Is hydropower clean?

October 2016

CLEARPATH | CLEAN ENERGY. THE CONSERVATIVE WAY.

Key takeaways

1. Every major energy source (including wind and solar) creates some amount of carbon emissions over their lifetimes either directly (e.g., from burning a fuel) or indirectly (e.g. during manufacturing). The majority of hydropower emissions are indirect, such as from submerged plants and soils that release methane.

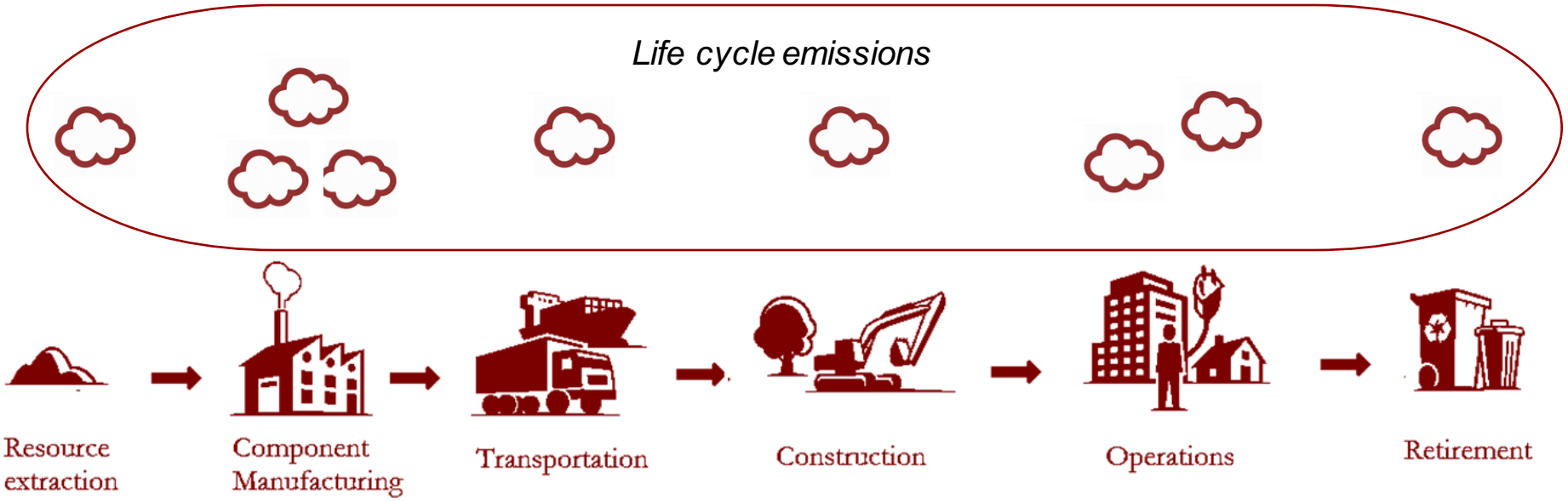
2. Hydropower makes more than 16% of the world's electricity so by sheer scale it contributes to global emissions. Recent studies suggest hydropower projects and reservoirs may produce more emissions than originally expected. Emissions must be calculated on a case-by-case basis, but the average project is still very clean after adjusting for these new findings

3. Hydropower plant reservoirs also provide valuable services to local communities, such as flood control or irrigation water for agriculture. These dams also provide water supplies and support other types of economic development. Therefore, the benefits of reservoir-related emissions are likely understated by solely comparing the value of the electricity they produce.

Recent news reports cast hydropower as dirty

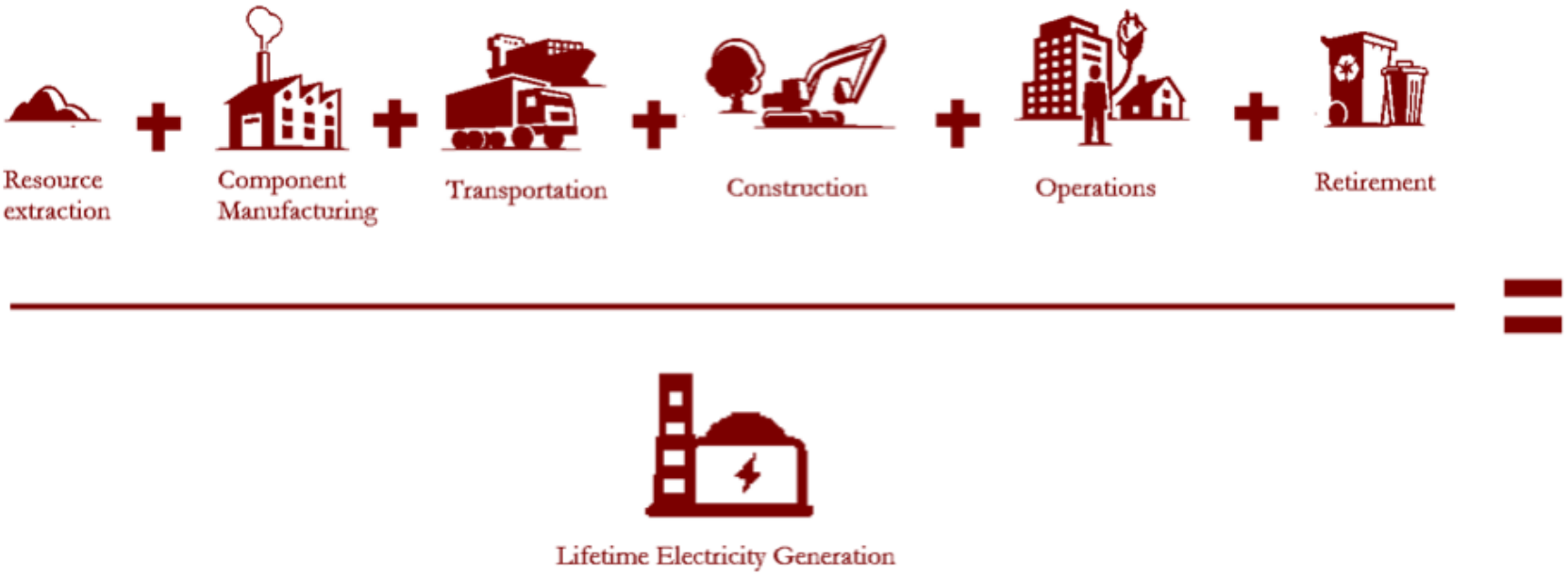
The Seattle Times	"Hydropower isn't carbon neutral after all, WSU researchers say"
INTERNATIONAL RIVERS people • water • life	"Dams are the largest single anthropogenic source of methane"
The Christian Science Monitor	"Is hydropower less clean than it seems? A new study synthesizing prior research on water reservoir emissions suggests that they may emit the equivalent of a billion tons of carbon dioxide every year"
MIT Technology Review	"Hydroelectric power isn't as green as we thought"

Life cycle emissions diagram



The sum of the emissions from each stage of the project is called its total life cycle emissions. It varies for each project, but researchers have come up ways to approximate emissions for each technology

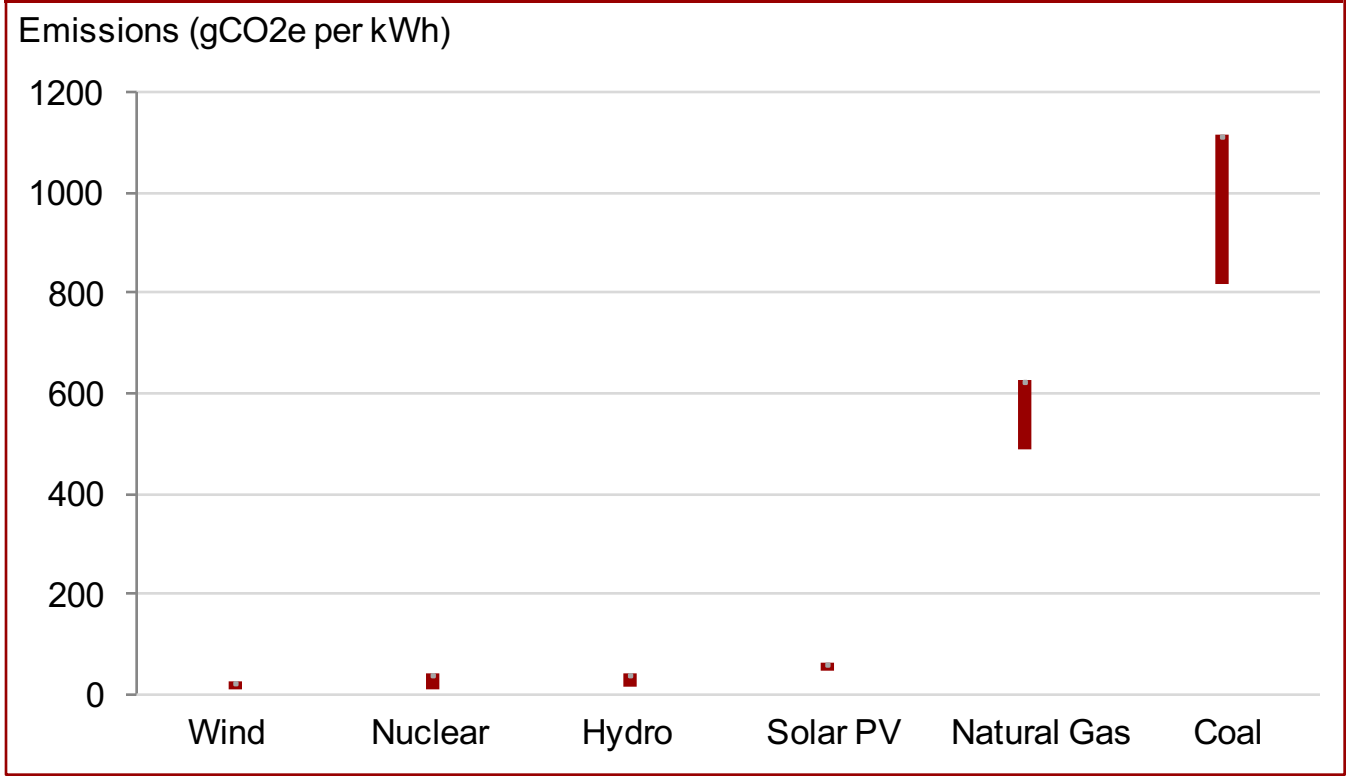
Life cycle emissions diagram



The most common method is to divide life cycle emissions by lifetime generation. This generates a standard metric that can be used to compare lifecycle emissions across multiple power sources. Using this metric, hydropower is consistently ranked among the world's cleanest energy technologies

Prior life cycle analyses show hydropower is clean

Range of median life cycle emissions across four studies



"Compared to other renewables, on a lifecycle basis ***hydropower releases fewer greenhouse gas emissions than electricity generation from biomass and solar*** *and about the same as emissions from wind, nuclear, and geothermal plants."*

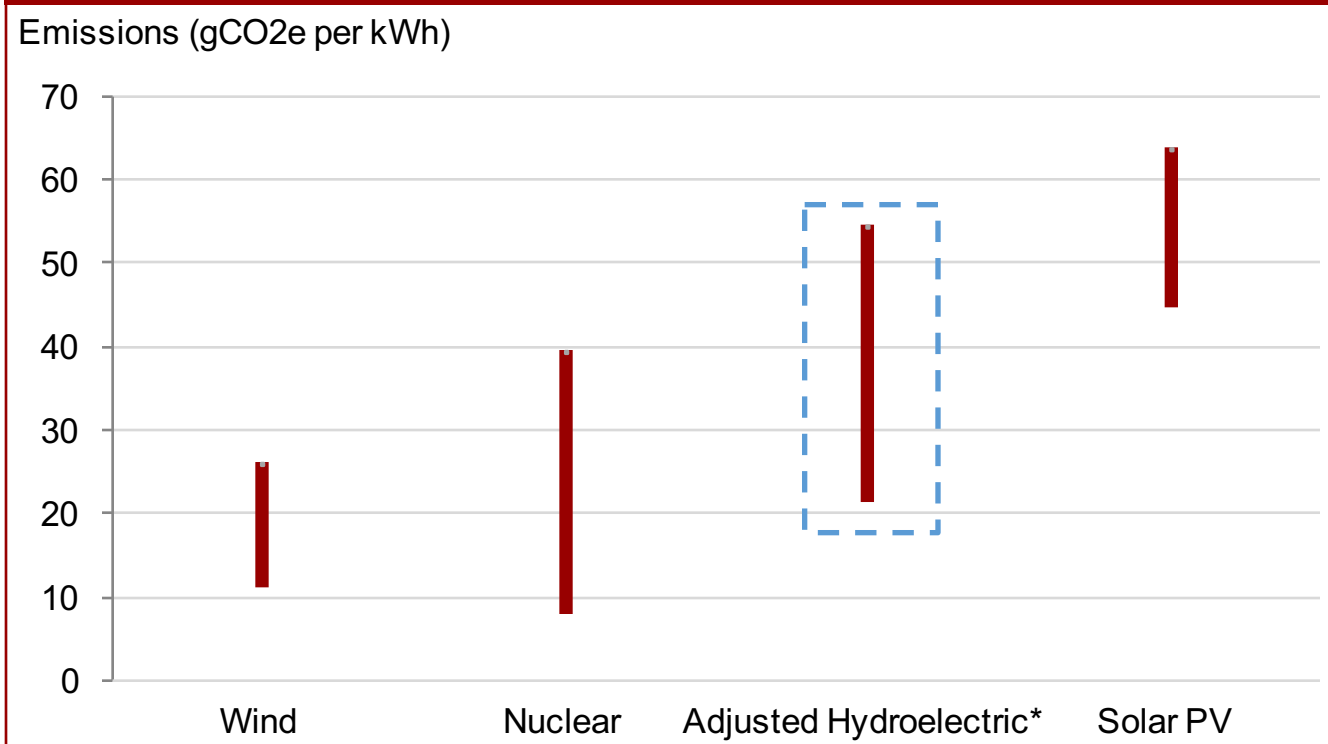
– Center for Climate and Energy Solutions

Note: Every hydropower project's emissions must be analyzed on an individual basis. Project emissions can vary widely but these provide estimates of the global average. Figures shown here are the range of median estimates for each technology in the four studies below. See the appendix for more details.

Source: Hydro Quebec (2015), IPCC(2014), NETL (2013), World Nuclear Association (2011)

Hydropower is clean with new emission adjustments

Range of median life cycle emissions across four studies



Even after increasing median hydropower life cycle emissions by 25%, it is still comparable with other zero-emission plants.

Some studies suggest emissions from poorly located hydropower plants can be comparable to fossil plants, but these are the exception rather than the norm.

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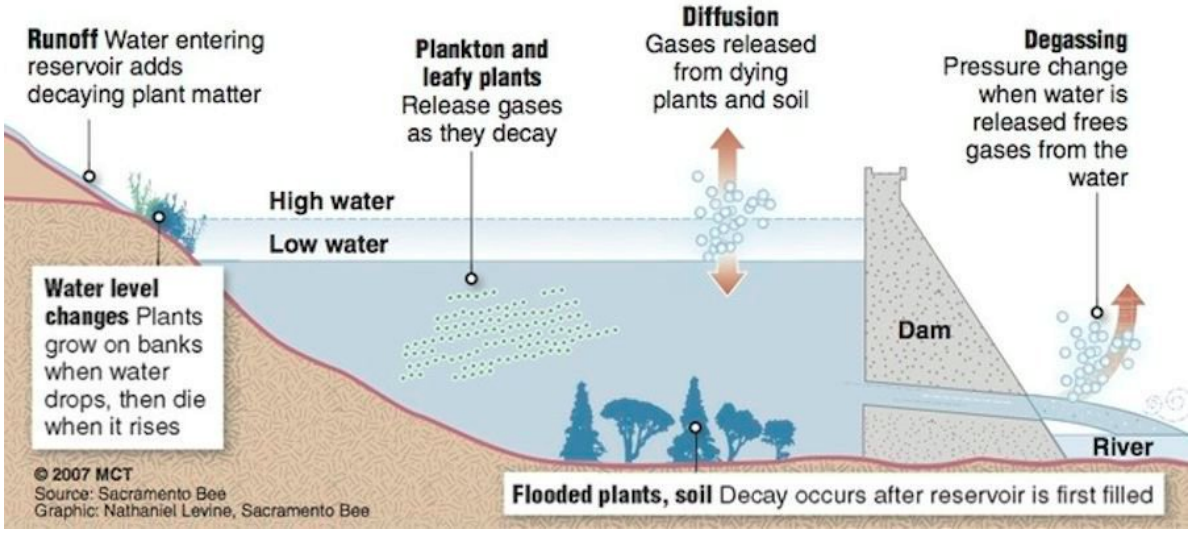
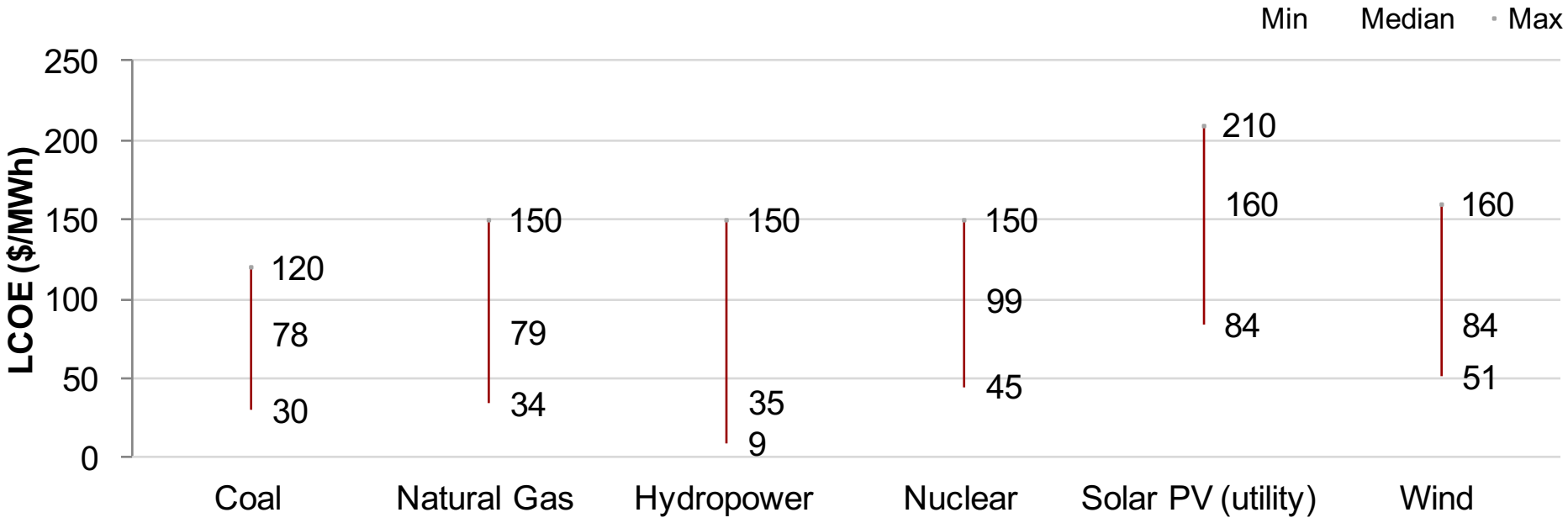
Reservoir emissions may be higher than expected



A recent study featured in BioScience found that reservoirs may emit about 25 percent more methane than previously thought. Some of the main sources of methane are described above. The paper's estimates focused on all reservoirs, including those not used for hydropower production. It acknowledged more work needed to be done to better understand and estimate reservoir emissions.

Hydropower is also one of the cheapest power options



Hydropower is one of the lowest cost energy resources available today. It also delivers non-electricity benefits, such as flood control and water management. Because of this, it makes 16% of electricity in the world today

Source: IPCC, based on 10% cost of capital and high utilization

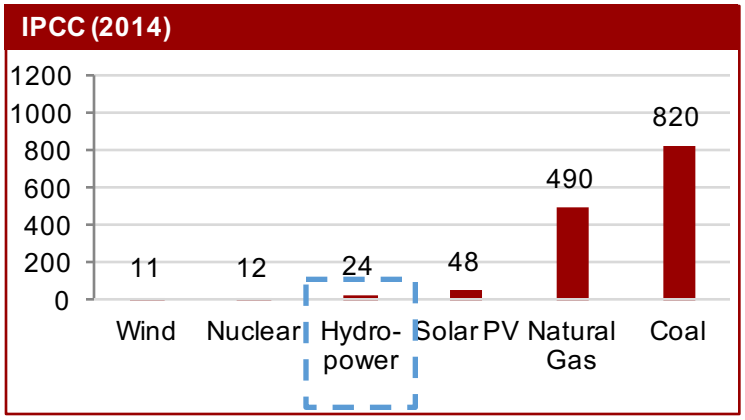
Conclusion

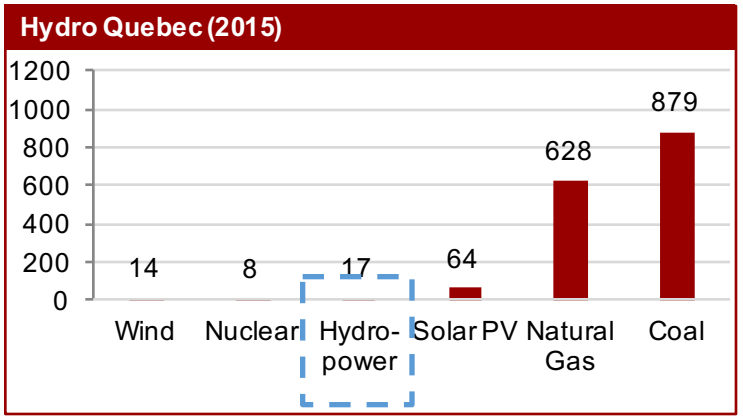
Lifecycle emissions are comparable to solar energy	Hydropower is a very clean resource because it does not produce any emissions when run. Indirect emissions from methane can be significant, but even after including these increases the average hydropower plant is still comparable to solar power
Classifying hydropower as a dirty resource works against clean energy goals.	Hydropower still has lots of room to grow both at home and abroad: four thousand reservoirs are currently planned for construction and capacity is expected to grow by more than 73%. The alternative is often coal plants which produce 35 times more emissions
Hydropower delivers many non-electricity benefits.	Hydropower plant reservoirs also provide valuable services to local communities, such as flood control or irrigation water for agriculture. These dams also provide water supplies and support other types of economic development. Therefore, the benefits of reservoir-related emissions are likely understated

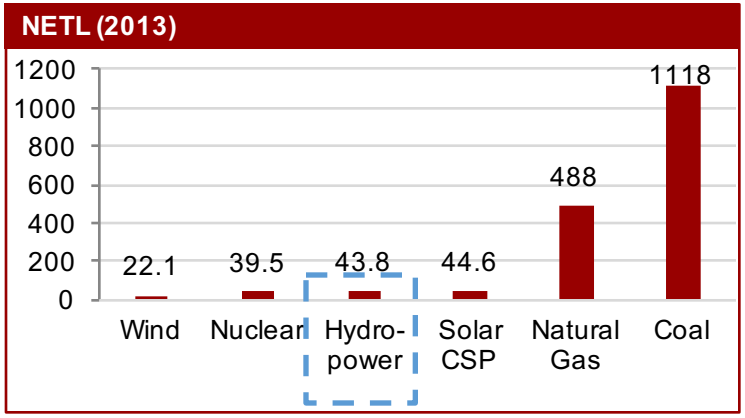
Appendix

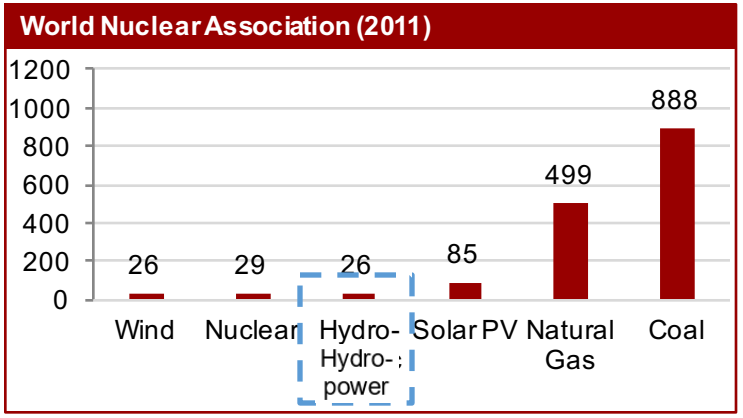
Prior life cycle analyses show hydropower is clean

Median emissions (gCO2e per kWh)









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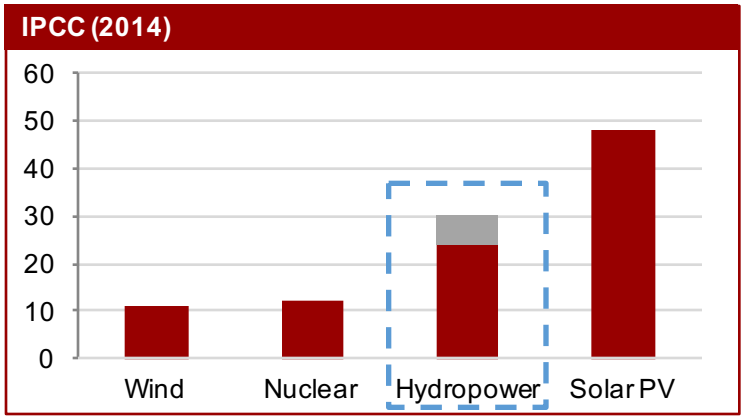

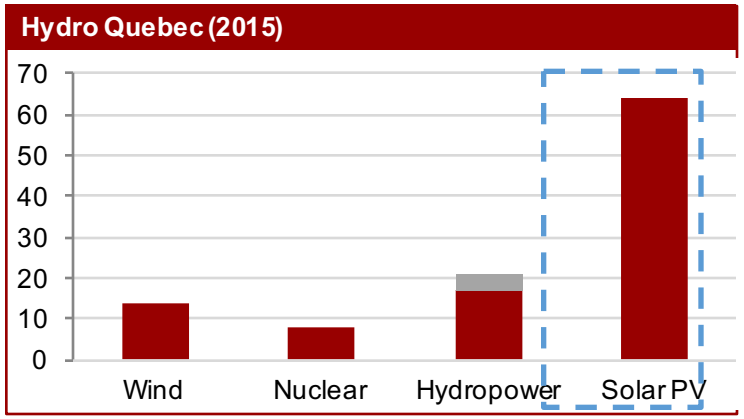

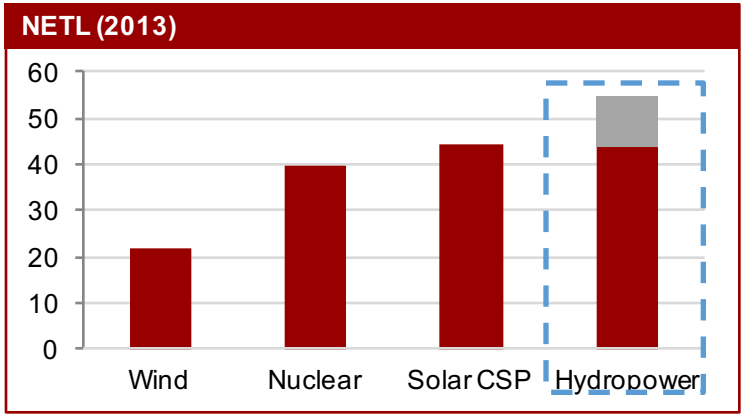

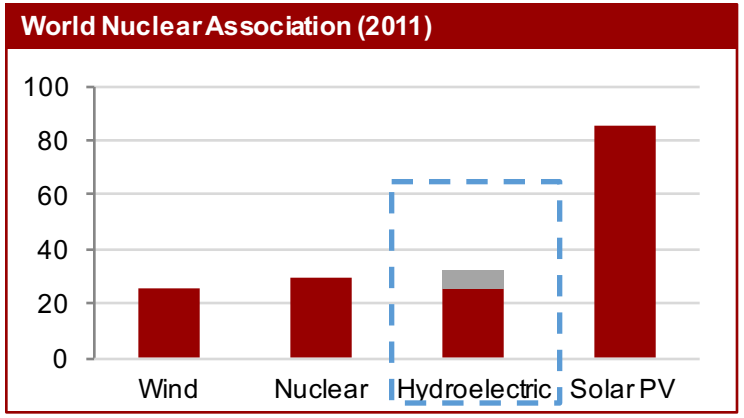

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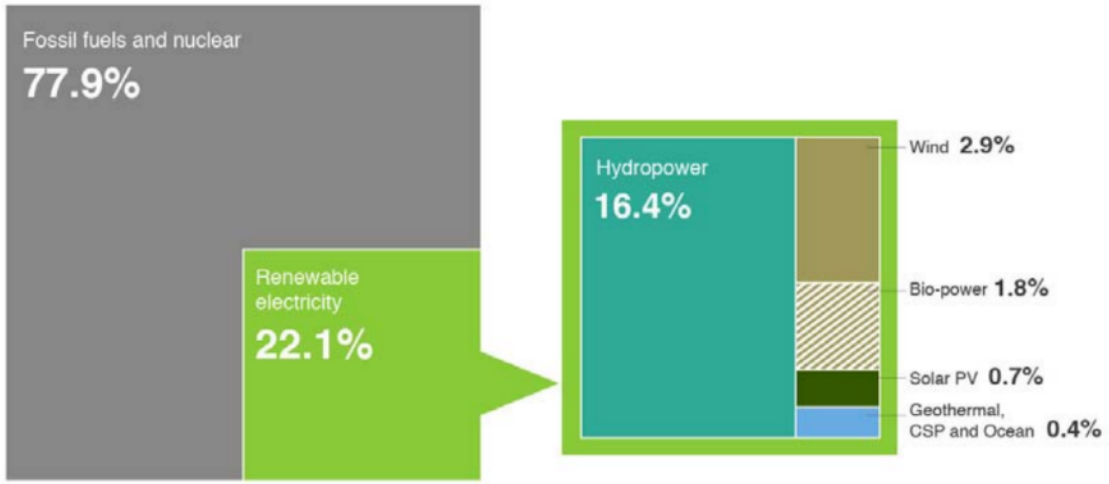
Hydropower plays a large role in the electricity mix

Figure 3 – Estimated renewable energy share of global electricity production, 2013

Source: REN21 - Renewables 2014 Global Status Report



Hydropower's role in the global energy mix is large and it will continue to grow. Over 1 billion people lack access to electricity today. Global hydropower capacity is expected to grow 73% in the next 10-20 years to help meet demand and minimize emissions