Measuring What Lasts: Quantifying Persistence in Behavioral and Operational Savings

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ABSTRACT

Large commercial and industrial facilities are increasingly turning to behavioral and operational strategies to improve efficiency and reduce operating costs. Yet a key uncertainty remains: how long do these impacts truly last, and how can their persistence be quantified from a utility or grid-operator perspective?

Unlocking lasting savings is not just about technology, but about how systems are managed, maintained, and used by people. Evaluating persistence therefore requires looking beyond energy models to the behaviors and organizational structures that sustain or erode performance over time.

This paper presents the Behavioral Persistence Study conducted for the Independent Electricity System Operator's Energy Performance and Energy Manager programs. The study developed a persistence scoring system that links specific operational measures such as recommissioning schedules, control strategies, and staff engagement practices to a persistence propensity index. Rather than replacing existing effective useful life (EUL) assumptions, the index provides a structured basis for evaluating confidence in those assumptions and identifying measures that may warrant future EUL refinement as additional persistence data becomes available. These measure-level scores were derived through interviews, on-site observations, and comparison against IESO default EUL values, creating a transparent bridge between qualitative evidence and EUL assumptions.

The framework examines how control systems are maintained, how behavioral practices evolve, and which organizational factors drive long-term persistence. By pairing human insights with structured persistence metrics, the study provides a starting point for defensible, scalable method for refining EULs and strengthening portfolio planning for non-capital measures.

Results include measure-level persistence scores, persistence propensity findings, and insights showing how human factors ultimately shape the longevity of energy savings.

Introduction

The persistence of energy-saving measures is defined by their Effective Useful Life (EUL) - the average duration a measure continues to yield savings. Behavioral and O&M measures typically have shorter EULs compared to capital retrofit measures, as they are more sensitive to changes in organizational practices, equipment, and policies.

However, under certain conditions (e.g., robust maintenance plans, corporate support), the persistence of these measures may exceed their default EULs. This study will examine those factors and provide evidence to refine default EULs. The primary objectives of this study are:

- Provide recommendations for program design and measure documentation to ensure the continued persistence of behavioral and O&M measures in the commercial sector.

- Propose a high-level framework for evaluating the persistence of behavioral energy savings as a function of interactions between two key domains: properties of the measure (technology or intervention) and properties of the organizational context.

Background

IESO delivers several programs that support large commercial and industrial customers with energy efficiency at their facilities. These programs include incentives for capital projects, low- and no-cost behavioural, operation and maintenance (O&M) interventions, as well as a range of controls strategies. IESO programs relevant to this study include the following:

- Energy Performance Program (EPP): Pay-for-performance program that incentivizes energy efficiency improvements, including both O&M and equipment/building upgrades. Incentives are tied to verified energy and demand impacts, supported by robust data requirements, including multiple years of hourly interval data and billing analysis savings reports.
- Energy Manager Program (EM): IESO provides funding to companies to hire an energy manager to improve energy efficiency performance of enrolled facilities. The energy manager must demonstrate implementation of either capital or O&M measures via annual report.
- Retrofit Program: IESO's standard prescriptive and custom commercial and industrial energy efficiency program that provides incentives for a range of energy efficiency projects. Behavioural and/or operational measures could include building management systems or other controls strategies.

The study team is primarily interested in behavioural and O&M measures implemented at facilities participating in the above IESO programs. Specifically, this study aims to help IESO understand qualitative characteristics for facilities that can expect to see energy savings from implementing behavioural and O&M interventions over the years.

Understanding persistence of these measures that are so often tied to how people using and operating these facilities interact with them will help the IESO to more accurately quantify lifetime benefits of investments in these types of measures and inform future program framework planning. Insights from the interviews will help improve future program strategies and ensure continued energy savings.

While the original intent of the study was to quantify EULs more accurately, the recency of project implementation prevented this. Instead, the study focuses on more qualitative aspects of organizations and measures that indicate propensity for realizing savings year over year.

Literature Review

The Uniform Methods Project (UMP) includes an evaluation protocol (Chapter 17) specific to residential behavioural programs, where interventions are treated as discrete measures. In the commercial and industrial sectors, behavioural interventions are typically subsumed within the protocols for Strategic Energy Management (SEM) (Chapter 24), where they are not isolated as stand-alone measures. This creates a gap regarding measure-specific

assessment of persistence for behavioural and operational interventions, particularly when implemented in the commercial/industrial context and outside of formal SEM frameworks.

There is also a gap regarding *ex ante* projection of expected savings lifetimes for behavioural and operational savings implemented in such programs. Some recent work has used statistical persistence functions combined with *ex post* observations collected through participant interviews:

- Chapman *et al* (ACEEE, 2024) – SEM persistence study conducts survival analysis based on observations after 4-6 years post-implementation. Using the Kaplan-Meier estimator for survival functions, they estimated EUL for SEM measures of 8.5 year.
- Skumatz *et al* (IEPEC, 2018) – Found EULs for behavioural and social marketing programs were mostly within the range of 2.5-3.3, with results ranging between approximately 2 years and 5 years.

A limitation with this type of approach is that it still requires several years of a program being in place before a meaningful projection about future persistence can be made. It also relies on qualitative reporting by participants, who are asked directly about whether the measure is still in service. This could introduce bias insofar as respondents would be motivated by various factors (e.g. continued or future program incentives) to self-report in a positive light.

An additional limitation is that measure persistence and savings persistence are not necessarily equivalent. A participant may report that a control strategy, operating procedure, or behavioural practice remains in place, while the associated savings may diminish over time due to factors such as schedule drift, setpoint changes, overrides, or changing facility operations and personnel. Evaluating persistence requires consideration of not only whether a measure continues to exist, but also whether it continues to operate in a manner consistent with the savings it was originally designed to achieve.

The qualitative assessment framework proposed in this paper aims to complement, not replace, existing protocols and case-specific research. Just because a participant indicates they engaged in a particular behavioural or O&M measure does not necessarily mean that the volume of savings or the time period over which savings are accrued are all uniform.

This framework provides a basis for a structured, generalizable method for assigning a project or intervention a “persistence propensity score”, which could be used *ex ante* to inform program design or early forecasting of results. This assessment provides qualitative data on the nature or quality of the persistence of a particular measure, reflecting the importance of practical potential alongside technical potential of behavioural and O&M measures.

The score is not intended to directly replace measured EULs, but rather to provide an evidence-based confidence modifier where long-term persistence data are not available.

Methodology

To assess persistence propensity across behavioural and O&M measures, the study team engaged IESO EPP, EM, and Retrofit participants in in-depth interviews regarding their behavioural and O&M measures. The interviews covered the following topics:

- Confirmation and detailed description of the measure/intervention implemented at the facility (including control strategies, equipment controlled, operating procedure updates, and how the strategy operates within the facility)
- Timeline for measure implementation (i.e., when did the facility first begin the behavioural or O&M intervention)
- Current status of the intervention (including any adjustments, manual overrides, and whether the strategy is still in place)
- If the strategy is not still in place, timing of when the facility users/operators ceased the behavioural or O&M intervention
- If the strategy is still in place, potential for updates/changes to said strategy and how frequently adjustments or fine tuning is made
- Objectives for implementing behavioural and O&M measures
- Measurement of energy reduction, operational efficiency gains, or non-energy benefits (e.g., occupant comfort or usability, etc.)
- Organizational capacity, project benefits, and energy efficiency motivators

The team completed 30 interviews, encompassing 52 distinct measures. Table 1 below shows the mix of facility types and measures covered in the completed interviews. Table 2 shows the mix of measure categories covered by the interviews.

Table 1. Interview Disposition

Facility Type	Number of Interviews
Commercial Office	2
Commercial Warehouse	2
Government/Public Institution	1
Healthcare	2
Hotel/Hospitality	1
Industrial	12
Multifamily Residential	5
School (K-12)	1
University/College	4
TOTAL	30

Table 2. Measure Categories

Measure Category	Number of Data Points
Building Automation Systems (BAS)	5
Equipment Tuning & Recalibration	6
HVAC Optimization and Controls	14
Lighting Controls and Scheduling	16
Occupant Behavior/Awareness Campaigns	3
Refrigeration & Process Efficiency	6
Other	2
TOTAL	52

For each interview, the study team thematically coded interview transcripts to qualitatively analyze key takeaways on implementation motivation, how impacts are internally tracked and measured, how building users and operators engage with the behavioural or O&M strategy, how adjustments are made and why, and guidance for building users or operators. The interviews covered topics such as formalized energy reduction/sustainability plans, buy-in from building operators and users, and incorporation of energy reduction strategies into operating procedures.

Additionally, based on specific timeline-oriented questions, the study team compared the current length of strategy implementation to default EUL values used by IESO. Given that some measures have default EULs of 11 to 15 years and implementation of these strategies was relatively recent, this study could not provide meaningful data on whether default EULs are being met or not on a case-by-case basis. Instead, the study focused on qualitative aspects and practical limitations/enablers that facilities cite as essential for continuing to accrue savings from these types of projects. This included a discussion of override risk. Interviewees were also asked about how they maintain set points, schedules, or ongoing maintenance practices and were scored accordingly: never, ad hoc adjustment/maintenance, regularly scheduled maintenance, or fully automated maintenance. Respondents that indicated no or ad hoc adjustment/maintenance procedures suggest that those facilities might be less attentive to maintaining O&M practices, and potentially less likely to see energy savings through the anticipated useful life of the measure. Those that indicated regularly scheduled or fully automated adjustment/maintenance indicate higher user buy-in and interaction with the designated strategy. These interview topics informed the persistence scoring framework presented below.

Persistence Propensity Scoring Framework

At a high level, the likelihood of persistence of behavioral savings can be viewed as a function of two scorable domains: **Organizational Capacity Score and Measure Capacity**.

Research indicates that persisting savings emerge from the right alignment between an organization and a measure. Staff capacity and turnover, for example, can present a significant barrier for SEM even if opportunities exist (Chapman, *et al*). On the other hand, organizations with robust processes and management systems in place can sustain lower-potential measures, such as manual processes. This suggests a relationship that is multiplicative or threshold-based (i.e. a certain amount of one is required to sustain the other).

The proposed framework is substantiated by the qualitative findings presented in the *Results* section of this report. Measure-based properties could include energy and non-energy benefits, such as the extent to which a measure enables automation and control. Organization-based properties could include internal buy-in and organizational processes that enable consistent upkeep. A third index is not directly implied by these results but may be worth considering in generalizing the framework outside of the IESO program context: external factors that enable organizational capacity. This could include ongoing program participation and requirements, as well as regulatory influences that occur in a jurisdiction. A future application could map persistence propensity scores to EUL adjustment factors or confidence intervals around default EUL assumptions.

Organizational Capacity Score (Org. Capacity) includes the following: formalization of an energy management policy, integration of energy-related practices into standard operating procedures, and cultural buy-in for energy efficiency practices, projects, and procedures. Based on interview data, the study team assigned an organizational capacity index of 1 (low), 2

(medium), or 3 (high). For example, if an interviewee indicated participation in the IESO's SEM program and the presence of a corporate sustainability plan and energy saving practices, that organization might receive a 3 for high organizational capacity. If an interviewee indicated no formal energy policy and lack of follow-through on multiple measures, that organization might receive a 1 for low organizational capacity.

Measure Capacity Score (Meas. Capacity) includes the following: extent of benefits (energy and non-energy benefits), override risk, and frequency of fine-tuning or. Based on interview data, the study team then assigned a measure persistence index of 1 (low), 2 (medium), or 3 (high). If an interviewee indicated that their facility staff monitored set points or sequences and tracked energy saving and non-energy benefits for a measure that was rarely overridden, that measure would likely receive a 3 for a high measure capacity score.

For each measure, using the organizational capacity score (a) and measure persistence score (b), we derived a persistence propensity index (c) based on a weighted Pythagorean theorem-based formula, shown below.

$$c = \sqrt{a^2 + b^{1.5}}$$

The study opted for this scoring over other scoring formulas to limit the numerical difference between the lowest scoring measures and the highest scoring measures so that lower scoring measures would not be disproportionately discounted. Organizational capacity score carries a slightly higher weight that measure capacity. This formula is meant to illustrate the study hypothesis that organizational capacity can have a meaningful impact on reaching or exceeding measure EULs and simply represents one of many possible frameworks.

After deriving the raw scores, the study team normalized these scores to the 50th percentile score, shown in the matrix below. These percentages represent one possible quantitative way to contextualize a project's propensity for meeting or exceeding rated EULs. For example, a project at a high organizational capacity site with high measure capacity would receive a PPI score of 144%. This example is illustrative and presents one possible way to provide an early assessment on the potential for persistence for certain projects.

	Org. Cap.		
Meas. Cap.	1	2	3
1	54%	86%	121%
2	75%	100%	132%
3	95%	116%	144%

Figure 1. PPI scores normalized to 50th percentile

The persistence propensity index score is not intended to replace measured EUL values or serve as a direct predictor of savings lifetime. It could potentially serve as the basis for an EUL adjustment factor, although further analysis would be needed looking at the distribution of PPI scores over a larger population. Here, it is envisioned as a decision-support tool that provides additional context regarding the likelihood that a measure will achieve its expected useful life or more. Measures with high persistence propensity scores may demonstrate characteristics of sustained savings and could be considered candidates for future EUL extensions, while measures with lower scores may warrant scrutiny or future persistence research. In practice, the framework could be used to prioritize measures for follow-up evaluation, identify opportunities for program

intervention, and inform future discussion regarding EUL assumptions as longitudinal persistence data become available.

Results

The sections below present persistence propensity scores and qualitative findings among the projects considered in this study.

Persistence Propensity Scores

Figures 2 and 3 show the organizational capacity and measure capacity scores for the organizations and measures in this study. Under half of the interviewees indicated strong organizational capacity for energy efficiency (i.e. formal energy/sustainability policies, operational procedures that prioritize efficiency, strong culture/buy-in). Over half of all measures discussed showed high measure capacity, indicating low override risk, active monitoring/adjustment, and realized project benefits. Note that interviewees were drawn from participant populations for existing IESO programs. These organizations might have a higher organizational capacity and willingness to pursue energy efficiency measures than the general population (i.e., their participation in existing programs signals an existing interest in energy efficiency).

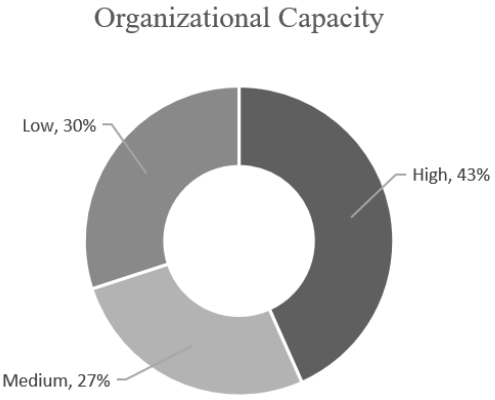

Figure 2. Organizational capacity for interviewee organizations. N=30.

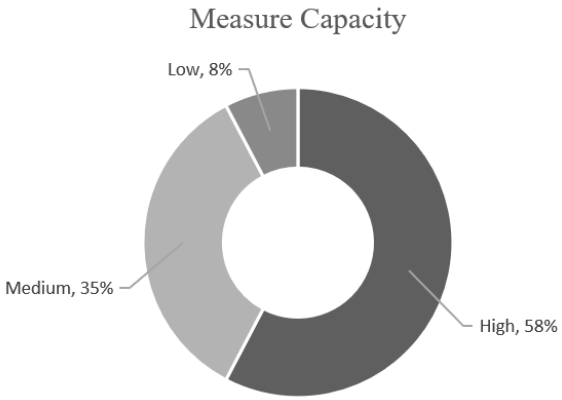

Figure 3. Measure capacity for measures discussed. N=52.

The persistence propensity index (PPI) score for each measure is derived by using the weighted formula described in the methodology above. Figure 4 below shows the frequency of each measure propensity score among the measures covered in the interviews and Figure 5 displays the frequency of projects in matrix form.

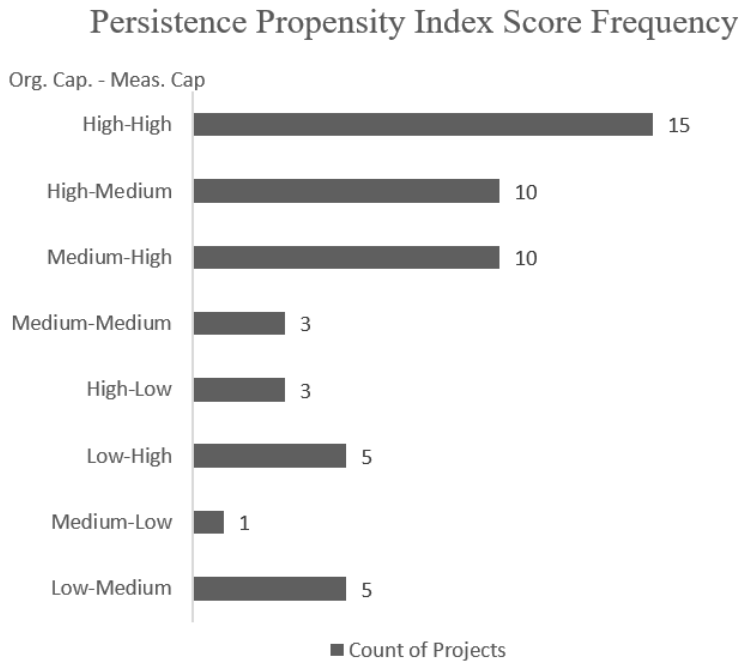

Figure 4. Persistence Propensity Score. N=52.

	Org. Cap.		
Meas. Cap.	1	2	3
1	0	1	3
2	5	3	10
3	5	10	15

Figure 5. Count of Projects for Each PPI score. N=52.

Using PPI a normalization to the 50th percentile, projects in this study were assigned percentages as scores. These percentages represent one possible framework for looking at how organizational capacity and measure capacity might be used to provide additional confidence in EULs or gain contextual insight into how programs should interact and support these organizations in order to enable them to meet or exceed rated EUL for various measures. Figure 6 shows the count of projects at each permutation of PPI score normalized to the 50th percentile.

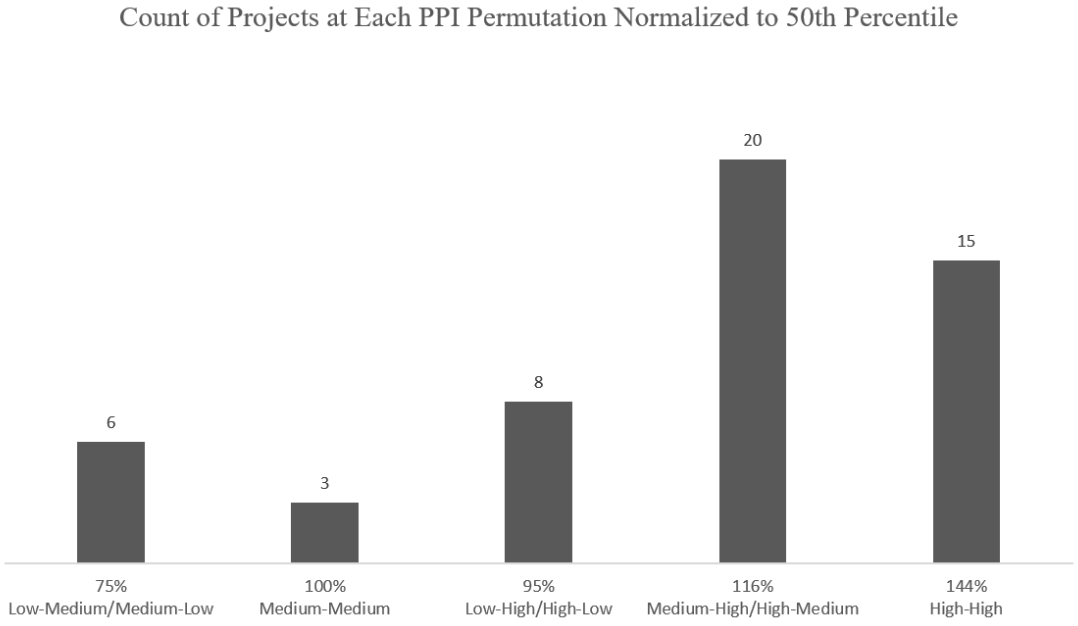

Figure 6. Count of Projects at Each PPI Score Permutation Normalized to 50th Percentile. N=52.

The majority of measures discussed in this study were measures with high persistence capacity. Of these measures, 50% were sited at facilities with high organizational capacity, 33% at medium organizational capacity, and 17% at low organizational capacity (Table 3), loosely suggesting that high-capacity measures are more frequently found at high organizational capacity sites.

Table 3. Measure Capacity Breakdown by Organizational Capacity Type

Organizational Capacity	Count of High Capacity Measures	Percent of all High Capacity Measures	Count of Medium Capacity Measures	Percent of all Medium Capacity Measures	Count of Low Capacity Measures	Percent of all Low Capacity Measures
High	15	50%	10	56%	3	75%
Medium	10	33%	3	17%	1	25%
Low	5	17%	5	28%	0	0%
TOTAL	30	-	18	-	4	-

Measure Category Results

Interviews with facility operators and managers were able to identify how long the implemented strategies have been delivering savings. In most cases, the time between strategy implementation and data collection has not approached current measure EUL. No lighting controls/scheduling measures have reached their EUL—the default value is 15 years and most of these projects were implemented more recently than that. Facilities with higher organizational capacity for energy efficiency have reached or exceeded default EULs in the following measure

categories: building automation systems, equipment tuning and recalibration, HVAC optimization and controls, occupant behaviour/awareness campaigns, and other (which mainly represents kaizen or continuous improvement strategies), shown in Table 4.

Every site operator except for one indicated that the O&M or control strategy put into place in recent years is ongoing. When asked if there was an anticipated stoppage date for the strategy, all facility operators (except one) indicated that they intended to retain the O&M measures or control strategies as long as facility operations continued. The facility that indicated that they ceased their air leakage detection and repair program indicated that, due to staff turnover, the program was discontinued, but that they are planning to restart that strategy in this next year.

Table 4. Measures Reaching Default EUL by Measure Category and Organizational Capacity

Measure Category and Organizational Capacity	Average Default EUL (years)	Count of Measures that Have Not Reached or Exceeded Default EUL	Count of Measures that Have Reached or Exceeded Default EUL	Total
Building Automation Systems (BAS)	**7.00**	**3**	**2**	**5**
High		2	2	4
Medium		1		1
Equipment Tuning & Recalibration	**2.17**	**3**	**3**	**6**
High		1	3	4
Medium		2		2
HVAC Optimization and Controls	**9.07**	**13**	**1**	**14**
High		6	1	7
Medium		5		5
Low		2		2
Lighting Controls and Scheduling	**15.00**	**17**		**17**
High		7		7
Medium		4		4
Low		6		6
Occupant Behavior/Awareness Campaigns	**1.00**		**3**	**3**
High			2	2
Medium			1	1
Refrigeration & Process Efficiency	**6.00**	**3**	**2**	**5**
High		2		2
Medium		1		1

Low			2	2
Other	**1.00**		**2**	**2**
High			2	2

Applying the PPI scores to each of these individual projects demonstrates how EULs might adjust based on organizational characteristics. Table 5 shows the average default or rated EULs for key measure categories and how those averages might be adjusted based on PPI score.

Table 5. Average Default EULs and PPI Adjustments by Measure Category

Measure Category	Average Default EUL	Potential Adjusted EUL Based on PPI Score
Building Automation Systems (BAS)	7.00	9.52
Equipment Tuning & Recalibration	2.17	2.52
HVAC Optimization and Controls	9.07	10.46
Lighting Controls and Scheduling	15.00	16.99
Occupant Behavior/Awareness Campaigns	1.00	1.21
Refrigeration & Process Efficiency	6.00	7.25
Other	1.00	1.44

Based on the organizational capacity of the projects included in this study, the IESO programs could consider a higher propensity for meeting or exceeding EULs for these O&M and behavioural measures. While this does not directly imply that all projects will exceed EULs, the PPI adjusted EUL reflects the potential for these projects to achieve or exceed EULs.

Qualitative Findings from High Persistence Propensity Scoring Organizations and Measures

Interviews with facility operators and managers detailed some key contextual information on the duration of savings from operational, maintenance, and behavioural strategies. Key findings are as follows:

O&M and behavioural measures provide energy and non-energy benefits. Facility operators are more likely to continue these strategies to realize both energy and non-energy benefits.

- For example, industrial facilities implementing air leakage detection and repair programs indicate that this practice is necessary in supporting "both energy savings and equipment reliability." Air leakage detection and repair strategies are typically ongoing in industrial facilities, and this strategy is vital for the continued operation of certain manufacturers. Production efficiency for these types of industrial facilities taking on behavioural and O&M measures is a key benefit for maintaining these practices indefinitely. One facility manager indicated, "It's just about being efficient and producing any type of product

we're making. So the more efficiency we can be or cost effective we can be in making the products…the more sustainable we are." Industrial facilities that implemented behavioural or O&M measures also indicate that specific industrial process controls not only reduce operating costs (via saving energy) but also extend time between equipment repairs and rebuilding.

- For commercial and multifamily properties, lighting and HVAC controls not only reduce operating expenses but can provide more fine-grained control to enhance customer comfort. One multifamily building manager indicated that it's "a real no-brainer to install those types of [HVAC] controls systems," and that it limits the maximum temperature an occupant can set without "freez[ing] people out." Another property manager spoke to the need to balance energy efficiency with capital spend. They said, "We will look at and are mindful of…energy efficiency and…we don't always purchase the cheapest window per se. We understand that spending a little bit more, you see that not directly in terms of…your capital spend, but you see that in building performance."
- Additionally, some commercial facilities indicated that in order to stay competitive in the market, having features like advanced lighting and HVAC controls is essential to attracting tenants. Additionally, controls strategies are increasingly allowing for fault detection, which can be a key selling point to implementing such O&M measures.
- One municipality interviewee spoke about the benefits of advanced sensor lighting controls for their LED installation in a water treatment plant. They emphasized the fact that the lighting system does not require calibration or any day-to-day effort on the part of the facilities managers, and the ability to have lights on constantly in certain zones but have sensors for other zones was key for their operations. The interviewee said, "Some of that newer technology is actually kind of neat because a lot of it doesn't turn on until you're actually walking through it. So as you're walking, the lights are coming on and you look behind you, they're shutting off."
- Colleges and universities interviewed for this study are extremely focused on making progress towards sustainability and energy goals, which increases their organizational capacity across the board. As one interviewee put it, "One of the big things for the University…is this emission reduction, and we [are] hoping to get to be carbon neutral by 2050." The colleges and universities that were interviewed had quite a few automatic behavioural and O&M measures such as advanced sensor lighting, smart thermostats, and building automation systems that allow them to manage and monitor issues centrally. They have to balance areas of a campus with vastly different energy needs. For example, a science lab may need more energy around the clock than a dining hall, which shuts down after hours. An interviewee said that, "So we can start to…hold all the buildings essentially accountable to their energy usage. We'll be doing that potentially by billing the individual occupants for their energy usage. That's just a little tricky because it's going to negatively impact facilities like science who tend to be very energy intensive." Campuses also bring unique challenges beyond building use case, including building age. A facilities manager explained this by saying, "We are, as I like to say, a building of many vintages. So, we have some very old parts of our building, and we have some really new parts of our building. And with each of that comes [unique] infrastructure when it comes to energy consumption and things like that."

Continual and consistent upkeep of set points, schedules, controls strategies, and the potential for fault detection is key to ensuring savings are persistent.

- For industrial facilities implementing air leakage detection and repair programs, a facility manager noted "you have to be more diligent and actually look for them [air leaks] because there's a lot of noise, you don't necessarily hear them…so that's where this detection program came into play." This comment indicates that for O&M measures to realize energy savings, continual upkeep is required. The need for consistency for these types of O&M measures also reflects the need for formalized policies and procedures, which help preserve institutional knowledge and maintain practices even with staff turnover.
- In commercial facilities, implementing controls strategies allows operators to gain real-time views into how equipment is functioning. Connected sensors allow for remote operation and fault detection and the ability to change set points and schedules remotely.
- When asked about savings persistence, one industrial facility manager reflected that "it just comes down to the regular ongoing reviews and upkeep of set points."
- A facilities manager at a university is asking questions in their day-to-day operations such as, "Are there more global changes we can make by changing behavior, right? As simple as changing the set point by one or two degrees, right? And then are there equipment replacements?" Their maintenance schedules reflect that kind of curiosity about their processes. Fine tuning operations in these cases reflects heightened organizational capacity for energy efficiency.
- In healthcare, some efficiency measures can be difficult to do because these facilities do not want to compromise medical equipment or lighting in any area. These interviewees mentioned a vigilance around any outages or issues, and one manager noted that "Maintenance staff reviews the lighting website monthly. They also have members of the staff that are in charge of reporting any lights that are going out or not operating as intended." In this instance, the controls strategy enables regular monitoring and adjustment to better control facility operations.

Internal buy-in from facility operators and occupants is key to seeing persistence for these types of measures.

- The majority of interviewees indicated that getting buy-in from facility operators and occupants is key to making behavioural and O&M measures persistent. One industrial facility manager indicated that "success in energy projects depends on having the right people in key positions, strong relationships between site staff and management, and leveraging available incentives for project approval." Another industrial facility manager reflected that for operational changes to continue delivering savings, making those practices as easy as possible to do creates consistent behaviour change.
- For commercial and multifamily facilities, tenant buy-in is essential for adjusting lighting and HVAC schedules and set points. One commercial facility operator indicated that overrides rarely happen for lighting controls strategies since they actively work with occupants to adjust lighting controls/scheduling to meet their needs. That responsiveness ensures comfort and energy savings. For HVAC set points, another facility operator indicated that initially implementation resulted in complaints, but when the management company responded to feedback from occupants and adjusted accordingly, complaints diminished. Another facility operator noted "The facility's maintenance team is also dedicated to daily/weekly checkups on the new lighting and HVAC systems to guarantee the clients are receiving maximum comfort and the facility is maximizing efficiency,"

indicating that buy-in from operators and interaction with occupants are essential to maintain usability and persistent energy savings.

- Some industrial interviewees developed a unique approach to fostering buy-in and excitement about energy saving measures and collaboration, called a Kaizen. As one energy manager described it, “We have something called Kaizens…which are small continuous improvement teams that are generated from the manufacturing floor. Some of our energy ideas coming from the shop floor would include heater schedules, set point changes, [and] installation of VFDs on electric motors, those types of savings are typically smaller in magnitude…A lot of little projects add up to a lot of savings and that's what we find successful here.” Company culture and buy-in take consistent effort and attention to curate, but once it is established, looking out for energy savings becomes second nature to the employees and the management. Employees have a vested interest in making process improvements that directly impact them, and when they are rewarded for contributing their thoughts and opinions, ideas for energy savings flourish. Another industrial facility that implements the Kaizen idea explained that, “If you are used to a way of doing things, change is not always an easy thing and trying to get people to go through that change process with us and being open is challenging, but we've seen improvements. One of the things we did was a Kaizen program wherein you identify an opportunity for improvement and not only when you identify it, but also when it is implemented, you get rewarded. So, we added energy savings to that also and that's has actually helped in people identifying or taking actions when they see something.”
- The cohort SEM model means that practices like this being done by one industrial facility can spread to others. Another industrial facility specifically mentioned the benefit they have gotten from the collaboration across companies in similar industries. The energy manager said that, “One thing that they did great in my opinion…is that they kept us together. I know who works in the other…plant, [but] we never…talk about improvement in anything. I would talk about the soccer game, but never about our improvement. So, [in] our cohort [we can] say hey, Johnny, can you tell us how you did those LED lights? Who did you get it from? How much [did] it cost? Can I contact you offline?” The cohort model encouraged companies who may interact in other contexts but not mention energy efficiency in their typical interactions to focus on that and share what they have learned.
- Learning from other companies can lower the barrier to entry for some of these energy efficiency measures, and show what is possible and the benefits that can be achieved. When the barrier to entry is lower, an organization’s capacity to do one of the measures increases and their propensity to continue increases. It can become a virtuous cycle of savings and lessons shared between companies. The organizational capacity, interest in energy efficiency, and capacity to do these measures all impact behavioural persistence and the likelihood of reaching the EUL or even going beyond it.
- For example, a low organizational capacity site and a high organizational capacity site who implemented the same measures may have different reasoning behind the measure and different propensities for persistence. A low organizational capacity site who did lighting control measures said that, “Well, more efficient energy usage is always appreciated for us. It's a relatively small aspect, a very insignificant aspect of our electrical costs, but more or less, we know that it’s the better way to go, so why not take it?" This outlook, combined with the lack of any formal energy policy or procedures, indicates that the company is interested in energy savings through lighting control

measures but does not necessarily have a high capacity for energy efficiency or a substantial amount of bandwidth to dedicate to persisting with upkeep of these measures over the course of 15 years, which is the EUL for lighting controls. In contrast, a high capacity site that also did lighting control measures said that, “On average, we have somewhere between 100 and 140 energy conservation projects on the go at any given time…I can tell you that in terms of generic kind of upgrades that we've had, lighting upgrades definitely have been part of the program. They were supported by the IESO controls for lighting [and that] is something that we've delved into an awful lot." This perspective indicates that energy efficiency is a key focus for the company, and that lighting controls are seen as the more “generic” upgrades, rather than the only upgrade or the most involved upgrade done by the company. They have extensive energy conservation projects going on concurrently, and that combined with the fact that they have a robust energy management plan that includes targets and reporting requirements, this company has a high capacity and has a higher propensity to persist with the lighting control measures to the 15-year EUL or beyond it.

Conclusions and Recommendations

Qualitative information from interviews with organizations that undertook behavioural and O&M measures indicates that the persistence of these types of measures cannot be viewed through a technical lens alone - both measure characteristics and organizational context inform savings accrued through the life of the measure. High organizational capacity, demonstrated through energy reduction/sustainability policies, operator and user buy-in, and participation in more holistic program offerings might prove to be a key enabler of savings over the life of a measure.

Energy and non-energy benefits also impact behavioural and O&M measure persistence. If an energy saving intervention provides business continuity, reduces operating costs, enhances comfort or usability, or results in other energy and non-energy benefits, facility operators are more likely to engage in that behavioural or O&M measure for extended periods of time, resulting in savings accrued across multiple years. These co-benefits demonstrate that these measures do not exist in isolation and could be a key driver of reaching or exceeding default EULs.

Another consideration is that EULs for behavioural and O&M measures might not be a static number. EULs for these types of interventions might be organization-specific. For example, an EUL might be adjusted downward for organizations that do not incorporate energy efficiency practices into their operating procedures. One consideration for program designers and implementers is whether EULs should be applied universally across all measures of a certain category, or if more nuanced factors should be applied depending on organizational context. One potential application of the persistence propensity framework is to inform future EUL adjustment factors. While this study does not recommend modifying existing IESO EUL values based solely on persistence propensity scores, the framework provides a structured way to assess confidence in current EUL assumptions. Measures with high scores exhibit organizational and operational characteristics associated with sustained performance and may be candidates for future EUL extensions, while lower-scoring measures may warrant additional monitoring. Future research combining persistence propensity scores with longitudinal measurement and verification data could establish whether high-scoring measures consistently achieve or exceed their expected useful lives and provide the empirical basis for defensible EUL adjustments.

Recommendations for program design include the following:

- Consider using variable or conditional EULs for behavioural and O&M measures. Factors such as organizational capacity and measure override risk should be considered when determining adjusted EULs for these types of measures.
- Assess organizational capacity factors for participants at program intake stages and throughout program participation. This qualitative data will inform conditional EULs. Verification of energy management policies, cultural buy-in, and other organizational factors can be assessed during program application stages to inform how these factors might impact EULs of any behavioural or O&M measures undertaken by the participant.
- Use organizational capacity and PPI scores to inform technical assistance and capacity-building support that programs might consider providing. This context can be used to influence program strategy to better meet customers' needs.
- On a case-by-case basis, use persistence propensity index scores to potentially adjust EULs to inform program planning, measure mix, and overall program direction/strategy. The exact values would require further validation to provide a defensible quantitative factor.
- Undertake future research to validate claims on organizational capacity. Consider interviewing the same participants (if possible) to see if EULs hold up as time progresses. This could also include metering or other M&V studies to tie qualitative/self-reported claims to actual energy savings.

Additional time for behavioural and O&M measures to run their course and metering would be required to make realistic adjustments to measure EULs. This research, however, can help program administrators assess potential for persistence using qualitative characteristics of participating organizations and projects.

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