

# Ensuring a Reliable Grid: The Role of Transmission Services

Building and Maintaining the Backbone of  
Our Energy Future

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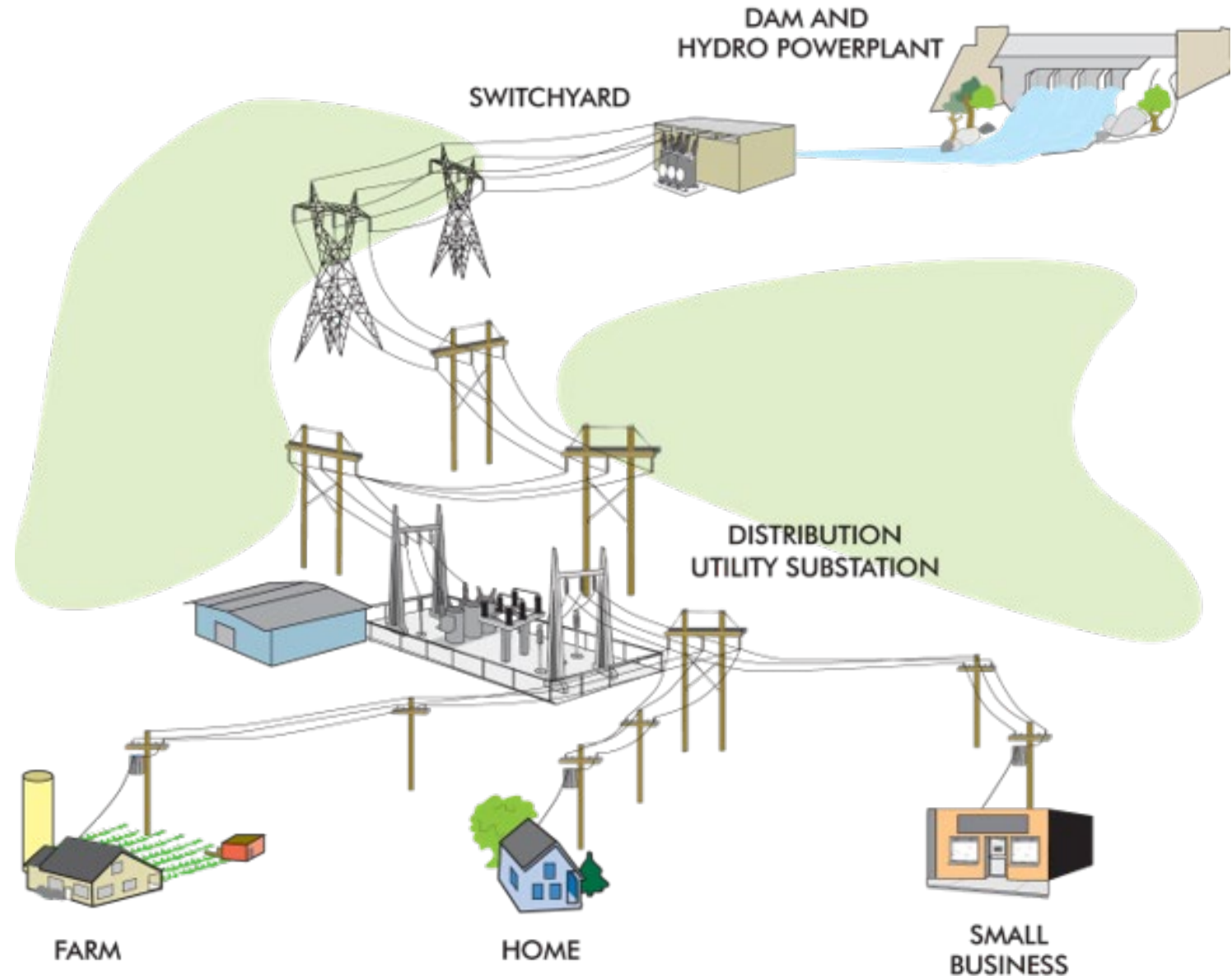
# Introduction to Transmission

## What is transmission?

- The high-voltage network that carries electricity from power plants to substations, where it is then distributed to homes and businesses
- It's like the interstate highway system for electricity
- CRSP has ~2,400 miles of high-voltage transmission
  - WAPA has +17,000 miles

## Why is it important?

- Enables reliable delivery of electricity over long distances
- Supports economic development and energy independence
- Allows diverse energy sources to reach consumers



# What is Transmission Planning?

## Definition:

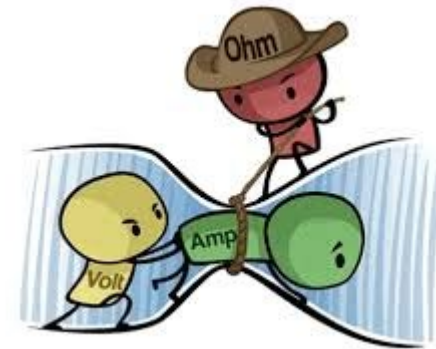
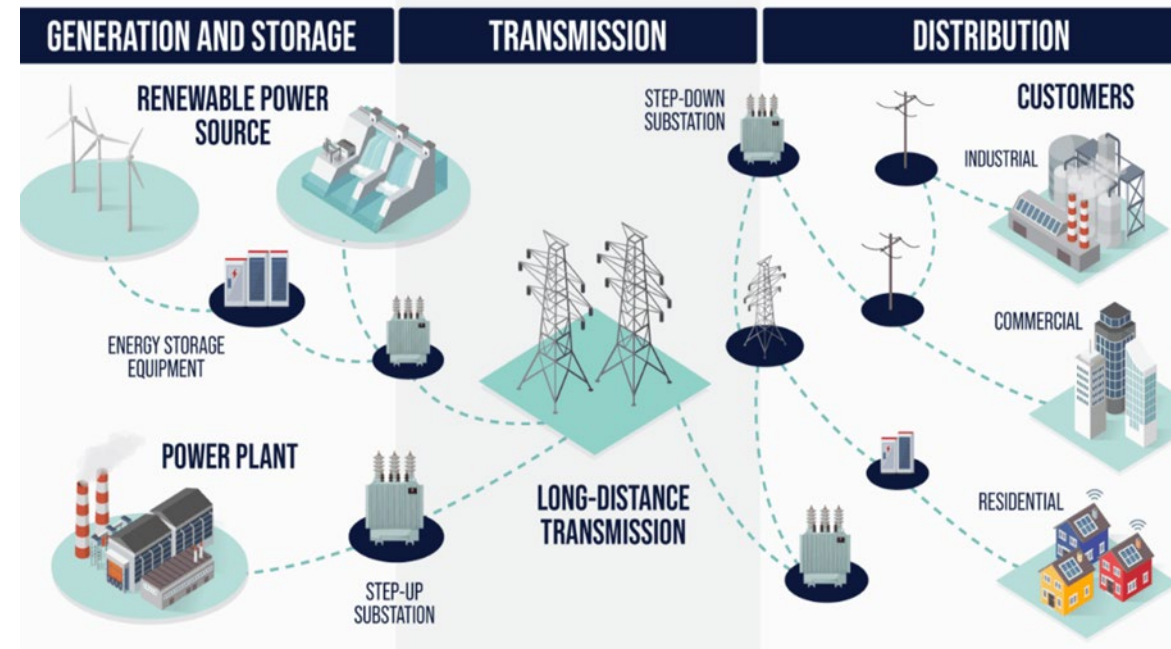
- The process of identifying future electricity needs and developing long-term plans for expanding and upgrading the transmission system to meet those needs.

## Core Mission:

- To ensure a reliable, efficient, and cost-effective transmission grid for the future.

## Keep in Mind:

- The three most basic components of electricity are voltage, current, and resistance.
  - Voltage is like the pressure that pushes water through the hose, it is measured in volts (V).
  - Current is like the diameter of the hose. The wider it is, the more water will flow through. It is measured in amps (I or A).
  - Resistance is like sand in the hose that slows down the water flow. It is measured in ohms (R or  $\Omega$ ).



# Key Roles of Transmission Services

## System Reliability Studies:

- Analyzing the grid's ability to withstand disturbances (e.g., equipment failures, extreme weather)
- Identifying potential bottlenecks or weaknesses

## Future Needs Assessment:

- Forecasting electricity demand growth (e.g., data centers)
- Anticipating changes in generation sources (e.g., renewables)

## Transmission Expansion Planning:

- Developing plans for new lines, substations, and upgrades to existing infrastructure
- Evaluating different options based on cost, reliability, and environmental impact

## Policy and Regulatory Compliance:

- Ensuring plans meet industry standards and regulatory requirements
- Collaborating with regional grid operators and regulators



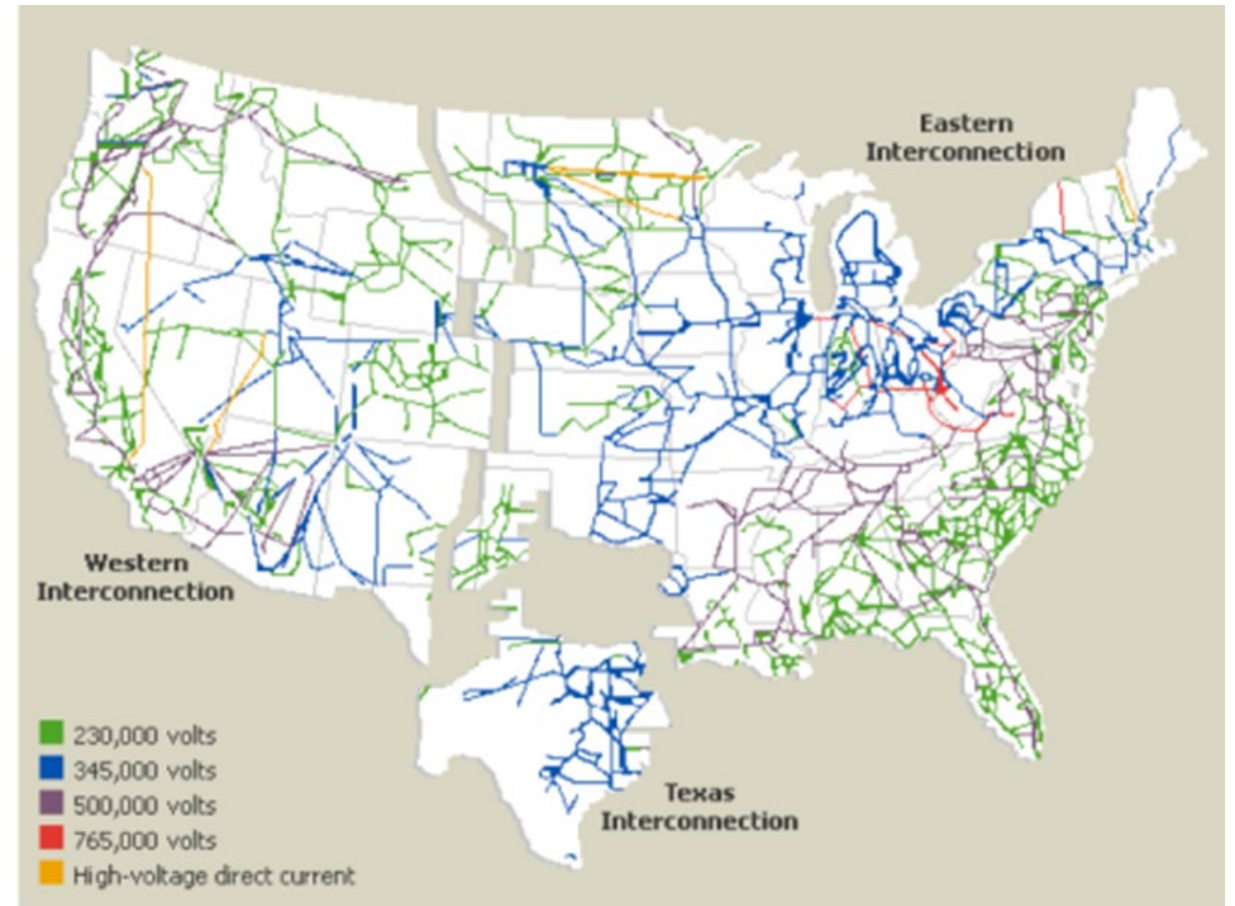
# Interconnections: Connecting New Power Sources

## What are interconnections?

- The process of connecting new power plants, large solar farms, wind farms, or even large industrial facilities to the existing transmission grid
- Essential for bringing new energy online

## Why are they dealt with by planning?

- Any new connection can impact the stability and capacity of the existing grid
- Planning identifies necessary upgrades to accommodate the new power source without compromising reliability
- Transmission Business Unit and Transmission Planning work towards WAPA's mission of developing and upgrading electrical infrastructure to facilitate the delivery of reliable hydropower generation



# How Interconnections are Dealt With (High-Level)

## Step 1: Application:

A developer submits a request to connect a new facility.

- Facilitated by our Transmission Business Unit

## Step 2: Study Process:

- **Feasibility Study:** Initial assessment of the impact and potential connection points
- **System Impact Study:** Detailed analysis of how the new connection affects grid reliability, voltage, and power flow. Identifies necessary upgrades
- **Facilities Study:** Determines the specific physical modifications and equipment needed for the interconnection

**Step 3: Agreement & Construction:** Once studies are complete and upgrades are identified, an agreement is reached, and construction proceeds

**Key Consideration:** Ensures the grid can safely and reliably integrate new power without affecting existing customers



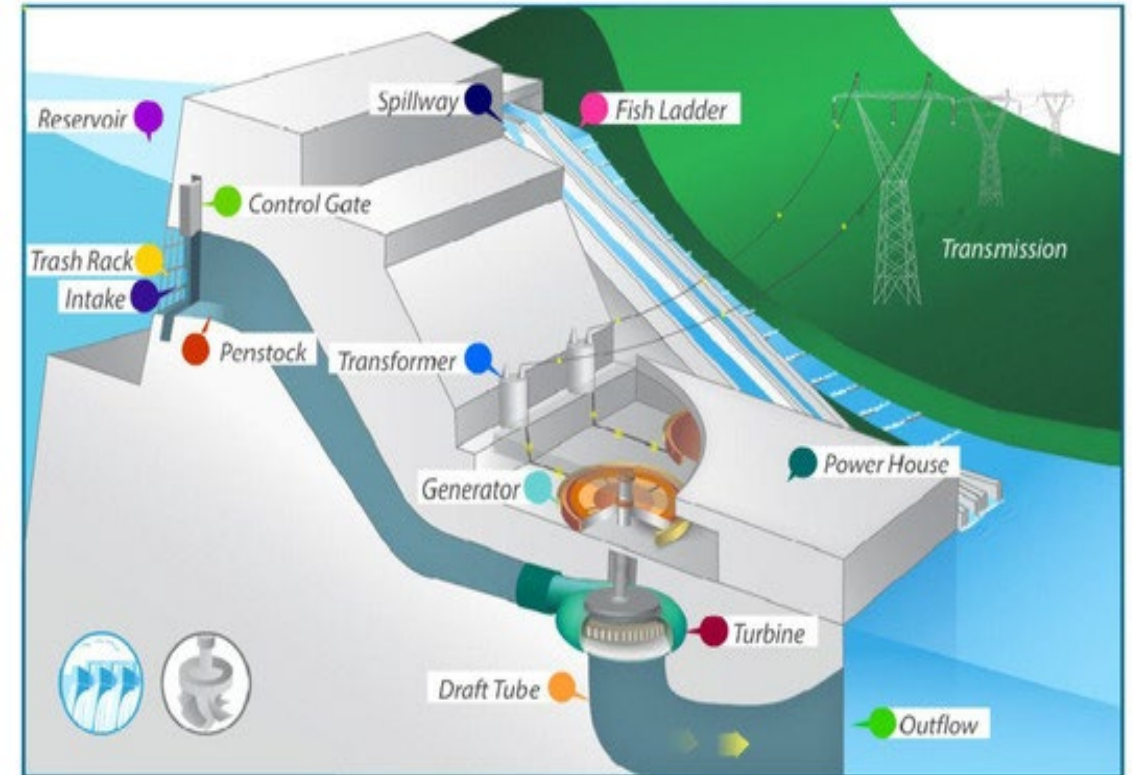
# Impact of Hydropower Changes on Transmission Services

## Understanding Hydropower's Role:

- Hydroelectric facilities are crucial for grid stability due to their ability to quickly increase or decrease power output.
- They provide significant amounts of renewable energy and often perform essential grid services like voltage support and frequency regulation.

## Impact of Lower Water Levels:

- **Reduced Generation Capacity:** Less water means a hydro plant cannot produce as much electricity, reducing the amount of power available to the transmission grid from that source.
- **Loss of Dispatchability:** The ability to quickly ramp up or down power, which is vital for balancing supply and demand, is severely limited.
- **Reduced Ancillary Services:** Hydro facilities contribute to grid reliability by providing:
  - **Voltage Support:** Their generators can inject or absorb reactive power to maintain stable voltage levels on the transmission lines.
  - **Frequency Regulation:** They can rapidly adjust output to keep the grid frequency stable.
  - **Spinning Reserve:** Quick-start capability for sudden increases in demand or loss of other generation.
- **Transmission Congestion:** To compensate for reduced hydro output, more power may need to be imported from other regions or generated from alternative sources (e.g., thermal plants). This can increase power flow on transmission lines not typically designed for such heavy loads, leading to congestion and potential overloads.
- **Increased Transmission Losses:** Longer distances for power transfer due to rerouting can result in higher energy losses as heat during transmission.



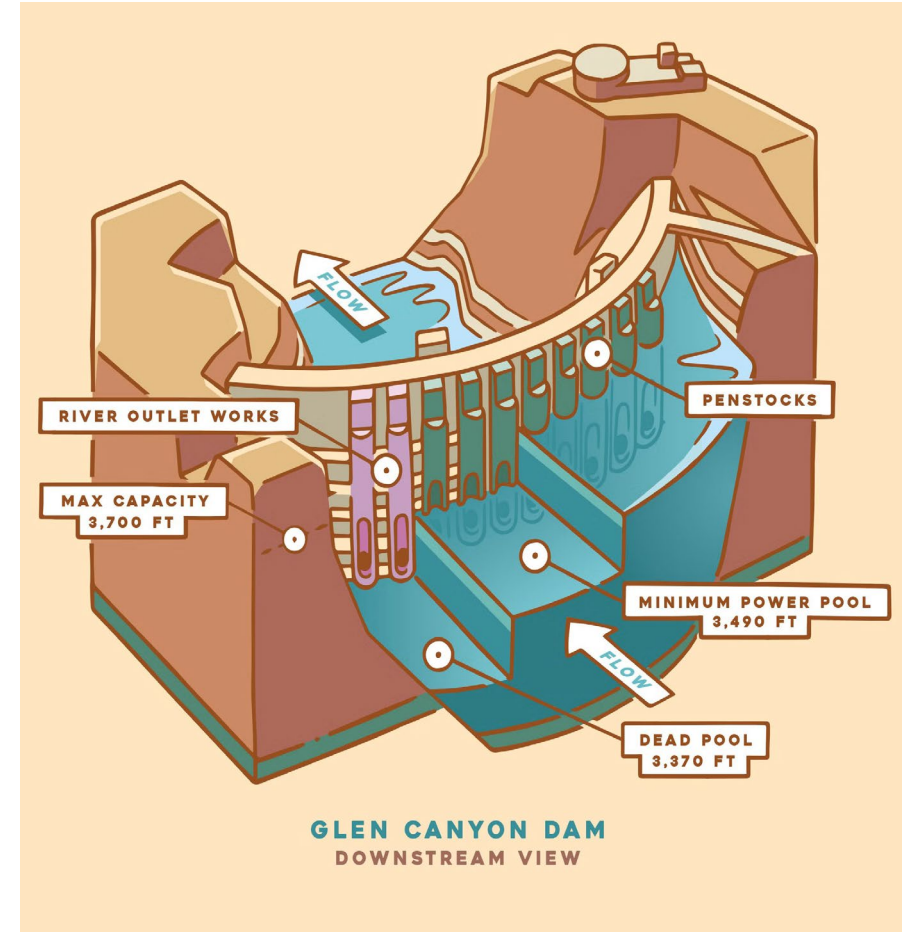
# Impact of Hydropower Changes on Transmission Services (continued)

## Impact of Bypassing the Turbine (e.g., for environmental flows or maintenance):

- **Complete Loss of Generation:** When water bypasses the turbine, the facility generates no electricity, effectively removing its power contribution from the transmission grid.
- **Loss of All Ancillary Services:** Similar to low water levels, but often more immediate and complete, the grid loses that facility's ability to provide voltage support, frequency regulation, and reserves.
- **Sudden Shift in Power Balance:** If this happens unexpectedly, it requires other generators to ramp up quickly and transmission operators to reroute power, placing sudden stress on the transmission system.
- **Increased Reliance on Other Resources:** The transmission grid must immediately rely more heavily on other more expensive or less flexible power sources, which may be located further away, increasing transmission demand and costs.

## Consequences for Transmission Services:

- **Increased Operational Complexity:** Transmission operators must work harder to balance the grid with fewer flexible resources.
- **Higher System Costs:** The need to bring online less efficient "peaking" plants or pay for transmission upgrades to handle rerouted power.
- **Potential for Voltage and Frequency Instability:** With reduced hydro support, the grid becomes more susceptible to fluctuations.
- **Reduced Grid Resiliency:** The system's ability to withstand unexpected events is diminished.



# Conclusion: The Vital Role of Transmission Services

Transmission services are essential for:

- Ensuring the lights stay on today and tomorrow
- Integrating new, cleaner energy sources
- Adapting to changing energy demands and technologies
- Maintaining a strong, resilient, and economically efficient grid



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