

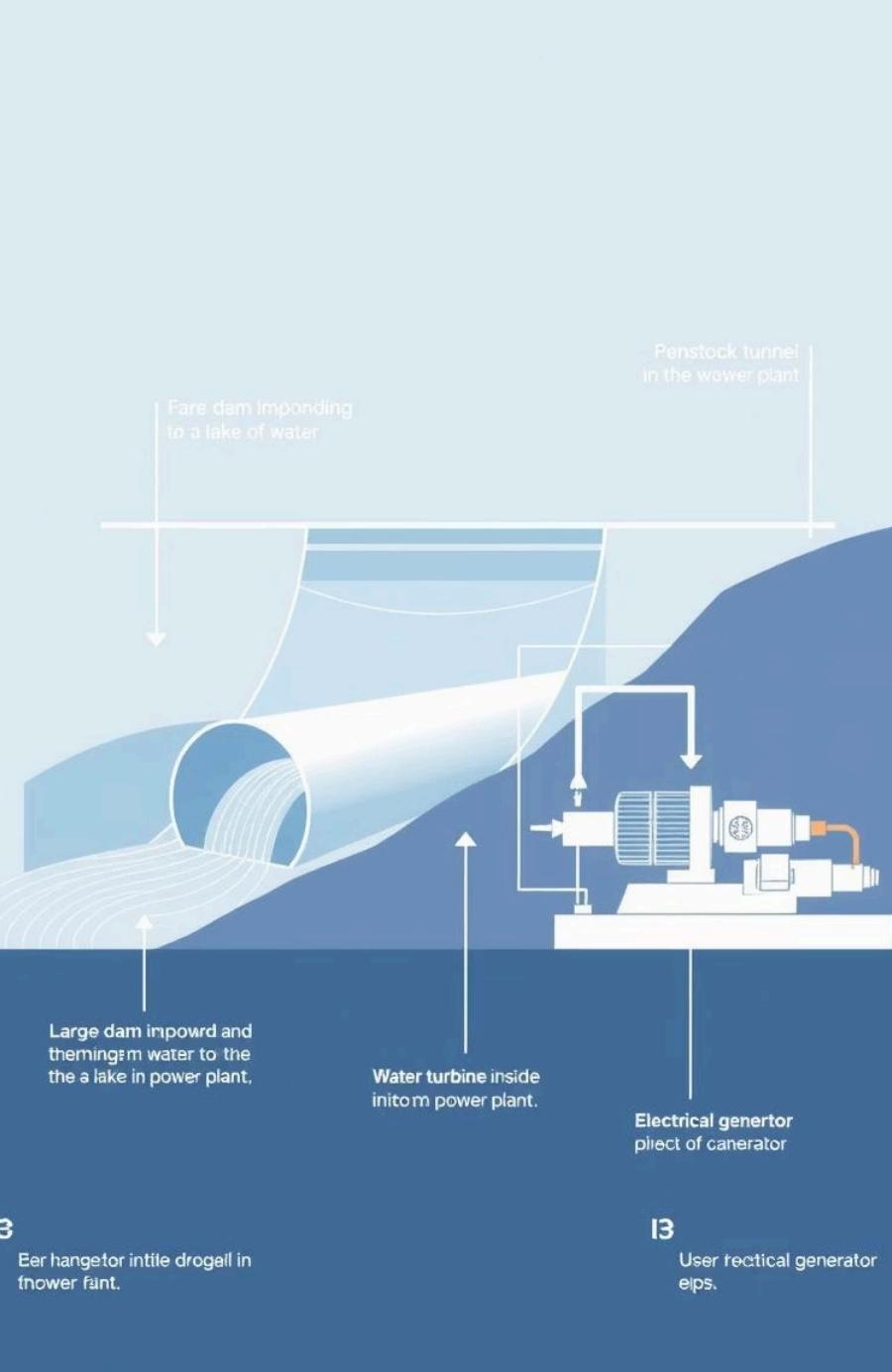
Harnessing the Power of Water: An Overview of Hydropower Plants

Hydropower plants generate renewable electricity by converting the energy of flowing water.

As of 2022, the global hydropower capacity reached 1,330 gigawatts, providing approximately 16% of the world's electricity.

In the United States, hydropower contributes about 84 gigawatts, covering roughly 6.2% of the national electricity demand.





How Hydropower Plants Work: Basic Principles

Water's potential energy transforms into electricity

Key elements: dam, reservoir, penstock, turbine, generator

Turbine types: Francis (common), Kaplan (low head), Pelton (high head)

Types of Hydropower Plants

Impoundment (Dam)

Builds reservoir to store water for steady power generation.

Run-of-River

Uses river's natural flow, minimal water storage required.

Pumped Storage

Moves water up reservoir in low demand; releases at peak times.

Environmental Impacts: Considerations and Mitigation



Benefits

- Renewable energy source
- Flood control
- Water supply management

Concerns

- Habitat alteration
- Fish migration barriers
- Methane emissions from reservoirs

Solutions

- Fish ladders
- Minimum flow requirements
- Reservoir management



Hydropower Plant Efficiency and Capacity



Efficiency

80-90%, higher than most energy sources



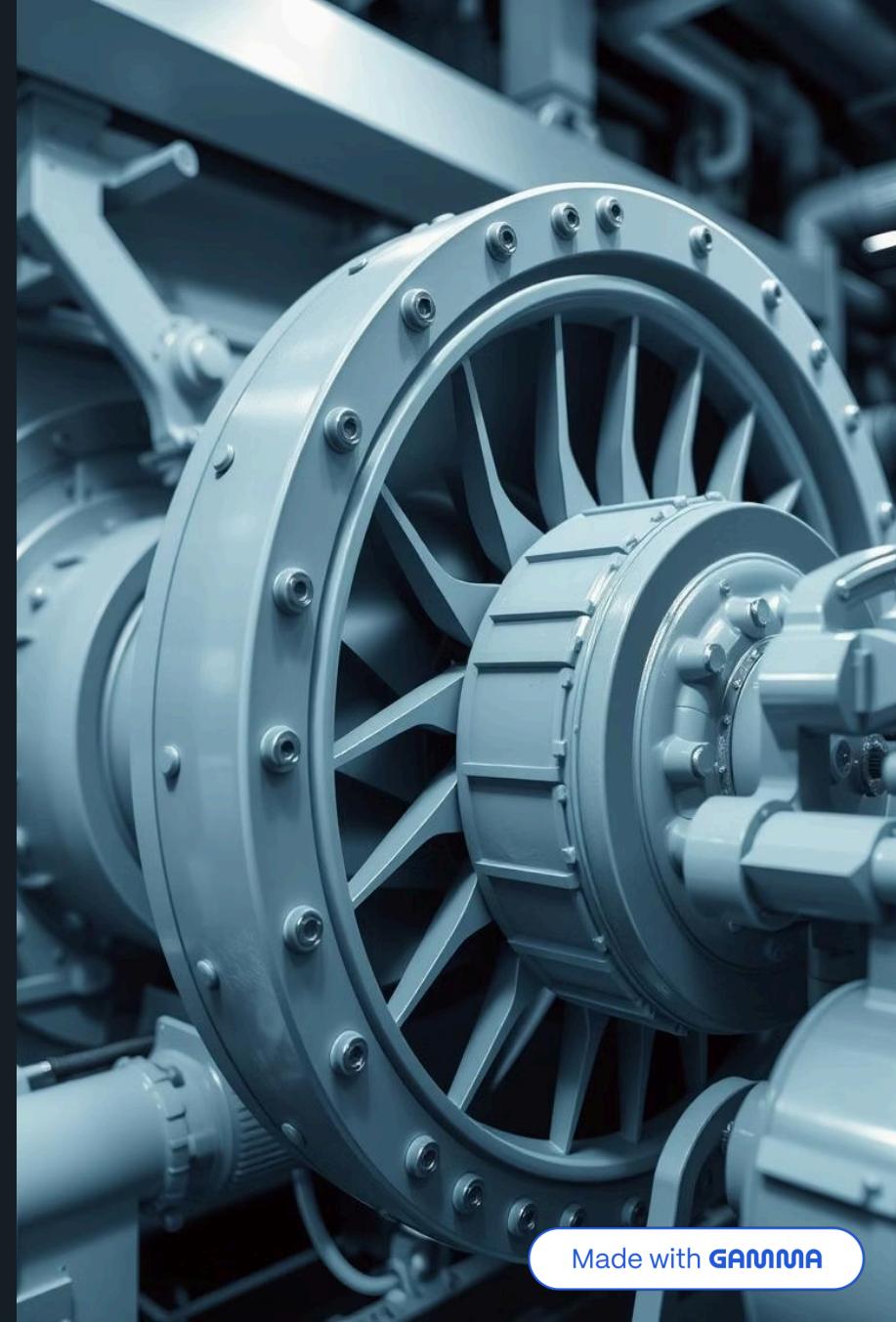
Capacity Factor

Varies between 30-70% depending on water availability



Capacity Formula

Flow rate x head x gravity x efficiency



Case Study: The Three Gorges Dam

- 1
- 2
- 3

Location

Yangtze River, China

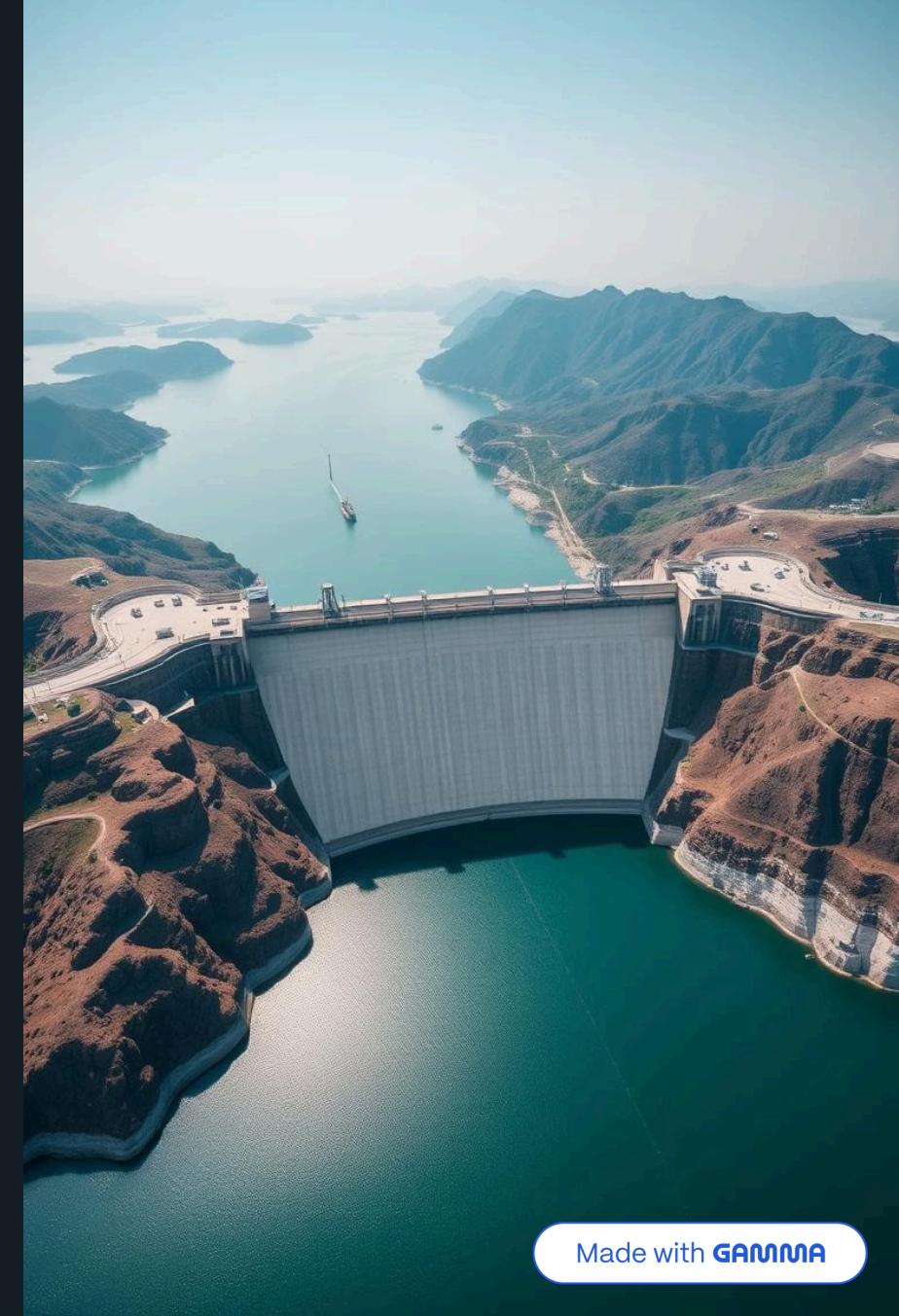
Installed Capacity

22.5 GW – world's largest hydropower plant

Environmental Concerns

Displacement of 1.3 million people

Ecological impacts on river ecosystem





Case Study: Grand Coulee Dam



Location & Capacity

Columbia River, Washington
State; 6.8 GW capacity



Benefits

Irrigation, flood control, and
power generation



Challenges

Effects on salmon migration and native communities



The Future of Hydropower

Modernize Plants

Improve efficiency with new technology

Innovate Technologies

Focus on pumped storage and tidal power

Balance Environment & Energy

Address ecological impacts carefully

Growth Projection

IEA expects 2.5% annual growth through 2030