

Hydropower Benefits, Impacts, and Solutions -- some issues do not apply to every dam

## **Benefits of Dams and Hydropower**

Source of electric power [less than 3% of large ( $\geq 2\text{m}$  high) dams in the US produce power]

- Provide base-load electricity to the grid

- Provide flexible capacity to meet peak-load electricity demands

- Diversify energy source portfolio

Water storage (run of the river dams have limited storage capacity)

Flood control (run of the river dams have limited flood control potential)

Regulate flows; maintain flow during dry season (if reservoir has storage capacity)

Provide flatwater navigation opportunities

Provide still-water recreation opportunities

## **Costs and Impacts of Dams and Hydropower**

Dams and reservoirs flood rivers; eliminate riparian habitats and functions

Dams, reservoirs, and fish impacts infringe on Indigenous treaty rights

Safety hazard (29% of 91,468 dams in US National Inventory of Dams rated high or significant hazard)

Safety hazard ( $>13,000$  low-head dams pose drowning hazard; ASCE 2023)

Decrease or eliminate populations of salmon and other anadromous fishes

- Block access to spawning habitat of adult fish

- Block routes of out-migrating juvenile fish

- Kill juvenile fish (in reservoirs, passing through turbines, gas supersaturation in bypass flows)

- Eliminate downstream current juveniles need for migration

- Delay juvenile migration relative to smoltification (physiological transition to saltwater)

Decrease or eliminate ecological functions of anadromous fish runs

Flood habitat of riverine fish

Dewatered river channels in bypass reaches

Obstruct sediment transport, impacts to downriver habitats and organisms

Degraded flow regimes

- Decreased flows during reservoir recharge periods

- Increased flows during peak power demands

- Flow fluctuation, causing riverbank erosion

- Loss, reduction, or degradation in riparian zone

Cause water loss, due to reservoir evaporation

Degraded water quality

- Increased water temperatures, reduced dissolved Oxygen (hostile to salmonids)

- Harmful algal blooms (e.g., Klamath dam incidents, incl. fish kills)

Greenhouse gas emissions: methane releases from reservoirs in agricultural areas

Land taking (condemnation): reservoirs displace private landowners and federal land users

Free-flowing river recreational opportunities: loss (reservoirs) or reduction/degradation (below dams)

Limited or degraded recreational opportunities on dam-controlled rivers, restricted to water releases

Subsidies

- Congressional funding for hydro development projects (see Reisner 1986)

- Low or zero-interest loans for hydro development projects (Reisner 1986)

- Tax breaks to corporate dam owner/operators (21% of revenues during 1980s)

- Small hydro developers/operators sell electricity to utilities at inflated (above market) rates

  - (Public Utility Regulatory Policies Act, PURPA; enacted 1978)

- Free use of public rivers; hydro profits without use fees for the public river resource

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## **Solutions: Approaches to Reduce or Prevent Hydropower Impacts**

Change hydropower operations: implement water releases appropriate for fish and recreational uses

Conservation and Efficiency: reduce energy demand to support dam removal

Reduce peak load: peak load management devices, peak load pricing, smart grid technology

Reduce consumption: provide incentives to reduce demand, encourage energy efficiency

Revise laws and regulations (e.g., ~40 million US residents banned from using clotheslines)

Hydropower license renewal (FERC): compel impact mitigation or dam removal

Original licenses pre-date most envt laws; hydro projects must conform to laws during relicensing

FERC can impose requirements to mitigate environmental impacts during relicensing

(result: operator reduces impacts, license application rejected, or dam removal)

Reduce or eliminate subsidies for hydro projects, esp. large dams

Remove dams determined to be obsolete, unsafe, or unreasonably impactful

1916 dams removed in US since 1912; 1670 dams removed since 1990

Install free-flow turbines in rivers, instead of building channel-spanning dams

Recognize Tribal treaty rights

Recognize rights of rivers

## **Sources**

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