effectively negated PACE for residential properties—an action that proved critical to throttling progress. In the subsequent months, the Carbon War Room was forced to pivot and contemplate how PACE could be retooled for the commercial sector. While the Carbon War Room continues to hold a positive outlook on the various forms of PACE discussed in this paper, its attempt to export the PACE structure to certain European municipalities also proved more difficult than anticipated. The takeaway from this experience is that PACE—like any other financial tool—is one of a myriad of options that policy makers, financiers, project developers, and real estate owners should consider.

Since each building has its own unique envelope, equipment, operations, lease structures, and ownership needs, there will never be one financial mechanism that will be appropriate for all buildings. We should think of the technology, policy, and financial tools highlighted in this guide as a Swiss Army suite of solutions and resist our urge to let "the perfect be the enemy of the good".

Lesson 2: Demand Stimulation and Aggregation is Key

Often treated as an afterthought, with a mentality of "if we build it they will come," marketing and promotion of energy efficiency has so far not created the demand pull that the energy effficiency industry needs. The problem of insufficient demand has in clear examples been attributed to a number of factors, including but not limited to:

- **Marketing/communication:** The pitch has too often been a technical, product-focused sell, rather than considering the buyer benefit and the service offer.
- **Budget:** When governments and local entities embark on an EEBE program, budgets for communication are most often severely restricted.

- **Language:** How do we reorient our language to address the needs, wants, and interests of asset owners? Terms like "efficiency", "audit" and "retrofit" do not naturally stimulate consumer interest.

- **Evidence base:** Many asset owners may be positively disposed to "being green" but need convincing on the economics. Recent research that suggests that buildings with high energy efficiency ratings are more likely to have high occupancy rates, and higher rents, has been challenged by some.

Lesson 3: Risk Is Not Adequately Quantified, Mitigated or Priced

Running across the systemic barriers discussed previously in this guide, the perception that energy efficiency measures are "risky" is ubiquitous.

The uncertainty with regards to savings makes it difficult for capital providers to lend based on the projected energy savings—unless the counter party has a sufficiently attractive credit profile, which is often not the case if the building ownership has been set up as a Special Purpose Vehicles (SPV) or Limited Liability Corporation (LLC) with little or no collateral. Insurance products like Energi's Energy Savings Warranty Program and mechanisms like assessment finance and on-bill repayment represent promising innovations that could limit the risk exposure.

Broad diffusion of successful projects and case studies will increase the evidence base and, in turn, increase the comfort of all within the sector to press ahead with retrofits.

FROM CONCEPT TO DEPLOYMENT: A PROGRESS UPDATE ON THE PACE COMMERCIAL CONSORTIUM

In September 2011, the Carbon War Room announced the formation of the PACE Commercial Consortium (PCC) in partnership with Ygrene Energy Fund, Energi, and Lockheed Martin with an expected commitment of $650 million from Barclays Capital to fund retrofit projects in the Miami and Sacramento markets. One of the first market milestones took place when PCC member Ygrene Energy Fund partnered with the City of Sacramento to create the Clean Energy Sacramento program. The program is a public-private partnership that brings private capital and management together with the city to achieve broad-scale commercial and residential building upgrades, with the objective of achieving dramatic GHG reductions while simultaneously stimulating the local economy. With the experience of the program formation and launch now behind them, the specific learnings achieved in launching the program were the following:

- **Getting the details right:** The consortium found the municipal and legal process to get final bond documents and authorization to be complicated and time-consuming—even more so than program administrators initially forecasted. To launch a program that works at scale requires deep commitment from both public and private partners, accompanied by substantial investment of resources and expertise from the private sector program operator. Ultimately, without deep local investment, staffing and commitment, a program cannot succeed.

- **Information is key:** Additionally, ensuring that all municipal stakeholders were up to speed and educated about the nuances of PACE transpired to be more challenging than initially anticipated. Municipal stakeholders, lacking the right information (or worse, receiving misinformation in some cases), have stalled or delayed programs across the US. Focusing on economic benefits as primary drivers and environmental benefits second has been a successful tactic in overcoming some of these barriers.

- **Diversified and local financing:** In terms of financing, the Carbon War Room originally built the PCC around a single, large-scale financial partner. When that partner pulled back from PACE and the PCC, the partnership effectively dissolved, The fund administrator needed to rapidly retool its approach, causing some delays. The fund administrator responded by replacing its sole financial partner strategy with one that leverages a diverse set of local and global financial partners to provide more program stability and, ultimately, a stronger position from which to fund projects.

- **White vans now moving:** Despite the delays in getting these PACE districts established, projects are now being funded and the "white vans are moving". Thanks to the persistence of the consortium members, most notably Ygrene Energy Fund and the City of Sacramento—the Clean Energy Sacramento program is now available to commercial property owners and is delivering environmental and financial returns. For example, the district's first project, 520 Capitol Mall, is already saving $47,000 a year on energy costs as a result of a $526,000 energy upgrade program. Only three months after deployment, over $1 million in retrofit projects have completed construction and over $10 million in applications have been submitted. These types of building upgrades, completed en masse across the city of Sacramento, will play a significant role in reaching Sacramento Mayor Kevin Johnson's goal to upgrade 25 percent of buildings by 2020. Achieving that goal could eliminate as much as 200,000 metric tons of carbon emissions, create up to 22,000 jobs, and provide up to $3.8 billion in privately funded economic stimulus.[72] Miami is next on the horizon, with an expected launch in the summer of 2013.

[72] According to an economic model developed by independent research firm ECONorthwest. http://pacenow.org/wp-content/uploads/2012/08/Economic-Impact-Analysis-of-Property-Assessed-Clean-Energy-Programs-PACE.pdf

Conclusion

Energy efficiency in the built environment provides the opportunity to abate gigaton levels of CO_2e while generating hundreds of billions of dollars of profits

CONCLUSION

Energy efficiency is arguably the most profitable carbon abatement strategies we have at our disposal that neither requires changes in policy nor depends upon subsidies. The United States currently spends over $400 billion each year to power its homes and commercial buildings and this energy is responsible for almost 40 percent of the nation's CO_2 emissions.[73] This represents a massive opportunity to cut costs and reduce emissions. For example, the US Department of Energy estimates that commercial buildings could be made up to 80 percent more efficient using new and existing technologies.[74] HSBC has estimated the total size of the current energy efficiency for buildings market to be $87 billion per year today, and the potential market in 2020 to be $245 billion per year globally.[75] Because of this tremendous potential for market growth, it is clear that energy efficiency measures represent one of the most promising opportunities to profitably reduce society's energy consumption and CO_2 emissions.

In terms of steps that can be taken today to capitalize on this opportunity, it has often been said that what is not measured cannot be managed. Simply increasing awareness of current energy use among building occupants often results in incremental energy savings. As our technology section illustrated, there is a logical progression for evaluating the energy consumption of a building (or portfolio of buildings) that allows for building owners and tenants to benefit from energy efficiency improvements. Deeper savings can be captured by building owners that do not want to rely on their own capital thanks to a multitude of available financial options, ranging from performance guarantees, assessment finance, on-bill, and Energy Savings Agreements. Policy makers have the capacity to move beyond the boom/bust cycle of perverse short-term incentives like rebates and, instead, create a framework for capital and technology entrepreneurs to offer third-party financed solutions—as described in our section on policy.

With this guide, the Carbon War Room hopes to provide the background and context required for understanding how to implement energy efficiency programs. Energy efficiency is the opportunity of our generation and one that will be met with the leadership of the many stakeholders who have engaged with the Carbon War Room during this process.

IMAGE: JOHN HORNER PHOTOGRAPHY. OFFICE DA

[73] Dept. of Energy. http://www1.eere.energy.gov/buildings/about.html
[74] Dept. of Energy. October 2008. http://energy.gov/articles/obama-administration-launches-new-energy-efficiency-efforts
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Works Cited

INDUSTRY RESOURCES

American Council for an Energy-Efficient Economy (ACEEE)
The American Council for an Energy-Efficient Economy is a non-profit, 501(c)(3) organization that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. ACEEE carries out its mission by: "conducting in-depth technical and policy analyses, advising policy makers and program managers, convening conferences and workshops, and educating businesses and consumers."

Better Buildings Partnership (BBP)
The Better Buildings Partnership (BBP) is a collaboration of London's leading commercial property owners and allied organizations, supported by the Mayor of London and the Greater London Authority. It aims to develop solutions capable of improving the sustainability of London's existing commercial building stock and achieve substantial CO_2 savings in support of the Mayor's target of a 60 percent reduction in emissions by 2025.

Built Environment Coalition (BEC)
The Built Environment Coalition was formed to address the widening gap between communities' needs to improve sustainability and disaster resiliency and their abilities to meet those needs. The BEC addresses this gap by employing community-based evaluations and targeted field tests of new solutions in partnership with government agencies, companies and non-profits to develop community capacity.

Center for American Progress (CAP)
The Center for American Progress is an NGO that both lobbies governments and disseminates research. The organization focuses on a myriad of issues, ranging from national security to media. Its environmental initiatives focus on low-carbon policies that encourage comprehensive upgrades in energy efficiency, as well as environmentally safe and sustainable energy diversification.

Ceres
Ceres is an advocate for sustainability leadership. Ceres mobilizes a powerful network of investors, companies and public interest groups to accelerate and expand the adoption of sustainable business practices and solutions to build a healthy global economy.

Clinton Climate Initiative (CCI)
Building on President Clinton's long-standing commitment to the environment, the Clinton Climate Initiative (CCI) is implementing programs that create and advance solutions to the root causes of climate change—while also helping to reduce our reliance on oil, saving money for individuals and governments, creating jobs, and growing economies. CCI, in partnership with the C40 Climate Leadership Group (C40), focuses on helping large cities to reduce their carbon emissions. Its partnerships with Microsoft, ICLEI, and Autodesk provide software and expertise that help cities to measure their GHG emissions.

Efficiency Cities Network (ECN)
The Efficiency Cities Network provides the opportunity for government staff, researchers, technical providers, and NGOs to share their ideas and experiences on how to achieve energy efficiency at scale. The goal of ECN is to learn the most effective and efficient ways to increase the adoption of retrofit technologies.

Environmental Defense Fund (EDF)
The Environmental Defense Fund is one of the largest climate change NGOs operating in the United States. Its mission is "to preserve the natural systems on which all life depends". Specifically, EDF supports cleaner energy sources and greater energy efficiency in order to cut carbon pollution and help to stabilize the climate.

European Council for an Energy Efficient Economy (ECEEE)
The European Council for an Energy Efficient Economy offers governments, industry, research institutes, and citizen organizations a unique resource of evidence-based knowledge and reliable information. It actively participates in the European policy-making process and acts as an informational resource through its website.

ICLEI
ICLEI is a membership association of local governments committed to advancing climate protection and sustainable development. It provides technical, legal, and program administration resources to local governments to implement energy efficiency and other projects related to climate change.

Natural Resources Defense Council (NRDC)—Center for Market Innovation
The Natural Resources Defense Council is a leading US NGO focused on oceans, endangered wildlife, and mitigating climate change. Through its Center for Market Innovation, the NRDC is attempting to move private finance into energy efficiency retrofits.

Rocky Mountain Institute (RMI)
The Rocky Mountain Institute is an independent NGO that focuses on researching market-based solutions in the built environment, energy resources, mobility, and vehicle efficiency. RMI works extensively with the private sector, as well as with civil society and government, to apply the framework of natural capitalism, which emphasizes integrative design, advanced technologies, and intelligent markets.

Southeastern Energy Efficiency Alliance (SEEA)
The Southeastern Energy Efficiency Alliance promotes energy efficiency programs in the southeast of the US by bringing together industry and government officials and pooling regional resources. SEEA creates policy mechanisms that incentivize investment in energy efficiency and works with stakeholders to develop cost-effective and feasible regional programs that lower costs through economies of scale.

The European Alliance of Companies for Energy Efficiency in Buildings (EuroACE)
The European Alliance of Companies for Energy Efficiency in Buildings aims "to help Europe move towards a more sustainable pattern of energy use in buildings" to reduce carbon dioxide emissions and help the European Union meet its commitments under the Kyoto protocol. EuroACE is made up of more than 20 member companies, representing European manufacturers, distributors and installers of energy-saving goods and services.

WHITE PAPERS

1. Baker, Jake, et al. "United States Building Energy Efficiency Retrofits." Rep. Ed. Mark Fulton. Rockefeller Foundation & DB Climate Change Advisors. 2012.
In this joint report, the authors analyze the investment potential for energy efficiency in the United States and the implications that this has for related policy. The report focuses on how to achieve the most robust economic benefits from energy efficiency investment.

2. Buonicore, Anthony J. "Emerging Best Practice for Underwriting Commercially Attractive Energy Efficiency Loans." Working paper no. 12–002. N.p.: "Building Energy Performance Assessment News." 2012.
This paper reviews market-ready, commercially attractive financing mechanisms and the emerging best practices needed to facilitate proper underwriting of energy efficiency loans, with the goal of accelerating the deep energy efficiency retrofit market.

3. Copithorne, Brad. "Creating Financing Markets for Energy Efficiency Projects in Commercial Buildings." Environmental Defense Fund. 2011.
This short document provides a concise overview of the market barriers to investment in energy efficiency projects, and describes a two-part solution that will overcome these barriers.

4. Dyer, Colin, et al. "A Profitable and Resource Efficient Future: Catalyzing Retrofit Financing and Investing in Commercial Real Estate." Rep. Geneva: World Economic Forum. 2011.
The report equips policy makers and industry leaders with the information needed to build and scale retrofit markets around the world. It highlights the business potential waiting to be tapped by multiple industries and underscores the acute need for government leaders to take action now.

5. Eichholtz, Piet, Nils Kok, and John M. Quigley. "The Economics of Green Building." Working paper no. W10–003. Fisher Center for Real Estate and Urban Economics & UC Berkeley. 2011.
The authors analyze the economics of incremental improvements in the sustainability of buildings, concluding that there are many economic benefits to "greening" a building beyond the energy savings and reduced carbon emissions.

6. Energy Upgrade California, and Energy Independence. "Property Assessed Clean Energy (PACE) Replication Guidance Package for Local Governments." Rep. Sacramento: State of California. 2012.
This manual will assist local governments in their efforts to establish and operate Property Assessed Clean Energy (PACE) programs. It provides a general overview of PACE and the considerations for local governments contemplating PACE program design and administration.

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This paper establishes the potential size of the retrofit market in the United States and examines the emergence of new financing models that offer the promise of overcoming historical barriers and unlocking the true potential of this market.

8. Granade, Hannah, Jon Creyts, Anton Derkach, Philip Farese, Scott Nyquist, and Ken Ostrowski. "Unlocking Energy Efficiency in the US Economy." Rep. McKinsey Global Energy and Materials. 2009.
This report provides an assessment of the political and economic barriers to widespread implementation of energy efficiency projects, and concludes that energy efficiency offers a vast, low-cost resource for the US, but only if the nation can create comprehensive and innovative approaches to unlock it.

9. Hayes, Sara, Steven Nadel, Chris Granada, and Kathryn Hottel. "What Have We Learned from Energy Efficiency Financing Programs." Rep. no. U115. Washington, DC: American Council for an Energy-Efficient Economy. 2011.
This ACEEE report provides an overview of existing financing mechanisms for energy efficiency projects, with the goal of improving upon these mechanisms and developing a set of tools that will help asset owners and managers increase the pace of the implementation of these projects.

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In this report, the authors present research on the implementation, benefits, and challenges of all existing financing strategies and models for energy efficiency projects.

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This Pike Research report provides a comprehensive analysis of building technology solutions for increasing energy efficiency in existing buildings, and provides a market analysis and forecast for these technologies.

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This paper argues that energy efficiency offers an opportunity for institutional investors such as pension funds, insurance companies, and mutual funds to manage the risks of climate change while earning a competitive rate of return on their investment and the utility, demand producing, and finance enable policy drivers that can foster a secondary market and encourage institutional investments into retrofits.

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This report focuses on cost-effective opportunities to improve the energy efficiency of the residential and commercial building stock in Spain. The analysis reviews progress to date in the US, UK, and Spain and develops a new business model that the authors believe can greatly accelerate the pace of energy efficiency retrofit uptake in various sectors.

ABOUT THE CARBON WAR ROOM

Carbon War Room works on breaking down market barriers for capital to flow to entrepreneurial solutions to climate change, by employing a sector-based approach focusing on the solutions that make economic sense right now. We target the movement of institutional capital into a working marketplace and the elimination of market inefficiencies (in the form of insufficient information and high transaction costs, among others). Policy and technology are necessary conditions to the solution, however, they are neither sufficient nor the bottleneck to progress.

Our vision is to see markets functioning properly and clean technology successfully scaling to promote climate wealth, business and economic growth. In the role of a climate wealth catalyst, Carbon War Room focuses on areas where a sector-by-sector approach to climate change can be applied to generate gigaton-scale carbon savings. We seek to complement existing efforts and organisations, leveraging our convening power, our market-driven, solutions-oriented focus, and our powerful global network to develop and implement catalytic change.

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John Horner is an Architectural Photographer living in the Boston area. he works nationally and internationally to document the built environment. his work is frequently published in books and magazines such as Dwell, Architecture, Elle decor, Interior + Design, Metropolis, Frame, Design New England, Boston, Boston Home, The Boston Globe, The New York Times, and many others. In addition, his work has won numerous awards form the AIA and various design organizations. he is currently working on a long term project to produce the images for the new MIT Campus Guide to be published in 2015 by the Princeton Architectural Press. More of his work can be seen at www.johnhornerphotography.com.

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