

SWITCH Presentation

Supposed to be parting thoughts but I'm no longer moving :>)

Rob Miller

June 1, 2018 (My mom's birthday)

Agenda – I Will Move Quickly

- Development work at 3G and CanPower
 - Honorable mention: Axio-SunEd, Northland, and Canadian Hydro projects
- Some of the benefits or outcomes of the microFIT and FIT program
- The GHG emissions reduction gap, and my concern that our politicians are not doing enough to address the problem; it seems to continue to be all talk and not enough action.
- Some Favorite Blogs or Media Feeds
- If there is time: Visualizing Energy and carbon pathways in Canada; a recap of some of David Layzell's work. One of the best presentations I've seen.



3G is an experienced developer in the wind and solar energy sector in Canada. The company's principals have experience developing over 200 MW's of wind and 200 MW's of solar PV projects across Canada.

<http://www.3g-energy.com/>

Contact information:

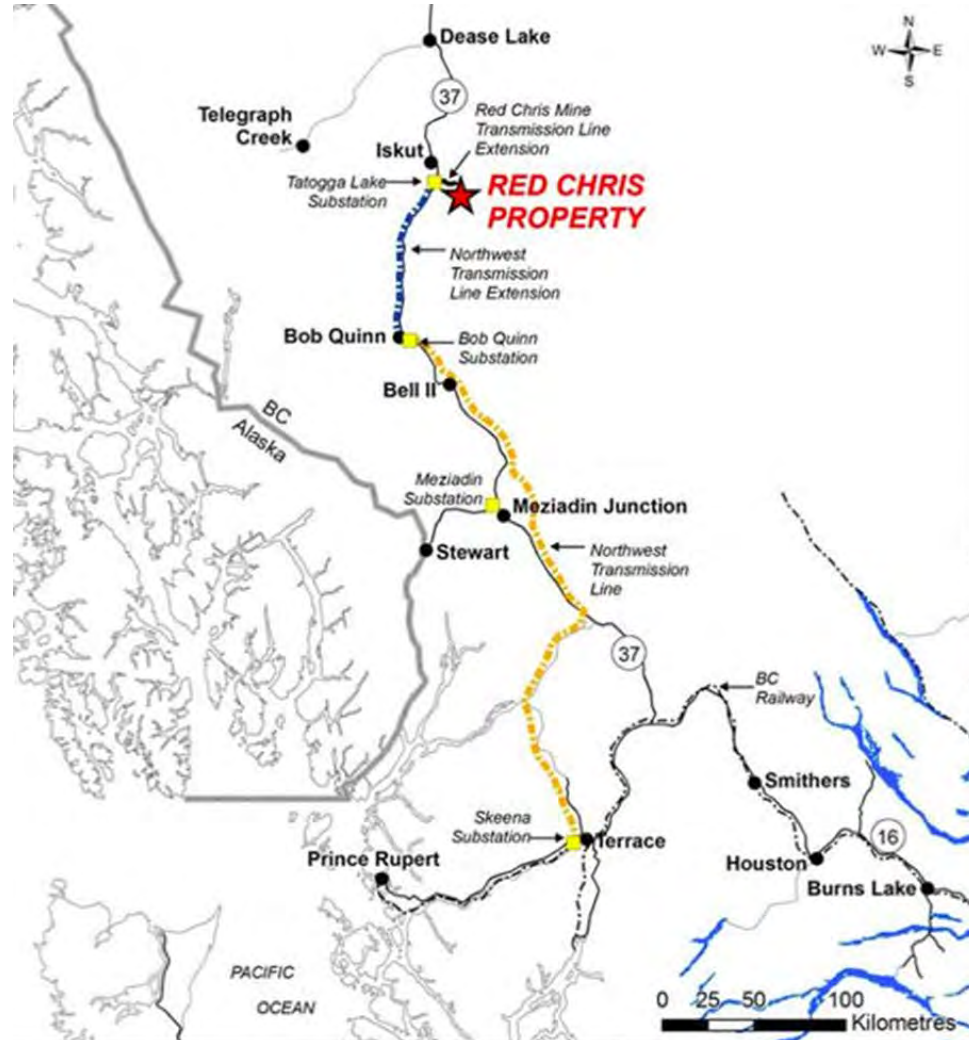
Graham Findlay, T: (613) 769-1300, Email: gfindlay@3g-energy.com

Rob Miller, T: (613) 888-0466, Email: rmiller@3g-energy.com

Some Project Examples:

- 1) Iskut, BC 130-250 MW
- 2) Willow Bunch, SK 100-200 MW
- 3) Manitoba, 600-700 MW
- 4) Higgins Mountain, NS 150 MW

Where I Was Last Week: Iskut, BC



Iskut Wind Project: 140 to 250 MW

Where is the project?

TSAYBAHE MOUNTAIN

Phase 1 is proposed for **Tsaybahe Mountain** and would consist of approximately **35 wind turbines**, each turbine being about 4 MW's in size. This first phase could be 140–150 MW in total nameplate capacity.

ZECHTOO MOUNTAIN

Phase 2 is proposed for **Zechtoo Mountain** and it would be developed after the project on Tsaybahe is complete. Phase 2 would be comprised of approximately **25 wind turbines** totaling 100 MW in capacity.



This image shows the proposed locations of the wind turbines.

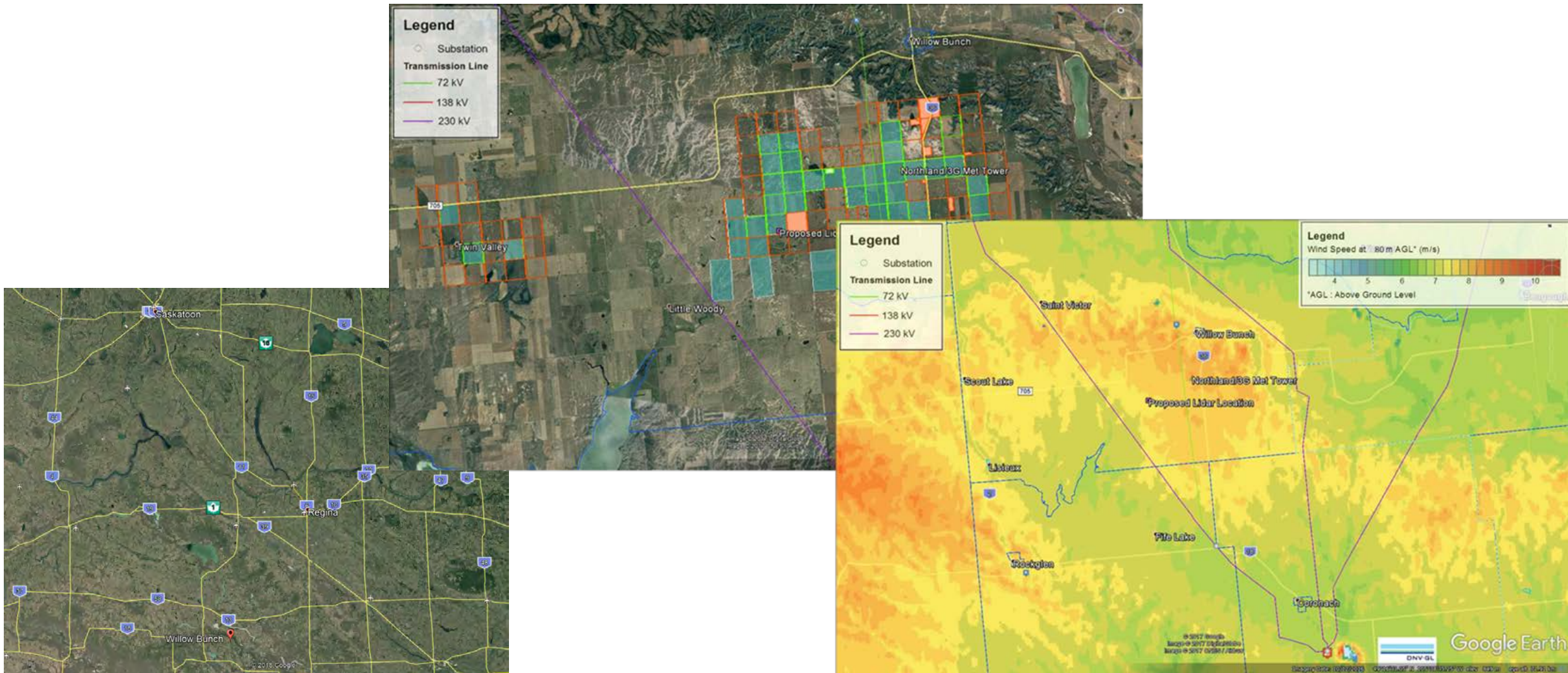
Appearance

The image below shows turbines on Tsaybahe Mountain in locations (blue dots) and the yellow line is the current access road.

What's not yet shown are things like the substation, maintenance building, equipment storage areas, and the power line going along the highway to the BC Hydro Tatogga Lake Substation, connecting to the North-West Transmission Line (NWTL).

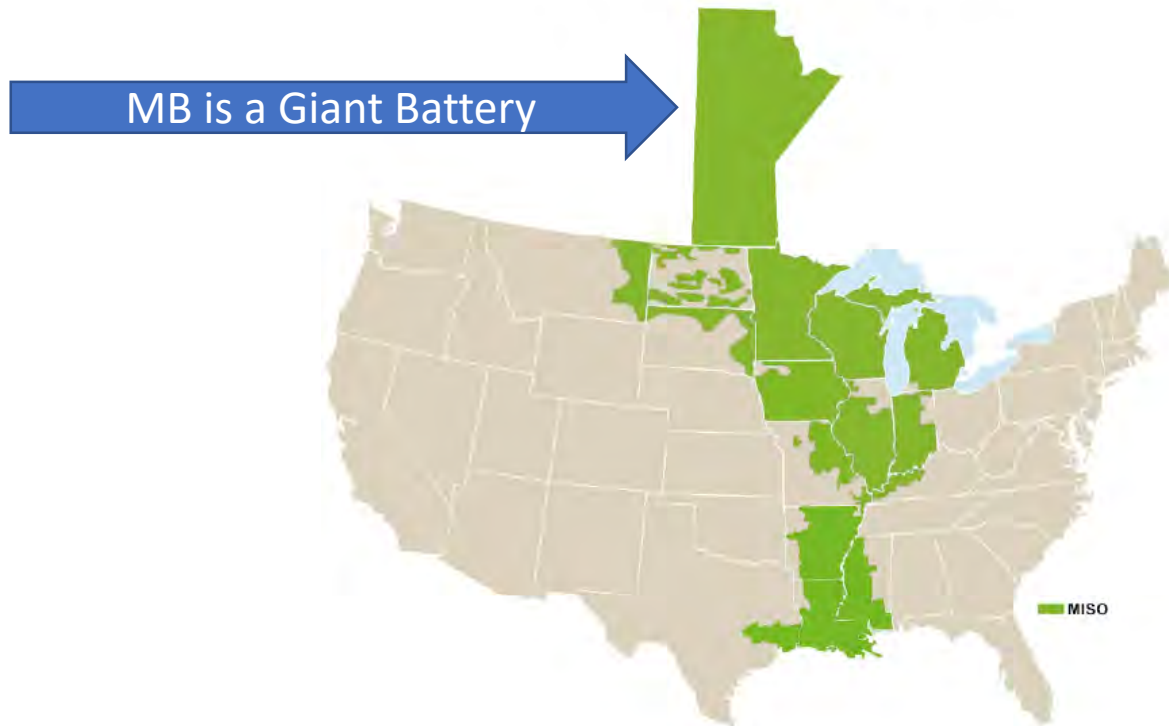


Willow Bunch SK: 100 - 200 MW Wind Project

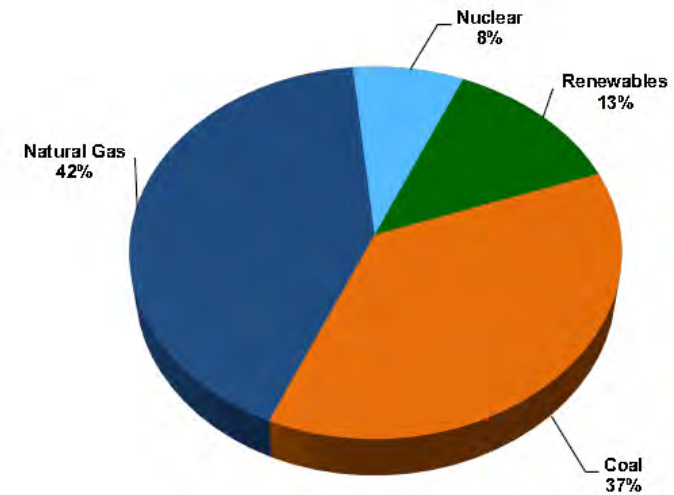


Looking at Manitoba: Export Opportunity

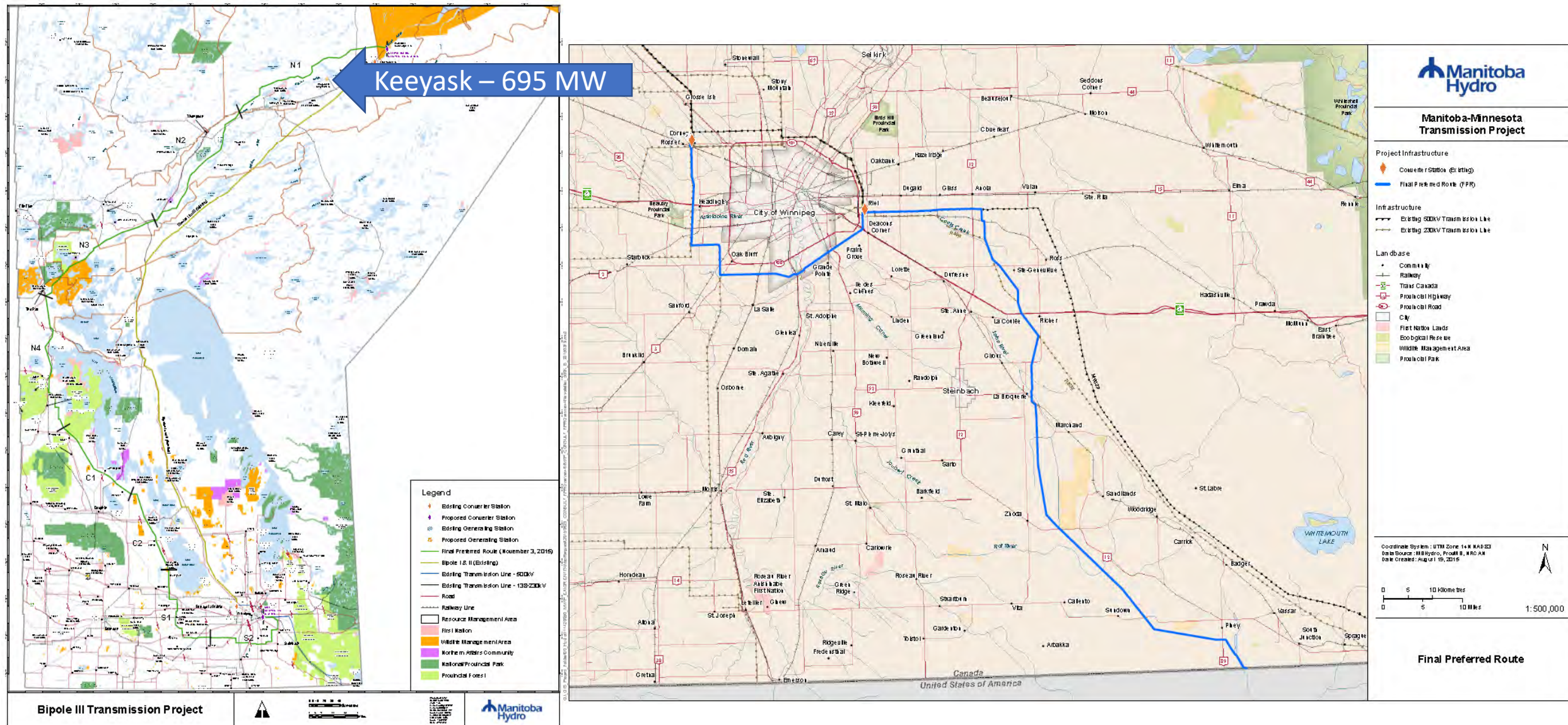
MISO's Diverse Footprint



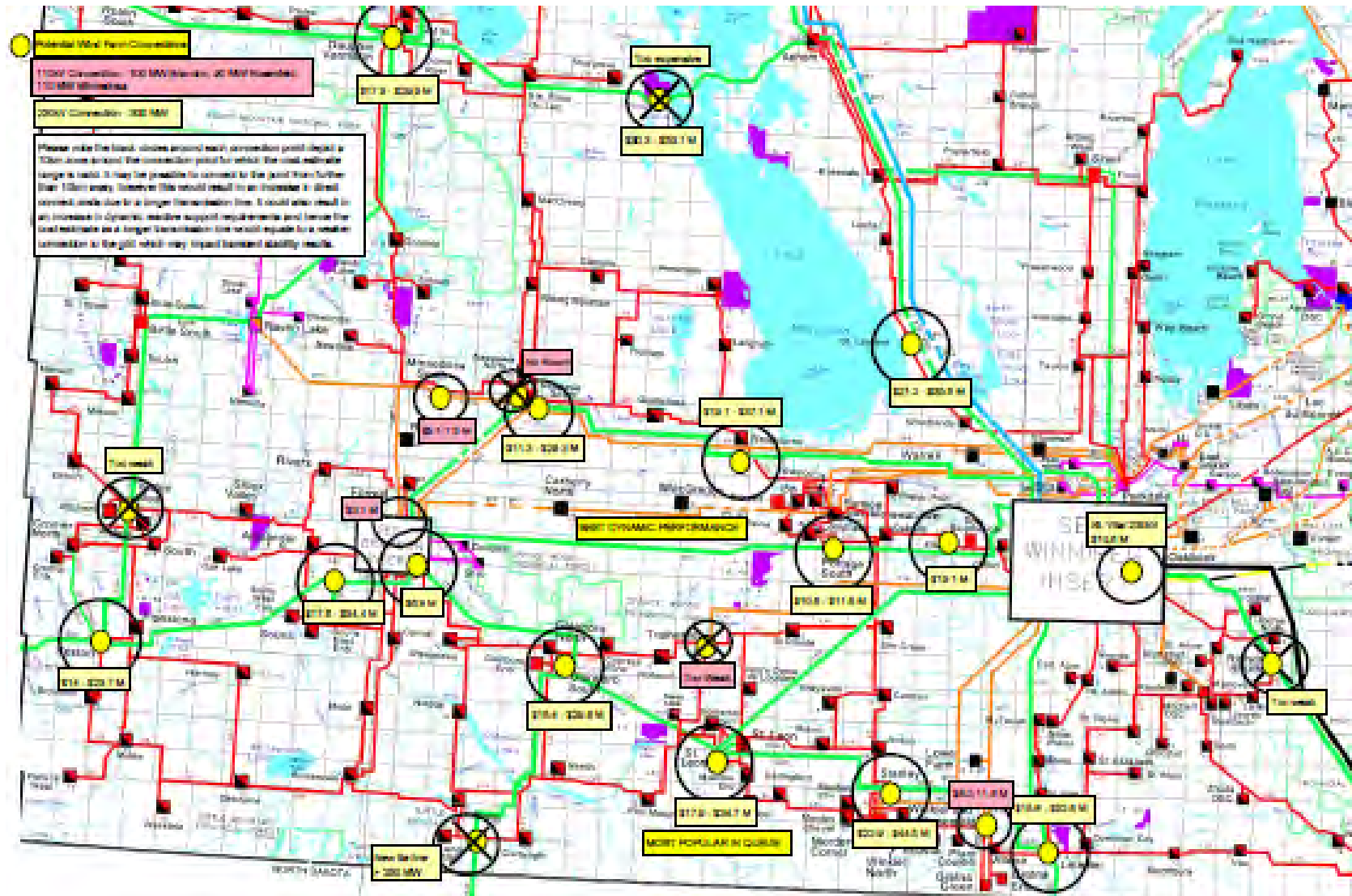
MISO's Capacity Market



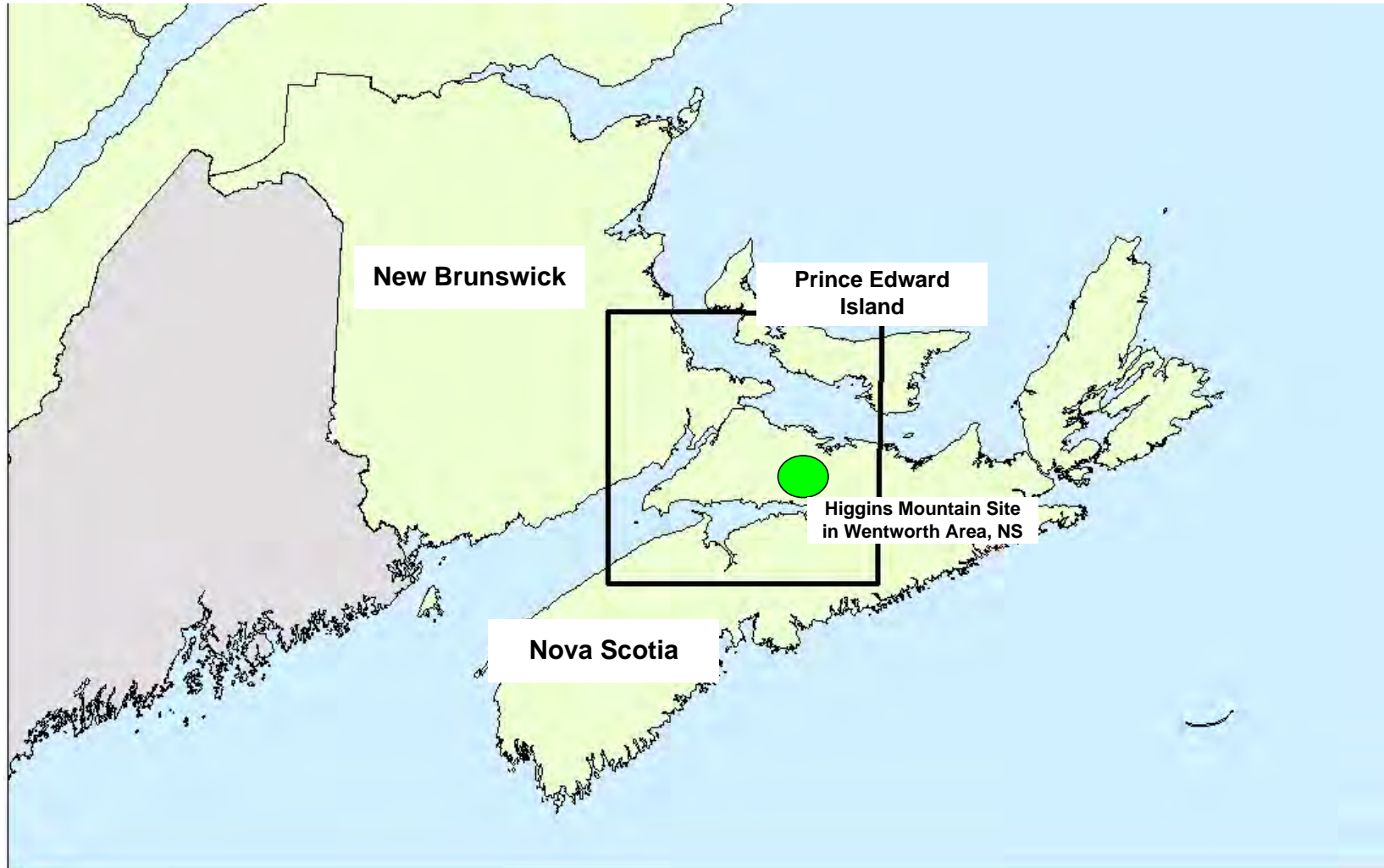
HVDC Bi-Pole III is Increasing Capacity



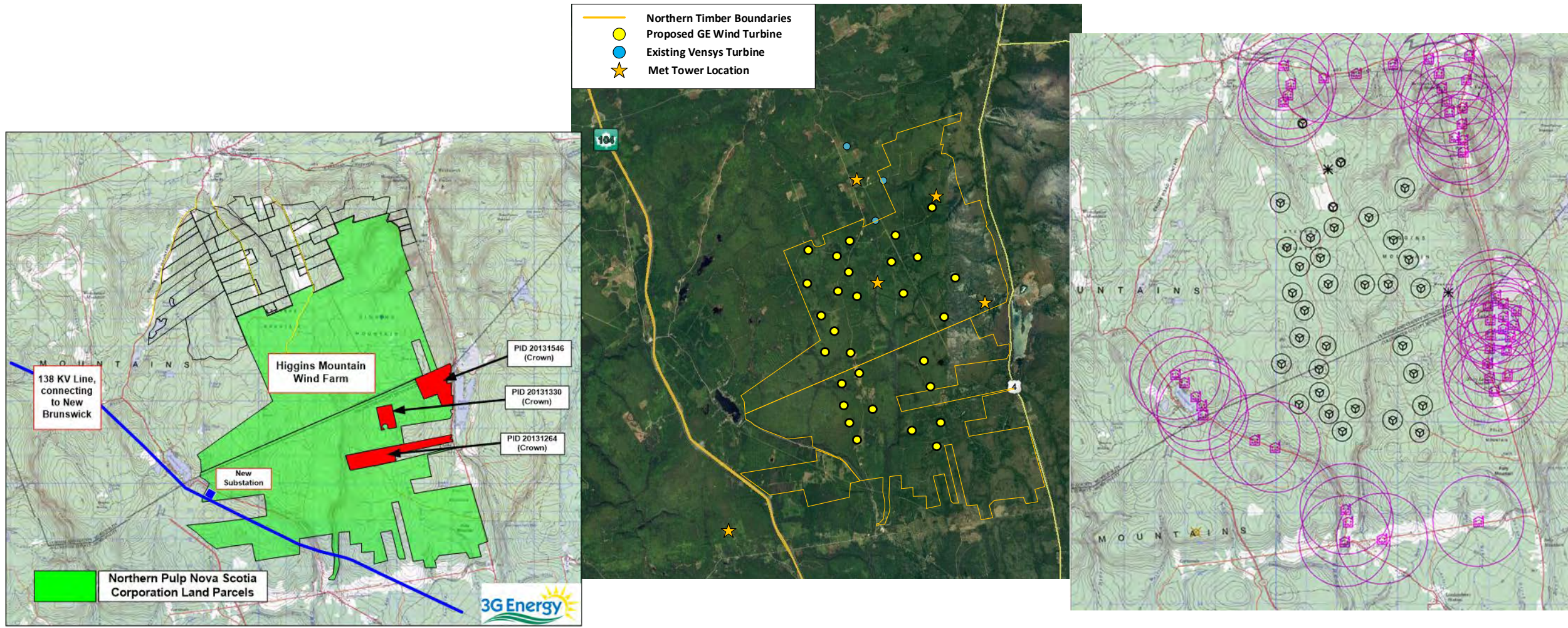
Southern Manitoba Transmission System and Wind Sites



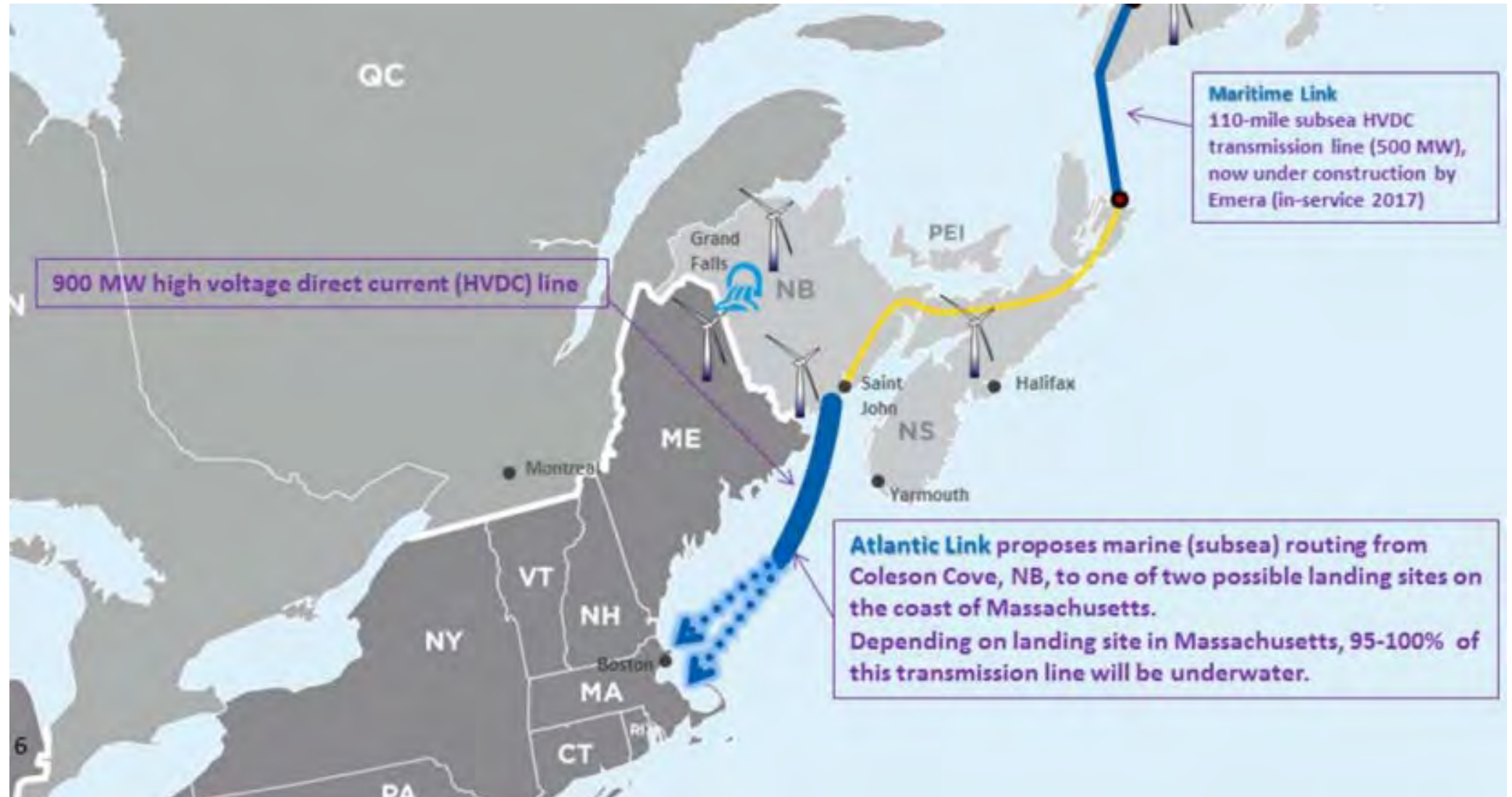
Higgins Mountain NS



Higgins Mountain NS – 150 MW Wind Farm

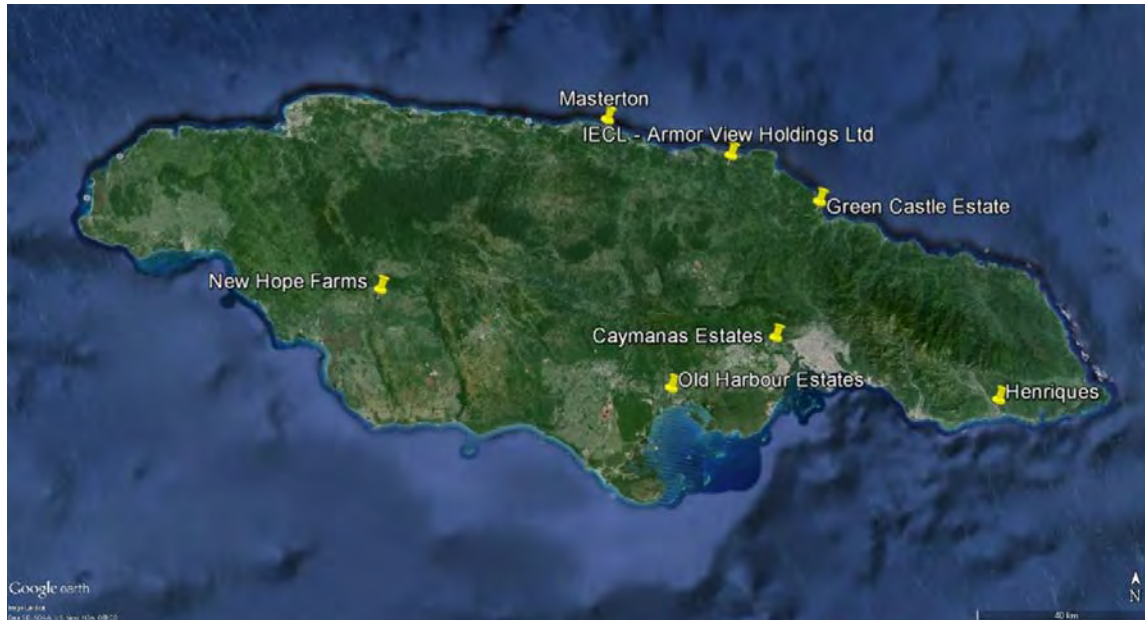


EMERA's Atlantic Link Project

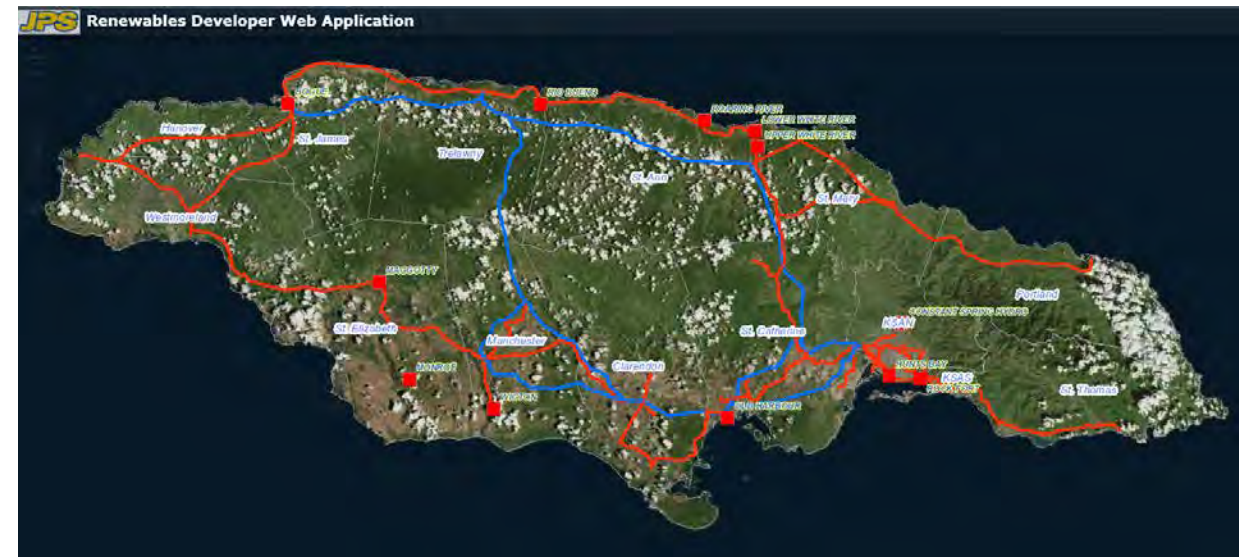


CanPower – Jamaica – Solar PV

Several Trips and Sites Visited



The Grid



Red circuits are 69 kV. Blue circuits are 138 kV.

CanPower – Sites In Jamaica

Green Castle Estates 20 MW Solar Farm



Date: Mar 8, 2018
Drawn by: G Findlay, P Eng

Plot Scale: As Shown



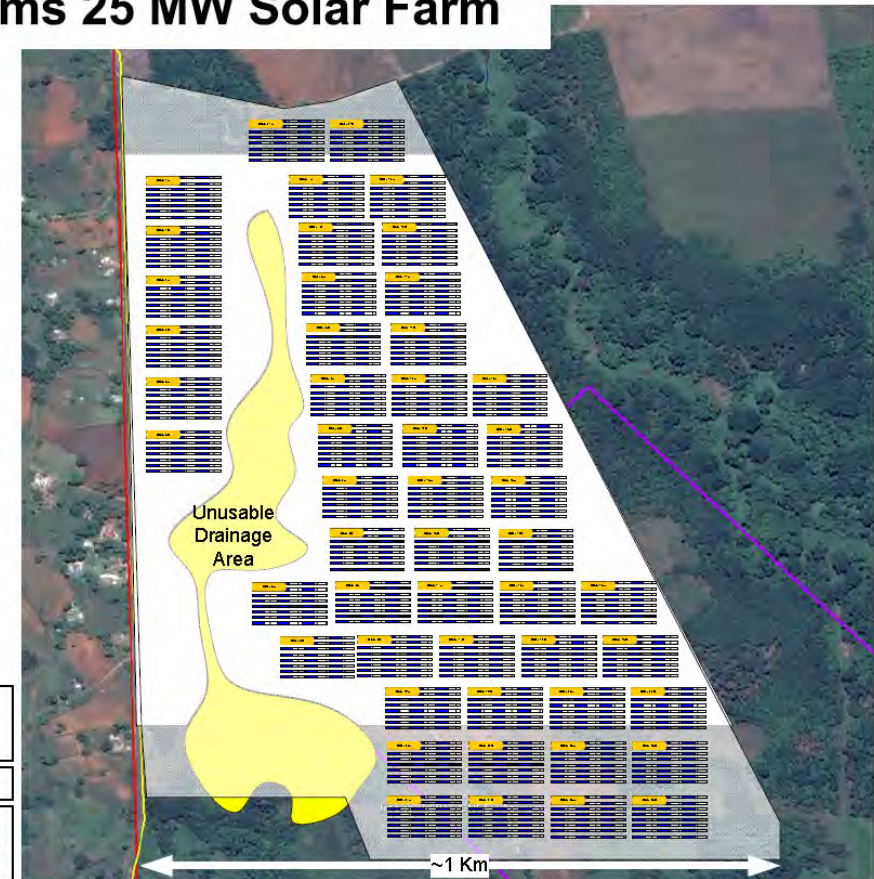
Drawing No:
GCE-S2

Bounded Area : Approx 74 Hectares

New Hope Farms 25 MW Solar Farm

Bounded Area :
Approx 220 Acres

Effective Use Area:
Approx 200 Acres



Date: Mar 15, 2016
Drawn by: G Findlay, P Eng

Plot Scale: As Shown

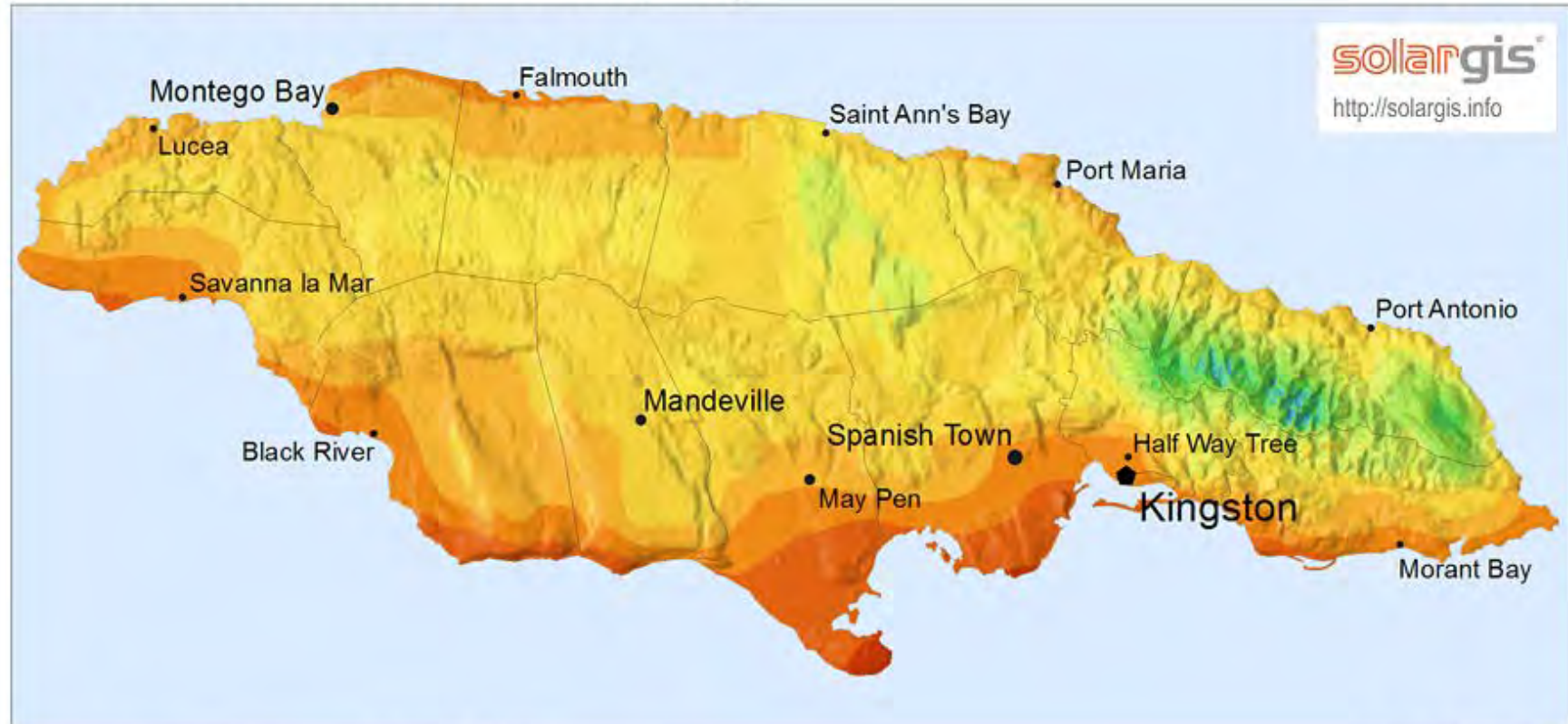


Drawing No:
NHF-S2 – Rev 2

Solar Resource

Global Horizontal Irradiation (GHI)

Jamaica



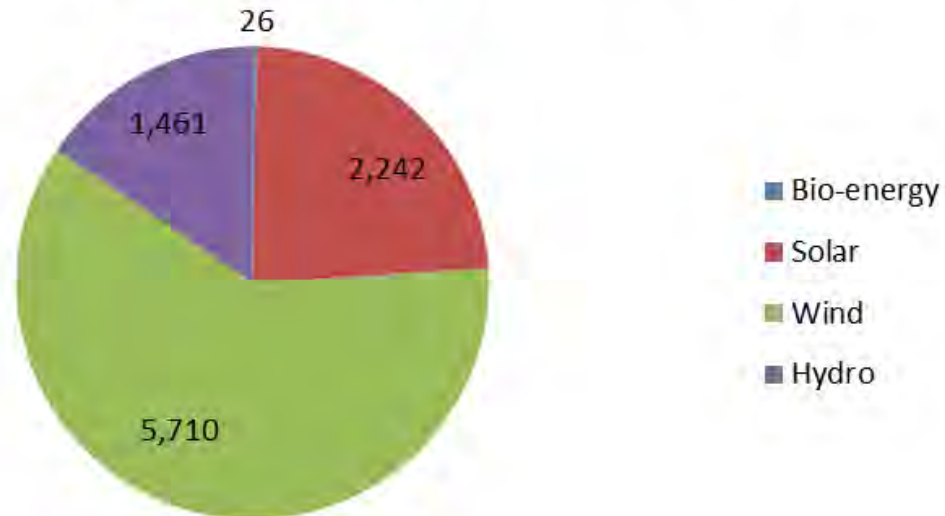
Average annual sum, period 1999-2013



GHI Solar Map © 2014 GeoModel Solar

FIT – RESOP Economic Benefit

Contract Capacity as of Dec. 31, 2017



Energy Source	MW's	Cost \$/kW	CAPEX Estimate (\$billions)
Bio-energy	26	\$ 4,200	\$ 0.11
Solar	2,242	\$ 4,500	\$ 10.09
Wind	5,710	\$ 2,500	\$ 14.28
Hydro	1,461	\$ 2,900	\$ 4.24
			\$ 28.71

Source: Active Generation List published by the IESO. (<http://www.ieso.ca/-/media/files/ieso/document-library/power-data/supply/ieso-active-contracted-generation-list.xlsx?la=en>).

Some Local Kingston Data - SUCCESS

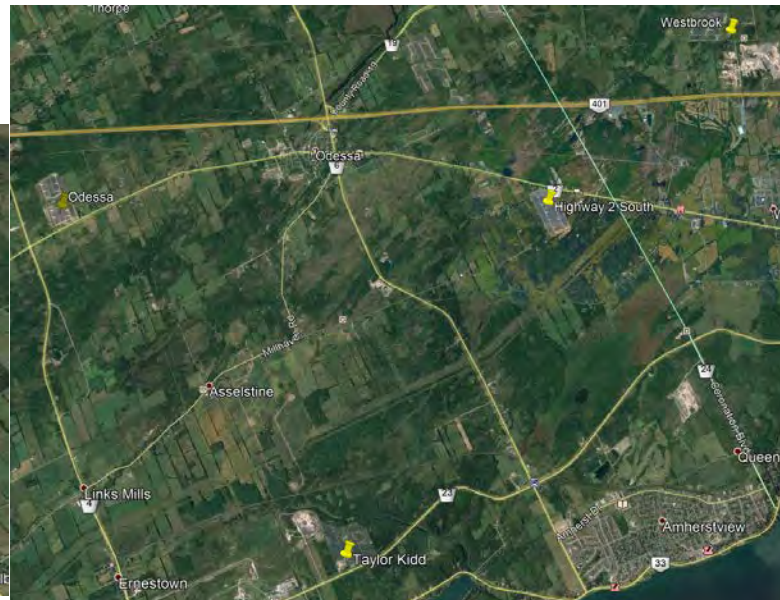
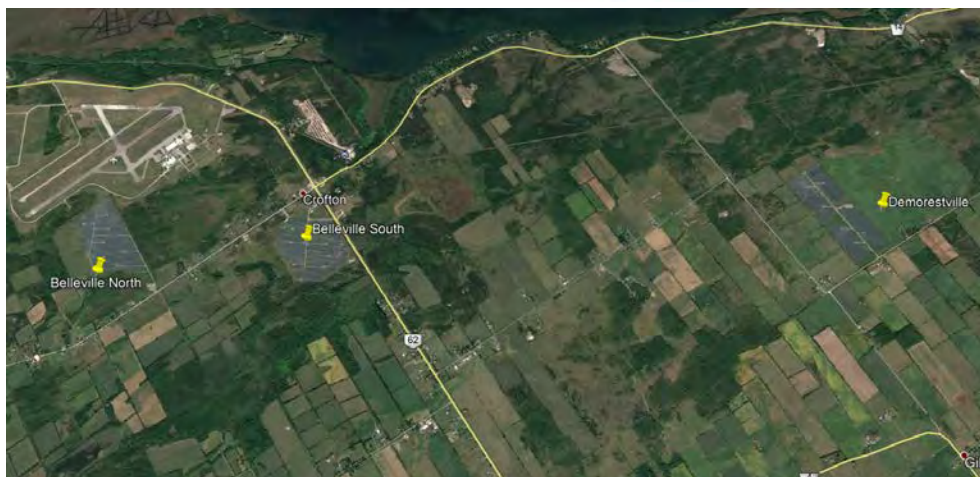
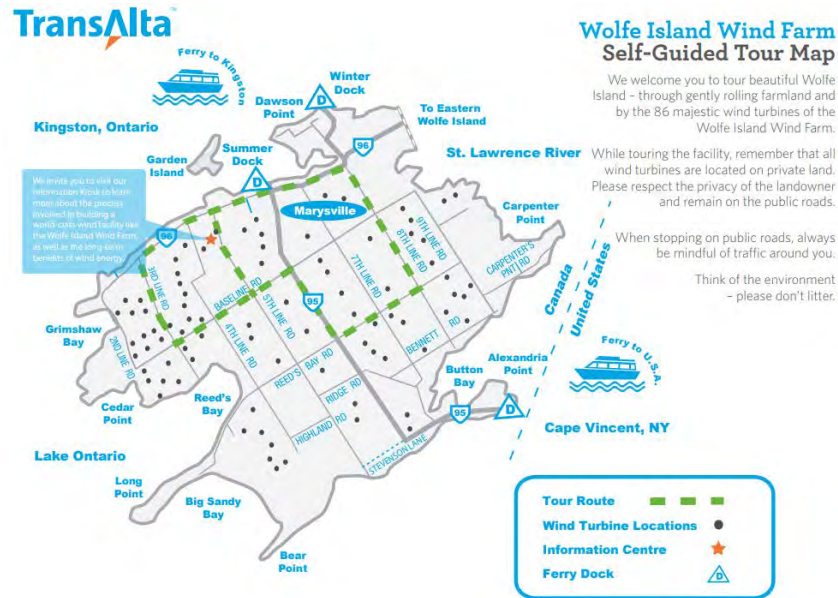
- As of the end of 2017 Kingston Hydro (Utilities Kingston) was at:
 - 5 FIT generators (665 kW),
 - 143 MicroFIT generators (1176 kW) ,
 - 3 Net-Metered generators (12kW).
- TOTAL is 1.8 MW's
- This does not include Hydro One, which is also in the City.

From

Hugh McLaren

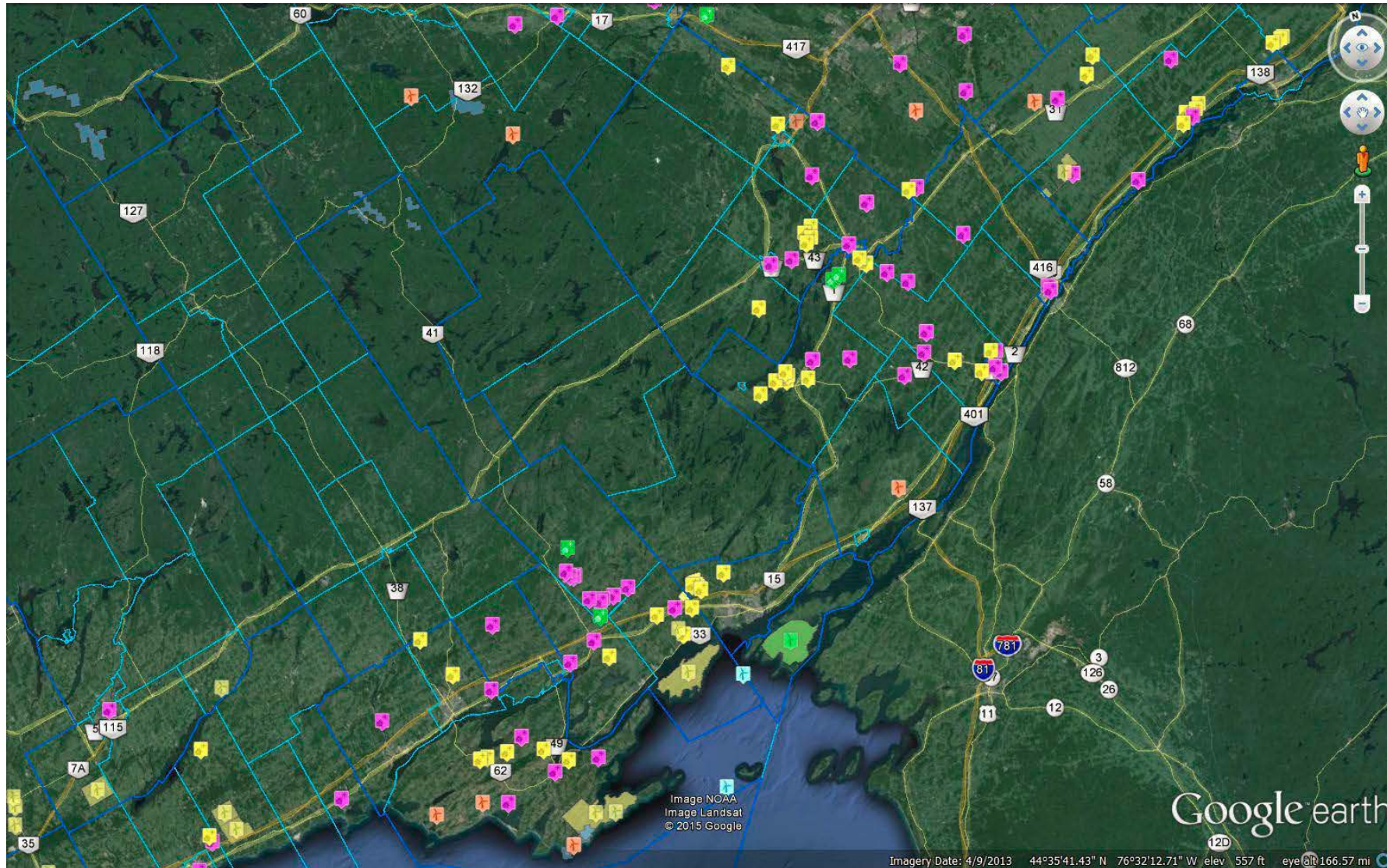
Services Advisor - Conservation
P.O. Box 790, Kingston, ON K7L 4X7
P: 613-546-1181 x.2509
hmclaren@utilitieskingston.com

Local Wind and Solar I Worked On



[illegible]

DNV-GL Database: Eastern Ontario

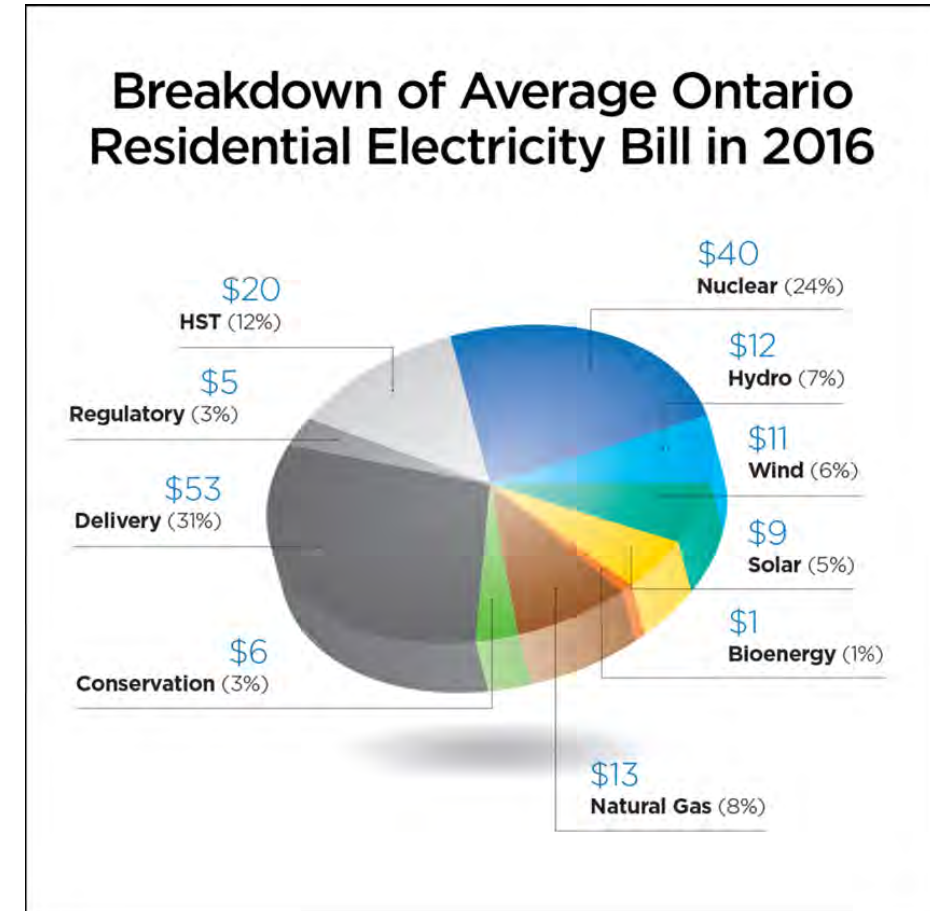


Don't Blame Solar For High Hydro Costs in Ontario

- [Wind and solar will be a long-term positive legacy. At the end of the contracts assets are still in place and the fuel is free.](#)
- <http://environmentaldefence.ca/report/ontarios-electricity-system/>

Wind, solar and biogas are only responsible for a small share of electricity bills, about \$20 per month, or 12 per cent of an average Ontario residential electricity bill.

- <https://www.pvbuzz.com/solar-high-hydro-costs-ontario/>



Source: https://d36rd3gki5z3d3.cloudfront.net/wp-content/uploads/2017/02/ElectricityRates_FB_v1-2-1024x1024.png

Blame Nuclear For Most of Our Cost Increases!



EB-2016-0152
Nuclear Rate Smoothing

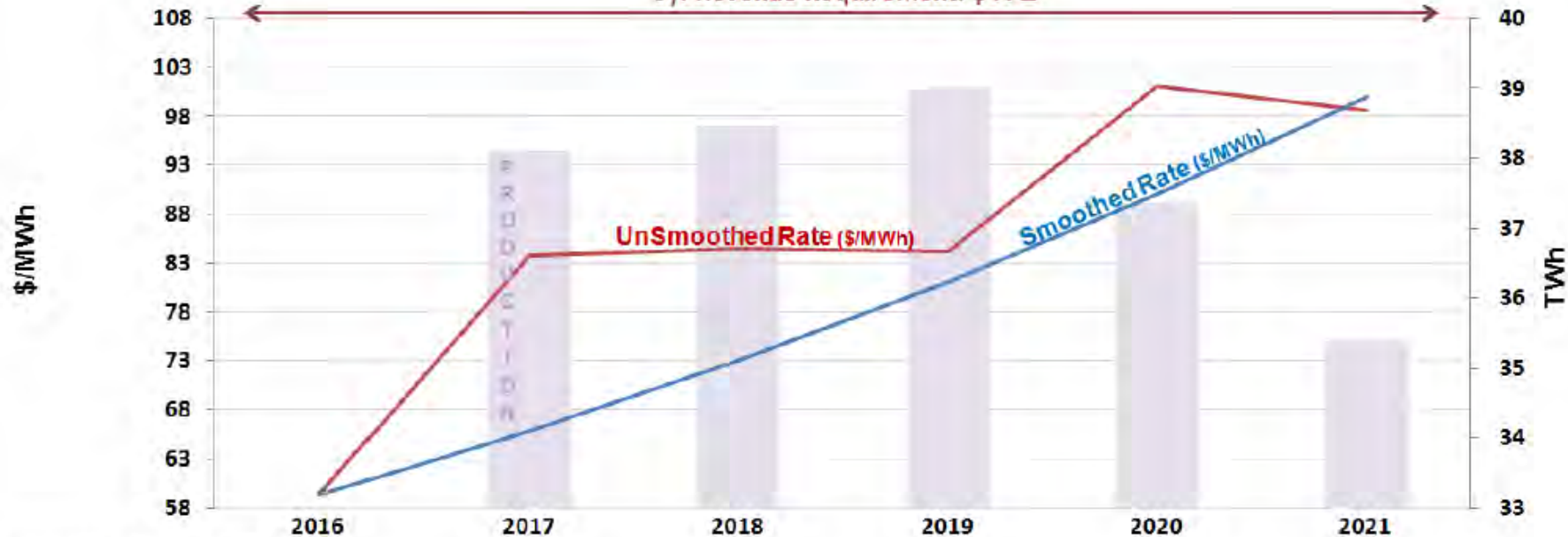
*Untranscribed Technical Conference
September 23, 2016*

Chris Fralick
Vice President, Regulatory Affairs
Randy Pugh
Director, Regulatory Affairs

Mechanics of OPG's Rate Smoothing Proposal

Rate Smoothing Proposal 2017-2021

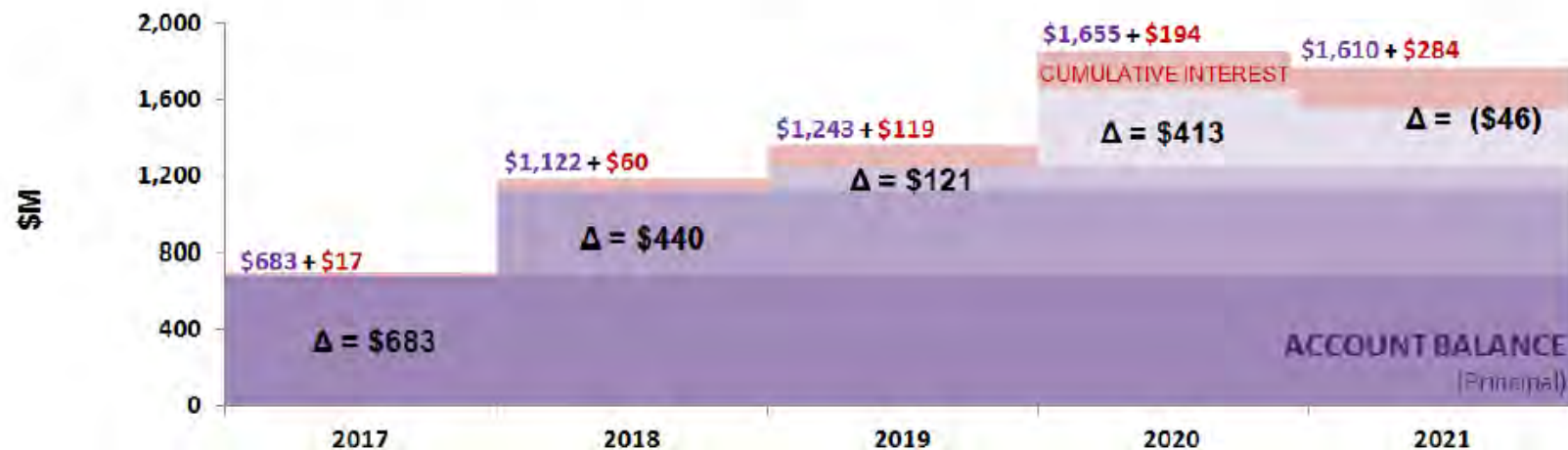
5yr Revenue Requirement: \$17B



1) Proposed Production (TWh)	2016	2017	2018	2019	2020	2021
2) Unsmoothed Rates (\$/MWh)	59.29	83.73	84.48	84.17	101.05	98.62
3) Smoothed Rate (\$/MWh)	59.29	65.81	73.05	81.09	90.01	99.91

Mechanics of OPG's Rate Smoothing Proposal

Rate Smoothing Deferral Account 2017-2021



1) Proposed Production (TWh)	38.1	38.5	39.0	37.4	35.4
2) Unsmoothed Rates (\$/MWh)	83.73	84.48	84.17	101.05	98.62
3) Smoothed Rate (\$/MWh)	65.81	73.05	81.09	90.01	99.91
4) Annual Deferred Amt (\$M)	683	440	121	413	(46)
5) Cumulative Deferred Amt (\$M)	683	1,122	1,243	1,655	1,610
6) Est. Interest Expense (\$M)	17	43	59	75	90
7) Est. Cumulative Interest (\$M)	17	60	119	194	284

Rate Smoothing Criteria

Post-Recovery Transition

- Rate smoothing should not result in a large step-change in rates at the end of the recovery period. OPG's proposal minimizes the risk of significant customer "rate shock" when the recovery period ends



Intergenerational Equity

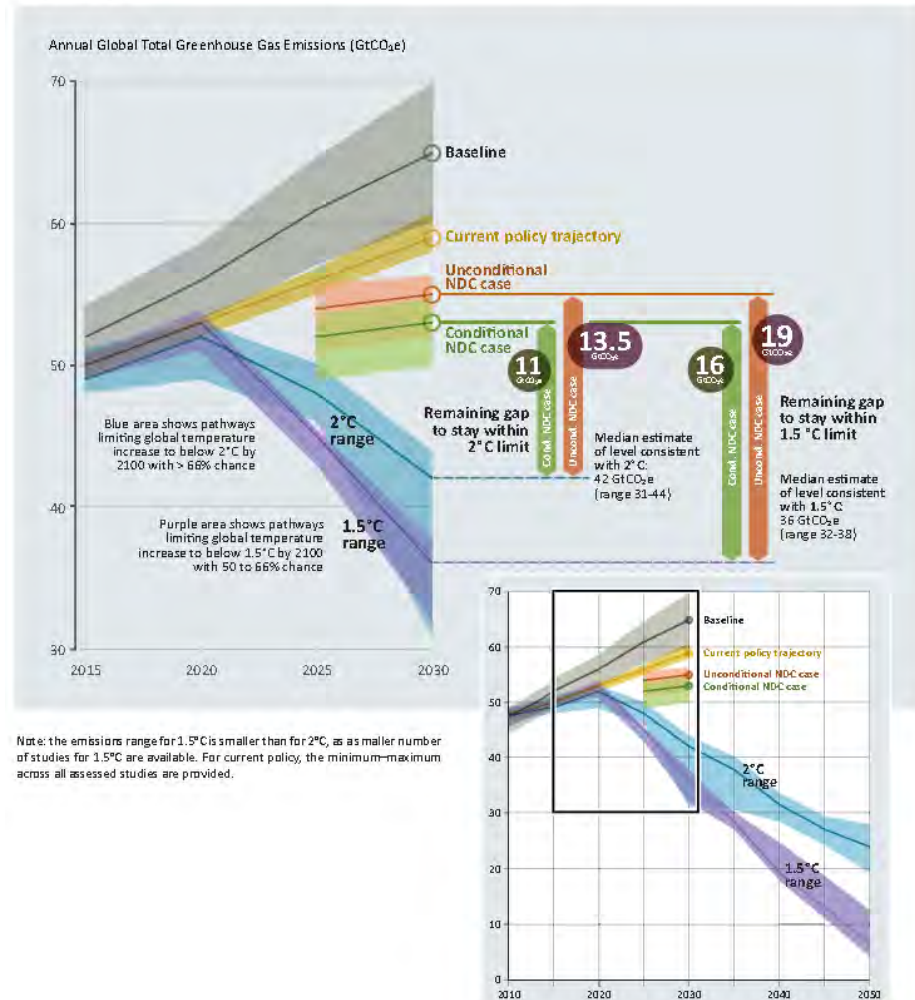
- Rate smoothing necessarily involves transferring recovery of certain costs from one period to another. OPG's proposal aims to balance the benefit of stable rates against the carrying costs borne by future customers

Customer Bill Impact

- Rate smoothing is about balancing the short-term and long-term costs and benefits listed above. The magnitude of the customer bill impact over the full deferral and recovery period should be reasonable in the circumstances

What Worries ME: The Global Gap – 13.5 Gt

Figure ES.2: Global greenhouse gas emissions under different scenarios and the emissions gap in 2030 (median estimate and 10th to 90th percentile range).



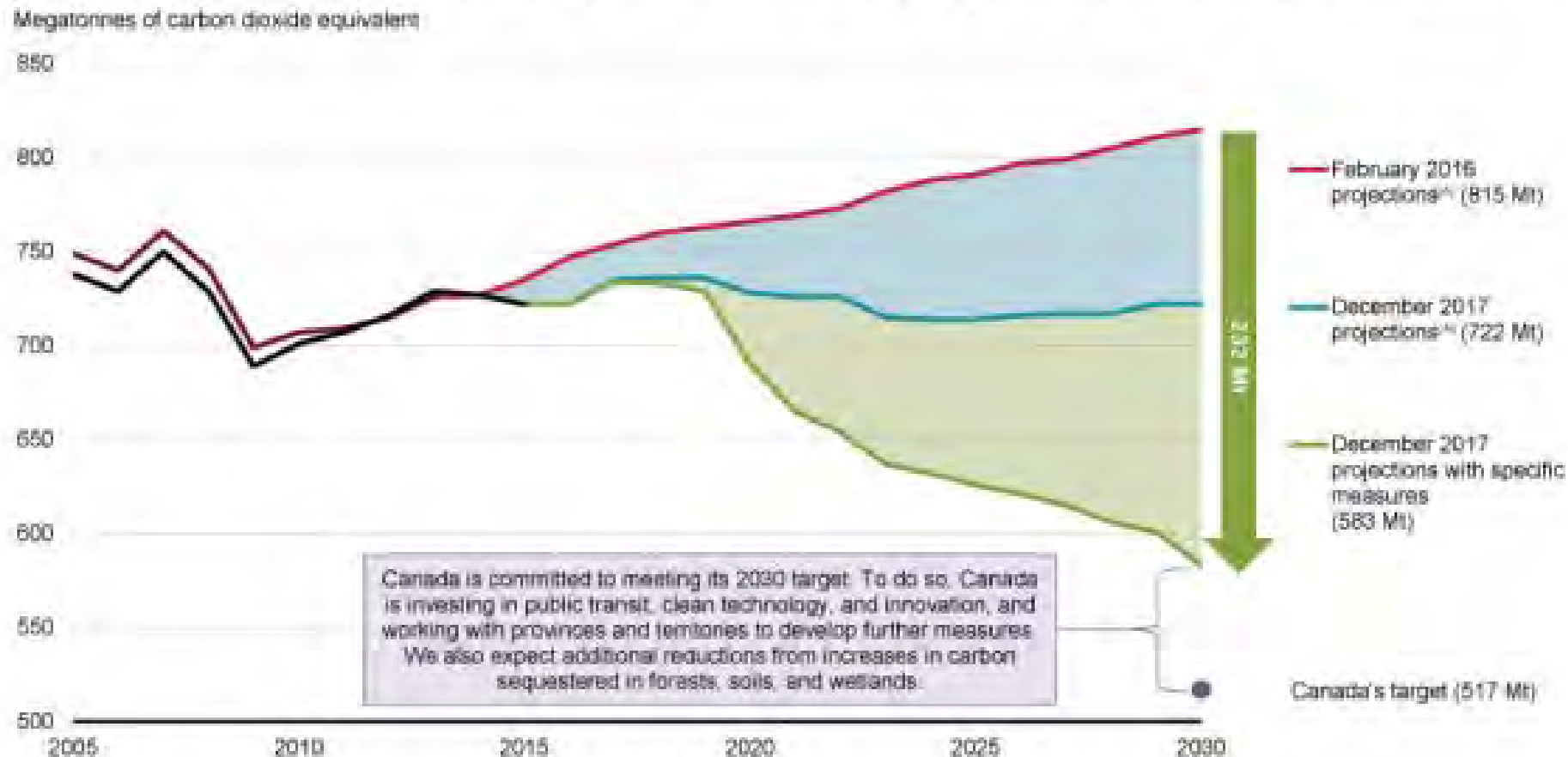
Source:

https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf

The Emissions Gap Report 2017, a UN Environment Synthesis Report

What Worries ME: The Canadian Gap – 205 or 232 Mt

Figure 1. Historical greenhouse gas emissions and projections, Canada, 2005 to 2030¹



700 Mt Flat Line and Sources of GHG's

Figure S-1 Canadian GHG Emissions Trend (2005–2016) (excluding LULUCF)

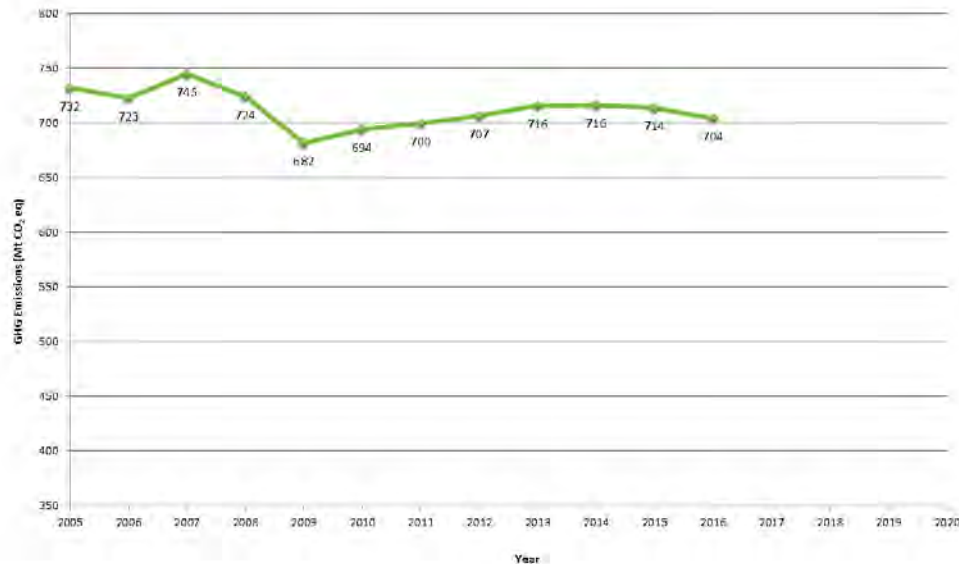
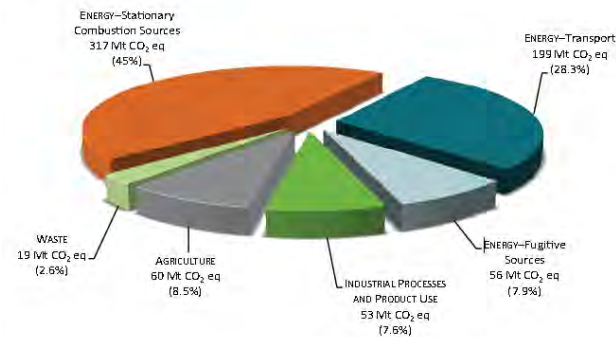
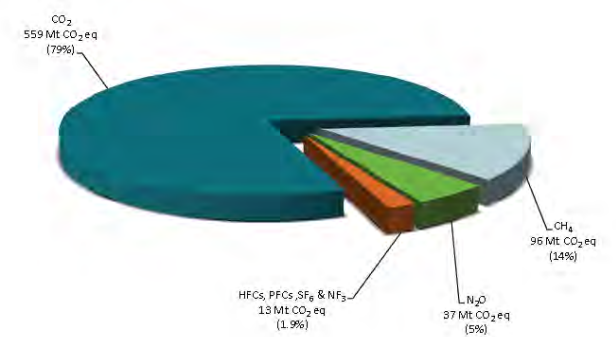


Figure S-2 Breakdown of Canada's Emissions by IPCC Sector (2016)*



*Note: Totals may not add up due to rounding.

Figure S-3 Breakdown of Canada's Emissions by GHG (2016)*

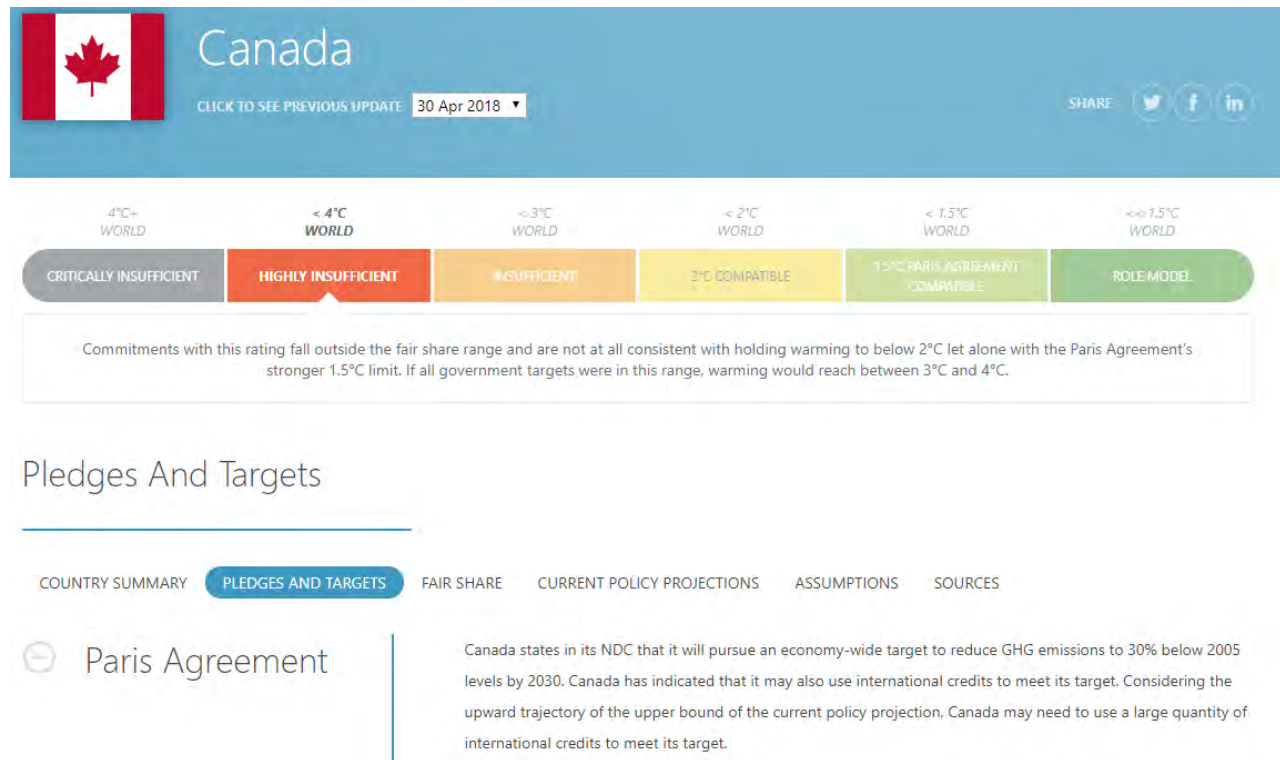


Total: 704 Mt CO₂ eq

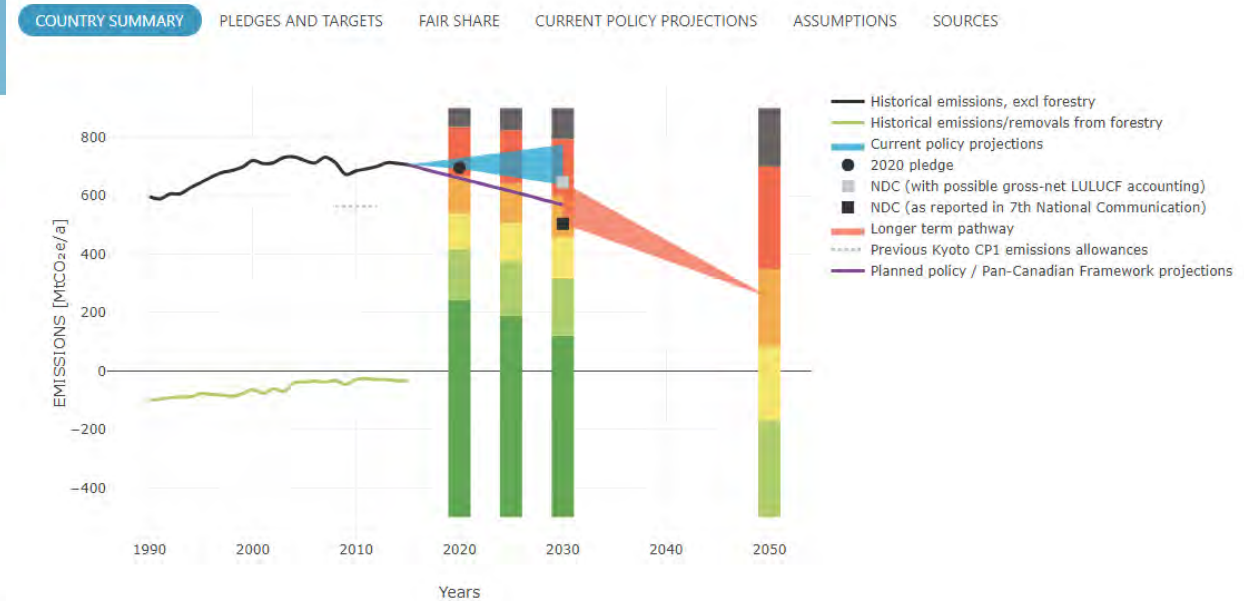
- 81% is from Stationary Combustion, Transport and Fugitive Emissions
- 79% of our GHG emissions is CO₂ from combustion
- Based on 2014 data Canada is only 1.6% of global GHG emissions, BUT, we are one of the highest per capita emitters.

Source: <https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/emissions-inventories-reporting/nir-executive-summary/National%20Inventory%20Report%20Executive%20Summary%202018.pdf>

Climate Action Tracker – Highly Insufficient



<https://climateactiontracker.org/countries/canada/pledges-and-targets/>



<https://climateactiontracker.org/countries/canada/>

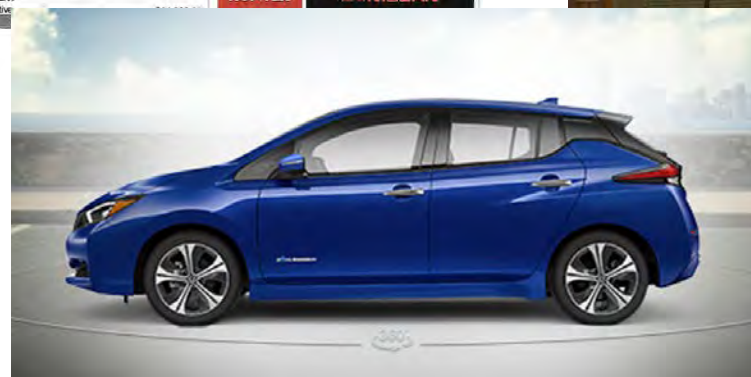
How Do We Fix This?

- Electrification
 - As long as electricity is from non GHG emitting sources, like renewables
 - Electrify transportation and space heating
 - We have to stop burning fossil fuels; gasoline, diesel, and natural gas
 - Maybe we should build (green) electricity transmission lines and not oil and/or gas pipelines.
 - I think it is a simple choice, but a tough (political) decision.

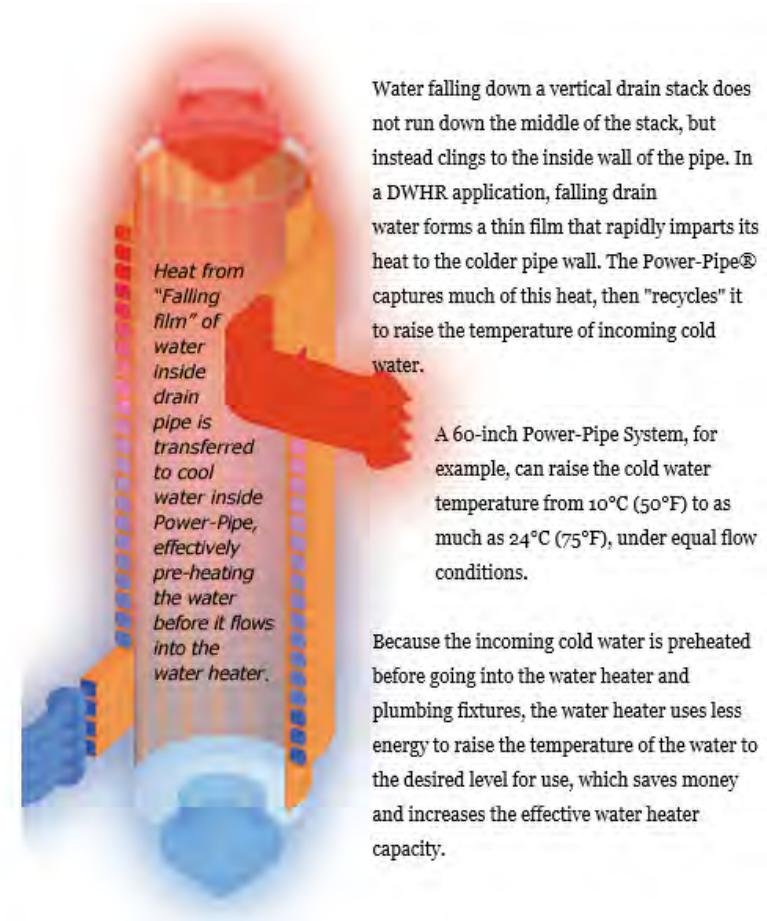
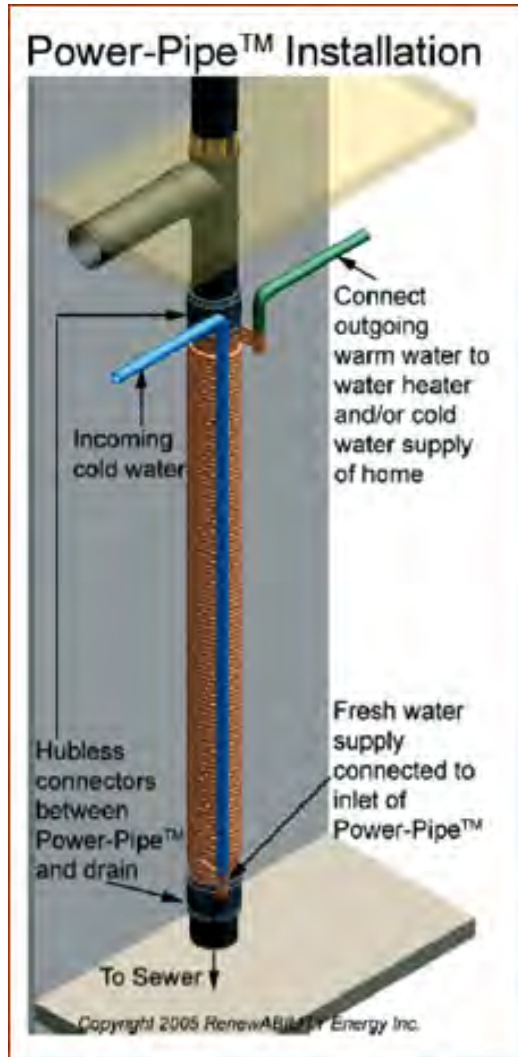
What Can We do? What Have I Tried To Do?



KINGSTON NISSAN		DEAL SUMMARY	407225
775 Gardners Rd. Kingston, ON K7M7B1 Tel: 613-384-2531 Fax: 613-384-2543		DESKT CUST# 5249443	DEAL#
Financial Services Manager:			STOCK#
DATE OF SALE		YEAR TYPE MAKE MODEL MFR MOD CODE TRIM	
BUYER Robert Miller 172 Churchill Cms. Kingston ON K7L 4N2 (613) 885-0468 robert.miller@googco.ca LIC. M4359-65806-50519		2018 New Nissan LEAF PSTE18 SL Hatchback	
VEHICLE AND OPTIONS		PKG EXLT. COLOR INT. COLOR	
Basic MSRP \$41,998.00		AA00 Deep Blue Pearl Black, Leather-Appointed Seating	
DEEP BLUE PEARL \$300.00		VN	
PACKAGE ADD. VIND OPTIONS MONOTONE PAINT, BLACK LEATHER-APPOINTED SEATING		MAX DIST. TRAV. DELIVERY DATE	
Destination \$1,990.00		NM	
Air Tax \$100.00			
Total MSRP \$44,348.00			
PRICE INFORMATION		REMARKS:	
Total Vehicle Price \$44,348.00		1/ We have reviewed the above disclosure and agree to the vehicle, price and payment information as declared.	
Wheel Locks \$80.00			
GMVIC \$10.00			
Tire Tax \$18.75			
Vehicle Recovery Program \$199.00			
Subtotal \$44,655.75			
HST 13% \$5,805.25			
Subtotal \$50,461.00			
DOWN PAYMENT			
ON Gov Incentive			
TOTAL			

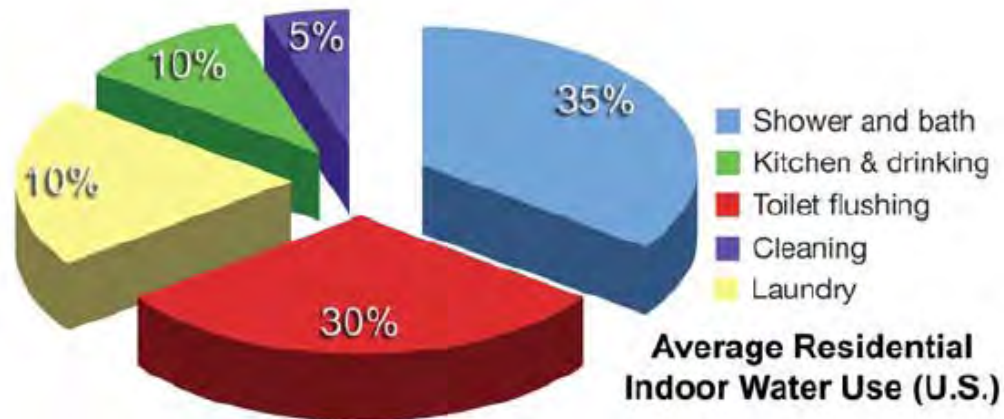


Power Pipe



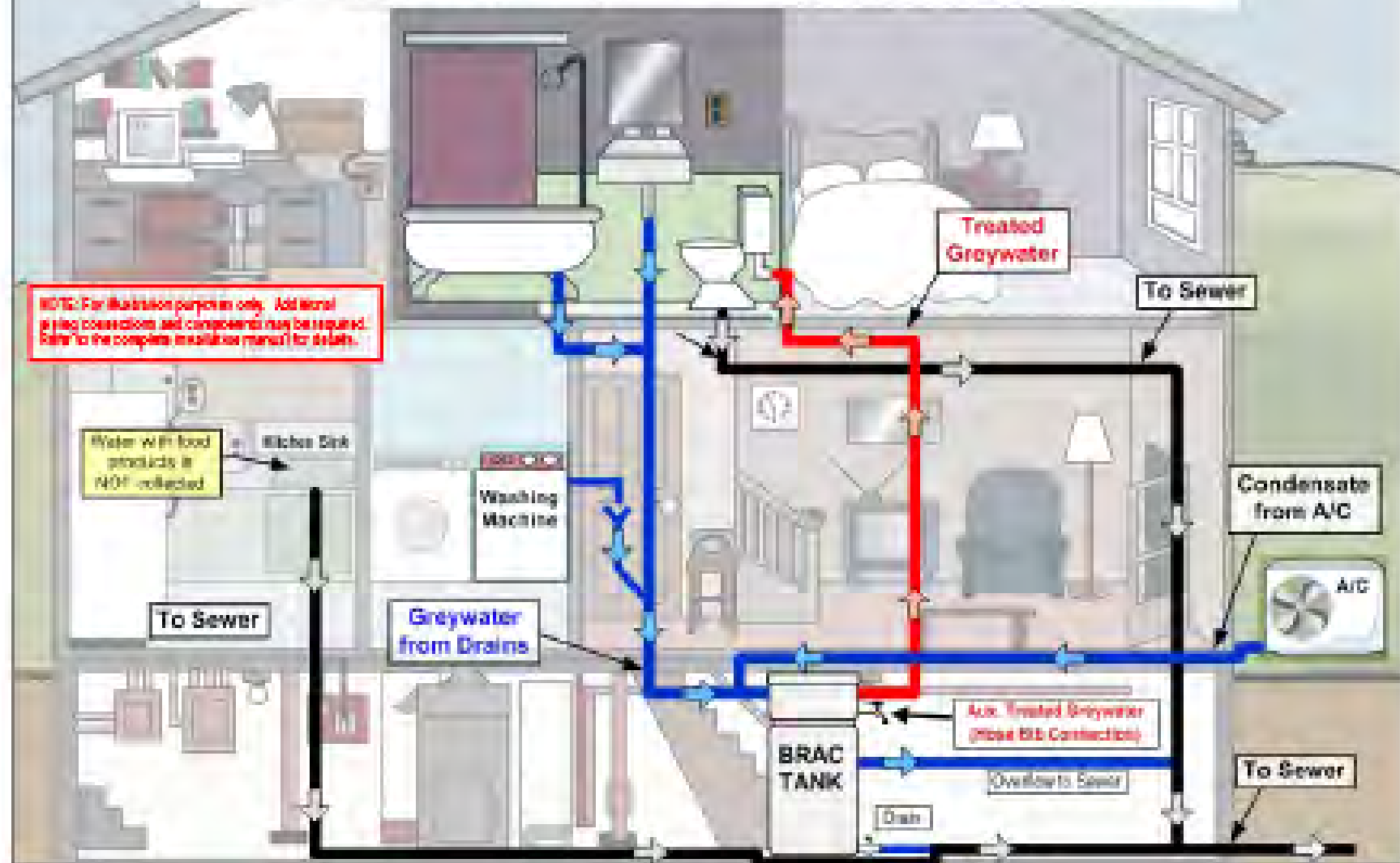
Greywater Recycling

- About 1/3 of the water we use is to flush toilets
- We only pay about \$0.50 for 1,000 litres (a cubic metre) of municipal water (double that for sewage)
- What do you pay for 1 litre of pop?
- We use treated, delivered, and potable water to flush toilets
- One water conservation idea is to collect, store, and use 'Gray Water' to flush toilets



How the Brac system works

Nearly a third of your water (and the money that you spend on it) goes down the toilet. The Brac Greywater System is an inexpensive solution to the problem.



Some Favorite Blogs or Media Feeds

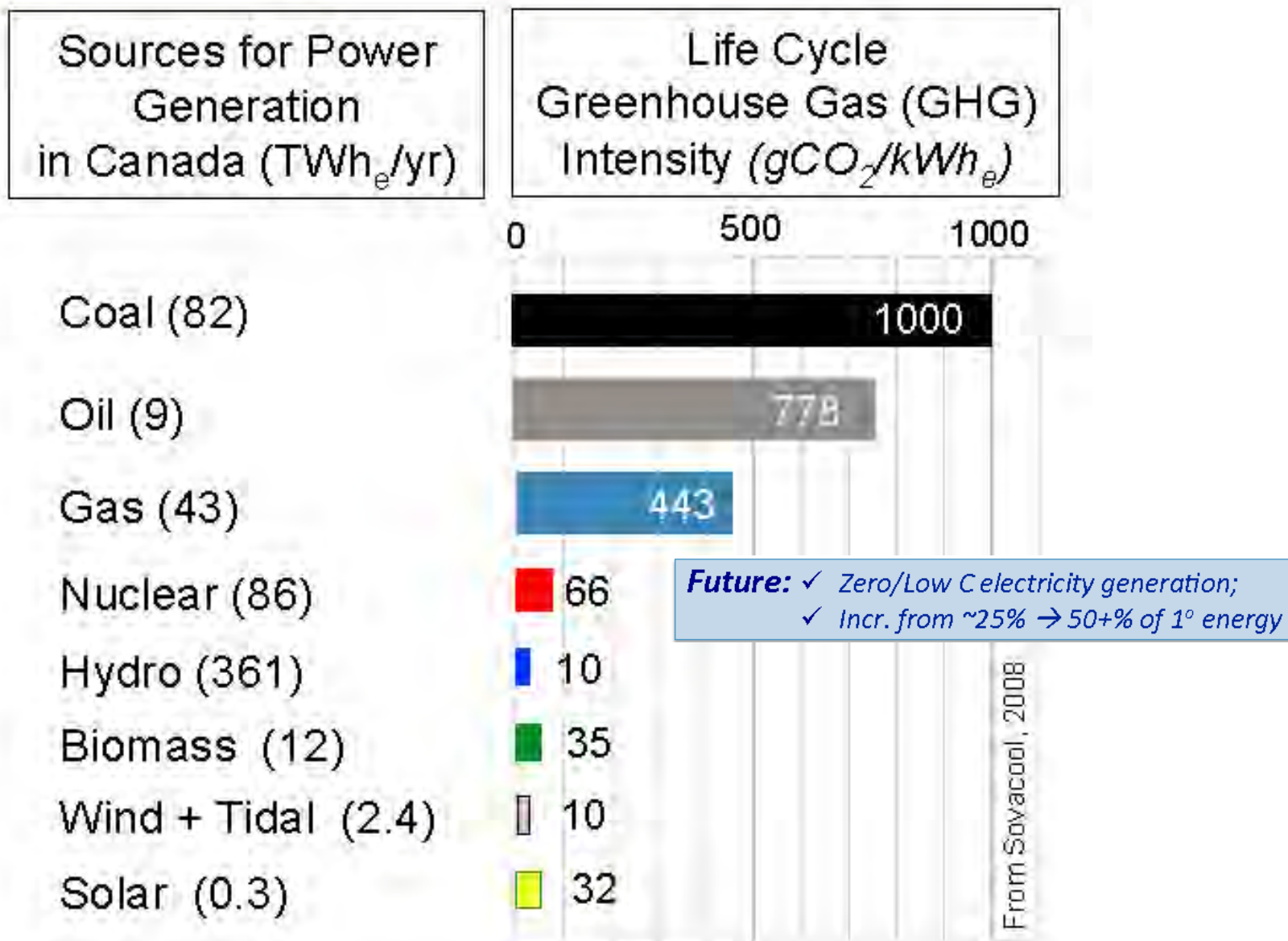
- <https://www.greentechmedia.com>
 - gtm = Greentech media and there are sections for solar, storage, wind, etc.
- <https://www.pvbuzz.com/>
 - **DON'T BLAME SOLAR POWER FOR HIGH HYDRO COSTS IN ONTARIO**
<https://www.pvbuzz.com/solar-high-hydro-costs-ontario/>
- <https://www.renewableenergyworld.com/index.html>
 - There are sections for solar, storage, wind, etc.
- <http://mercomcapital.com/>
 - You then have to sign up for their 'Clean Energy Market Intelligence Report'

Visualizing Energy:

*A case for
rethinking Canada's
electrical systems.*

David B. Layzell, PhD, FRSC
- University of Calgary -

Electricity: No emissions at point of use!



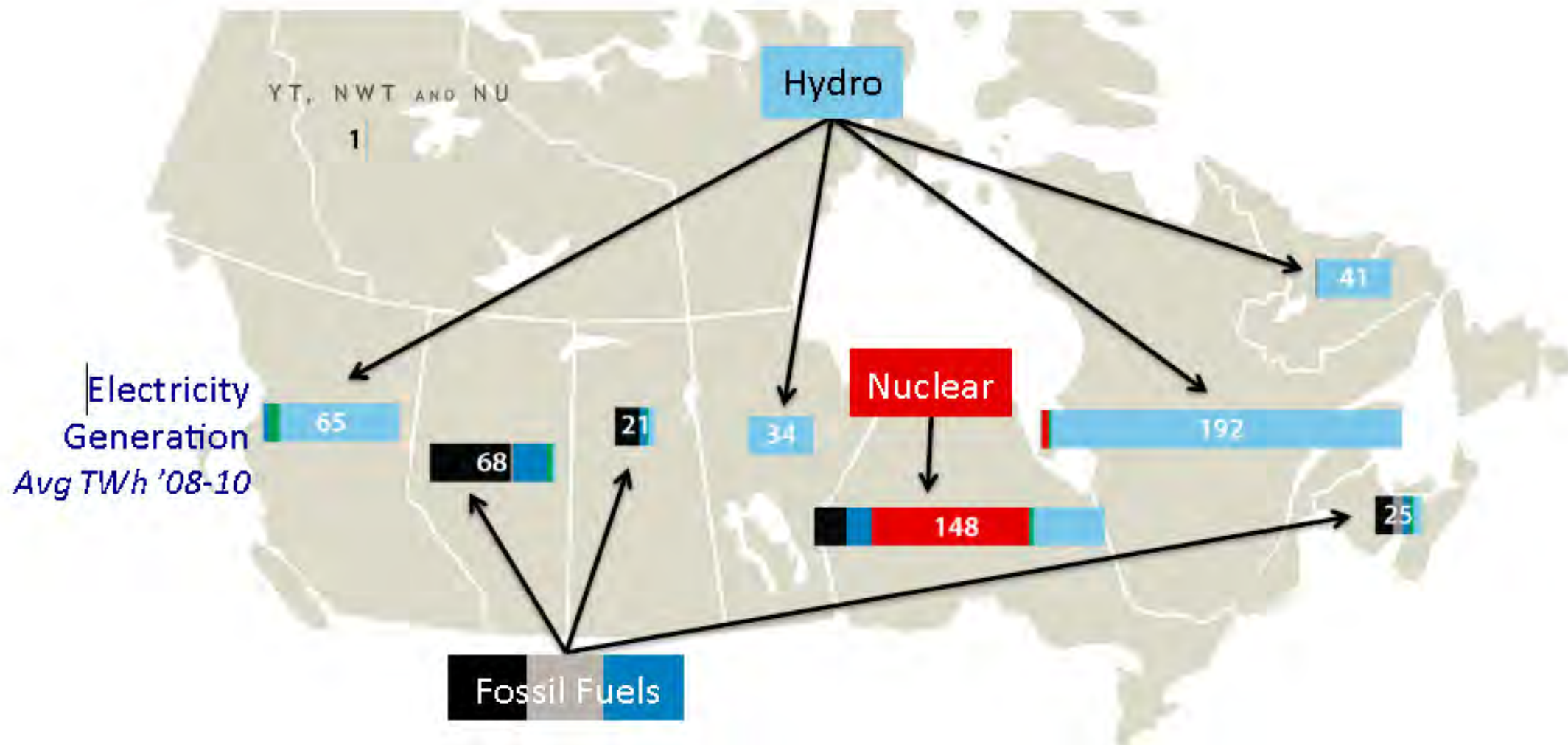


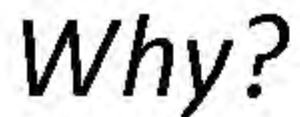
UNIVERSITY OF
CALGARY



Institute for Sustainable
ENERGY, ENVIRONMENT
AND ECONOMY

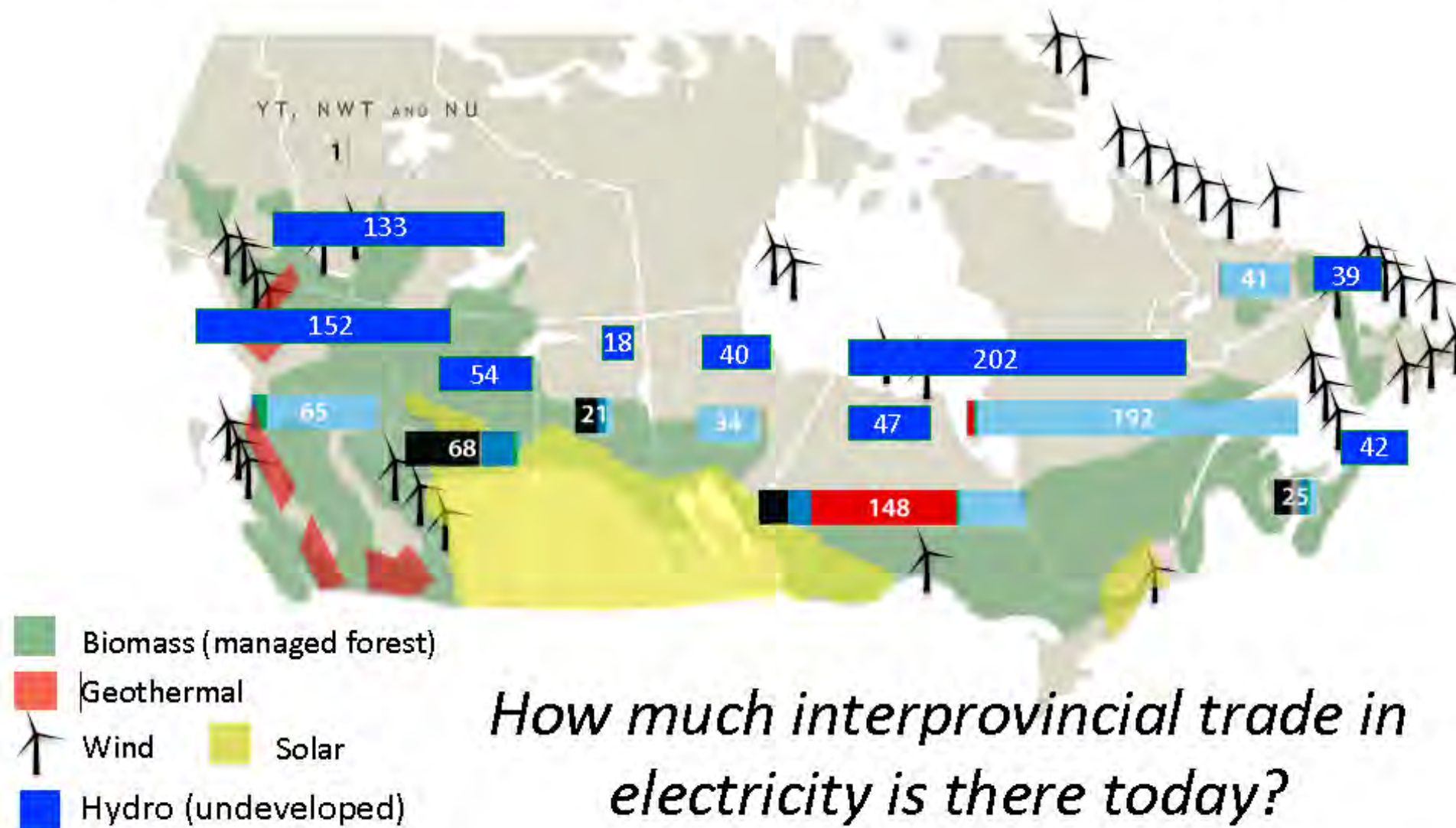
Electricity Production





Could provinces work together to solve this challenge?

Canada has the Renewable Energy Resources

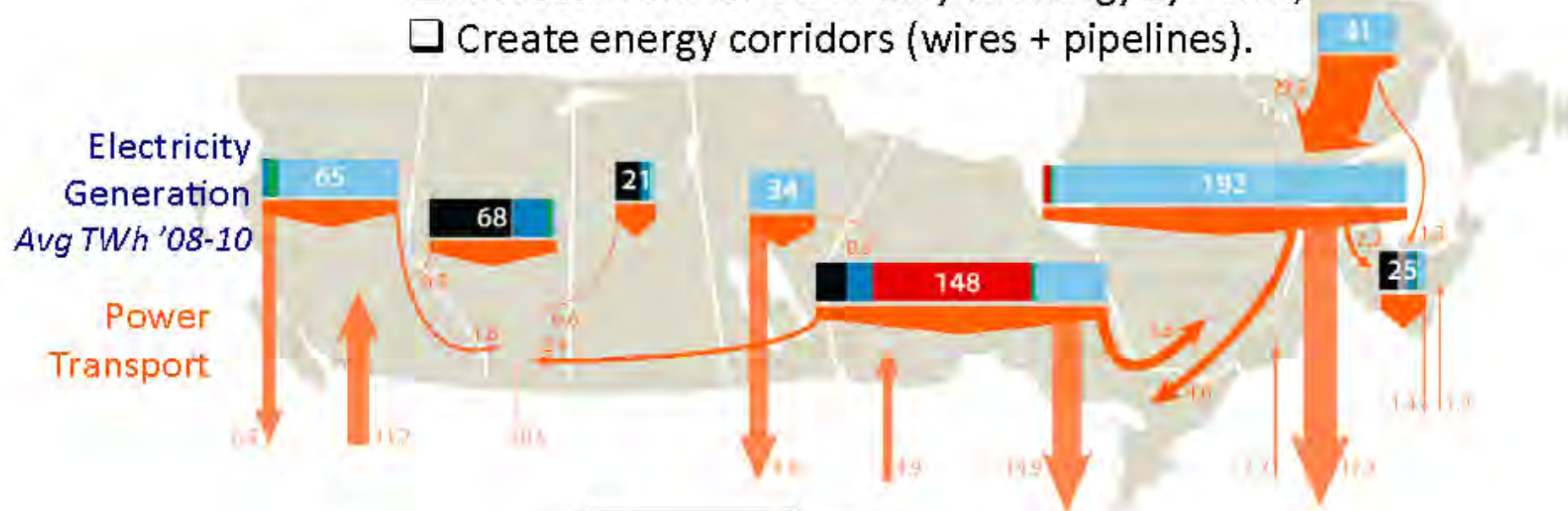




Most (~80%) of Current Cross-Border Power Trade is N-S, not EW

Benefits of Interprovincial Cooperation:

- ☐ Dramatically lower GHGs,
- ☐ Reduce air pollution & health costs;
- ☐ Large Hydro: excellent backup for wind & solar;
- ☐ Take advantage of time zone differences;
- ☐ Increase role for electricity in energy systems;
- ☐ Create energy corridors (wires + pipelines).



Needs:

- ☐ E-W Grids
- ☐ Better integration and cooperation
- ☐ Policies

Can We Build East-West Transmission Lines?

Hydropower Generation Options

Figure 2.1 provides an overview of the generation and transmission options for hydropower generation.

- Is this 'greenwashing' the oil sands?
- It makes more sense to me to build powerlines, instead of pipelines, and move green electrons!

Figure 2.1: Overview of Hydropower Generation and Transmission Options



Transmission Ideas Out There (Interesting, Wild??)



Figure 1: One concept of a combined Canada and USA overlaying grid

Source: How a TransCanada Electric Superhighway will Profitably Achieve Renewable Energy Objectives By Dennis Woodford, P.Eng., President, Electranix Corporation (on behalf of concerned Professional Engineers across Canada) August 11, 2016