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TABLE OF CONTENTS

H08:
REAL-TIME ENERGY MANAGEMENT: YEAR 1 RESULTS & YEAR 2 PERSISTENCE

REAL-TIME ENERGY MANAGEMENT: YEAR 1 RESULTS & YEAR 2 PERSISTENCE

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ABSTRACT:

Even the best commercial buildings have "operational stray" – sensors break, schedules are wrong for the season, and switches are set to manual. NRDC's 2013 report on The Tower Companies' Real-Time Energy Management project provided detail on how Tower worked with AtSite to identify and correct stray in three of Tower's commercial office buildings, reduced the costs of the program while producing savings, determined other values for Tower, and established lessons learned for others exploring similar programs.

In this paper, we review certain key findings from the NRDC report and provide information from Tower and AtSite that offer a glimpse of the second year of the on-going program. Preliminary information (collected by Tower and AtSite) suggests the energy savings seen in the first year appear to persist through year two using similar methods as described in the NRDC Report. Based on Tower and AtSite reports of progress working with building teams, we provide an update to certain lessons learned, with an emphasis on engaging building staff.

INTRODUCTION

In December 2011, The Tower Companies ("Tower"), an owner and operator of commercial and multi-family residential apartment buildings, launched a program to optimize energy use in its buildings. The centerpiece of the program was to use energy usage information – electricity and gas meter data – to identify and correct system inefficiencies in the buildings and to take advantage of opportunities to reduce energy usage and costs. Tower engaged AtSite, a Washington, D.C. based sustainable solutions firm, to help implement the program and deliver energy advisory services.

The Natural Resource Defense Council ("NRDC") worked with Tower from program inception through the first year to study its effectiveness and to deliver key "lessons learned" to market participants, including utilities and building owners. In October 2013, NRDC published its report titled *Real-Time Energy Management: A Case Study of Three Large Commercial Buildings in Washington, D.C.* ("NRDC Report").

The market for Real-Time Energy Management ("RTEM") is growing , yet many building owners, utilities, tenants, and other market participants have questions about the effectiveness of programs and risk. While NRDC's report found the Tower program delivered strong returns on the investment to implement the program, the results described were limited to the first year after implementation.

A key question for many market participants is whether a building owner or operator will maintain improved building performance after the initial period of savings. In this paper, the authors review NRDC's findings and analysis of Tower's RTEM activities. This paper then provides energy usage information (as reported by Tower and AtSite) in order to obtain directional insights into year two results.

TOWER'S REAL-TIME ENERGY MANAGEMENT PROGRAM

Tower's RTEM program, as implemented in year one, is fully described in the NRDC report. The centerpiece of the program is the service delivered by AtSite. AtSite provides Tower with visibility into and intelligence around energy usage patterns to find anomalies and opportunities for improvement. To do this, Tower and AtSite identified data streams in each building to be monitored, including installing submeters on the chilled water units in each building and installing "pulse meters" to obtain the "whole-building" data ("whole-building" data is the same meter data that would be collected by the electric utility). AtSite's cloud-technology platform, InSite, gives Tower customized data visualization, analytics, and reporting tools.

AtSite also delivers data analytics and engineering support to Tower. Key examples of this support include AtSite delivery and analysis of daily reports to Tower building teams illustrating previous day usage compared to its historical average. Tower building teams also maintained monthly in-person meetings with the AtSite efficiency experts throughout year two, including Tower executive management on a quarterly basis, to discuss progress, operational changes, and potential energy conservation measures (ECMs).

In addition, Tower cooperated with AtSite to perform seasonal walk-throughs of each building and periodic night audits, the purpose of which was to investigate issues identified in the data and recognize operations that needed to be corrected. Further, AtSite staff was in regular contact with Tower staff to diagnose energy usage anomalies identified in daily reports and resolve issues. At the outset of the RTEM program, Tower and AtSite focused on identifying and obtaining useful data streams, followed by using the data to identify trends, correlations, and predictions that would otherwise likely be hidden.

YEAR ONE RESULTS

NRDC found that during the first year of the program (2012), Tower realized a 13.2 percent reduction in electricity use and avoided nearly $220,000 in energy costs in the three commercial office buildings. Figure 1, also Table 1 from the referenced NRDC report, provides more detail regarding these energy savings.

Among the key lessons learned is that substantial gains are available to building owners that operate buildings with attention to low and no-cost energy efficiency strategies and consistent best practices. NRDC concluded the program would most likely deliver greater value for Tower than the energy savings reported and documented, such as reduced maintenance expenses, higher rents, and improved occupant/tenant comfort in the buildings. NRDC found that a range of measures implemented in the first year accounted for the savings.

YEAR TWO RESULTS

Major elements of Tower's program and on-going activity as described in the NRDC Report remained in place for year two. Energy usage information for the three buildings (as recorded by AtSite and Tower) indicates that the savings realized in year one were maintained and substantial savings in each of the three commercial office buildings were achieved.

The 2013 data provided by AtSite illustrates that electricity usage was reduced by an additional 7% as compared to a normalized 2012, and 22% as compared to the 2011 normalized baseline. Figure 2 below describes electricity savings from the first and second years of the program.

Figure 1: 2012 Energy Savings Summary from NRDC

	Square Feet	2012 Occupancy	2011 kWh	2012 kWh	kWh Savings	$ Savings	Percent of kWh Savings
1707 L Street	109,926	302	1,965,135	1,516,274	448,861	$58,352	23%
1828 L Street	332,928	928	5,590,937	5,227,183	363,754	$47,288	7%
1909 K Street	239,128	462	5,197,305	4,327,589	869,716	$113,063	17%
Total for three buildings combined			**12,753,377**	**11,071,046**	**1,682,331**	**$218,703**	**13.2% Average**

Energy savings were determined using a whole building, year-over-year method. Results were normalized for weather and occupancy. The 12-month study period was January 2012 through December 2012, and the 12-month baseline period was January 2011 through December 2011. The total percentage of energy savings is determined by total normalized usage in all three buildings in 2012 as compared with total usage in 2011.

Figure 2: First Two Years of Program Savings*

**The baseline year is 2011; savings for 2012 and 2013 are measured against 2011 baseline. The data is adjusted for weather and occupancy against baseline. 2012 savings are NRDC's calculations, as published in the Report. 2013 savings are based on AtSite's calculations and data collection.*

Building Name	2012 kWh Savings	2012 $ Savings	2012 Percent of kWh Savings	2013 kWh Savings	2013 $ Savings	2013 Percent of kWh Savings
1701 L Street	448,861	$ 58,352	23%	580,561	$ 72,570	28%
1828 L Street	363,754	$ 47,288	7%	826,528	$ 103,316	14%
1909 K Street	869,716	$ 113,063	11%	1,386,676	$ 173,334	25%
Total	**1,682,331**	**$ 218,703**	**13.2% Average**	**2,793,765**	**$ 349,221**	**21% Average**

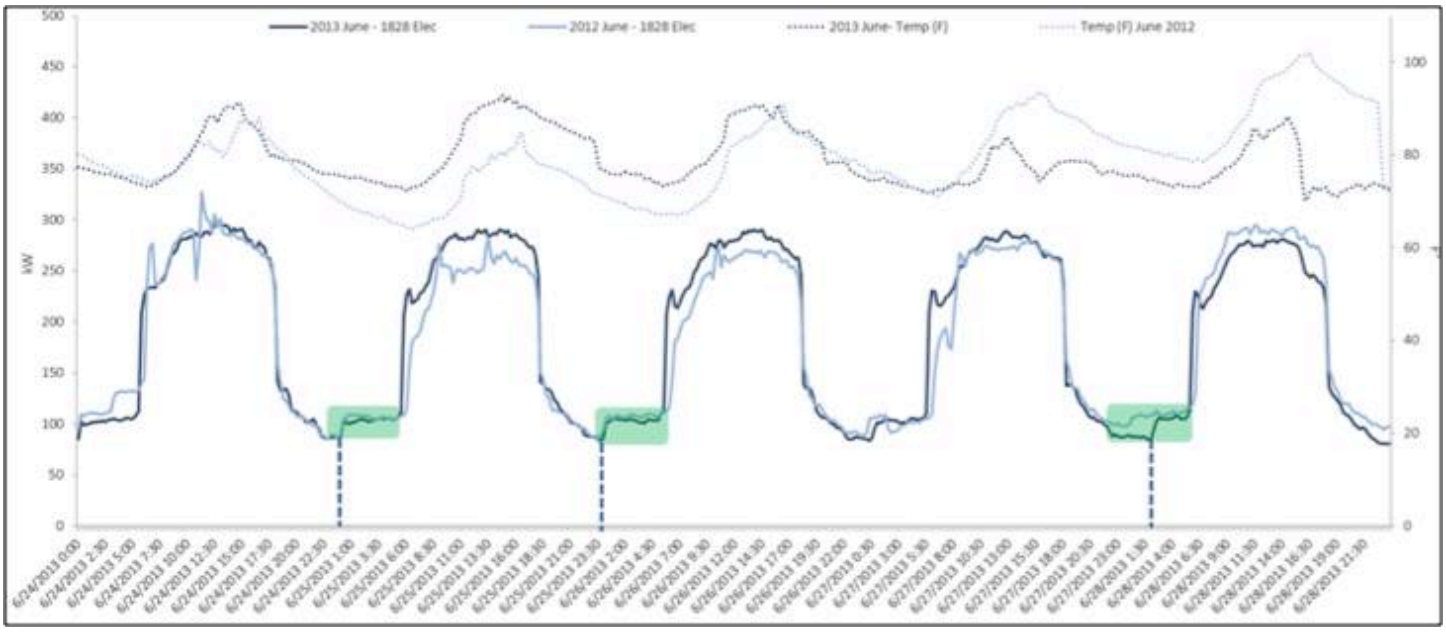
CONTEXT OF FINDINGS

In this working paper, prepared to accompany an education session at the 2014 USGBC Greenbuild conference, the authors include preliminary results based on self-reported meter readings from Tower and AtSite without external review of the data and without an assessment of potentially material factors in the buildings that could have occurred in year two. The data presented in the NRDC report was derived from utility billing information, and the 2013 data presented here is collected by Tower's installed meters. The results were adjusted for weather by AtSite (using a conventional method) as a baseline for comparison against 2012 usage. The 2013 results are also adjusted for occupancy, which was tracked and provided by Tower on a frequent basis.

NRDC has not separately validated the reported energy usage for 2013. The authors of the NRDC report participated in meetings with Tower and AtSite in 2012, observed ECMs, and reviewed energy usage data reported by the utility during the first year of the program. The contributions by NRDC in this paper were provided only in an effort to describe the conclusions from the original report, to provide directional results on persistence of savings based on the self-reported information, and to offer continued observations on lessons learned along with the members of the Tower and AtSite team.

Figure 3: Sample Anomaly Detection from 1828 L St NW

After some investigation, the team found that the building automation system had triggered some floors to need air conditioning at night. This issue was resolved quickly by working with the controls contractor to review and re-program the settings to the correct schedule based on tenant lease hours.



RE-VISITING KEY LESSONS LEARNED

Operational stray will continue to occur, even in the best buildings. Several instances of operational stray from the first year of the program were detailed in the NRDC report, such as a chiller cycling on and off due to faulty sensors. With the RTEM program in place, Tower was able to catch and correct these instances quickly. Unlike making equipment repairs or replacement – catching and correcting system faults does not mean that new instances of stray will not occur and in fact, there are a few examples that show it continued to occur in year two of the program. These instances of stray indicate how maintaining RTEM programs beyond year one is likely to deliver continued value through more consistent operations. Without the RTEM program in place, it is reasonable to assume that Tower would have caught and corrected these anomalies many weeks or even months later than they in fact did, resulting in increased costs and resulting in wear and tear on equipment.

An example of stray is useful to consider. In 2013, an AtSite analyst noticed an unusual "bump" in night time usage in the building at 1828 L Street and contacted the building engineer. Refer to figure 3, which shows the "whole building" usage at the main electricity meter. A similar bump was not seen in the meter data tied to the building chiller plant, suggesting it must be coming from another source of errant usage.

ENGAGING BUILDING TEAMS & CULTURE CHANGE

One of Tower's stated objectives at the outset of the program was to guide its building teams to make educated decisions based on granular energy usage information, made available from meters and submeters, in the day-to-day operation of its buildings.

NRDC documented in its Report the process of Tower building teams becoming comfortable with the help of AtSite's analysts and engineers. NRDC highlighted the value of the AtSite team meeting with the Tower building teams to review findings and to track progress implementing corrective actions. These interactions appeared to help Tower to catch and correct anomalies quickly and served to help train the Tower facility teams on methods of using information to operate their buildings with greater control.

Even two years into the RTEM program (2013) these meetings continued to deliver value. Tower facility teams appeared to increase their ability to identify efficiency opportunities and take corrective action, which was reflected in increased ECM ideas more frequently being suggested by building teams. Tower believes it has succeeded in integrating new data sources and insights into day-to-day building operations.

Tower's experience was that incorporating energy reduction as a priority was a slow process in many instances. For example, building engineers have many other competing tasks and day-to-day deadlines to assure building occupants are satisfied and their requirements are fulfilled. There are times when energy strategies and related actions items are not pursued as a priority. Follow-up by AtSite analysts and Tower managers remains a key ingredient in program success.

Implementing the program at scale has offered certain advantages, such as developing operational materials for Tower staff and buildings. AtSite developed customized guides and checklists (titled Standard Operating Procedures or SOPs) for the building teams. These 1-page documents for each building identify equipment-specific operating parameters tuned to outside conditions. The purpose of these documents is to serve as a reference guide when transitioning between seasons, when operators need to adjust certain operations as it relates to specific occupant requests and conditions. The documents are posted in each building's engineering office as a quick reference guide for building operations.

NEXT DAY IS REAL TIME ENOUGH

NRDC's report described daily reports AtSite sends by email to the Tower building teams reviewing the prior day's usage, and in some cases the prior week's usage. These reports are an important resource and a source of actionable intelligence about system usage in the building. The report data is energy-focused, and illustrates whole-building energy usage (not specific building components).

These reports appear to be sufficiently "real time" enough to deliver value to the user – in this case, building teams. By delivering usage results close to the time the usage occurred, building

teams are positioned to recall the events and tie any unusual usage to causes. Catching stray within a few days is likely to be a substantial improvement over the condition that appears common in commercial office buildings, which is to only notice and catch stray after it has persisted for an unknown period. This delay could be weeks, months, or more due to lack of more frequent data and only receiving utility invoices on a monthly basis.

VALUE-ADDS TO TOWER

In year one, Tower reduced energy expenses in an amount exceeding the hard costs to implement the program. The NRDC report explained that Tower likely realized substantial additional value from the program in the form of reduced maintenance expenses, higher rents, and more.

After year two, Tower realized several values from the RTEM program over and above the documented savings from lower electricity expenses. Examples of these additional benefits include:

- Reducing peak demand utility costs.
- Documented energy savings (substantiated by the AtSite system that enables the RTEM program) allowed Tower to participate in a custom incentive program called "CEIC," which is operated by Pepco through the Empower Maryland program.
- Tower routinely surveys its tenants with regard to levels of satisfaction with the building; Tower is finding greater levels of tenant satisfaction in its surveys and has earned associated industry awards.
- Tower has benefited from substantially reduced water usage in the three office buildings, and management attributes this to better operation of the chilled water plants, which leads to reduced evaporation in the system cooling towers. While this has not yet been documented, it is consistent with findings and experience of other programs.

Tower implemented its RTEM program across a large portfolio of buildings. Tower owns and manages six (6) multi-tenant commercial office properties totaling approximately 1.3 million SF, and three (3) high-rise residential properties that total approximately 1.2 million SF (The Blairs). All are located in Washington, D.C. and nearby Montgomery County, Maryland, and all of these buildings are in the RTEM program.

The overall portfolio, which consists of commercial office and residential buildings, realized 11.6 % electricity savings or an estimated $485,000 in 2012 and 17.0% and $682,000 in 2013; both years are compared to a weather and occupancy normalized 2011 baseline.

CONCLUSION

Once a full cycle is complete, the focus should return to identifying the next set of high-value data streams to incorporate into the InSite platform. This is not a "one-size-fits-all" solution; some buildings may only need simple benchmarking, while other buildings may require full engineering support. The goal is to recognize the importance of continuity through visibility and access to a specialized support team.

Achieving substantial, consistent, and persistent energy savings in building operations occurs by approaching the process as a continuous and collaborative one. Tower and AtSite have implemented systems and processes that enable the building engineering and management teams to use information as a form of intelligence about building operations. This process establishes a continuous improvement program. The result is better, smarter, more sustainable buildings.

ACKNOWLEDGEMENTS

We very much appreciate the input and contributions of Philip Henderson (NRDC) who helped us to consider the key lessons learned and the need in the market for affirmation of savings persistence.

We would also like to recognize efforts by The Tower Companies' former Chief Sustainability Officer, David Borchardt, who played a key role and helped to take the program from initial concept and development through implementation and beyond to yield significant savings. Jim Lewis, VP of Engineering for The Tower Companies, was instrumental from the beginning and continues to support and lead the building engineering teams to achieve great success. There are also many contractors associated with the success of this program including, but not limited to, HVAC Concepts, LLC and CDS Mechanical.

Justin Lee, Sam Quinn, Brandon Chase, Erin Beddingfield, and many other team members were the engineering and analytical brains behind the AtSite team for the initial two years of the program. Their knowledge and attention to detail provided great momentum for years to come.

Of course, this real-time energy management program would not be possible without the constant cooperation, enthusiasm, and collaboration from The Tower Companies' passionate and energetic building engineering and property management teams. These teams include, but are not limited to, Marvin Atwell, Dave Chalmers, Dennis Gage, Nancy Hamaty, Eric Harris, Mike Newman, Donna Nurmi, Nathan Sims, Kendrick Smith, and Debbie Webb.

In closing, we would especially like to thank Jeffrey, Gary, and Ronald Abramson, Partners of The Tower Companies, for their pioneering leadership and support throughout the entire program. They are recognized throughout the industry for sustainability leadership and this program is only one representation of how they lead by example.

RESOURCES

[1] Henderson, P. and M. Waltner. (October 2013). Real-Time Energy Management: A Case Study of Three Large Commercial Buildings in Washington, D.C.. Natural Resource Defense Council (NRDC). NRDC Website, Available: http://www.nrdc.org/business/casestudies/files/tower-companies-case-study.pdf

[2] Martin, Richard. (August 2013). Building Energy Management Systems Will Reach $5.6 Billion in Annual Revenue by 2020. Navigant Research. Available: http://www.navigantresearch.com/newsroom/building-energy-management-systems-will-reach-5-6-billion-in-annual-revenue-by-2020

[3] We note that Tower implemented the real-time energy management program in many buildings in its portfolio, including 2.5 million square feet of owned and managed commercial and high-rise residential buildings. NRDC's report examined only the results of the program in three multi-tenant commercial office buildings in downtown Washington, D.C.

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