OPERATIONS REPORT

IMPROVING BUILDING PERFORMANCE

Reduce Energy Consumption by 20% with Little or No Cost: A Guide to Energy Efficiency Technologies

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THE CARBON WAR ROOM | GREEN CAPITAL OPERATION

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OVERVIEW

This white paper is intended to give building owners and operators a roadmap on reducing the energy consumption of their buildings. In many cases, knowing where to start is part of the challenge, and sometimes the allure of renewables, retrofits and even conservation efforts deflect attention from simply optimising the existing building first. The pages that follow will outline an ordered approach to getting started and set the stage for deeper research on defining building performance goals and prioritising implementation measures that achieve those objectives. This white paper will begin in Section 1: Getting Started with a discussion about why building owners interested in maximising internal rate of return (IRR), should care about energy efficiency. In Section 2: A Plan for Implementation we provide a systematic order of intervention measures that can achieve the highest return for the lowest cost. In Section 3: The Deep Retrofit: Using Capital Wisely we highlight how to go from energy efficiency measures that reduce consumption from 5-20% to deeper retrofits that can improve efficiencies by up to 75% but require finance.

It is our conviction that implementing energy efficiency can be a rather straightforward process. This begins with optimising what you have (energy efficiency), then changing the building (envelope, renewables, etc), asking occupants for behavioural modifications, and utilising demand response methods. The white paper presents several companies that the Carbon War Room has worked with and believes represent best-in-class global technologies. Additionally, we use a real-life example throughout the paper to illustrate in practice what might otherwise seem theoretical.

INTRODUCTION

Talk of energy efficiency improvements has become ubiquitous among building owners and managers. The reasons are simple. Energy efficiency saves money and reduces a building's environmental impact. Consider these facts:

- According to the US Department of Energy, commercial buildings account for 35% of US electricity consumption[1]
- Commercial buildings spend 30% of their operating budgets on energy costs[2]
- Commercial buildings comprise nearly 20% of global carbon emissions[3]
- These numbers will only increase, since energy demand and cost are expected to rise dramatically in the next few decades[4].

It is widely accepted that the easiest way to save money is to waste less energy. The US Department of Energy concluded that "Building efficiency represents one of the easiest, most immediate and most cost-effective ways to reduce carbon emissions." Elsewhere, measures to meet carbon reduction targets are more specific, near term and, in some cases, mandatory. The European Union, for instance, is targeting a 30% reduction in emissions by 2020.[5]

In recent years, there has been a proliferation of policy measures intended to require energy efficiency disclosures and benchmarking in regions as disparate as several US states, the European Union, Brazil, China and Australia. Yet, despite the recent policy interventions, commercial building energy efficiency projects are miniscule in comparison to their potential. So why is energy efficiency the "highest priority for virtually no one?"[6] For some, the 'split-incentive' schism provides few incentives for owners to invest in measures that solely benefit their tenants. Others might see the value in increased tenant comfort, the potential to capitalise energy savings via resale value, and the soft benefits of being associated with being 'green', but often the perception is that improving the energy efficiency of their buildings means spending inherently limited capital to upgrade or retrofit their buildings' systems.

Undertaking an energy efficiency plan need not pose an intractable problem, however. There are a variety of cost-effective energy efficiency measures that are both easy to implement and work within a building owner's existing building operation systems. These 'low-/no-cost' energy conservation measures often pay for themselves in one to two years.

SECTION 1: GETTING STARTED

Transitioning from talk of energy efficiency to action that reduces energy use (and, consequently, saves money) requires some initial planning, including: 1) assessment of a building's starting position; 2) recognition of challenges; and 3) determination of an economic model.

Assessing a building's starting position

There is no one-size-fits-all solution to improving building performance. Each building has a unique set of capabilities and limitations. A building owner must assess the building's starting position, taking stock of the building's systems and operations and assess what, if any, energy efficiency measures have been implemented to date. Ideally, the starting position is captured as part of a gap analysis associated with a Strategic Facility Plan[7], which maps facility goals to business objectives.

Addressing simple questions will help building owners understand their options:

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), and what is connected to it – major Heating, Ventilation and Air-Conditioning (HVAC) systems, zone-level systems, lighting?
3. When were the building systems last tuned?

Answers to the above questions can guide a building owner's options for energy efficiency measures and establish the starting position to optimise building performance. Building owners are keenly aware of the benefits of energy efficiency and improving building performance: reducing operating expenses, enhancing tenant satisfaction and lowering an organisation's environmental impact. Each of these can increase net operating income and positively influence asset value.

The challenges of implementing energy efficiency improvements, however, are less understood, and often perceived as being difficult to overcome.

Recognising the challenges

Challenges with energy efficiency measures typically come down to economics, but not because the numbers aren't attractive; rather, the decisions and associated benefits don't map to the same stakeholders. Much has been written about split incentives, where owners, managers and tenants each have differing interests around investments to secure energy savings. The stakeholder value chain is unique in almost every building that isn't owner occupied. Understanding that ecosystem and how it translates to decision making around energy efficiency is paramount in prioritising efforts and allocating resources. Simply put, tenants often pay for their energy consumption but don't have the time horizon or authority to invest in the energy performance of building systems – beyond rent, that is. Most owners, on the other hand, are selective in deploying capital towards building performance, even though increasing transparency around operating costs is enabling tenants and buyers to correlate energy performance with rent premiums and asset value. Property and facility managers can contribute to the 'challenge' by imposing an additional level of conservatism in adopting any technology risk or by discounting the operational or behavioural benefits around visibility that are associated with energy management.

Other challenges will be enumerated by the gap analysis elicited by questions in the previous section. Most of the 'gap' will arise around less automated buildings (eg pneumatic zones), systems integration challenges with the current BAS (eg lack of support for open communication protocols), lack of uniform standards for interpreting the data or lack of information about the building (eg no asset lists, occupancy schedules, mechanical drawings, utility data, etc). Challenges also arise from ill-equipped or over-tasked facilities staffs.

Determine an economic model

When getting started, one of the most underestimated facets is the economic model required to support an efficiency plan. The economic model represents more than navigating the stakeholder value chain and establishing the level of investment or budget.

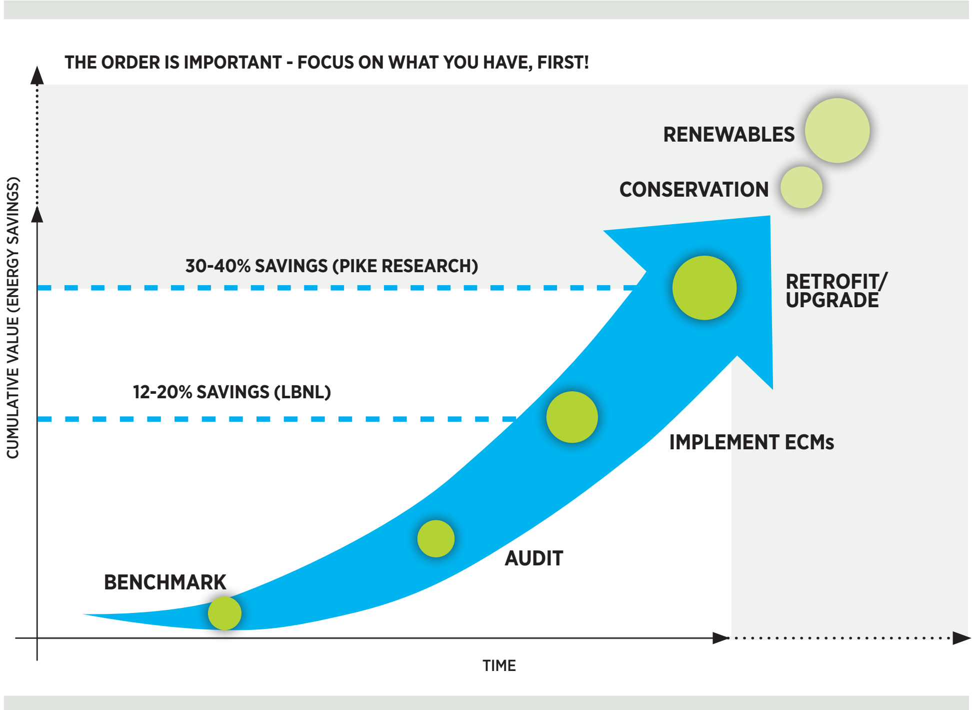
Decision makers must also consider the following:

- What are the decision criteria for pursuing various measures?
- What accountability exists to ensure performance?
- Will efficiency measures result in future savings or just recognise an immediate gain to the bottom line?
- What is the desired return on investment or payback period? How will this be measured and communicated to the stakeholders?

SECTION 2: A PLAN FOR IMPLEMENTATION

Our methodology for energy efficiency improvement is about energy *consumption*, as opposed to energy cost savings. The latter can be achieved through demand response, which is often mistakenly referred to as 'energy efficiency'. Curtailment actions typically require occupant sacrifice through pre-cooling, thermostat setbacks and lighting changes, which run counter to the notion of energy efficiency. The consumption that is reduced in peak periods is mostly moved to off-peak periods. While there may be a carbon benefit, as peak generation plants may be less efficient and can be used less frequently, this practice is not considered as energy efficiency in this paper. Our recommended process is straight forward – optimise with what you have first (energy efficiency), then change the building (envelope, renewables, etc), ask occupants for behavioural modifications and utilise demand response methods.

Figure 1. Process Steps to Improve Building Performance



Source: Lawrence Berkely National Lab's (Building Commissioning, Mills, 2009)

This process for implementing energy efficiency measures is ordered – each step has prerequisites and progressively enhances energy and systems performance. The steps are as listed below, and will be elaborated on in the next section.

Step 1: Benchmarking
Perform a whole building analysis to identify a building's baseline and relative performance and to identify further areas of investigation.

Step 2: Audit
Perform a detailed analysis of the systems in the building to identify energy conservation measures (ECMs), often referred to as 'low-/no-cost' projects.

Step 3: Implementation
Implement ECMs; measure and verify the energy consumption reduction.

Step 4: Capital upgrades and other measures
Taking account of the savings (and other financing) and of the detailed model of the building's operation from the preceding steps, a building owner can consider more expensive efficiency measures.

Because the process begins at the building's unique starting position, a building owner may start at the appropriate step along the continuum. For example, a building that has already been benchmarked could entertain a retro-commissioning audit, assuming the benchmarking data is accessible.

Case Study: 123 Main Street

Consider the following building example (123 Main St), whose owner was interested enough in building performance to pursue a LEED certification for EBOM (Existing Buildings Operations & Maintenance) to meet the single tenant's request. Initial inventory of the building indicated that it was built in 2005, includes direct digital control (DDC), with a Johnson Controls Metasys BAS that is connected to all HVAC systems, but not lighting. Electricity is used for both heat and cooling, with a blended rate of $0.15/kWh. Natural gas is used for heating water only.

The owner of the building is a local real estate developer who also holds on to various properties for investment tax shields. He has negotiated a long-term lease with a global software company for this property, which provides its own facility management. In other words, the tenant pays the energy bills and can make some operational changes to the facility. Capital improvements will require the owner's approval.

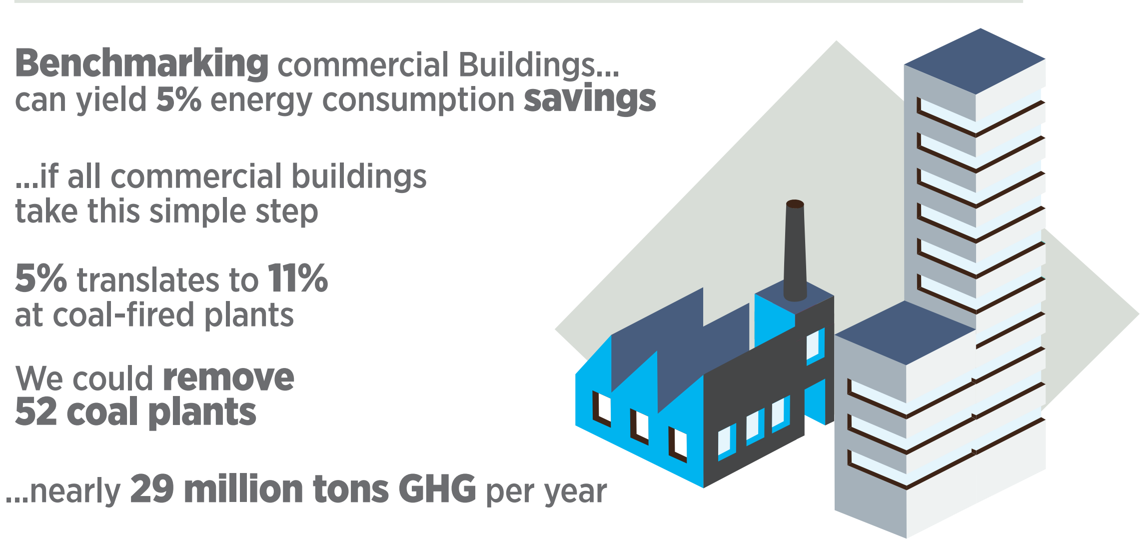
Step 1: Benchmarking

The foundational step in any energy efficiency plan is benchmarking. In the US, ENERGY STAR®, a joint programme between the US Department of Energy and the US Environmental Protection Agency (EPA), 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"[8]. Other programmes around the world have established a similar uniform scorecard for buildings. The EPA's Portfolio Manager benchmarking tool at www.energystar.gov provides an energy performance score on a scale of 1-100, with 100 being the most energy efficient and one being the least. The score represents a percentile ranking compared to the overall national building stock. ENERGY STAR certification is awarded to buildings that score 75 or above, indicating they are in the top 25 % of buildings across the nation. Similar to the well-known ENERGY STAR mark on products ranging from computers to refrigerators, ENERGY STAR buildings are recognised for demonstrating superior energy performance.

A building's energy use represents perhaps the single largest factor determining its environmental sustainability. Recognising this, the US Green Building Council's LEED® for Existing Buildings (LEED-EB) rating system incorporates the ENERGY STAR score as both a prerequisite and as a source of the credit points that are required for LEED green building certification. 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, the single largest source of potential points in the LEED® rating system.

However, all benchmarking is not equal. Increased frequency of data collection can be an important factor in setting a more reliable baseline. Increased resolution of energy data translates to an understanding of load shape and sets up analysis about energy performance relative to weather, occupancy, set points and schedules. Buildings with energy management systems or a BAS with meter data have an advantage, as they are able to automate the process of data collection. While increased data granularity can add cost, the granularity of data is the key factor in achieving and sustaining savings.

Figure 2. US Implications for Benchmarking Commercial Buildings



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

Tools/technologies

There are a number of tools available in the marketplace that can help building operators benchmark their energy performance, implement tracking of ongoing consumption and even engage their occupants. Some of the following companies offer tools that include varying degrees of energy monitoring/measurement and analytic functions to identify coarse energy savings recommendations.

FirstFuel, Retroficiency®
Uses interval 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, SCIenergy®
Energy management, including real-time consumption monitoring and visualisation of meters and sub-meters. Includes varying degrees of analytics functions and custom reports and dashboards; some solutions include automating ENERGY STAR score calculations, and even submission to EPA's Portfolio Manager.

Lucid Design Group™
Energy and carbon-tracking dashboard and kiosks for visualising energy consumption for employee and/or guest engagement. Includes social networking features to compare energy performance across buildings.

Sustainable Real Estate Solutions™ (SRS)
Uses its Peer Building Benchmarking database of over 120,000 buildings, updated regularly, to facilitate a benchmarking best practice that complements ENERGY STAR's nationwide rating with local building comparisons across 12 key performance indicators.

Case Study: Benchmarking in Practice

Consider our building at 123 Main St. To determine the building's benchmark, the building engineer decided to calculate the ENERGY STAR score, since it is an important factor in LEED-EBOM certification. Buildings are required to have a score of 75 to qualify, and incremental points have strong impact on LEED Energy and Atmosphere credits.

To generate the score, the building engineer hired a service provider to put together the paperwork. The service provider visited the building and conducted a walkthrough, working under the supervision of a licensed professional engineer. Since the utility consumption data was readily available (the building uses an energy monitoring solution), the service provider was able to do the calculations quickly. Scheduling this site visit and getting the building data, however, proved difficult and took several weeks. Once the engineer submitted the signed package to the EPA, it took a few weeks to receive the score of 65. Disappointing! From start to finish, it took nearly two but months, but signaled there was a significant opportunity to save energy.

Step 2: Facility Audit

Benchmarking a building, preferably with granular information, gives its owner or operator a sense of its overall performance relative to other buildings, normalised for influencing factors like weather and occupancy. Generally, a facility audit is a study of how energy is used in a facility and a set of recommendations on ways to improve energy efficiency and reduce energy costs.[9] Audits can range in the level of analysis, from a preliminary visual examination of a building (The American Society of Heating Air Conditioning and Refrigeration Engineers (ASHRAE) Level 1 Audit) to a detailed analysis of the sources of energy consumption by asset type (lighting, HVAC, plug-load, process, etc).

The below are examples of more detailed analyses.

ASHRAE Level 2 [2-4 weeks]
Energy Survey and Analysis – auditor conducts in-depth interviews with operating personnel and performs 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. All ECMs are identified and prioritised from that data, and capital projects identified for further review.

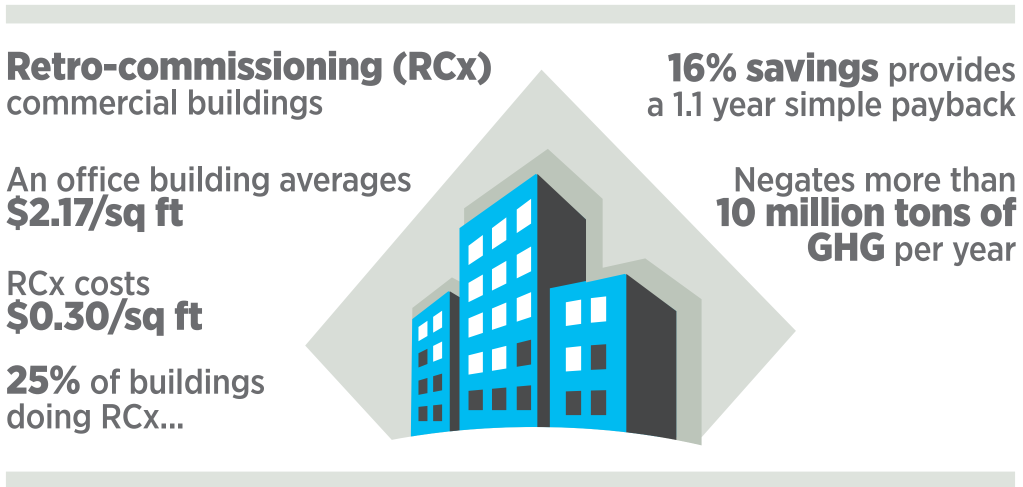
ASHRAE Level 3 [8-12 weeks]
Detailed Analysis of Capital-Intensive Modifications (Investment-grade Audit) – this audit provides the further review to justify capital-intensive opportunities and includes a higher degree of energy simulation and modeling, monitoring, data collection and engineering analysis.

Traditional retro-commissioning (RCx)[10] [typically 4-6 months for utility programmes]
A 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 improper equipment performance, equipment or systems that need to be replaced and operational strategies for improving the performance of the various building systems."[11]

As with benchmarking, the manner and depth of data collection is a central concern, influencing the breadth of opportunities identified. To perform a successful audit, data must be collected that describes the specifications, schedule, operating conditions and purpose of all building assets, as well as the environment in which the assets operate. Data granularity is even more important at the audit stage as it ties to the subsequent measurement and verification plan to ensure sustainability of savings.

The value in performing a facility audit is the identification and prioritisation of low-cost and no-cost ECMs. The shortcoming of performing an audit is that it reflects a snapshot of performance. To be effective, building operators need to repeat audits every few years to keep buildings performing optimally.

Figure 3. Retro-Commissioning and its Potential



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

Tools/technologies
Energy audits have evolved with software and data capture tools. One of the fastest-growing audit types is RCx, which is expected to grow from 2,000 agents in 2010 to over 20,000 when the market reaches maturity[12]. These types of audits are designed to capture building data, support energy simulation and modelling, or provide an ongoing monitoring component. Monitoring performance beyond the audit is often called monitoring-based commissioning, continuous commissioning®[13], ongoing commissioning or persistent commissioning. Each of these has the same objective: to sustain identified savings.

The below are a sample of technology-based tools that have the potential to accelerate RCx, or even amplify the benefits.

Cimetrics™, Facility Dynamics
A thorough audit provides the necessary inputs to software energy models from these solution providers. ECMs and retrofit measures can be simulated through modelling, while predicted performance outcomes and ROI estimates improve evaluation and decision making.

ecoInsight
Providing professionals with mobile audit capabilities, integrated product pricing and performance information, and sales proposal generation tools. Information about building equipment, energy use and occupancy information is collected through a mobile device, making the data immediately usable for analysis, collaboration and proposal generation.

kWhOURS
A tablet-based auditing tool for 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% of the time required on an audit, along with some of the cost.

SCIenergy®
Solutions 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 for RCx engineers to have visibility into system performance so they can target specific assets for deeper investigation.

Case Study: Retro-Commissioning (RCx) in Action

Having benchmarked the facility at 123 Main Street, the building engineer planned a deeper inspection. The 70,000 square-foot office building includes three packaged HVAC units, along with 95 fan-powered variable air volume (VAV) and fan-powered boxes (all with electric reheat). He discovered that the engineering firm that installed the RTUs also offers retro-commissioning (RCx). Since the RCx service qualified for a utility rebate, he agreed to an RCx. The building engineer turned over the utility data compiled for the benchmarking study. It was not in the file format the RCx agent had hoped for, but he said it would work.

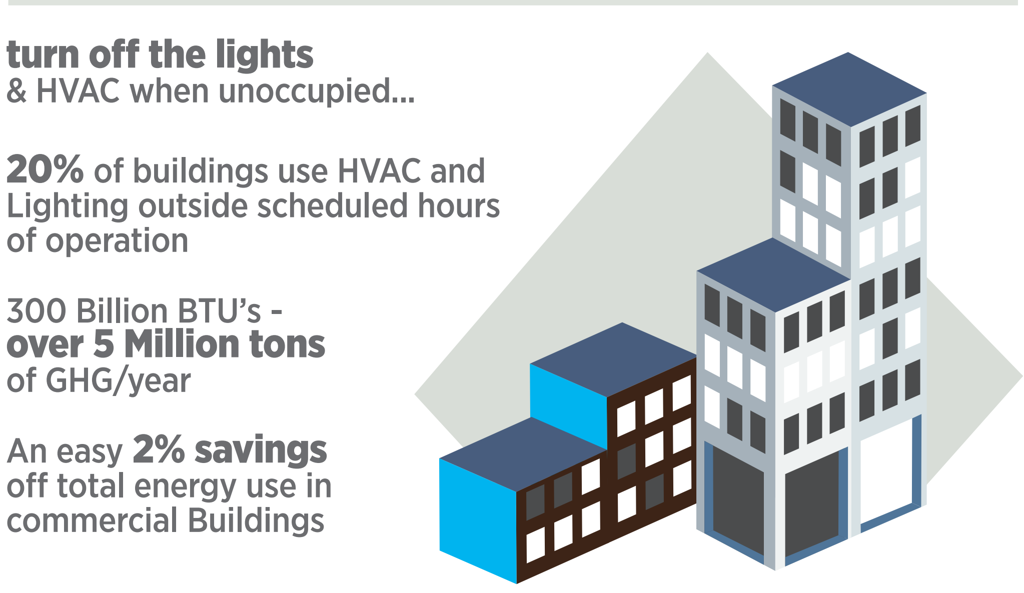
The RCx agent conducted a thorough inspection of the building. The utility programme specified that he designate 20% of the 95 VAVs for physical inspection. The RCx agent chose VAVs spread throughout the building, but adjusted based on the business activities in those zones. He was on site for a few days, but was required to come back when it was warmer to check the operation of the RTUs in a cooling mode. After five months, he submitted a report detailing eight ECMs, including calculated project costs, as well as the expected energy savings. Each ECM in the report had a payback of fewer than 12 months, and could qualify for additional rebate if implemented.

Step 3: Implementation

After completing the first two steps, a building owner understands the baseline energy performance and has a detailed understanding of the low-/no-cost ECMs to correct performance deviations. Most service providers who conduct an energy audit or deeper retro-commissioning of a building will provide a detailed written report, identifying ECMs that will deliver 12-20% energy reductions[14]. Implementing these ECMs is how these energy savings manifest into real operating capital reductions – ie utility bills decrease. Obtaining the resources to complete these ECMs is sometimes the challenge, since multiple skillsets – energy, information technology, HVAC and building controls – are needed in various combinations to complete the projects. Often, an external project manager will direct building engineers to complete these ECMs.

To confirm that the ECMs had the desired effect, a building owner needs to 'commission' each implemented measure. It is imperative that a building owner establishes a measurement and verification (M&V) plan to ensure the measure achieves the intended energy reduction. 15 Most utility programmes require it to get paid. Periodic monitoring confirms performance and ensures the sustainability of the improvement

Figure 4. Using HVAC and Lighting More Efficiently



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Case Study: From Benchmark, Audit and RCx to Energy Conservation Measures (ECMs)

Having audited the facility at 123 Main Street, the building engineer decided to pursue some of the identified ECMs. He prioritised the ECMs by the amount of expected energy savings, since the utility rebate required kWh reductions. Of the eight ECMs mentioned previously in his report, here is a summary of five of the implementation outcomes:

- Control settings for schedules that didn't match
- Outdoor air temperature sensor that was shaded in the afternoon
- Filters that required changing
- Over-charged compressor on RTU #2
- Compatibility problem between the controls in the rooftop units and the BAS, causing a lengthy warm-up sequence.

Integrated approaches

There are a number of firms that have combined activities from benchmarking to RCx and implementation of ECMs into a single service offering. Using technology, these firms aim to integrate the various data acquired in benchmarking so as to be more efficient in their building audits. Technology typically incorporates some form of monitoring and fault detection, and is also the means to sustain the implemented energy savings. It is now possible to use technology to combine all three steps – benchmarking, audit and implementation – into one approach. Such an integrated approach offers both time- and consumption-saving advantages. Accelerating the time to savings can change the owner's return on investment. For instance, an integrated approach utilises the same team to collect and analyse energy data, which is then used in the audit of the facility. The same firm then interprets 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.

Consider how some of the technologies mentioned previously can provide visibility of energy and systems performance to retro-commissioning agents – *before* they set foot on site. In other words, an engineer or technician doing the benchmarking step is collecting data appropriate for retro-commissioning – not just an ENERGY STAR score, or some other consumption scorecard. Additionally, technology put in place to monitor energy and systems performance can be used throughout implementation to provide M&V. Finally and, perhaps most importantly, technology that provides ongoing commissioning enables the building engineers to sustain the savings and identify further operational savings.

A sample of these integrated approaches, and their varying degrees of technology, are summarised below.

BuildingIQ – The BuildingIQ System

The BuildingIQ System offers a solution that works with an existing BAS to predict energy demand and directly adjust HVAC system parameters to continuously optimise energy use. The solution affects energy consumption by pre-planning HVAC operations, managing set points and continuously updating the settings throughout the day for any changes to internal or external conditions.

EnerNOC – EfficiencySMART™

EfficiencySMART™'s most comprehensive offering is 'commissioning', which translates to seasoned energy engineers conducting a thorough site review, then identifying major sources of energy consumption and delivering a detailed analysis of systems and equipment performance. The company uses gateways as required to capture key data in order to support its analysis and provides recommendations to users.

SCIenergy – Intelligent Retro-commissioning™ (iRCx™)

iRCx™ combines energy management and fault detection software with a modified RCx process. The company claims that it is able to accelerate the RCx process because the RCx engineer can better understand energy consumption, and 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 provides the ability to automatically identify issues worthy of attention.

BuildingIQ | ENERNOC | SCIenergy | SkyFoundry

SECTION 3: THE DEEP RETROFIT – USING CAPITAL WISELY

Every building engineer has their wish list of upgrades and retrofits to building systems (HVAC, lighting, etc). Following the approach suggested in this paper may validate that wish list, and even suggest additional retrofit or upgrade measures. In terms of implementing these measures once they have been identified, these steps can typically be financed through an operating expense budget, and payback periods are relatively short. On the other hand, larger retrofit measures require tapping into the capital expense budget, which is increasingly constrained.

Some alternatives to using capital from building owners have emerged and are helping to further drive building performance. Most, if not all, of these methods also take an ordered approach to optimising existing systems. The savings garnered from an ordered approach, coupled with the savings from capital retrofits, drives building owners' and financial institutions' ability to derive financial returns. Savvy building owners will make an informed decision regarding whether to first achieve basic building performance improvements before entertaining financed retrofits. For many owners, combining retrofits with existing system optimisation adds value by being a turnkey service that ensures a step change in performance.

Below are the methods that have attracted some attention in recent years. Each focuses on whole-building performance, as opposed to project financing to support system-level retrofits. The 'private' methods listed below (ie Energy Service Agreements, PACE, On-Bill Repayment (OBR) Financing) are gaining traction in the commercial marketplace as they do not require upfront capital and are potentially "off-balance" sheet for the building owner.

Energy Service Agreements (Green Campus Partners, Green City Finance, Metrus Energy, Abundant Power™, SCIenergy – which acquired Transcend Equity[16])

Whole-building performance approach. This pays the owner's utility bills and typically implements HVAC, lighting, and control system upgrades via a shared-savings model.

Third-Party On-Bill Financing/Pay As You Save

A mechanism that provides capital (often debt) to a building owner, with repayment via utility bills; debt is attached to the meter. Current programs in US are offered by the utility, though both UK Green Deal and Environmental Defense Fund are pioneering separate programs that would enable third-party capital providers to lend via the utility bill.

Property Assessed Clean Energy/PACE (Ygrene Energy Fund, Clean Fund, Abundant Power™)

Utilizes property tax assessments to provide capital for large-scale retrofits; repayment obligation is attached to the property, not the building owner. 28 states and District of Columbia have passed PACE authorization legislation. Canada, Australia, and New Zealand have active programs similar to PACE.

Like whole-building upgrades, renewables – solar, wind, etc – have more sex appeal than optimising existing building systems, and often are packaged with their own financing mechanisms. While these are not considered 'energy efficiency', they do complement efforts to support building performance once the consumption profile is understood and optimised.

CONCLUSIONS AND RECOMMENDATIONS

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. On the contrary, building owners can devise a building performance plan that is based upon the building's starting position. For some, achieving efficiency gains means starting from benchmarking, while others may start further along the continuum based on prior efforts. Further, building owners can condense the process by using an integrated approach that shortens the time to implement ECMs, amplifies the associated savings and ensures the long-term sustainability of those savings.

The building performance industry is clearly evolving to meet carbon reduction goals. Energy efficiency – including optimisation and retrofits – is the logical starting point, and there are advantages to approaching the process steps in order: benchmark, audit, implement ECMs, retrofit. Other initiatives – including conservation, renewables and even demand response – may be implemented after this, could be important elements in a company's strategy, and are critical elements in our global efforts to reverse the effects of climate change.

While it is clear that successfully following these steps will save building owners money, the benefits of carbon reduction are also apparent. The profound impact of reducing consumption at the point of use is unquestioned. For electrical consumption from coal in the US, for example, 1kWh reduced at the point of use translates to 2-3kWh in negated production at the power plant. For commercial buildings, that means a 10% reduction in electricity consumption from ECMs identified and implemented during retro-commissioning, for example, could result in more than a 22% decrease in primary energy, including a 6-10% reduction in emissions from coal-fired generation alone.[17] Fortunately, building owners do not need carbon markets or taxes for the value proposition to support energy efficiency investments. Financial paybacks are well under two years for the simple – albeit non-sexy – building performance optimisation steps, using only energy savings as the driver. By adding in the positive impacts of occupant satisfaction, facility staff productivity and advantages of equipment longevity, the business case is solid. Using a discrete, or project, approach to managing building performance, however, will lead only to short-term results. Using a discrete, or project, approach to managing building performance, however, will lead only to short-term results. We recommend that the technology tools referenced in this guide be used to enable – not replace – facilities teams. Continued savings and corresponding carbon reduction require ongoing resources to sustain these initial efforts.

Figure 5: US Commercial Building Energy Consumption

Commercial buildings in the US account for...

35% of total **electricity** consumption

Power plants have to produce **225%** of that need to offset losses

45% comes from **464** coal-fired generation plants

Coal accounts for **99.9%** of GHG emissions tied to electricity use

See the connection?

Source: US EPA Clean Energy: Calculations and References

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8 “ENERGY STAR Building Manual”, Chapter 2, Section 2.1 (Revised April 2008) available at http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH2_Benchmarking

9 FLEX YOUR POWER Website: http://www.fypower.org/

10 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, prioritising the low-/no-cost measures

11 “ENERGY STAR Building Upgrade Manual”, United States Environmental Protection Agency, Office of Air and Radiation, 2008 Edition

12 Pike Research, “Energy Efficiency Retrofits in Commercial and Public Buildings”, Nock (2010)

13 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

14 “Building Commissioning: A Golden Opportunity for Energy Costs and Greenhouse Gas Emissions”, Mills, LBNL, 2009 (http://cx.lbl.gov/2009-assessment.html)

15 “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/

16 Note: Transcend Equity Development was acquired by SCIenergy in March 2012. All Transcend employees have moved to SCIenergy and will offer MESA™ (Managed Energy Services Agreement) directly and through certified partners

17 Commercial buildings account for 14% of all electricity consumption and coal represents 45% of US electricity production. Friction losses through transmission and distribution account for 2-3kWh for every 1kWh consumed. “Reinventing Fire”, Amory Lovins (2011)

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