Energy Efficient Buildings Hub

REPORT

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Preliminary report: scaling up advanced energy retrofits within large portfolios of commercial buildings

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Executive Summary

Buildings account for significant resource consumption and existing buildings are particularly problematic given their long lifespan and slow turnover of stock. This paper investigates the relative efficacy of different approaches to achieving rapid adoption of energy efficiency measures among owners of large portfolios of buildings who, by virtue of their large holdings, can have a wider impact on the building stock than owners of single buildings. In this analysis, we draw on literature on organizations, innovation and supply chain management to compare owner types across a range of scales, and explore various approaches, challenges and portfolio strategies. We find that richer organizations are both more systematic and more opportunistic in pursuing energy efficiency, jurisdiction-based influences can be persuasive, human resource management issues are central to successful scale-up within organizations, and symbolic arguments for energy efficiency carry little weight outside of the governmental and non-profit sectors.

Among the owner types compared here, we give particular attention to Real Estate Investment Trusts (REITs), and argue that they face specific challenges in scaling-up energy efficiency and implementing an Energy Management System (EnMS). In particular, REITs face unique principal-agent challenges, occupant behavior and usability challenges, and complex organizational structures. Within this market segment, we find that many existing policies and programs that aim to help owners develop strategies for implementing an organization-wide EnMS do not appropriately target tenanted organizations. In addition, there are underexplored opportunities to connect resiliency to energy efficiency.

1. Introduction

Buildings are responsible for 72% of national electricity consumption, 39% of energy use, 38% of carbon dioxide emissions, 40% of raw materials use, 30% of solid waste, and 14% of potable water consumption in the United States (French 2011), and the numbers are similar in other advanced industrialized nations. Substantial efforts to improve the performance of new and existing buildings are underway, especially regarding energy use. More stringent regulations and encouragement of innovation can set new buildings on a more efficient path. Existing buildings are the bigger problem given relatively outdated technology and constraining economic circumstances relating to depreciation schedules, existing lease terms and other factors that contribute to slow turnover of the stock. This is especially a concern in countries such as the United States with low effective energy prices that give owners and tenants little incentive to invest in energy efficiency. In addition, there are often principal-agent misalignments that complicate the motivations for energy efficiency upgrades and retrofits (Kleindorfer et al. 1993; Panayotou and Zinnes, 1994; Prindle and Finlinson 2011).

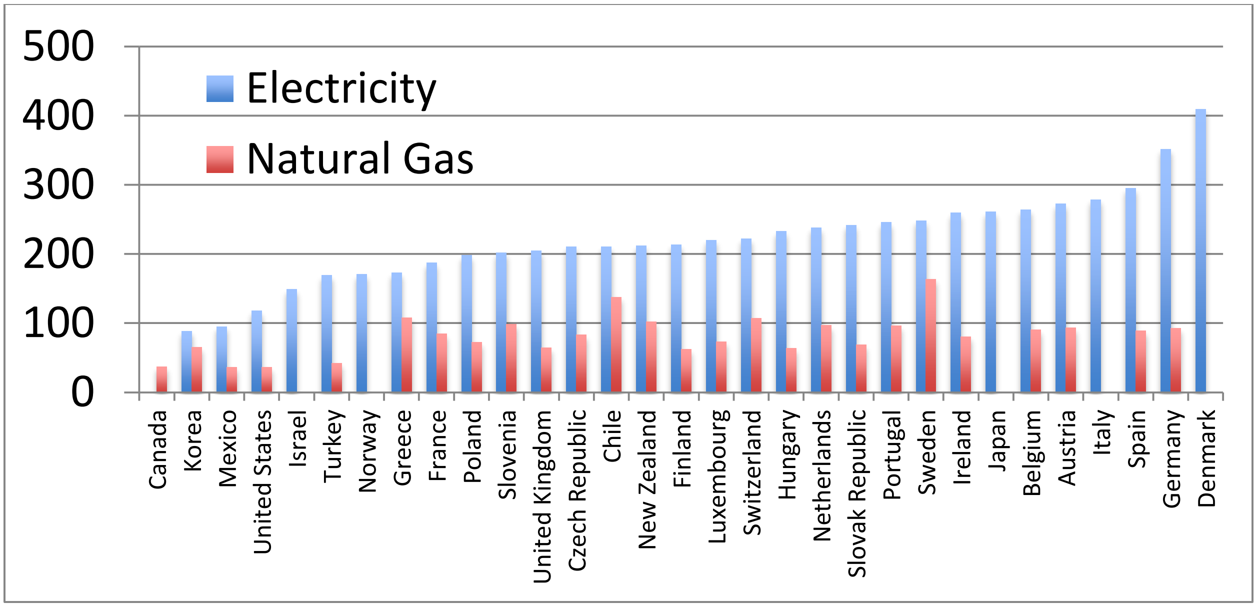

Figure 1: Average energy prices in USD/MWh (IEA 2012)

There is good reason for property owners to invest in energy efficiency measures. Eichholtz et al. (2012) explain that owners with green buildings in their portfolios are likely to see direct benefits through higher rents, lower operating costs, more resilience to fluctuating energy costs, and higher occupancy levels and property values, as well as indirect benefits through better reputation, branding and customer loyalty. Their recent empirical research found statistically significant associations between number of green buildings in a portfolio (with energy efficiency being a key component of a green building) and financial performance of real estate investment trusts (REITs) (Eichholtz et al. 2012). In addition, a growing body of literature acknowledges the role of green buildings in increasing occupant comfort and wellbeing, thus positively impacting occupant productivity (Deuble and de Dear 2012; Heerwagen, J. 2000; Leaman and Bordass 2007; Miller et al. 2009).

Countries such as Canada, China, Russia, and the USA are searching for smarter operating strategies and more cost-effective ways to make the stock of existing buildings energy efficient. This requires both regulatory- and market-based mechanisms, and relies on concerted effort from political leaders as well as property owners. In addition to generating direct benefits to building owners and occupants, tackling the existing building stock is crucial if we intend to mitigate climate change in a meaningful way (Eichholtz et al. 2012; Jaffe and Stavins 1994; Martin et al. 2012). As Long et al. (2011) argue, “Rapid uptake of energy efficiency is the single largest and most cost effective means of meeting rising global demand for energy services while reducing greenhouse gas (GHG) emissions” (p. 195).

Despite the benefits of increased energy efficiency, and the breadth and depth of both theoretical and empirical research being undertaken in this area, much of the work being done to-date does not adequately address the unique challenges facing owners of multi-tenanted properties. This is an especially challenging market segment, due to principal-agent misalignments that complicate the motivations for energy efficiency upgrades and retrofits (Kleindorfer et al. 1993; Panayotou and Zinnes, 1994; Prindle and Finlinson 2011), as well as the difficulty in targeting occupant behavior (Janda, 2013). Within this particular market segment, we find that many existing policies and programs that aim to help owners develop strategies for implementing an organization-wide Energy Management System (EnMS) – such as ISO 50001 – do not appropriately target tenanted organizations. In addition, there are underexplored opportunities to connect resiliency to energy efficiency by including resiliency as one component of a comprehensive organization-wide energy efficiency strategy, and by viewing energy efficiency as one component of resiliency; this synergy is also not well-addressed in the literature. Thus, we will argue in favor of a comprehensive organization-wide EnMS and the implementation of energy efficiency strategies, while noting that it is particularly suitable to organizations owning multi-tenanted commercial properties.

This paper investigates the relative success of different approaches to achieving rapid adoption of energy efficiency measures among owners of large portfolios of buildings who, by virtue of their large holdings, can have a wider impact on the building stock than owners of single buildings. In this analysis, we compare owner types at three scales – local (university), national (REIT), and global (multi-national corporation) and explore how owners utilize jurisdictional tools and regulations, and how tensions inherent in owner size, strategy and structure impact success.

The format of this paper is as follows. First, we outline a theoretical and conceptual framework for the research, drawing from literature on organizations, innovation and supply chain management. We find these three fields to be important drivers of owner success in scaling up building retrofit measures, and use them to frame our subsequent analysis. Next, we consider how governments at various scales attempt to influence organizational uptake of energy efficiency. We then look more closely at REITs to determine the challenges they face and the strategies they might use to succeed in scaling up energy efficiency within their portfolios. Finally, we discuss key findings and broader implications for the field.

2. Organizational Issues

We frame this research through an organizational lens, viewing organizations as drivers of change within the larger framework of the real-estate market. Prindle and Finlinson (2011) lend support to this argument when they explain, "In the U.S. today, organizations are becoming larger and more diverse, so attempting to understand and control energy use based on building type or end-use is less important than understanding how organizations can measure and manage performance across a wide range of building types and end uses" (p. 307). This is particularly appropriate for an owner entity that holds multiple properties, each with a variety of tenant types and sizes. Prindle and Finlinson (2011) further argue that strategies implemented for building management and operation are often stronger drivers of building performance than technology measures or building characteristics. Thus, it makes sense to take an organizational approach to understanding the implementation of energy efficiency strategies and systems.

Conceptualizing Organizations and Organizational Decision Making

One way to conceptualize an organization is as an organism (Teixeira and Werther, 2013). In this framework, which makes a connection to natural ecosystems, organizations need to adapt and remain flexible in order to survive and thrive. This is a helpful framework to conceptualize the need for organizations to implement energy efficiency practices in particular, as the volatility of energy as a resource – in availability and price – is unlikely to remain in a steady state in coming years.

Kleindorfer et al. (1993) explain that it may be difficult to identify the boundary between groups and organizations, but that organizations typically have distinct characteristics, including a hierarchical structure, procedures that have been standardized or systematized, a larger size, and more complex activities. They frame organizational decision-making as distinct from individual and group decision-making, although they acknowledge that individuals and groups are nested within organizations. Behavior and decision-making within organizations is ultimately an exploration of the interrelation between agency and structure within firms (Andrews, 2008).

The nature of the activity an organization undertakes is largely determined by the broader field the firm resides in (DiMaggio and Powell 1983). Although a variety of organizations and firms exist, organizations are quite homogenous in their structure, nature, and activities within industry fields (DiMaggio and Powell 1983), and indeed this is the case within commercial real estate. This highlights the importance of the industry as a driver of organizational norms and a level of structure worth studying.

Despite some level of structural homogeneity, firms are likely to have a unique culture within the organization. Teixeira and Werther (2013) explain, "Organizational culture is the fiber and sinew of all firms. It can be through of as an organization's personality – a curious blend of history, successes, failures, beliefs, myths, actions, and rewards" (p. 334). This culture can be leveraged to spur new practices within the organization.

Innovation

Innovation is an important driver of success in implementing an EnMS within an organization and more broadly within specific industries and the larger real-estate market. Innovation can be viewed both as a process of technological advancement in energy efficiency in buildings and as a management strategy within an organization that helps support the diffusion and adoption of these technologies. We focus here on organizational factors that support innovation. Some researchers credit organizational innovation as one of the biggest drivers of success in firms, responsible for fostering a culture of adaptive flexibility that ensures a firm can survive periods of change and transition (Teixeira and Werther, 2013).

Innovations in energy efficiency can be broadly characterized as technological innovations. Technological innovation – relating to innovation in process and product – is the more traditional approach in the innovation literature (Ganter and Hecker 2013). Many researchers (Beerepoot and Beerepoot 2007; Dewar and Dutton 1986; Ganter and Hecker 2013; Jaffe and Stavins 1994;

Rogers 1995) share a similar definition of innovation in this context as bringing to market new products or methods of production. In this vein of thinking about innovation we ask in this research – how can the widespread diffusion of these innovations be encouraged in buildings in order to spur the scale up of energy efficiency measures throughout a portfolio and, eventually, a wider locality? A number of organizational factors support or hinder the adoption of energy efficient innovations in buildings. We outline below the major areas of focus in organizational innovation.

Characteristics of the Firm

Several explanatory variables about innovators -- collective entities or individuals – are advanced in this literature (Wejnert, 2002). These include familiarity with the innovation and position in social networks along with status characteristics, socioeconomic characteristics, and personal qualities. Of these, studies of firm-level innovation tend to focus on knowledge acquisition and management familiarity, managerial attitudes towards change (personal qualities), and whether the structure of the firm is conducive to innovation (Dewar and Dutton 1986, Cohen and Levinthal, 1990). Drawing on the work of numerous other innovation authors from mainly the management school, Dewar and Dutton predict associations for innovation adoption according to whether the innovation is perceived as fundamental or incremental. They do not offer predictions for outcomes in between, which we term "hybrid," but acknowledge the great importance of this potentially vast and difficult-to-characterize area of the adoption continuum.

On the one hand, more complex (larger) firms would be pre-disposed to greater acquisition of in-depth knowledge of energy efficiency and green building, generally, than less complex (smaller) ones, which would not have dedicated R&D departments and/or a technology champion. However, this does not necessarily mean that larger, more complex firms are predisposed to adopt fundamental changes in energy efficiency technology over incremental ones, given a variety of potential constraints including customer and shareholder expectations along with sheer effort required to disseminate change throughout a large organization. Management attitudes favoring change and the centralization of the firm (leaving little room for potentially powerful interest groups to resist change) should strongly increase the likelihood of adoption of fundamental energy strategies and either have no effect on or diminish the likelihood of incremental adoption. In a similar manner, the ownership structure of the firm is expected to affect adoption behavior as it proxies for the relative influence of actors – not only management and employees, but especially management and shareholders (who may demand green building). Also, ownership structure may mediate decision-making regarding the time horizons of green building costs and benefits, wherein more autonomous, self-financed firms may be afforded a longer time horizon for investments. In spite of the afore going, a small, well-capitalized firm run by a small number of cohesive thought leaders, may be a source of and adopter of fundamental energy efficiency technologies.

Institutional Setting of the Firm

The remaining group of variables describes the context in which the innovation is being advanced and includes geographical settings, societal culture and political-economic conditions (Wejnert 2002). In considering the influence of customers, shareholders and source of financing, the institutional setting of the firm has been characterized in earlier sections; more generally all these variables and their predicted relationships will at times overlap. Cultural homogeneity is believed to have a positive relationship to adoption as this implies more 'structural equivalence' between the promoter and adopter of the innovation (Burt 1987, DiMaggio and Powell 1983). Adoption rates of certain energy efficiency technologies might therefore be more prevalent in owner-occupied or single-tenanted buildings than in multi-tenanted ones, or in the relatively homogeneous industrial warehouse sector than Class A office space. Geographical settings tend to affect adoption as a function of the appropriateness of the innovation to the would-be adopter, along with local jurisdictional policies.

Decision-making of the Firm – Characteristics of the Innovation

Of the various predictors of innovation adoption, those that inform the decision-making of the firm probably offer the most insight into the future of building energy efficiency. While firms exist according to their production and efficiency related functions (Coase 1937; Williamson 1975), they simultaneously may subscribe to cultural and legitimacy-directed activities (DiMaggio and Powell 1983). The former may help to explain why some firms accept and others reject fundamental energy efficiency technologies and practices. The latter may explain incremental energy efficiency regimes and/or green building as "ceremonial" (á la Perrow 1970), as is perhaps the case with many buildings certified by LEED.

The standard microeconomic equation used by firms to evaluate a course of action relates to an innovation's benefits and costs. Where benefits outweigh costs, an action is taken (green building is adopted). The more complicated version of this equation attempts to factor in the time horizon of costs and benefits (life cycle viewpoint of green building), the role of uncertainty and risk, search and replacement costs, switching and opportunity costs, and direct versus indirect benefits and costs. Consideration of these complicating factors will tend to favor larger, more complex firms over smaller ones for many of the same reasons cited above. These will also tend to inhibit fundamental technology adoption in favor of a more incremental approach. Finally, because the process of building design and construction is ultimately project specific, benefit/cost calculations will vary according to the principal use of a building, utility cost and climate (Andrews and Krogmann 2009) and whether the building will be retained or sold, and tenant lease conditions (especially who pays for utilities). These high transaction costs make the case for widespread energy efficiency adoption more difficult.

Supply Chain Issues

From an economics perspective, firms typically strive to minimize costs and maximize profits (Shepherd 1979). The supply chain is a crucial element in achieving this goal, with transaction cost being a key focus within this. The supply chain can traditionally be thought of as the flow of materials and processes from raw input to end-use, encompassing all activities and decisions along the way in this process (Blanchard 2010). It is inherently interdisciplinary (Ketchen and Giunipero 2004). This is an important area of focus in our research because much of what firms do is driven in some way by the needs, goals and strategies inherent in the supply chain. This includes not just manufacturing firms, but service firms as well. Ensuring an efficient supply chain inevitably requires decision-making from a variety of actors, some within and some outside the firm; thus, not all aspects of the supply chain can be controlled at the organizational level (Ketchen and Giunipero 2004). Ketchen and Giunipero (2004) argue that a supply chain's "members" may be more loyal to their own organization than to the overall chain, thus requiring an understanding of agency at different levels of analysis. This has implications for firm-wide management strategy, as an understanding of potential principal-agent misalignments is crucial to success.

There is also growing recognition within firms that increasing the sustainability dimensions of their supply chain has both internal and external benefits (Blanchard 2010; Hoejmose et al. 2012; Seuring and Muller 2008; Srivastava 2007). In order to green the supply chain a targeted strategy within the firm is required, including a holistic approach that integrates environmental management across organizational operations (Srivastava 2007). Greening the supply chain can have far-reaching environmental impacts, because it may induce suppliers within a chain to green their own operations in order to provide more environmentally friendly inputs for the purchasing organization further up in the hierarchy (Arimura et al. 2011). In the case of building retrofits, for instance, an owner organization greening its supply chain could have far-reaching impacts by requiring more energy efficient technologies along with greener construction supplies during retrofit construction, greener cleaning products throughout its buildings, and better waste management strategies both during and after construction. It is generally understood that larger organizations with a more formal organizational structure have more institutional support to implement organization-wide shifts to a greener supply chain (Arimura et al. 2011).

Building Retrofits and Supply Chain Issues

From a supply-chain perspective, commercial building energy-efficiency retrofits are problematic especially because of their high transaction costs. These costs are due to the great uncertainties about existing conditions, the challenge of coordinating many small and specialized actors, and the customized, craftwork nature of each project. As a result, vendors are experimenting with alternative approaches for rationalizing the supply chain for retrofits including, for example, development and deployment of energy monitoring tools (Hinkle and Schiller 2009).

There is growing recognition that significantly deeper savings can be achieved by building owners and tenants in treating buildings as integrated systems and providing building owners, operators and other users with standardized energy management practices. Standards such as the recently published ISO 50001 seek to make energy management a business process on par with product development, quality control or human resources administration. However, for this ambition to be successful, adopting organizations will need to find a workable balance between integration and standardization, on the one hand, and sufficient freedom to adjust to elements of local context such as building size and use, lease type, energy cost and any pricing incentives, and other contextual factors that affect adoption behavior, on the other.

3. <u>Jurisdictional Influences</u>

Owners with large portfolios span a range of scales. We identify three owner types that are well suited to exploring a range of issues faced by owner organizations in their decision-making about energy efficiency. Universities serve as a good example of a local-scale owner, as their holdings – defined by a campus geography – are typically located in a single municipality. REITs often own properties across a regional geography or across multiple states, typically within the context of a single country. Thus, they serve as a good example of a national-scale owner organization. Finally, multi-national corporations (MNCs) serve as a good example of a global owner entity, as they often have holdings that span the boundaries of multiple countries. We explain each of these in turn below.

Local Property Owners: Universities

Universities have unique challenges due to the nature of their operations. They house not only employees within many buildings, but also full time resident students, who consume energy and resources well beyond the structure of a work week (Prindle and Finlinson, 2011). However, the nature of a campus is such that it bounds the organization spatially; this has advantages. The university may be better able to respond to local context and standardize across a portfolio, given that all buildings are (typically) within a single jurisdiction or municipality. Additionally, as both owner and occupier of most of its buildings, a university has additional leverage in diffusing energy efficiency measures throughout its building stock. Campus complexes can also pursue energy efficiency beyond the level of the building by installing efficient district energy systems that deliver heating, electricity, and possibly cooling to multiple buildings, as well as campus-wide building management systems. Medical centers, research parks, and military bases share many of these characteristics.

National Property Owners: REITs

REITs (Real Estate Investment Trusts) have an immense amount of leverage in changing the built environment. Commercial real estate developers are influential in shaping patterns of resource consumption, waste disposal and transportation networks through choices they make about siting, location, built form, and financing (Guile and Cohon 1997). The challenge for commercial and residential REITs lies in the fact that their holdings are rarely owner-occupied. Multi-tenanted properties require thoughtful communication and a very clear strategy in diffusing energy-efficiency technologies and practices throughout a portfolio of buildings, particularly when tenants are varied, and often have their own missions, strategies and goals. In addition, REITs have the added challenge of needing to respond to local context in order to successfully implement energy efficiency strategies across buildings. Although standardization of energy efficiency practices could offer a more streamlined approach to a portfolio-wide rollout of retrofits, this is typically not feasible because buildings owned by REITs are often located in different geographies, densities, and climates.

Additionally, due to the varied structure and nature of REITs in the U.S., there is no clear likelihood of adoption of energy efficiency measures that we can assume across all REITs. Although all REITs have shareholders, some are publicly traded, while others are not; this may influence level of "greenness" the REIT strives for (Eicholtz et al. 2012). Also, some REITs manage their own properties directly, while others contract with facilities management firms; this creates a distinction between more centralized versus distributed control over building operations within a portfolio. REITs offer a variety of lease terms to tenants, ranging from shortto long-term, based on property type and other factors such as whether the building is sub-metered and therefore who pays the energy bill. Finally, REIT structure can be either merchant or institutional; this determines the typical holding period for properties.

Global Property Owners: Multi-National Corporations

Unlike REITs, multi-national corporations (MNCs) – depending on their size and type of operation – often occupy many of the buildings that they own, giving them a clear advantage in diffusing technologies and practices portfolio-wide. The challenge here is in adapting technologies and practices to a wide variety of building and end-use types (e.g. administrative operations in one building and manufacturing in another) and across geographies. As well, the degree of centralization within MNCs is variable. Whereas some MNCs establish firm rules for energy efficiency and/or green building compliance across their building stock, others stop at promulgating guidelines and letting local teams make the final decision. Often, the location of the cost center for building projects follows this same logic – if funding from corporate central is required this provides more impetus in requiring specific building attributes. Of more than 2,000 ISO 50001 site energy management certifications worldwide, the vast majority are industrial companies based in Europe, as shown in Table 1. This suggests an explanatory role for the MNC's region of origin.

Table 1 ISO 50001 Certified Organizations (March 2013)

Source: NAGUS 2013

Country	By Organization	By Site
Germany	616	1,108
United Kingdom	46	138
Sweden	51	119
Italy	62	87
Spain	55	63
Korea	27	53
India	44	50
Taiwan	32	42
France	25	31
Japan	18	30
Austria	16	29
Denmark	28	28
Ireland	21	23
Turkey	18	20
United States	18	18
Rest of World	159	177
Total	1,236	2,016

Influence of Jurisdiction-Based Approaches

At each of the scales outlined above (local, national and global) a range of jurisdictional-based policies influence the actions of property owners. Some of these are more successful than others in encouraging owners to adopt energy efficiency measures. A brief graphical breakdown of owner types, scales, and jurisdictional tools can be found in Table 2. We highlight a few of these policies for discussion below.

At the local scale, property owners face a number of regulatory mechanisms that are unique to the local level, such as building codes and zoning. Building codes serve useful roles in mandating minimum levels of energy efficiency in buildings. However, as regulatory tools they may hinder the diffusion of innovation. First, the administrative process of code writing and enforcement allows those outside of the building trade to make decisions about materials. This leads to choices that are safe and standard at best, inefficient and unsustainable at worst. Insurance companies, as one example, have historically played a large role in the final iteration of building codes, as they have a vested interest in lessening their liability (Davis 2007). This likely plays a significant role in what materials are chosen for code specification and what materials are excluded, and may have implications on the feasibility of adopting innovative or energy efficient new methods or materials. Oster and Quigley (1976) argue that codes result in unnecessary regulatory hurdles that often prevent the use of the best, most efficient and most context-responsive material. In articulating preference for one material type over another, codes are also preferential to some builders and construction firms over others. Finally, some researchers (Beerepoot and Beerepoot 2007; Chirarattananon et al. 2010) argue that regulatory mechanisms that require only a minimum standard provide no incentive for builders, engineers or architects to innovate beyond the minimum.

Table 2: Influence on Owners' Scale-Up Plans of Jurisdiction-Based Tools

Scale	**Approaches**	**Owner Type**		
		University	REIT	MNC
Global	Model codes International Standards	Low	Low	Medium
National	Model codes Tax policy Equipment efficiency standards Disclosure requirements	Low	Medium	High
Local	Building codes Zoning ordinances Property tax policy Disclosure requirements	High	High	Medium

A renewed interest in outcome- or performance-based codes may prove an ally of more innovative firms, who are willing to take on some level of risk for the promise of better building performance. While performance-based codes (as found in ASHRAE 90.1, 189.1, and Standard

100 for existing commercial buildings) more easily facilitate innovative designs, they do not solve the problem of materials or technologies not yet approved for code inclusion. Historically, performance-based codes suffer from compliance and other implementation challenges; however, the introduction of more sophisticated building performance-tracking devices may eventually provide more certainty in this otherwise murky area. The more aggressive jurisdictional incentive programs for energy efficiency adopt performance-based approaches – e.g, the New Jersey Pay for Performance (P4P) Program wherein building owners are rewarded with financial incentives for building retrofits that achieve at least a 15% improvement over baseline, with the final incentive paid only after a year's worth of utility bills demonstrating accomplishment of the benchmark. To a certain extent, performance-based requirements have been incorporated into many other energy efficiency and green building programs, including Energy Star and LEED, to the extent that a building owner is required to demonstrate some level of performance relative to a peer group or beyond the prevailing energy subcode. Table 3 shows which types of organizations take advantage of the P4P program.

Requirements for commercial building owners to undergo an annual energy benchmarking process and then disclose or report annual energy consumption to the local jurisdiction are fairly new policy tools, so evidence regarding their success is still unclear. New York City was the first U.S. jurisdiction to enact such a law, and San Francisco, Chicago and Philadelphia have since followed suit.

Table 3: New Jersey Pay-for-Performance (P4P) Participants by Owner Type, April 2013

Owner Type	**Total # of Bldgs**	**Total SF**
Gov't & Education	247	13,972,091
All Real Estate (REITs, developers, property managers)	412	11,776,422
Corporations (regional, nat'l & int'l)	102	11,298,086
Universities (public & private)	17	1,016,776
TOTAL	778	38,063,375

In New York, Local Law (LL) 84 was passed in 2009 under the Greener, Greater Buildings Plan, which is one component of the City's comprehensive PlaNYC sustainability initiative (City of New York 2012). Under LL84, commercial property owners of buildings greater that 10,000 square feet (929 m2) in size are now required to benchmark and disclose annual energy consumption to the City (City of New York 2012). The first year of required benchmarking under LL84 was in 2011, and data from that year was publicly released in September of 2012. Although it is too early to quantify any citywide energy savings as a result of the requirement, the data highlighted surprising anomalies in the performance of some buildings that were thought to be highly energy efficient. This may incentivize property owners of underperforming buildings to make improvements to "keep up" with their competitors.

A previous national-level disclosure-and-benchmarking law whose impacts have been well studied is the Toxics Release Inventory (TRI). Grantees of the U.S. Environmental Protection Agency's Science to Achieve Results grant program have performed a variety of studies that provide both established insights and testable hypotheses for this new application of disclosure and benchmarking to energy use in buildings.

At a policy level, states with worse pollution based on TRI disclosures subsequently have increased their environmental regulatory spending more than states with lesser apparent problems (Patten 1998). At a business management level, firms with larger liability from emissions or greater stock valuation declines following disclosure make larger reductions (Konar and Cohen 1997). Once the effect of “dirty dozen” listing fades, the single most important benefit of TRI is that plant managers discover opportunities for source reduction as they prepare their compliance paperwork (Kraft et al 2011). Yet without technical assistance, firms often fail to take advantage of the opportunities identified (Massey 2011). This and other voluntary disclosure programs experience varied responses: “clean” firms get cleaner and “dirty” firms don’t change much (Delmas et al 2010).

Related to jurisdictional-based approaches are utility-based incentives, such as the Pay for Performance program described above or the smart grid investment project led by PECO Energy in the greater Philadelphia region. PECO’s Smart Future Greater Philadelphia project received funding from the American Recovery and Reinvestment Act (ARRA) and aims to deploy approximately 600,000 Advanced Metering Infrastructure (AMI) units along with related data management and communication systems across its territory (Department of Energy 2012). Although different from traditional jurisdictional-based approaches, programs such as these deserve attention as important motivators of energy efficiency upgrades. They offer installation of specific technology and provide a wider network of support across a region. A greater Philadelphia area REIT that we have worked with has taken advantage of the PECO program in order to subsidize its installation of new energy efficient technologies and implementation of new energy management practices. Other utility companies are following suit in different regions of the U.S.

Organizational Size

There are advantages and disadvantages to both large and small owner organizations and these constraints and advantages impact an owner’s ability to make some types of energy efficiency changes to buildings. Large organizations generally have three clear advantages over small organizations: They benefit from larger economies of scale, have access to greater financial resources, and can have a wider geographic impact by upgrading a full portfolio. Conversely, small organizations have their own distinct advantages: It may be easier to incorporate local context (e.g. variations in geography, climate, density, etc.) when the portfolio is smaller, and it may be more feasible to implement a standardized approach to energy efficiency across the portfolio.

For universities, size does not determine the uptake of energy efficiency. Instead, relative resources are the most important factor. Illustratively, Princeton University (Princeton, NJ, USA) has 7,500 students of which two thirds are undergraduate students, and an endowment of $1.6 million per student (Princeton University 2013; Ordoludus 2006). A few miles away is Rutgers, The State University of New Jersey (New Brunswick, NJ, USA), which has 58,000 students of which three quarters are undergraduates, and an endowment of $15,000 per student (Rutgers University 2013; Ordoludus 2006). Princeton’s buildings are built to a higher performance standard than those of Rutgers, its central plant is more up to date, and it spends more freely on operation and maintenance, commissioning, LEED certification, and performance monitoring than Rutgers. Princeton also has the wherewithal to construct more adventurously designed buildings that represent fundamental rather than incremental improvements, in part because they can afford to monitor these experiments and intervene when things get off track.

REITs and MNCs demonstrate a similar pattern as shown for universities, where profitability better predicts quality of buildings than size. The highest performing private sector buildings currently under construction in the United States are owned by the likes of Apple and Google, and the deepest private-sector retrofits have been done by companies like Adobe Systems. These high performance requirements do not extend down the supply chain, so far the supply chain is mainly managed to reduce costs and protect brand names.

Broadly, we find that larger, more centralized organizations are better equipped to apply for and benefit from jurisdictional subsidies and comply with regulations. This lends support to the theoretical literature outlined above regarding organizational structure and its impact on the diffusion of innovation and successful supply chain management.

4. REIT-Specific Organizational Issues and Challenges

Taking as a starting point the above framework for organizations and innovation, this section aims to address a particular type of organization in more detail – owners of multi-tenanted commercial properties, typically Real Estate Investment Trusts (REITs). As explained above, REITs have an immense amount of leverage in changing the built environment. but face unique and particular challenges as property owners when implementing a scale-up strategy. These challenges include conflicts in priorities between owner and tenant base (principal-agent misalignments), usability of technology for occupants, and organizational structure.

We expand on these challenges faced by REITs in more detail below.

Principal-Agent Misalignments

As mentioned previously, REITs have the particular challenge of needing to diffuse technologies among a diverse tenant base. Drawing from economics, the differing priorities and motivating factors of the owner organization and its tenant customers is known as the principal-agent issue (Kleindorfer et al. 1993; Panayotou and Zinnes, 1994; Prindle and Finlinson 2011). This issue is particularly problematic in energy efficiency if the party responsible for adopting a retrofit measure is not the same party that will reap the financial benefit from the increase in efficiency. For instance, multi-tenanted commercial buildings are often centrally metered, so the tenant receives no monthly price signal regarding their electricity consumption. If the building owner is then reliant on the tenant organizations to adopt behavioral and technological measures that support a building-wide retrofit, they need to be creative about crafting incentives to encourage tenants to act in a way that is supportive of the building-wide effort. This is a particular challenge in buildings with tenants of varying sizes, budgets, missions and organizational priority.

We find that the owner strategy can be successful when it involves careful experimentation followed by an explicit scale-up process that includes communication and systematic evaluation efforts at regular points in the rollout of energy-saving retrofit measures. Implementing a building-wide shift to a direct metering arrangement, which is available from utility companies in many jurisdictions, can help shift price signals to the tenant in conjunction with a parallel lease structure. In addition, we know that building occupants tend to be more tolerant of building conditions in green (versus non-green) buildings (Deuble and de Dear 2012; Leaman and Bordass 2007). Thus, building owners can push the health and productivity benefits of greener spaces to tenants as a way to encourage the adoption of measures within their individual organizations that benefit the building as a whole. In our experience, behavioral strategies, including attempts to change building occupant behavior, are increasingly adopted by organizations that have some degree of distributed control over building design and operation, which includes most REITs. The last thing a property owner wants (and especially the property manager whose compensation depends on it) is a dissatisfied tenant. Engaging the tenant directly in setting the terms of and executing energy saving behavior is a more collaborative approach than dictating terms through leases, although the latter too is an instrument of behavior change. Conversely, highly centralized organizations with large portfolios that we have studied have tended to opt for building energy changes that are less interactive with and less obvious to the building tenant and to pursue these through legal or other mechanistic means.

Usability & Building Performance

A related theme emerges around whether building users find a given energy efficient technology to be usable and if/how user insights about the experience are harvested. Innovation literature identifies user feedback as a key ingredient in successful innovations (von Hippel 1998). Or, in marketing terms, users are the day-to-day consumers of energy efficient buildings. Typical usability metrics include effectiveness in meeting targets, efficiency in using resources while doing so, and the user's satisfaction with the experience (Bevan and MacLeod 1994). Lessons learned from earlier generations of energy-efficient and passive solar buildings tell us that usability determines success, and lack of usability hinders the diffusion of innovations (Blumstein, Kreig, Schipper and York 1980; Case 1984; Wener 1984; Volink, Meertens and Midden 2002).

Post-occupancy evaluation (POE) can provide valuable feedback on an existing building's usability and human effects (Wener, 1989; Zimmerman and Martin 2001). A versatile research tool, POE can offer both diagnostic and prognostic research information by focusing upon the needs and interests of building occupants (Preiser, 1988). The operation of commercial buildings has numerous objectives that require balancing, among them, cost containment, efficient operation and occupant well-being.

POE and building commissioning (which brings a third party in to verify the technical performance of a new building system) are widely recognized as good management practices but they are not as widely implemented. The additional cost of performing these evaluations means that only well-resourced organizations include it as a standard practice. We find that REITs will make the investment as part of their customer-relations efforts, although they prefer to keep the results of the evaluations confidential. MNCs may perform such evaluations as part of their human resources management function. University campuses less often perform such evaluations. The most recent version of the USGBC's LEED green building rating system has encouraged greater uptake of POE and commissioning by making it mandatory for certification.

Organizational Structure

Unlike MNCs, which typically have hierarchical corporate structures, REITs often have flatter and less hierarchical organizational structures; this has implications for the implementation of new energy efficiency initiatives. Instead of top-down enforcement, the central corporate arm of a REIT often only has moderate implementation power company-wide, instead serving as more of a centralized resource hub for regional leads in other branches of the organization.

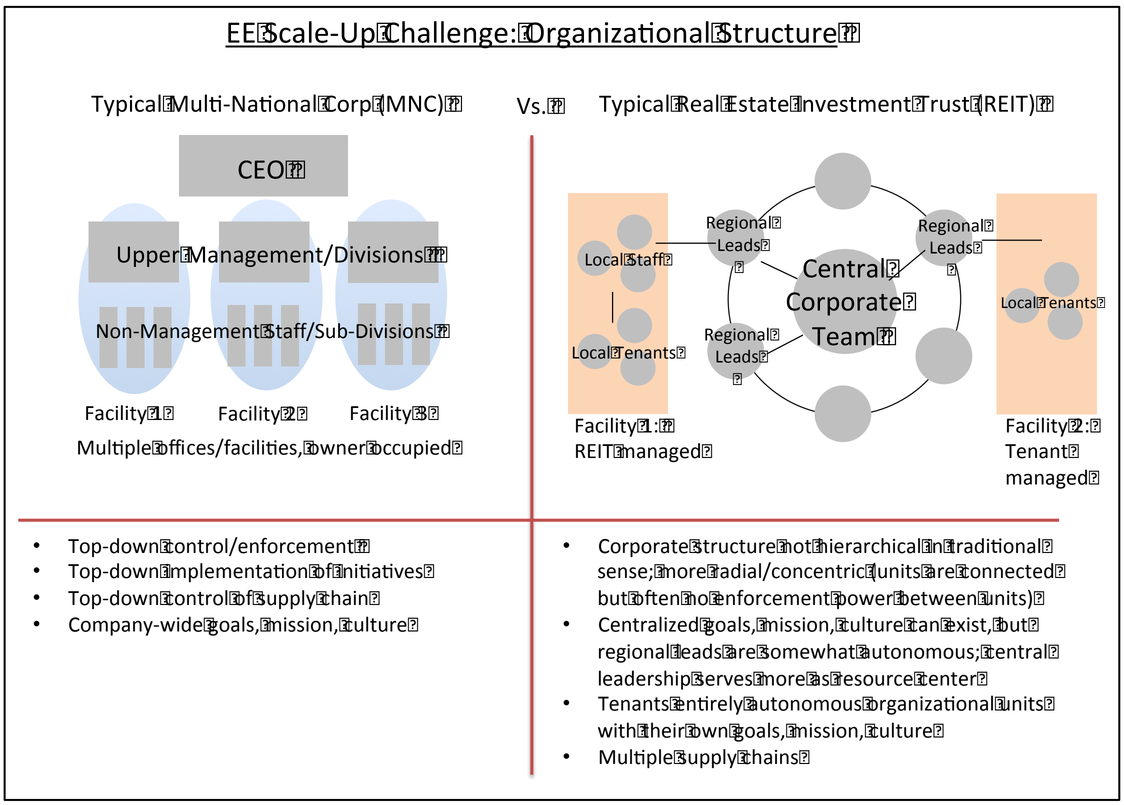

Figure 2: REIT Organizational Structure Challenges & Characteristics

Empirically within the REIT category, two companies of similar size but with different ownership structures have innovated quite differently. A publicly traded REIT with which we work has rolled out a very systematic program of incremental energy efficiency improvements, testing each change in pilot buildings before applying it to the remainder of the portfolio on a rolling basis as investment funds and hurdle rates allow. This REIT does not scale up improvements that perform marginally or that cause blowback from tenants.

A privately held REIT with which we work has been more ad hoc, ignoring the energy efficiency fashion in the industry until the lead owner had an epiphany, and then rolling out improvements quite aggressively. The sudden ramp-up has been followed by a modest amount of evaluation to identify what works and what does not. Dissemination throughout the portfolio has largely followed the timing of the commercial renovation cycle rather than a systematic harvesting of cost-effective efficiency improvements wherever they can be identified.

5. Strategies for Owners of Multi-Tenanted Properties

Keeping in mind the unique challenges that are specific to REIT organizations, we discuss current approaches to energy efficiency and where these strategies need adaptation and modification for use in a multi-tenanted property. In addition, this section discusses underexplored areas that REITs may be able to take particular advantage of, such as the benefits of a resilient organization and the synergies between energy efficiency and resiliency.

Voluntary certification programs

There is growing recognition that significantly deeper savings can be achieved by building owners and tenants in treating buildings as integrated systems and providing building owners, operators and other users with standardized energy management practices. Standards such as the recently published ISO 50001 seek to make energy management a business process on par with product development, quality control or human resources administration. However, for this ambition to be successful, adopting organizations will need to find a workable balance between integration and standardization, on the one hand, and sufficient freedom to adjust to elements of local context such as building size and use, lease type, energy cost and any pricing incentives, and other contextual factors that affect adoption behavior, on the other.

Standards such as ISO 50001 can offer a clear pathway towards energy efficiency, but are often more appropriately suited for “plug-and-play” use by owner-occupied entities, such as MNCs. However, IS0 50001 provides a good starting point for energy management that, with some modification and adaptation, can serve as a helpful guide for REITs as well, even if the organization does not seek certification.

We offer here an outline of the ISO 50001 system with targeted strategies for modifying certain steps of the system for use by REITs. More broadly, considerations for use of the ISO system can be outlined in 3 main points:

1. Tenants are not given consideration in ISO 50001 and are important to REITs for obvious (previously noted) reasons. Further, the exact role for a tenant within a REIT’s ISO process is not clearly defined: Tenants could serve an internal or external role, or a hybrid of the two. They are external stakeholders in the sense that they are REIT customers and drivers of revenue. They are internal stakeholders in that they are within the boundaries of actors that impact energy use within a REIT structure. The REIT should define this somewhat ambiguous tenant role prior to undertaking energy retrofits, and should decide how much or how little tenants will be included in

the energy efficiency scale-up initiative. How much will be required of tenants? How much will they be informed? Will they be treated as an external stakeholder or an internal partner, or some combination in between?

2. ISO gives no consideration to occupant behavior. Although important to any organization, it is particularly relevant to a property owner with multi-tenanted facilities. REITs will need to determine at the outset of an energy efficiency initiative if they are willing and able to tackle occupant behavior at this point and, if so, to what extent.
3. Finally, ISO does not acknowledge or incorporate the nested levels of influence that a REIT must consider when undertaking an energy efficiency project. This nested structure includes: multiple levels/scales of influence within individual buildings, multiple levels/scales of decision-making within the owner organization, and multiple jurisdictional/policy influences at different scales (local, state, national) across a portfolio.

Table 4: ISO 50001 Considerations in Multi-tenanted Properties: Toolkit for Action

Issue	Description of Issue	Sections of ISO 50001 Impacted by Issue	Resources/Suggested Actions
Tenant Role	ISO 50001 outlines roles for internal and external stakeholders, but not for the complex split-incentive issue that is inherent in the relationship between tenant and landlord. Tenants could serve an internal or external role, or a hybrid of the two. They are external stakeholders in the sense that they are REIT customers and drivers of revenue. They are internal stakeholders in that they are within the boundaries of actors that impact energy use within a REIT structure.	1.1.2: Understand your business drivers 1.3.2 Develop the implementation plan 1.3.3 Establish communication channels 3.1 (All sub-components of this step): Establish energy objectives and targets 4.5: Communicate across the organization 5.7: Manage energy considerations in design 5.9: Decide on external communications	Owner/Tenant Collaborations Green Tenant Toolkit (Bus. Council on Climate Change) BOMA guide for LL/Tenant sustainability in the workplace. NJIT Tenant Toolkit PSU/CMU Plug-load Management Green Leasing Green Lease Library American Bar Association Task Force on Green Leases PlaNYC 2030 guidance on split incentive issue
Organizational Structure	ISO 50001 can be implemented most seamlessly by organizations with a top-down hierarchical structure. Many REITs and property owners, due in part to their jurisdictional complexity and holdings that cross geographic boundaries, are in fact structured very differently. Although there might be a central corporate headquarters, this office may or may not have authority or implementation power over regional branches and managers. This may lend itself to a more "radial" organizational structure, which changes the way ISO would be implemented.	1.1.1: Identify key internal influencers 1.2 (All sub-components of this step): Secure top management 1.3.2: Develop the implementation plan 1.3.3: Establish communication channels 1.4: Understand EnMs Documentation 2.5.1: Get the right people together 2.5.2 Review relevant organizational information 4.4: Conduct a management review 4.5: Communicate across the organization 5.3 Ensure competence of personnel 5.6 Incorporate energy considerations in procurement	Organizational Diagram Develop a flowchart or diagram of organizational structure. Identify key decision-points and areas of influence. Incentives/Bonuses Possible financial or other incentives for employees to engage those in other sectors/divisions/geographies in energy efficiency efforts. Alcoa (case study) HEI Hotels (case study)

Specific Highlights from ISO 50001

This section reviews each of the seven steps of the ISO 50001 system, calling attention to the broad goals and targets of each step, and highlighting areas of each step that would need particular consideration or modification by a REIT prior to implementation.

Step 1: Getting Started

Step 1 consists of four sub-steps that deal primarily with management structure and internal support for undertaking an energy improvement project. REITs can accomplish all of these steps without much modification to the ISO suggestions, but will need to give careful consideration to the following:

- As mentioned above, REITs need to define the tenant role. One option is to include tenants as a key external business driver, replacing the ISO-suggested "customer" in Step 1.1.2.
- Ideally a REIT's entire portfolio would define the scope of work and boundaries for an energy efficiency improvement scale-up project (Step 1.2.1). However, given the multi-tenanted, multi-jurisdictional conditions a REIT faces it likely makes more sense for a commercial property owner to define multiple boundaries for work. These boundaries could be selected based on a variety of characteristics given the goals, structure and size of the REIT. Examples include geography, building size, occupancy rate, etc.

Clearly defining these two points at the early stages of the planning process will help lay the groundwork for later steps and will help dictate a number of decisions further along in the system.

Step 2: Profile your Energy Situation

Step 2 is the ISO system's most in-depth and detailed section, and deals primarily with taking stock of the organization's current energy profile (uses, sources, costs, future projections, etc.). In order for a REIT to accomplish many of the goals within the various sub-steps of Step 2, it must first undertake some basic but important information gathering. The REIT should organize the following into one or more master documents:

- Utility providers within the portfolio, number of buildings served by each utility company, and primary contact person for each account.
- Energy cost differences in buildings located in different regions, and total monthly and annual energy usage for every building in the portfolio.
- All applicable jurisdictional policies, building codes, mandates and voluntary schemes for geographies where the REIT owns properties – organized by state, city, region, or however makes sense based on the location of the REIT's holdings and the boundaries of the policy or mandate.
- A listing of all buildings that are already complying with voluntary schemes (e.g. are Energy Star rated) or are enrolled in a local jurisdictional program.
- Internal staff person(s) responsible for managing and collecting this information currently and a newly appointed staff person who will be responsible for managing this new master list.

The organization may want to consider a map, chart, or other graphic to help organize some of this information.

Step 2 also requires the identification of significant energy uses and/or considerable opportunities for improvement (Steps 2.3.3, 2.3.4). In the case of a REIT, a significant energy use may come in the form of a single tenant but, as mentioned previously, ISO does not plan for or account for behavioral impacts in energy consumption. The REIT will need to determine if they are willing to tackle tenant behavior at this point, or confine the selection of significant energy uses to buildings/systems only. If they are willing to tackle occupant behavior, this will be outside of the scope of the ISO system.

Step 3: Develop Objectives, Targets and Action Plan

Step 3 takes all of the metrics and data gathered in the previous step and develops a plan for action. A REIT will undertake most of these steps as they are outlined in ISO 50001, but will have some modifications based on the boundaries identified in Step 1 and the role given to tenants. Some points to consider:

- ISO recommends at Step 3.1.5 that the planning team consider communicating about the intended energy targets and goals with the entire organization. In the case of a REIT, the team should determine if this is an appropriate time to communicate energy plans with tenants and, if so, to what extent.
- The selection of specific projects to implement (Step 3.2.1) may be somewhat pre-determined based on the boundaries for work defined and outlined in Step 1.

Step 4: Reality Check: Stop! Look! Can I Go?

Within the Step 4 recommendations for "checking-in," the REIT should review the logic and organization for undertaking the energy initiatives determined in earlier steps. Do the jurisdictional or regional boundaries for scope of work make sense now that projects are underway? Have priorities been appropriately identified? Are buildings taking advantage of any local or state incentives? Have any new incentives, mandates or policies been implemented in some areas of REIT holdings, but not others? Identify if organizational modifications are needed to the logic of the process before proceeding.

Step 5: Manage Current State And Improvements

Step 5 is the "do" component of ISO's Plan-Do-Check-Act system, and deals with the actual implementation of plans and goals developed in Steps 1-4. Much of the variation for REITs in following ISO 50001 must be dealt with in the earlier planning stages, so meeting the targets for Step 5 does not require much modification. However, some points to consider for moving forward at this point include:

- Step 5.4.1 – Defining awareness requirements for "all personnel included within the scope and boundaries of the energy management system" – could again include tenants for a REIT, and relates back to the initial point regarding tenant role within an energy improvement project. How much is the organization willing to require of its tenants? Awareness only? Action?

- Step 5.7, which targets energy considerations in design, should include an organizational plan or framework for the energy efficient fit-out of newly-leases spaces going forward.

Step 6: Check the System

Step 6 – the "check" component of ISO's Plan-Do-Check-Act system – can be implemented and followed by a REIT in much the same way that any organization would follow this step, keeping in mind the impact of any earlier decisions to include tenants or not, to exclude some buildings based on decided boundaries and scope of work, etc.

Step 7: Sustain and Improve the System

Step 7 – the "act" component of the Plan-Do-Check-Act system – can also be implemented by a REIT without much modification (again, as long as earlier additions and modifications have been incorporated and accounted for).

Additional resources for REITs seeking to implement an EnMS, which may help to overcome the principal-agent problem, include guidelines and templates for a so-called "green lease". The provisions of green leases vary from specifying the use of low VOC materials in re-design, to an a priori agreement to share utility bill information with the building owner to provisions that address capital investment in large scale energy efficient or renewable energy systems and any associated revenue. For further information, see the Green Tenant Toolkit and the Green Lease Library.

Resiliency

Resiliency guidelines and associated actions are another potential resource to organizations pursuing energy efficiency, given synergies in some of the objectives and the possibility to economize on building investment. At its most basic, resiliency refers to the ability (of an individual, group, organization, community, city, etc.) to withstand a significant shock to its system and to adequately recover from this shock (Rose and Krausmann, 2013; Zobel, 2011). The concept originates from the natural sciences, namely the study of ecosystems (Beermann, 2011). Most recently, resiliency has become a "buzz word" in the business and real estate communities as the northeast still works to recover from the damage caused by Hurricane Sandy. In this context, resilience is seen as the ability to withstand a natural disaster.

Although disaster preparedness is important, particularly f or property owners, resilience can and should be looked at through a broader lens. Shocks can come in many forms; organizational resilience – as one piece of a comprehensive management strategy – can help an organization withstand not just one-time shocks, but also longer-term economic shocks and uncertain risks from climate change. Further, resilient organizations are a key component of resilient societies (Beermann, 2011). Firms and organizations provide goods and services to individuals, neighborhoods and cities, giving these firms an important role in providing community-level continuity and stability in the case of a significant disruptive event.

Approaches to Organizational Resiliency

Increasing organizational resiliency is not a new theme, or one driven only by recent severe weather events. The International Standards Organization (ISO) has developed a host of systems targeting the broader themes of business continuity. These include, for instance, ISO 31000: Risk Management Principles and Guidelines, ISO 22323: Management Systems for Resilience in Organizations, ISO 22301: Business Continuity Management, and ISO 28002: Resilience in the Supply Chain. While each system varies in its scope and content, the overall goal is the same: develop an organization-wide strategy to ensure the firm is prepared for disruptive events. The strength of ISO lies in its comprehensive approach – regardless of the organization's choice to seek certification through ISO or not, the systems offer step-by-step guidelines for reaching all levels of the organization, ensuring ongoing success, and making improvements along the way until the new practice is fully integrated into the firm. As explained previously regarding ISO's energy management framework, firms should carefully adapt the system as needed to meet their organization's goals.

Expanding on the earlier discussion of innovation, Teixeira and Werther (2013) connect organizational resilience to innovation. They argue that organizational innovators can typically be grouped into one of three types: reactive, proactive and anticipatory. From anticipatory innovators emerges resilient organizations (Teixeira and Werther, 2013). Anticipatory innovators are not just proactively developing new solutions and processes, but doing so repeatedly, giving them a unique edge. Teixeira and Werther highlight important changes in the culture of businesses and firms. They explain, "Traditional sources of competitive advantage – economies of scale, control through vertical integration, and even cohesive cultures – have given away to time-to-market economies, flat and flexible structures, and organizations with fluid cultures willing to experiment with the 'new" (Teixeira and Werther, 2013). We argue that this cultural shift could potentially give REITs an advantage; whereas most multi-national corporations are traditionally hierarchical, REITs, by the nature of their operations and portfolio structure, are typically more radial in nature, with smaller divisions (often operating independently) branching off of a central corporate division. The corporate center often simply provides guidance, but does not dictate activities; thus, this unique structure leans towards the flat and flexible. If REITs are willing to innovate, they could leverage their organizational structure in new and creative ways to shift the culture towards one of resilience and adaptability.

Legnick-Hall et al. (2011) view organizational resiliency not just as an important organizational strategy, but as an embedded capacity within an organization; this capacity is derived from both micro-level (individual) characteristics and traits, such as employee knowledge, skills, and education, as well as characteristics of the organization, such as business processes, firm culture, and mission and vision. Thus, they target human resources management as a key driver of resilience capacity-building in organizations. As such, they outline traits of individual resiliency -- drawing from psychological literature – that they argue can be deliberately strengthened. This approach views individuals and individual interactions as the building blocks of firms, and key in the collective capacity building for resilient organizations (Legnick-Hall et al., 2011).

Rose and Krausmann (2013) address business continuity through what they term economic resiliency. They find that many current approaches to measuring and increasing resilience are better suited for communities or infrastructure, and do not adequately address issues facing individual businesses or local economies (Rose and Krausmann, 2013). Thus, they develop a set of metrics to identify both customer-side and supplier-side metrics that together form a framework to measure the robustness of an organization's ability to be resilient. Building on the argument by Legnick-Hall et al. (2011), they too identify human capital and management as key components of both supply-side and customer-side resiliency in firms.

It is also important to frame resiliency in organizations as more than simply the ability to return to a prior normal; those firms that see the benefits of embracing a "new normal," and using it as an opportunity to innovate, will have a strategic advantage over those that simply strive to return to the pre-shock baseline (Teixeira and Werther, 2013). REITs can take particular advantage of this. For example, a REIT that views electric grid shocks as an opportunity to develop innovative daylighting strategies in its buildings will reap benefits that go beyond a decreased reliance on electric lighting; it will also potentially result in happier tenants with more access to daylight in their workspaces, leading to positive branding for the REIT and a possible competitive edge in attracting new tenants.

Connecting Resiliency to Energy Efficiency

Resiliency can overlap well with energy efficiency goals. Addressing resiliency not as a mutually exclusive goal, but as a key interconnected component of a comprehensive EnMS generates additional benefits for the property owner. As the nonprofit Ceres noted in a 2010 symposium on resiliency and energy efficiency, "While there is growing momentum behind energy efficiency and the broader green building movement and well-established disaster mitigation programs in a number of states, the two communities have rarely collaborated – a potential source of inefficiency given that both groups strive to improve the performance of the same buildings" (Ceres, 2010). Addressing resiliency goals through energy efficiency will make property owners less vulnerable to extreme storm events – which translates to less disruption to rent-paying tenants – and lowers operating costs for owners. This synergy represents a valuable missed opportunity in the current conversation on resiliency.

Incorporating energy efficiency into a portfolio's resiliency strategy has benefits that go beyond the individual building and property owner. Resiliency is an important area of national focus, particularly post-Hurricane Sandy. The recent Department of Energy (DOE) report "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages" notes that in addition to reducing vulnerability to severe weather, a resilient grid also increases energy efficiency. It highlights case studies in Pennsylvania of electricity customers who were able to regain power quickly after Hurricanes Irene and Sandy due to the installation of smart meters or Advanced Metering Infrastructure (AMI). What the report overlooks is the important contribution individual buildings can make to grid resiliency; by reducing strain on the grid, through measures such as demand response and energy retrofits, commercial buildings, especially those that constitute a sizeable portfolio in aggregate, can be a key component of a resilient grid strategy; thus, REITs and other commercial property owners can potentially create benefits for the wider community by making their portfolio more energy resilient. Additionally, resilient organizations will be better able to withstand long-term, indirect impacts of climate change

(Beermann, 2011). Many of the potential risks of climate change come with a high degree of uncertainty and potentially high cost. Those organizations that remain flexible, innovative, and resilient will be better able to prepare for and withstand these uncertain shocks (Beermann, 2011).

6. Current Fieldwork

Our initial research and findings here, particularly regarding the challenges of developing an EnMS for a REIT, spurred a pilot project with a Philadelphia-area REIT to craft a framework for owners to develop a REIT-specific Environmental Management System (EMS), which includes energy objectives and also broader environmental/sustainability ones. The goal of the EMS is to ultimately provide guidance to REITs about *process* for developing such a system. The working draft of this EMS was presented at a roundtable of the National Association of Real Estate Investment Trusts (NAREIT) in San Francisco in January 2014. The idea of a REIT-specific EMS is gaining legitimate traction; an ad hoc working group grew out of the roundtable, and the Global Real Estate Sustainability Benchmark (GRESB), an industry organization depended upon by investors and owners to assess the environmental performance of real estate portfolios, has agreed to incorporate our EMS system into their benchmarking system in 2014.

7. Conclusions and Recommendations

This investigation of scaling up energy efficiency within large real estate portfolios suggests several conclusions. Empirical corroboration beyond our direct experience by means of aggregate statistics and detailed organizational case studies to confirm these conclusions would be valuable next steps.

- Large, capable organizations of all types will scoop up jurisdictional subsidies and comply with regulations more readily than smaller organizations. There is a clear efficiency-equity tradeoff.
- Under-capitalized organizations will not invest as much in energy efficiency and performance-oriented O&M as those with adequate resources. The equity concern heightens, but because of the positive spillovers of energy efficiency, planners should not sacrifice speed in scale-up on that altar.
- Local jurisdictional tools can influence all three types of organizations investigated here.
- National- and Global-level jurisdictional tools also have influence on all three organization types, but their influence grows as the scale of the organization grows.
- Mission-oriented non-profit organizations and governmental agencies are willing to justify green, energy-efficient investments in buildings based on their symbolic value, whereas REITs and MNCs place greater weight on the economic value added.
- Scaling up energy efficiency is as much a human resources challenge as it is a technological or logistical challenge. Training, education, and outreach are essential, not optional, components of any successful deployment strategy.
- The most widely effective strategy for scaling up energy efficiency within large portfolios is to make it systematic, so that it becomes part of the normal process of reinvestment, fine-tuning, and efficient O&M.

- Owners also can and should deploy energy efficiency opportunistically as subsidies, technological breakthroughs, or market demands materialize. They should have a portfolio-wide list of worthwhile projects in mind to make it easier to respond to these opportunities.
- REITs face specific challenges in scale-up, but can work around these challenges if they focus on implementing a process that works within the context of their organizational constraints.
- Resiliency is a beneficial added component to a scale-up strategy and can spur additional energy efficiency benefits in addition to decreasing a portfolio's vulnerability to natural disasters and decreasing insurance liability.

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