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Solar and Batteries: Economics and Resiliency

CANADA BEST MANAGED COMPANIES
Platinum member

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Agenda

Overview of JLR Innovative Energy team

Understanding the use of PV and BESS

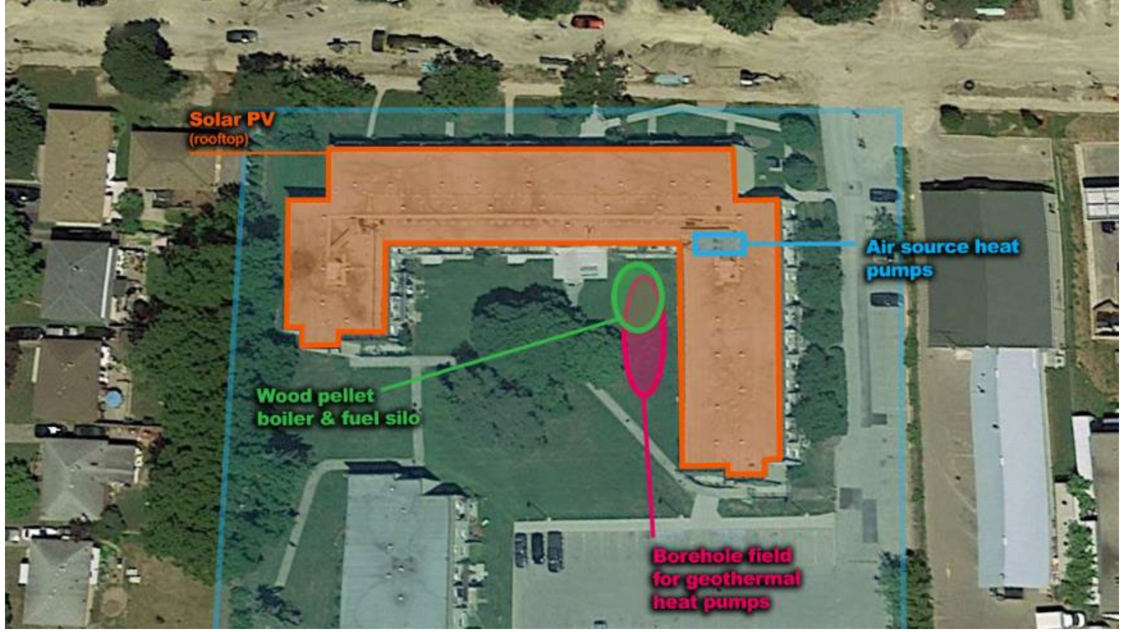
Project/Technology Examples

Discussion

Multidisciplinary **Services**

- Architecture
- Civil
- Electrical
- Energy Systems
- Environmental
- Mechanical
- Planning
- Structural

Innovative Energy



- Advisory Services - Energy Assets
- Renewable Energy Supply & Storage
- Energy & Carbon in Buildings
  - Environmental Infrastructure
  - Mining
- Energy & Carbon Strategy (portfolios, campuses)

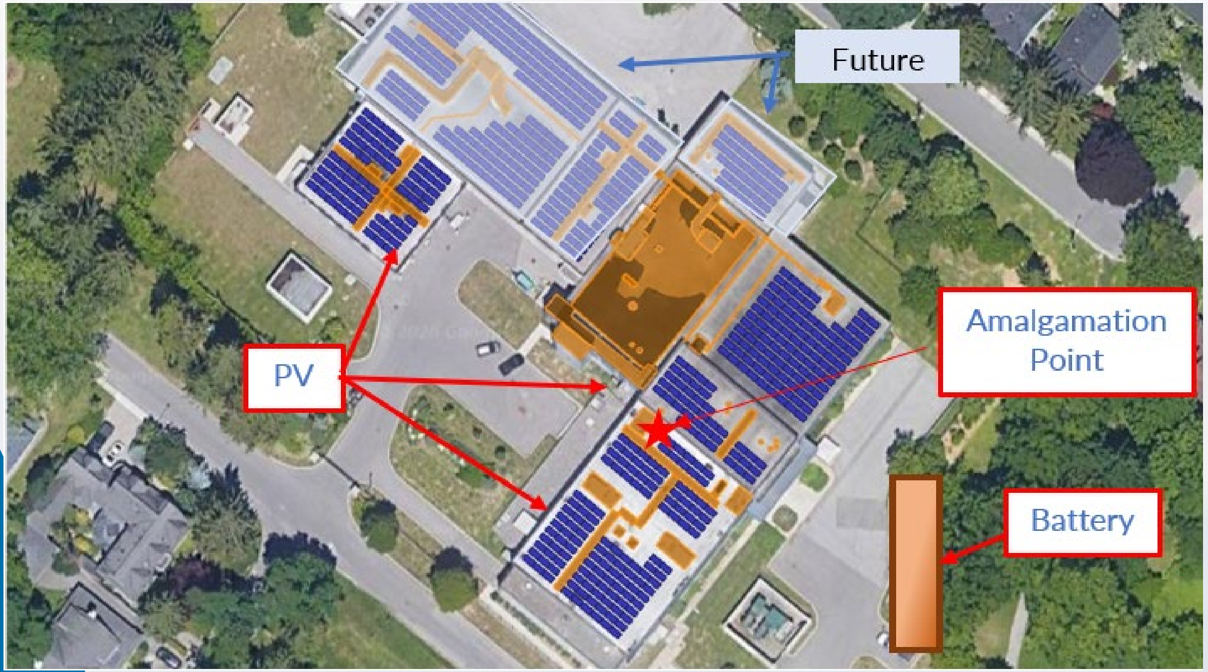
Solar and Batteries Cost Savings, GHG Reduction, and Resiliency Opportunities

Halton Oakville WTP Solar and Batteries

Feasibility study covering many Solar and Batteries scenarios

Design within WTP upgrade project (in progress)

- 116 kW PV (Phase 1), 2 MW / 2 MWh BESS for peak shaving and standby power



Electricity Rate Structures

Charge categories	Billed based on
Consumption Charges	$/kWh
Peak Demand Charges	$/kW during key times
Regulatory & Delivery Charges	Often both $/kWh and $/kW (usually small)

Often rolled up into an average or net $/kWh

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B) Monthly peak demand typically a small charge, but Ontario "Class A" has a special charge structure

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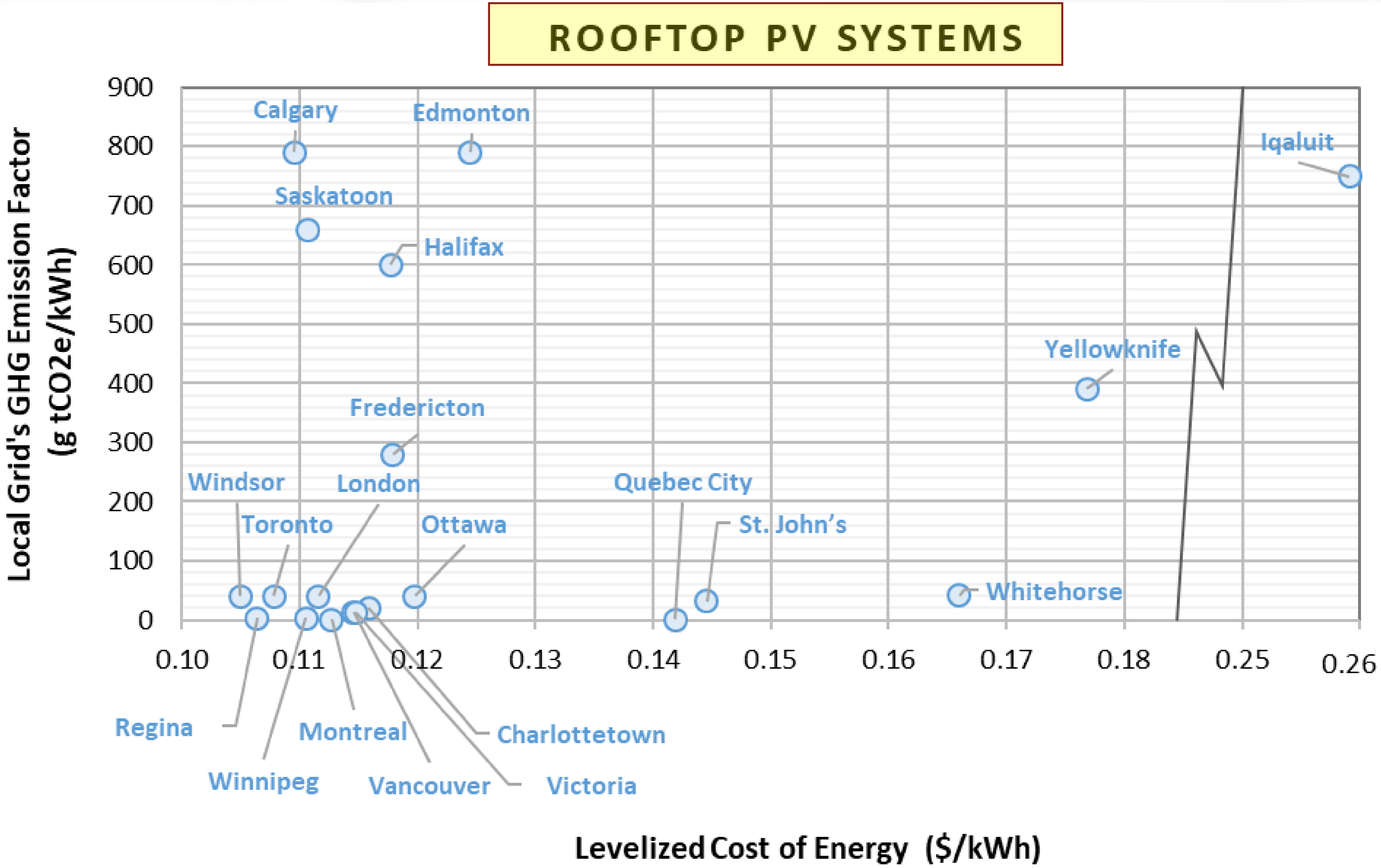
A) "kWh" Value of Solar Across Canada



- Grid competitive in nearly all jurisdictions
- GHG reductions vary significantly by province

A) “kWh” Hourly Markets – Batteries

- Energy Arbitrage (Buy low, Sell High) - better with a large delta
- JLR is currently working on 3 Utility scale solar & battery projects in **Alberta** (>60MW solar, >100 MWh Battery), that will provide services to the Alberta grid purely on a market basis
- **Ontario**’s upcoming LT1 Procurement process is looking for at least 1,500 MW of electrical storage (minimum 4-hour duration) for capacity contracts – to manage peaks.

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B) Monthly peak demand typically a small charge, but Ontario "Class A" has a special charge structure

C) Varies on hourly basis in electricity markets (Alberta, Ontario)

B) "kW" Value of Batteries
"Class A" Structure

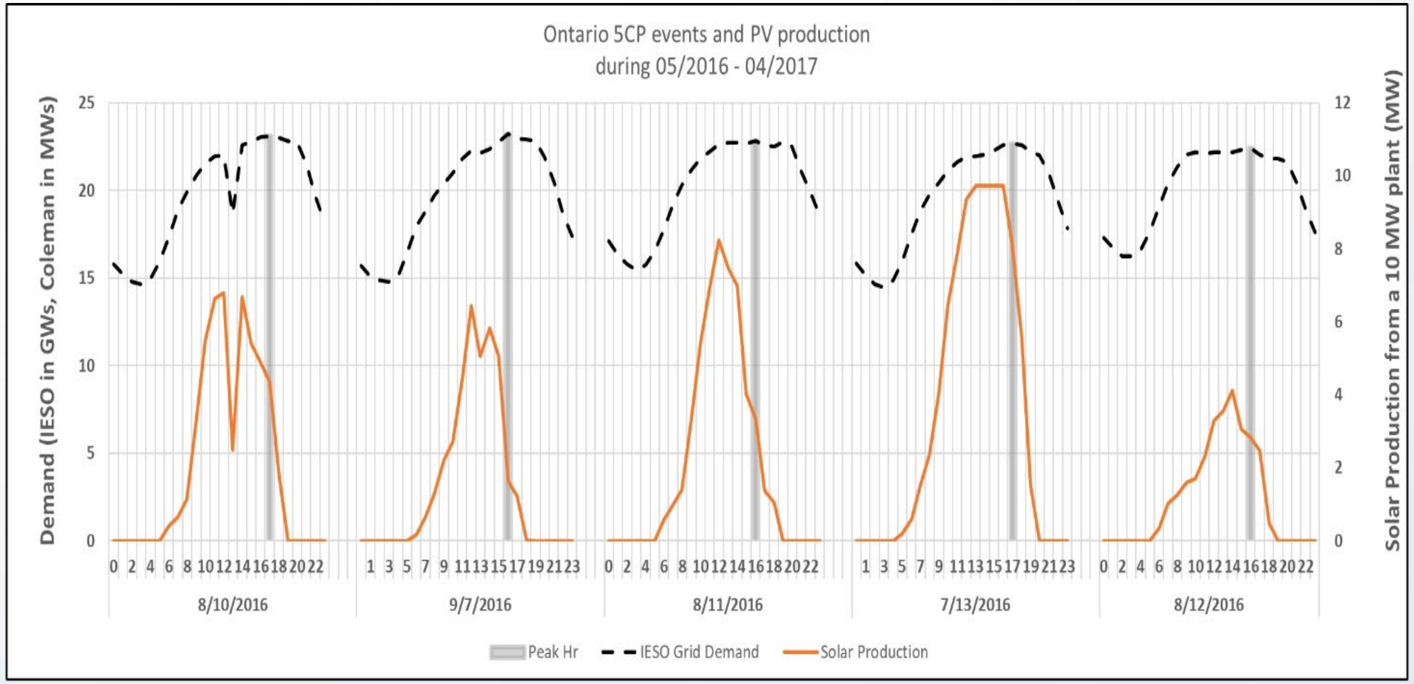
- "Class A" are "Big" users in Ontario
- Pay their "share" of Ontario's peak based on their consumption during the Province wide 5 peaks (5CP)

GA Year	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
$/kW5CP	$252	$282	$260	$393	$545	$518	$505	$549	$608	$527	$339	?

It had been rising over the years

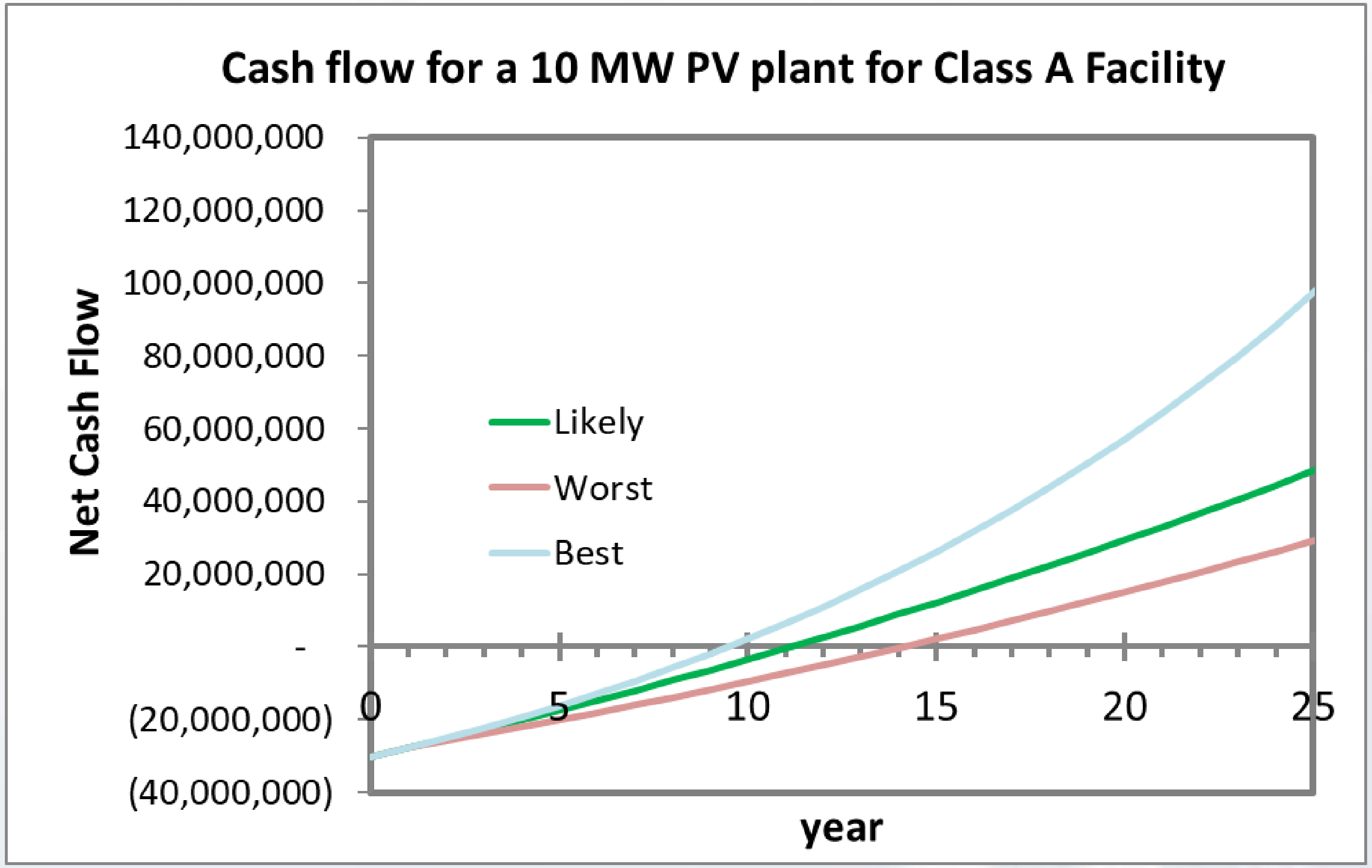
the Ontario gov't transferred non-hydro renewables out of the GA bucket, and COVID-19 also caused some anomalies

B) "kW" Value of Solar
"Class A" Structure



- Strong correlation between Ontario grid peaks and solar
- JLR's detailed analysis of historic hourly data finds that <u>up to 50% of PV</u> nameplate is available (on average)
- This is worth a lot for the Class A rate structure

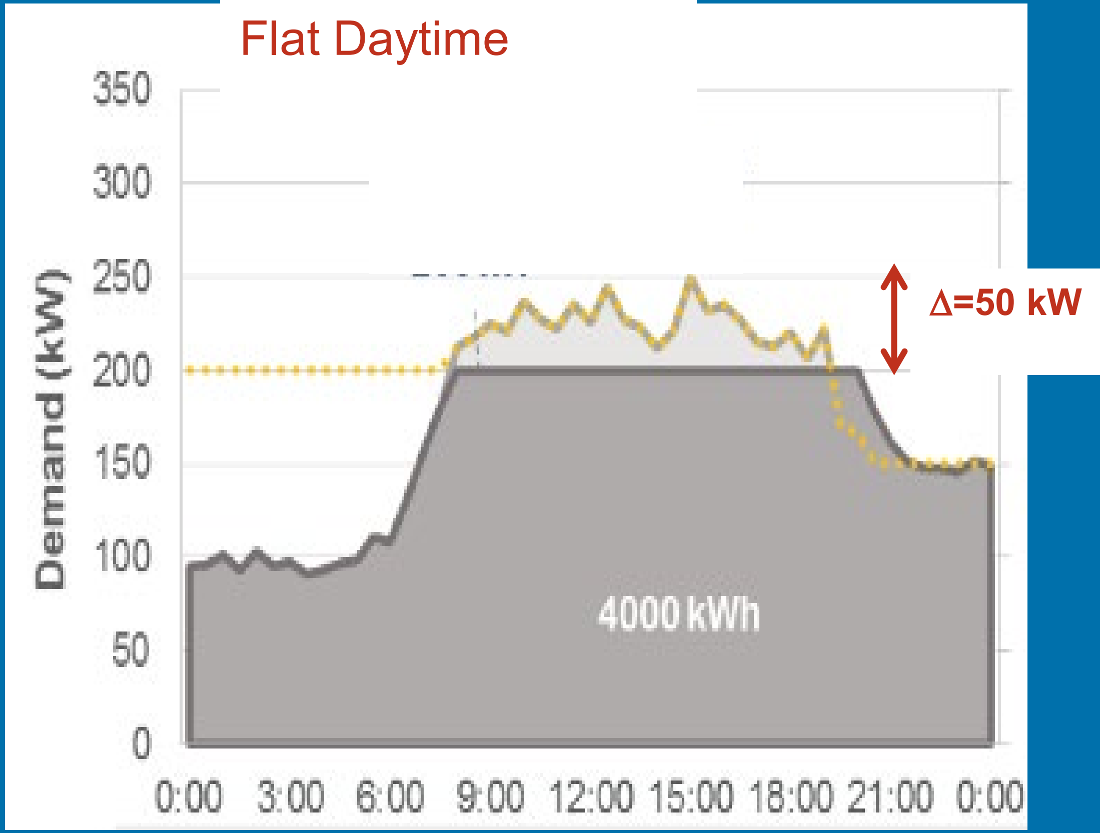
B) "kW" Value of Solar
"Class A" Structure

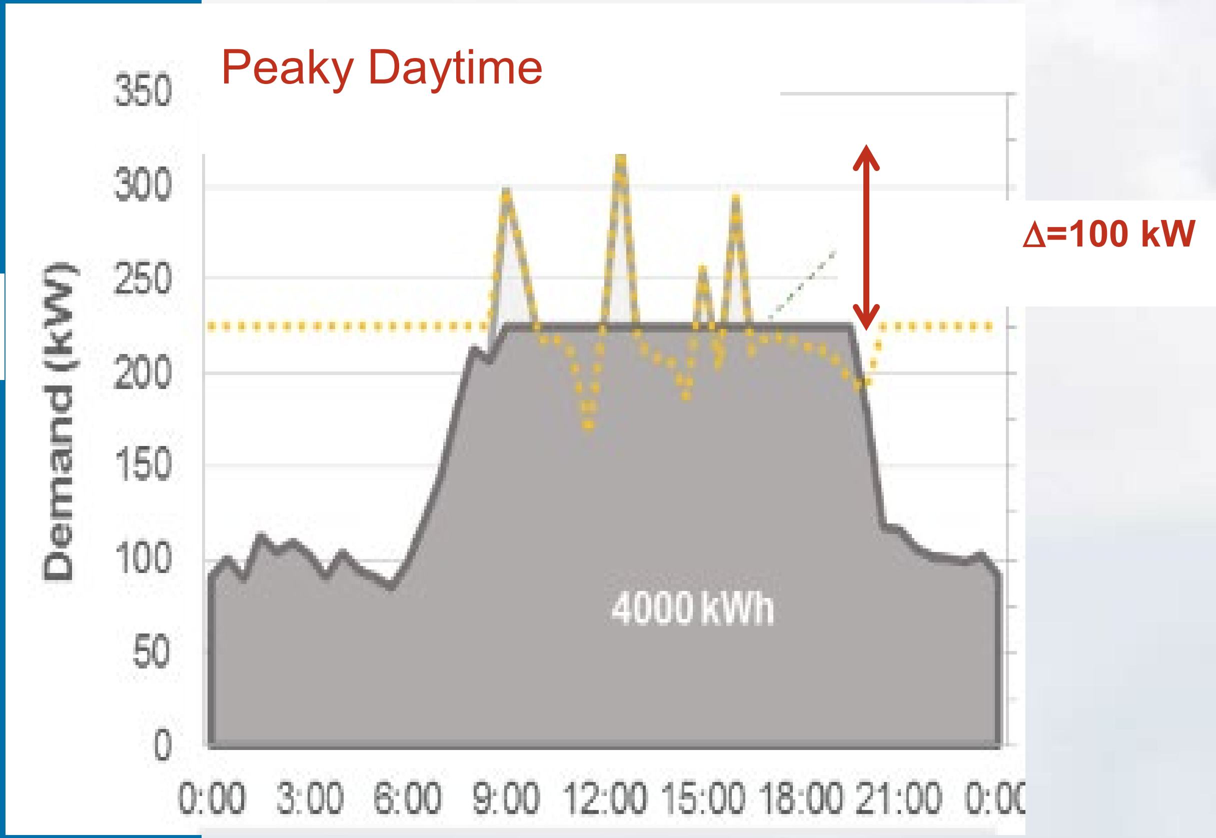


Additional benefits

- provides coverage throughout the day
- If GA value ↓ then hourly market prices (HOEP) ↑
- Visible to public, additional use of rooftops
- GHG reductions

B) "kW" Value of Batteries
Most Others (*"non-Class A"*)

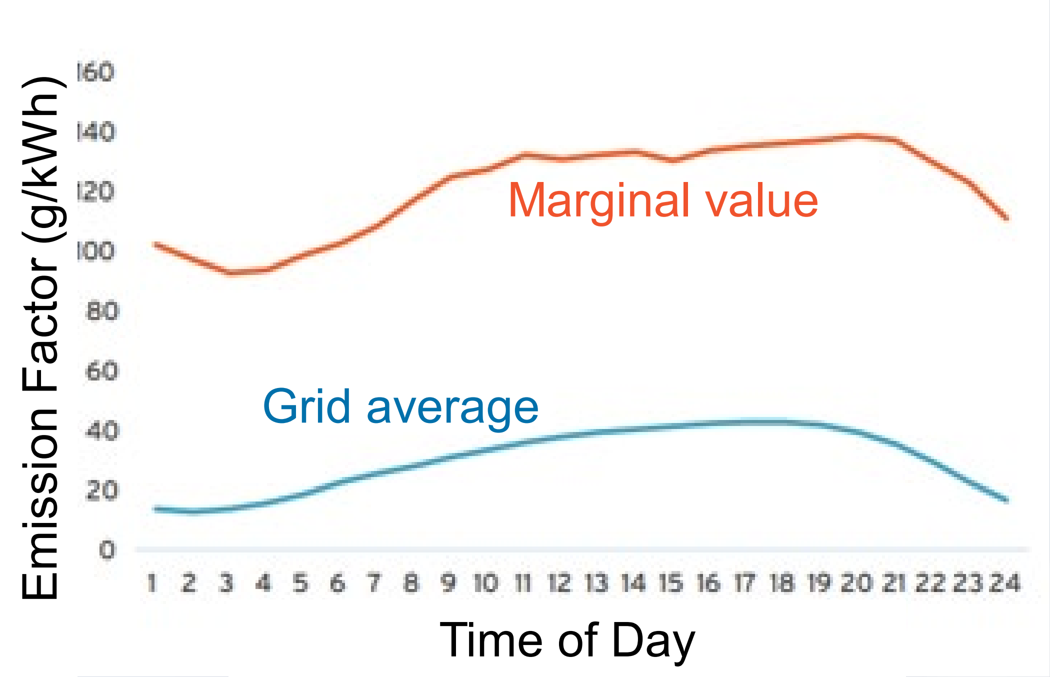




Other benefits of Solar and Batteries
GHG Emission Reductions

2020 Value
Annual AEF
31
(g CO_2eq/kWh)[4]

2020 Value
Annual MEF
123
(g CO_2eq/kWh)[7]
When estimating lifecycle emissions, multiply this value by 1.83 = **225 gCO_2eq/kWh**



GHG Emissions Reduction Solar

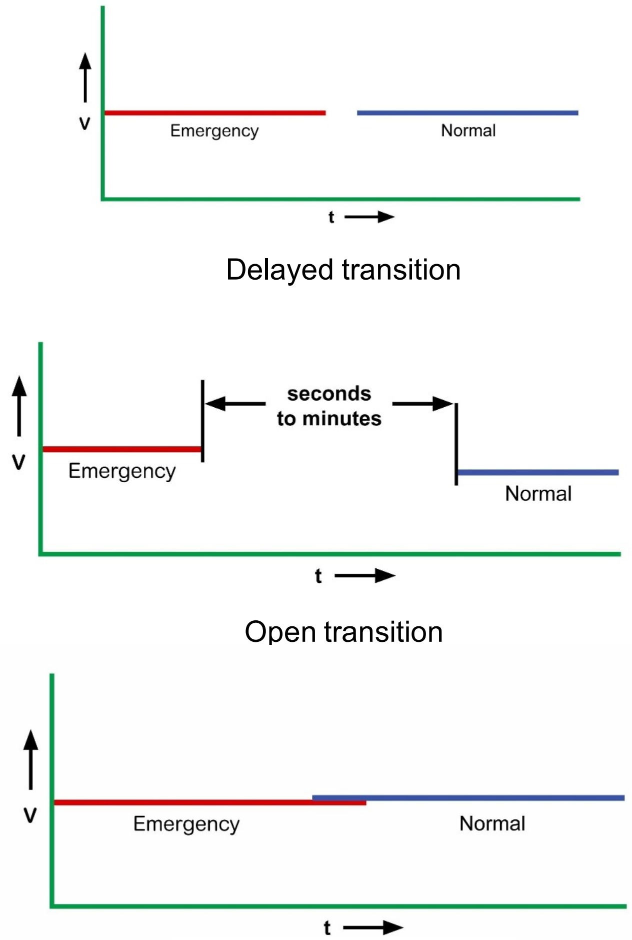
- Reduced grid energy consumption through self supply of renewable energy
- Additional benefit of solar due to marginal vs average grid emission factor

GHG Emissions Reduction Batteries

- Lower, depends on operating strategy.
- Hourly Ontario emissions factors are available on-line (through API) – can include in a multi-factor operational strategy

Other benefits of Solar and Batteries

Resiliency



Delayed transition

Open transition

Closed transition

- **Continued plant operation during grid outages** possible with a Battery – replace back-up generators?
- Can be coupled with Solar to provide supplemental power

Image from: https://www.eaton.com/ca/en-gb/catalog/services/microgrid-and-distributed-energy-resources.html

Conclusions

- Rate Structure details matter, and can be complicated
- Technologies are grid competitive, and they have value for multiple functions
- GHG reductions and resiliency improvements are just two of the many benefits

W&WW projects

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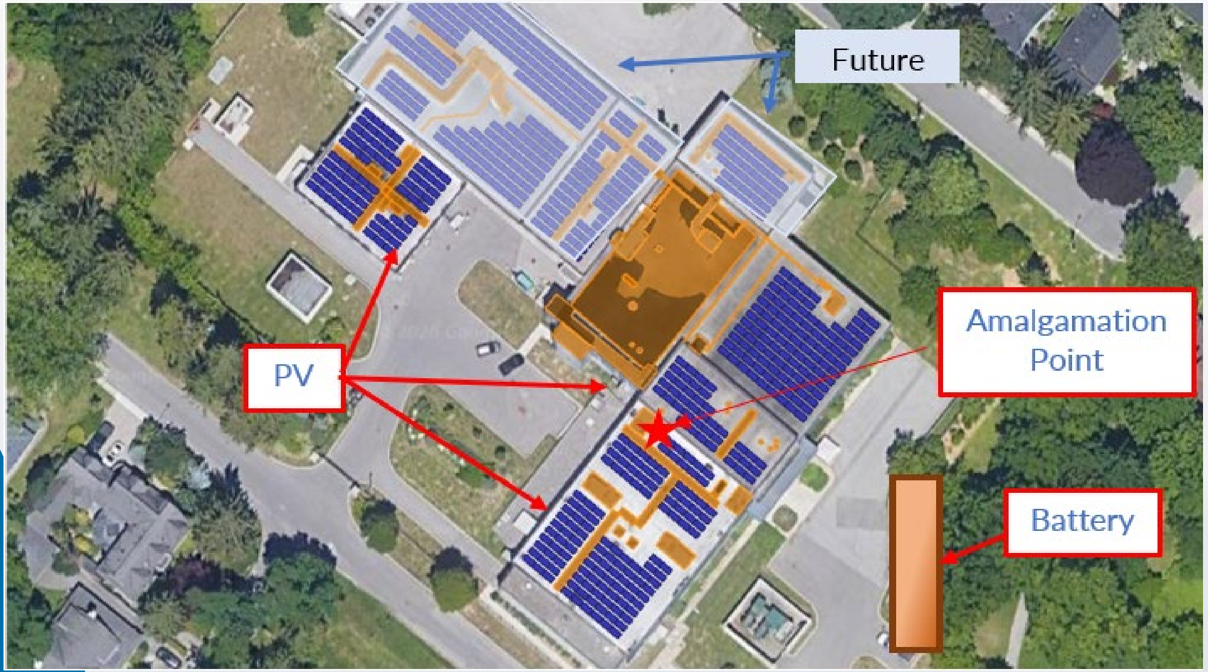
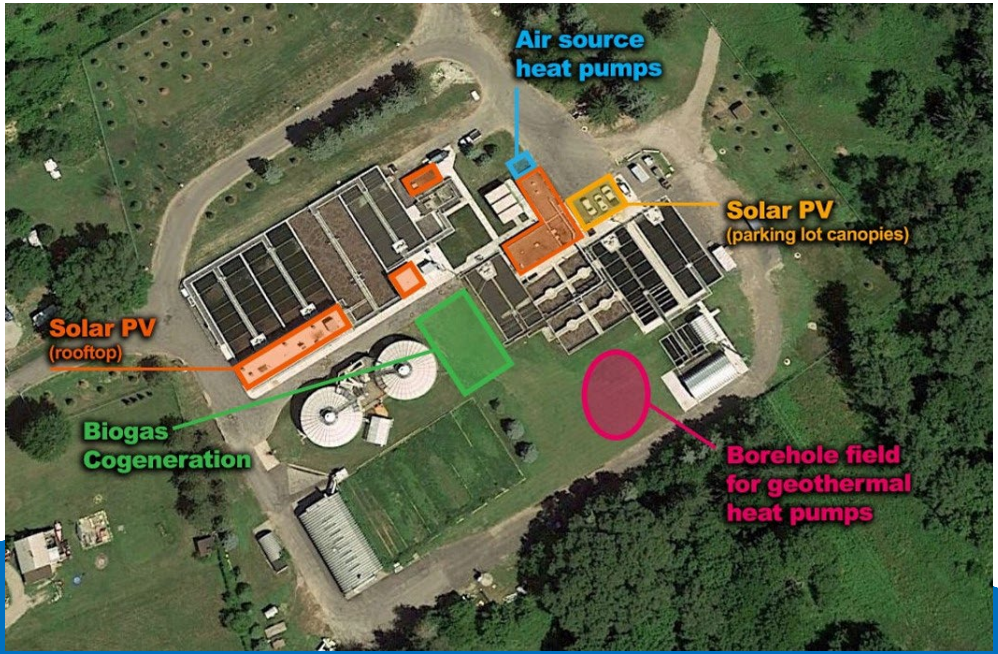


Saskatchewan Solar Feasibility

Site	Energy Generation (kWh)	GHG Reductions (tonnes CO2eq)	Electrical Review	Structural Review	Roof Replacement Due	Interconnection Review	Payback (years)	$/W DC	LCOE ($/kWh)	Lifetime Carbon Cost Effectiveness ($/tonne CO2eq)
ACT	421,418	83	Study Required	No Upgrades	2037	SL&P	23	$1.39	$0.1244	$247
CH	184,900	37	No Upgrades	Study Required	2034	SL&P	24	$1.56	$0.1457	$302
FH3	39,010	8	Study Required	Upgrades Likely	2043	SL&P <100 kW	26	$2.59	$0.2244	$509
LCC	114,600	23	No Upgrades	No Upgrades	2039	SaskPower Limited	26	$1.98	$0.1532	$350
PHQ	566,900	112	No Upgrades	Upgrades Likely	2040	SL&P	26	$1.63	$0.1630	$317
SFH	703,300	139	Upgrades Likely	No Upgrades	2020	SL&P	14	$1.34	$0.0937	$236
CSE	117,070	23	No Upgrades	No Upgrades	2021 Complete	SL&P	22	$1.90	$0.1311	$358
WWTP – RT	390,200	77	Study Required	Upgrades Likely	Unknown	Load Displacement	26	$2.16	$0.1836	$398
WWTP – SGM	2,175,300	431	Study Required	N/A	N/A	Load Displacement	16	$1.56	$0.0836	$229
WWTP - LGM	22,000,000	4,331	Study Required	N/A	N/A	Revenue System	13	$1.10	$0.0637	$172

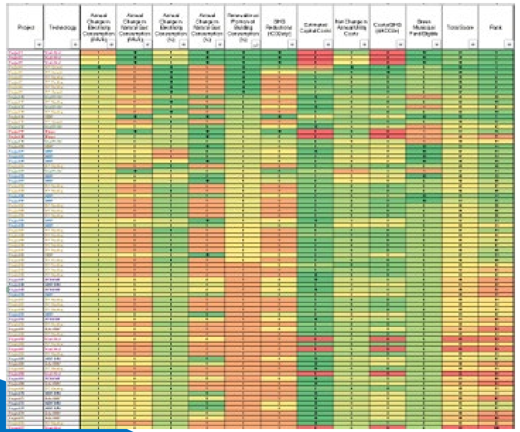
Oxford County Long-term Renewable Energy Plan

- Identify viable projects to support 100% renewable energy by 2050.
- Review of 41 municipal facilities x 14 technologies
  - Desktop analysis with utility data via a screening tool
  - Assess size, energy/carbon savings, capital costs
  - Feasibility studies and reports of the top 10 projects.



Renewable Energy Opportunities at WWTP

Screening Tool Output Sheet



Discussion

Thank you!

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