PY2023 EM&V Key Findings and Recommendations 2021-2024 CDMF Retrofit Program

| No. | KEY FINDINGS | 2023 EM&V RECOMMENDATIONS | IMPACT | IESO RESPONSE |
|-----|--|--|--------|---|
| 1. | Lighting measures base case MAL- assumed wattages. The evaluation team compared the average verified base case wattage estimates from the impact sample projects to MAL-deemed values for PY21 through PY23. The "Average 750-watt HID lamp/ T8 HO" base measure provided sufficient samples and low precision to support a finding. The description below presents the average deemed and verified values for the "Average 750-watt HID lamp/ T8 HO" base case wattage in the PY2023 sample. The deemed base case wattage for this measure fell outside of the error bounds of the verified base case wattage estimates. The error bounds of the verified estimate for PY2021 to PY2023 rolling population and PY2023 population ranged from 0.34 kW to 0.40 kW and 0.32 kW to 0.38 kW respectively. | Recommendation 1: Consider updating the base case wattage MAL assumption for the "Average 750-watt HID lamp/ T8 HO" to better align with the evaluation verified base case wattages. | High | The IESO will review and update the base case wattage MAL assumption for "Average 750-watt HID lamp/ T8 HO", where applicable. |
| | • "Average 750-watt HID lamp/T8 HO" | | | |

- Deemed wattage: 0.63 kW
- $\circ \qquad \text{Verified wattage: 0.35 kW}$

Verified wattage precision: 8%



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2. Conservation case wattages for horticultural lighting measures. The differences between deemed and verified conservation case wattages are drivers of the low average realization rate for Lighting greenhouse measures. To obtain a comprehensive understanding, the combined results from PY2021, PY2022, and PY2023 were utilized to verify the conservation case wattages for each horticultural lighting measure. The average deemed and verified values for conservation case wattages in the PY2023 sample with the respective precision value

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 "LED Grow Lights – Vegetable Greenhouses"

(at 90% confidence) is presented below.

- Deemed Wattage: 0.54 kW
- Verified Wattage: 0.59 kW
- Verified Wattage precision: 6%

Analysis results do not include the LED grow lights - cannabis warehouses measure due to their limited sample size. The deemed conservation wattage for vegetable LED grow lights fell outside of the error bounds of the verified conservation wattage estimate. The error bounds of the verified estimate for LED grow lights-vegetable greenhouses, range from 0.57 kW to 0.64 kW. While inter-lighting LEDs exhibited a similar trend, their sample error bounds are not sufficient to support a recommendation. In PY2023, verified inter-lighting LEDs conservation case measures fell within the sample error bound (i.e. wide precision bound of 23%). The evaluation team will continue to monitor and gather additional data over the coming years for the interlighting LED grow light fixtures and provide recommendations, appropriately.

Recommendation 2: It is recommended to review and consider updating the conservation case assumptions for the LED grow lights—vegetable greenhouses horticultural lighting measure to better align with verified data. High The IESO will review the conservation case assumptions for the LED Grow Lights – Vegetable Greenhouses measure and update, where required.



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3. An opportunity exists to increase uptake and savings by deepening relationships with key sectors interested in non-lighting equipment. IESO staff explained that they were working to develop direct relationships with relevant organizations associated within the various business sectors eligible for the program. IESO staff, delivery vendors, and applicant representatives and contractors suggested that the commercial and industrial sectors (11 applicant representatives and contractors; one delivery vendor) and multifamily residential sectors (five applicant representatives and contractors; one delivery vendor) would be most interested in non-lighting equipment. In addition, four applicant representatives mentioned the food/agricultural sector and the municipal sectors. Applicant representatives and contractors thought the commercial/industrial and multifamily residential sector might be most interested in HVAC upgrades (eight and four respondents, respectively), ventilation upgrades (three respondents) for the food/agricultural sector, HVAC upgrades (two respondents), and insulation (two respondents) for the municipal sector. One delivery vendor mentioned that VFDs, motors, pumps, heat pumps, cooling systems, and highly specialized, sector-

specific non-lighting equipment might be

of interest to these sectors.

Recommendation 3a: As part of these relationship-building efforts with key business sectors and associated organizations, further explore which non-lighting measures most interest them and what program participation barriers they may face.

Recommendation 3b: Analyze participation data to identify any sectorlevel participation gaps that could be addressed by targeted marketing or outreach. For example, the recent address standardization update within the Retrofit Portal may make it easier to cross-check participants against population data (e.g., sector-specific lists of hospitals, institutions, etc.) to reveal sectors that show the most uptake potential.

Recommendation 3c: Consider consumer-to-consumer outreach and marketing strategies to encourage past participants to help promote the program to their peers. An example of this may be to create an e-mail template or social media post describing the program that the participant could easily share with their networks (e.g., other businesses in their sector, sector-related organizations, other business groups). Participants could be encouraged to customize the e-mail or post to indicate which upgrades they completed, or savings achieved. Medium The IESO will continue to seek opportunities to enhance marketing, outreach and deepen relationships with customers in the business sector to drive greater awareness and participation in the program, while considering program enhancements and the offerings that benefit this sector.



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4. Additional IESO-supported training as well as assistance with qualifications and certifications could make applicant representatives and contractors even better resources for participants. IESO staff and delivery vendors said contractors greatly impacted customers' decisions to install equipment, and that most contractors could adequately explain the benefits to customers. However, they noted that some could use more training and suggested specific training on equipment less familiar to contractors (i.e., heat pumps). Most participants (58%) heard about the program through a contractor or equipment vendor and indicated that the information or recommendations they received from a contractor, vendor, or supplier was an "extremely influential" or "very influential" factor on their company's decision to do the upgrades (66% for Prescriptive, 72% for Custom). Nearly one-third (31%) of applicant representatives and contractors did not receive any training. Of those that received training, only 44% said they were "completely satisfied" or "somewhat satisfied" with the program training and education. They often suggested further training on offerings associated with the program (40%) and the application process (35%), and program rules (33%). Some said they would be interested in additional qualifications, certifications, or credentials, such as IESO-specific certifications for applicant representatives (4%), energy audit training (2%), and energy modeling software packages (2%). One IESO staff member recommended a centralized market actor network to better communicate program changes and to more easily generate feedback. Similarly, another IESO staff member said further outreach to market actors in the nonlighting sector would be the most important improvement the program could make.

Recommendation 4a: Identify opportunities to support applicant representatives and contractors in pursuing additional qualifications, certifications, or credentials that may interest them (e.g., IESO-specific certifications for applicant representatives, energy audit training, or training on and/or support in purchasing energy modeling software packages).

Recommendation 4b: Consider developing a centralized market actor network to ensure contractors, distributors, suppliers, and manufacturers are well informed about the program and any changes, receive the training they may need, and facilitate quicker and easier communication. This network could be supported by an online portal where market actors, delivery vendors, and IESO are the users. The portal could serve as a repository of information that is shared, including materials from trainings and other communications. The IESO offers educational tools, resources, and training to businesses and professionals in Ontario to enhance their competencies in energy efficiency and energy management practices on the Save on Energy website. The IESO will continue to assess and identify opportunities to provide support to applicant representatives, contractors, and market actors, including additional resources and training, and centralization of such resources, information, and communications for the Retrofit program.



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5. Increased prescriptive incentives may be leading some customers to choose the Prescriptive track over the Custom track. The program experienced several significant modifications in PY2023. Two of these changes included the following: (1) shifting from a Prescriptive-only delivery model in May, when a custom track was added for lighting and nonlighting equipment; and (2) increasing incentives for non-lighting equipment through the prescriptive track in October. Most delivery vendors and IESO staff did not believe that incentive increase for prescriptive projects impacted the Custom track negatively. One delivery vendor said some customers changed their projects from Custom to Prescriptive when the Prescriptive increase occurred; they indicated that this, in turn, resulted in some projects claiming fewer savings than might have been realized through the Custom track. The Prescriptive track offering a higher incentive was mentioned by a relatively small percentage of applicant representatives and contactors (13%) and participants (13%) as a reason for participants not completing projects through the Custom track. To minimize the risk of missed savings opportunities, a delivery vendor suggested identifying ways to ensure the Prescriptive and Custom tracks were equally attractive to

Recommendation 5: Continue monitoring the balance between Prescriptive and Custom incentives such that each stream is attractive to potential participants while being costeffective. Medium The IESO will continue to monitor and regularly review and update the Prescriptive and Custom incentives to ensure that they are balanced and attractive to potential participants while being cost-effective.



customers.

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6. Additional equipment and services were suggested to help increase non-lighting applications. Nearly three-fourths of applicant representatives and contractors (69%) indicated their customers could typically install all equipment in which they displayed interest. These respondents, however, also provided numerous suggestions for additional non-lighting equipment and support services, including batteries (14%), controls and sensors (9%), solar PV (9%), hiring additional technical reviewers (5%), building automation systems (5%), and energy management systems (5%). Nearly twofifths of participants (39%) provided nonlighting equipment suggestions, including additional HVAC equipment (35%), additional types of heat pumps (14%), automation systems/controls (11%), and solar PV/wind (11%). IESO and delivery vendor staff suggested including energy audits and energy management systems (especially for industrial facilities or large commercial customers); solar; controls; and additional HVAC equipment.

Recommendation 6: Explore the feasibility of incorporating additional non-lighting Prescriptive incentives for equipment that aligns with program goals and cost-effectiveness targets. Refer to Recommendation 2a which suggests exploring which non-lighting measures would be of the most interest to business sectors with the most potential for increased uptake and savings. Medium

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The IESO will continue to explore additional opportunities to incorporate cost-effective non-lighting Prescriptive incentives for equipment upgrades into the program that align with the program's objectives.



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Medium

- 7. In Suite Temperature Controls (ISTC) deemed assumptions and delivery. During the PY2023 evaluation, nine out of the 27 ISTC projects were evaluated. Only one evaluated project had electric space heating and cooling, as required by the measure eligibility criteria. Six projects had electric space heating without cooling, and two projects had electric space cooling with gas heating. Additionally, ISTC measure assumptions provide energy and demand savings for each thermostat or ISTC installed controlling the entire conditioned space heating and cooling load. However, in the evaluated applications with only space heating, an average of 2.4 thermostats were installed per multi-residential unit, and in applications with only space cooling, an average of 1.2 thermostats were installed per multi-residential unit. Note: a recommendation to ensure delivery agents and technical reviewers are aware of measure eligibility criteria and program rules was included in the PY2022 evaluation. In response to the recommendation in PY2022, this has been addressed with vendors, and they have been informed to enforce the measure
- 8. Variable Speed Drive and Variable Displacement Compressed Air Prescriptive Energy and Demand Savings. The MSS for these measures state "Variable Displacement savings is assumed to be 80% of the VSD Compressor." However, the Prescriptive energy and demand savings table shows VSD Compressor savings to be 80% of the Variable Displacement compressor savings.

eligibility criteria.

Recommendation 7: Consider limiting the available participant incentive to one programmable thermostat and/or occupancy sensor per multi-residential unit. The IESO will review and consider limiting the number of programmable thermostats and/or occupancy sensors to building owners/operators of qualified multi-unit residential buildings, where the incented thermostats and/or occupancy sensors are controlling the same space and do not result in additional energy savings.

Recommendation 8: Consider updating the Prescriptive energy and demand savings of the Compressed Air VD/VSD measures to correct for the error, so VD Compressor savings are 80% of VSD Compressor savings, as intended.

Medium

The IESO will update the Prescriptive energy and demand savings of the Compressed Air VD/VSD measures, such that the VD Compressor savings are 80% of the VSD Compressor savings.



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- 9. The current equipment offerings generally meet the needs of most greenhouse customers, though some suggestions were provided for consideration. Suggestions for additional energy-efficient equipment to consider including in the Greenhouse Stream varied and included offering broader types of DER measures (one IESO staff member), adding programmable light fixtures with customizable color rendering (one IESO staff member), expanding the lighting offerings beyond the Design Lights Consortium's (DLC) greenhouse qualified products list (one IESO staff member), expanding the solar panels with battery storage offering to more areas in the province (one delivery vendor and one surveyed participant), cogeneration (one IESO staff member and one surveyed participant), sand batteries (one surveyed participant), and including a solar-only offering for customers who cannot afford or do not want to install the battery component (one delivery vendor).
- 10. A hesitancy to adopt new equipment among greenhouse customers is likely impacting program participation. Two IESO staff member reported that many growers are risk averse and hesitant to adopt new equipment even if they know it will save them energy given concerns about the potential for negative impacts that new equipment may have on their produce in terms of color, taste, or texture. One IESO staff member noted that the related manufacturers have done a lot of their own testing to prove that different lighting offerings would not have a negative impact on a variety of produce.

Recommendation 9a: Explore the feasibility of incentivizing additional equipment recommended by interviewees and survey respondents (e.g., broader DER measures, programmable light fixtures with customizable color rendering, sand batteries).

Recommendation 9b: Explore the feasibility of expanding the solar panel with battery storage offering to other areas in Ontario that are experiencing or may soon experience grid constraint.

Recommendation 9c: Conduct additional research around grower interest in adding a solar-only offering alongside the Greenhouse Stream's current solar panel with battery storage offering.

Recommendation 10: Increase educational efforts around current program offerings to ease customer hesitancy around trying new equipment. For example, this may include working with manufacturers to communicate the results of the lighting demonstrations they have conducted on a variety of produce or expanding the catalogue of case studies to include greenhouse participants who grow different product types. Medium The IESO will continue to explore the feasibility of introducing additional costeffective measures to the program, including the expansion of regional measures to other areas of the province where beneficial to address grid constraints.

Medium

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The IESO is considering case studies with a variety of greenhouse participants to elevate the benefits of LED lighting in several sub-sectors and provide greater education on lighting technologies to inform customers and ease hesitancy with adopting energyefficiency technologies.



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Low

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11. Horticultural lighting measures annual HOU. The deemed annual HOU for horticultural lighting measures in the Measure Substantiation Sheets are inconsistent with the deemed annual HOU observed in the Greenhouse Advanced Lighting Control measure. For instance, deemed HOU for horticultural interlighting is assumed to be 5,327 hours, while the deemed HOU in the greenhouse advanced lighting control measure assumptions is assumed to be 2,848 hours for lights serving tomatoes, 3,339 hours for lights serving peppers and 2,784 hours

for lights serving cucumbers.

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Recommendation 11a: Consider updating horticultural lighting measures annual HOU to be consistent with other greenhouse lighting measures to ensure consistency.

Recommendation 11b: Review and consider updating the prescriptive application worksheet to a quasiprescriptive approach in which the participant is asked to input the crop type served by the lighting as well as the conservation case wattage into the application. This would allow for a more accurate determination of the appropriate annual HOU for projects with varying crop types, and thereby increase the likelihood that the deemed energy savings will more accurately represent actual realized energy savings. Medium The IESO will review and consider updates to horticultural lighting measures for the annual HOU to align with other greenhouse lighting measures and enable more accurate savings, where appropriate.

12. Photon flux baseline assumptions. The current LED grow lights baseline uses a 1,000-watt high-pressure sodium (HPS) fixture for the LED grow lights in vegetable greenhouses. Studies indicate that the photon flux of an HPS fixture can be approximated to be 1.3 to 1.7 times its wattage, resulting in an expected baseline photon flux of 1,300 to 1,700 µmol/s. However, the verified photon flux for the conservation case fixtures is approximately 2,700 µmol/s. This discrepancy indicates that facilities are installing fixtures that are able to provide more lighting output than needed through an HPS. This also further explain the higher verified conservation case wattage as discussed in Finding 2. The photon flux should remain consistent between the baseline and conservation case lighting.

Recommendation 12a: Review and consider updating the algorithm used to calculate the baseline photon flux based on fixture wattage. The combined results of EM&V from multiple years can be utilized to determine the appropriate calculation methodology, as they involve the collection and analysis of actual data during the evaluation of horticultural measures.

Recommendation 12b: Review and consider updating the prescriptive application worksheet to a quasiprescriptive approach in which the participant is asked to input the photon flux (umol/s) and conservation case wattage into the application. This would allow for a more thorough and accurate review of the correlation between photon flux and fixture wattage and adjust the algorithm used to calculate the baseline photon flux as suggested above. The IESO will review and consider updates to the calculation for the baseline photon flux for horticultural measures.

