The strange case of Prince Edward Island: A perfect storm for heating electrification

ESIG Forecasting Workshop, Salt Lake
Session 4B: Power System Impacts of Rapid Electrification
June 12, 2024

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Debbie Lew of ESIG doing her best imitation of Nick

HickoryLedge

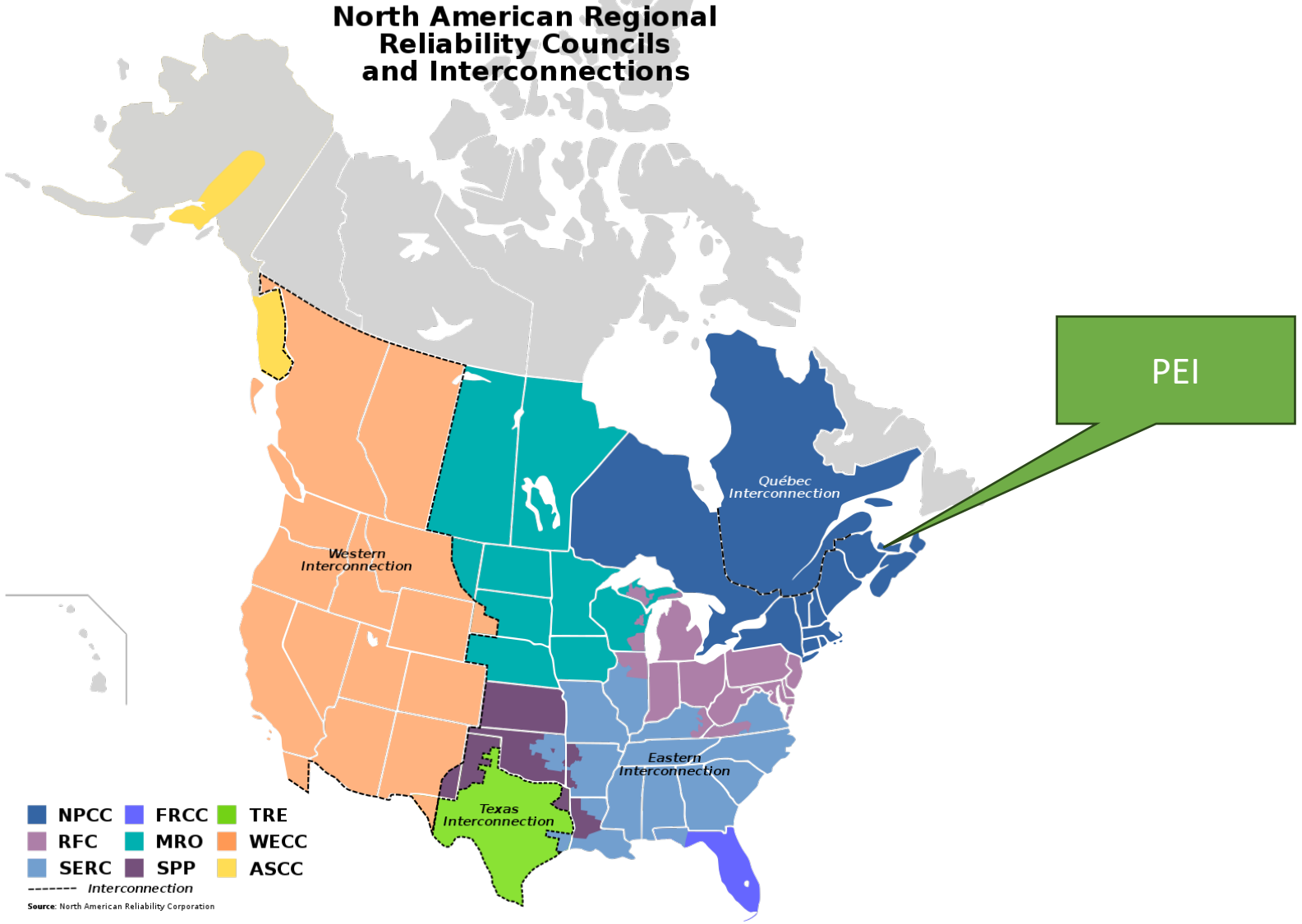
Wind Energy Institute of Canada
Institut de l'énergie éolienne du Canada

Overview

- An Island System
- Encouraging Electrification: Heat pump Incentives
- Perfect Storm
- A tale of tail(s): Polar Vortex
- Canary in the Coal Mine?

This is a part 1 of the story. Come to the ESIG Fall Technical Workshop in Providence for part 2.

Welcome to Prince Edward Island

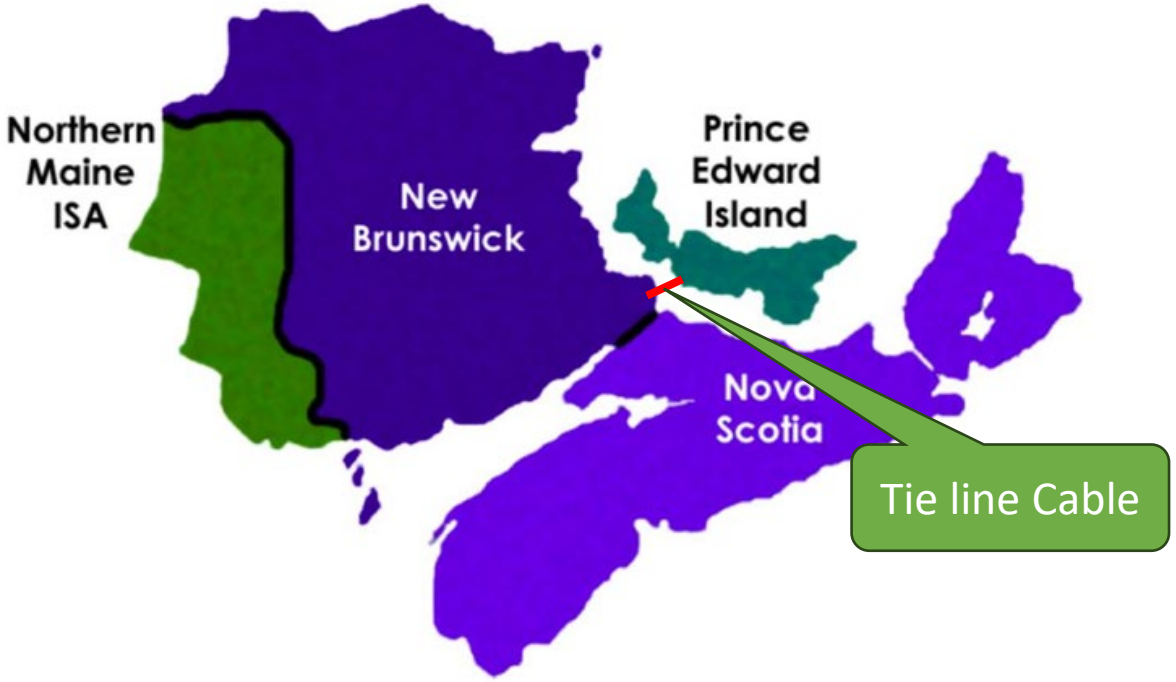


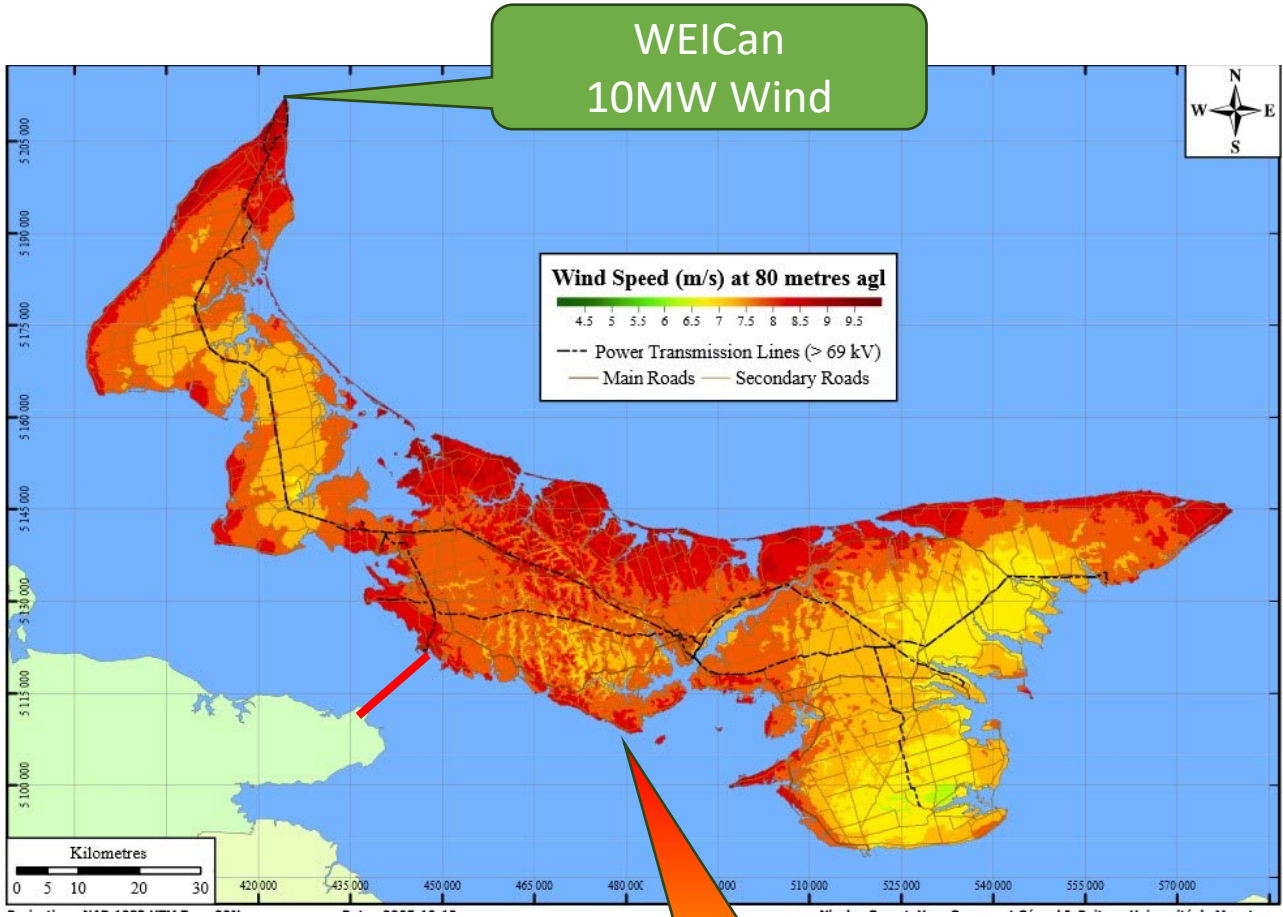
PEI

- Member NPCC
- Synchronous with Eastern Interconnection
- Population: 157k
- Area: 2185 sq. mi
- Customers/Meters: 94k (Maritime Electric + City of Summerside)

PEI System

Figure 2-1 — Maritimes Area Region for Capacity Planning[7]





- Regional Capacity
- System Operator: Maritime Electric (mostly)... (City of Summerside ~10%)
- Generation: (mostly) PEI Energy Corporation (a Crown Corporation)

PEI Capacity Outlook c. 2022

Maritime Electric Capacity Resources for 2023	
Capacity Resource	**Capacity (MW)**
Maritime Electric Combustion Turbines	89
ELCC[a] of On-Island Wind Turbines	21
Point Lepreau Nuclear Generating Station[b]	29
Short-Term Capacity Purchases from NB Power[c]	172
Total	**311**

93 MW nameplate

Effective load carrying capacity ("ELCC") of a generator reflects how much the generator is able to contribute toward

[1] Maritime Electric is under NB Power's control authority and not directly obligated to meet NERC and NPCC planning reserve requirements, but the Company's Interconnection Agreement with NB Power requires it to have enough capacity to meet its firm peak load plus 15 per cent.

Capacity Resource Study

Evaluation of Various Technology Options for Maritime Electric Company

Prepared for

Maritime Electric Company, Ltd.

Prepared by Sargent & Lundy

Report SL-017203
FINAL
December [illegible], 2022
Project 14782.001

Resource	2015-2019 Average	2020	2021	2022	2023	2024
MECL's Capacity Obligation (MW)	**261**	**284**	**302**	**306**	**311**	**316**
Total MECL Capacity (MW)	**276**	**287**	**302**	**306** *(est.)*	**311** *(est.)*	**316** *(est.)*
Total On-Island Capacity (%)[1]	59.4%	51.6%	49.1%	37.0%	36.4%	35.8%
Total Off-Island Capacity, i.e., Purchased from Mainland (%)	40.6%	48.4%	50.9%	63.0%	63.6%	64.2%

Source for these tables

20% PRM

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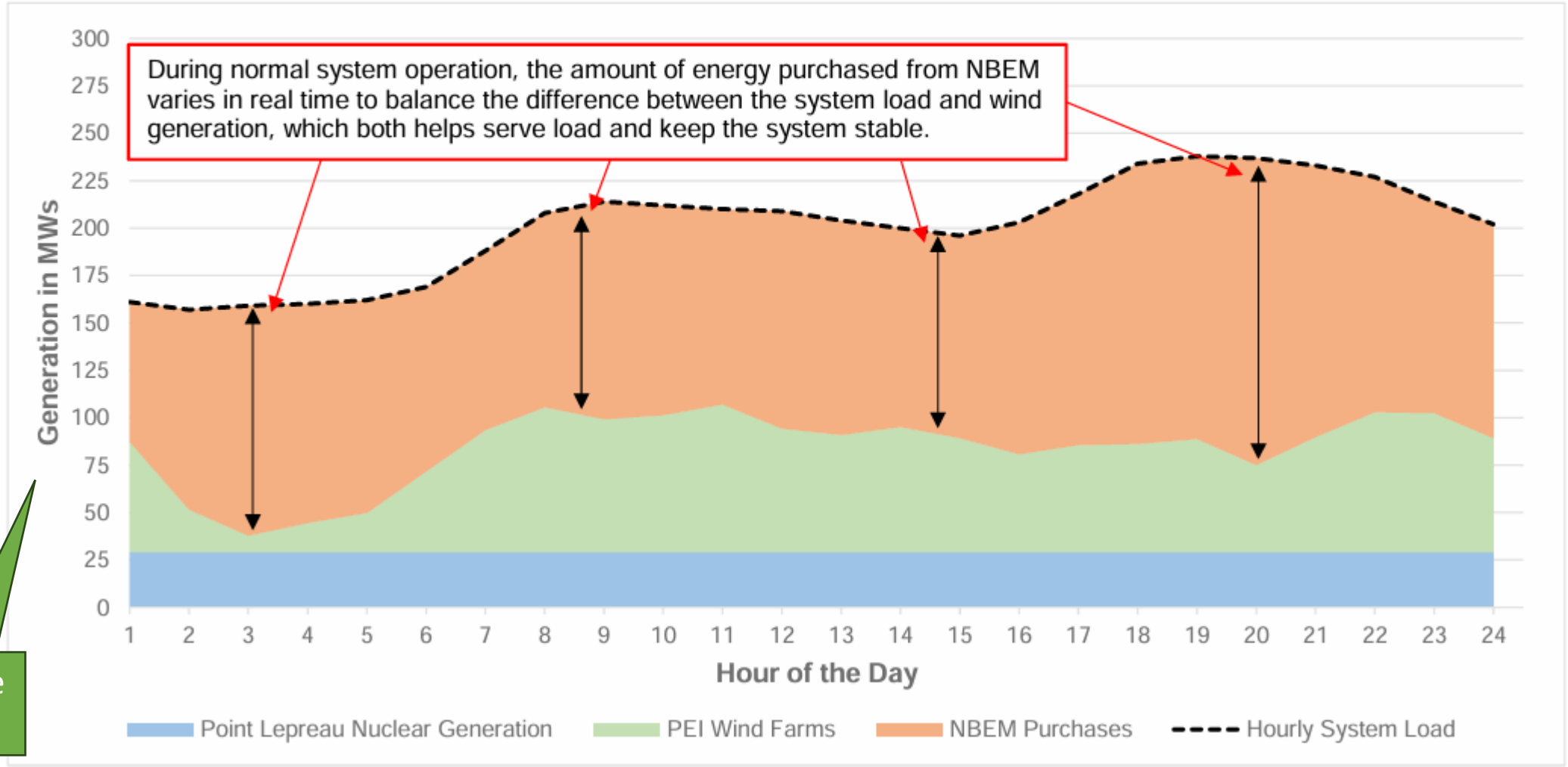
Figure 2-2 — Typical Winter Day System Dispatch



Maritime Electric

Source: Capacity Resource Study; Sargent & Lundy, December 2022

PEI has ambitious targets….

Nice consolidated website:

princeedwardisland.ca/en/topic/energy-efficiency

Environment, Energy and Climate Action

Some of the priorities include:

- Achieving Net Zero by 2040 by reducing emissions, switching to cleaner sources of energy, and pursuing innovation and transformational change
- Implementing carbon mitigation and adaptation plans to address the effects of climate change

Online Services

Net Zero Free Heat Pump Program

Installing a heat pump can help you save money on your energy bills and make your home more comfortable. Starting January 3, 2024, Islanders with an annual household net income of $100,000 or less may be eligible for a free heat pump for their home.

Point of Sale Heat Pump Rebates

How do I get a heat pump rebate?

All Islanders may be eligible for a $1200 point of sale rebate on eligible mini-split heat pumps for their homes.

Energy Rebate

The 2018 Budget Address outlined the following program: A large part of our efforts will be to engage Islanders directly in reducing carbon emissions and working to make electricity cheaper. Significantly, we are in this plan committing to providing...

Heat pump program

Government of Prince Edward Island
Department Environment, Energy and Climate Action
4th Floor, Jones Building, 11 Kent Street
P.O. Box 2000, Charlottetown, PE C1A 7N8
| www.princeedwardisland.ca

- Nearly 3000 free heat pumps have been installed since Dec 1st, 2021 with a planned further 7000 installations by March 2024 (capacity is currently around ~600 installs/month)
- just recently raised the income threshold to 100k
- Heat pumps installed are primarily air-source “mini splits” (e.g. Fujitsu, LG, Daikin, ...)

Free heat pump program:

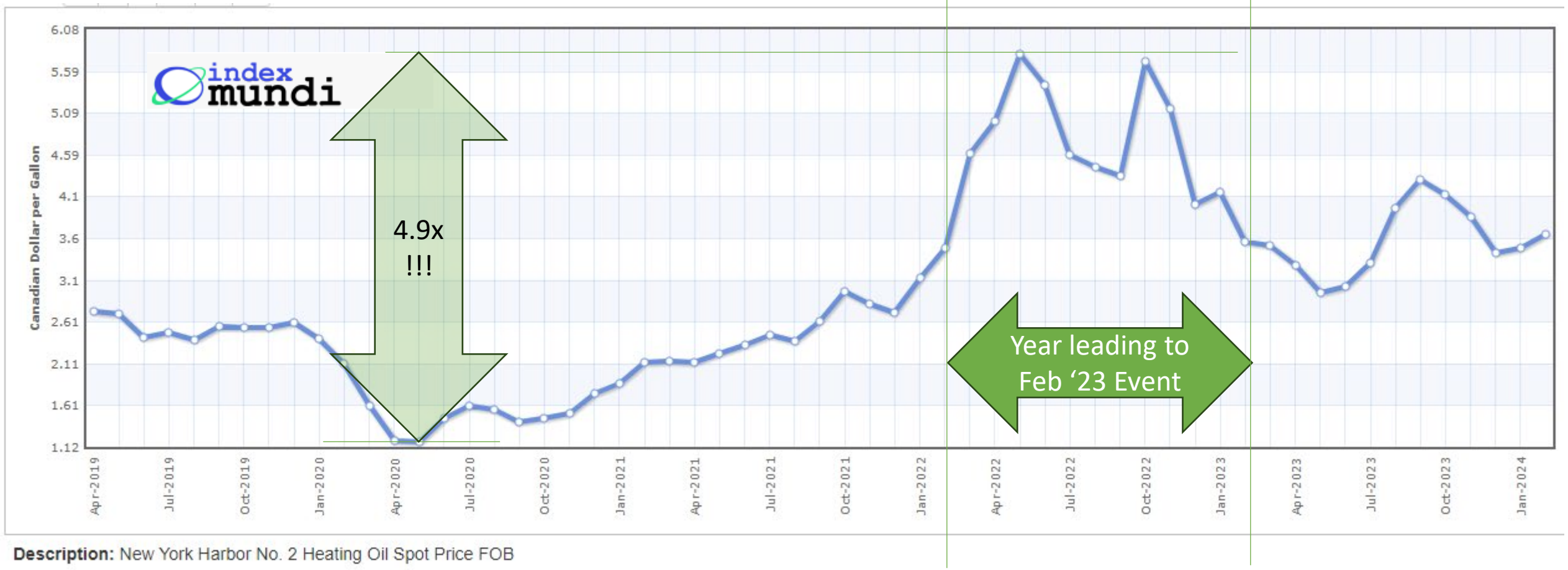
Totals Applicants:

Declared Income Thresholds:

Total - $35,000 or less	1,841
Total - $55,000 or less	4,611
Total - $55,000 - $75,000	517

Application Grand Total: 6,969

Price of Home Heating Oil



Description: New York Harbor No. 2 Heating Oil Spot Price FOB

Unit: Canadian Dollar per Gallon

Solar and EV Program

EV and PV growth is substantial

Doesn't enter this story. Yet.

PV rebate: ~20MW completed (thru 2/23)

>500 EV/PHEV inc Level 2 Chargers added thru '23

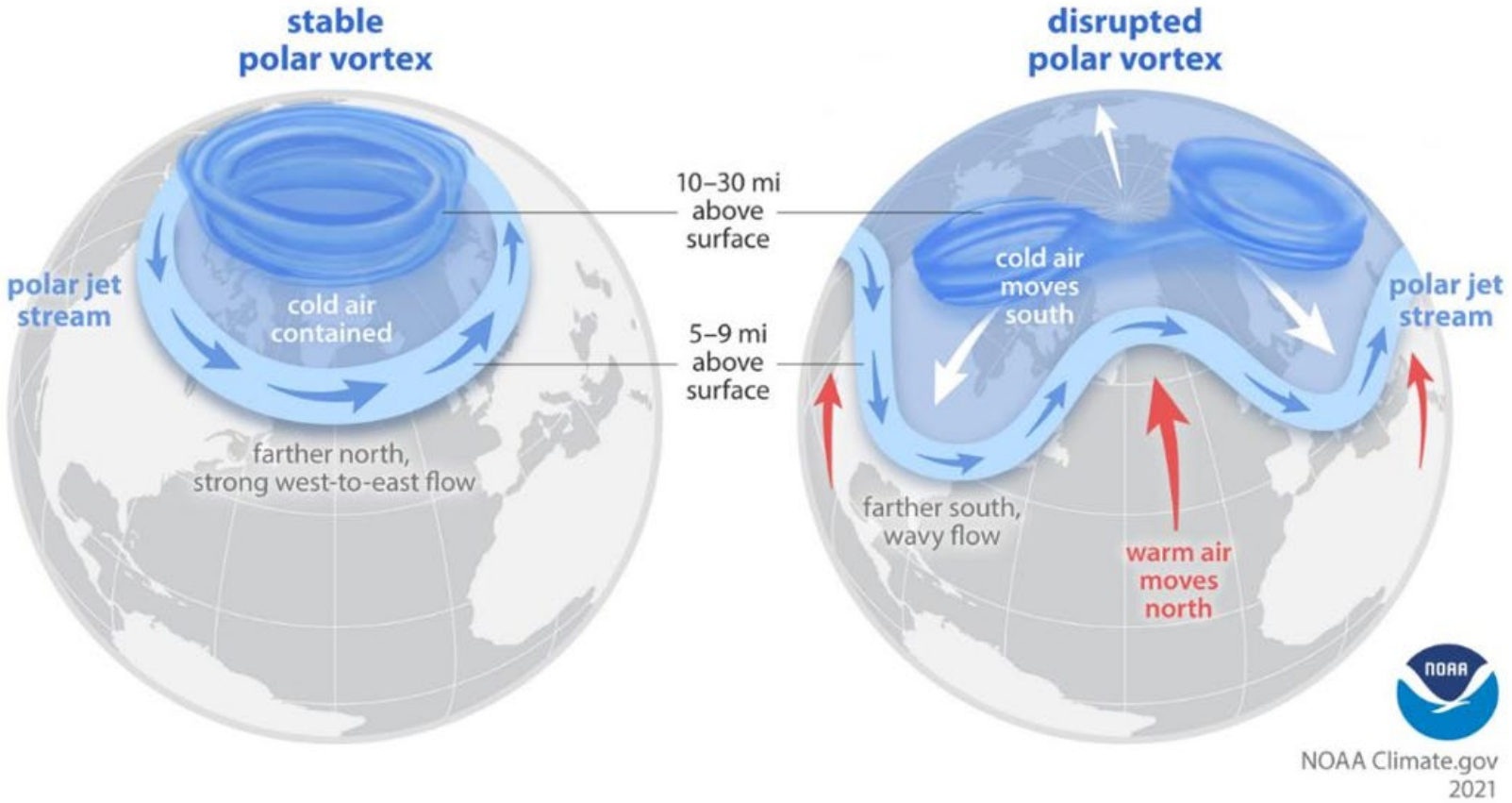
SOLAR REBATE APPLICATIONS FROM 2019 UNTIL FEB. 13, 2023

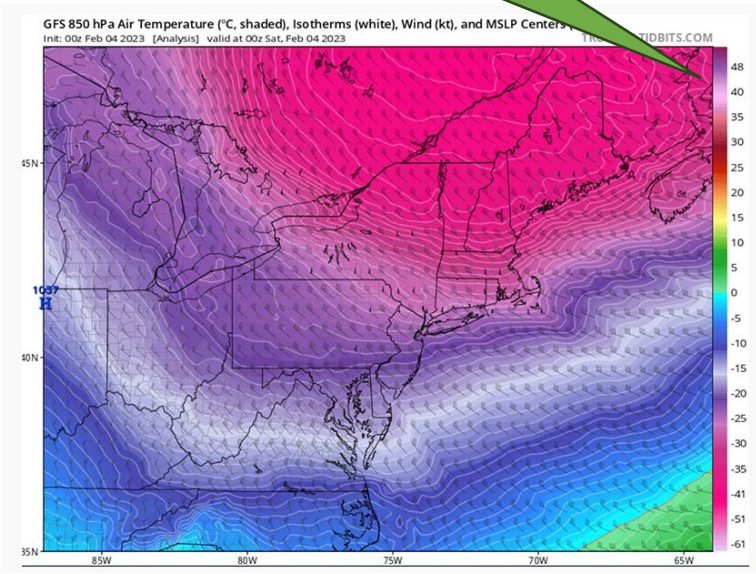
Updated: Feb. 22, 2023

By: Anna Dao, efficiencyPEI

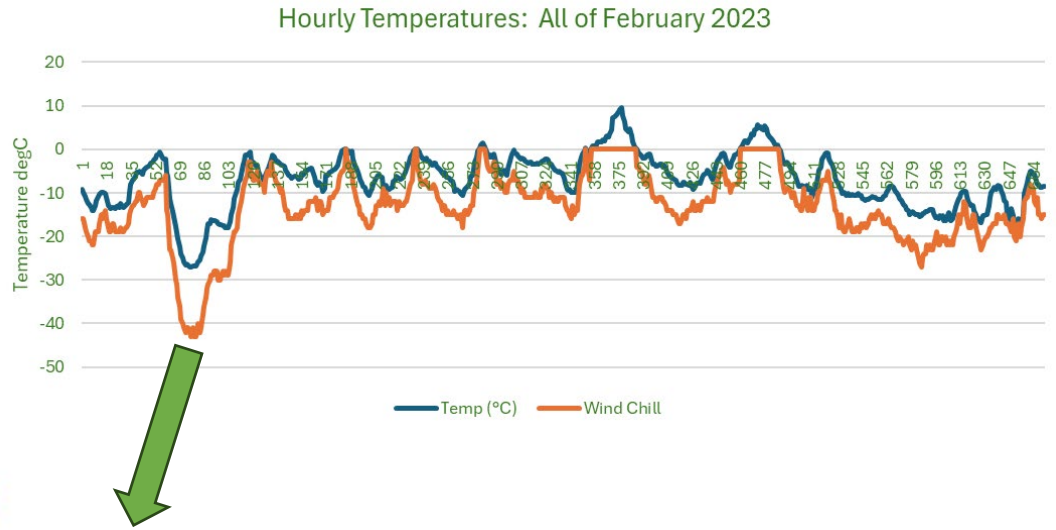
			COMPLETE				
Fiscal Year (*)	Total applications received	Total DC KW	Total applications	%	DC kW	Total ($) installation cost	Total ($) Rebate paid
2019-20	203	512	4	2%	93	236,680	31,445
2020-21	467	3,991	275	59%	2,978	9,223,889	2,444,611
2021-22	955	8,789	567	59%	6,312	19,902,604	5,164,135
2022-2023 (**)	1,360	20,966	935	69%	10,874	34,672,277	8,581,563
Total	**2,985**	**34,257**	**1,781**	**60%**	**20,257**	**64,035,450**	**16,221,754**
	Average	**11.48**			**11.37**	**35,954.77**	**9,108.23**

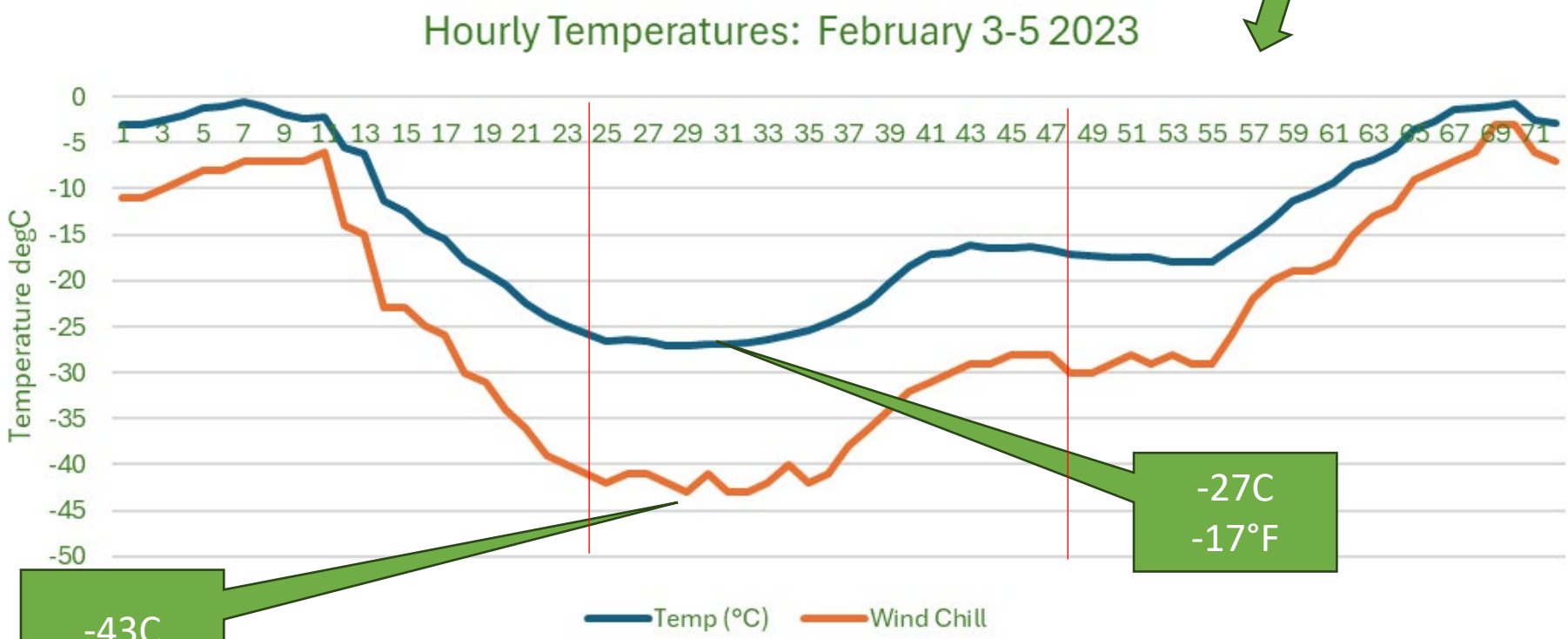
Polar Vortex: Feb 3-5, 2023





Really *cold*





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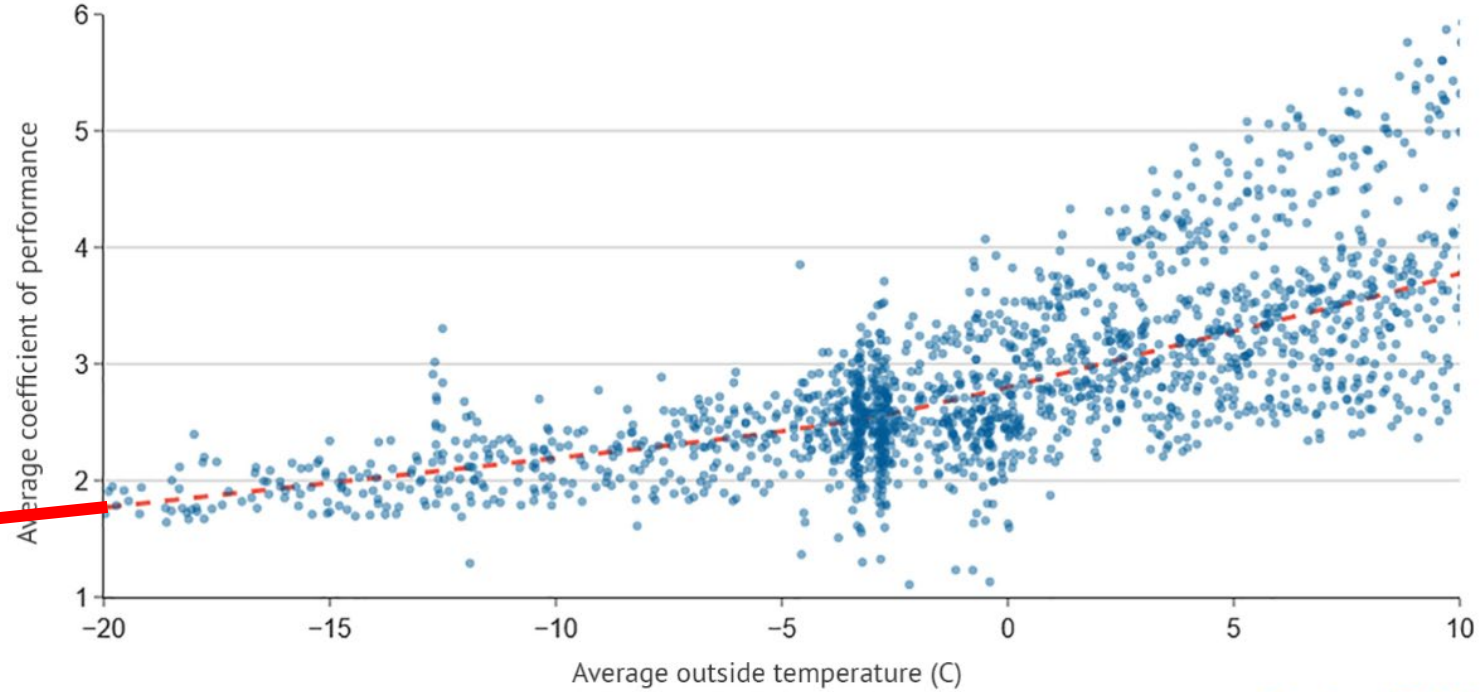
Heat pumps & Cold Weather:

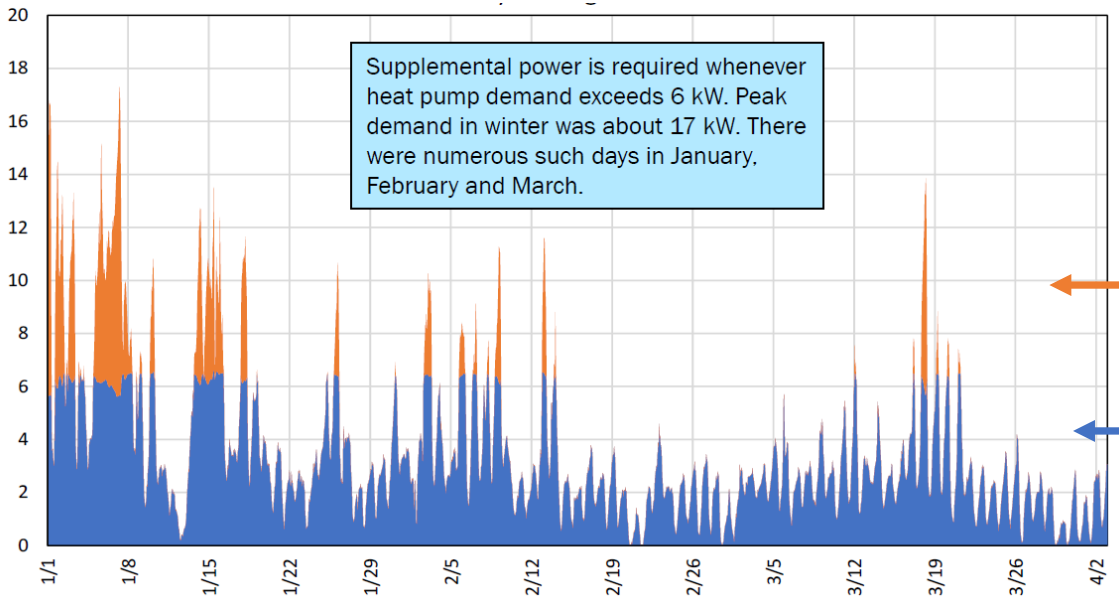
Feb 4, 2023 in PEI



Duncan Gibb, et al 2023

CarbonBrief
CLEAR ON CLIMATE

Arthur Maniaci, NYISO, 2023



Resistance heat load

Heat pump load

Nick Miller

HickoryLedge

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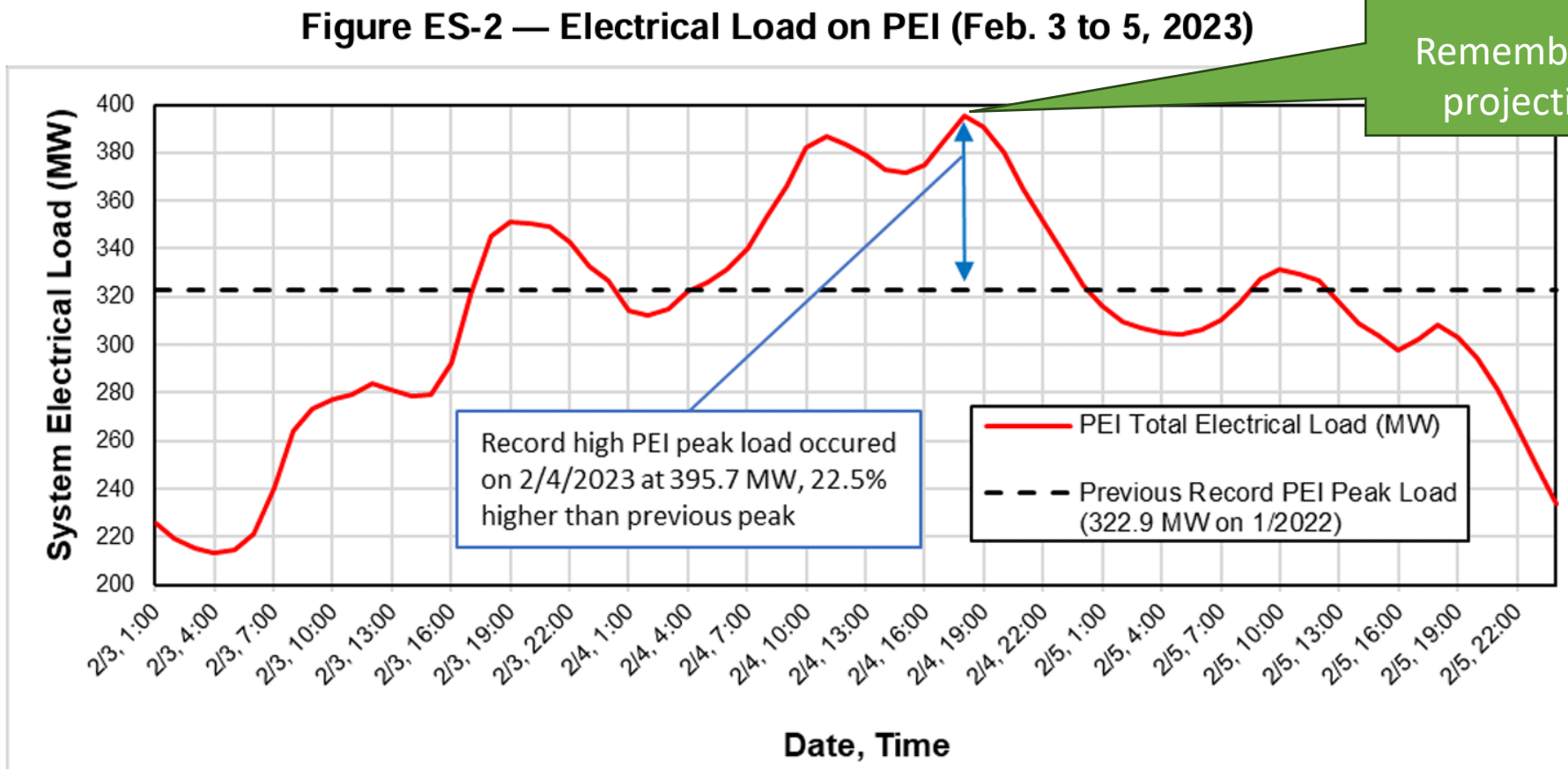
Whoa! +22.5% in one year

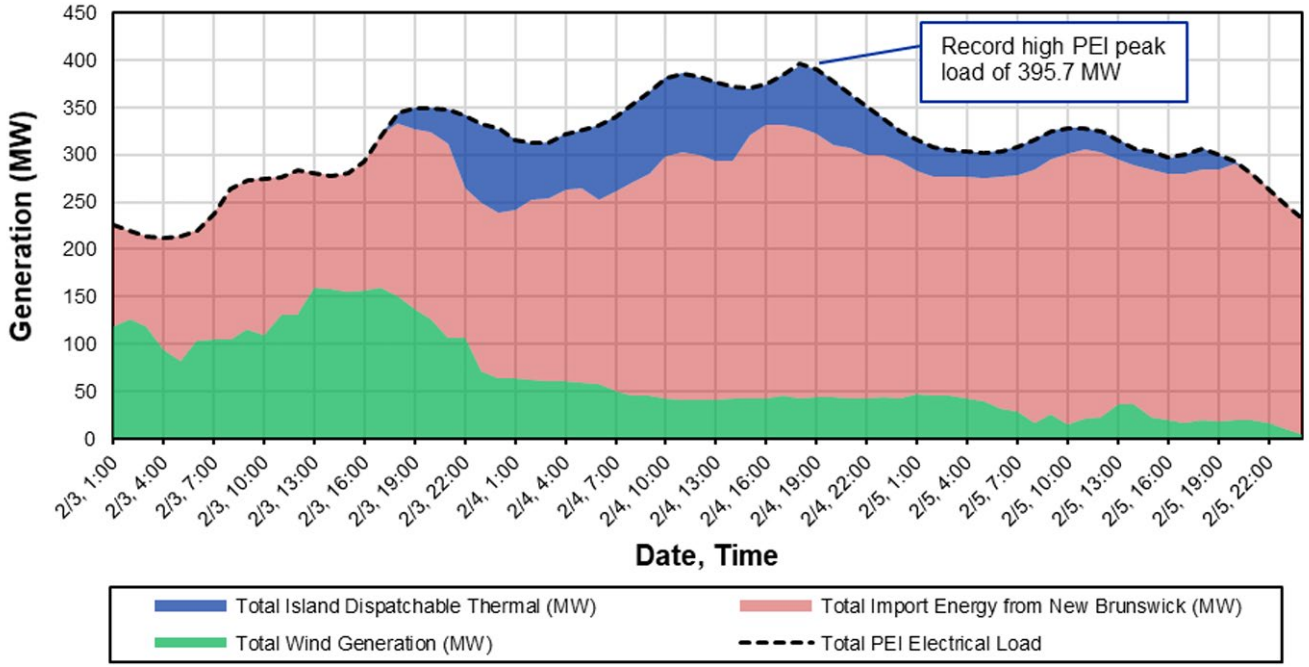
396MW!!!

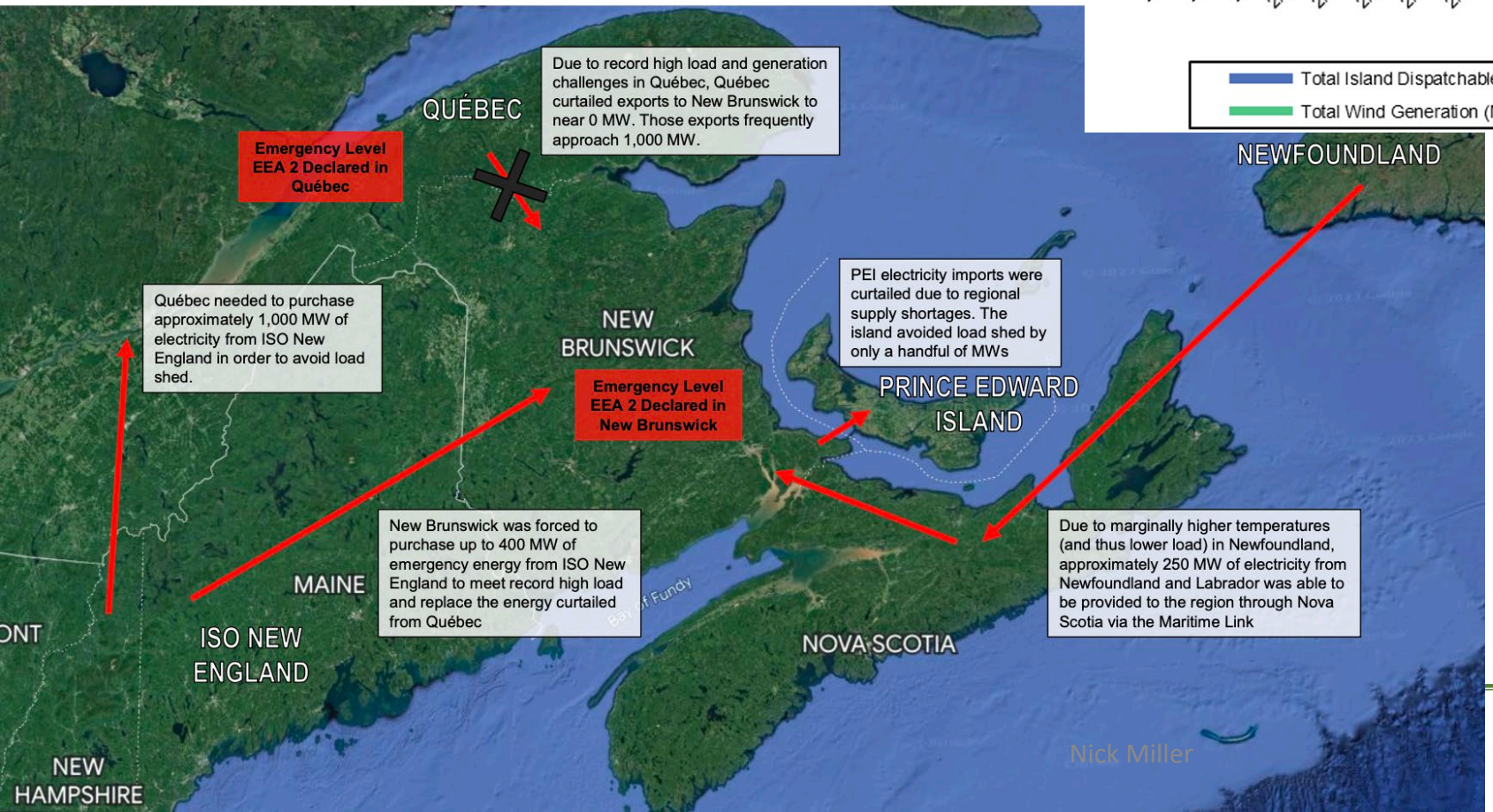
Remember 311MW for 2023 projection in 2022 study?



Source: Extreme Weather Event Capacity Impact: Addendum to Dec 2022 Maritime Electric Capacity Resources Study; Sargent & Lundy July 12, 2023

Got by with a little help from their neighbors' neighbors





Source: Extreme Weather Event Capacity Impact: Addendum to Dec 2022 Maritime Electric Capacity Resources Study; Sargent & Lundy July 12, 2023

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Wind Generation

- "...only 25 percent ..were operational.."*
- Extreme cold *plus* Turbulence
- Some turbines that tripped on turbulence quickly got too cold to restart
- Lubrication, etc.

Source: Extreme Weather Event Capacity Impact: Addendum to Dec 2022 Maritime Electric Capacity Resources Study; Sargent & Lundy July 12, 2023

Figure 2-3 — PEI Wind Generation and Wind Speed (Feb. 3 to 5, 2023)

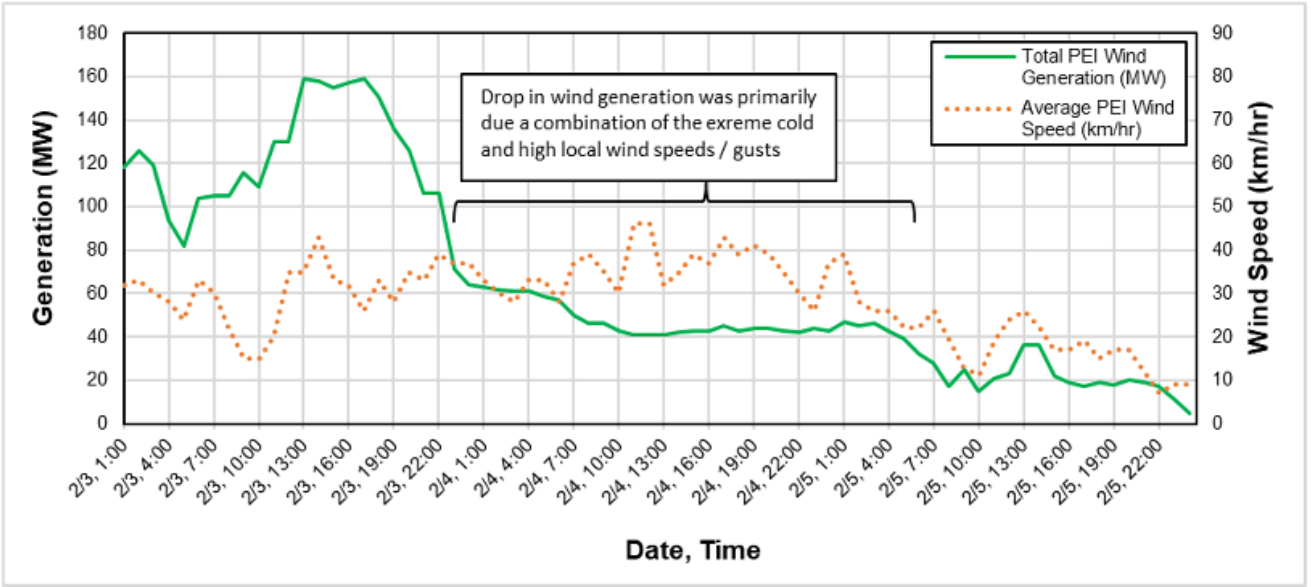
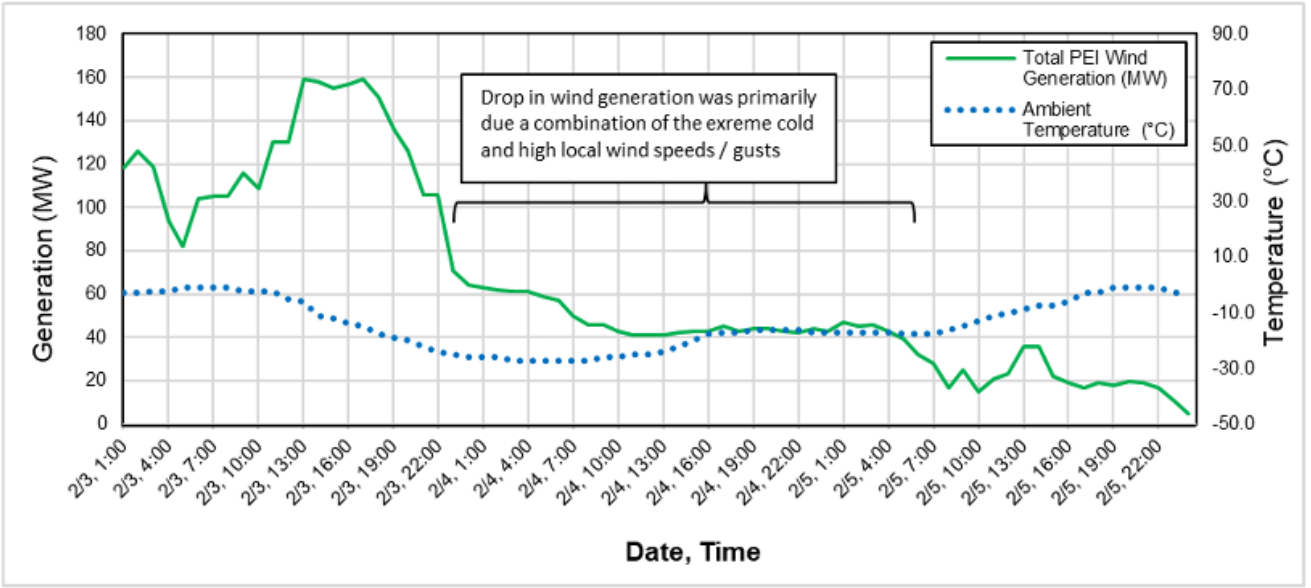


Figure 2-4 — PEI Wind Generation and Temperature (Feb. 3 to 5, 2023)



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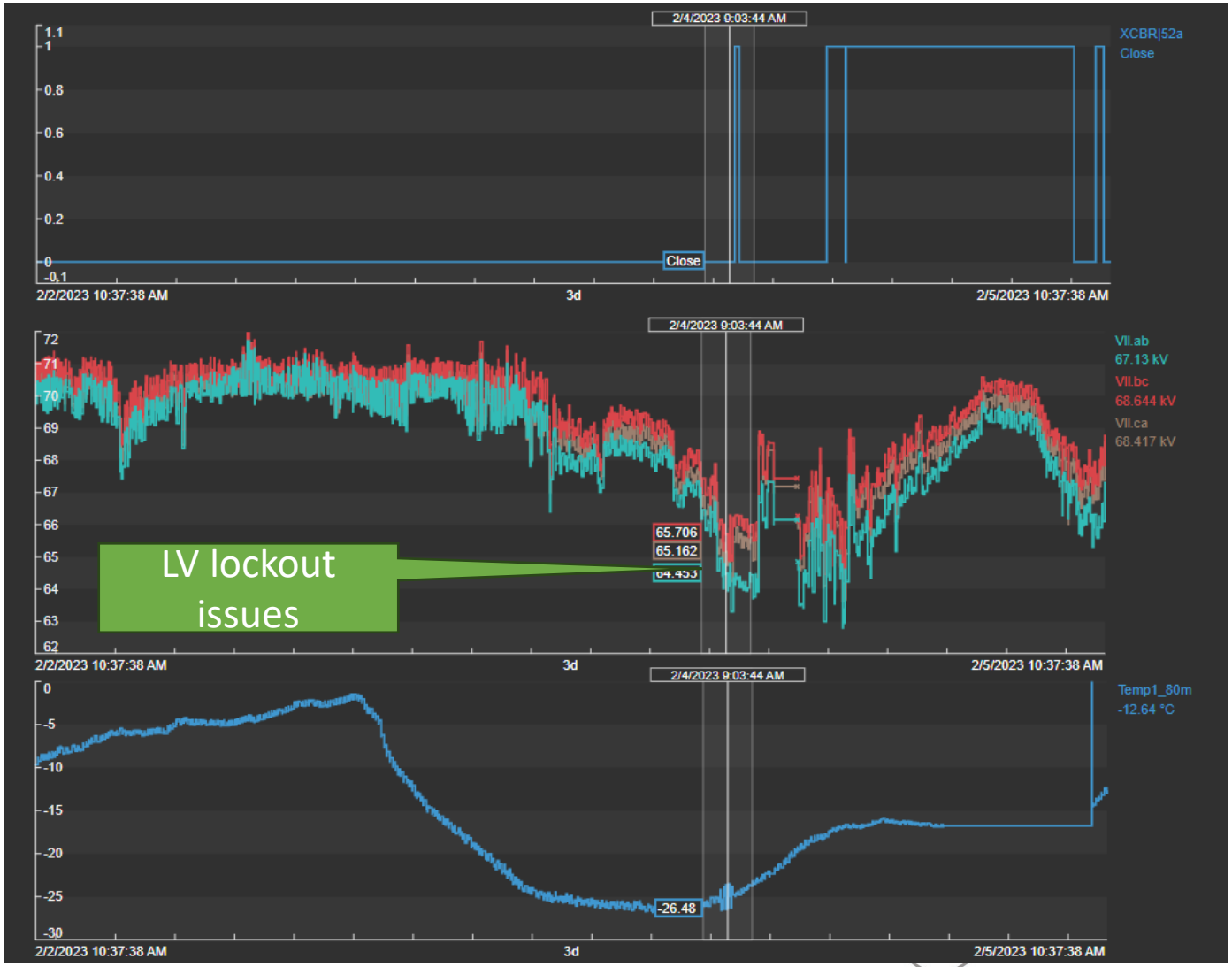
WTG detail (WEICan units)

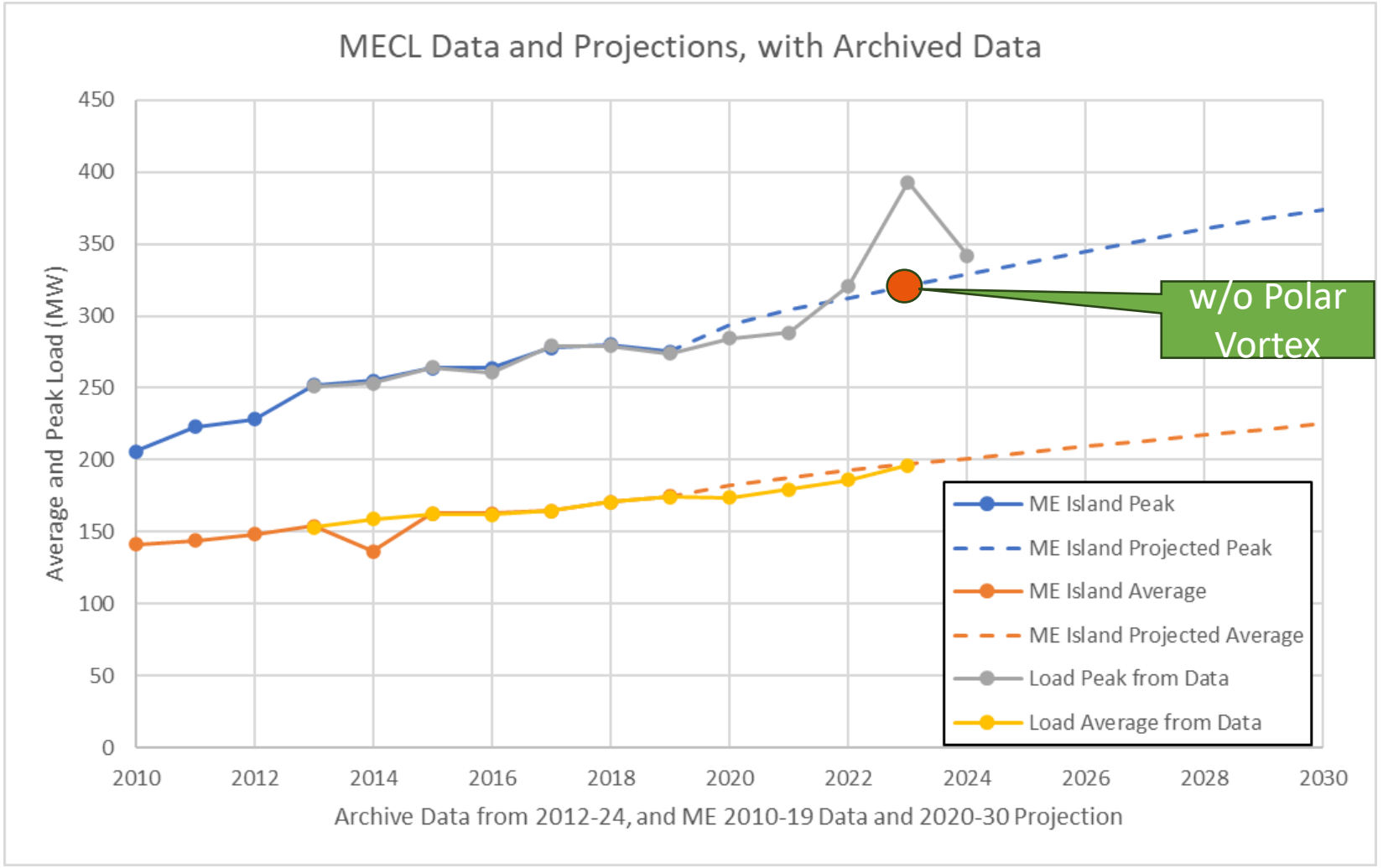
- Lubrication Issues
- Low voltage lock-out



* Per Extreme Weather Event Capacity Impact: Addendum to Dec 2022 Maritime Electric Capacity Resources Study; Sargent & Lundy July 12, 2023

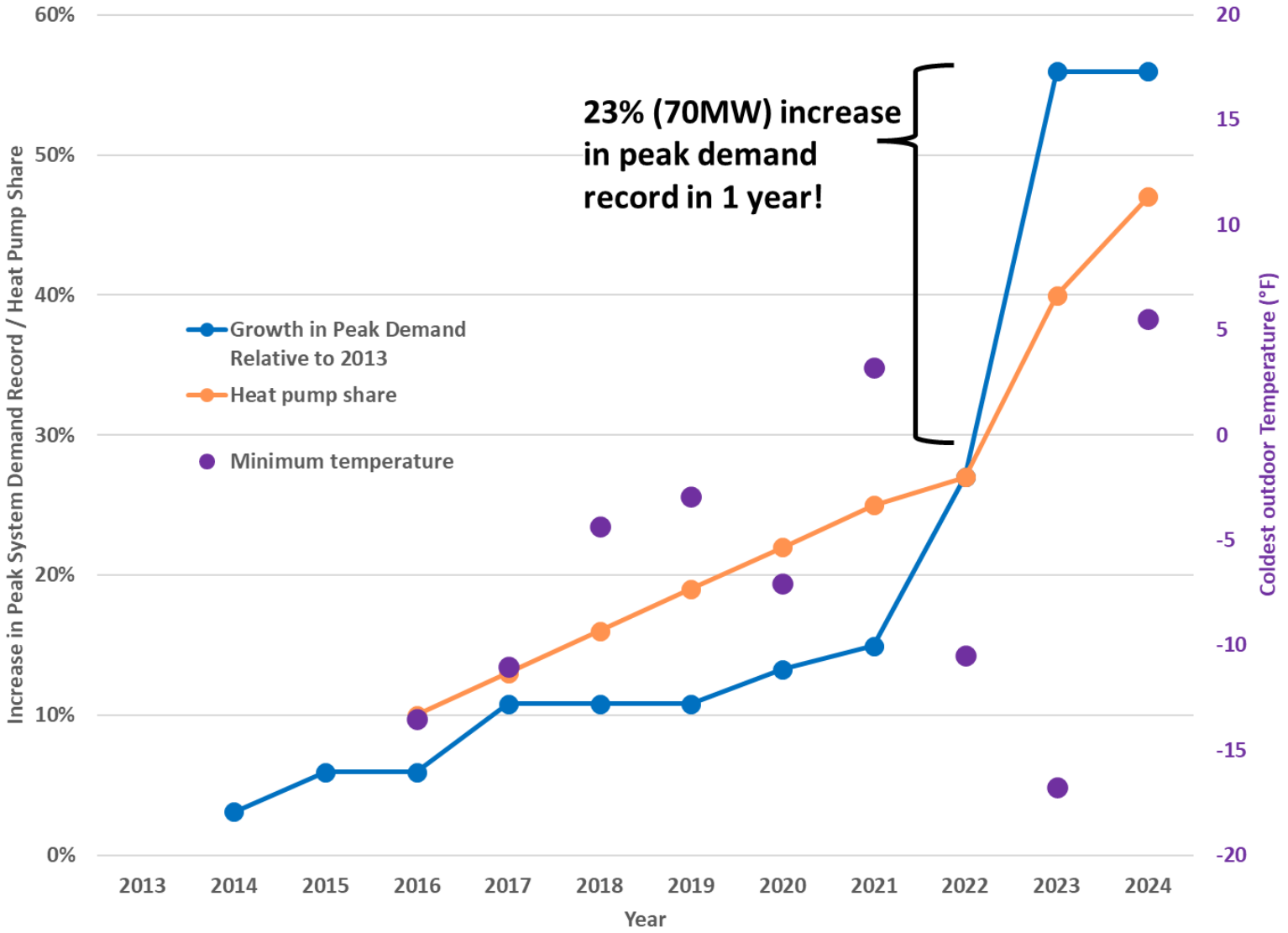
Forecasting

- PEI longer-term load forecasting has been reasonably accurate
- In this view, the Polar Vortex is an outlier



Source: https://www.princeedwardisland.ca/en/feature/pei-wind-energy#/service/WindEnergy/WindEnergy

Lurking risk, appears only when it gets very cold



ESIG, Grid Planning for Building Electrification, forthcoming

NERC

- Level 3 Essential Action Alert: “Cold Weather Preparations for Extreme Weather Events III” (May 15, 2023)
- “...Readiness and Plans...mitigating risk for the upcoming winter...”
- Highest severity level for NERC
- 1st time ever issued

Another worry: NERC FRT/ Momentary Cessation

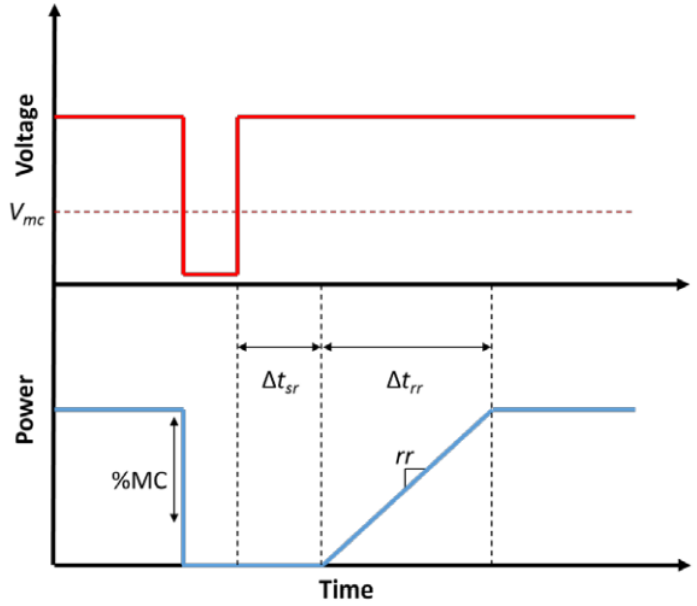


Figure 1: Illustration of Momentary Cessation Characteristics

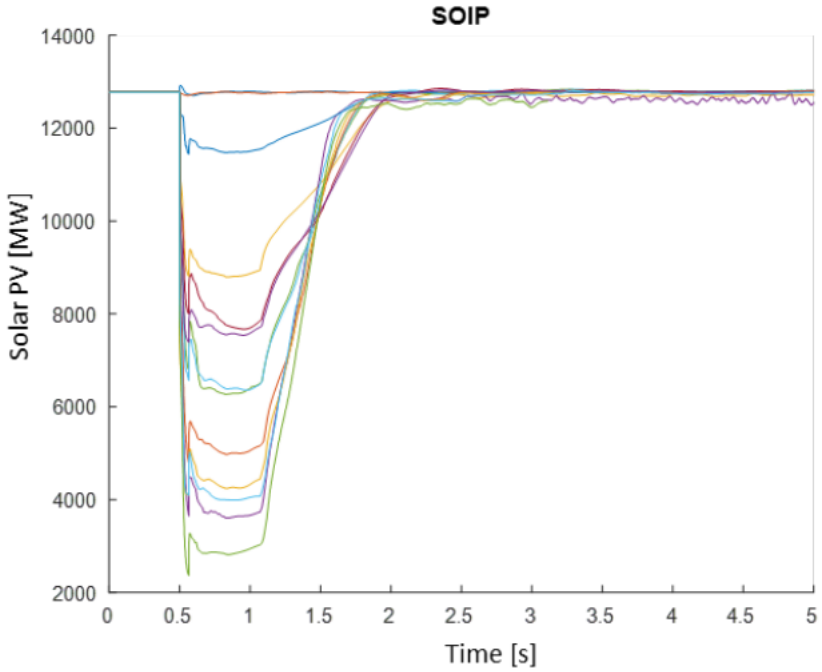


Figure 10: Solar PV Active Power Output for Case 2 Momentary Cessation Settings

- 25% of peak load of relatively homogenous and incompletely understood character
- Not looming on the radar. Yet. (sez Nick)

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Resource Loss Protection Criteria Assessment
NERC Inverter-Based Resource Performance Task Force (IRPTF)
White Paper – February 2018

Observations (lessons Learned)

- Addressing specific components of projected load (especially growth) into load forecasting is essential
- Economic externalities can combine to amplify expected changes (e.g. price of heating oil in this case)
- Extremes of weather have impact on some of those components
- Need to reflect this seems to parallel recent emphasis on weather-dependent forced outage rates in capacity planning.

What's the plan? Stay tuned, and attend ESIG Workshop in Providence: Planning for and operating thru extreme weather with high heat pump load in PEI

Thanks

nicholas.miller@hickoryledge.com

Loss of the tie to New Brunswick: Elephant in the planning room

Figure ES-1 — Historical System Winter Load Histogram (2018-2021)

Comparison to the Amount of Load MECL Could Serve During a Disconnection of PEI from the Mainland

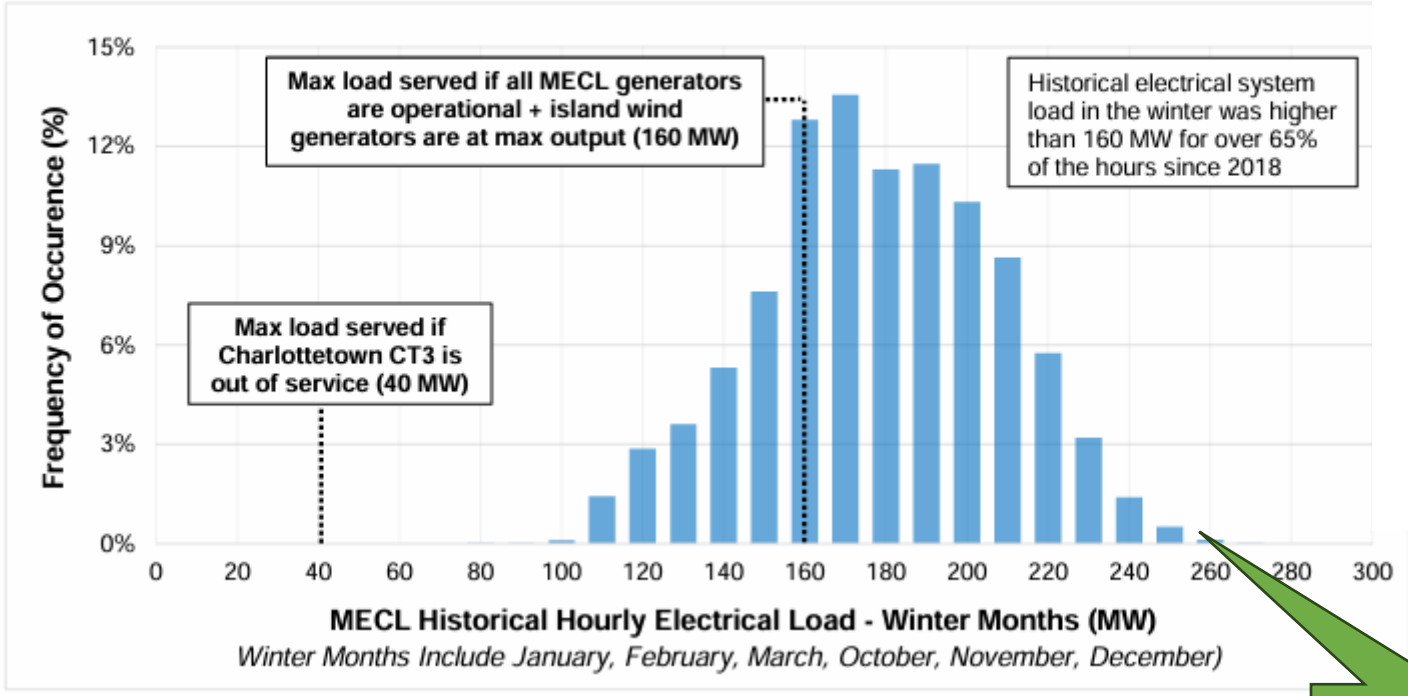


Table ES-2 — Historical Generation and Carbo

Source	Average Historical Generation (GWh, 2019-2021)[1]	% of Total
MECL Diesel Generators	1.2[3]	0.1%
Customer-Owned Generation (i.e., net-metered solar)	3.9	0.3%
PEI Wind Farms	295.3	21.0%
Point Lepreau Nuclear Generating Station	210.0	14.9%
Purchases from NBEM	898.1	63.7%
Total	1,408.5[3]	100.0%

MECL only (?) [No Summerside}

Source: