MAY 14, 2024

Battery Energy Storage System Safety for Greenhouses

Presentations by: IESO, University of Windsor, Save on Energy, Energy Storage Canada, Electrical Safety Authority, Underwriters Laboratories, Ontario Ministry of Economic Development, Job Creation & Trade

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SAVE ON ENERGY POWER WHAT'S NEXT

Agenda

- Regional Planning in Southwest Ontario
- Grid Innovation Study Findings
- Save on Energy Distributed Energy Resources Incentives
- Safety Considerations for BESS
- Safety Codes and Standards for BESS
- Safety Regulations for BESS
- Behind-the-Meter Energy Storage Case Studies in Ontario

Poll

Show of hands:

Who has cell phones or laptops in their homes or workplaces?

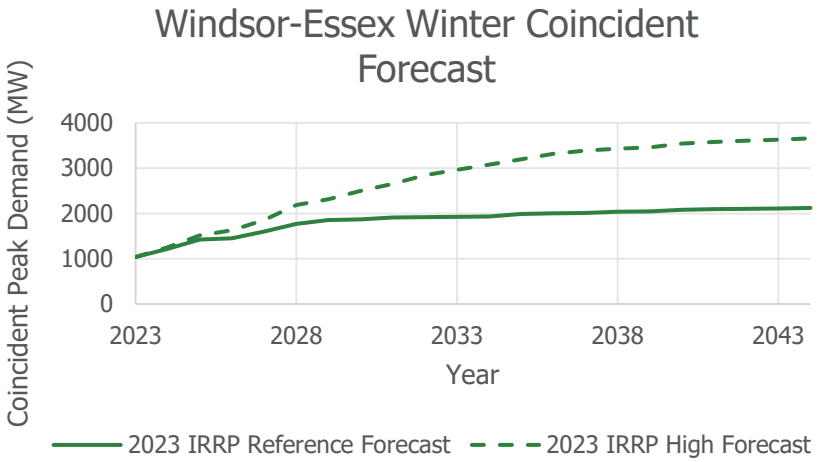
Who has electric vehicles or battery storage at home or on-site?

IESO Regional Planning
Southwest Ontario

Candida D'Costa, Sr. Transmission Planning Engineer
Transmission Planning, IESO

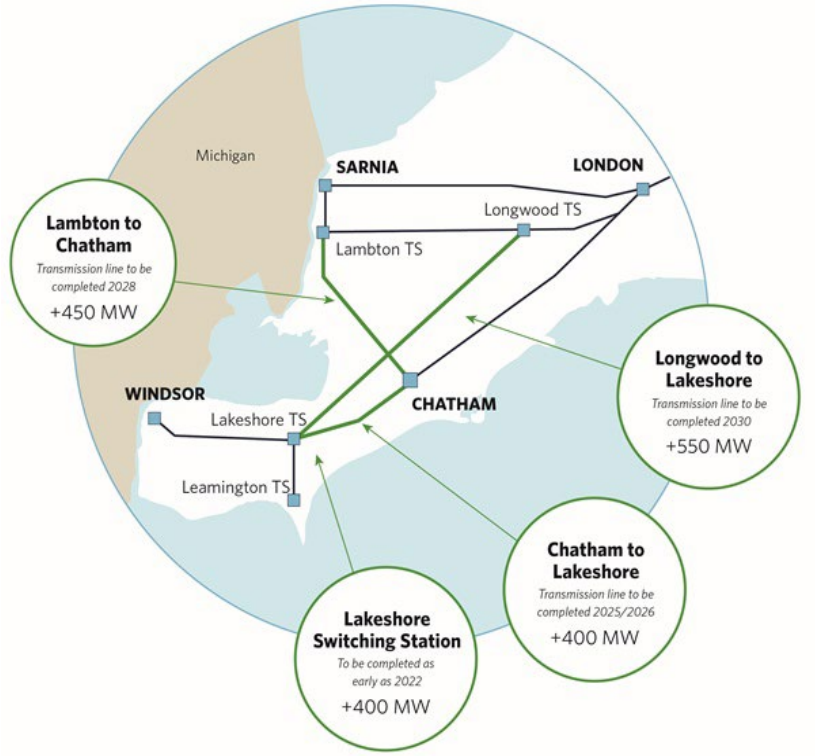
Driver for Southwest Ontario Bulk and Regional Planning

- Electricity demand in Windsor-Essex and Chatham areas is increasing rapidly as a result of growth in the agricultural and industrial sectors
  - Vegetable greenhouse expansion, to provide year-round local produce
  - Intensification of greenhouses through of indoor lighting, and
  - Industrial economic development
- Demand in the area is expected to grow significantly



Recent planning for Southwest Ontario

- A multi-pronged approach to develop solutions that will provide 2,300 MW of additional capacity by 2035 including:
  - New switching station in the Municipality of Lakeshore – in service April 2022
  - Three new sets of transmission lines to be in service by 2025, 2028 and 2030 (Chatham to Lakeshore, Lambton to Chatham and Longwood to Lakeshore)
  - Targeted energy-efficiency programs and innovative projects
  - Local generation resources



Innovative solutions in Windsor-Essex

- $1.1M+ invested to test energy-efficient measures in greenhouses including low intensity LEDs and Artificial Intelligence
- In collaboration with the Ontario Energy Board (OEB), the IESO is testing a near real-time, local electricity market to tap into local energy supplies in Leamington
- To date, the IESO has committed $65.2M in incentives to nearly 50 local growers to install LED grow lights that will result in an estimated 618 GWh in energy savings and 2.2 MW in demand savings
- Continued investment in energy efficiency with expanded programs, including incentives to install LED lighting, advanced controls or behind-the-meter resources

High-Level Learnings from an IESO Grid Innovation Fund Project

DER Design Considerations for the Ontario Greenhouse Sector

Rupp Carriveau, Director of Environmental Energy Institute, PhD PEng
University of Windsor

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Greenhouse DERs

Project Sponsors

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360ENERGY
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ONTARIO GREENHOUSE VEGETABLE GROWERS

UNDER SUN Acres USA INC

RISING SUN Acres EST. 1965

University of Windsor

TURBULENCE & ENERGY LAB

environmental energy institute

Greenhouse Overview

- This UWin IESO GIF Project was focused on the Detailed Load Profiling of 5 "Sector Representative" Greenhouses in Southwestern Ontario.
- These loads served as the design foundation for a variety of individual site and networked Distributed Energy Resource (DER) solutions for these operations.
- Potential DER components included Solar PV, Renewable Gas Fired Cogeneration, and Battery Energy Storage Systems.

Table #1: Five-Grower Network Overview

Greenhouse	Crop	Supplemental Lighting
1	Pepper	Unlit
2	Pepper	Unlit
3	Cucumbers & Tomatoes	HPS
4	Cucumbers & Tomatoes	HPS
5	Long English Cucumbers	HPS

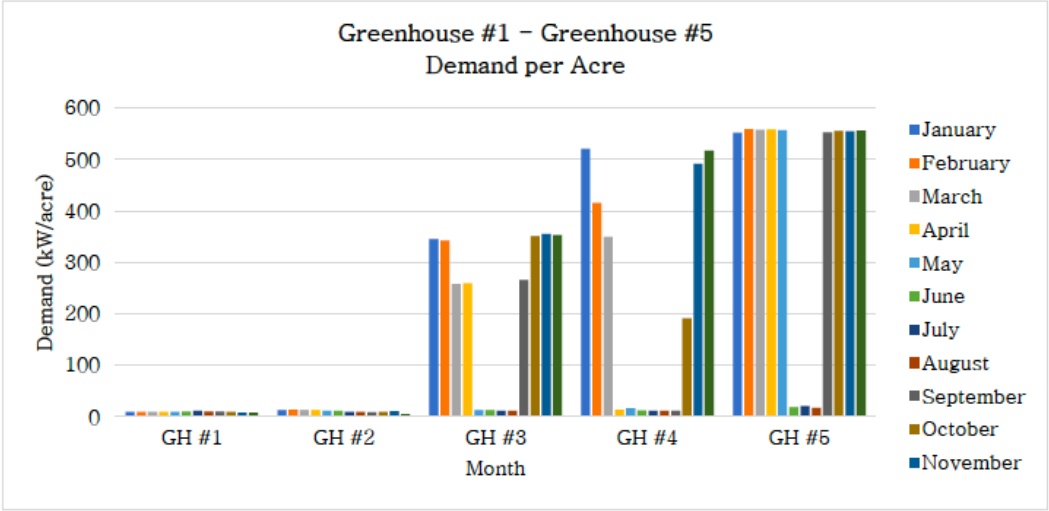


Figure #1: Demand per Acre

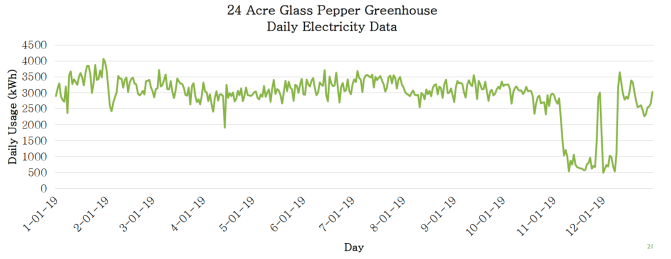
Greenhouse DERs

Process

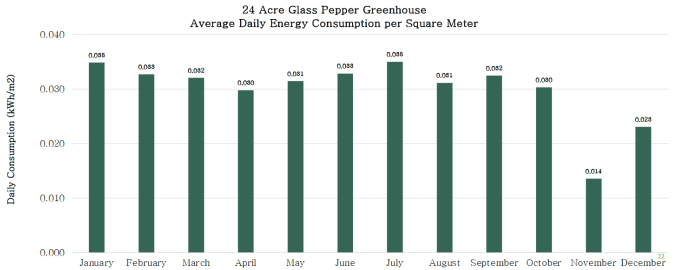
GREENHOUSE #1 ANALYSIS

1. Greenhouse Overview
   1. Greenhouse Profile
   2. Crop Cycle
2. Load Profile
   1. Overview
   2. Monthly Analysis
   3. Detailed Load Analysis
3. Electricity Billing Analysis
   1. Electricity Charges Definitions
   2. Monthly Bill Overview
   3. Breakdown of Electricity Charges
   4. Cost of Electricity
4. Projected Load Profile: Addition of Lighting
   1. Lighting Cycle and Hours
   2. Lighting Load Profile
   3. Lighting Results
5. Design of Distributed Energy Resources
   1. Design #1
   2. Design #2
   3. Design #3
   4. Design #4
   5. Design #5
6. Design Feasibility and Economic Analysis

DAILY ELECTRICITY DATA (KWH)



DAILY CONSUMPTION (KWH/M²)



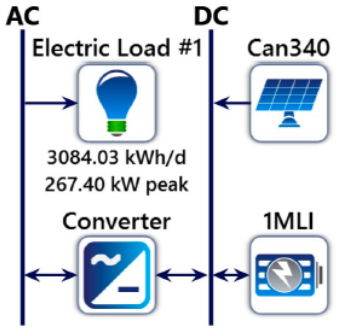
Greenhouse

Outcomes

System Architecture

Component	Name	Size	Unit
PV	Canadian Solar340CS6U-340P	1,329	kW
Storage	Generic 1MWh Li-Ion	3	strings
System converter	System Converter	338	kW
Dispatch strategy	HOMER Load Following		

Schematic



- **Photovoltaic Panels:** 1338 kW
  - 3932 Solar Panels (~13,000 m²)
  - Row Spacing: 1.16m
  - Collectors Tilt: 12°
  - Azimuth: 0° (Due South)
- **System Inverter:** 338 kW
- **Battery:** 3 MW
  - Autonomy: 18.7 hrs

Table #3: Greenhouse #1 Design Results

Greenhouse #1 Design	Project Cost	Cost of Electricity ($/kWh)	Grid Consumption (%)
#1 Photovoltaic & Battery	$3,768,938	$0.12	15.1
#2 Cogeneration & Battery (NG)	$7,642,758	$0.25	1.50
#3 Cogeneration & Battery (Biogas)	$16,317,115	$0.52	1.36
#4 Cogeneration, PV, & Battery (NG)	$7,720,234	$0.25	1.36
#5 Cogeneration, PV, & Battery (Biogas)	$16,394,870	$0.53	1.36

Distributed Energy Resources Incentive Greenhouse Sector

Vicki Gagnon, Business Advisor, Public Sector & Agriculture
Demand Side Management, IESO

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SAVE ON ENERGY POWER WHAT'S NEXT

Retrofit Program – Eligible Projects

- Projects eligible for the Retrofit Program are generally those that provide sustainable, measurable and verifiable reductions in peak electricity demand and electricity consumption
- Incentive offerings include custom rates and predefined rates for prescriptive equipment upgrades. These are based on the amount of energy or demand savings of the new equipment

What types of projects are eligible?

- LED grow lights
- Photocells and timers for lighting controls
- Dual and natural exhaust vents
- High-efficiency ventilation exhaust fans
- Recirculation ventilation fans
- HVAC equipment replacement, redesign
- Variable-speed drive installations
- Refer to SaveOnEnergy.ca/Retrofit for a complete list

Retrofit – Greenhouse Stream

- LED grow lights for vegetable greenhouses
- LED grow lights for cannabis greenhouses and warehouses
- Horticulture inter-lighting LED grow light fixtures
- Advanced lighting controls – incentive for **greenhouses: incentive rate set at $0.35/kWh**
- **Distributed Energy Resources (DERs) SW Region**

Distributed Energy Resources (DERs)

The incentive:

- **$1,435/kW** for solar PV, based on installed generation capacity of the solar PV solution; and
- **$260/kWh** for battery storage, based on installed storage capacity of the energy storage solution
- 50% of eligible project costs

DERs – Eligibility

Southwest Region – greenhouse operations in:

1. **Chatham/Lambton/Sarnia**; and
2. **Windsor/Essex region**

Facilities installing DERs must be located in the target area identified by FSA to be eligible for incentives:

Southwest region: N0P, N0R, N8H, N8M, N8N, N8P, N8R, N8S, N8T, N8V, N8W, N8X, N8Y, N9A, N9B, N9C, N9E, N9G, N9H, N9J, N9K, N9V, N9Y

DERs – Eligibility cont'd

- PV panels, **coupled with battery storage** – must be mounted on **new or existing building rooftops**
- The DER **must not inject electricity into the distribution system**, nor be entered into a net metering agreement with the local electricity distribution company for bill credits in exchange for any excess electricity that is generated and injected into the distribution system

Retrofit – Key Documents

Worksheets

Mandatory Custom Stream

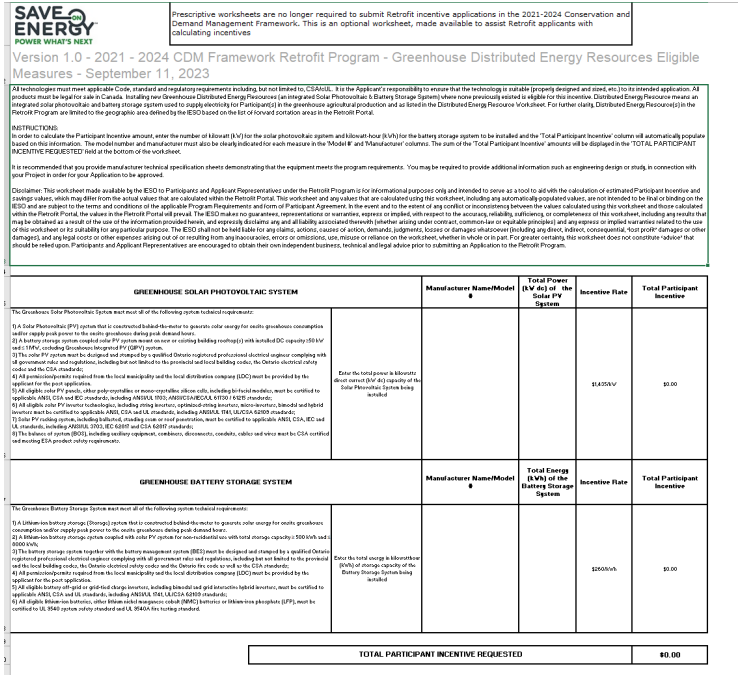
The following worksheet is required to be submitted with each custom stream Retrofit application.

- Custom Lighting / Non-Lighting Project
  Version 2.0 – July 21, 2023 | xlsx

Mandatory Southwest Region Greenhouse Solar PV and Battery DER Worksheet

The following worksheet is required to be submitted with each Retrofit application for Greenhouse Southwest region distributed energy resources solar PV and battery systems.

- Distributed Energy Resources (PV& Battery) for Southwest Region
  Version 3.0 – February 28, 2024 | xlsx



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Prescriptive worksheets are no longer required to submit Retrofit incentive applications in the 2021-2024 Conservation and Demand Management Framework. This is an optional worksheet, made available to assist Retrofit applicants with calculating incentives

Version 1.0 - 2021 - 2024 CDM Framework Retrofit Program - Greenhouse Distributed Energy Resources Eligible Measures - September 11, 2023

All technologies must meet applicable Code, standard and regulatory requirements including, but not limited to, CSA/cUL. It is the Applicant's responsibility to ensure that the technology is suitable (properly designed and sized, etc.) to its intended application. All products must be legal for sale in Canada. Installing new Greenhouse Distributed Energy Resources (an integrated Solar Photovoltaic & Battery Storage System) where none previously existed is eligible for this incentive. Distributed Energy Resource means an integrated solar photovoltaic and battery storage system used to supply electricity for Participant(s) in the greenhouse agricultural production and as listed in the Distributed Energy Resource Worksheet. For further clarity, Distributed Energy Resource(s) in the Retrofit Program are limited to the geographic area defined by the IESO based on the list of forward sortation areas in the Retrofit Portal.

INSTRUCTIONS:
In order to calculate the Participant Incentive amount, enter the number of kilowatt (kW) for the solar photovoltaic system and kilowatt-hour (kWh) for the battery storage system to be installed and the 'Total Participant Incentive' column will automatically populate based on this information. The model number and manufacturer must also be clearly indicated for each measure in the 'Model #' and 'Manufacturer' columns. The sum of the 'Total Participant Incentive' amounts will be displayed in the 'TOTAL PARTICIPANT INCENTIVE REQUESTED' field at the bottom of the worksheet.

It is recommended that you provide manufacturer technical specification sheets demonstrating that the equipment meets the program requirements. You may be required to provide additional information such as engineering design or study, in connection with your Project in order for your Application to be approved.

Disclaimer: This worksheet made available by the IESO to Participants and Applicant Representatives under the Retrofit Program is for informational purposes only and intended to serve as a tool to aid with the calculation of estimated Participant Incentive and savings values, which may differ from the actual values that are calculated within the Retrofit Portal. This worksheet and any values that are calculated using this worksheet, including any automatically populated values, are not intended to be final or binding on the IESO and are subject to the terms and conditions of the applicable Program Requirements and form of Participant Agreement. In the event and to the extent of any conflict or inconsistency between the values calculated using this worksheet and those calculated within the Retrofit Portal, the values in the Retrofit Portal will prevail. The IESO makes no guarantees, representations or warranties, express or implied, with respect to the accuracy, reliability, sufficiency, or completeness of this worksheet, including any results that may be obtained as a result of the use of the information provided herein, and expressly disclaims any and all liability associated therewith (whether arising under contract, common-law or equitable principles) and any express or implied warranties related to the use of this worksheet or its suitability for any particular purpose. The IESO shall not be held liable for any claims, actions, causes of action, demands, judgments, losses or damages whatsoever (including any direct, indirect, consequential, 'lost profit' damages or other damages), and any legal costs or other expenses arising out of or resulting from any inaccuracies, errors or omissions, use, misuse or reliance on the worksheet, whether in whole or in part. For greater certainty, this worksheet does not constitute 'advice' that should be relied upon. Participants and Applicant Representatives are encouraged to obtain their own independent business, technical and legal advice prior to submitting an Application to the Retrofit Program.

GREENHOUSE SOLAR PHOTOVOLTAIC SYSTEM		Manufacturer Name/Model #	Total Power (kW dc) of the Solar PV System	Incentive Rate	Total Participant Incentive
The Greenhouse Solar Photovoltaic System must meet all of the following system technical requirements: 1) A Solar Photovoltaic (PV) system that is constructed behind-the-meter to generate solar energy for onsite greenhouse consumption and/or supply peak power to the onsite greenhouse during peak demand hours; 2) A battery storage system coupled solar PV system sized on new or existing building rooftop(s) with installed DC capacity ≥ 50 kW and ≤ 1 MW, excluding Greenhouse Integrated PV (GIPV) system; 3) The solar PV system must be designed and stamped by a qualified Ontario registered professional electrical engineer complying with all government rules and regulations, including but not limited to the provincial and local building codes, the Ontario electrical safety codes and the CSA standards; 4) All permission/permits required from the local municipality and the local distribution company (LDC) must be provided by the applicant for the post-application; 5) All eligible solar PV panels, either poly-crystalline or mono-crystalline silicon cells, including bi-facial modules, must be certified to applicable ANSI, CSA and IEC standards, including ANSI/UL 1703, ANSI/CAN/UL/C/A 61730 / 61215 standards; 6) All eligible solar PV inverter technologies, including string inverters, optimized-string inverters, micro-inverters, bimodal and hybrid inverters must be certified to applicable ANSI, CSA and UL standards, including ANSI/UL 1741, UL/CSA 62109 standards; 7) Solar PV racking system, including ballasted, standing seam or roof penetration, must be certified to applicable ANSI, CSA, IEC and UL standards, including ANSI/UL 2703, IEC 62817 and CSA 62817 standards; 8) The balance of system (BOS), including ancillary equipment, combiners, disconnects, conduits, cables and wires must be CSA certified and meeting ESA product safety requirements.	Enter the total power in kilowatts direct current (kW dc) capacity of the Solar Photovoltaic System being installed			$1,425/kW	$0.00

GREENHOUSE BATTERY STORAGE SYSTEM		Manufacturer Name/Model #	Total Energy (kWh) of the Battery Storage System	Incentive Rate	Total Participant Incentive
The Greenhouse Battery Storage System must meet all of the following system technical requirements: 1) A Lithium-ion battery storage (Storage) system that is constructed behind-the-meter to generate solar energy for onsite greenhouse consumption and/or supply peak power to the onsite greenhouse during peak demand hours; 2) A lithium-ion battery storage system coupled with solar PV system for non-residential use with total storage capacity ≥ 500 kWh and ≤ 8000 kWh; 3) The battery storage system together with the battery management system (BMS) must be designed and stamped by a qualified Ontario registered professional electrical engineer complying with all government rules and regulations, including but not limited to the provincial and the local building codes, the Ontario electrical safety codes and the Ontario fire code as well as the CSA standards; 4) All permission/permits required from the local municipality and the local distribution company (LDC) must be provided by the applicant for the post-application; 5) All eligible battery off-grid or grid-tied charge inverters, including bimodal and grid interactive hybrid inverters, must be certified to applicable ANSI, CSA and UL standards, including ANSI/UL 1741, UL/CSA 62109 standards; 6) All eligible lithium-ion batteries, either lithium nickel manganese cobalt (NMC) batteries or lithium-iron phosphate (LFP), must be certified to UL 9540 system safety standard and UL 9540A fire testing standard.	Enter the total storage in kilowatt-hour (kWh) of storage capacity of the Battery Storage System being installed			$260/kWh	$0.00
			TOTAL PARTICIPANT INCENTIVE REQUESTED		$0.00

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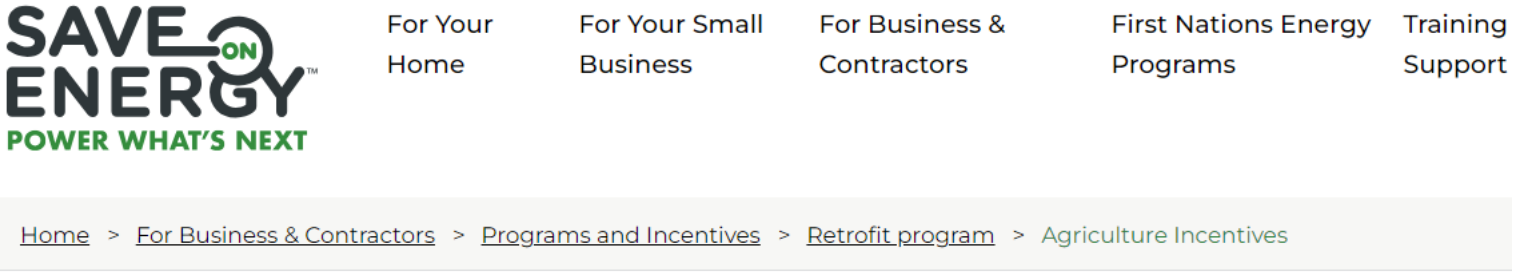
Retrofit – Support



To apply for incentives:

- use the Greenhouse worksheets in the Retrofit Program
- contact tel: 1-877-247-1095
- SouthwesternOutreach@retrofitprogram.ca

Battery Energy Storage Systems Safety Considerations

Leone King, Manager, Communications and Member Relations
Energy Storage Canada

ENERGY STORAGE CANADA

BESS Safety 101

Energy Storage Canada

Visit our website
energystoragecanada.org

About Energy Storage Canada

- Canada's national trade association for energy storage
- Non-profit organization. Founded 2016
- Nearly 100 members east to west coast
- Technology agnostic - short and long duration, all types, end-to-end supply/value chain

Why Energy Storage?

Electricity supply is changing

Demand patterns are changing

Grid operators need additional resources & tools

ESRs can increase the utility & efficiency of existing resources

ESRs offer versatility, sustainability, reliability & affordability

ESRs can help support net-zero goals & decarbonization efforts

What is Energy Storage?

Energy Storage is any technology or process that captures energy when it is not needed and stores it for later use, eventually discharging it.

Chemical
Batteries (lithium-ion, zinc, sodium, etc..)
Power-to-Clean Fuels (1-way power flow)

Mechanical
Pumped Hydro
Compressed Air / Liquids / Gases (CAES, LAES, CO2 etc..)
Flywheel
Gravity

Thermal
Steady State Materials (1-way power flow)
Phase Change Materials (1-way power flow)

Electrical
Capacitors / Supercapacitors

Industrial Process
Demand response enable by storage of commercial/industrial manufacturing and product fabrication processes. (1-way power flow)

Battery Energy Storage Systems (BESS)

- BESS is one class of energy storage technology, based at a fundamental level, on the same technology as the battery for the phone in your pocket or your laptop.
- It's classified as a type of chemical storage
- Currently, lithium-ion is the most popular battery chemistry
  - medium-to-high energy and power density
  - its rapid response
  - mature supply chain = fast commercial deployment.
- However, other battery chemistries are being developed using Zinc or Vanadium (flow batteries) for example.

Principal BESS Components

1. **Battery Management System**
   Monitors the condition & functions of the battery cells
2. **Power Conversion System**
   Allows battery to charge & discharge
3. **Energy Management System**
   Collects & analyzes energy data to manage the full system
4. **Safety Systems**
   Can include temperature control system, HVAC system, fire control system

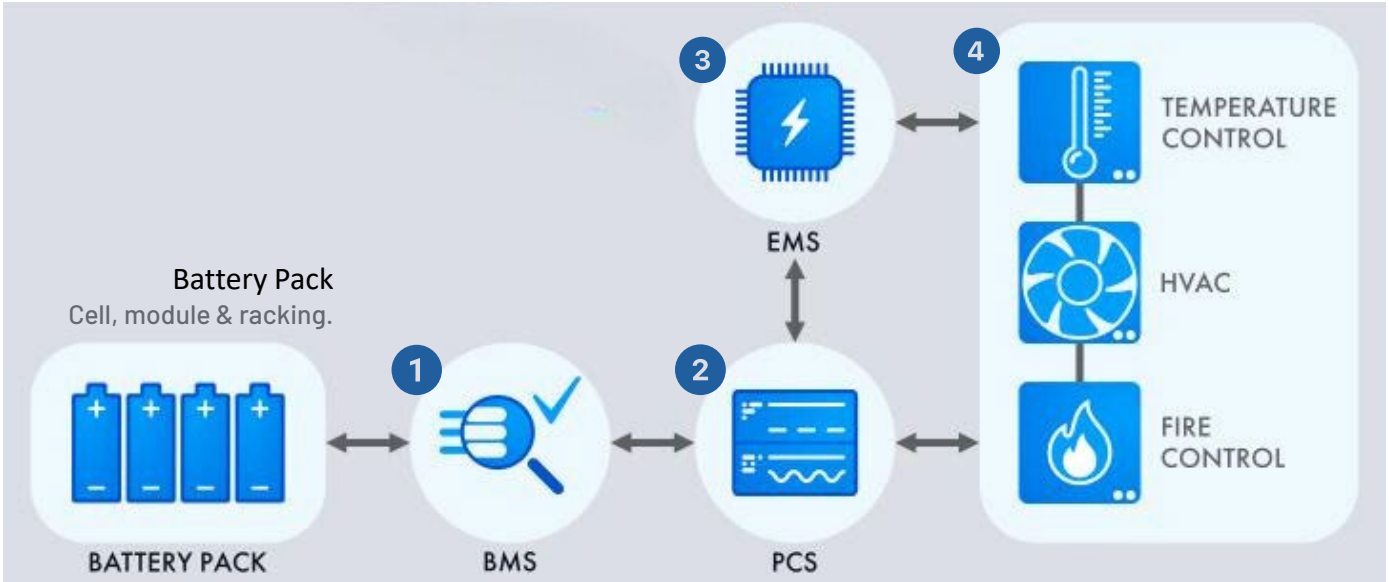


Image Credit to integrasources.com

BESS Components

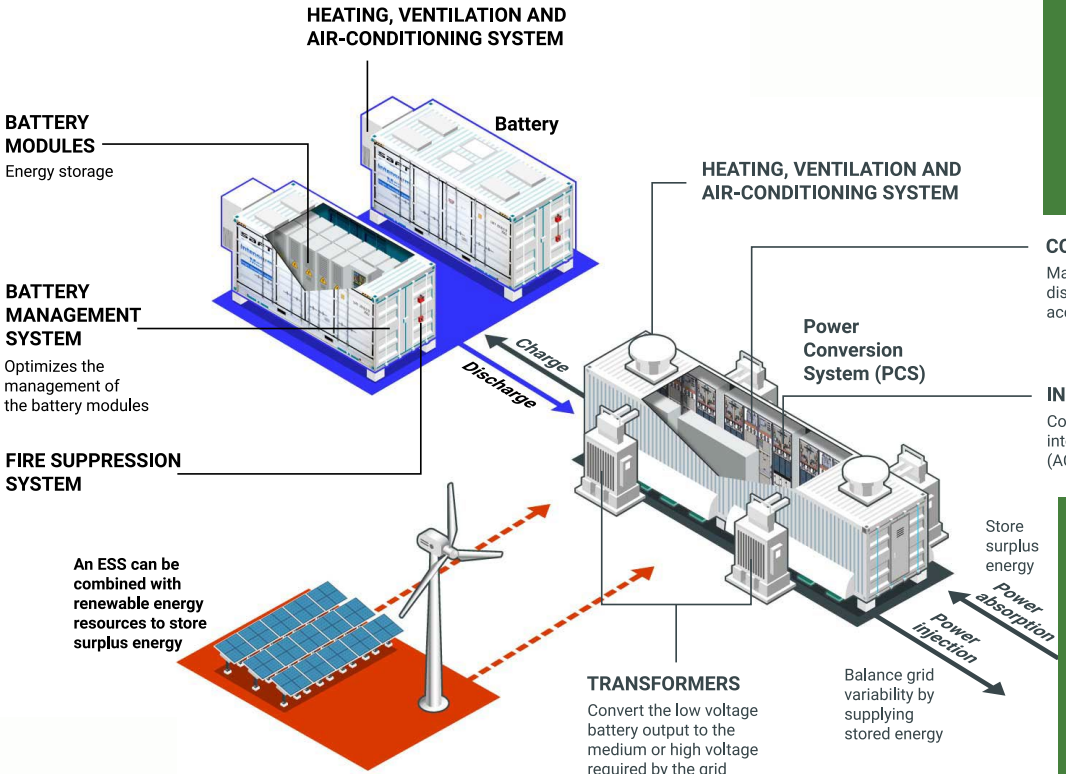


Image Credit to Total Energy - https://totalenergies.com/infographics

Benefits of BESS

BESS stores surplus electricity from non-emitting sources to be available when energy production is low or demand is high

Lower Emissions

Optimizes electricity generated, delays high-cost infrastructure, & store low-cost energy.

Reduce Costs

Fast responses to fluctuations in supply & demand. Maintains system balance.

More Reliability

Providing backup power ensures continuity of critical services.

Backup Power

BESS Fire Safety

- The safety concerns related to BESS are often as diverse as the communities where the assets are installed.
- Fire safety is one that we hear a lot but:
  - Incidents of fire (or thermal runaway) are rare & becoming rarer.
  - There are safety standards for BESS specifically related to fire detection & suppression.
  - There are numerous passive & active fire systems in each BESS installation.
  - Each installation develops an emergency response plan with local first responders.

Examples of preventative measures/systems:

Battery Management Systems (BMS) | Sparkers | Thermal Images
Electrical Protection | Ventilation | Fire Suppression Systems
Thermal Management Systems (TMS) | Remote Monitoring
Site Design | Detection Devices | Deflagration Panels
Non-Walk-in Designs | Case Clearance | Emergency Plan

What About in Canada?

Battery Energy Storage: Thermal Runaway & Fire Risk
Prepared by BBA - July 2023

Asked **four of the leading original equipment manufacturers** (OEMs) of BESS working in Canada & North America about safety procedures & mitigation strategies.

Asked to provide any incidents of thermal runaway/fire.

- Of the four, only one had encountered an incident of thermal runaway, related to an old product. No incidents for their current product.
- All four described the risk of thermal runaway as extremely low.
- Low risk in combination with the additional mitigation measures to prevent thermal runaway from becoming a fire ensures the benefits to communities far outweigh the risks.

Emergency Response Providers

- BESS owners, in addition to the previously mentioned suppression systems, must have a detailed emergency response plan for each site.
- These plans are shared with, and often developed in consultation with, emergency response providers, in a locality.
- Our communications with first responders indicate many feel well-equipped to manage an emergency response at a BESS site.
    - This includes Ontario's Association of Fire Chiefs, which last September, released a handbook for firefighters for "Solar Electricity & Battery Energy Storage Systems Safety."

Environmental Concerns

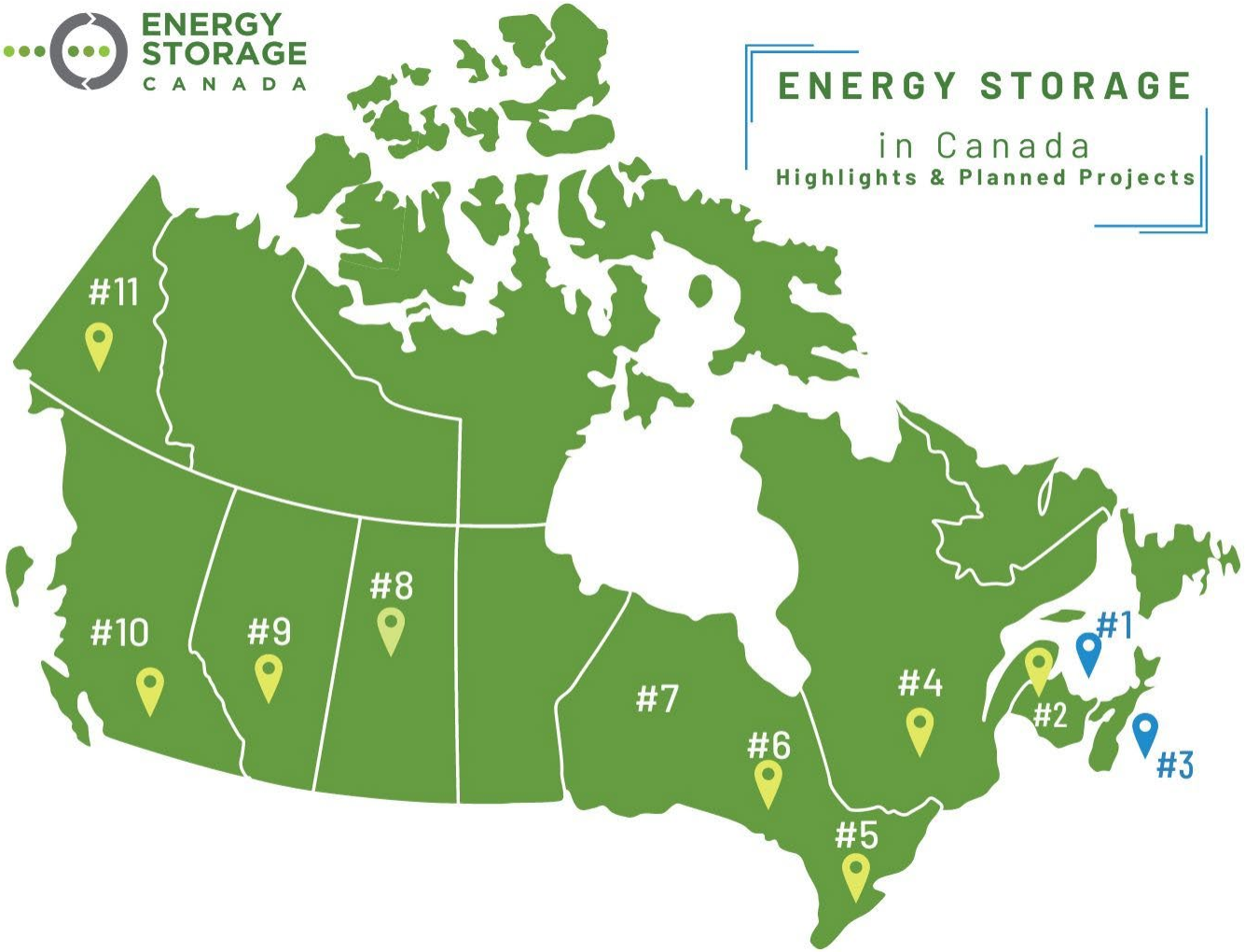
- BESS have a comparably small geographic footprint for non-emitting assets.
- They can be installed with minimal impact on the soil, housed on skids, that can be removed at the end of the asset's life cycle.
- Toxicity/toxic gases
  - Gases released in the event of a fire are not present at a significant enough level to harm.
  - Water table - safety authorities recommend not using water for BESS fires.
- Mineral waste - Recycling companies are already operating, R&D is being done, and repurposing happening.

Experts, manufacturers, and Owner/Operators **ALL** emphasize environmental risks can be minimized if not eliminated with proper planning, environmental assessments, & stakeholder engagements.

ENERGY STORAGE CANADA

ENERGY STORAGE in Canada

Highlights & Planned Projects



#1 PRINCE EDWARD ISLAND
10 MW Summerside Sunbank BESS

#2 NEW BRUNSWICK
5.8 MW - Burchill Wind Project

#3 NOVA SCOTIA
WMA Ltd/NS Power Project

#4 QUEBEC
2.5 MW - EVLO storage & solar

#5 NIAGARA FALLS
OPG 174 MW Pumped Storage

#6 ONEIDA ENERGY STORAGE
Oneida LP 250 MW Battery

#7 ONTARIO
2500 MW Procurement
(929.9 Announced to Date)

#8 SASKATCHEWAN
20 MW Utility Scale BESS

#9 ALBERTA
10 MW ENMAX Crossfield
180 MW Enfinite
10 MW TransAlta WindCharger

#10 BRITISH COLUMBIA
1 MW Summerland

#11 YUKON
40 MW Yukon Energy & Sungrid

Battery Energy Storage Systems Safety Codes and Standards

Andrew Pottier, Senior Codes and Regulatory Services Representative
UL Solutions
Underwriter Laboratories of Canada

Development of ESS rules

2021/2022

- Publication January 1, 2021
- New definitions
- New 64-918 series of rules specific to the installation of energy storage systems
- 2018 edition did not contain ESS requirements
- Seen as a burden to industry
- Working group formed in late August of 2021
- Interim ESS proposal completed, balloted and passed in November 2022

2023/2024

- Final proposal completed, balloted and passed in June 2023
  - Revised definitions for field-assembled and self-contained energy storage systems
  - 64-918 series of rules completely rewritten
  - New 64-1000 rules regarding ESS in general
  - New 64-1100 rules specific to residential installations
- Requirements based primarily on
  - ANSI/CAN/UL 9540, Ed. 3, the Standard for Energy Storage Systems and Equipment
  - NFPA 855
- Publication March 1, 2024

Canadian Electrical Code

Appendix B Note, Section 64 Definitions - Field-assembled energy storage systems

This Appendix B note provides clarity to this definition and includes additional information regarding

- The various pieces of equipment that may be incorporated in an energy storage system
- Approved energy storage systems that require assembly at the installation site
- Systems that are approved at a manufacture's facility
- Systems that are approved at an installation site

Canadian Electrical Code equipment approval

64-1002, Installation requirements of energy storage systems

1) This Rule identifies that energy storage systems utilizing batteries must be “approved”.

The term “Approved” is defined in Section 2 of the Canadian Electrical Code.

This definition states that electrical equipment used in an installation that falls with jurisdiction of the inspection department must be approved.

Approval includes certification, field evaluation, and acceptance by the inspection authority.

ANSI/CAN/UL 9540

The Standard for **Energy Storage Systems and Equipment**

These requirements cover an energy storage system (ESS) that is intended to receive and store energy in some form so that the ESS can provide electrical energy to loads or to a local area electrical power system.

Battery Energy Storage Systems Regulations Overseen by Electrical Safety Authority

Tatjana Dinic, Code Engineer
Electrical Safety Authority

Discussion topics

- Electrical Safety Authority
- Regulations that ESA oversees
- Ontario Electrical Safety Code (OESC)
  - OESC Rule 2-004 1) Notification of work
  - OESC Rule 2-010 Plans and specifications
  - OESC Rule 2-022 Sale or use of electrical equipment

Electrical Safety Authority

- The Electrical Safety Authority (the ESA) is designated by Ontario Regulation 89/99 as the responsible authority for the administration of Part VIII (ELECTRICAL SAFETY) of the Electricity Act, 1998, S.O. 1998, c.15, Sched. A. (the EA), and under the Safety and Consumer Statutes Administration Act, 1996, S.O. 1996, c.19 (the SCSAA) as a delegated administrative authority (DAA).

- As part of its mandate, the ESA's primary responsibilities include enforcement of the Electricity Act and corresponding regulations.

Regulations that ESA oversees

- The Ontario government has given ESA a mandate to improve public electrical safety. We administer Part VIII of the Electricity Act and oversee these five related regulations:

1) Ontario Electrical Safety Code (Regulation 164/99) — sets out how to do electrical work.
2) Licensing of Electrical Contractors and Master Electricians (Regulation 570/05) — sets requirements for businesses and certain people who can do electrical work.
3) Electrical Distribution Safety (Regulation 22/04) — provides objective-based electrical safety oversight and sets out the accountabilities of companies licensed to distribute electricity.

Regulations that ESA oversees

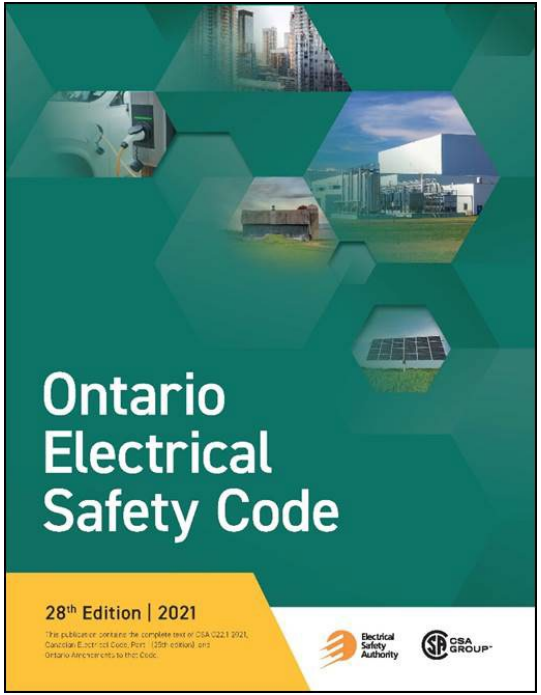
- The Ontario government has given ESA a mandate to improve public electrical safety. We administer Part VIII of the Electricity Act and oversee these five related regulations, cont.:

4) Electrical Product Safety (Regulation 438/07) — governs pre-market approval of electrical products before their sale, distribution and advertisement. We also respond to unsafe industrial and commercial electrical products already on the market. Health Canada responds to unsafe consumer electrical products.

5) Administrative Penalties (Regulation 12/23) — sets out what and how ESA can issue administrative penalties for non-compliant action(s).

Ontario Electrical Safety Code (OESC)

- The Ontario Electrical Safety Code, Ontario Regulation 164/99, is comprised of the Canadian Electrical Code Part I (CEC) together with specific Ontario Amendments. Development of the CEC Part I is led by the Canadian Standards Association (CSA).
- **Ontario Electrical Safety Code (28th edition/2021)**
  - The Ministry approved the regulatory amendment to adopt the 2021 edition of the Ontario Electrical Safety Code (OESC or "the Code"), which **came into effect May 5, 2022.**



OESC Rule 2-004 1) Notification of work

The Contractor shall:

- File a notification with the Electrical Safety Authority for any work on an electrical installation:
  - Prior to commencement of work
    - In situations where this is not practicable, a notification must be filed within 48 hours of the work being started

OESC Rule 2-010 Plans and specifications

Submission required before work commences for:

- 3ø service or stand-by generation ≥ 400 A
- 1ø service or stand-by generation ≥ 600 A
- Feeder > 1000 A
- An emergency power supply for life safety systems
- **Power-generating equipment or energy storage systems > 10 kW**
- Customer owned high voltage with some exclusions

OESC Rule 2-022 Sale or use of electrical equipment

Submission required before work commences for:

Equipment must be approved for:

- Use
- Advertisement
- Display
- Sale
- Other disposal

OESC Rule 2-022 Sale or use of electrical equipment

OESC Rule 2-022 Sale or use of electrical equipment

Recognized Field Evaluation Agency Markings

Behind-the-Meter Energy Storage Installations Case Studies in Ontario

Nick Buncic, Senior Account Executive, Advanced Manufacturing Branch
Ministry of Economic Development, Job Creation & Trade

Berry Global

Battery Storage Systems

Projects Partners:

- Berry Global, international manufacturer and marketer of plastic packaging products
- Enel North America, via its Enel X energy services division

Project Description:

- From 2018 – 2022, Enel X purchased and installed four battery systems for Berry Global at its various operations in Ontario (Belleville, Orillia, North Bay and GTA)
- Four behind-the-meter lithium-ion battery installations, totalling 5MW / 10MWh
- Enel X operates the systems, provides peak prediction services and has enrolled the batteries IESO's demand response program

A battery storage system for Berry Global in Belleville, Ont. (Courtesy Enel)

Benefits for Berry Global:

- ✓ Financial benefits of participating in IESO demand response program under Enel X (Virtual Hourly Demand Response)
- ✓ Peak-shaving to help manage Global Adjustment (GA) charges and reduce costs
- ✓ Forecasting 20% to 30% energy bill savings annually

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John Paul II Catholic Secondary School

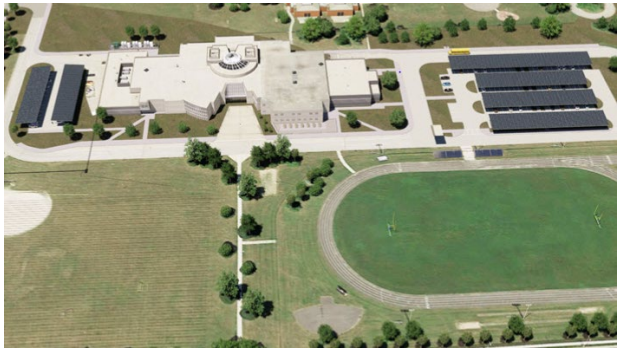
Advanced Technology Suite

Projects Partners:

- London District Catholic School Board & Ameresco Inc.

Project Description:

- Ameresco oversaw the installation of a wide variety of technologies both inside and outside school buildings, aimed at achieving net-zero. Project technologies include:
  - Advanced geothermal heating and cooling with 117,460 feet of underground and system piping
  - 2,706 solar panels as covered carports
  - Four electric vehicle charging stations (three car & one bus)
  - **1.1 MW / 2.2 MWh battery energy storage system** (participating in IESO's demand response program)
  - Microgrid
  - Integrated building controls



Benefits to the School:

- ✓ No upfront CAPEX: contracted under a 25-year Energy-as-a-Service (EaaS) agreement with Ameresco
- ✓ Stabilized energy costs and avoidance of carbon tax costs over long-term via fuel switching from gas to all-electric
- ✓ Educational: inspire and educate student population/ future workforce on technologies and zero-carbon projects
- ✓ North America's first carbon neutral retrofitted K-12 facility

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StackTeck

AI – Enabled Battery Storage System

Projects Partners:

- Brampton, ON - StackTeck is a global provider of sophisticated integrated plastic tooling solutions for the injection molding industry
- STEM Inc., California-based, AI-driven clean energy solutions and services

Project Description:

- A STEM 1 MW / 2 MWh battery energy storage system was installed at the StackTeck facility
- The BESS leverages STEM's Athena software, which predicts GA coincident peaks and autonomously directs the energy storage system to discharge the battery to reduce load sourced from the utility

A STEM battery storage system (Courtesy Utility Dive)

Benefits for StackTech:

✓ Prior to the STEM installation, StackTeck was spending roughly 60% of its facility's electric bill on charges from GA; the project resulted in more predictable monthly energy bills and dramatic savings for StackTeck

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Q&A

- Candida D'Costa, IESO Regional Planning
- Rupp Carriveau, University of Windsor
- Vicki Gagnon, Save on Energy, BESS incentives
- Leone King, Energy Storage Canada,
- Andrew Pottier, Underwriter Laboratories (UL)
- Tatjana Dinic, Electrical Safety Authority
- Nick Buncic, Ministry of Economic Development, Job Creation & Trade

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