

Interprovincial transmission in Canada

Pacific Energy Innovation Association

Dunsmuir auditorium, Vancouver

May 7, 2024

Presented by: Madeleine McPherson

Credit: Madeleine Seattle

Sustainable Energy System Integration and Transitions (SESIT) Group

Energy Modelling Hub

Institute for Integrated Energy Systems (IESVic), University of Victoria

Presentation Outline

Many studies show the benefits of inter-provincial transmission

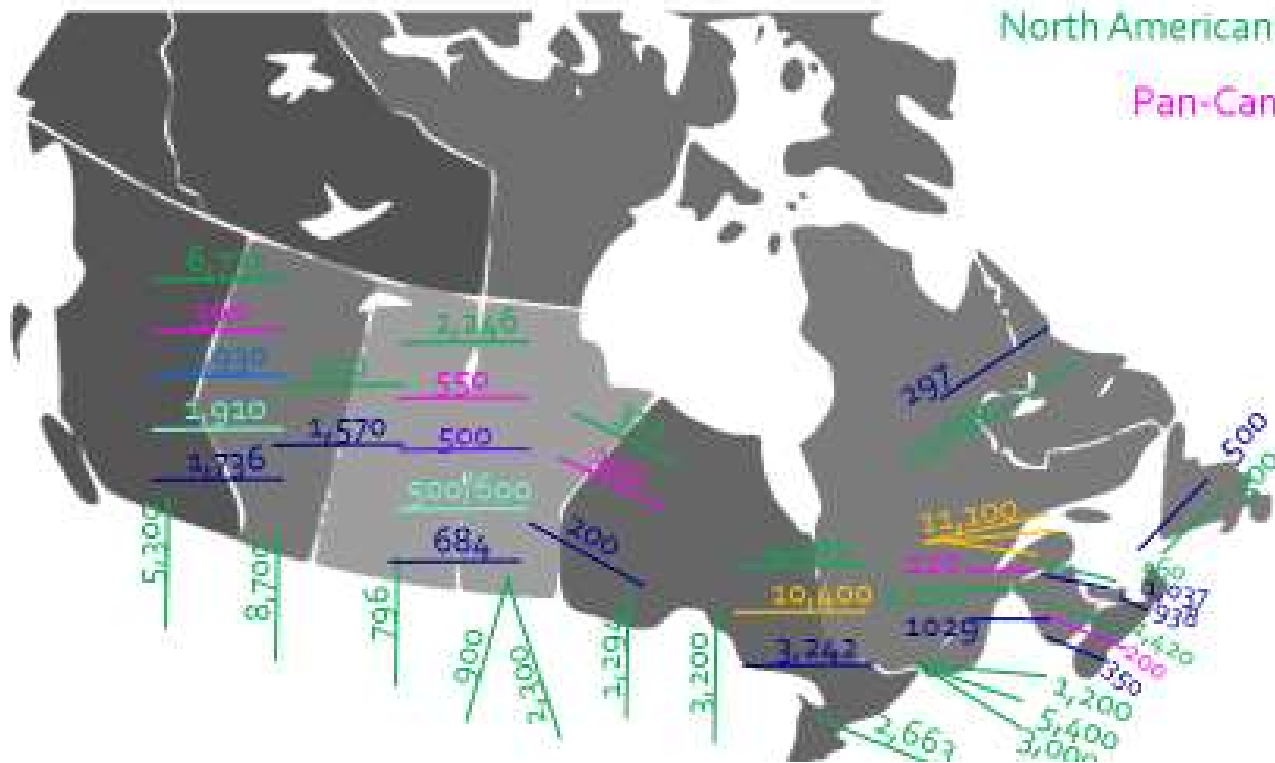
Benefits span several dimensions

And yet, transmission expansion is limited in Canada... why?

International experience may provide some lessons

Moving forward

Several studies have demonstrated the benefits of inter-provincial transmission expansion projects ...



North American Renewable Integration Study (NARIS)

Pan-Canadian Wind Integration Study (PCWIS)

SaskPower/Manitoba Hydro Regional Coordination Study

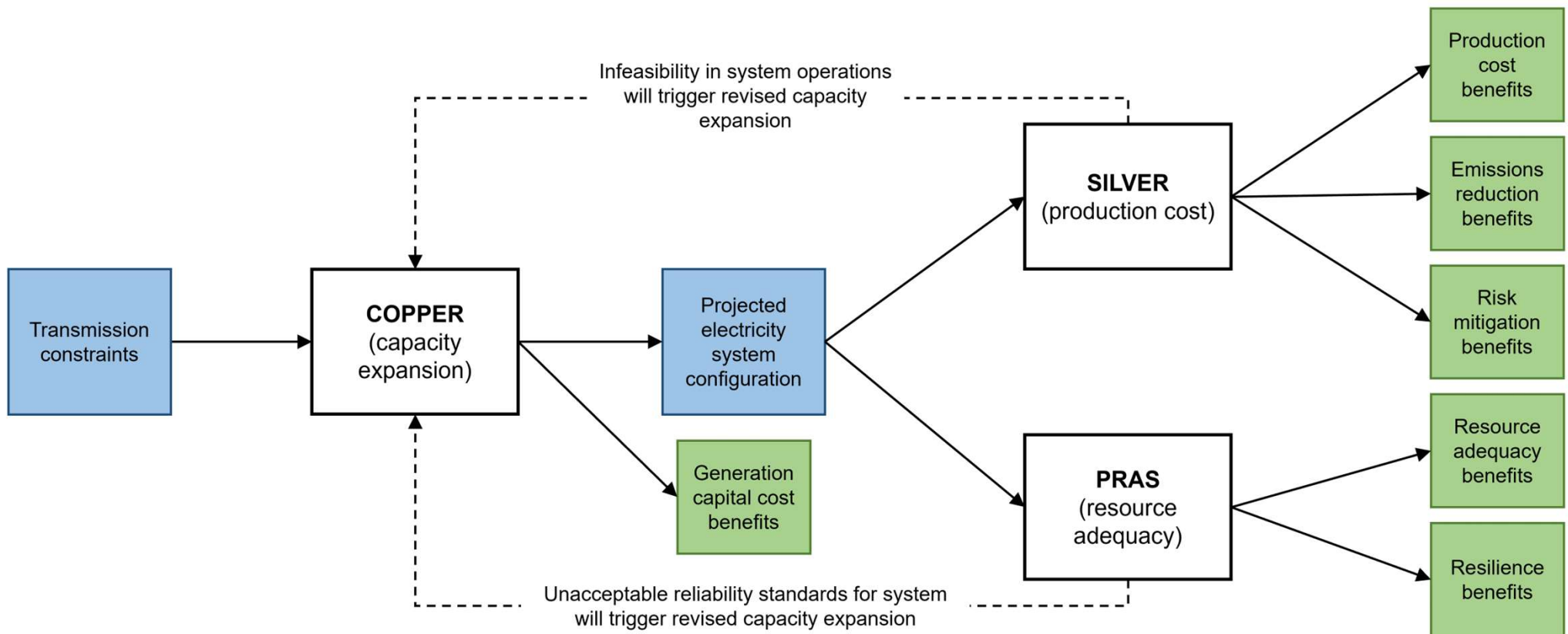
Renewable Electricity Coordination & Strategic Infrastructure (RECSI)

English et al. (2020) – Flexibility requirements

East Grid – Canada Grid

Sustainable Energy Systems Integration & Transmission (SESIT)

Expansion – multi-benefit analysis of transmission expansion



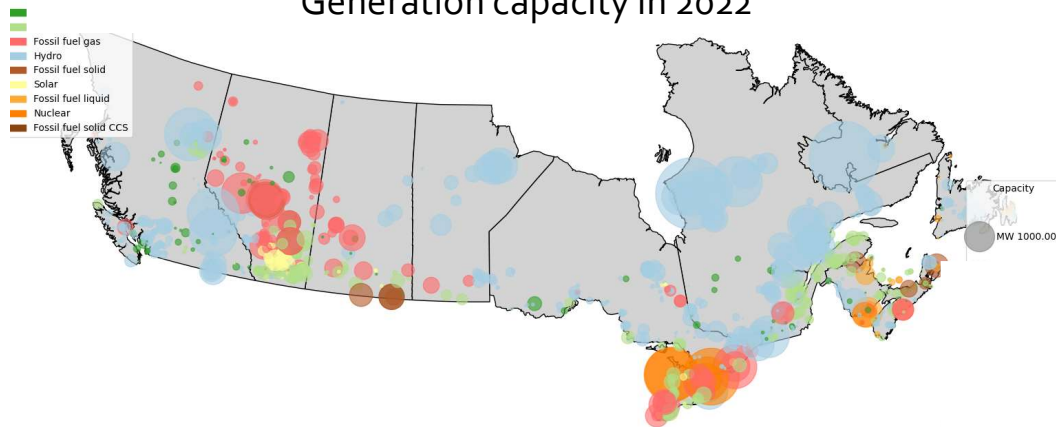
Multi-benefits of transmission expansion

Benefit	Description
Production cost benefit	Fuel cost savings; reduced thermal power plants cycling; reduced curtailment
Emission reduction benefit	Reduced CO ₂ equivalent (65 -170 \$/ton from 2024 to 2030)
Generation capital cost	Reduced capital cost by accessing better quality renewable regions
Risk mitigation benefits	Production cost savings across a range of uncertain future conditions >> varying gas price & load growth >> alternative renewable build-out & thermal plant retirements
Resource adequacy benefits	Reduced loss-of-load expectation compared to the cost of a new combustion turbine necessary to achieve the same level of reliability
Resilience benefit	Reduction in unserved energy during loss-of-load events that remain after resource adequacy improvements (assumed at 20,000 \$/MWh)

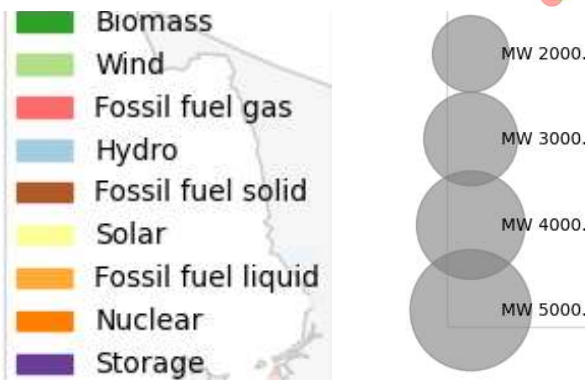
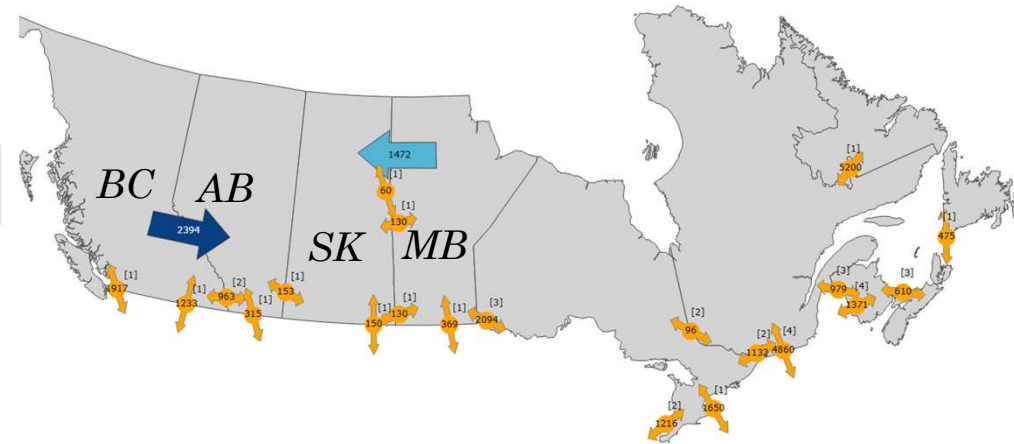
Energy Systems Integration Group. 2022. *Multi-Value Transmission, Planning for a Clean Energy Future*. A Report of the Transmission Benefits Valuation Task Force. Reston, VA. <https://www.esig.energy/multi-value-transmission-planning-report>.

Case study - transmission expansion across BC-AB & SK-MB interties

Generation capacity in 2022



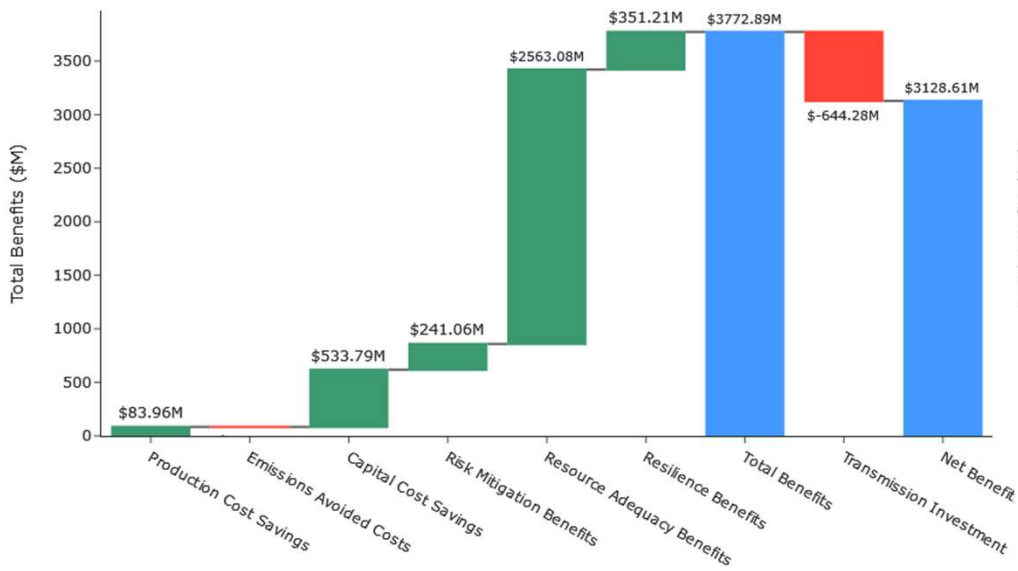
Interties in 2022 (orange) and 2050 (blue)



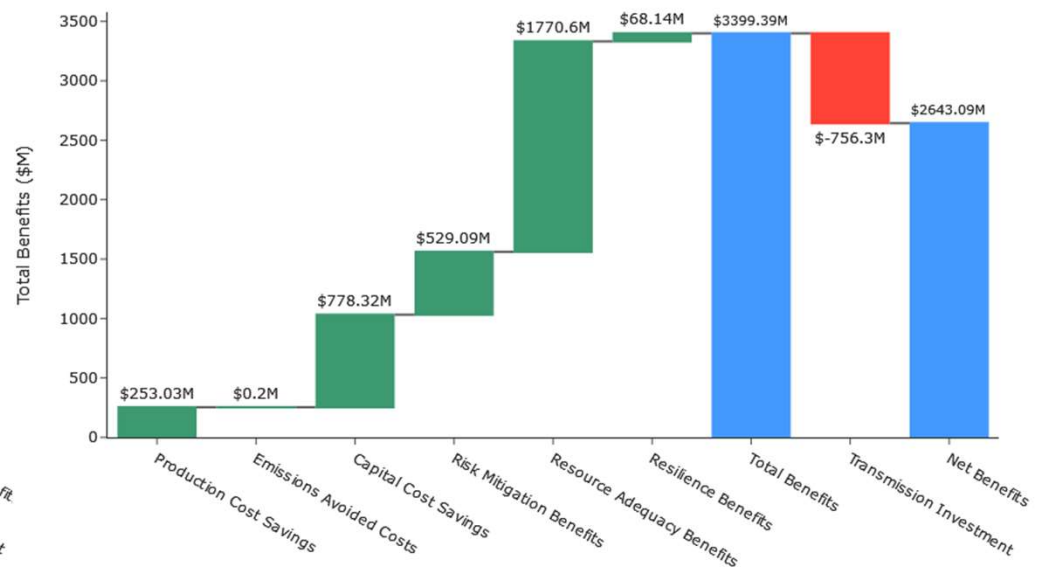
Transmission corridor	Additional (new) transmission capacity (MW)	Transmission investment (M\$)
BC-AB	2,395	\$644
MB-SK	1,472	\$756

Multi-benefit stacking

BC – AB Transmission Expansion

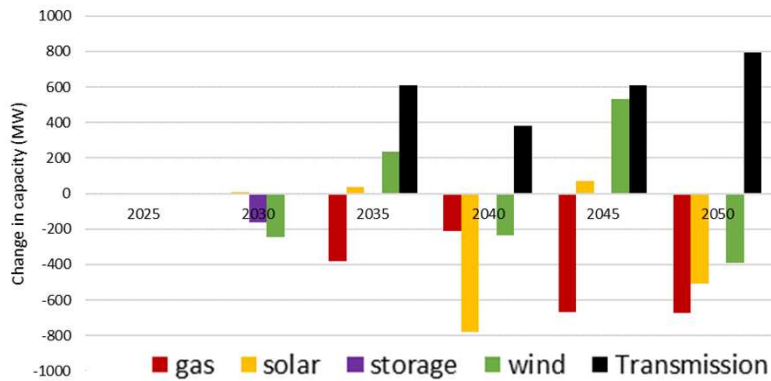


MB – SK Transmission Expansion

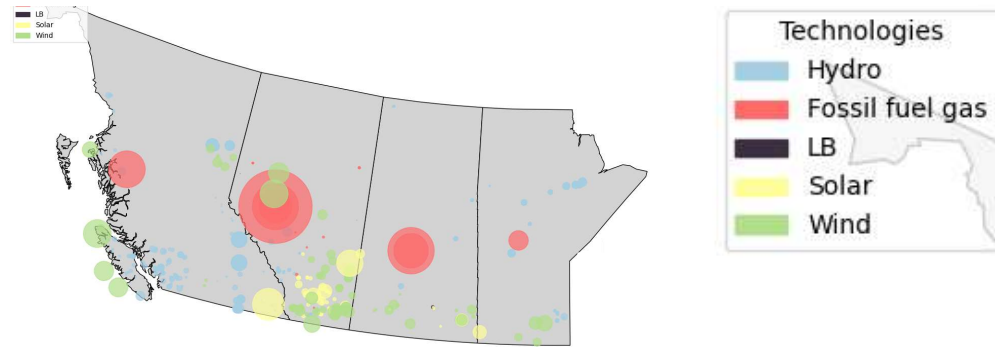


Generation capacity

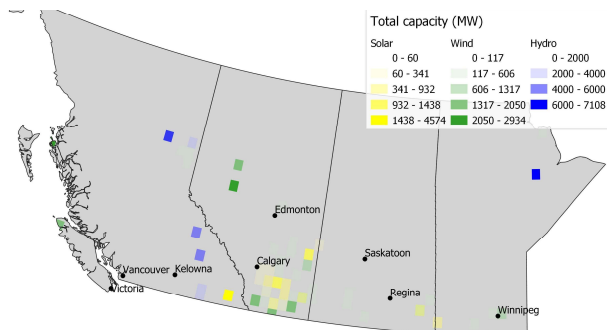
BC – AB change in new capacity
(with transmission expansion)



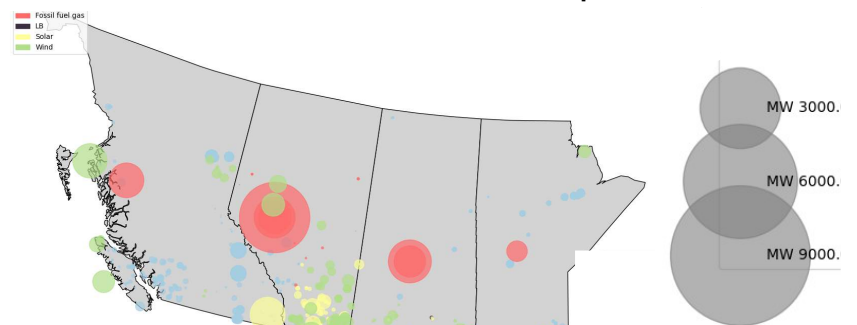
No-transmission expansion scenario



Renewable locations in 2050
(existing and new)

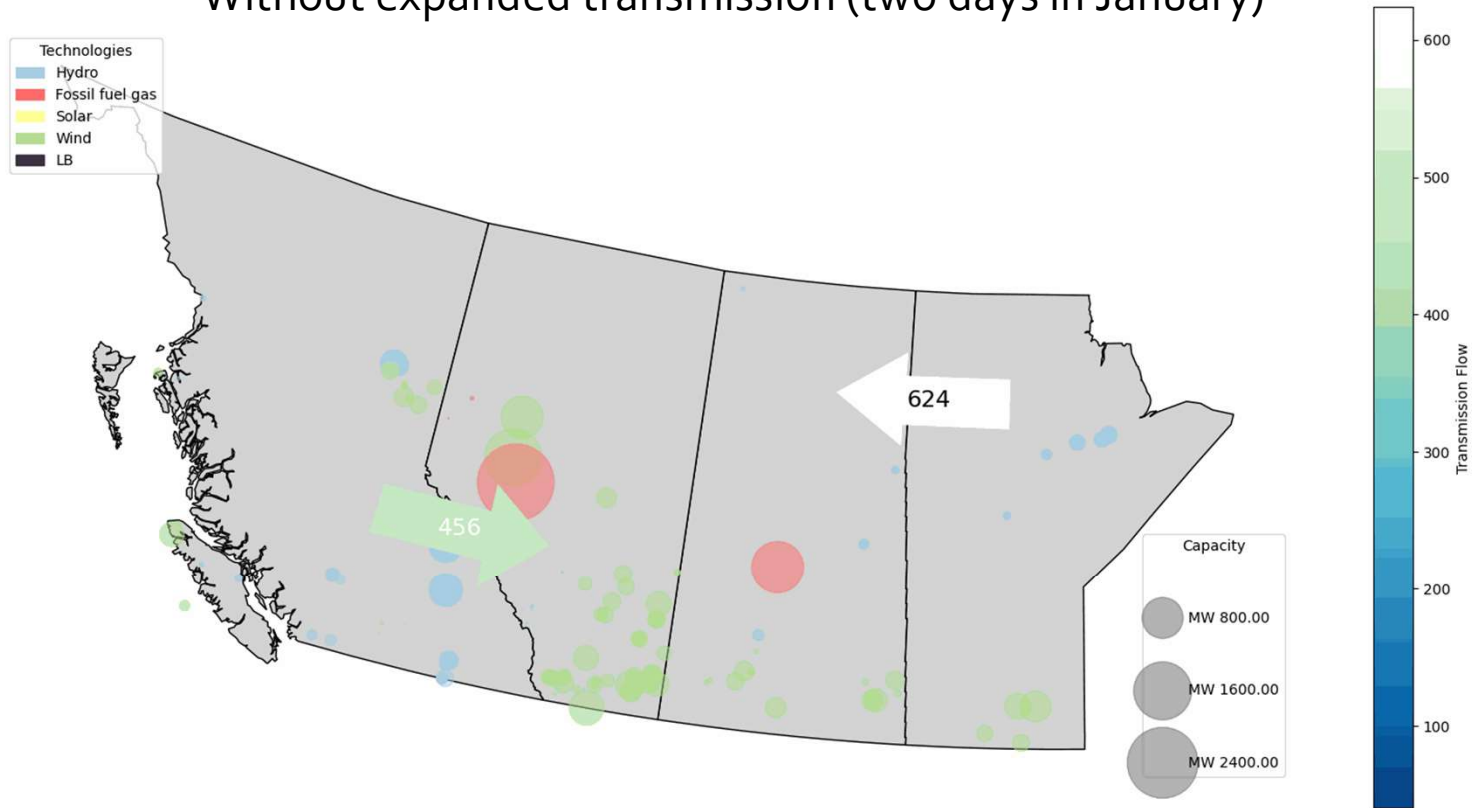


Unconstrained transmission expansion scenario



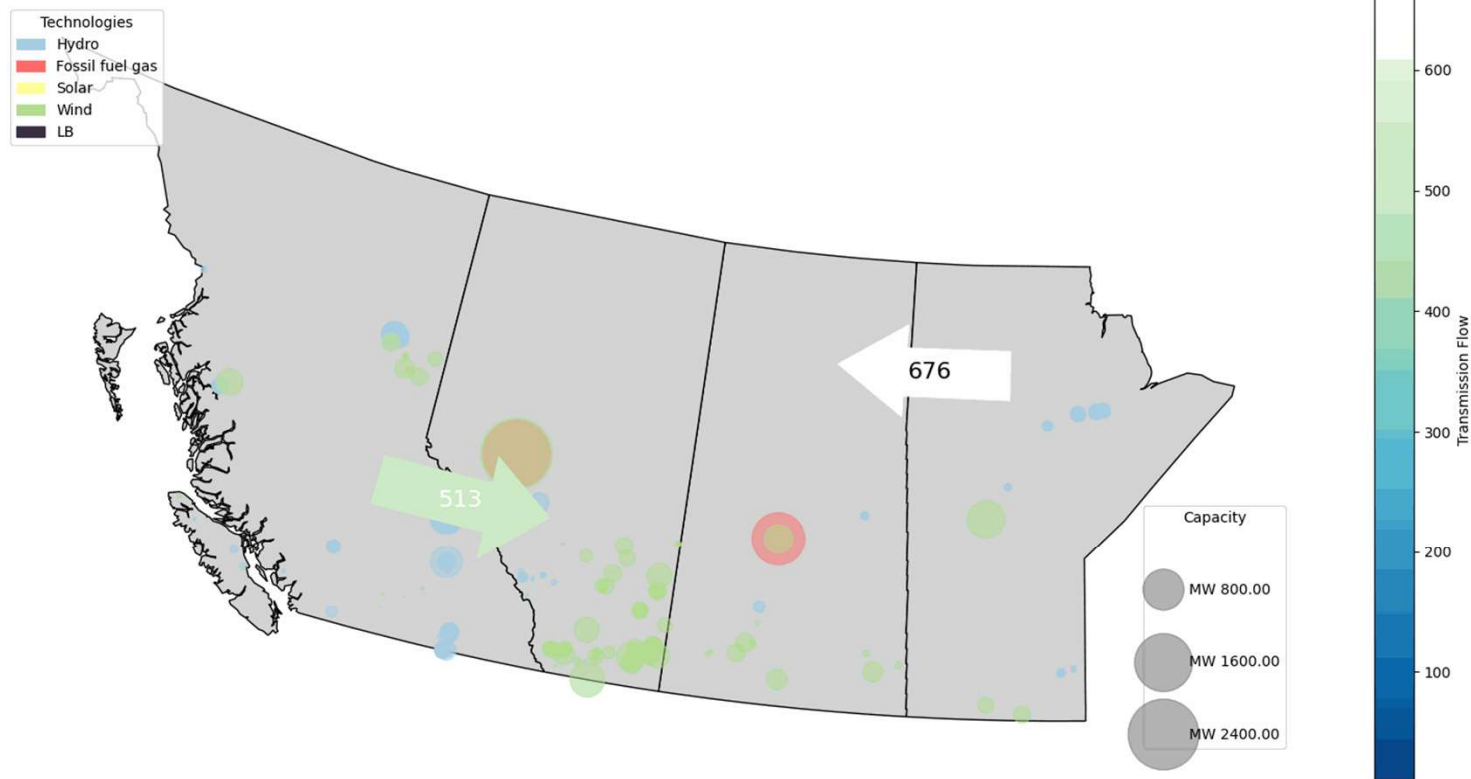
Generation & inter-provincial flow

Without expanded transmission (two days in January)



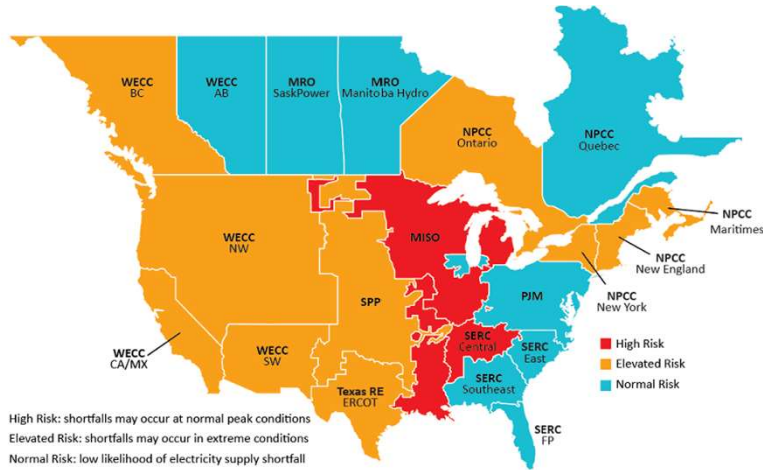
Generation & inter-provincial flow

With expanded transmission (two days in January)



Reliability

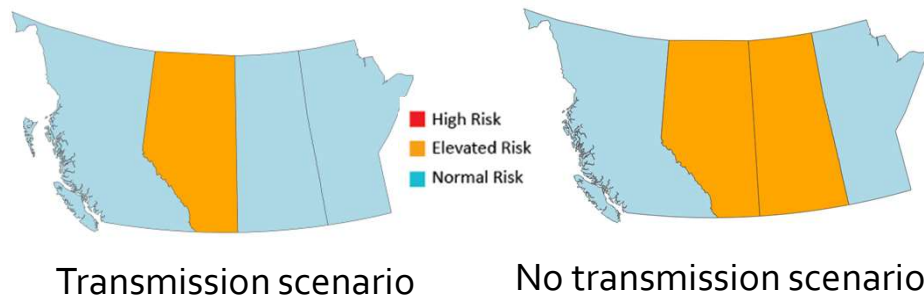
WECC report: risk area summary for 2024-2028



Projected reliability metrics for 2026
(from NERC's 2023 Long-term reliability assessment)

Region	LOLE (event-h/year)	EUE (MWh/year)
British Columbia (BC)	0.75	15,991
Alberta (AB)	0	0
Saskatchewan (SK)	0.90	117
Manitoba (MB)	0.04	29

"1-day-in-10-years" reliability criteria in 2050



Transmission scenario

No transmission scenario

Modelled reliability metrics for 2050 scenarios

Scenario	LOLE (event-h/year)	EUE (MWh/year)
BC-AB (existing transmission)	0.70	3,354
BC-AB (transmission expansion)	0.65	2,032
MB-SK (existing transmission)	0.41	282
MB-SK (transmission expansion)	0.07	20

Model limitations

- We don't model the US power system
 - Instead, we use historical data to parameterize imports/exports with the USA
 - Flows with the USA would be different in future years with different conditions
- We lack access to data
 - To model hydro flexibility (minimum generation and water conveyance requirements)
 - There may be less flexibility in the BC Hydro dams than we model here
 - Current modelling is based on 2021 data
 - 2025 result are skewed >> more modelled build out time than is possible
- No wheeling charges in COPPER model
- Details of CER provisions are still currently in discussion
 - Modelled the original release of the CER, but changes has been made since then
 - Uncertainty on emission cap, carbon offsets allowed, EoL of thermal generators

... any yet procurement is limited for a variety of reasons

Provincial jurisdiction over energy

- > lack of effective incentives – revenues flow to provincial government; improper valuation of interties
- > regulatory and market structure mismatch between provinces
- > economic barriers – can't access new customers in neighboring provinces
- > political barriers – local jobs; provincial rivalries; local accountability; provincial champions
 - federal action is seen as threatening independence and powers

Lack of leadership on power sector planning, including now decarbonization

- > lack of innovative culture within the regulatory/market space
- > lack of centralized discourse – lack of venue for a cohesive dialogue
 - >>> allow vested interests to dominate the conversation & maintain the status quo

Local concerns -NIMBY

... any yet procurement is limited for a variety of reasons

Provincial jurisdiction over energy

- > lack of effective incentives – revenues flow to provincial government; improper valuation of interties
- > regulatory and market structure mismatch between provinces
- > economic barriers – can't access new customers in neighboring provinces
- > political barriers – local jobs; provincial rivalries; local accountability; provincial champions
 - federal action is seen as threatening independence and powers

Lack of leadership on power sector planning, including now decarbonization

- > lack of innovative culture within the regulators across Canada
- > lack of centralized discourse – lack of venue for a cohesive dialogue
 - >>> allow vested interests to dominate the conversation & maintain the status quo

Local concerns -NIMBY

> *lack of effective incentives*

- Improper valuation of interties
 - What transmission benefits are considered by the regulator?
 - Is resilience, reliability, resource adequacy benefits been considered?
- BCUC Order in Council – keeping rates low
 - prioritizes not increasing consumer rates to ‘protect consumers’
 - does not account for building infrastructure that helps us meet our climate targets, while maintaining reliable and resilient system
- Modelling demonstrates that inter-provincial transmission has net benefits
- Should inter-provincial transmission that delivers net benefits be part of BCUC’s mandate?

... any yet procurement is limited for a variety of reasons

Provincial jurisdiction over energy

- > lack of effective incentives - revenues flow to provincial government; improper valuation of interties
- > regulatory and market structure mismatch between provinces
- > economic barriers – can't access new customers in neighboring provinces
- > political barriers – local jobs; provincial rivalries; local accountability; provincial champions
 - federal action is seen as threatening independence and powers

Lack of leadership on power sector planning, including now decarbonization

- > lack of innovative culture within the regulators across Canada
- > lack of centralized discourse – lack of venue for a cohesive dialogue
 - >>> allow vested interests to dominate the conversation & maintain the status quo

Local concerns -NIMBY

Regulatory mismatch

- The context for transmission expansion varies by province
- Canada doesn't have federal intervention (like FERC or the IRA support)
- Regulation and tariffs across Canada:
 - Transmission is regulated by provincial regulators under a cost-of-service methodology
 - Each regulator sets a rate of return, based on their allowed investments
 - This approach favors additional assets (over which a return is earned) instead of alternative approaches (e.g., DSM) which are less straightforward to remunerate
- Provinces fall into one of three categories
 - Vertically integrated crown corporations with little competition
 - Vertically integrated private companies with little competition
 - Unbundled electricity sector with open wholesale & retail competition

*(1) Vertically integrated crown corporations
- little competition*

Provinces include:	British Columbia, Saskatchewan, Manitoba, Quebec, New Brunswick, Newfoundland
Ownership	Provincial government owns the dominate electricity company High degree of vertical integration (ownership is <i>not</i> unbundled)
Operations	Crown corp. oversees generation, transmission, system operation, distribution, retail <i>Not</i> operationally unbundled
Market/ procurement	Wholesale market based on bilateral contracts and regulated retail market IPPs can play a small role through long-term contracts Retail market is not open to competition
Politics	Utilities are not independent; they are influenced by other priorities such as regional development, economic support for industries, etc. Crown corps. earn revenues for the provincial government and are generally popular among citizens

(2) Vertically integrated private companies - with little competition

Provinces include:	Nova Scotia, PEI (to some extent)
Ownership	Single investor-owned company is responsible for the electricity sector NS - High degree of vertical integration PEI - Moderate degree of vertical integration – imports ~75% of power from NB Power
Operations	Nova Scotia Power (NSPI) regulated by Utility & Review Board System operator (NSPSO) operates wholesale market functions as part of NSPI IPPs can sell to NSPI which then distributes to consumers (RE can be sold directly)
Market/ procurement	Wholesale market based on bilateral contracts and regulated retail market There are some supply contracts from IPPs & imports from other provinces
Politics	Clean Energy Solutions Task Force established in 2023 – recommending an independent system operator & standalone energy regulator

(3) Unbundled electricity sector - with open wholesale & retail competition

Provinces include:	Alberta and Ontario
Ownership	Generation by investor- & municipally- owned companies (& Crown corp. in Ontario) Transmission assets are mostly owned by investor-owned companies
Operations	IESO is responsible for planning, conservation, market design* Distribution is under the control of municipal companies (AB and ON)
Market/ procurement	Open, competitive, organized wholesale market providing an hourly price signal Transmission asset owners earn a profit based on a regulated transmission tariff Ontario has a <i>Transmission Rights Market</i> (can import, export, or transport energy) Competitive retail market - competitive retailers in an open retail market
Politics	AB – recently released green paper on transmission (cost allocation, congestion, interties) ON – dual-peaking (due to electrification), capacity shortfall, DR program, nuclear expansion, ultra-low overnight pricing introduced in 2023

Projects in Canada

New Brunswick/ Nova Scotia Transmission Reliability project

- New 345 kV line; 65 km long; parallel to existing line
- Increase energy operational flexibility & reliability in Nova Scotia
 - to integrate renewables & phase out fossil generation
- Engagement & environmental assessments currently underway; construction in Fall 2024 (?)

Ontario & Quebec – new electricity trade agreement between provincial governments

- Annual capacity swap of 600 MW trade agreement between IESO & Hydro-Quebec
- Take advantage of complementary seasonal peaks in demand (ON in summer QC in winter)
- 10-year agreement –no payments by either party ('protecting ratepayers in both provinces')

Birtle Transmission project

- 230 kV line in MB to boarder with SK to transmit power to SK
- began public engagement in 2016; energized in 2021

Status	PTs	Name	Origin	Endpoint	Line length (km)	Stated cost
Planned	MB-NU	Kivalliq Hydro-Fibre Link	Gillam, MB	Kivalliq Region, NU	1200	\$3 billion
Conceptual	BC-YK	BC-Yukon Intertie	Whitehorse, YK	Iskut, BC	763	\$1.7 billion
Conceptual	ON-QC	Abitibi-Timmins intertie	Abitibi, QC	Timmins, ON		
Conceptual	ON-QC	Montreal-Toronto intertie	Montreal, QC	Toronto, ON		

Alberta – released green paper on transmission

Addressing seven policy issues:

- Contribution of generation to transmission costs

- Responsibility for line losses

- Non-wires solutions

- Congestion policy

- Cost allocation for transmission

- Cost allocation for ancillary services

- Treatment of interties

Context from the USA

- Studies - the US needs to (at least!) double transmission capacity to meet climate goals
 - Transmission reduces electricity prices and improves reliability
- Transmission *IS* being built (\$25 billion in 2020) but it is the wrong kind
 - There is declining investment in large scale transmission in the USA
- Transmission policy incentivizes lines that don't support reliability or climate goals
 1. Vertically-integrated utilities
 - do not want to build transmission that exposes their generating units to competition
 - prefer to build & rate base local lines, which avoids competition with merchant TOs
 2. Regulatory gaps allow TOs to build local lines without undergoing meaningful regulatory scrutiny
 - whereas merchant lines get bogged down in siting disputes

Result: almost all transmission constructed locally, without competition or regulatory oversight

- Congress has commissioned research to look at regional transmission
- FERC has a new Notice of Proposed Rulemaking (NOPR) to help fix the issue

Context from the EU

- Local transmission - congestion management is a huge problem
 - Zones are treated as copper plate (don't have locational marginal pricing)
 - Transmission is difficult to site & build (population density)
 - Happening slowly though - HVDC line from North to South Germany is being built
- Inter-regional transmission – ENTSO-E
 - Represents 39 electricity TSOs from 35 countries
 - Pan-European Transmission Network plans and cost-benefit analysis:
 - 10-year network development plan is the basis for EU projects of common interest
- Each country retains policy autonomy
- Offshore wind strategy -
 - Shifting from (country) self-sufficiency to large exporting countries (with offshore)

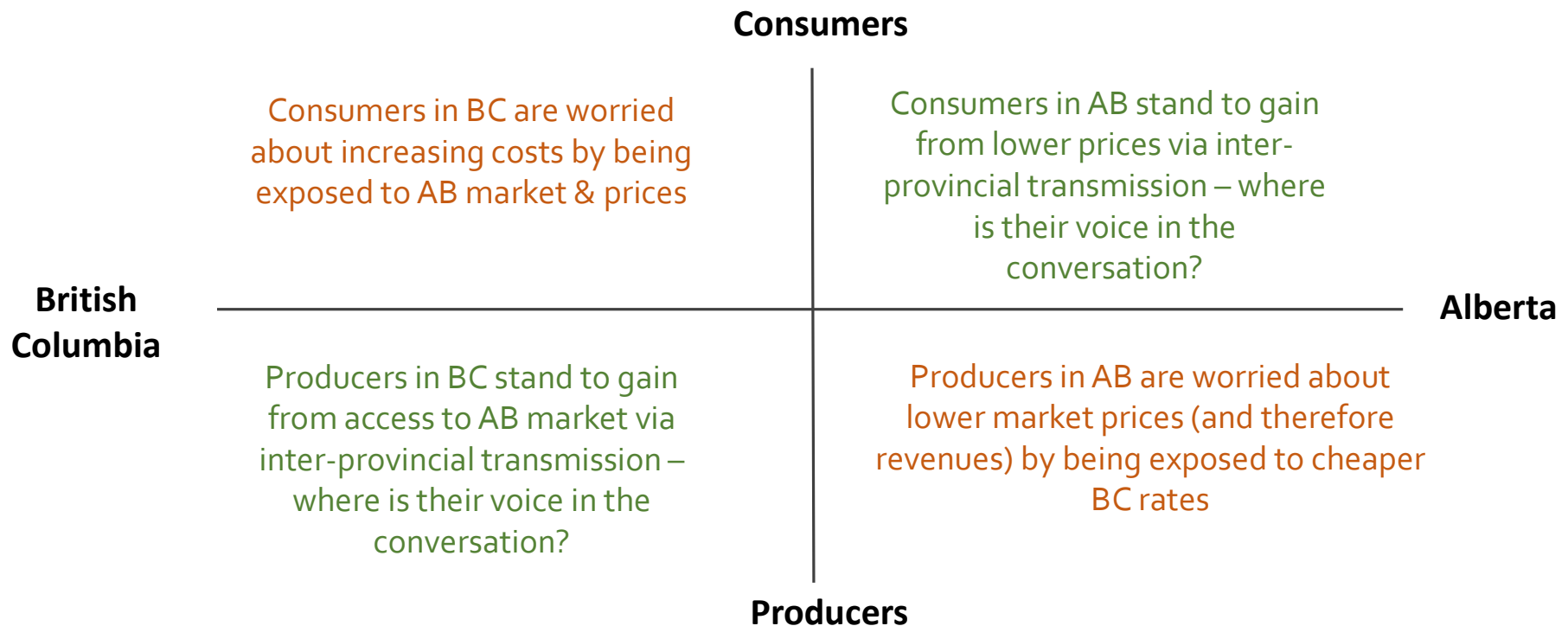
The international context

– lessons learned & successful attributes

	Nordic	Japan
Government commitment to break down provincialism	<p>(1) Nord Pool - wholesale market owned by the four countries' TSOs</p> <p>(2) Nordic Council of Ministers TSOs have joint planning sessions</p> <p>(3) Nordic Energy Research group</p>	Organization for Cross-regional Coordination of Transmission Operators (OCCTO) – formulation of a long-term network plan
Sharing of benefits	<p>Network plan is the basis for project selection</p> <p>Denmark: major wind expansion backed up with hydro power from Norway;</p> <p>Bigger markets that are more attractive to investors and increased cost efficiency</p>	Move power from offshore wind power projects to demand centers; improve resilience
Autonomy	Each country retains policy autonomy	Regional monopolies

Next steps – change the narrative...?

Bilateral approach that focuses on giving the winners a voice and minimizing the impacts on losers



Next steps – bridge the gap between Provincial targets & utility planning

- In provinces with a crown corporation, there can (and should) be a connection between provincial decarbonization targets & policy and utility infrastructure planning
- In British Columbia, there is a gap between:
 - provincial decarbonization targets published in the CleanBC plan
 - modelling with an energy-economy model (gTech) and
 - power system planning published in the 10-year capital plan
 - BC Hydro infrastructure planning modelled in...?
- In provinces with vertically integrated crown corporations, provincial ownership could help the government execute on transition plans

Next steps – federal or merchant levers

- Current process:
 - provinces agree to pay the development cost in its province
 - a long-term contract (signed by the two provinces) support the investment
- Federal government – could support/create incentives
 - Nordic inspiration – combination of Council of Ministers + Research Hub
 - Federal financial support for transmission infrastructure
 - Harmonization of trade across provincial boundaries
- Merchant transmission line
 - Funded by the federal government and/or private investors
 - Contracted by institutions > generators/TSOs in Alberta, Power Marketers, etc.
 - Potentially built on the same right of way inter-provincial pipelines...

Future work

- Embarking on a study - multi-country analysis
 - Planning – degree of centralization
 - Building – process (competitive tendering; do regulations favour incumbents)
 - Operation – access; competitiveness
 - Renumeration – market design; standardized rate of return
- Tease out lessons learned from structures that exist internationally that might be applicable to the Canadian context
 - Following the process of lesson sharing that we engaged in during the renewable integration debates of the early 2010's



Thank you

mmcpherson@uvic.ca