



QUÉBEC ELECTRICITY, **CLEAN ENERGY** PAR EXCELLENCE



Comparison of Power
Generation Options



Comparison of
Electricity Mixes



Third Party
Expertise





Comparison of Power Generation Options

HYDRO-QUÉBEC, NORTH AMERICAN LEADER IN THE FIGHT AGAINST CLIMATE CHANGE





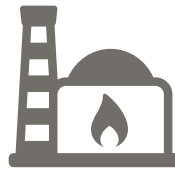
GHG EMISSION RATE

According to a study by CIRAIG,^a the greenhouse gas (GHG) emission rate of hydropower, calculated based on a life cycle assessment (LCA), is very similar to that of nuclear or wind power. However, this emission rate is much lower than that of other power generation options.

GHG EMISSION RATE OF HYDROPOWER



5 times lower
than solar
photovoltaic energy



50 times lower
than a gas-fired
thermal plant



70 times lower
than a coal-fired
thermal plant

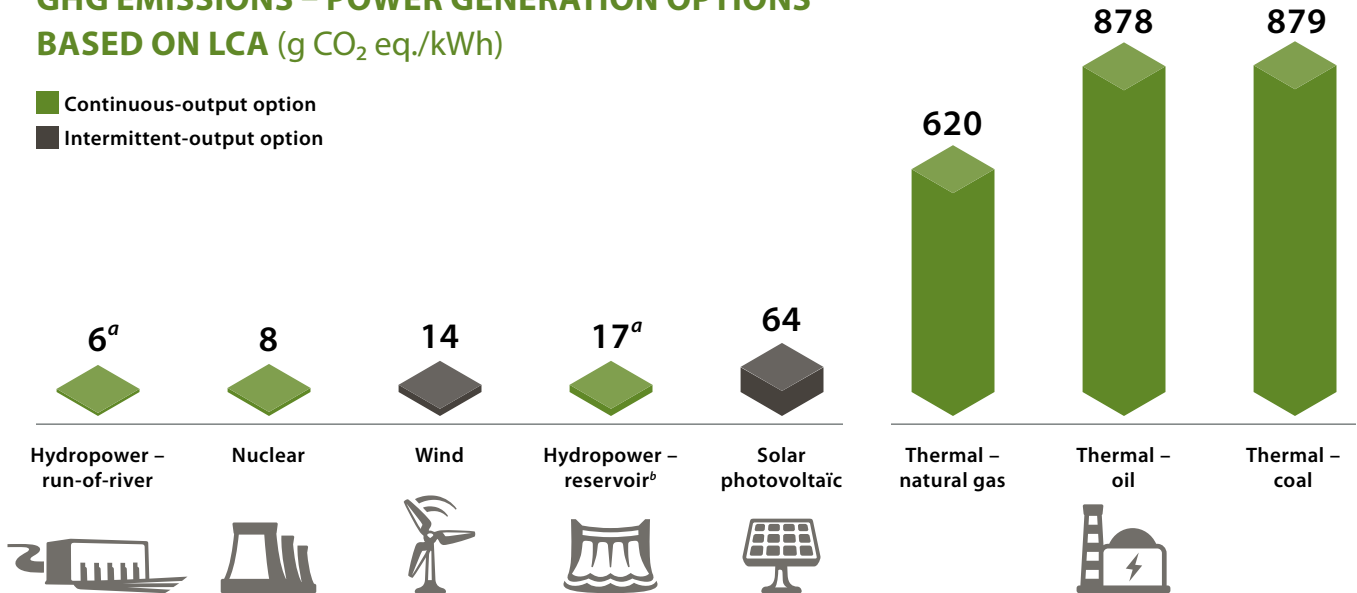
a) Centre international de référence sur le cycle de vie des produits, procédés et services.



GHG EMISSION RATE

GHG EMISSIONS – POWER GENERATION OPTIONS BASED ON LCA (g CO₂ eq./kWh)

- Continuous-output option
- Intermittent-output option



a) Hydro-Québec's results.

b) Reservoir hydropower differs from run-of-river hydropower with respect to GHG emissions. After it is impounded, a reservoir releases GHG emissions, the emission rate diminishing gradually over the following ten years. This is why GHG emission rates are higher for reservoir hydropower than for run-of-river hydropower.



HYDROPOWER, THE CLEANEST OPTION

HYDROPOWER HAS THE SMALLEST ENVIRONMENTAL IMPACT

Hydropower ranks number one among generation options based on the following environmental indicators. It has been also ranked as second for the resource use indicator.



Acidification

Eutrophication



Climate change

Ozone layer depletion

**Photochemical
oxidation (smog)**



Human toxicity



Comparison of Electricity Mixes

QUÉBEC'S ELECTRICITY MIX:
97% RENEWABLE ENERGY





QUÉBEC'S ELECTRICITY MIX

The electricity mix is the energy generated by all electricity generating stations in operation, including purchases from independent producers and imports from neighboring systems.

According to the CIRAIG study, Québec's electricity mix contributes the least to climate change and has the smallest impact on human health and ecosystem quality.

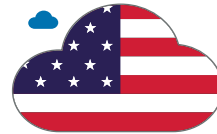
QUÉBEC'S ELECTRICITY GHG EMISSION RATE



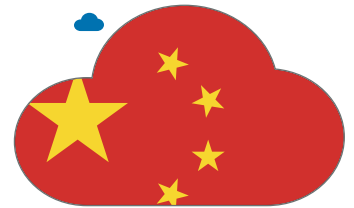
25 times lower
than Denmark's mix



30 times lower
than Germany's mix



35 times lower
than the U.S. mix



55 times lower
than China's mix

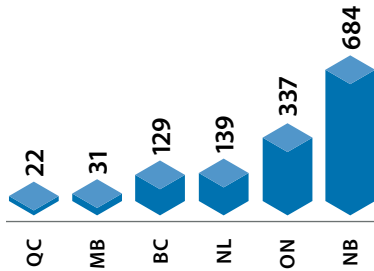


GHG EMISSION RATE

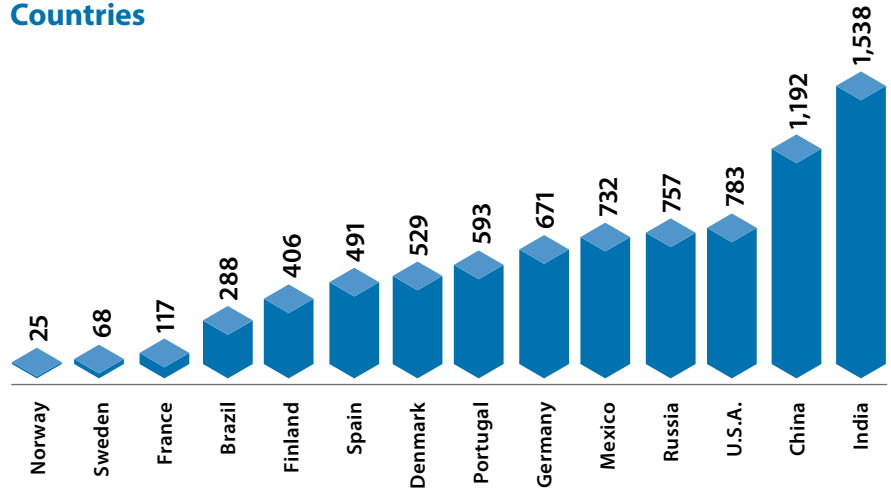
GHG EMISSIONS – ELECTRICITY MIX BY PROVINCE AND COUNTRY (g CO₂ eq./kWh)

Value shown corresponds to the generation, purchase, import, transmission and distribution of electric power.

Provinces



Countries

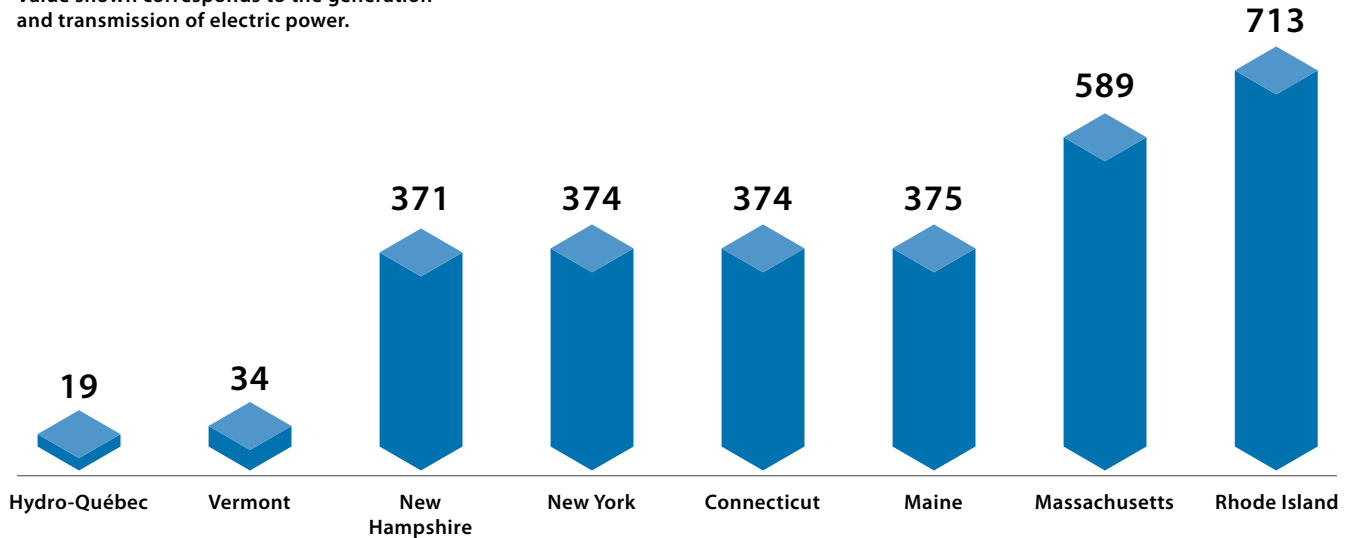




GHG EMISSION RATE

GHG EMISSIONS – HYDRO-QUÉBEC AND SELECTED U.S. STATES (g CO₂ eq./kWh)

Value shown corresponds to the generation and transmission of electric power.



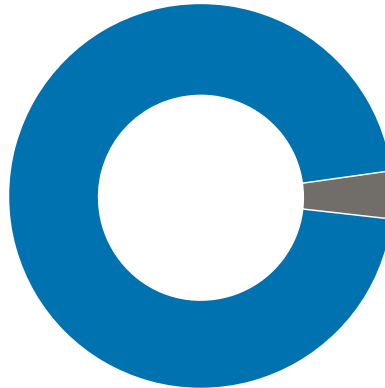


QUÉBEC ELECTRICITY, AMONG THE BEST!

QUÉBEC'S ELECTRICITY MIX – 2012 PRIMARY ENERGY BREAKDOWN (%)



Hydropower
95.33%



Thermal – fossil

Oil	Coal
0.03%	0.30%
Natural gas	Nuclear
0.21%	2.62%



Thermal – renewable

Biogas	Biomass
0.09%	0.53%



Wind
0.88%

The electricity distributed in Québec:

- 80% is generated by Hydro-Québec, mainly by its hydroelectric generating stations
- 20% is purchased from Québec independent power producers (small hydropower plants or wind, biomass or biogas power) or imported from other Canadian provinces or the U.S. Northeast.



Third Party Expertise

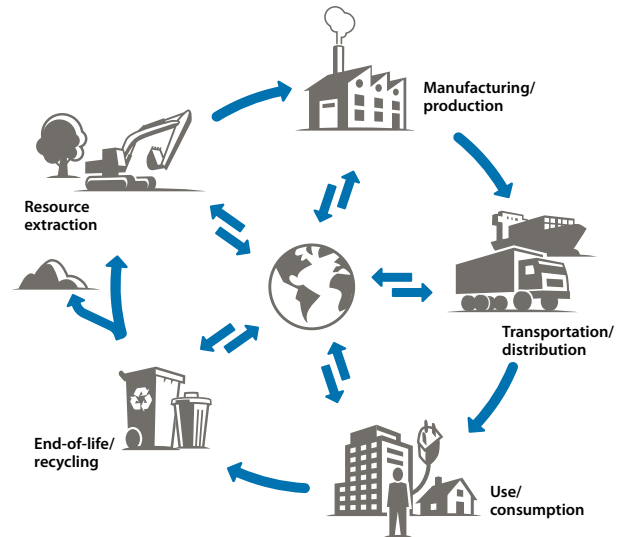
MANDATE ENTRUSTED TO CIRAIG

Hydro-Québec asked CIRAIG, a world-renowned centre of expertise in life cycle assessments, to compare different power generation options and the electricity mixes in different parts of the world. CIRAIG based the comparison on life cycle assessments and published a report of the study in 2014 titled *Comparaison des filières de production d'électricité et des bouquets d'énergie électrique^a* (in French only).

^a <http://www.hydroquebec.com/developpement-durable/centre-documentation/acv-comparaison-filiere-production-electricite.html>

LIFE CYCLE ASSESSMENT

A life cycle assessment determines and quantifies the environmental impacts of a product, process or service over its entire life cycle.



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