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Challenges and Solutions to Sustainable Hydropower in Canada

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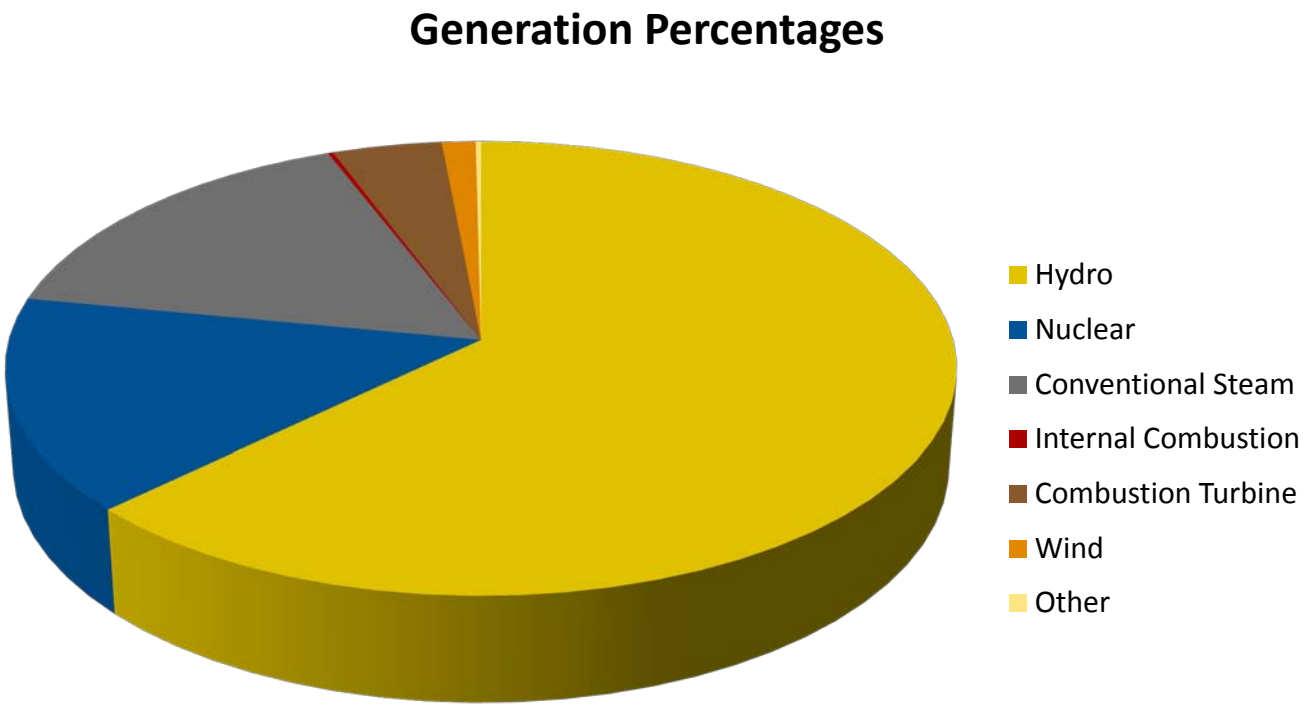
HYDRO CONTEXT



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WORLD CONTEXT

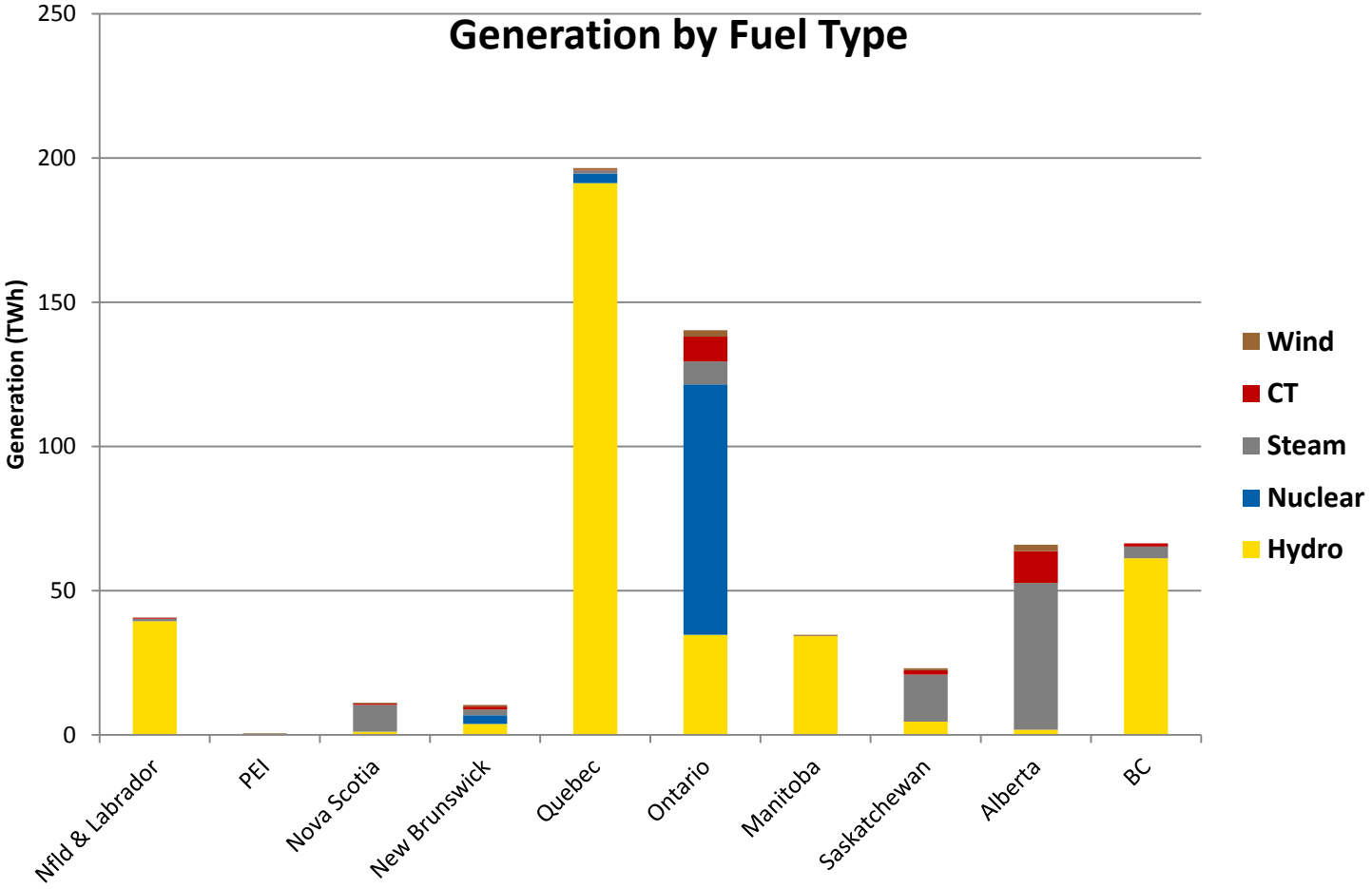
If we reduced the world's population to a representative 100 people:

- **57 Asian, 21 European, 9 African, 8 North American, 5 South American**
- **6 would control >50% of wealth, 5 in USA**
- **1 would have been to college**
- **24 would have no electricity, 71 with no access to the internet**
- **80 would live in substandard housing, 39 earning <$2/day**

By contrast:

- **Canada is 5th in primary energy production**
- **Canada is 7th in primary energy consumption**
- **Canada is 3rd in hydroelectric generation**

CANADA'S HYDRO



CANADA'S HYDRO DIMENSIONS

Variability includes:

- **Approximately 70% of the stations are less than 50 MW but more than 35 stations are larger than 500 MW**
- **Some provinces have many small stations (NS, Quebec, Ont., N & L, BC) and some have several larger stations (Que, Ont, Man., BC)**
- **Stations can be used for baseload, peaking, export, load following, support for wind, can be run seasonally, or for flood control, ice control and to support fish migration**
- **Some provinces have mostly coastal stations (dealing with migratory species) while others are more freshwater environments**

FISH SPECIES

There is variability in the focus of different provinces on different fish species:

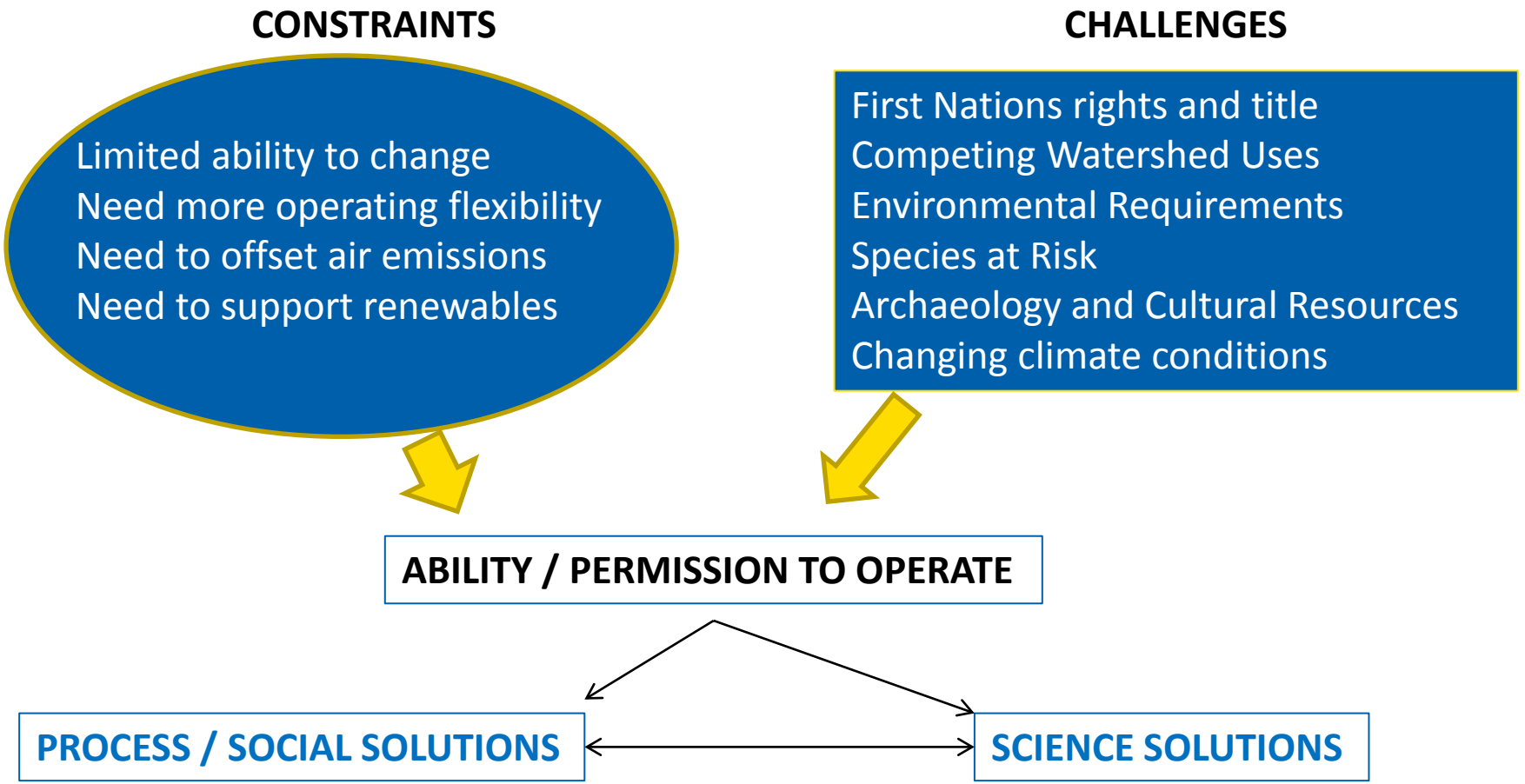
	Main Fish Species By Province								
	BC	Alta	Sask	MB	Ont	Que	NB	NS	NL
Kokanee	•			•					
Sturgeon	•	•	•	•	•				
Salmon	•				•	•	•	•	•
Trout	•	•	•	•	•	•	•	•	•
Pike	•	•	•	•	•	•			•
Walleye	•	•	•	•	•	•			
Whitefish	•	•	•	•	•	•	•	•	•
Smallmouth Bass			•	•	•	•	•	•	
Largemouth Bass			•	•	•	•			
Arctic Char		•		•			•		•
Burbot		•	•	•	•	•			
Muskellunge					•	•	•		
Alewife					•	•	•	•	
American Eel					•	•	•	•	

PAST HYDRO DRIVERS

Hydro Projects were originally built to address a growing need for electricity to fuel the industrialization of the country. Drivers for such development included:

- **Electrification of rural or more remote areas of Canada**
- **Many direct links to industry with companies themselves developing projects to support pulp and paper, mining, smelting, and manufacturing**
- **Support for the World War 2 power needs**
- **Jobs and economic development – construction was labor intensive**
- **Flood control and ice control**
- **Use of available, renewable natural resources**

New Constraints & Challenges



FIRST NATIONS

CHALLENGES

- Court Determined Rights and Title
- Multiple First Nations in one area
- Land or Equity Demands
- Lengthier Approval Processes
- Benefits Agreements
- Archaeological Considerations

OPPORTUNITIES

- Partnerships
- Streamlined Approval Processes
- Access to Growing Labor Force
- Local Knowledge

APPROACHES

- Settlement of Grievances/Claims
- MOUs or other Agreements
- Negotiated Equity (esp. in North)
- Use New Projects to Address Old

COMPETING RESOURCE USE

- Agriculture & Industry Water Needs
- Cottage – Water Levels
- White Water Requirements
- Support of Commercial Fisheries
- Recreational Fisheries
- Flood Control
- Municipal Water Supply
- Wildlife Considerations
- Access & Safety Issues

- In most cases utilities engage in IRP, Relicensing, or Water Use Planning.
- BC Hydro is a stellar example – more than 20 plans, hundreds of studies leading to more than 200 commitments for action, operating change or study
- Important elements for success include:
  - Defined decision making authority and pathway/process
  - Setting of limits and boundaries
  - Concept of "Tradeoffs"
  - Time
  - Adaptive Management
  - Prioritization of Needs to be Met

Environment / Fisheries

One of the largest areas of emerging requirements for hydropower to address includes the great number of competing fishery and and environmental challenges:

- **declining fish stocks**
- **fish passage, stranding, fragmentation,**
- **water quality, temperature, hydraulics, hydrology,**
- **habitat alteration via reduced/ increased flow, reservoir level changes, ramping rates**
- **invasive species**
- **nutrient transfer or changes**
- **interspecies competition**

SPECIFIC SCIENCE CHALLENGES:

- **Cost effective monitoring / study (productivity, habitat, ecosystem mgmt)**
- **Innovation for physical or operational solutions**
- **Precision among multiple causal elements**
- **Transferability of results to other environments**

Environment / Fisheries

PROCESS SOLUTIONS:

- **Advocacy for Legislative changes to focus efforts and resource use**
- **Best Management Practices**
- **Collaboration with other Users**

SCIENCE SOLUTIONS:

- **Consideration of Ecosystem Approach**
- **Adaptive Management**
- **Indicator Species**
- **Focused Research for topics like Productivity**

Biodiversity / Species at Risk

CHALLENGES:

- **Emerging legislation that was not readily contemplated by Existing Hydro**
- **Limited, court-challengeable provisions for permit or exemption**
- **Complex sources of the problem – not all hydro-related**
- **Poor history in North America of actually recovering species**
- **Limited opportunities to actually take action**

APPROACHES:

- **Offsets / Habitat Banking / Habitat Aggregation**
- **Prioritization of Sites**
- **Legislative Advocacy**

There is an ongoing challenge to find affordable, fit-for-purpose methodology for assessing risk, and monitoring mitigation results

New Construction

Recent Projects:

- **Wuskwatim (Manitoba)**
- **Revelstoke 5 (BC)**
- **Niagara Tunnel (Ontario)**

Upcoming:

- **Muskrat Falls (Labrador)**
- **Site C (BC)**
- **Conawapa and Keeyask (Manitoba)**
- **Little Jackfish, Lower Mattagami, New Post Creek (Ontario)**
- **Eastmain 1A and Romaine (Quebec)**

Other Dimensions of New Projects

- **Higher expectation for Benefits Agreements**
- **First Nations in at the start**
- **New Canadian Environmental Assessment Act 2012**
- **Need for Representative, Indicator Methods, Focused Methods**
- **Uncertain how SARA will be addressed**
- **Dealing with downsized and re-organized government**

SUMMARY

- **Existing Hydro now meeting challenges of modern day demands**
- **Hydro continues to be a sustainable means of generating electricity**
- **There is a large role science can play in addressing the many environmental challenges facing hydro systems**