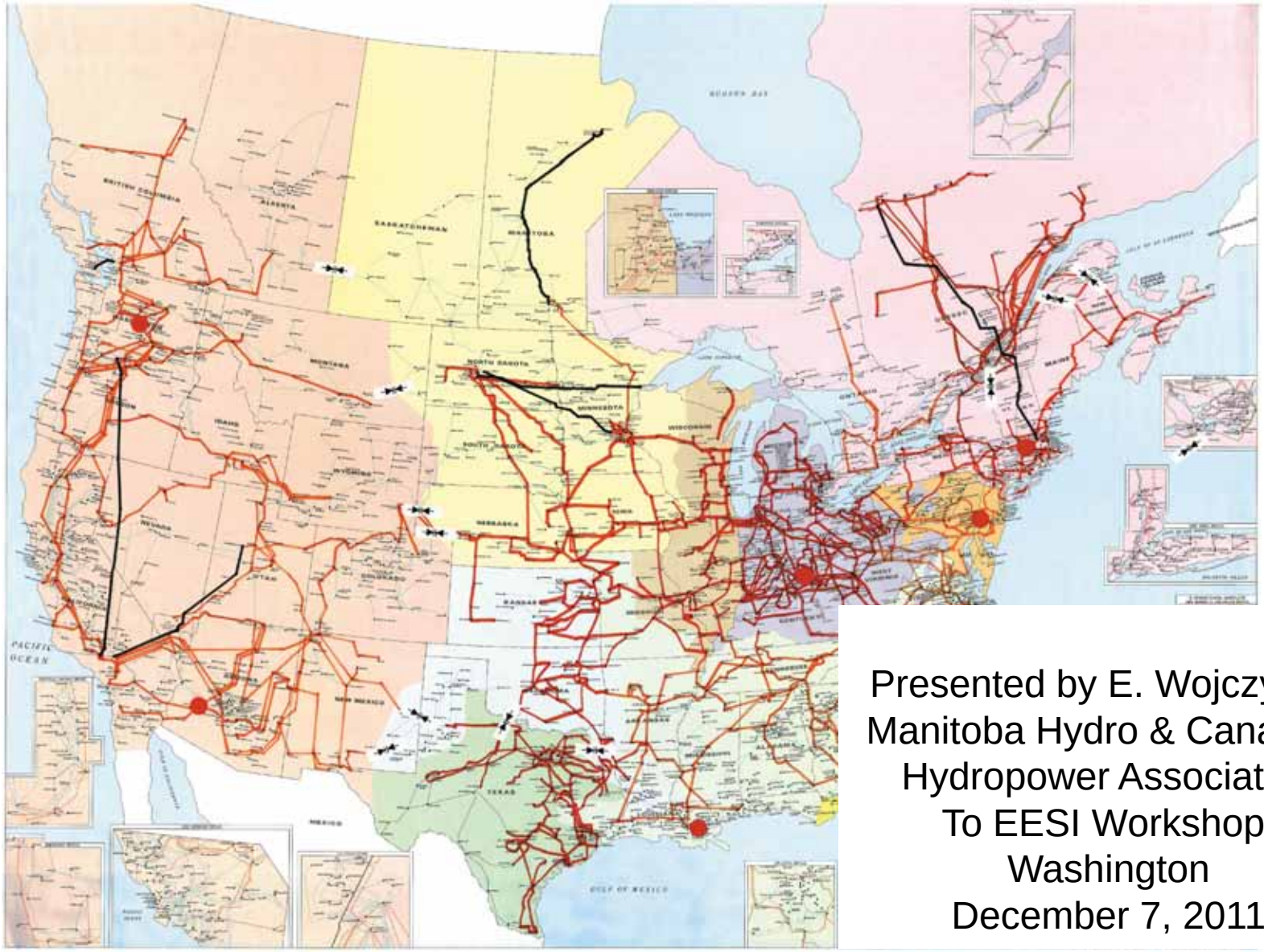
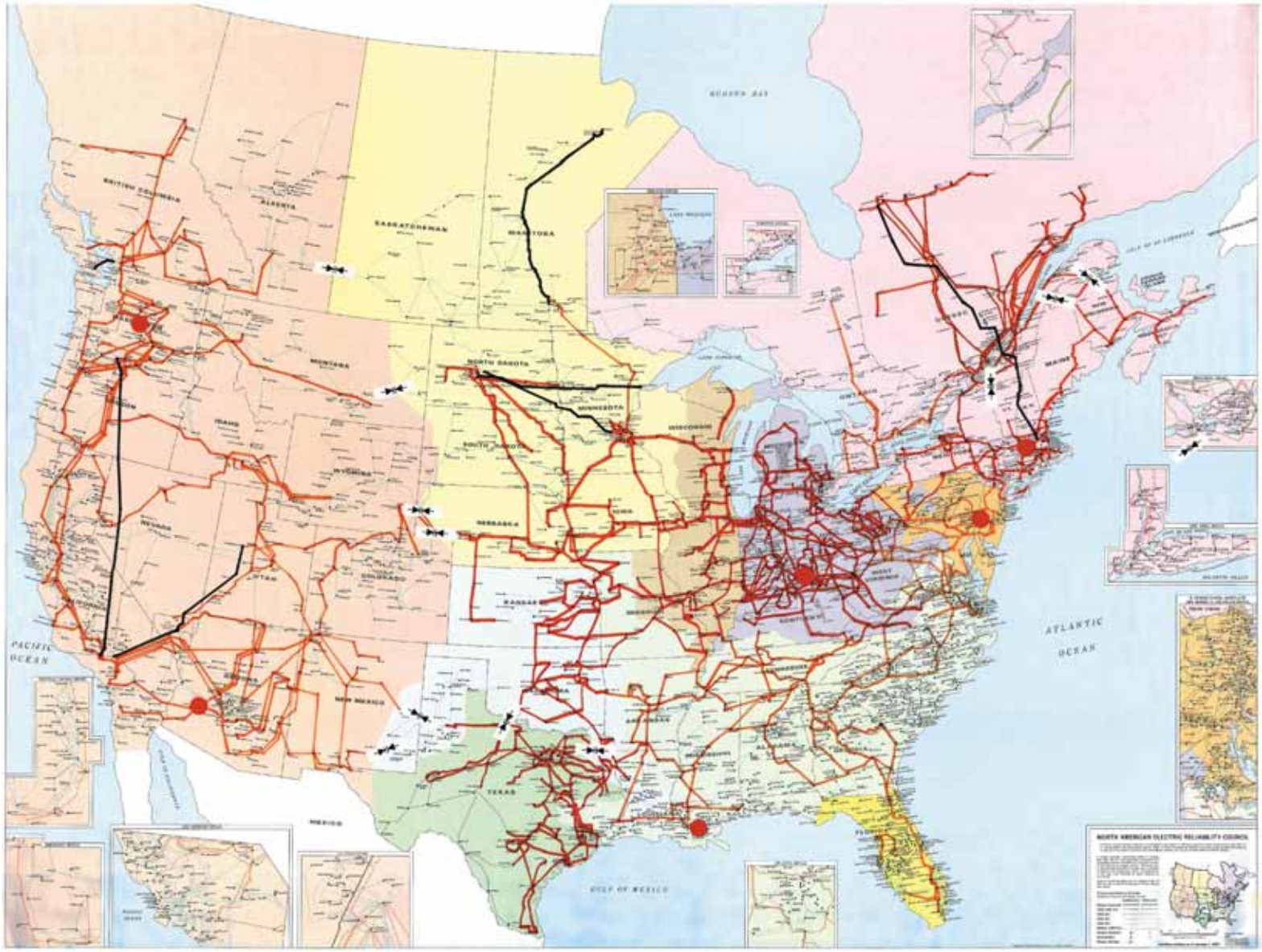
Building Our Future:
Connecting North American Hydro and other Renewables

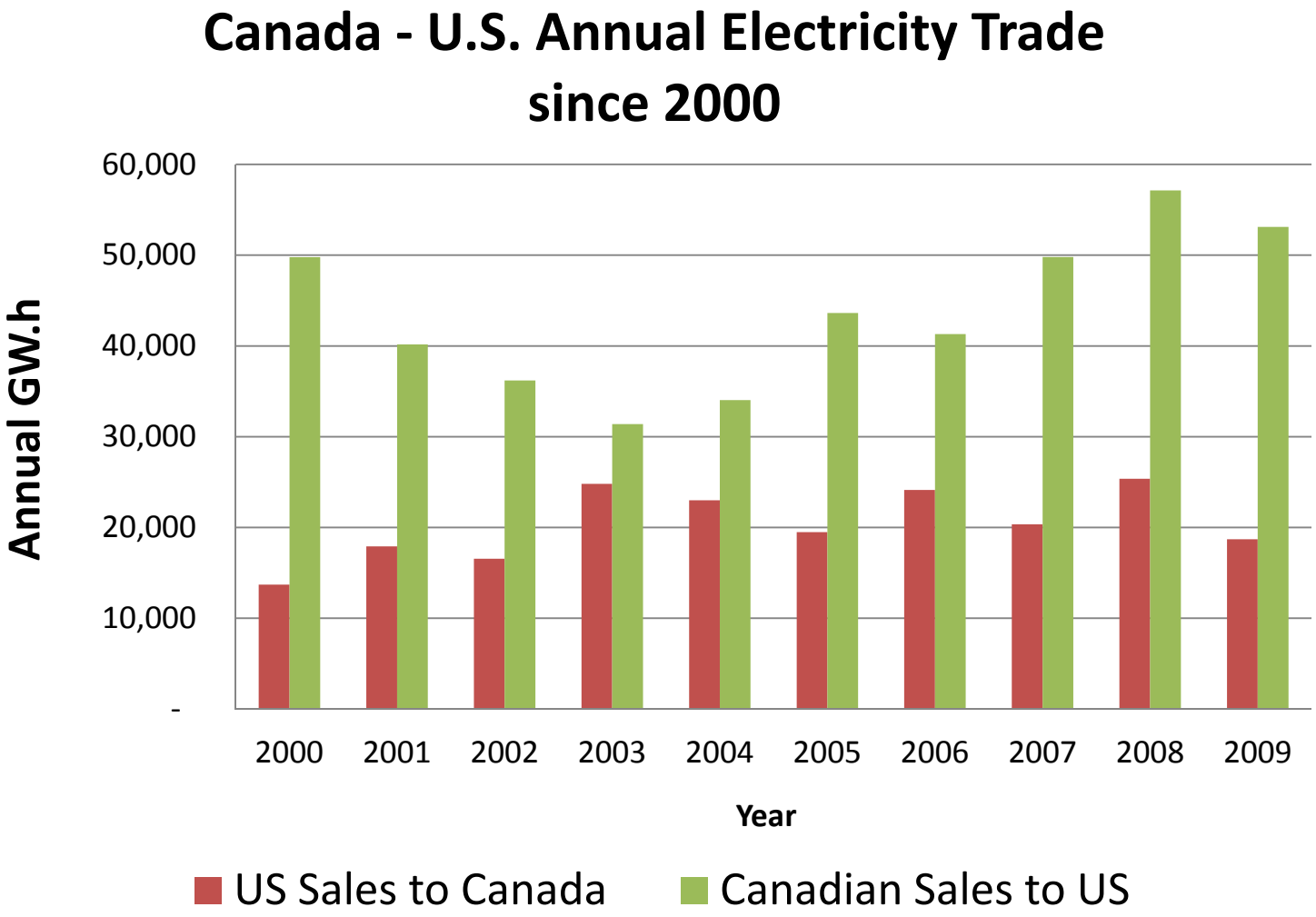


Presented by E. Wojczynski
Manitoba Hydro & Canadian Hydropower Association
To EESI Workshop,
Washington
December 7, 2011

US/Canadian Transmission System is Integrated Strong North-South but not Optimized



US & Canada electricity trade is large(billions of dollars) and bilateral



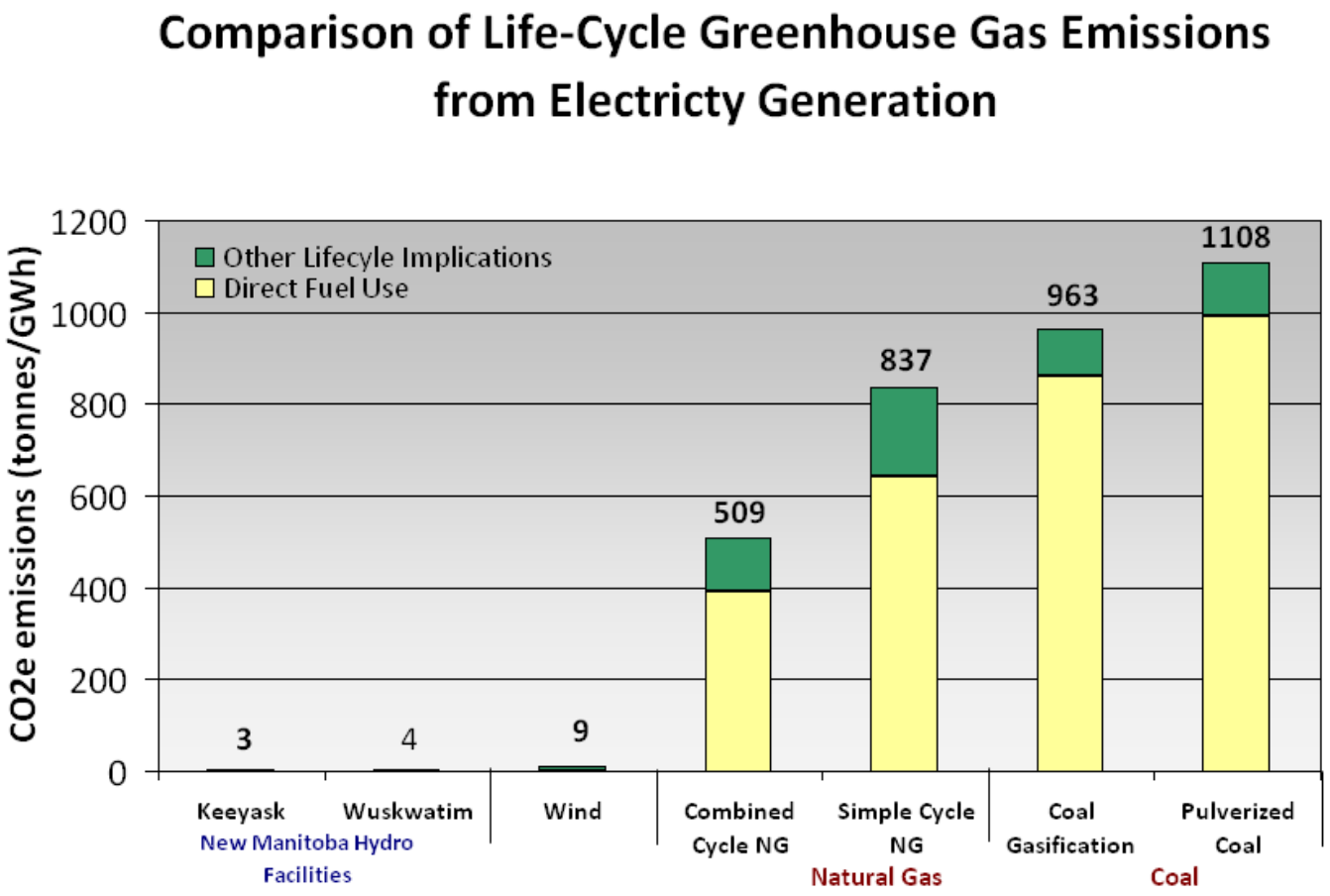
Canadian and US hydro can realistically more than double capacity

Canada
Technical Potential – 163,000 MW
Planned Hydro – 25,000 MW
Existing Capacity – 74,000MW
(4th largest in world)

USA
Can double from the existing capacity – 96,000MW
(2nd largest in world)

Expansion not theoretical potential but considering practical potential

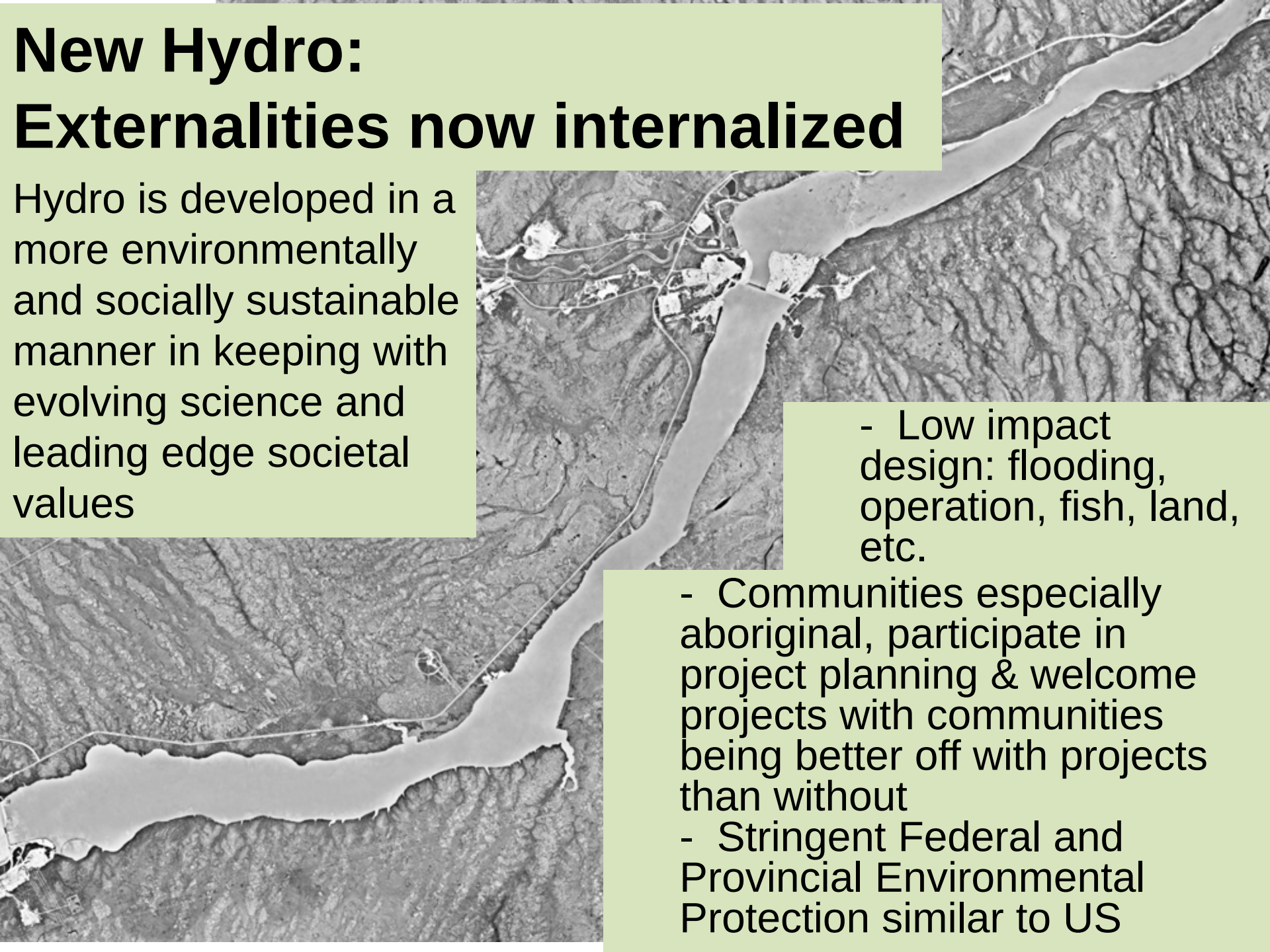
Hydropower is virtually GHG free



Source: Pembina Institute for Appropriate Development: - Based on Pembina Institute study: Life Cycle Evaluation of GHG Emissions and Land Change Related to Selected Power Generation Options in Manitoba

New Hydro: Externalities now internalized

Hydro is developed in a more environmentally and socially sustainable manner in keeping with evolving science and leading edge societal values



- Low impact design: flooding, operation, fish, land, etc.
- Communities especially aboriginal, participate in project planning & welcome projects with communities being better off with projects than without
- Stringent Federal and Provincial Environmental Protection similar to US

Wuskwatim New Generation: 200 MW, $1.6 B

- New Low head design
- Reduces to 200 MW from 350 MW flooding to 0.2 mi^2 from 54 mi^2
- Run-of-river
- Aboriginal communities participate in environmental studies, planning, construction and income

Business Opportunities

Pre-project & on-the job Training

Employment Opportunities

Hydro Imports Benefit USA

1) Hydropower is affordable, keeping costs down for U.S. ratepayers and assisting in keeping US economy competitive

2) Hydro "rechargeable battery" assists greater integration and development of US based wind & solar & biomass providing green jobs
   - Unique operational flexibility-dispatchable, Base Load & Peak Power

3) Regional transmission expansion for hydro also can connect other renewables and be overall lower cost due to economies of scale

4) Hydro& regional transmission allow systems to take advantage of hourly, daily, seasonal & annual differences in demand & supply
   - Optimized operation reduces costs for consumers
   - Reduced GHGs and pollutants
   - Greater energy security & electrical reliability

5)US & Canadian hydro expansion could electrify half of light fleet vehicles thus reducing:
   - 593 million tonnes CO2e
   - 1,630 million barrels/year oil imports by US from overseas.(56% of 2010)

Hydro is a No-Regrets-Option- beneficial regardless whether you emphasize affordability & the economy OR security OR GHGs& environment OR all

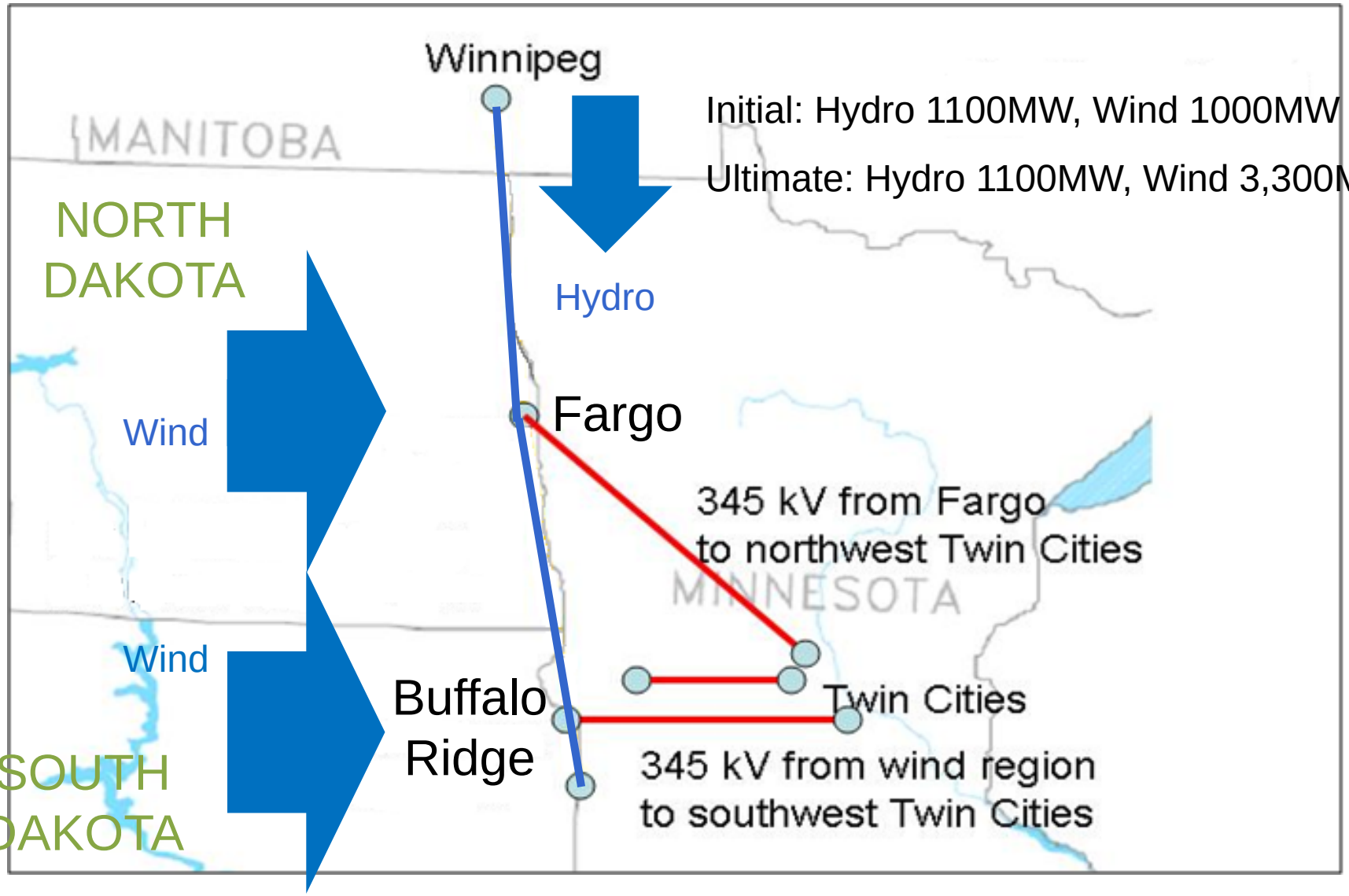
Recognition of New Large Hydro is Needed

- Federal and State Renewable Standards should qualify large new hydro as renewable because it is as renewable and clean as small hydro & wind

- Regional Transmission planning and development should maximize the overall value of the portfolio of renewable resources (wind, hydro, solar, biomass) & other generation

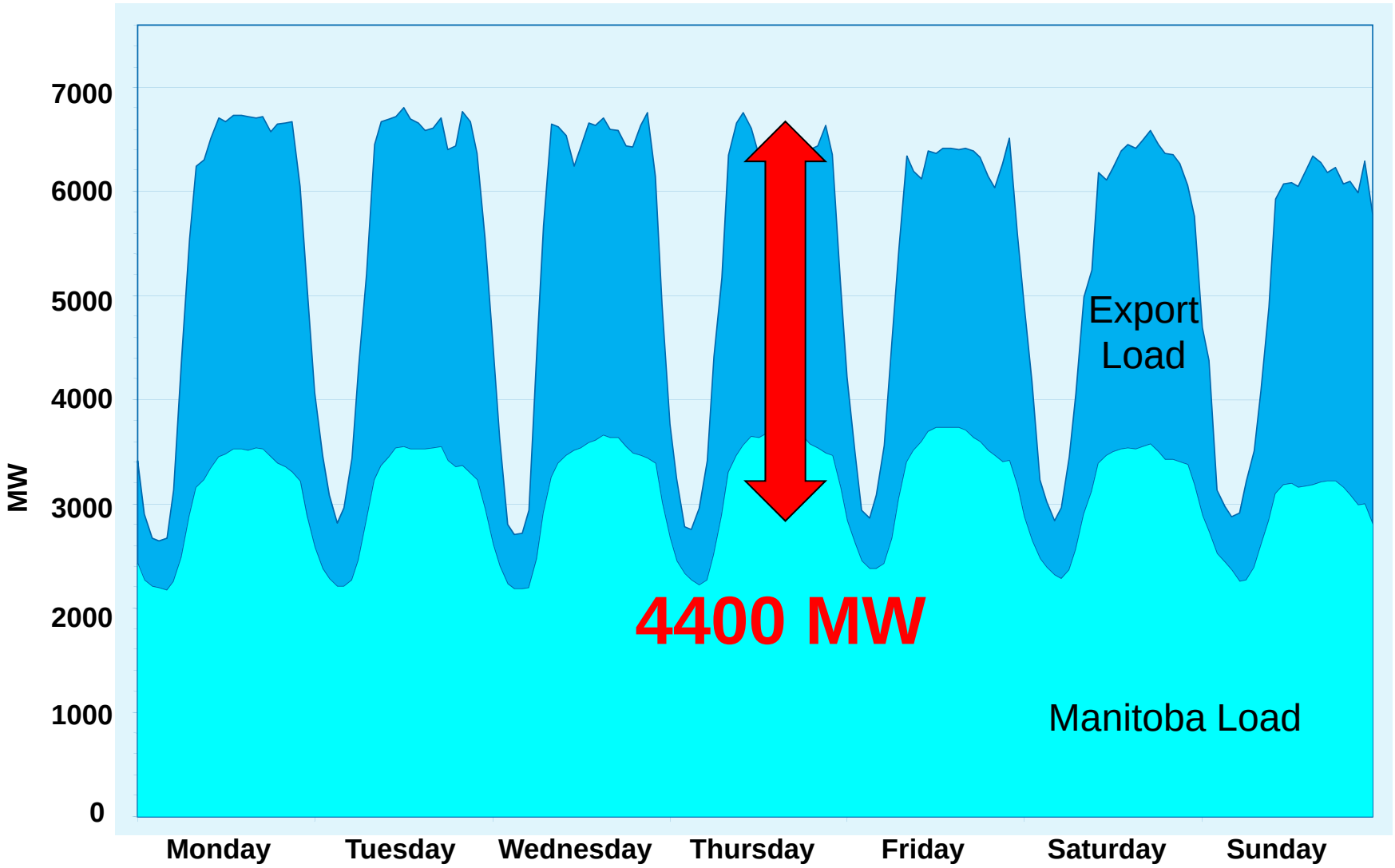

THANK
YOU

Proposed MB-US Regional TX Project Associated with new PPAs in Approval Stage

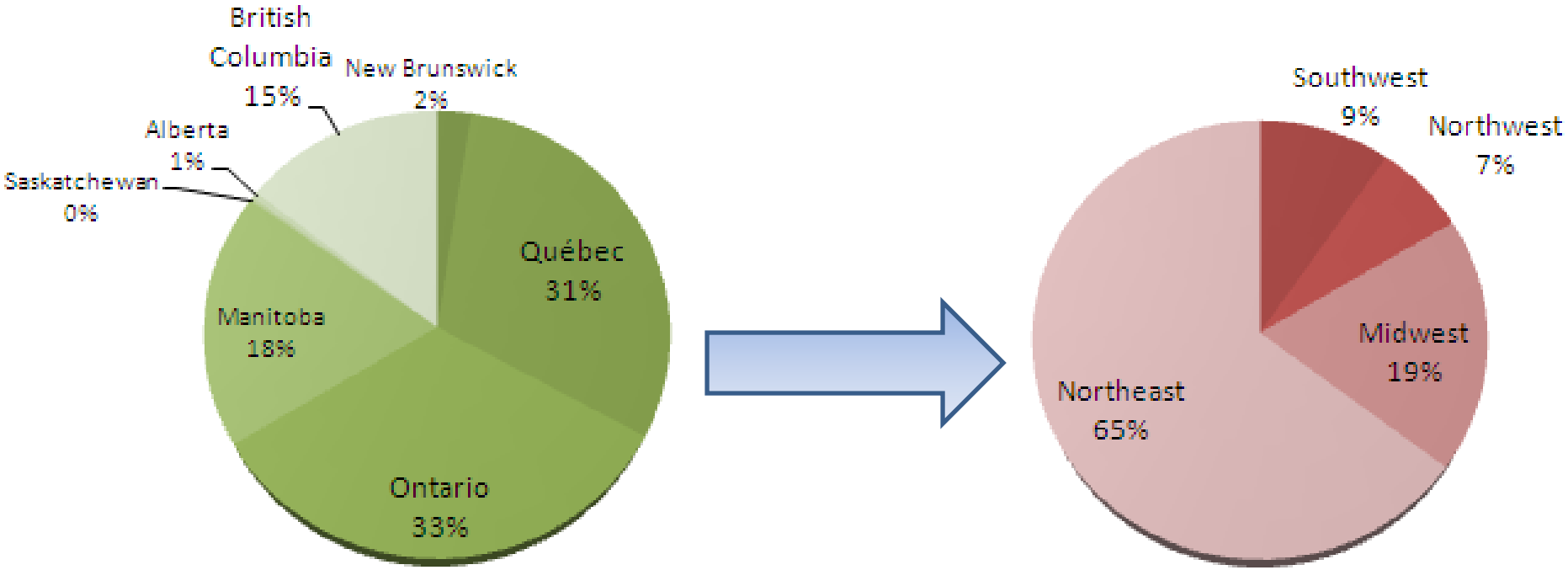


Hydro is Flexible and Fast

(Post Keeyask - Conawapa)

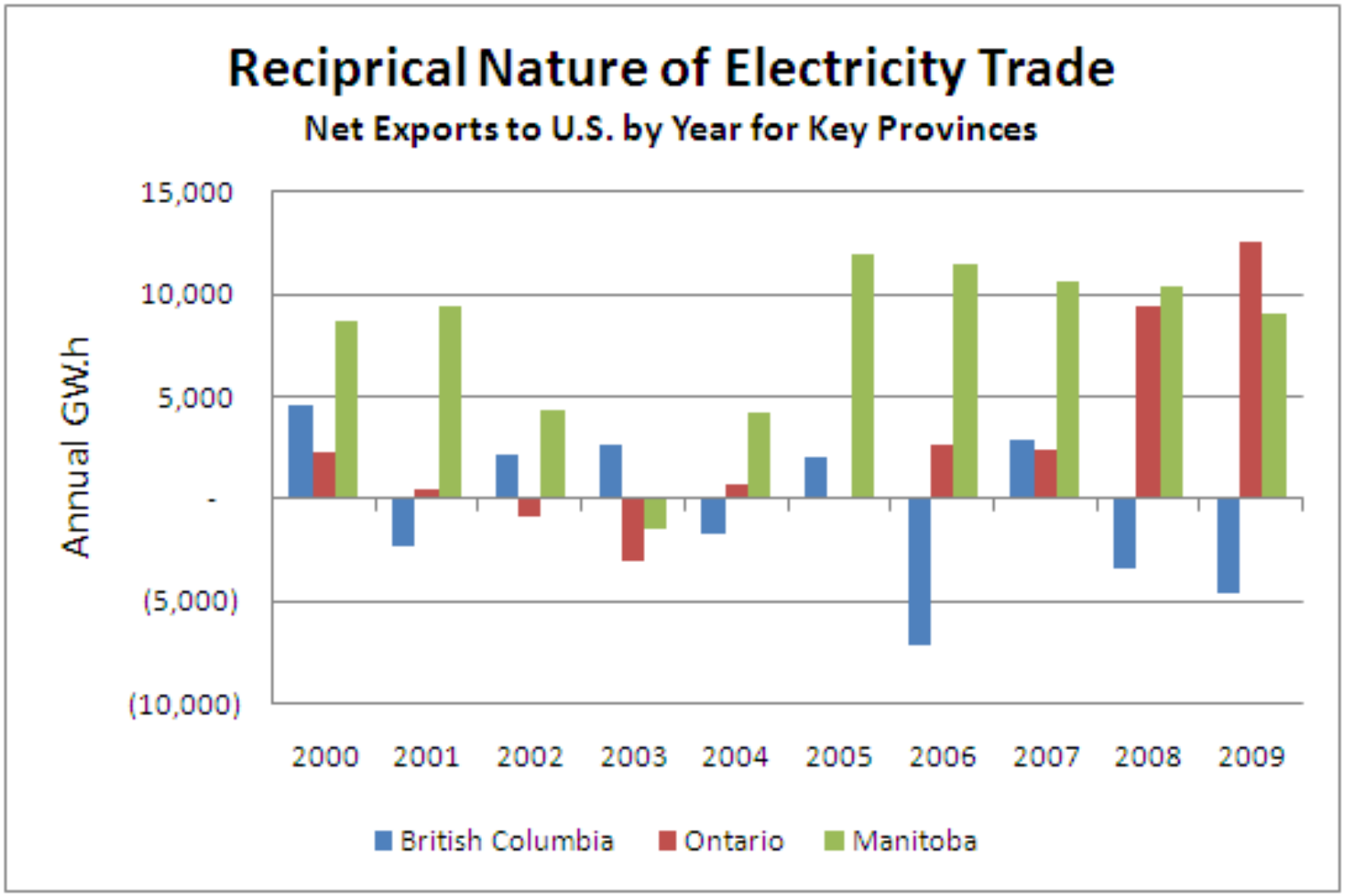


Electricity Exports (2008) benefit various US regions



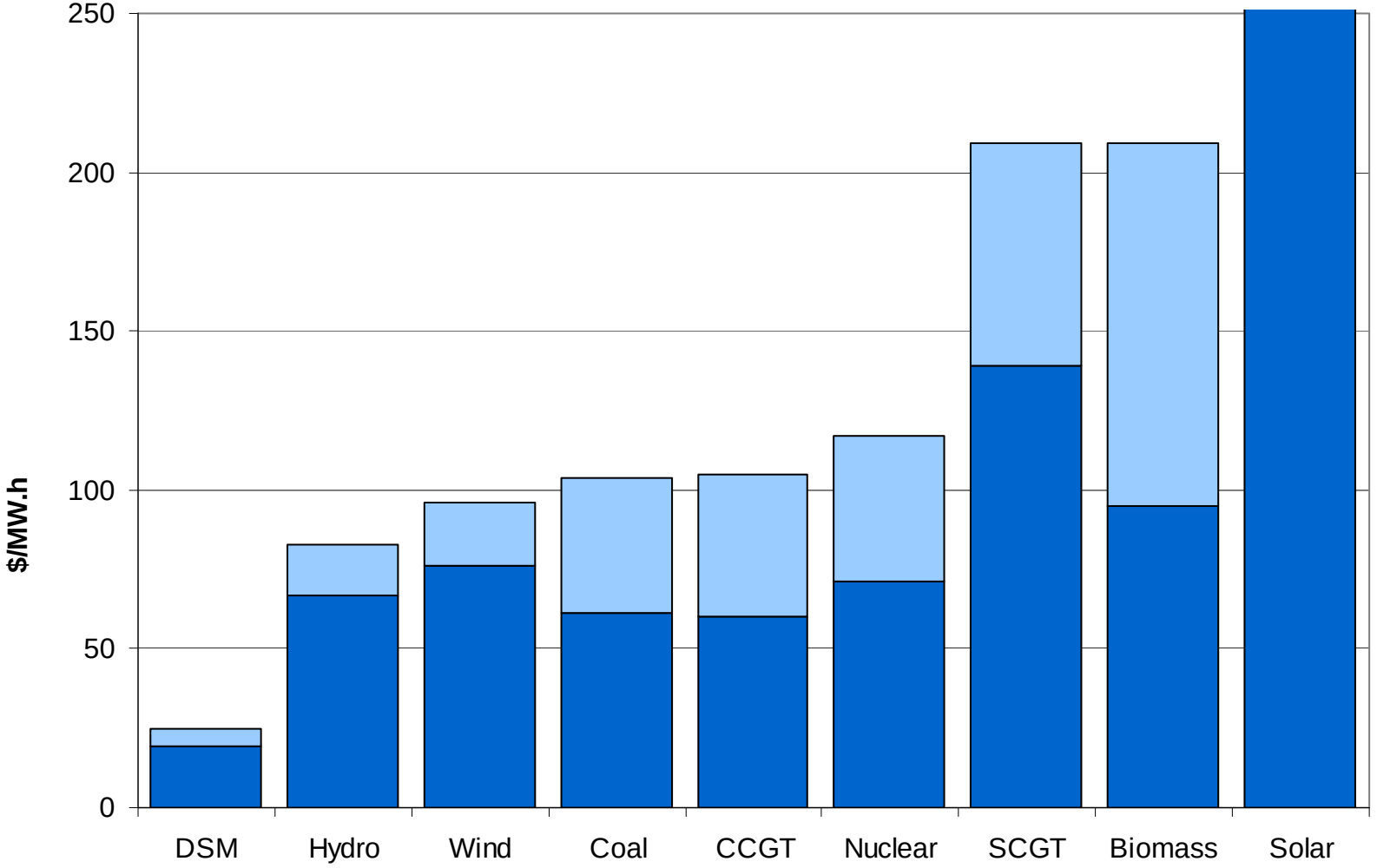
Northwest	Southwest	Midwest	Northeast
Colorado	Arizona	Illinois	New England
Washington	California	Indiana	New York
Montana	Wyoming	Missouri	Pennsylvania
Oregon	New Mexico	North Dakota	Michgan
	Idaho	Nebraska	
	Nevada	Minnesota	
	Texas		
	Utah		

Regional diversity beneficial to US&CDA: season, rain, wind, supply adequacy, etc



Range of Supply Options

No CO2 price, 6.1% real discount rate



USA & Canadian Hydro provide US & Cdn benefits - one example is light vehicle electrification

- Cdn hydro economic and acceptable expansion =
  100,000+ MW (conservative estimate, would be larger , .56CF) = 490+ TWh
- USA hydro expansion =
  60,000 MW (not include pumped storage, .32 CF) = 168 TWh

Total new North American hydro = 658+ TWh

- Electricity requirement if all NA Light Fleet Vehicles electrified
- Canada 73 TWh
- USA. 1,175 TWh
- Total NA 1,248 TWh
- Assume not all electrified due to long distance rural needs, PHEVs, etc.

Assume half of Light Fleet Vehicles electrified = 624 TWh.

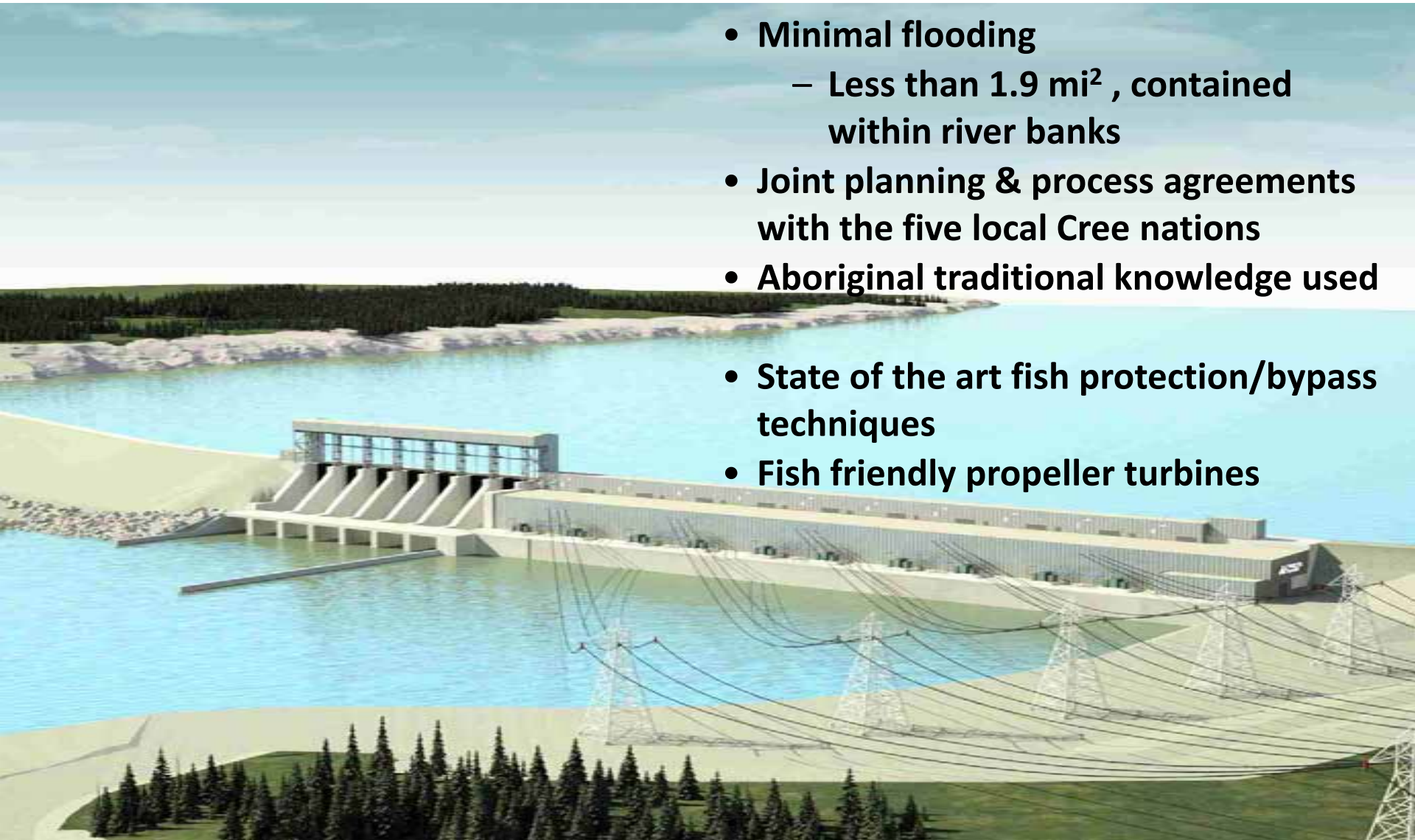
Thus, realistically: new North American hydro could meet the possible electrification of half of North American light fleet vehicles thus reducing:

- 593 million tonnes CO2e and
- 1,630 million barrels\year oil imports by US from overseas.
- 2010 overseas crude& petroleum USA imports =2911 million barrels\year
- Thus electrification could reduce overseas imports (2010) by 56%

Regional Transmission Expansion beneficial

- Facilitate new renewables: wind, hydro, solar & biomass
- Facilitates transfers for cost savings, energy security and electrical reliability
- Provides regional economic stimulus
    - Brattle (2011): Every $1 billion invested in US transmission infrastructure result in $2.4 billion in economic output and 13,000 equivalent years of employment
- Large transmission additions can be built in stages & provide regional supply rather than multiple small local transmission additions which are overall more costly and impacting.

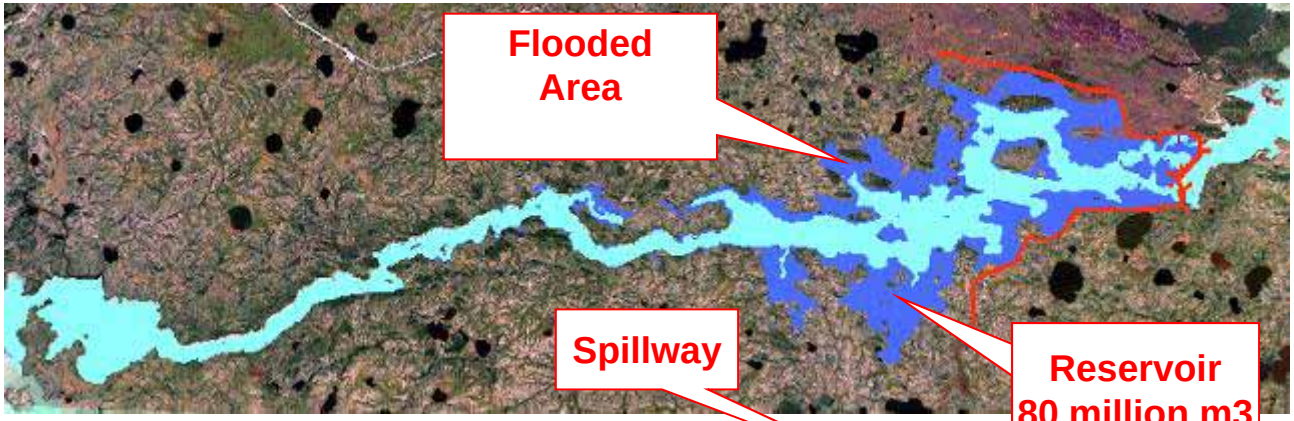
Conawapa Generating Station
1485 MW, $8 Billion



- **Minimal flooding**
  - **Less than 1.9 mi^2 , contained within river banks**
- **Joint planning & process agreements with the five local Cree nations**
- **Aboriginal traditional knowledge used**
- **State of the art fish protection/bypass techniques**
- **Fish friendly propeller turbines**

Keeyask – 695 MW, $5.6B

- Jointly planned with the 4 local Cree Nations
- Joint owners
- Low flooding
  17 sq mi
- Old design was 47 sq mi flooding



New Hydro in Manitoba