Hydropower in Context

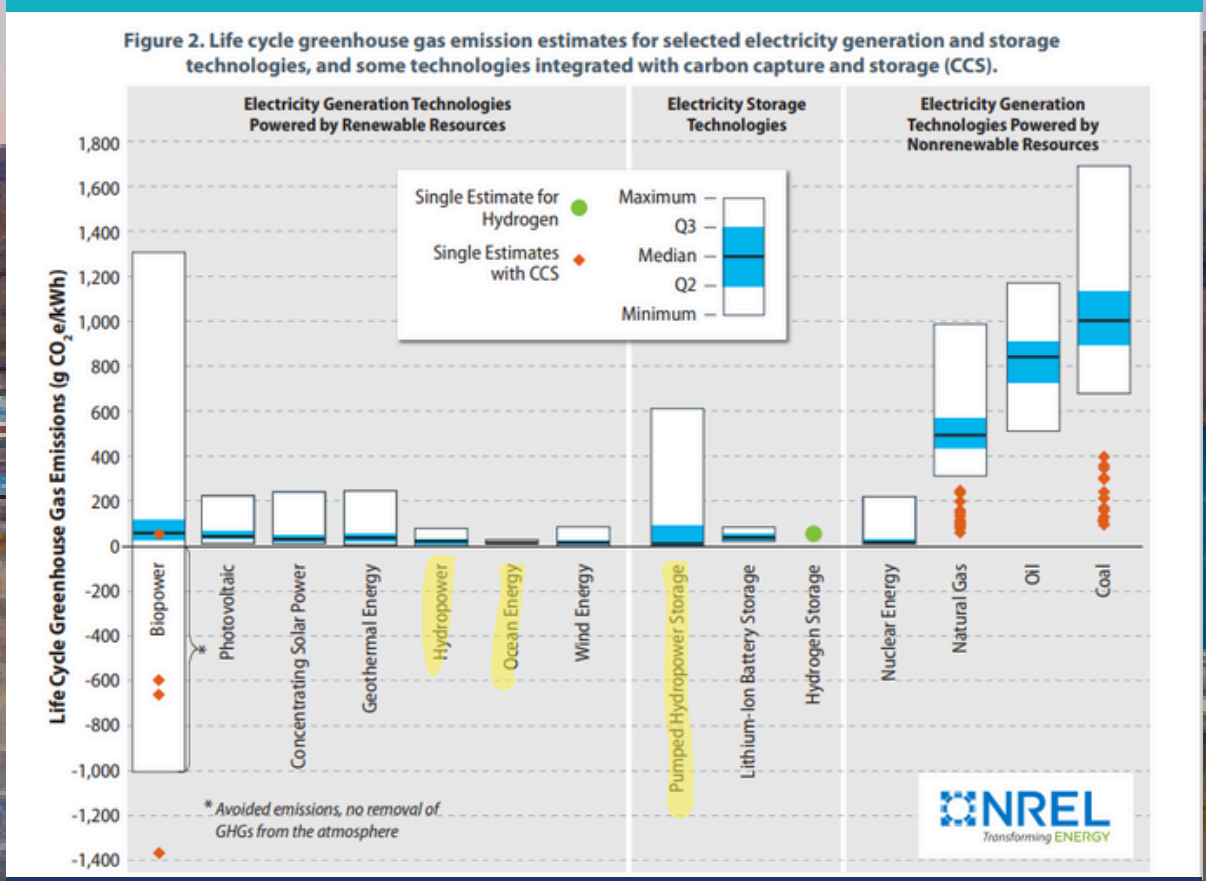
Greenhouse Gas Emissions

NHA
National Hydropower Association

The lifecycle greenhouse gas (GHG) emissions from hydropower, marine, and pumped storage are one of the lowest of any energy resource, according to a cross analysis from National Renewable Energy Laboratory (NREL). Most emissions associated with waterpower come from one-time, upstream activities like material acquisition and construction. [1]

The long lifespan of a hydroelectric facility offsets these initial emissions through the continuous generation of carbon free electricity for upwards of 50 years. [2] The flexibility of hydropower can also support the integration of 140GW of variable renewables, further reducing GHG emissions.[3]

Waterpower vs. Fossil Fuels and Other Renewables



Source: NREL Life Cycle Assessment Harmonization (2021)*

*Pumped storage construction timelines are highly variable and more research is needed on pumped storage lifecycle GHGs. *

[1] Life Cycle Assessment Harmonization | Energy Analysis | NREL (2021)
[2] History of Hydropower | DOE (2024)
[3] The Role of Hydropower Flexibility in Integrating Renewables in a Low-Carbon Grid

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All freshwater waterbodies like wetlands, canals, ponds, and ditches produce methane emissions.[4] Only 16% of waterbodies are reservoirs.[5]

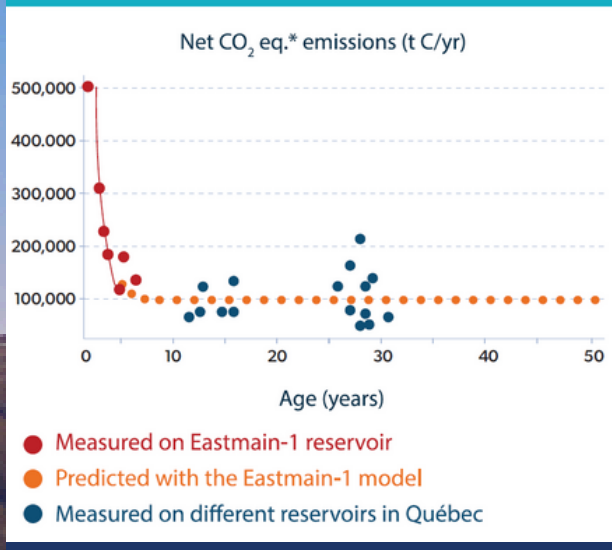
Of the 92,000 dams in the United States, less than 3% are used for generating hydroelectricity. [7]

Reservoirs serve multiple purposes including water supply, flood control, recreation, irrigation, and navigation. Oak Ridge National Lab identifies two ways to attribute emissions to hydropower:

1. Assign a portion of total reservoir emissions to power generation based on a weighted ranking of reservoir purposes
2. Assign a portion of total reservoir emissions to power generation based on the influence it has on water level and flow management. [5]

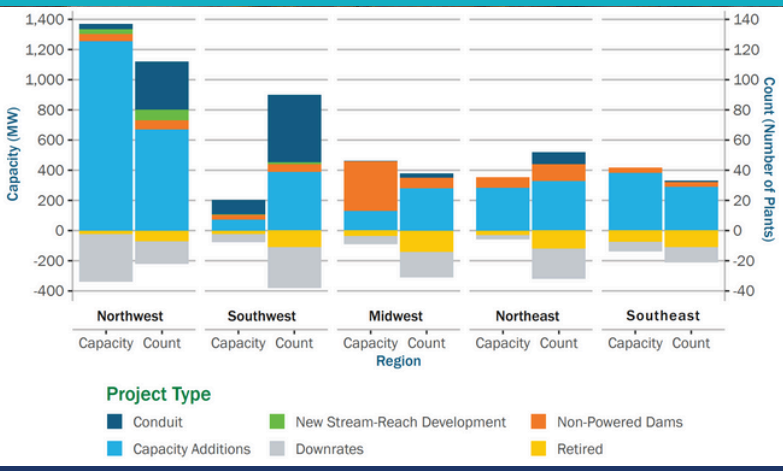
Research on measurement and attribution is **highly variable**.[10][9]

Reservoir Emissions Decrease Over Time



Source: Hydro Québec (2021)

Hydropower Growth in the U.S. from 2010-2022 did not create any new reservoirs



Source: U.S. Hydropower Market Report (2023)

Reservoirs older than 10-20 years emit less methane than newly flooded lands and can **serve as carbon sinks** overtime.[4][5][8] Since 2010, all 2,805MW of hydropower capacity growth was achieved **without creating any new reservoirs**.[6]

[4] Inventory of U.S. Greenhouse Gas Emissions and Sinks | EPA (2023)
[5] Getting Lost Tracking the Carbon Footprint of Hydropower | ORNL (2022)
[6] U.S. Hydropower Market Report | ORNL (2023)
[7] Hydropower Vision Report | DOE (2016)
[8] Understanding Quebec Hydropower | Hydro Quebec (2021)
[9] Improving Understanding of Greenhouse Gas Emissions from Reservoirs | ORNL (2023)
[10] 7 Reasons to Be Skeptical of the All-Res Model | NHA (2024)

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