May 14 to 16, 2014

Next Generation Solar®
Photovoltaics Canada
National Scientific Conference

Université de Montréal
Contributed Talk

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Implementing IEC 61853 in Canada: A Study of Common PV Operating Conditions in Ontario

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Overview

- Introduction to STEP
- Background
  - IEC 61853
- Aims
  - Evaluating IEC 61853 Testing Points
- Method
  - PVSyst Simulations
- Results
- Conclusion

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Introduction to STEP

- Sustainable Technology Evaluation Program
- Branch of TRCA
- Industry-level research supporting the dissemination of sustainable technologies in Ontario and beyond
- Funded by government, NGOs, industry and academic partnerships
- Education, Outreach, Training

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Introduction to STEP

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Background – IEC 61853

- Common Rating Standard IEC 61215 (and IEC 61646)
  - STC Conditions 25 ^{0}C; AM 1.5; 1000 W/m^2 ,etc.
  - P_{MAX}, V_{OC}, I_{SC}, Temp Coeffs., NOCT

ELECTRICAL DATA @ STC	REC215PE (BLK)
Peak Power Watts - P_{MAX} (Wp)	215
Watt Class Tolerance - P_{TOL} (W)	0/+5
Watt Class Tolerance - P_{TOL} (%)	0/+2
Maximum Power Voltage - V_{MPP} (V)	28.3
Maximum Power Current - I_{MPP} (A)	7.6
Open Circuit Voltage - V_{OC} (V)	36.3
Short Circuit Current - I_{SC} (A)	8.1
Module Efficiency (%)	13.0

Values at Standard Test Conditions STC (Air Mass AM1.5, Irr.

- To predict energy (profit) yield – simulate
- From limited data, assumptions are made regarding the performance at different:
  - Irradiance levels
  - Module temperatures
  - Incidence angles
  - Wind speeds (thermal model)
  - Variations in spectrums

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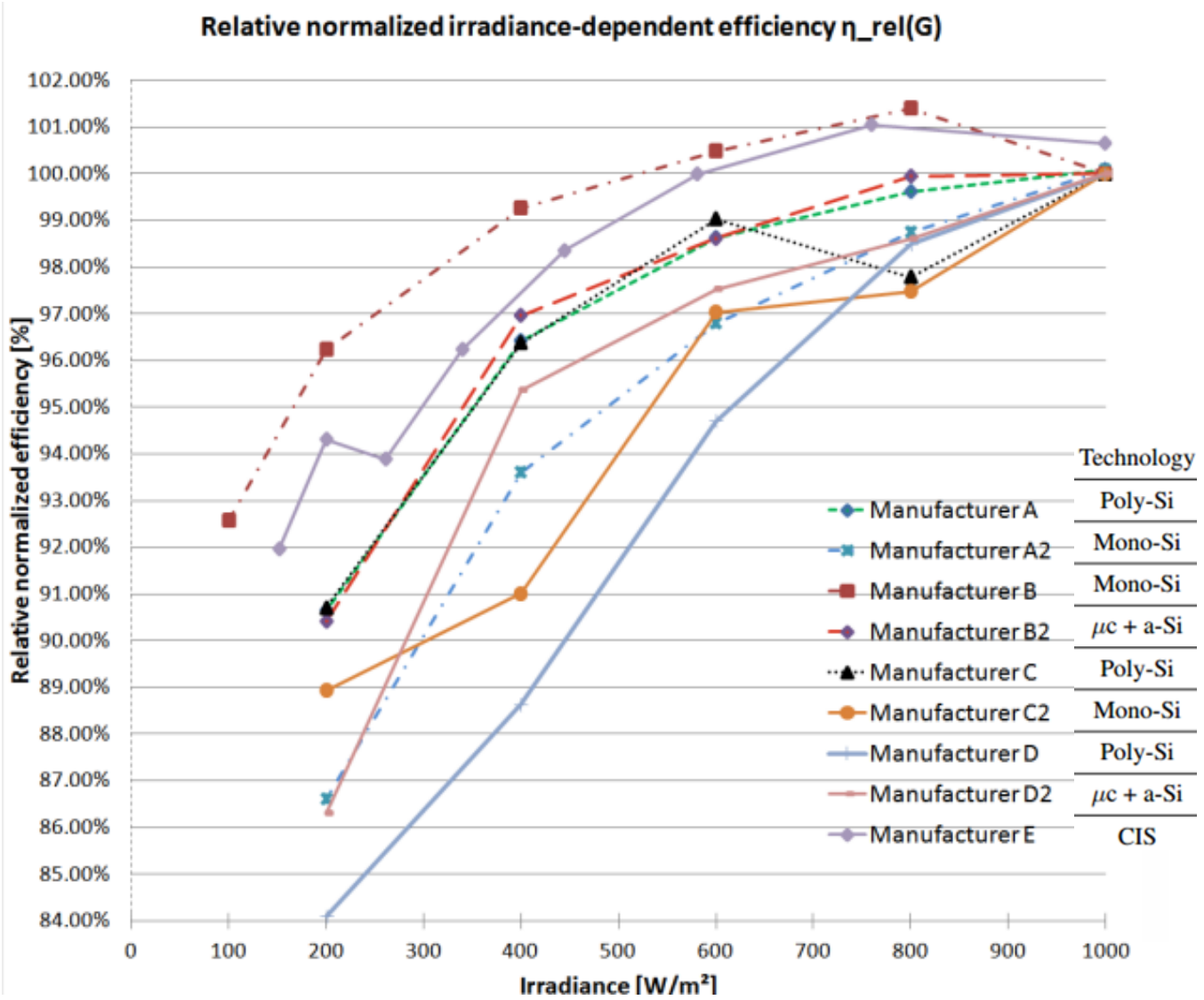
Background – IEC 61853

- Effect of irradiance level on efficiency [2]



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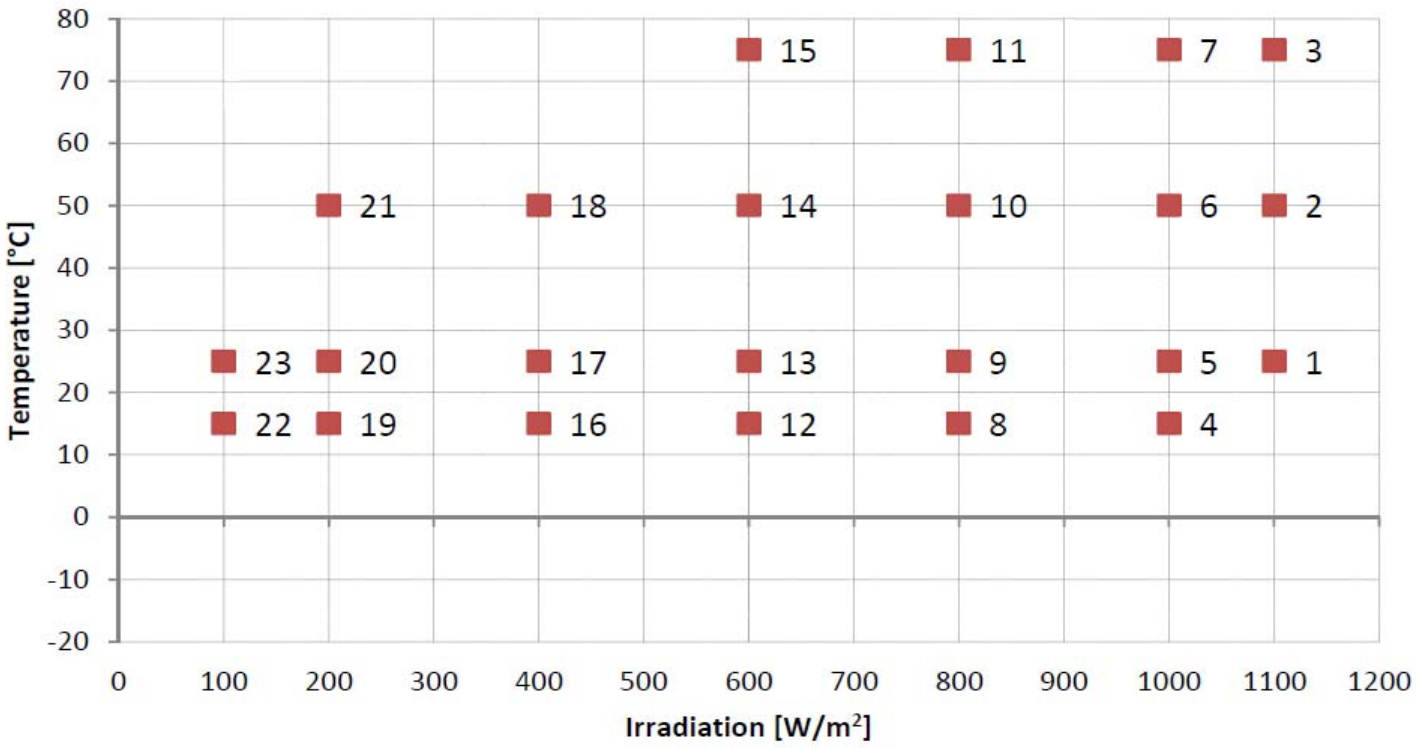
Background

- IEC 61853
- Addresses these assumptions via additional performance measurements
- Introduces matrix of 23 testing points
- **Suitable for Ontario / Canadian climate?**



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Aims

- STEP was funded by NRCan to complete multi-phase study concerning development of IEC 61853 for Ontario and Canadian climate
- **1st Phase: Compare Ontario/Canadian climate with IEC 61853 test points –are they suitable?**
- STEP commissioned SAIC (now Leidos) to complete that phase of the study
- STEP focus thus far has been on implementing monitoring infrastructure for tracing IV curves according to test matrix and acquiring data

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Evaluating IEC 61853

- Representative 100 kW ground mount and roof mount PV system simulated in PVSyst for 13 different locations in Ontario
- Climate data from Canadian Weather for Energy Calculation (CWEC) data files
- Output: hourly data for plane of array solar **irradiance**, **module temperature** and array **energy** produced over TMY

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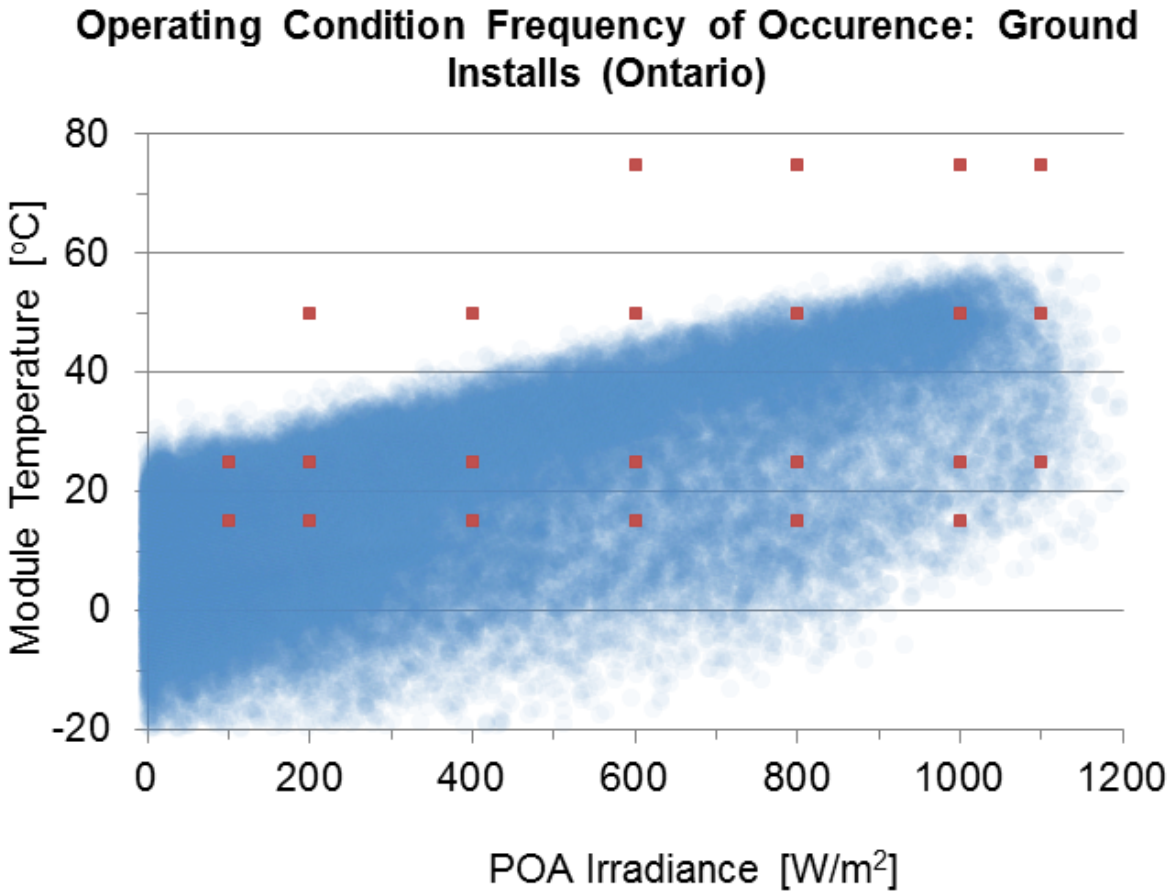
Results – Ground Mount



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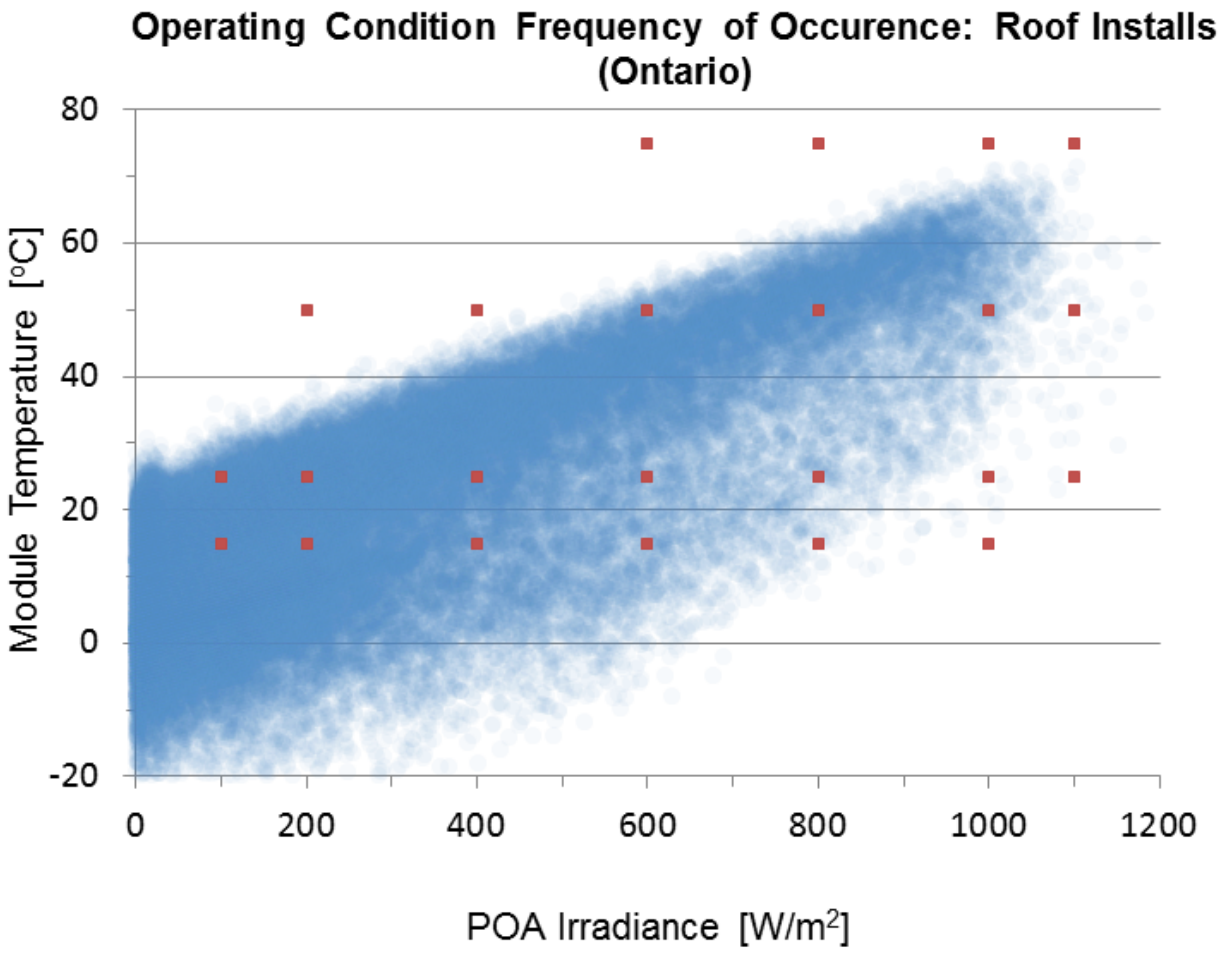
Results – Roof Mount



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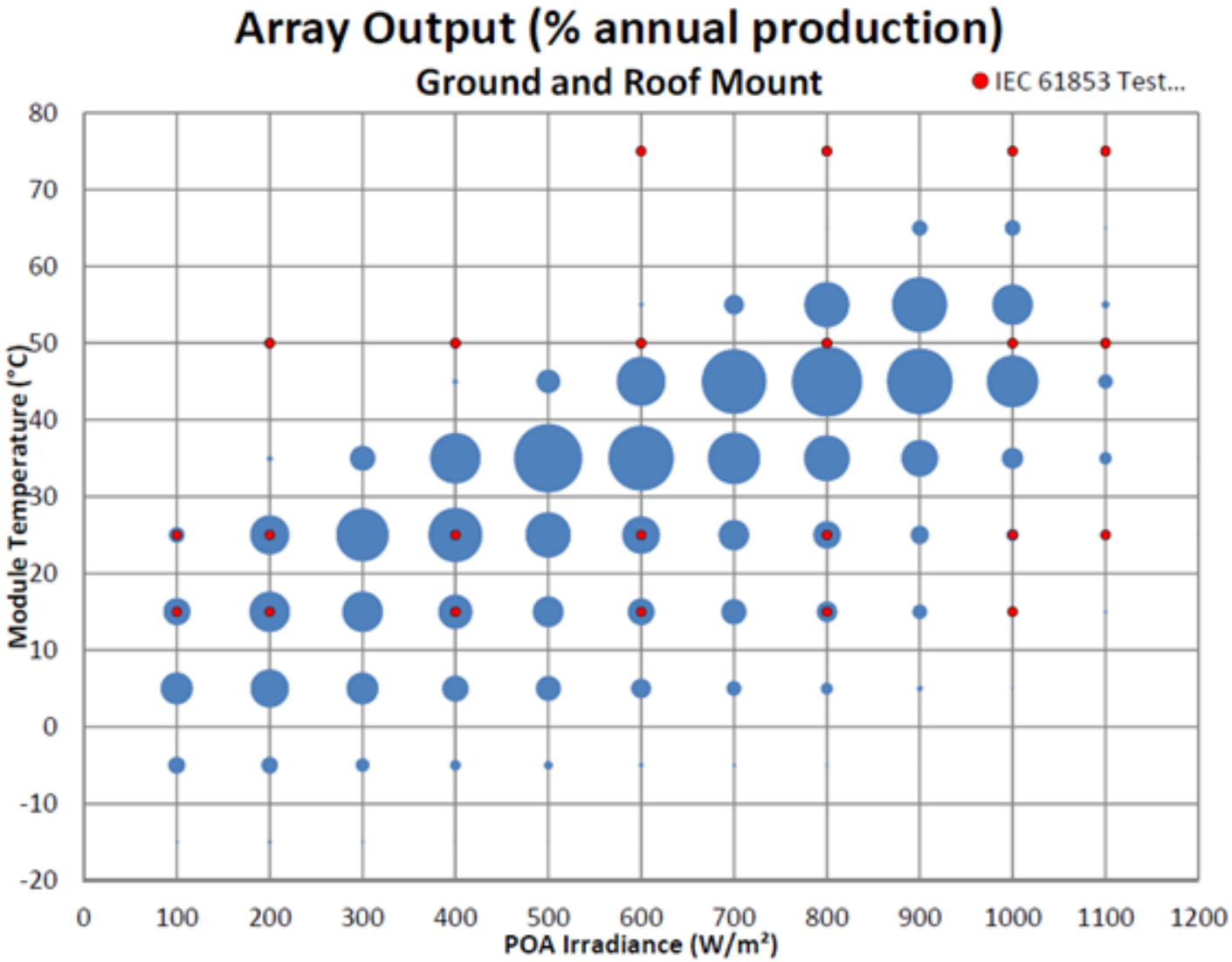
Results - Overall



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Results

- Over 26 (13 sites x 2 installations) simulations:
  - 23% of all energy is produced below 15 °C
  - 10% of energy is produced below 5 °C
  - Several high temperature points never occurred
- Worst disagreement was for Timmins
  - 33% of energy produced is below 15 °C
- Require new test points at 0 °C
- Some high temperature points unnecessary

		Irradiance						
		100 W/m²	200 W/m²	400 W/m²	600 W/m²	800 W/m²	1,000 W/m²	1,100 W/m²
Module Temperature	75°C				15	11	7	3
	50°C		21	18	14	10	6	2
	25°C	23	20	17	13	9	5	1
	15°C	22	19	16	12	8	4	
	0°C	28	27	26	25	24		

Not required Additions Optional

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Conclusion

- IEC 61853 allows for more accurate energy yield predictions via expanded testing
- Investigated if testing points are suitable for Ontario
- Simulated representative PV installations
- 23% of energy produced below testing matrix points
- Suggested changes to IEC 61853 matrix for Ontario climate
- **Future work** – use experimental data to inform development of performance metrics from results of IEC 61853-1 and -2

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Natural Resources Canada | Ressources naturelles Canada

Canada

Toronto and Region Conservation for The Living City

leidos

The Living City CAMPUS

STEP Sustainable Technologies Evaluation Program

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[2] B. Herteleer, J. Cappelle and J Driesen. "Quantifying low-light behaviour of photovoltaic modules by identifying their irradiance dependent efficiency from data sheets," in 27th EU PVSEC.

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