Building Performance and Climate

Kevin Monte de Ramos

INTRODUCTION

In a report published by the American Council for an Energy Efficient Economy (ACEEE), Steven Nadel and Adam Hinge state "To meet long-term climate goals, substantial energy savings and greenhouse gas emissions reductions must be obtained from existing buildings."[1] This realization has led several municipalities across the globe to explore mandatory building performance standards. Although some of these initiatives have focused on single family homes, the primary focus has been on the performance of complex systems used in commercial, institutional, and multiunit residential buildings. Nadel and Hinge estimate that building performance standards would reduce carbon dioxide (CO_2) emissions by an average of 30 percent from current levels simply by lowering their energy requirements.

[1] Nadel, S., & Hinge, A. (2020, June). *Mandatory building performance standards: A key policy for achieving climate goals.* Retrieved from https://www.caba.org/wp-content/uploads/2020/08/IS-2020-113.pdf

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In prior columns, this author explored data virtualization as a backbone for energy reduction and climate mitigation strategies, and electrification as a pathway to government climate mitigation commitments. This column highlights the need for a comprehensive and coordinated building performance strategy that includes the use of remote sensors and a virtual command center that allows real-time adjustments to system controls to balance occupancy preferences with commitments to climate action.

The primary metric used to assess building performance is known as energy intensity. Energy intensity is the amount of energy used per square foot of floor space. When coupled with adjustments for local climatic conditions and occupancy rates, an energy rating for the building is generated and used to label buildings in relation to other buildings. These ratings differ between countries and have differing requirements for certification. However, all green building certificates rely heavily on the energy intensity of building operations.

The most widely recognized building performance program is the Leadership in Energy and Environmental Design (LEED) green building certificate. LEED was developed by the United States Green Building Council (USGBC) and its parent corporation, the World Green Building Council (WorldGBC). Third party verification is used to award these certificates to building operators who have demonstrated excellence in resource efficiency, emissions mitigation, and cost-efficient whole building performance management.

For building managers and owners, building performance generates three key value streams that

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result in higher asset valuations. First, there are higher costs to build and design buildings to this higher performance standard. As such, green building certifications have an implied capital investment that warrants higher sales prices when the asset is transferred. The estimates provided by the WorldGBC suggest asset valuations for green buildings achieve premiums up to 30 percent when compared to similarly situated noncertified buildings. Second, green buildings command rental premiums up to 17 percent higher than those following conventional building standards. Third, occupancy rates for green buildings are thought to achieve 23 percent higher occupancy rates than noncertified properties. And lastly, building operating costs can be lowered significantly from what they might otherwise have been based on how building operators commission equipment and priority performance requirements.[2]

These cost savings result from lower water, fuel, and electricity costs. However, a new cost stream is emerging. Carbon pricing and carbon taxes might one day become significant considerations in the twenty-first century that can open up another revenue or value stream for high performing buildings. Large buildings could be given allotments or carbon credits on current levels of emissions. These hold some value today but are expected to rise significantly in value over time as carbon mitigation strategies are adopted worldwide; carbon dioxide equivalents (CO_2eq) being valued at $35/tonne is thought to rise over time to $450/tonne. When coupled with these allotments and credits to decline year-over-year, buildings that do not attain target emission reductions will be forced to purchase or pay fines equivalent to the market value of CO_2eq. This will add new cost streams, or revenue streams, for some environmentally conscious entities, and renew focus on whole building performance.

EXISTING BUILDINGS IN THE CROSSHAIRS

Terri Willis, the CEO of the World GBC, stated "Buildings — and mostly the world's old, energy guzzling and inefficient ones — currently account for around one third of global greenhouse gas emissions. They also place pressure on the world's valuable resources — an astounding 40 percent of global resources and 25 percent of global water are used in buildings according to the United Nations Environment Programme."[3] As members of the UN Global Compact, the WorldGBC will influence the ambitions of the Paris Climate Agreement and the UN Global Goals for Sustainable Development.

SensorSuite provides a set of sensors and controls to property and facilities management executives. These interconnected sensors and controls form a wireless mesh commonly referred to as the Internet of Things (IoT). IoT-enabled devices are commonplace today, allowing us to unlock doors or change lighting remotely, often via our smartphones. SensorSuite uses this capability to display real-time operating statistics of building equipment and provides for remote configuration of their controls.

SensorSuite describes themselves as a provider of an IoT-centric building performance monitoring platform, which allows building performance to be actively managed. Glen Spry, the newly appointed CEO of SensorSuite, has indicated progressive enterprises are inquiring about what new and important investments are being made by real property owners and operators to address future market demands for building performance. He concludes that over time, buildings will evolve into disparate classes of properties.

Building owners able to invest in renewable energy generation, battery storage, charging stations, and energy efficiency will command rental premiums, attract preferred tenants, and benefit from heightened asset valuations. Those properties unable or unwilling to invest in these emergent technologies will evolve to serve tenants seeking lower rents and willing to take on higher costs of in-suite energy charges or willing to pay a penalty in the form of a carbon tax if implemented.

Without regard for the natural segmentation of real property, all parties to the real estate transaction are sensitive to the energy and climate challenges ahead. It appears we are amidst an energy transition that targets energy and environmental performance of existing buildings. Even without conscious

[2] Alpin Limited. (2016/2017). LEED costs, benefits, and ROI (energy, water, CapEx, health and productivity). Retrieved from https://media.alpinme.com/pws/LEED-Costs-Benefits-ROI1.pdf

[3] Willis, T. (2015, Dec 3). *Why green buildings will be the real superhero at Paris, World Green Building Council*. Retrieved from https://emiratesgbc.org/wp-content/uploads/2020/06/Buildings_Day_summary_report_FINAL_compressed.pdf.

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action, building operators will be influenced by market forces to install energy efficient equipment that have more controls built into the assemblage and force late adopters of green technologies to passively monitor energy, economic, and environmental factors impacting the building performance.

Other organizations will make conscious decisions to monitor their energy, economic, and environmental factors more closely. These progressive enterprises, as Glen Spry referred to them, will adopt emergent technologies, leverage incentives to speed that adoption, and assign personnel to maximize the building performance. The question remains as to how to best balance these two strategic perspectives.

DIFFERING VALUE DRIVERS

Operating within existing buildings are a list of decision makers/actors, each of whom have a unique perspective that influences their preferences. **Table 1** highlights these key actors and how their associated perspective could impact their decisions regarding building performance.

To formulate a strategic handling of energy use within buildings, these differing perspectives must work together. The tactical approaches used must be ranked and prioritized before a coherent and unified approach can be agreed. The only party that can balance these perspectives will be the Executive Board who owns the building or site.

A published energy plan must first be established to balance the various perspectives offered. This strategic guidance from the Executive Board is needed to guide how best to manage operational costs and what types of risks the property owners are prepared to take on as their occupants stratify along targeted environmental and business outcomes.

Only a clear mandate from an Executive Board can align the choices of building performance stakeholders will make over the coming decades. Buildings themselves, like the tenants who occupy the property, will have differentiated valuations based on the investments made to their infrastructure and how those investments align around environmental targets.

ENVIRONMENTAL EXIT

Owners of aged properties will face a critical decision over the next decade — whether or not to sell their property to avoid emergent liabilities associated with their property holdings. In this case, the compliance risks are simply transferred to the next

Table 1. Actor Perspectives on Building Performance

Decision Maker/ Actor	Perspective	Positioning
Facility Manager and Site Engineer	Comfort of tenants and Functioning of Existing Equipment	Reacts to tenant inquiries and ensures existing equipment is meeting occupant requirements. Sometimes will draft plans for change in use of properties/buildings.
Property Management	Occupancy Rates, Trade Relations, and Collection of Rents.	Negotiates terms of lease and contracts for service providers. May be proactive in recommending equipment upgrades and performance standards, but typically in response to owner or tenant directives.
Maintenance Manager	Functioning of existing equipment; emergency repairs	No time or responsibility to consider energy efficiency, rather relegated to ensure current equipment is functioning to performance standards assigned by facilities' management
Energy Consultants and Advisors	Sell audits and assessments; generally funded by government agencies and utilities	Focused on delivering prescriptive assessments for equipment being incentivized by the market; Often advocates of whole building systems but often lacks the mandate to deliver on that scope.
Performance Contractors	Finance large scale energy efficiency implementations	Develops opportunities to deploy a suite of energy reductions and carbon mitigation measures by directly engaging property and facility managers. Offers financing of comprehensive energy management systems; often through the savings achieved by energy cost reductions.
Building Commissioners	Measurement and Verification; Performance Contract Compliance	Role to verify performance contracting metrics to ensure payments have been earned through achieved operational savings. Sometimes required by governments to ensure building performance standards adhere to environmental and energy commitments.
Mechanical and Lighting Contractors	Upgrades in associated systems	Beyond maintenance of associated systems, these contractors will promote opportunities to change out equipment prior to the systems end of life in favor of more energy efficient solutions.
In-House Energy Engineers	Energy Costs, Demand Response	Energy engineers will seek to lower utility budget requirements and advantage themselves to associated revenue opportunities via demand response. Often serve as in-house advocates for energy efficiency investments and develop associated use cases.
IT Personnel	Mesh Networks, Cyber Security, IT Solutions	Building automation may provide a point of vulnerability for computer networks and access to critical environmental controls. Complex IOT systems will require additional layers of security constraints to ensure vulnerabilities are not introduced that provide a gateway to other critical systems: process controls, environmental controls, security systems, computer networks, etc.

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set of property owners. Outside of Real Estate Investment Trusts (REITs), large buildings carry a valuation that would severely limit the pool of buyers.

These buyers will be aware of the associated liabilities needed to align the building with updated building performance standards. As such, exiting a property of significant valuation would need to be well-timed and priced efficiently to allow the new property owners enough capital to modernize the building. The longer the exit takes, the risk of the building's devaluation grows. In some instances, the best option for the owner might be to allow the property to lag in environmental standards, allow its value to depreciate, and allow decades to pass before allowing the property to sell at auction or transfer to the state or municipality.

There are alternatives for the owner. The holder of the property could make substantive investments to either bring the aged properties up to modern building performance standards or seek exceptions from the governing authorities. In the case of the latter, there is a risk that governing authorities will later overturn any exemptions that has been previously granted. As a result, holders of properties that lag building performance must be diligent in their choices. When opportunities arise to update the building systems or exterior upgrades, building operators can mitigate these risks by considering the building as a whole system and choosing the most energy efficient equipment available in the market.

Still, the greatest risk is that the building simply becomes incompatible with available systems when the owner/operators seek to modernize the building systems. Without viable options to modernize the property, its valuation will plummet until the price attracts a new owner willing to massively transform the property to bring it up to building performance standards.

In all cases, the simple deferral of investments will lead to the eventual abandonment of buildings to governments, who are often free from the strict compliance standards and have the authority to deem acquired properties historic sites to be maintained in its current configuration.

Luckily for the owners of such buildings, it is likely that generations will pass before mandatory compliance or property forfeiture ensues, providing leaseholders viable tenancy through the enforceable period of the Paris Climate Agreement. Owners still risk losing rental premiums over this extended duration, which will devalue the property over time.

INCREMENTAL UPGRADES

Most properties will see incremental upgrades to building systems, its exterior, as well as the equipment used by its occupants as a natural course of continued maintenance. The exact upgrades will be determined by the property managers, the building owners, and its tenants, often in consultation with the other actors highlighted in Table 1. Typical of these incremental upgrades are lighting vendors, who often self-finance the installation of LEDs on targeted common area lighting. There are also government-sponsored incentives and green financing for variable speed drives, systems commissioning, and other energy improvements to update facility reserve funds.

If existing buildings are to play a foundational role in climate mitigation, it is important to appreciate which decision makers/actors provide the most wholistic approach towards building renewal. This will take the property manager on a journey that often extends throughout the life of the structure. The issues therefore become: (1) how to prioritize which elements are to be addressed and the order in which these investments be made; and (2) the point within this process the market actors get called to the stage.

Existing building structures and systems have been installed or evolved to serve its current suite of leaseholders. Therefore, it is best to start with the systems that serve the common areas rather than the building structure or its design elements. If building systems are to be a starting point for building renewal, then the general use of the building and its types of occupants must remain constant.

If tenancy remains constant, then heating, ventilation, air conditioning, and refrigeration (HVAC/R) systems serve as a natural starting point. Tenant comfort and safety is directly impacted by the effectiveness of the air exchanges occurring throughout occupied space. These systems are especially important amidst concerns over COVID-19. The US House of Representatives has recently passed a stimulus bill that allocates billions of dollars to the Department of Education, which includes funding improvements

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to ventilation systems that are thought important to support in-person teaching.

These improvements to HVAC/R systems are just as important to other institutions: hospitals, office spaces, and multi-unit residential properties. Facility managers, site engineers, and/or maintenance managers work to ensure these exchanges effectively serve occupant needs. A look at their perspectives will reveal a mission to ensure existing equipment serves tenant preferences. As a result, their collective roles are largely reactive to what is communicated to them, often via secondhand reports provided through property management.

In the most simplistic of manners, no informational technology or measurement tracking is needed. The only actions required are direct observation of air flows, temperatures, and humidity taken by the property's personnel. Where simple maintenance is required, the tasks are immediately dispatched by those employed directly for that purpose. However, parts are often required, and specialized knowledge of equipment is often valued. In these cases, mechanical contractors should be brought on site to ensure the proper functioning of existing equipment. These contractors often simply reset the system configurations to original specifications and repair equipment as may be necessitated.

Ignored in this approach is a fresh look at the equipment and the underlying assumptions around which the HVAC/R equipment were originally commissioned. To provide additional control over the equipment, building automation systems have emerged to leverage interfaces provided by original equipment manufacturers. These systems use sensors, data logging, and internal controls to allow the equipment to remotely adjust equipment settings to accommodate scheduled activities, zonal conditioning, expected occupancy rates, specialized processes, intended production levels, and desired outcomes.

These systems allow both facility managers and system engineers access to raw data. Often such data logs must be downloaded manually, either via a USB key or through ethernet connections. In other cases, wireless connections allow similar access to the data. Still, the data alone are rarely of value without a custom interface that summarizes the readings and proactively notifies the managers of critical conditions. Even in this data-rich environment, the facilities management staff remains committed to satisfying tenant preferences and prioritizes the reliability of existing equipment. As such, rarely will these actors look more holistically at the building and the equipment together.

CLIMATE ACTION

To maximize energy savings and climate mitigation, new market actors often intervene. In-house energy engineers often take advantage of utility and government incentives. While this approach supports the broader market to attain sustainability goals, it does not look holistically at the energy savings potential of the property as a system. This requires looking beyond a single bank of lights, a particular set of drives, or setting back common area temperatures.

To accomplish a holistic review of building performance, energy consultants and performance contractors are typically relied upon. These market actors seek to maximize climate mitigation and energy efficiency outcomes for all buildings, and their unique perspective changes the dynamics offered to property managers. These actors seek to specify new windows, doors, update the building shell, expedite the change out of many HVAC/R equipment, promote lighting system upgrades, and recommission equipment to a newly designed building performance standard.

While this may be overwhelming at first glance, these system upgrades are simply scheduled investments with low-cost financing made available and supported by information technologies. Together these investments provide actionable insights into climate action. This becomes increasingly important when carbon mitigation is being incentivized by governments under the Paris Climate Accord.

Thoughtful IoT platform analytics are emerging to assist owners and operators of real property to benchmark building performance and to monetize the achievements of performance enhancements across the whole portfolio of real estate assets. The insights revealed by these convenient cloud-based dashboards guide clients in the allocation of capital to reduce utility costs, improve tenant comfort, and increase building valuations. Additionally, these systems can make users aware of needed building shell improvements by monitoring energy intensities, carbon footprints, and water usage.

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With artificial intelligence applications emerging to support building performance, holders of real property are no longer captive to the decades of knowledge accumulated by building operators of the embedded HVAC/R systems. In their place, an IoT dashboard of asset performance can replicate building system functionality visually, making clear the holistic interactions between building elements toward the greater ambitions of the holders of the real property.

The collection of billions of data points pulled from a portfolio of building systems inform artificial intelligence algorithms to apply industry best practices and determine when specific adjustments are needed to achieve peak building performance. SensorSuite is building upon this value proposition to gain market share as property technology (PropTech) innovator. By combining sensor and communications technologies with data analytics platforms, the company is able to maximize returns on investments for property and facility managers who seek opportunities to address building performance and climate.

IMPACT OF ELECTRIC VEHICLES

Another issue that at first appears disparate from building performance is the penetration of electric vehicles. With transportation leading fossil fuel consumption, governments have aligned to prioritize the electrification of commercial fleets and personal vehicles. Tax incentives have helped consumers act upon increased environmental awareness.

Furthermore, we see utilities and investors are realizing that battery storage is needed to facilitate the integration of distributed renewable generation. As such, we see companies such as Dominion Energy partnering with Proterra to replace 50 diesel school buses with electric buses in the State of Virginia.

The electrification of the transportation industry is underway. As a society we are moving to a point where electric vehicles will enter underserved markets, either through the sale of previously owned electric passenger cars as well as the introduction of battery-powered bikes, scooters, and skateboards.

From a building performance perspective, occupants will seek options to charge their vehicles or feed stored energy back into the electricity grid. For example, residential customers will demand charging stations be installed in private parking spaces or within a communal areas of the garage. Charging during off-peak periods allows consumers to seek to monetize battery stored in their vehicles. A logical option would be commercial properties to allow workers to feed-in electricity to offset building energy usage, perhaps with some compensation being paid. These simulations scale significantly when commercial fleets are considered as a means for facilities to offset or monetize the large battery stores contained within the personal vehicles, fleets, and fixed battery storage solutions.

Because of the increasing electricity vehicle penetration and the focus of grid operators to increase the reliability of integrated distributed renewables, building operators should not ignore electric vehicle charging solutions as a key architectural element of the property and a demand response solution in the management of electricity consumption.

CONCLUSION

As the global energy transition evolves, building performance will be critical in achieving national and regional climate mitigation commitments. Building performance will rely upon electric vehicle penetration to provide a mobile energy storage fleet to make the best use of renewable energy generation. Under very few scenarios do we see the targeted outcomes of the Climate Paris Agreement achieved by 2030 or 2050 without the adoption of advanced IoT to optimize building performance.

The question which remains for the industry is what entity is likely to emerge as the best agent for this transition of whole building performance. The complex suite of decision makers/ actors working to support real property holders means disparate metrics will slow the accomplishment of climate commitments, unless a key actor steps forward to coordinate sustainability investments across all elements impacting and processes occurring within building.

Consultations are underway as to whom is best suited to lead the adoption of emergent technologies to achieve climate commitments that will certainly challenge all organizations who hold significant portfolios of real property. Only the most disciplined market actors will find the means to consolidate the real estate industry around the global mission of minimizing the energy intensities of existing buildings.

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