Examining the contribution of hydroelectric renewal and greenfield development to grid decarbonization:

An enhanced capacity expansion model

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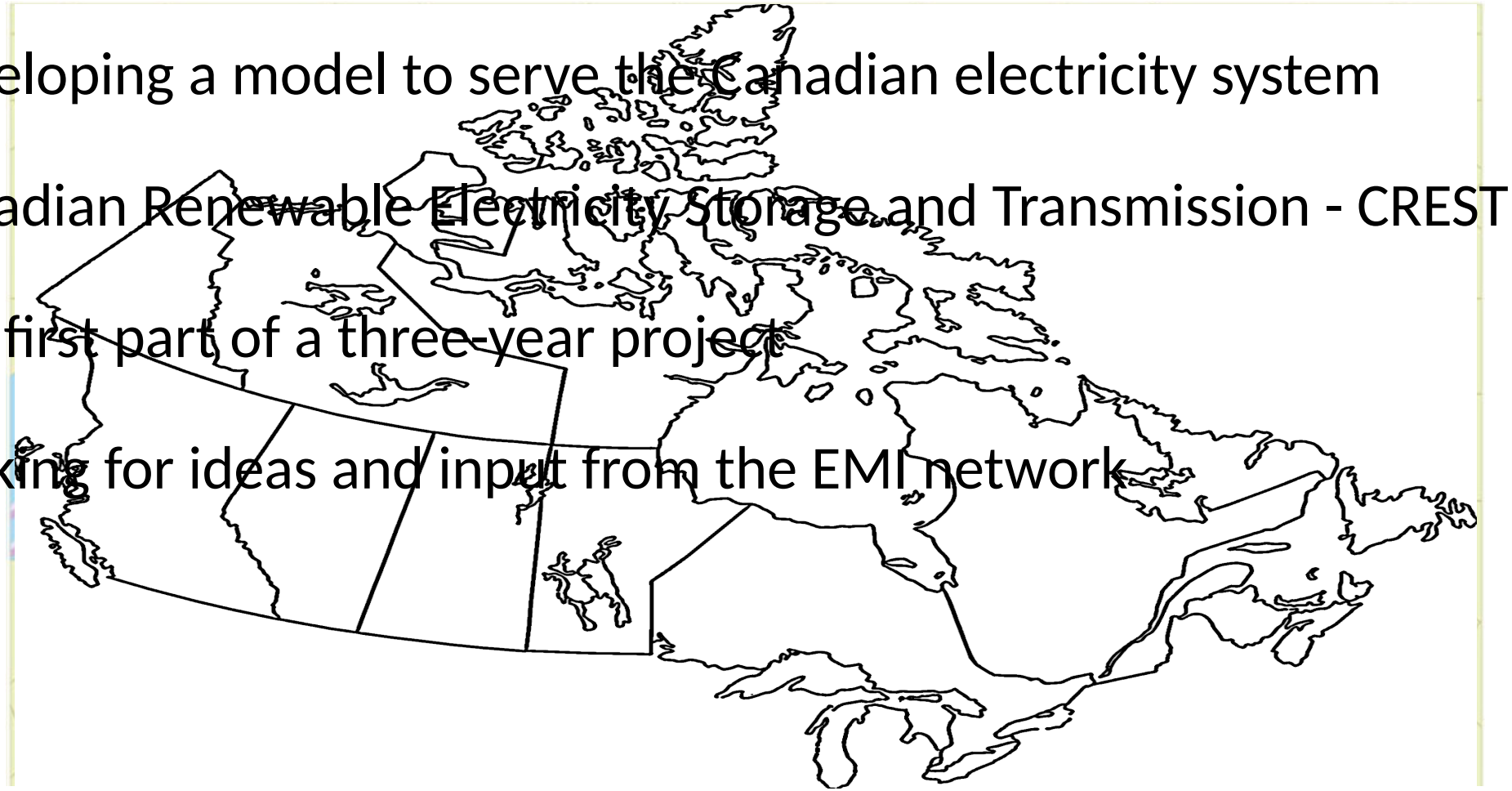
Introduction

- Capacity Expansion Models
- Developing a model to serve the Canadian electricity system
- Canadian Renewable Electricity Storage and Transmission - CREST
- The first part of a three-year project
- Looking for ideas and input from the EMI network



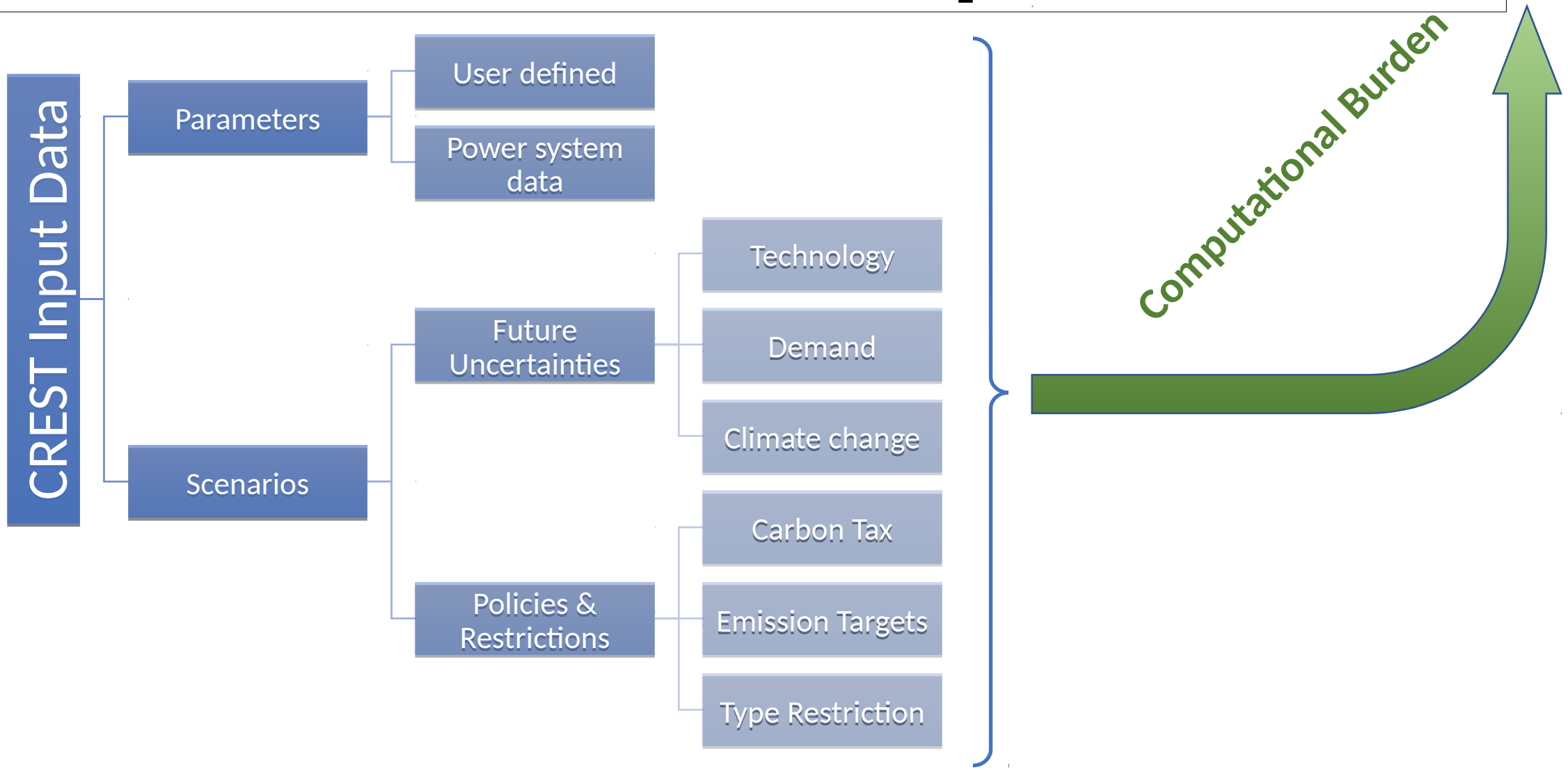
CREST – Model Description

- Optimize the development of the Canada electricity system
- Consider expansion in generation, transmission and storage
- Consider technical, economic, environmental and policy related aspects
- Model resolution

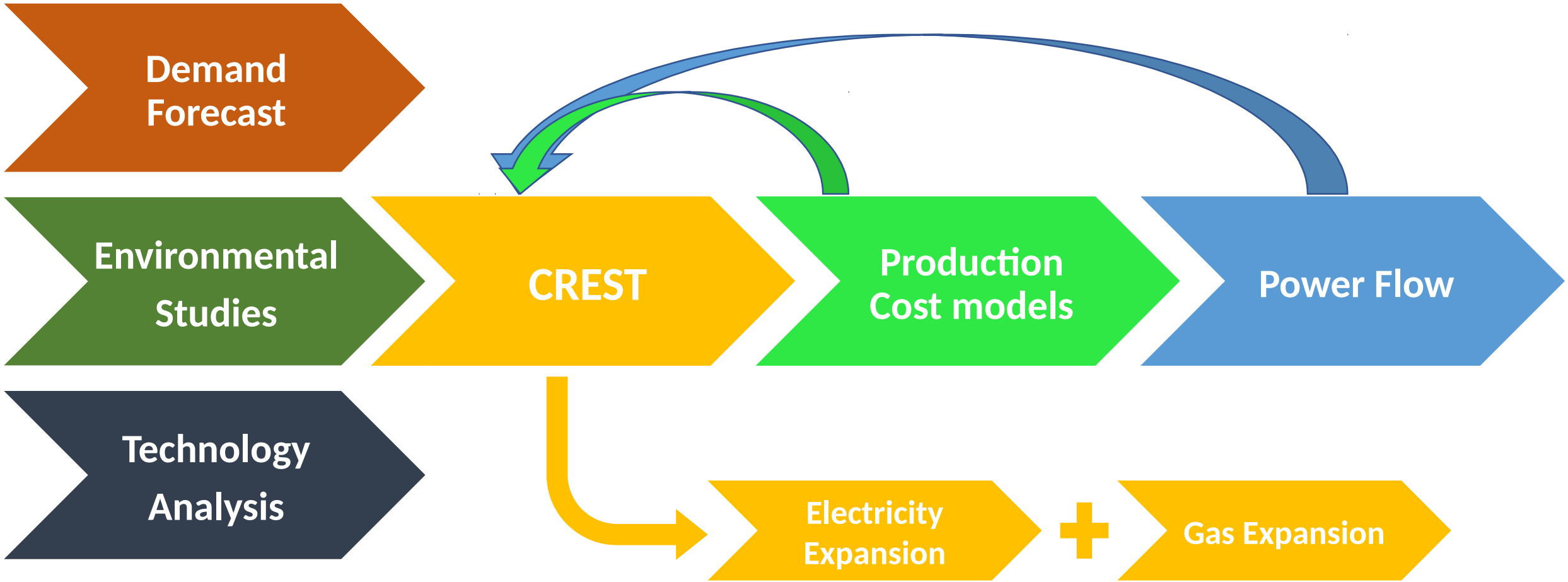
2278 Grid cells

8760 Hours

CREST – Sets of Input Data



CREST – Broader Modelling Context

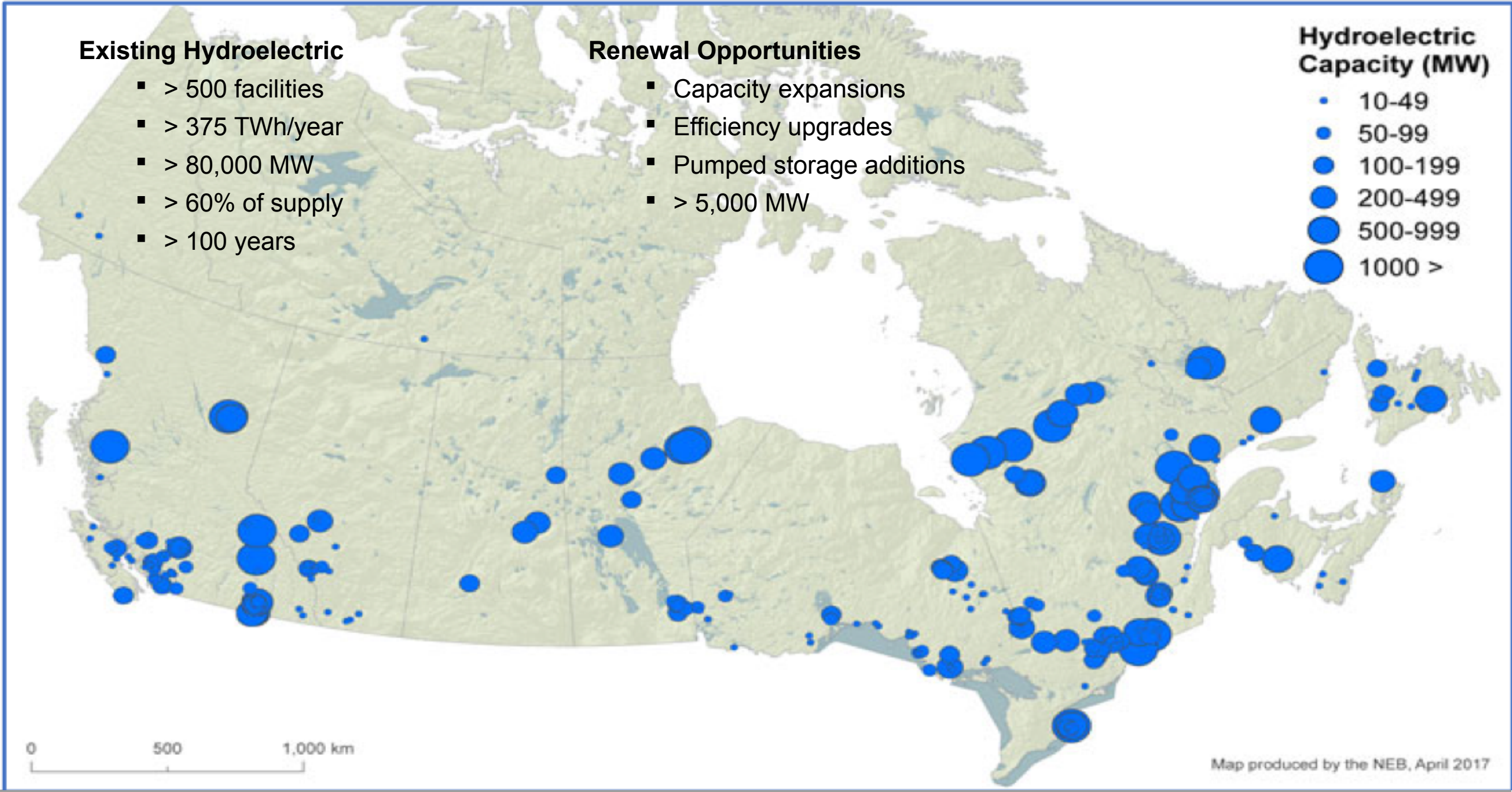


Existing Hydroelectric

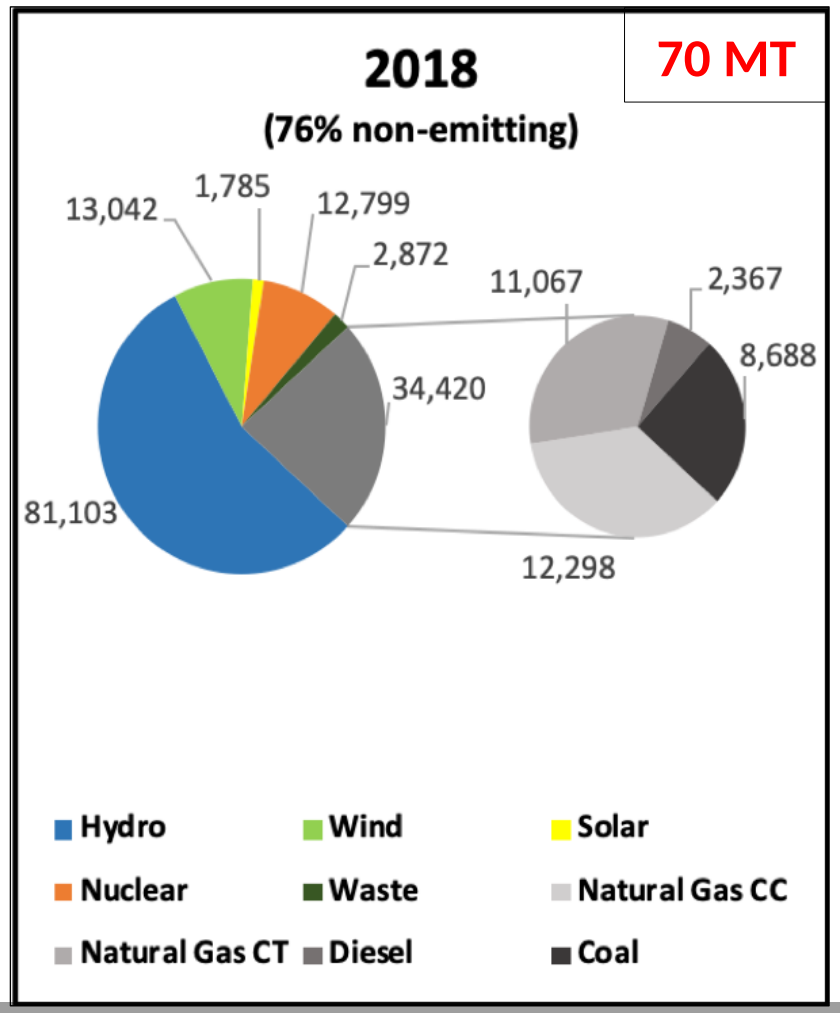
- > 500 facilities
- > 375 TWh/year
- > 80,000 MW
- > 60% of supply
- > 100 years

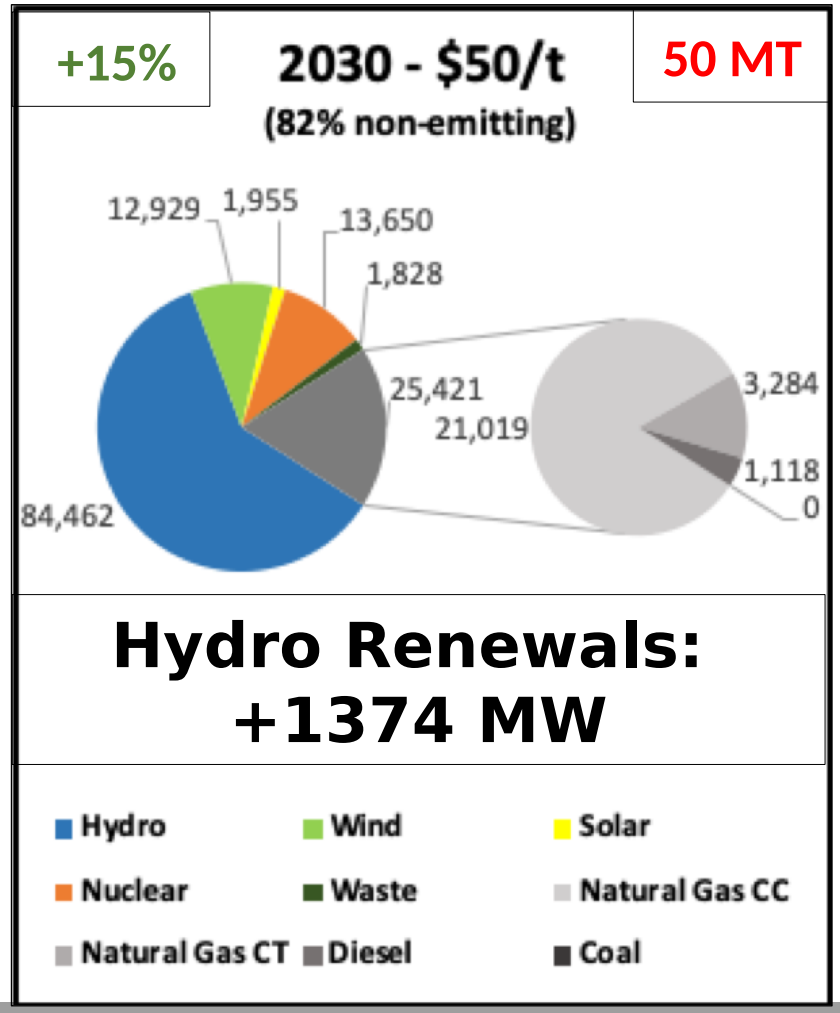
Renewal Opportunities

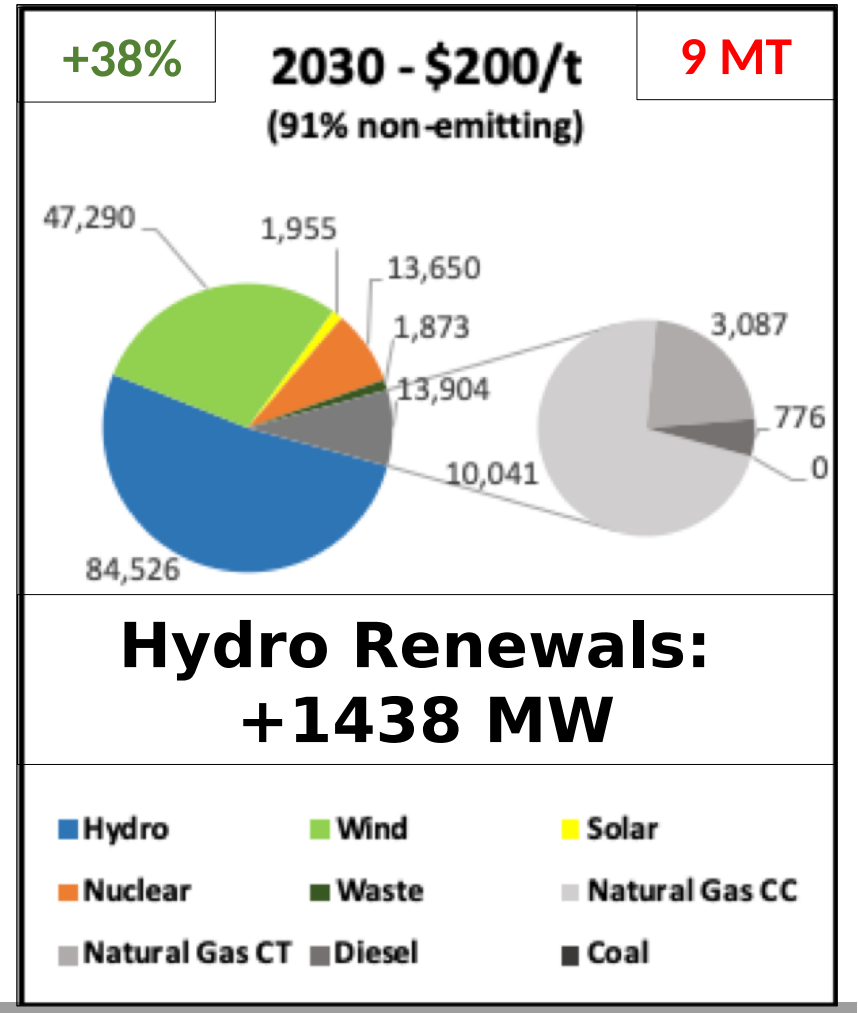
- Capacity expansions
- Efficiency upgrades
- Pumped storage additions
- > 5,000 MW



Installed Capacity – 2030







Model Development Opportunities

	Description	Benefits
#1	Convert CREST to a dynamic model	Allows evaluation of policy options over time
#2	Further disaggregate generation types	Improves cost and emissions estimates
#3	Model future resource costs declines	Allows exploration of technological change
#4	Include stranded asset costs	Provides clarity to stakeholders

Policy Implications

	Description	Questions Addressed
#1	> $150/t for 90% non-emitting capacity by 2030	What carbon price achieves the policy objective? What are the costs of different policy options?
#2	Under deep decarbonization, most natural gas must be retired, and very little can be built.	Can we build natural gas, and if so how much?
#3	Hydroelectric renewals offer a policy alternative	What are our options for rapid decarbonization? How do these options reduce emissions? Costs?
#4	At $50/t, electricity system emissions go from 70 Mt/y today to more than 85 MT/y in 2050	Why do we need to increase carbon prices? What are the costs of delaying action?