Impacts and Adaptation of the Hydroelectric Industry in the Province of Quebec, Canada

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• **Context**

• **Climate and hydrological considerations**
  - Climate and hydrological models
  - Impact Assessments

• **Adaptation to Climate Change**
  - The rationale
  - The experimentation
  - The instruments (non structural / structural)
  - Pre-requisite and barriers to adaptation

• **Conclusions**
Québec hydrography

- 10% of the Québec territory, 1,600,000 km²
- 4,500 rivers
- 500,000 lakes

2,000 km
Generating Options

**UNITED STATES 2008**

- **Electricity Generation: 4,110 TWh**
- Natural gas (22%)
- Coal (49%)
- Hydro (6%)
- Nuclear (20%)
- Other (2%)

**CANADA 2007**

- **Electricity Generation: 617 TWh**
- Hydro (59%)
- Nuclear (14%)
- Other (1%)
- Coal (20%)
- Natural gas (5%)

**QUÉBEC 2007**

- **Electricity Generation: 192 TWh**
- Hydro (95%)
- Nuclear (2%)
- Oil (1%)
- Other (2%)

Sources: (a) Energy Information Administration and Electric Power Annual, 2009 – (b) Statistics Canada, 2007
60 Hydro plants / 34,499 MW / 188 TWh

2009
#1 Hydro
42 run-of-the-river / 18 with reservoir Power houses
175 TWh storage capacity
La Grande River Hydro Project
the largest in North America from 1971

- Watershed 177,000 km²
- 3,000 km of new roads
- 7 transmissions lines + 7,000 km (735 kV)
- 9 reservoirs, total area ± 14,000 km²
- 9 power plants: 16,500 MW
  - +2 under construction: 17,500 MW
- A first and a last
La Grande-2 and La Grande-2A
Aluminium (90%), households (75%) and water (90%) heating and exports
The Great Ice Storm (1998 : 1,6 Billions $)
1,5 millions customers without electricity for up to 30 days

Saguenay (1996 : 800 M $)
Flood 1: 11,000 years

Hydro-Québec and Climate Change
Ouranos’ mission is to acquire and develop knowledge on climate change, its impact and related socioeconomic and environmental vulnerabilities, in order to inform decision makers about probable climate trends and advise them on identifying, assessing, promoting and implementing local and regional adaptation strategies.
The major Issues

• Public safety and secure infrastructures
• Energy supply
• Water resources
• Health
• Forestry, agricultural, mining, tourism and transportation operations
• Protecting the natural environment
Mean Annual Inflows 1943-2009

Écarts énergétiques annuels du parc total hydraulique d'Hydro-Québec + Churchill Falls

Mean Annual Inflows 1943-2009

Inflows

1943 -40000
1945 -35000
1947 -30000
1949 -25000
1951 -20000
1953 -15000
1955 -10000
1957 -5000
1959 0
1961 5000
1963 10000
1965 15000
1967 20000
1969 25000
1971 30000
1973 35000
1975 40000
1977 45000
1979 50000
1981 55000
1983 60000
1985 65000
1987 70000
1989 75000
1991 80000
1993 85000
1995 90000
1997 95000
1999 100000
2001 105000
2003 110000
2005 115000
2007 120000
2009 125000

GWh

Années

The question to be answered

• **How to manage climate change-associated risks in water resource infrastructure projects (existing and planned)?**

  ✓ Climate change impact study
  ✓ Implementation of Adaptation Measures
Climate and hydrological considerations
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