Mapping Energy Futures in Frog Lake First Nation, Alberta

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CASES Webinar, June 22, 2023

Co-MAPPING SOLUTIONS INC.

THE PROJECT

ACCELERATING IMPLEMENTATION OF RENEWABLE ENERGY IN INDIGENOUS COMMUNITIES

PETER BALLANTYNE CREE NATION

FROG LAKE CREE NATION

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UNIVERSITY OF SASKATCHEWAN

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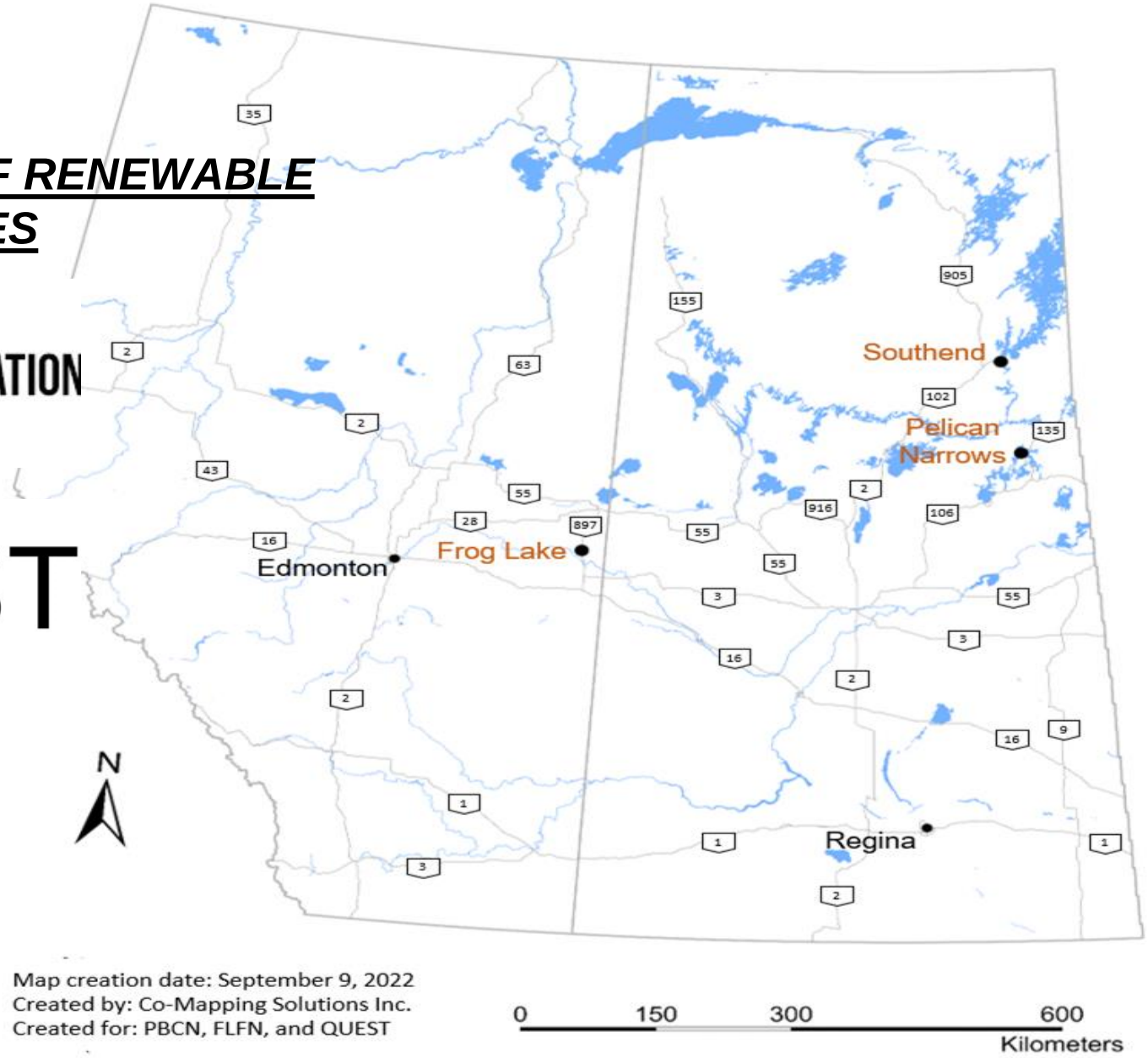

Context: energy transition = landscape transformation

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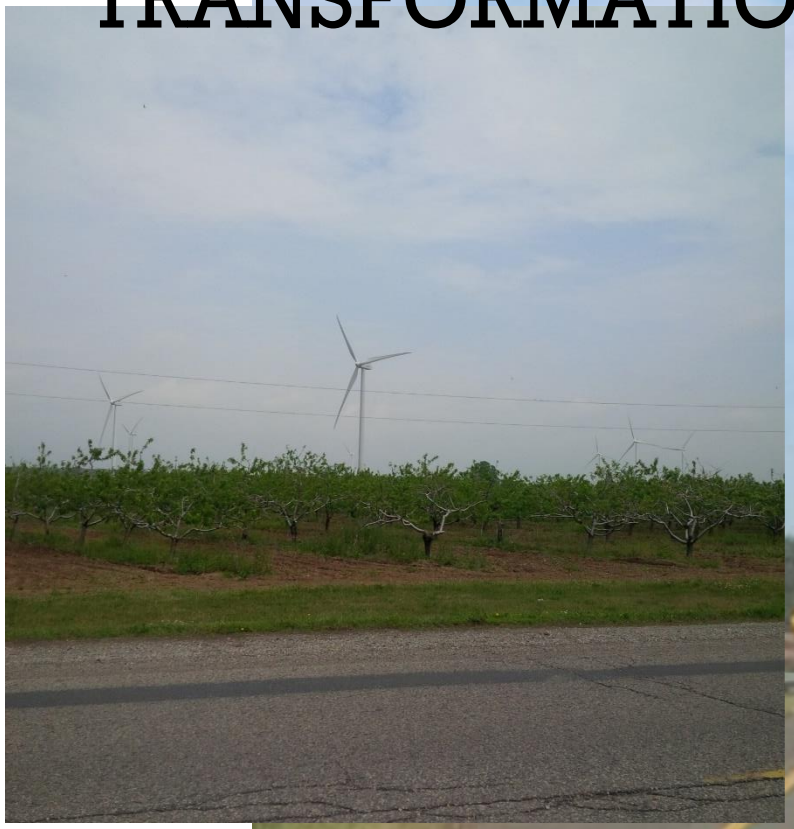
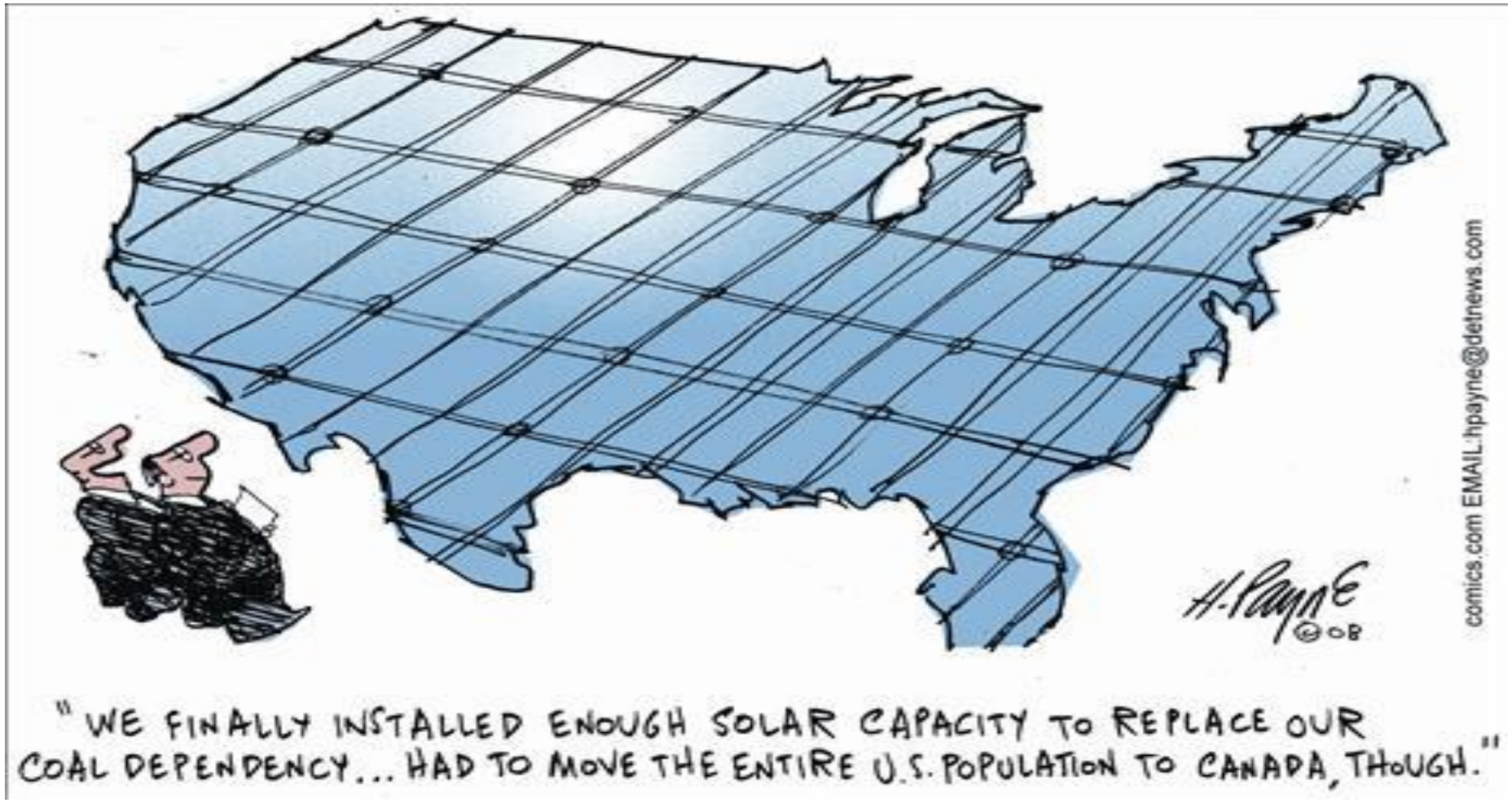


CONTEXT: ENERGY TRANSITION = LANDSCAPE TRANSFORMATION

Context: energy transition = landscape transformation



LIMITS OF ROOFTOP PV SYSTEMS

- The **average household** in Canada consumes ~25,000 kWh of energy annually while a **relatively large residential rooftop solar energy system** could produce ~14,000 kWh of electricity.
- On average, only 30-50% of total ***electricity currently consumed*** in a city could be produced if ALL technically suitable rooftops are covered with PV systems.
- In other words, rooftop solar systems are necessary but by themselves insufficient as a means of displacing carbon-intensive sources of energy.

Bayracki, Calvert, Brownson, 2015

Alberta Farmer
EXPRESS

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YOUR READING LIST

Schoepp: Putting solar farms on good land is a misguided way to go green
March 27, 2023 FROM THE HIP

Include safety in your plans before you work alone this spring
March 24, 2023 OPINION

Schoepp: Bullying takes many different forms and occurs in all walks of life
March 3, 2023 COLUMNS

Letters

Letters, April 27: Solar farms better suited to urban jungle

Calgary Herald

Published Apr 27, 2023 • Last updated Apr 27, 2023 • 2 minute read

5 Comments

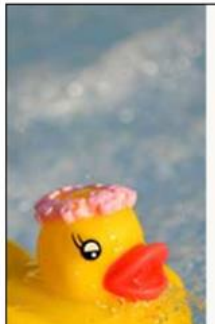
Schoepp: Putting solar farms

sylvanlakenews.com/news/170-mw-solar-farm-proposed-southwest-of-sylvan-lake/

SYLVAN LAKE NEWS

170-MW solar farm proposed southwest of Sylvan Lake

Some rural landowners concerned about loss of good farmland to new solar projects



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SOLAR FARMS OR FORESTS?

- C2 Solar has secured provincial environmental permits for its 10MW 'Project Violet' solar farm in Brunswick Mills (Bathurst).
- Although forest is being cleared, the EIA projects a net reduction in total GHG emissions.
  - It is not clear how the timber will be used, or whether the timber was likely to be cleared independently of the solar farm. This is second growth Acadian forest, originally slated for development as a forestry complex.
  - The opportunity costs in GHG reduction (i.e., less sequestration as a solar farm rather than forest regrowth) were not considered.

Proposed site for C2 Solar's Violet Solar Farm in Brunswick Mills (Bathurst). Image taken from the project's environmental impact assessment.

STRATEGIES TO MITIGATE LAND-USE IMPACTS

"Agrivoltaics"

https://cals.ncsu.edu/news/got-sheep-want-a-solar-farm/

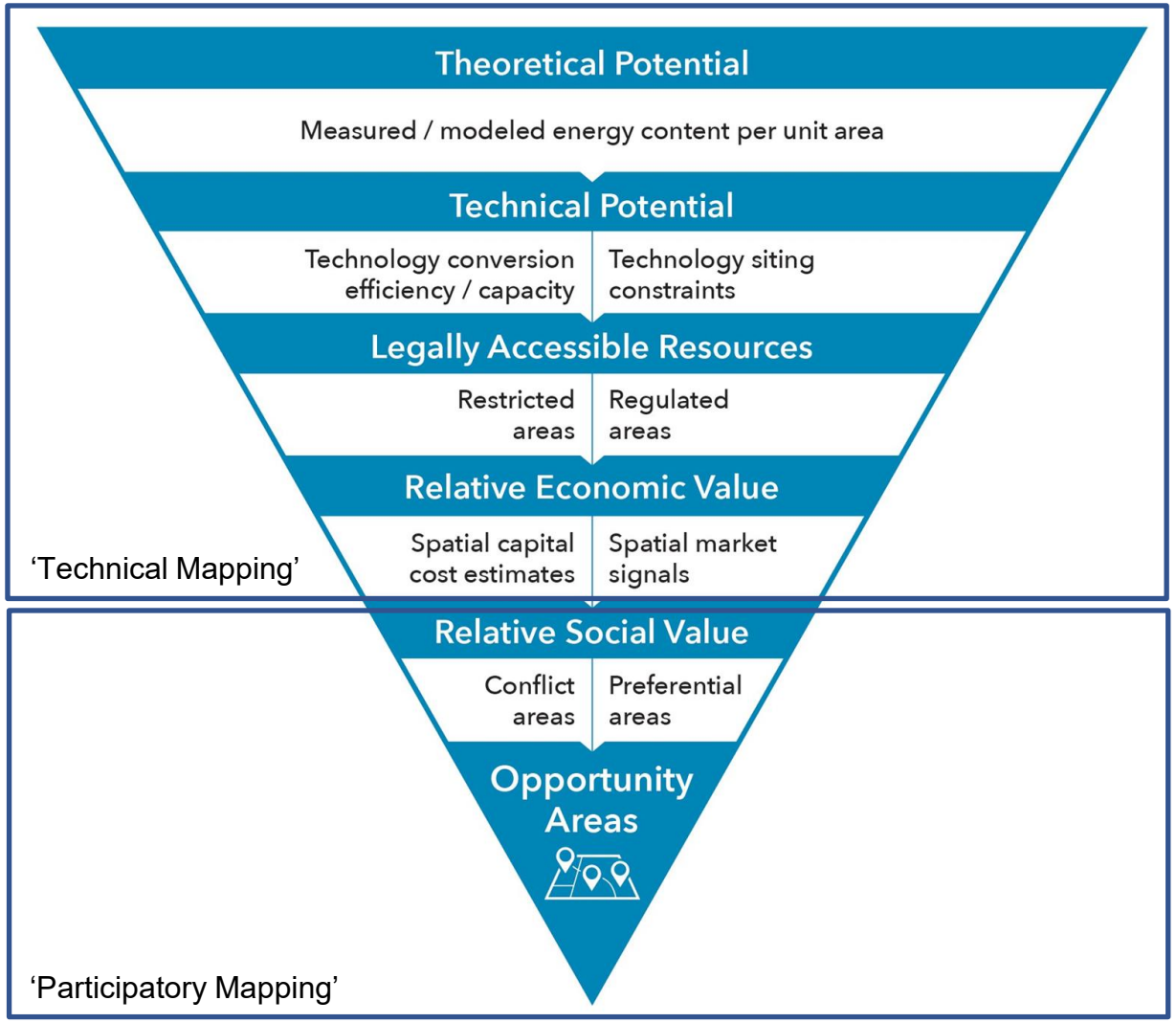
Figure 1: Dupraz et al.'s agrivoltaic system in Montpellier, France

Strategies to mitigate land-use impacts

"Floatovoltaics"

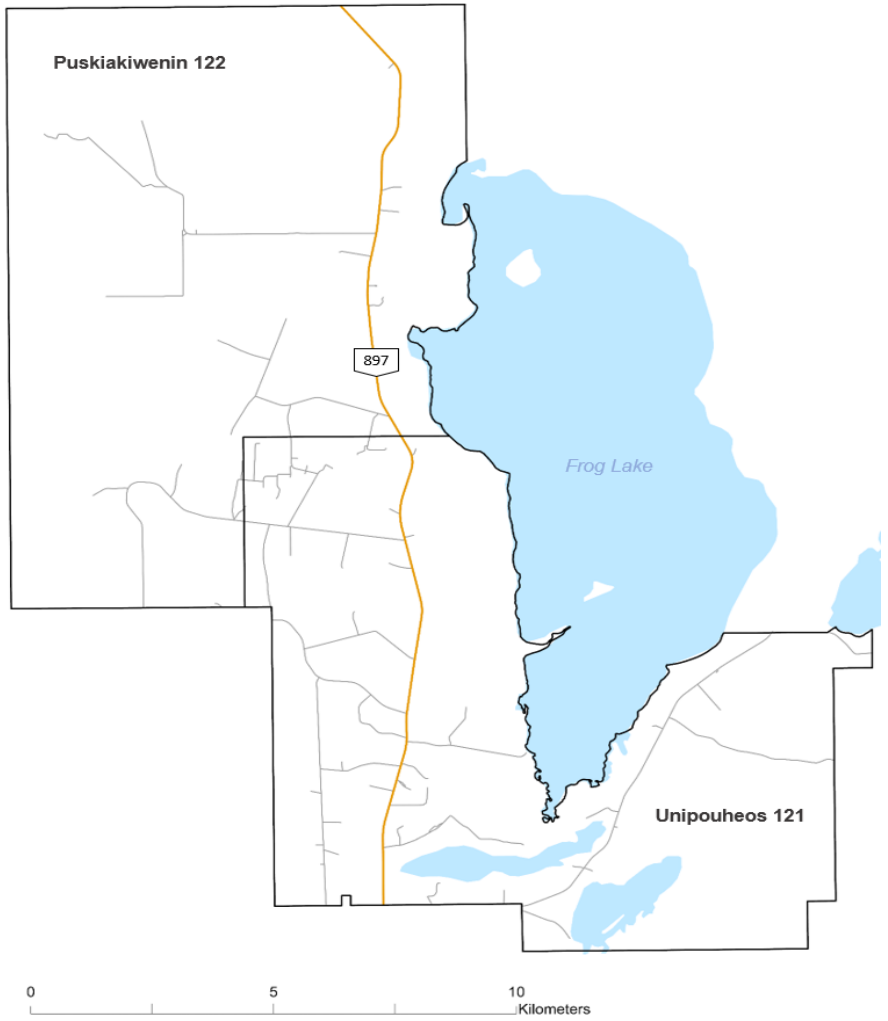
http://sustainableenergy.org/floatovoltaics-a-solution-for-water-and-energy-conservation/

Mapping opportunities for renewable energy

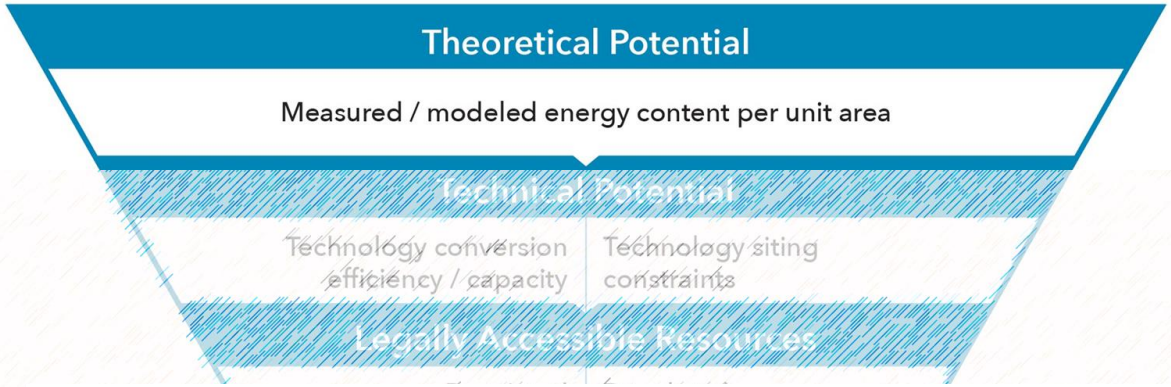


- Our process follows a standardized resource classification system, akin to a 'resource-reserve' classification system used in fossil fuels / minerals sectors.

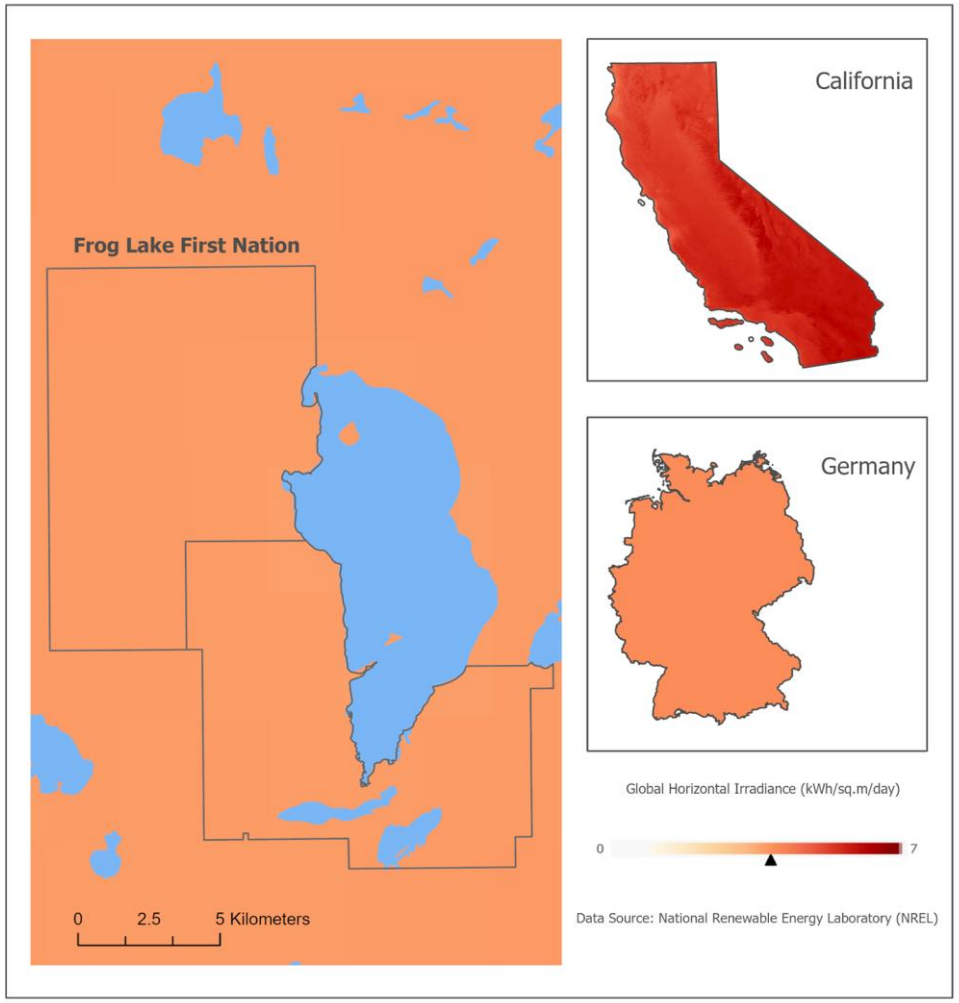
Mapping opportunities for solar farms in Frog Lake First Nation



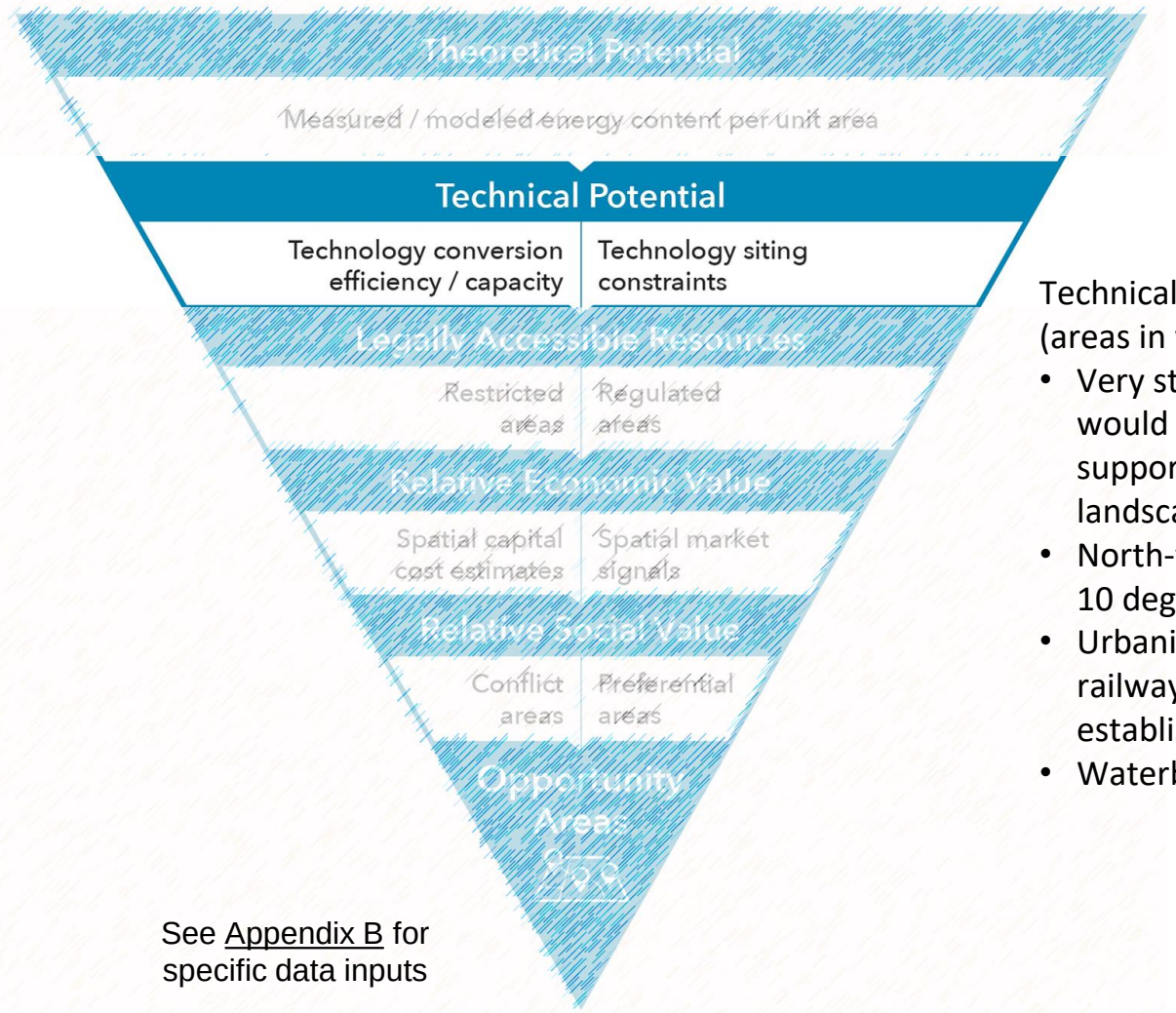
Theoretical potential



Resource data were derived from the National Renewable Energy Laboratory. For visualization purposes, we are comparing the solar resource with global leaders in solar farm development. This comparison helps to demonstrate that, simply speaking, the average annual irradiance received in FLFN is sufficient to support a large solar farm



Technically accessible resources

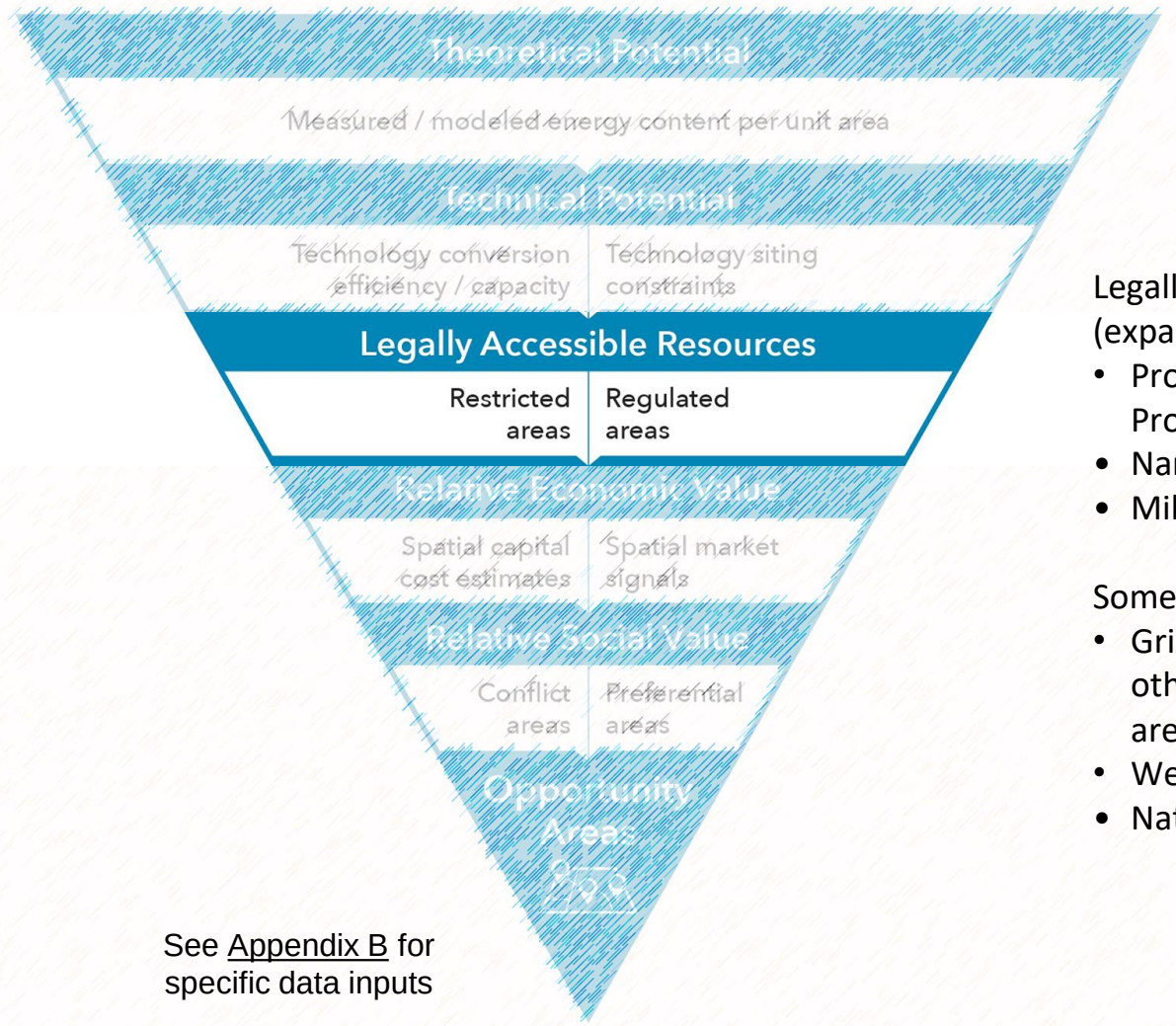


See Appendix B for specific data inputs

Technically inaccessible areas (areas in white):

- Very steep slopes that would require costly supports or changes to the landscape
- North-facing slopes above 10 degrees
- Urbanized areas; roads; railways; and other established infrastructure.
- Waterbodies

Legally accessible resources



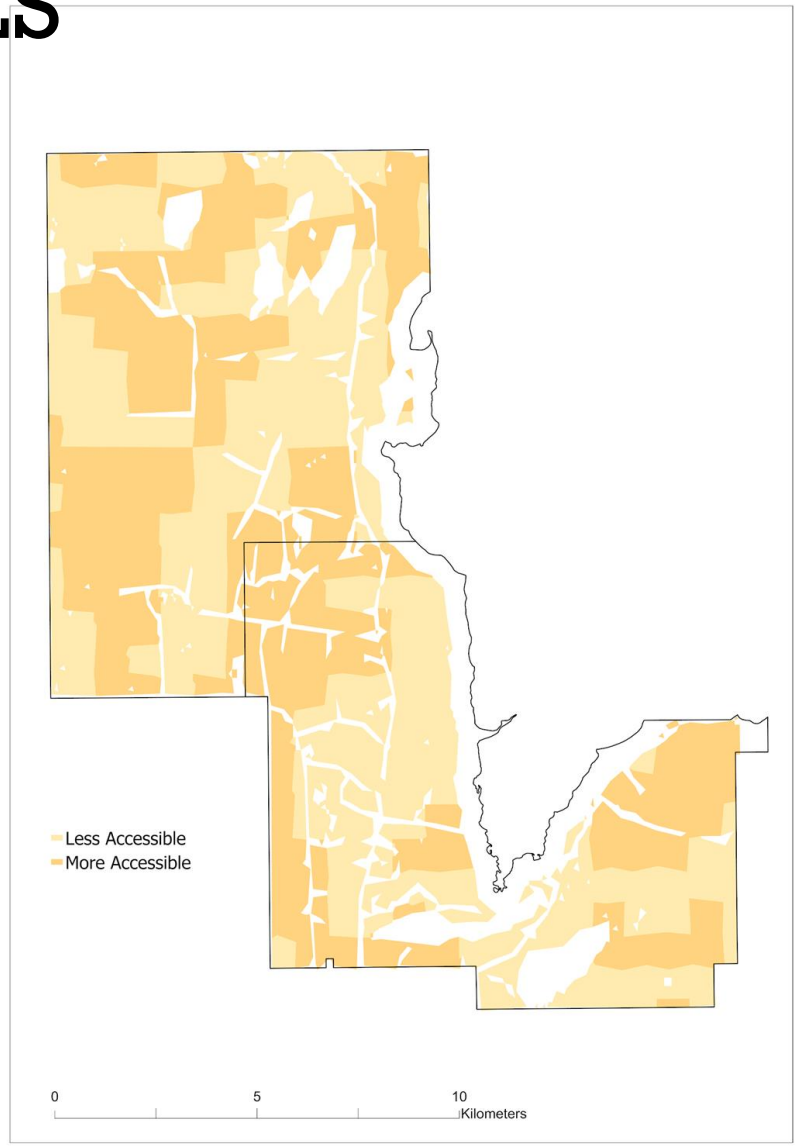
See Appendix B for specific data inputs

Legally inaccessible areas (expanded area in white):

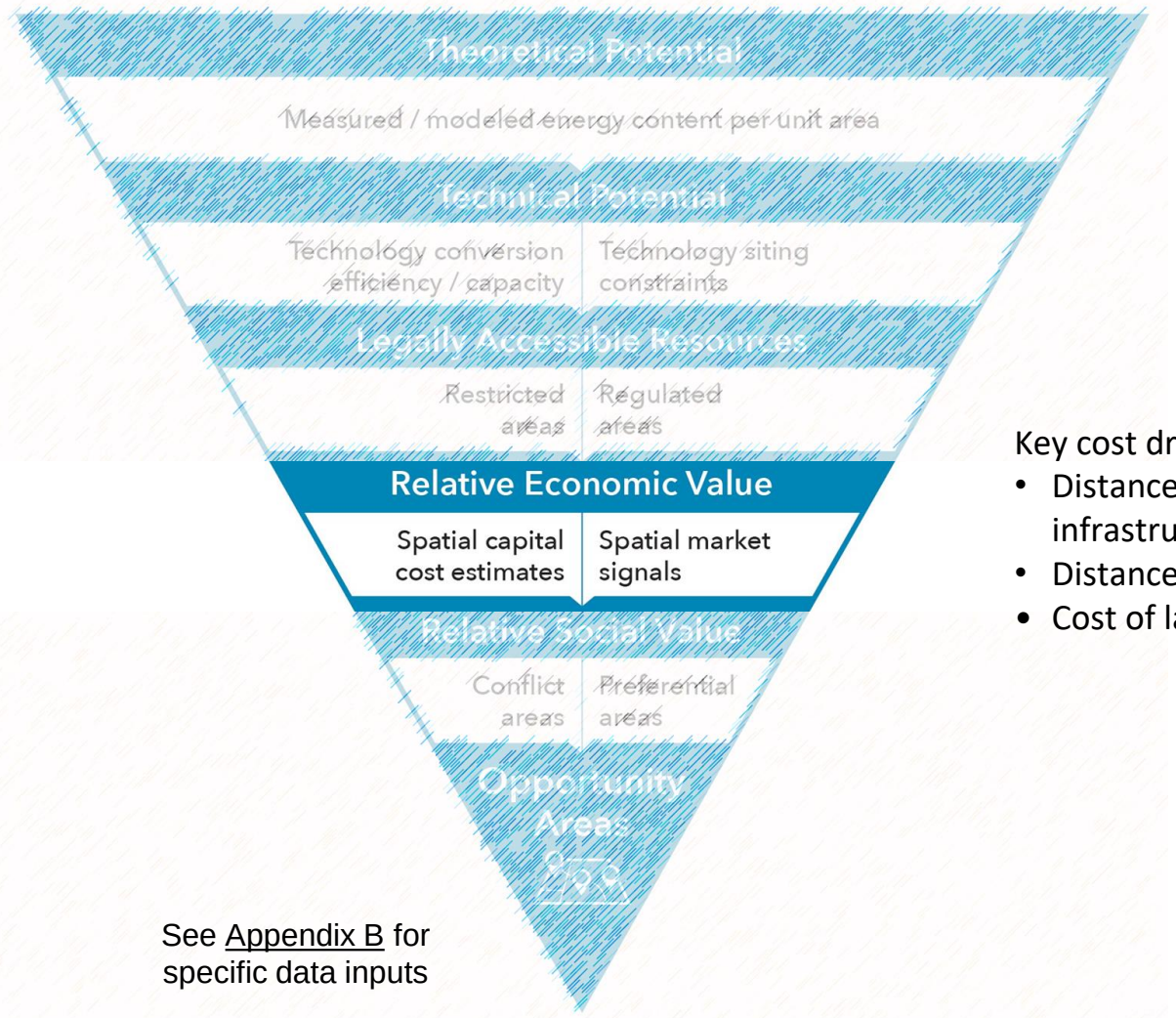
- Provincial Parks and Protected Areas
- Named waterbodies
- Military bases

Some regulatory controls:

- Grizzly bear, caribou, and other key species' habitat areas
- Wetlands & peatlands
- Native grasslands



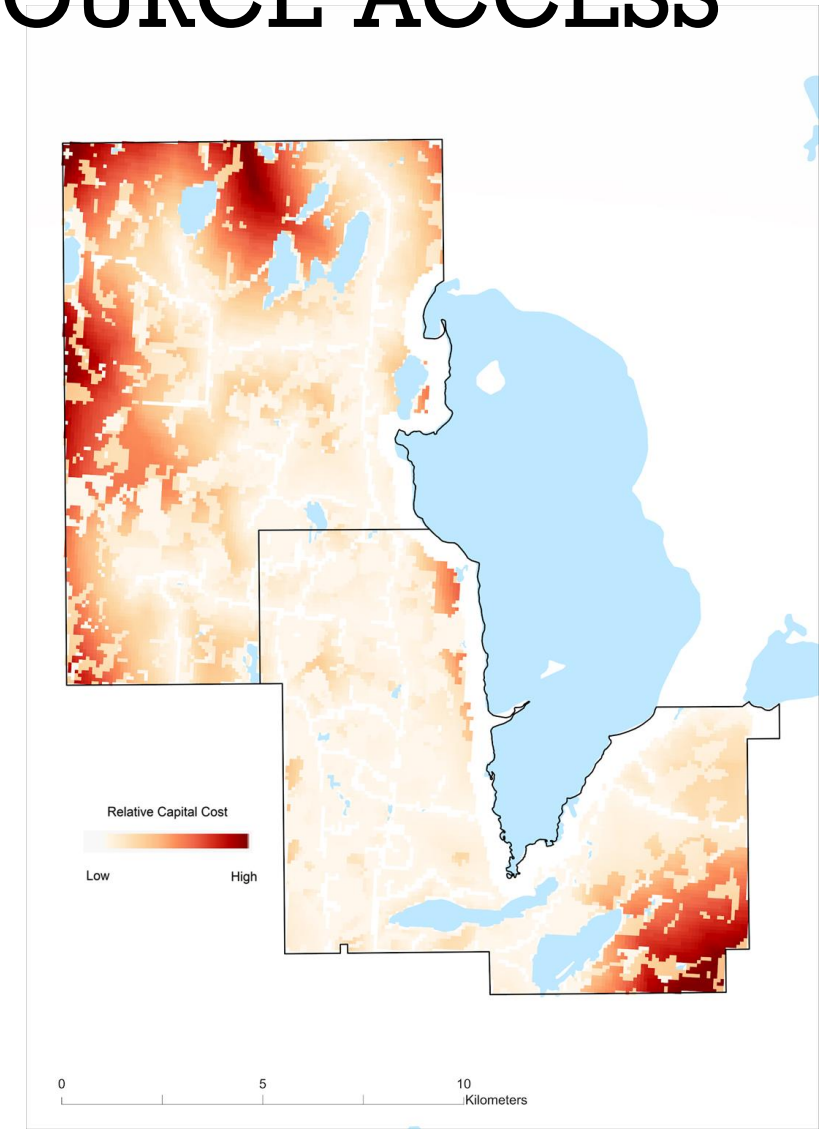
Relative capital cost of resource access



See Appendix B for specific data inputs

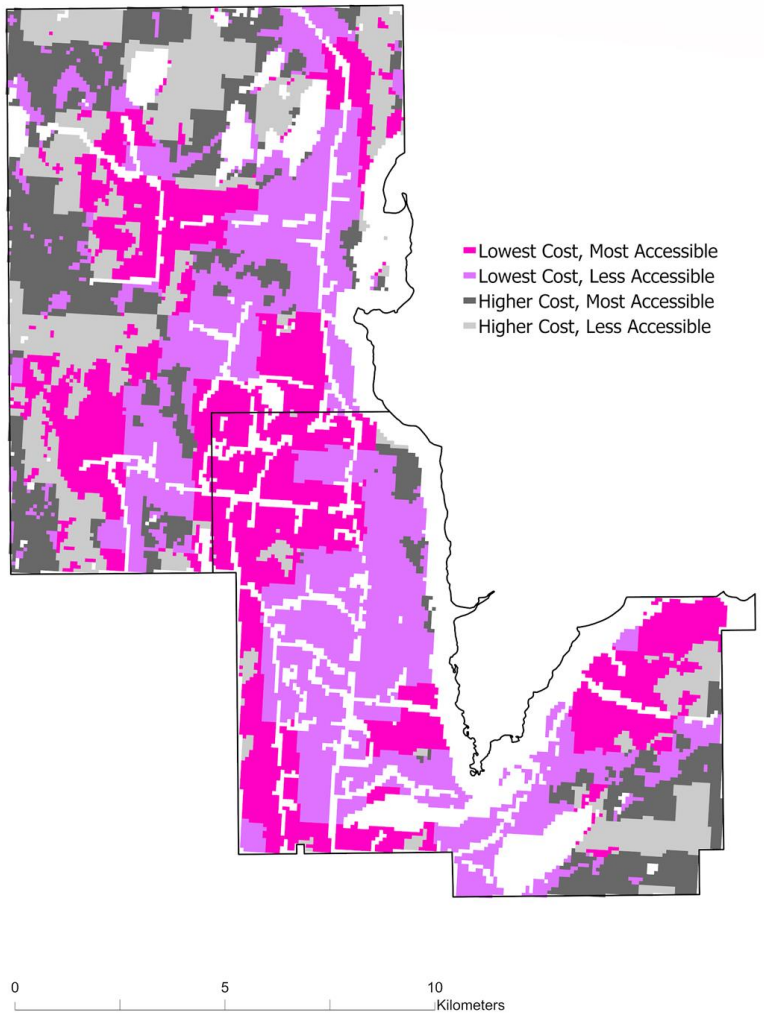
Key cost drivers:

- Distance to transmission infrastructure
- Distance to road network
- Cost of land clearing



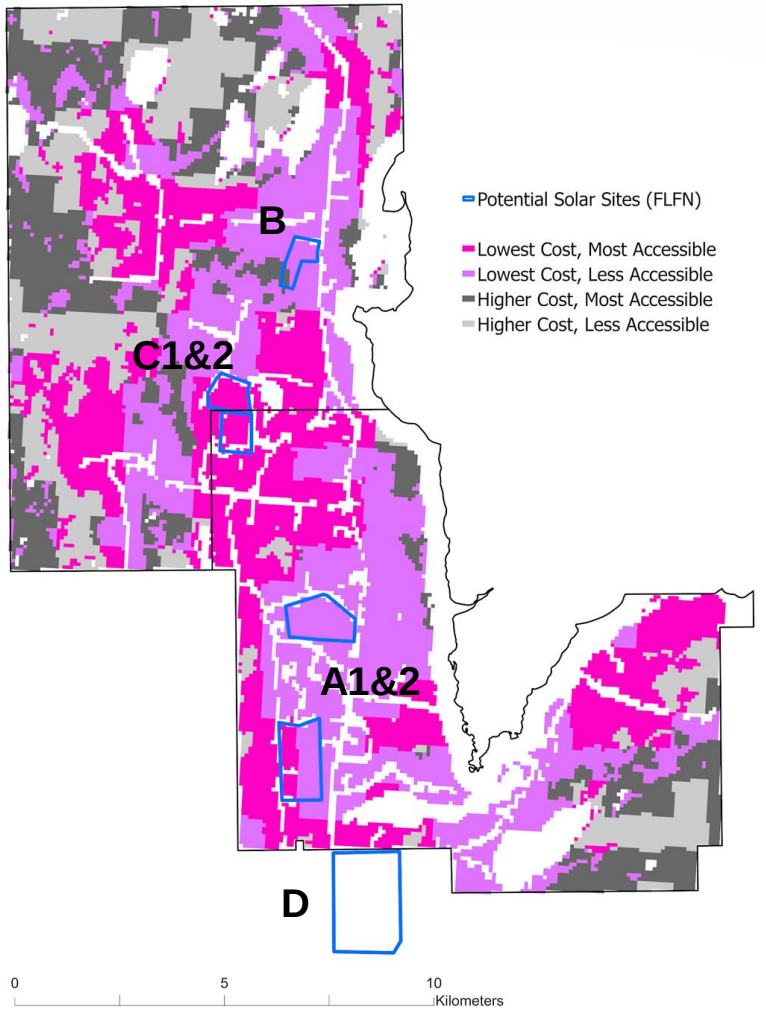
Finding accessible and low-cost sites

The integrated layer depicted here shows the least expensive 5% of land as the 'lowest cost' and the more permissive areas by regulatory concerns as 'most accessible'.



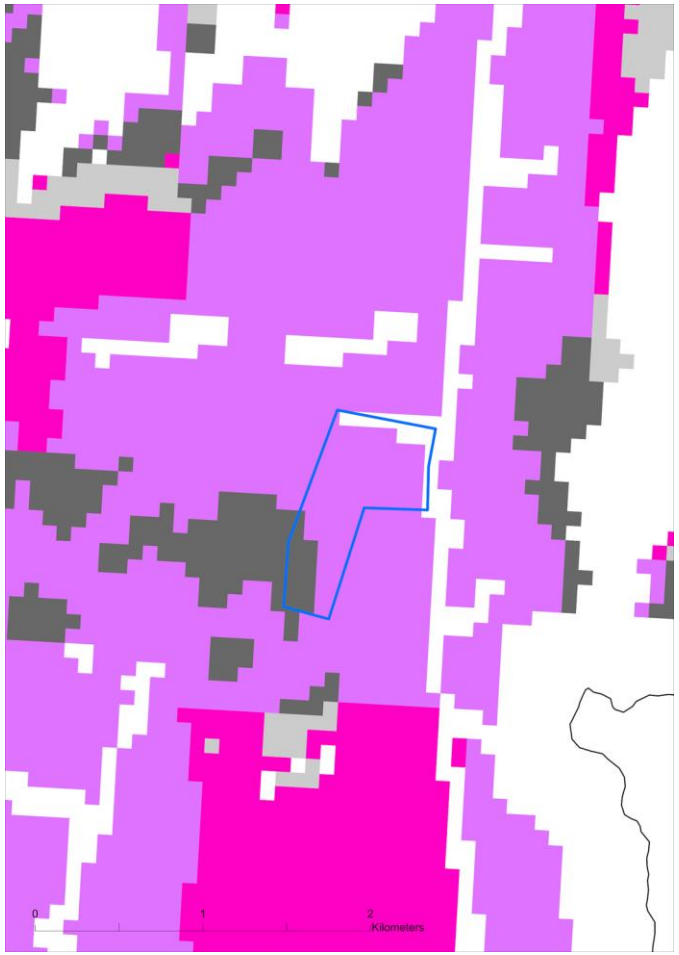
Preliminary findings – concurrence

The model endorses 5 potential solar PV sites that had already been identified through previous work and will help to prioritize future site searching and site due diligence efforts.



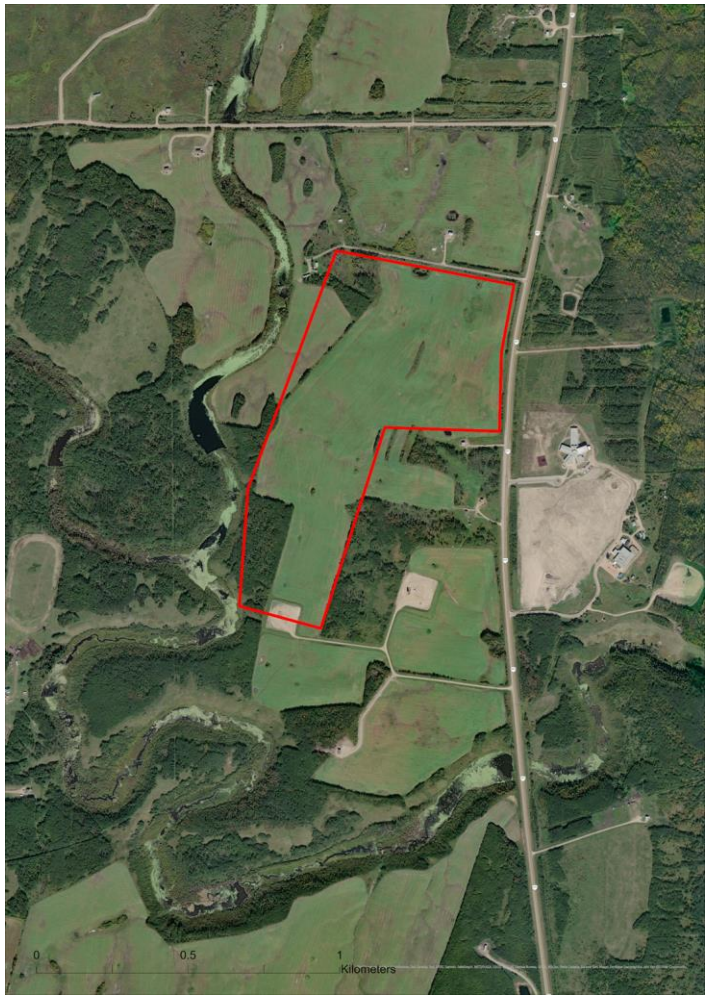
Preliminary findings – concurrence

Integrated Layer



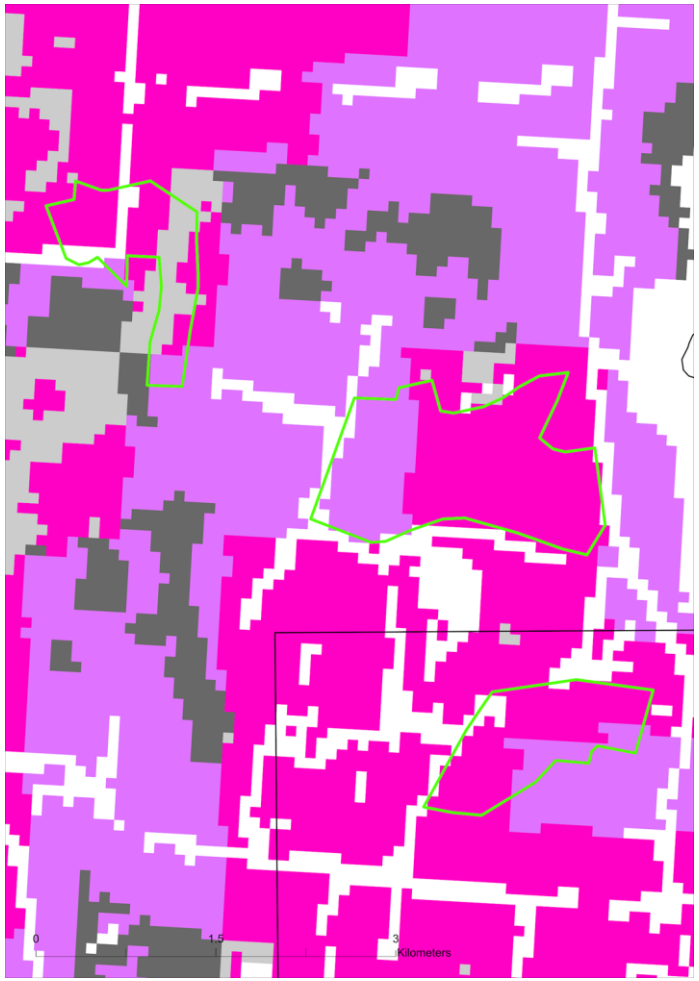
Site B

- on the less permissive side legally due to proximity to native grassland
- on class 5 Ag land
- low to moderate capital cost
- very minimal land clearing needed based on aerial imagery



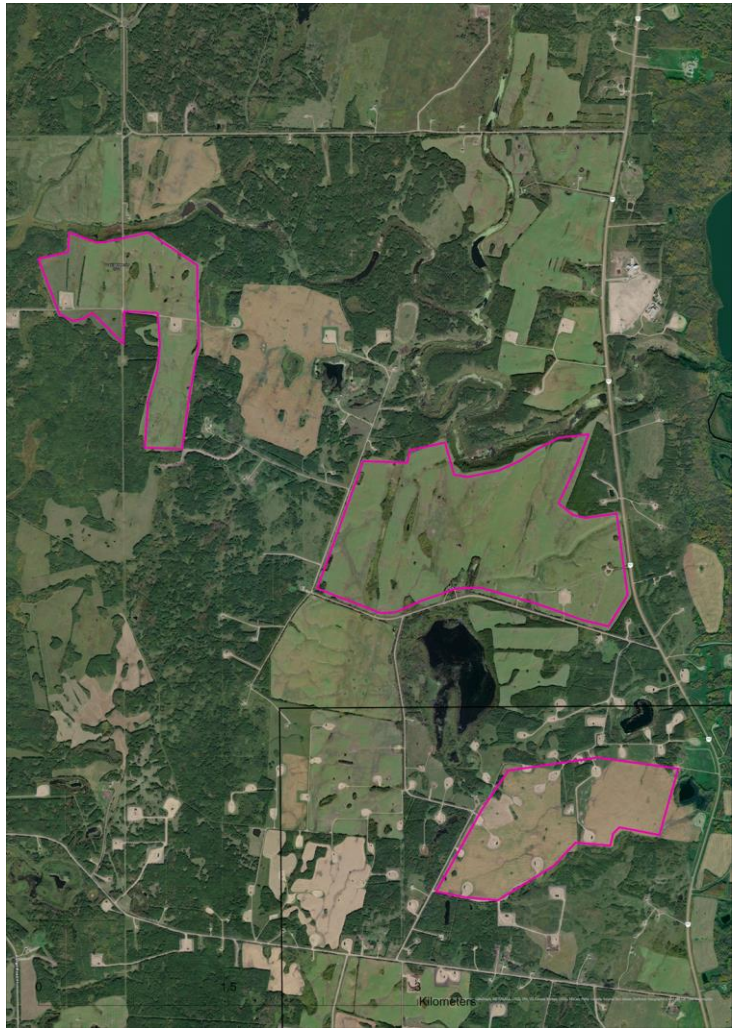
Preliminary findings – new insights

Integrated Layer



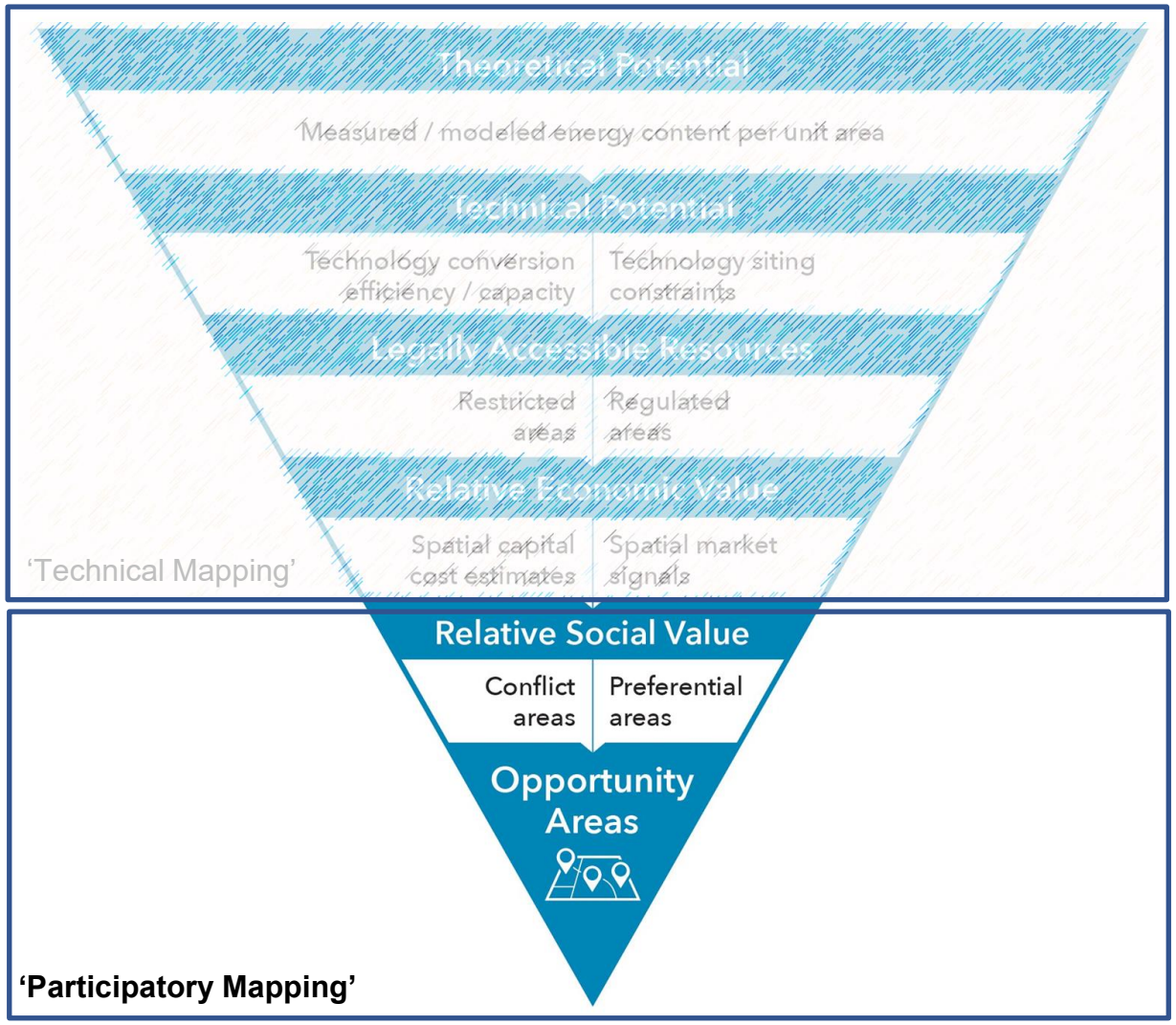
Sites E, F & G

- more permissive legally
- mainly class 4 Ag land, minimal class 3
- low capital cost due to close proximity to transmission + highway
- very minimal land clearing needed based on aerial imagery



Phase 2: Participatory Mapping

- Upon completion of participatory mapping, CMS produces a final report which combines insights from the technical and participatory mapping phases of the project, to serve as a focal point for ongoing discussions and action planning around solar energy development in FLFN.



Three streams of participatory mapping

Community Engagement

Who?

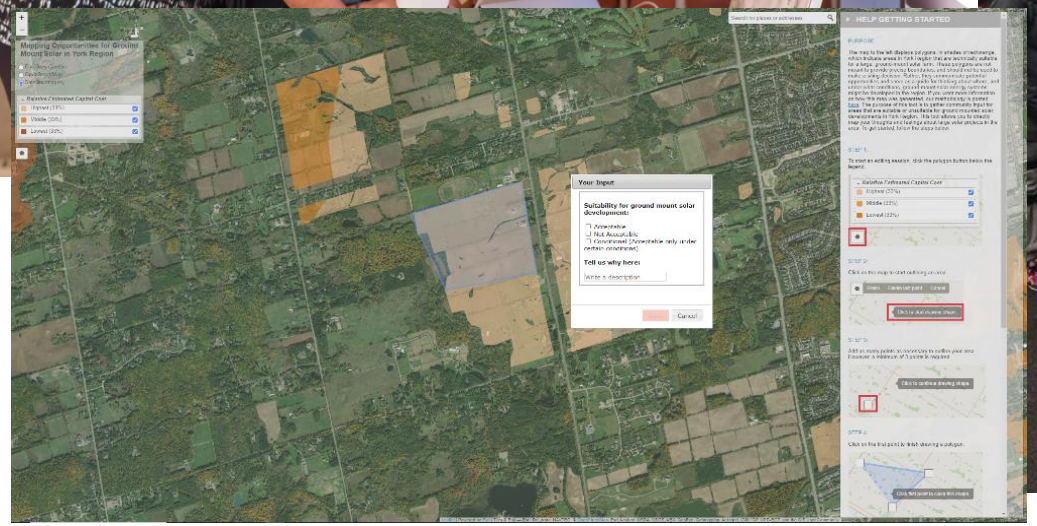
Individuals entitled to participate in discussions about major changes to their local landscape

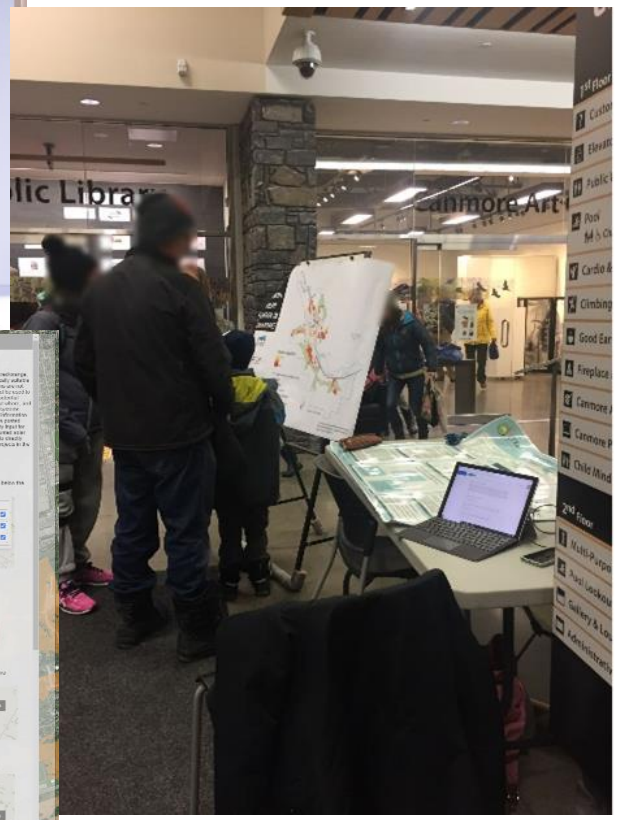
Why?

- Identify key concerns and establish early relations (consult)
- Raise awareness (inform)

How?

- Bring information to community spaces (library, farmers market).
- Open-ended surveys





Three streams of participatory mapping

Stakeholder Engagement

Who?

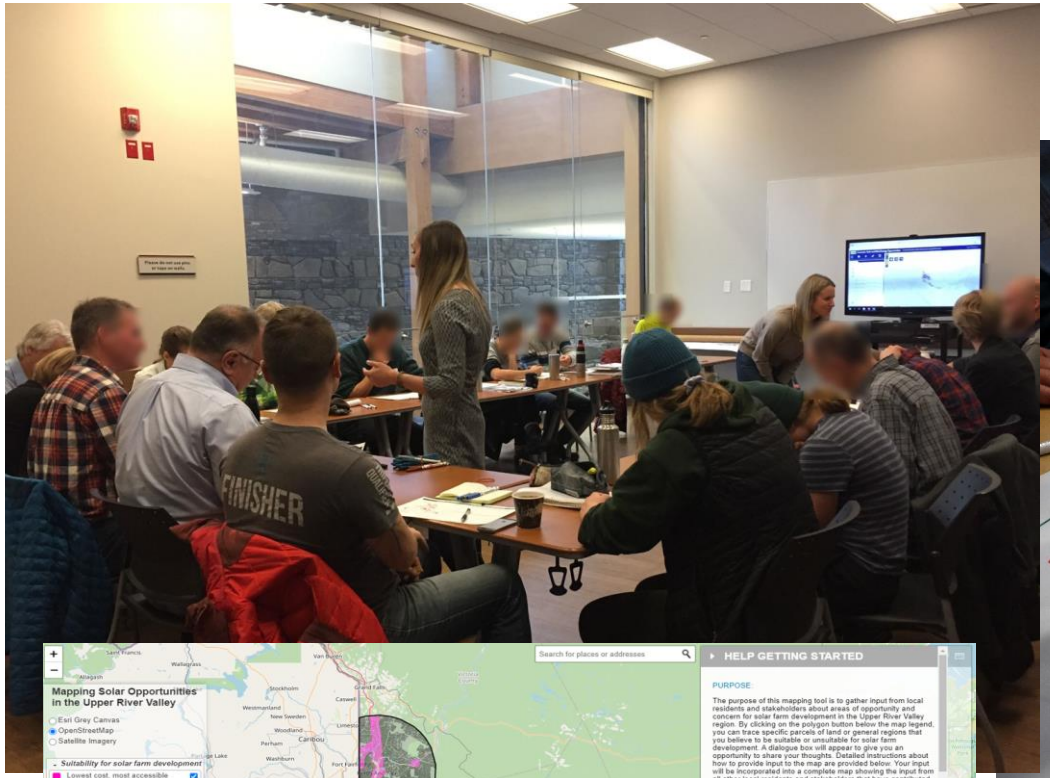
Individuals / organizations who have a vested interest that will be impacted directly

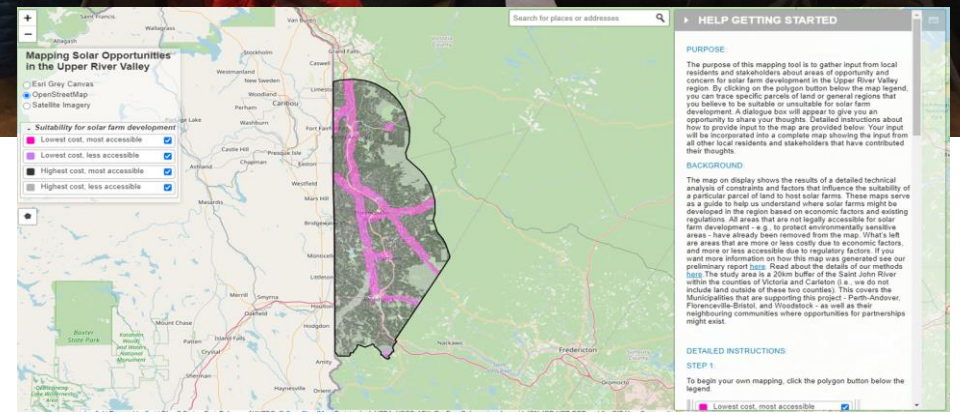
Why?

- Discuss specific issues and options / policies to mitigate (consult & involve)

How?

- Targeted invitations to key constituencies
- Focus group centered on specific theme / issue





Three streams of participatory mapping

Capacity-Holder Engagement

Who?

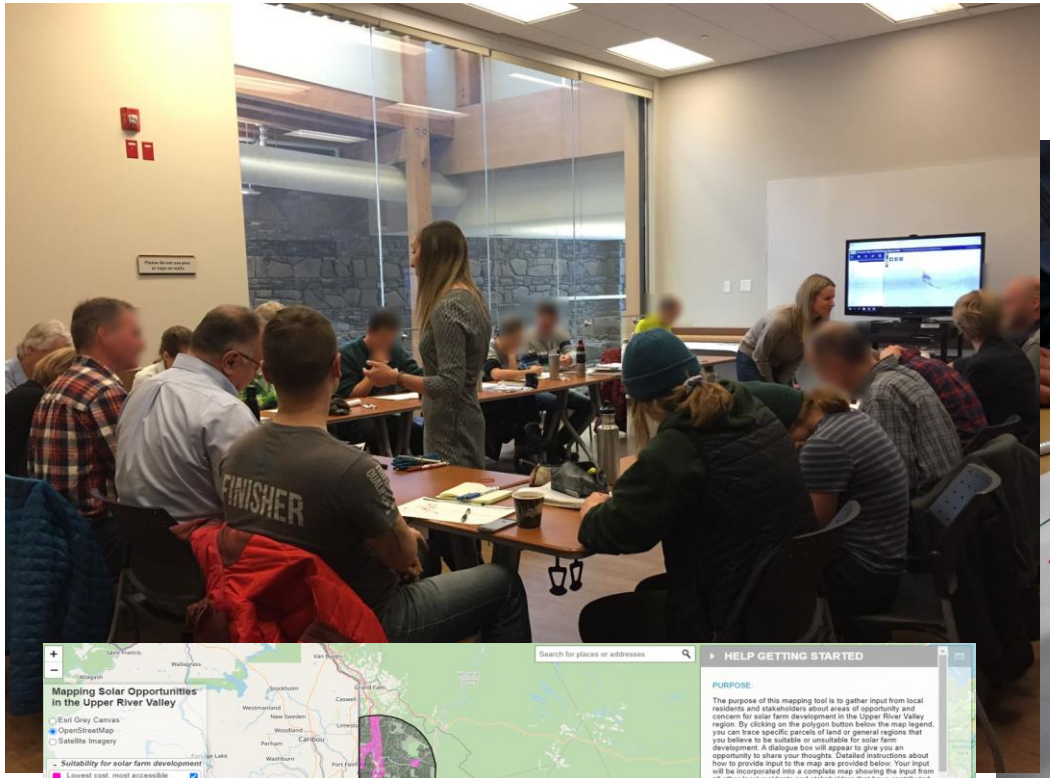
Individuals / organizations who possess resources that enable or disenable projects

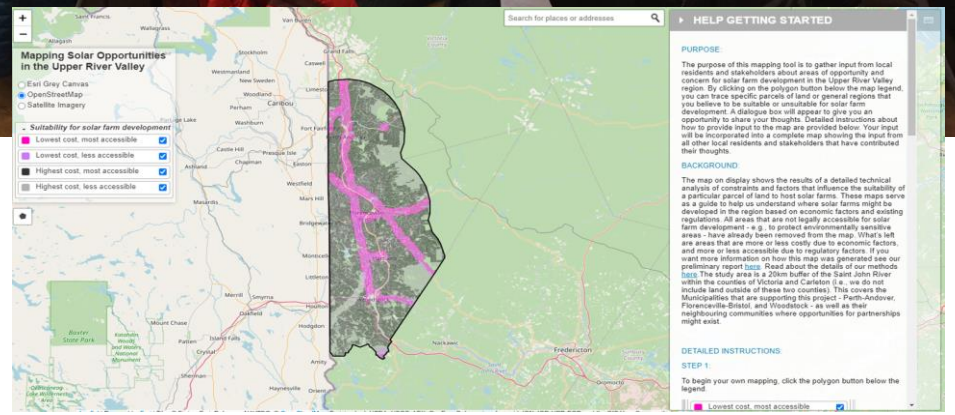
Why?

- Cross-sector dialogue & strategic / action planning (collaborate & empower)

How?

- Targeted invitations to key constituencies
- Focus group centered on specific theme / issue



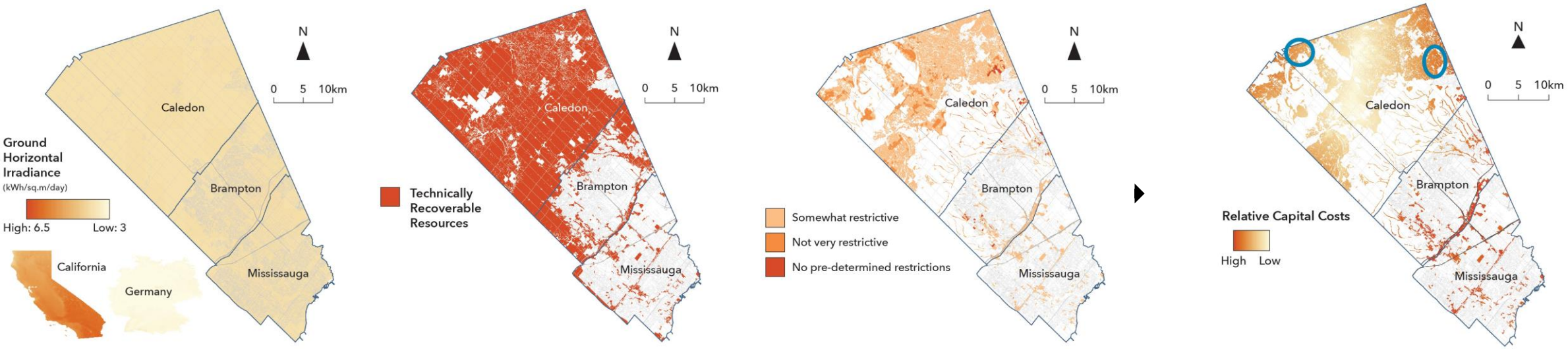


Community engagement in FLFN

- June 3, 2023
- 14 participants
- Conversation centered on what a successful solar project in FLFN looks like, and key areas in FLFN that should be protected (i.e., sacred areas, medicine gathering, hunting/fishing areas).

Community engagement in FLFN

Inform business decisions & raise awareness



Theoretical Resource Potential → Technically Recoverable Resources → Legally Accessible Resources → Opportunity Areas

For developers, site suitability mapping can inform prefeasibility assessments and site searching processes.

For the public, this information can indicate and anticipate where developers are most likely to inquire about land access.

Integrate land-use and energy planning

THANKY YOU FOR LISTENING!

For more information on our approach and methods, visit:

https://questcanada.org/aire-protocol

www.comapping.ca

Appendix A: Resource Classification System

Category	Definitions		Distinguishing Factors
Theoretical Potential	Measured or modeled energy potential across a geographic area. These maps depict physical expressions of energy flows across Earth's surface. Also referred to as physical limit or gross potential.		Irradiance; wind speed; heat value of biomass.
Technically Recoverable Resources	Theoretical resources are mapped as 'technically recoverable' or 'not technically recoverable'. These maps depict theoretical resources that can be converted into useful energy by prevailing technologies (**technology conversion efficiency** limit), at sites that can be accessed using reasonable engineering solutions (**technology siting constraints**). Both are dependent on interactions between the technology and site characteristics.	**Technology conversion efficiency** / capacity factor limit (a.k.a. 'production ceiling'): estimated net energy recovered based on system efficiencies and system capacity factors, typically assuming conversion technologies at or beyond the research and development stage of the innovation chain. This limit will increase through technical innovation.	Technology resource requirements (e.g., wind power profiles; biomass type); technology capacity factor and conversion efficiency.
		Technology siting constraints (a.k.a. 'carrying capacity'): includes site-specific barriers to infrastructure development and to system engineering and operation. [Note: in the case of biomass, residue coefficients are applied to account for the organic content that needs to be returned to the landscape to maintain a soil health].	Land cover; slope; altitude and other site specific physical attributes that are incompatible with technology implementation.
Legally-Accessible Resources	Technically recoverable resources that are accessible without violating existing regulations related to land-use and infrastructure siting. **Prohibited areas** are removed from consideration. **Regulated areas** are mapped along a gradient of 'regulatory risk' from high to low based on the discretionary powers held by government to approve or decline a project.	**Prohibited areas:** includes those areas and features that are protected from development by inhibitive regulations. Often, these areas are protected from all infrastructure development. In some cases, they are protected from specific kinds of renewable energy development.	Protections on cultural and natural heritage; zoning by-laws; infrastructure set-back requirements.
		Regulated areas: represents permissive regulations. The level of permissiveness relative to a specific technology is interpreted so that we can distinguish the likelihood of project approval.	
Relative Economic Value	Legally accessible resources are mapped according to relative economic potential, based on relatively low **spatial capital costs**. Map outputs created for this category become an input into community / stakeholder engagement exercises. Note: this does not map site-level economic viability – only potential.	**Spatial capital costs:** mapped on a gradient from relatively lower to relatively higher capital costs of development. These costs are a function of site access, site preparation, and connection to distribution / transmission systems. Spatial capital costs provide spatial information necessary to determine site-specific economic viability based on a more detailed site-level techno-economic analysis.	Distance to transmission / distribution infrastructure; distance to access roads; land value; land-cover; topography.
Relative Social Value	Sites that are likely to be developed with **least social conflict** and / or are perceived as **opportunity areas** possible implementation partners. Mapped primarily through participatory mapping with the general public, stakeholder groups, and organizations that have capacity to implement projects.	**Least social conflict**: mapped on a gradient from more to less acceptable. Participants indicate areas that they might find 'acceptable', 'not acceptable', or 'conditional' for the development of a particular resource. Those are compiled into a single map layer.	Proximity to home, work, and / or places of recreation; land-cover type and land-use trade-offs; risk of wildlife impacts
		Opportunity areas: identify locations at which shared benefits are accrued across individuals and organizations that have decision-making authority in the RE development process.	Land-owner willingness; land-use planning considerations; utility needs; private vs public land

Appendix B: Data inventory, Solar Mapping

Level of Analysis	Data Input (source hyperlinked)	Derived Model Input	Treatment in Model
Technically recoverable resources	Digital Elevation Model	slope > 10 degrees & north facing	Excluded
		slope > 35 degrees	Excluded
	Hydrographic Network	all waterbodies, excluding wetlands	Excluded
	Road Network	all roads	Excluded
Legally-accessible resources	Renewable Energy Wildlife Habitat Sensitivity Risk	Greater Sage-Grouse Range	Excluded
		Trumpeter Swan Waterbodies and Watercourses (800 m setback)	Excluded
		Caribou Zones	Excluded
		Mountain Goat and Sheep Zones	Excluded
		Piping Plover Waterbodies (200m setback)	Excluded
		Valley break (100m setback)	Excluded
		Named Lake (1000 m setback)	Excluded
		Permanent Wetlands (bog, fern, marsh, shallow open water, swamp - 100m setback)	Excluded
		Top break of intermittent watercourse or spring (45 m setback)	Excluded
		Top break of small permanent watercourse (45 m setback)	Excluded
		Top breatk of large permanent watercourse (100 m setback)	Excluded
		Special Access Zones	Less Accessible
		Key Wildlife and Biodiversity Zones	Less Accessible
		Grizzly Bear Zones	Less Accessible
		Important Bird Area (wetland based - 1000 m setback)	More Accessible
Relative economic value	Road Network	linear distance	$680/m
	Transmission Lines	linear distance	$530/m

Appendix C: Regulatory Mapping

Legend Label	Description	Example (see Appendix B for details)
Restricted area	Regulations inhibit RE development at these sites.	All national and provincial parks and protected areas; trumpeter swan, mountain goat and sheep, greater sage-grouse, woodland caribou, and piping plover areas; military bases, and named waterbodies
Less permissive / high regulatory control area	Regulations will impose conditions on RE development at these sites.	Key wildlife and biodiversity zones, grizzly bear core habitat, native grassland and a 1000 meter buffer around all named lakes; areas within 500m of native grasslands
More permissive / low regulatory control area	Although an EIA and other permits might still be required, there are no predetermined controls on RE development at these sites.	Special access zones, grizzly bear support habitat, and areas 500-1000 meters from native grassland