Environmental Law Institute

Summer School Webinar

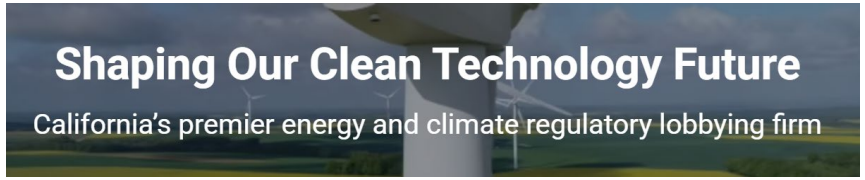
July 8, 2026

caliber

Caliber Strategies

Janea Scott
Partner

- Caliber designs innovative policies, navigates complex regulations and brings new and disruptive clean technologies to market.
- Prior to joining Caliber Strategies, Ms. Scott served as the Vice Chair of the California Energy Commission and as a Senior Counselor at the U.S. Department of the Interior.

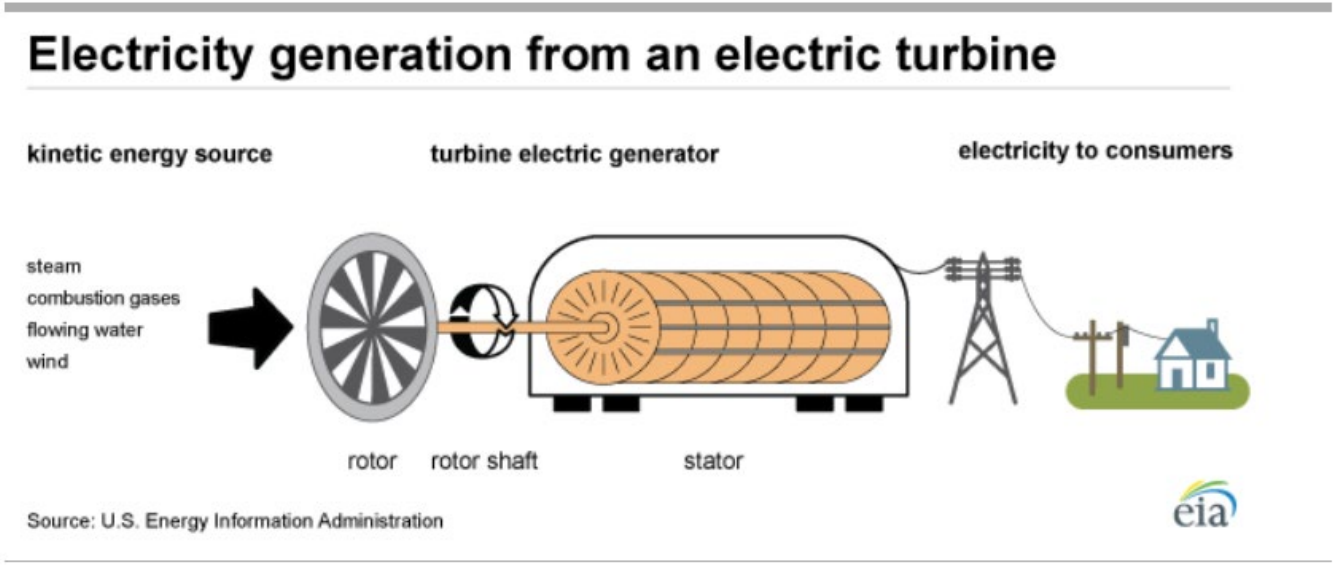


Energy Resources
(With a Focus on Clean Energy)

- Outline
  - How is electricity generated?
  - Different types of generation
    - Fossil Fuel
    - Nuclear/ Small Modular Nuclear Reactors
    - Hydropower
    - Solar
    - Wind
    - Geothermal
    - Hydrogen Fuel Cell
    - Energy Storage – battery, pumped hydro
  - Putting energy generation in context

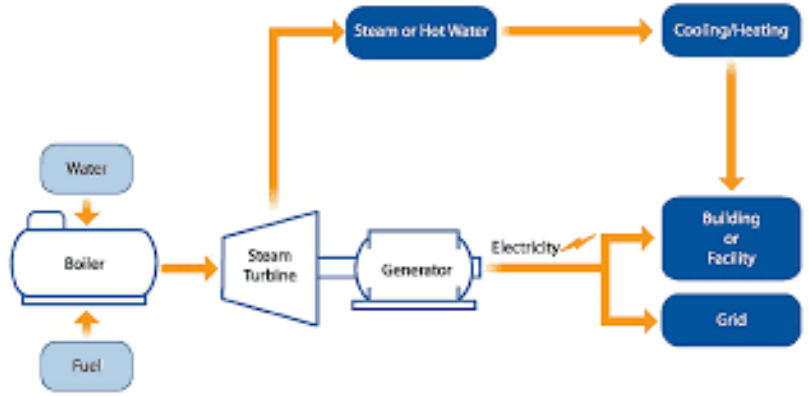
How is Electricity Generated?

- Most U.S. and world electricity generation is from electric power plants that use a turbine to drive electricity generators.
- In a turbine generator, a moving fluid—water, steam, combustion gases, or air—pushes a series of blades mounted on a rotor shaft.
- The force of the fluid on the blades spins (rotates) the rotor shaft of a generator.
- The generator, in turn, converts the mechanical (kinetic) energy of the rotor to electrical energy.



How is Electricity Generated – con't.

- Slightly more complex electricity generation systems include:
  - Combined cycle systems use combustion gases from one turbine to generate more electricity in another turbine. Most combined-cycle systems have separate generators for each turbine.
  - Combined-heat-and-power plants (CHP) and co-generators, use the heat that is not directly converted to electricity in a steam turbine, combustion turbine, or an internal-combustion-engine generator for industrial process heat or for space and water heating.
- Additionally, internal-combustion engines, like diesel generators, are also used for electricity generation.



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Fossil Fuels

Natural Gas: Major Pollutants

- Carbon dioxide (CO_2): about half of coal per unit of electricity
- Nitrogen oxides (NO_x): smog and respiratory impacts
- Methane (CH_4): potent greenhouse gas from leaks
- Carbon monoxide (CO): harmful at elevated concentrations

Petroleum: Major Pollutants

- Carbon dioxide (CO_2): high emissions per unit of electricity
- Sulfur dioxide (SO_2): especially high for heavy fuel oils
- Nitrogen oxides (NO_x): smog and ozone formation
- Particulate matter and air toxics: severe local health impacts

Coal: Major Pollutants

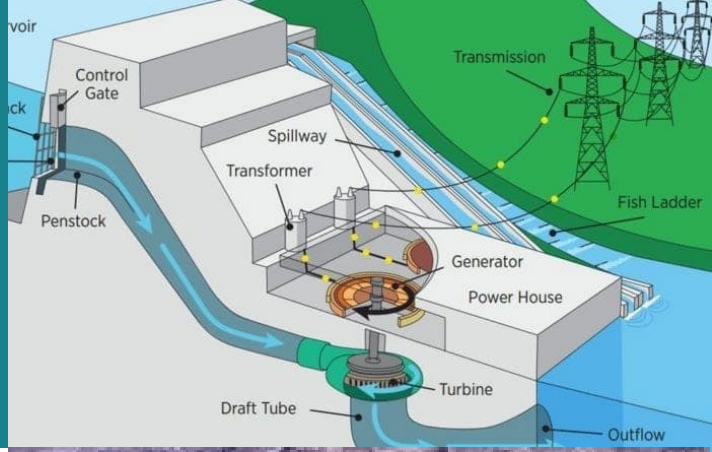
- Carbon dioxide (CO_2): highest emissions per unit of electricity
- Sulfur dioxide (SO_2): acid rain and respiratory disease
- Nitrogen oxides (NO_x): smog and ozone formation
- Fine particulate matter (PM2.5): heart and lung disease
- Mercury and toxic coal ash: long-term environmental contamination

Nuclear/ Small Modular Nuclear Reactors

- Nuclear power offers carbon-free, firm electricity, but faces challenges
  - Financial -- cost and risk
  - Siting, permitting, and regulation
  - Public trust
  - Long development timelines
  - Waste: remains radioactive for thousands of years, no permanent storage facility in the U.S., is stored on-site at plants, often in interim dry casks
- Small Modular Nuclear Reactors (SMRs)
  - An SMR operates similarly to traditional nuclear reactors but on a smaller scale.
  - They can be prefabricated and assembled in a factory, then transported to the site ready for use.
  - Require less space and can be flexibly adjusted to meet demand.

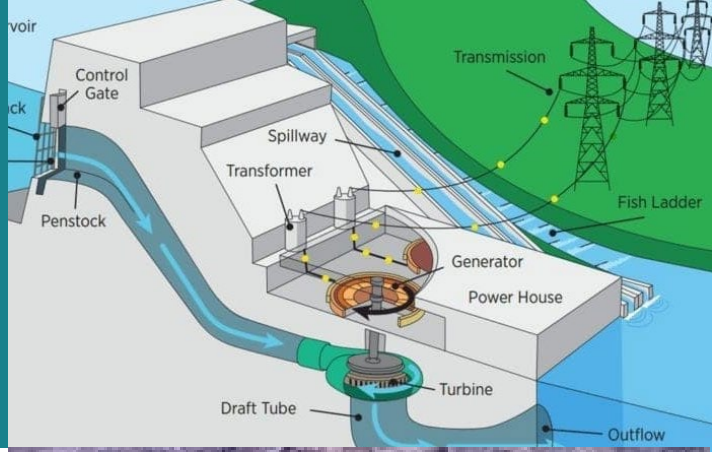
Hydropower

- Plays an outsized role in grid reliability, providing fast-ramping, dispatchable power during peak demand, heat waves, and emergency conditions
- Includes both large legacy facilities and pumped-storage projects, which function as long-duration energy storage for a solar-heavy grid
- Produces carbon-free electricity and helps reduce reliance on fossil generation during critical evening hours
- Output is highly variable year to year, with generation dropping sharply during droughts and dry winters



Hydropower, con't

- Increasingly exposed to climate change impacts, including reduced snowpack and altered runoff timing
- Opportunities for new large hydropower development are extremely limited due to environmental, tribal, and permitting constraints
- Environmental concerns—particularly impacts on fish, river ecosystems, and tribal cultural resources—shape operations and limit expansion
- In California, hydropower is best understood as a reliability and flexibility resource, not a scalable source of new clean generation



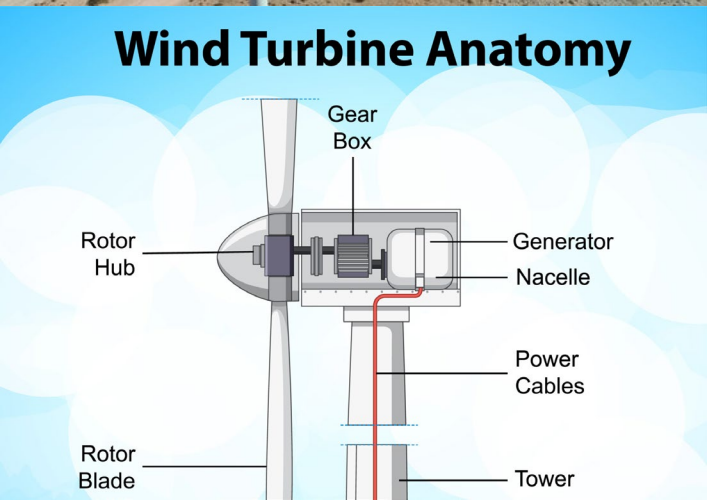
Solar

- There are two types of solar generation: solar thermal or concentrated solar (CSP) and photovoltaic solar (PV)
- Solar thermal: uses mirrors to concentrate sunlight to produce heat and the heat generates steam to drive a turbine
- Solar photovoltaic: converts sunlight directly into electricity using semiconductor cells
- The largest source of new generation capacity in California and a cornerstone of the state's clean energy strategy

Solar, con't.

- Provides carbon-free electricity and significant air quality benefits, particularly in communities historically overburdened by pollution
- Can be quickly deployed at both utility scale, community scale, and rooftop
- The lowest-cost source of new electricity in many regions
- Output is variable and weather-dependent, with no generation at night and reduced production during cloudy or smoky conditions

Onshore Wind



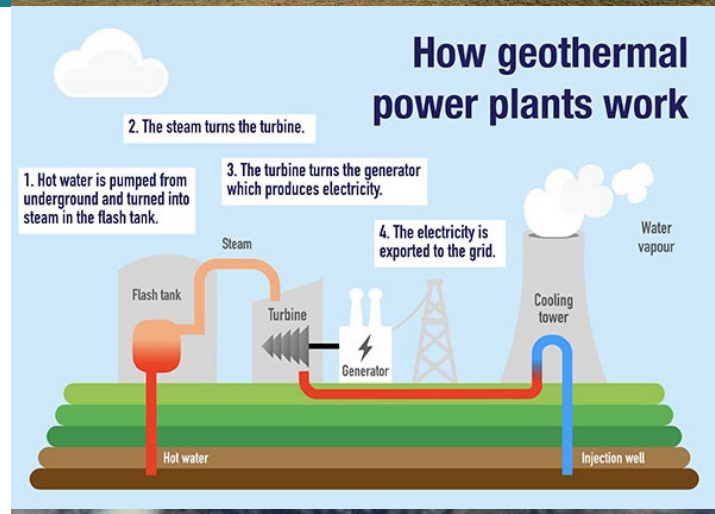
- Wind flows over the blades
  - Turbine blades are shaped like airplane wings.
  - Wind moving faster over one side creates lift, causing the blades to rotate.
- Blades turn the rotor
  - The rotor connects all blades to a central hub.
  - As wind speed increases, the rotor spins faster (up to a design limit).
- Rotation turns a shaft inside the nacelle
  - The rotor is connected to a low-speed shaft inside the nacelle (the box at the top of the tower).
- A gearbox increases rotational speed
  - Most turbines use a gearbox to convert slow rotation into much faster rotation needed by the generator.
  - Some newer turbines are direct-drive and skip the gearbox.
- The generator produces electricity
  - The fast-spinning shaft turns a generator, creating electricity through electromagnetic induction.

Offshore Wind

- Most wind turbines rely on the same basic physics, regardless of size or location
- Wind power is variable, but increasingly predictable and essential to modern grids
- Modern turbines can power thousands of homes each
- Offshore Wind is typically constructed with longer blades, has access to stronger steadier winds, costs more than onshore wind but has a higher energy output
- Onshore turbines are generally easier to construct and maintain
- Both onshore and offshore wind provide carbon and air pollutant-free electricity

Geothermal

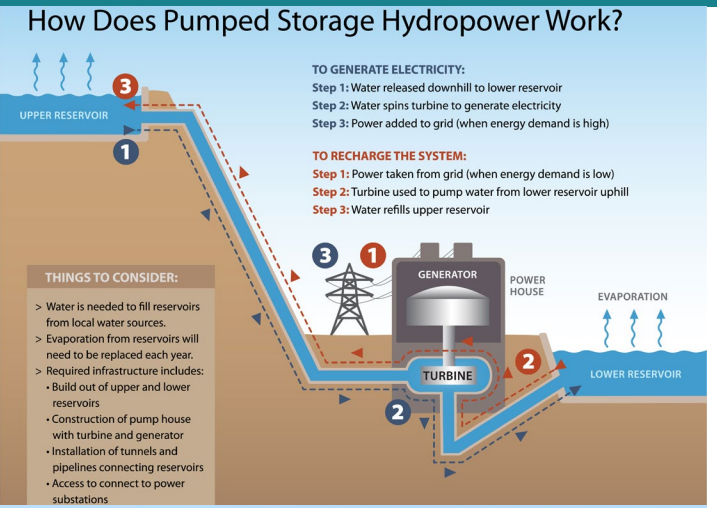
- Provides clean, carbon-free electricity with very low lifecycle greenhouse gas emissions
- Delivers firm, 24/7 baseload power, supporting grid reliability
- Is not weather-dependent, unlike solar or wind
- Requires a small surface footprint compared to other utility-scale power plants
- Offers long plant lifetimes and low operating costs once built
- Uses established drilling and subsurface expertise, including skills from oil and gas development
- Next-generation approaches (closed-loop, EGS) are not yet commercial at scale



Energy Storage – Battery Energy Storage Systems

- There are several technologies to store energy
- Battery Energy Storage Systems:
  - Electricity from the grid (often solar or wind) is used to charge batteries
  - When needed, batteries discharge electricity back to the grid
  - Fast response (milliseconds), ideal for reliability and grid stability
  - Modular and rapidly deployable, with short construction timelines
  - No on-site air pollution during operation
  - Typically limited to short durations (2–6 hours is most common)
  - High upfront costs, though prices are falling
  - Relies on critical minerals (e.g., lithium, nickel), raising mining and supply-chain concerns

Energy Storage – Pumped Hydro



- Uses electricity to pump water uphill from a lower reservoir to an upper reservoir
- When electricity is needed, water is released back downhill through turbines
- The turbines generate electricity, similar to a conventional hydropower plant
- Energy is stored as gravitational potential energy
- No fuel costs and no direct air emissions
- Proven technology that can provide long-duration storage, ranging from hours to days

Challenges to permitting large scale renewable energy include:

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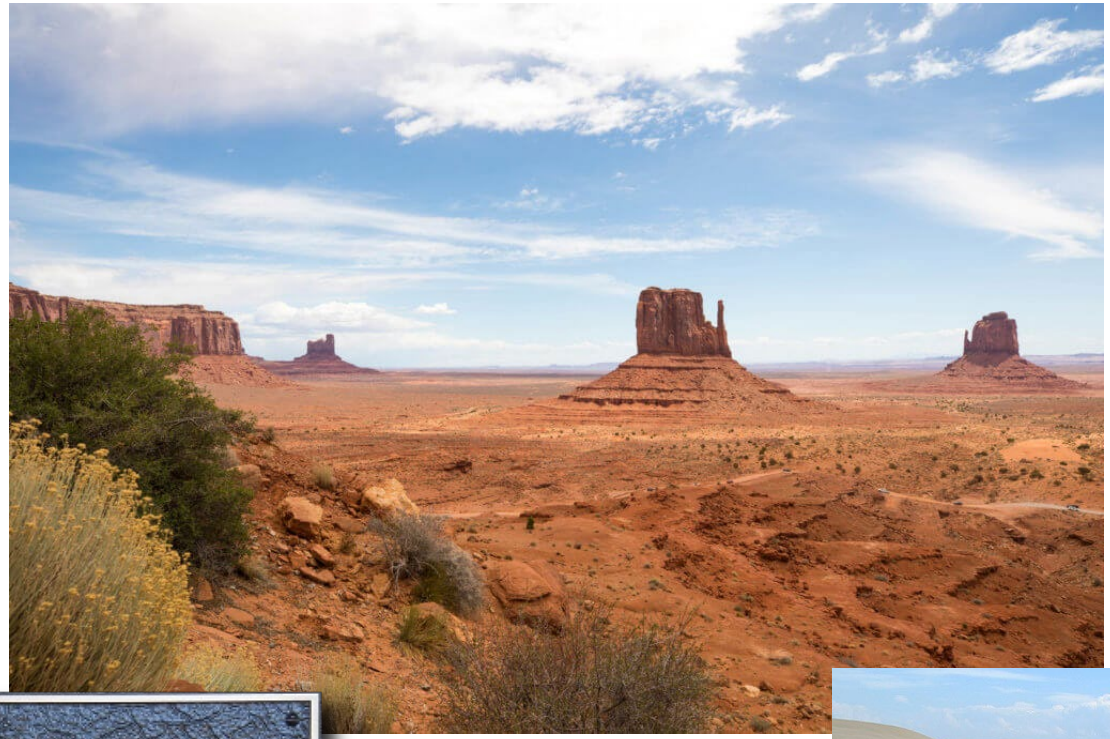
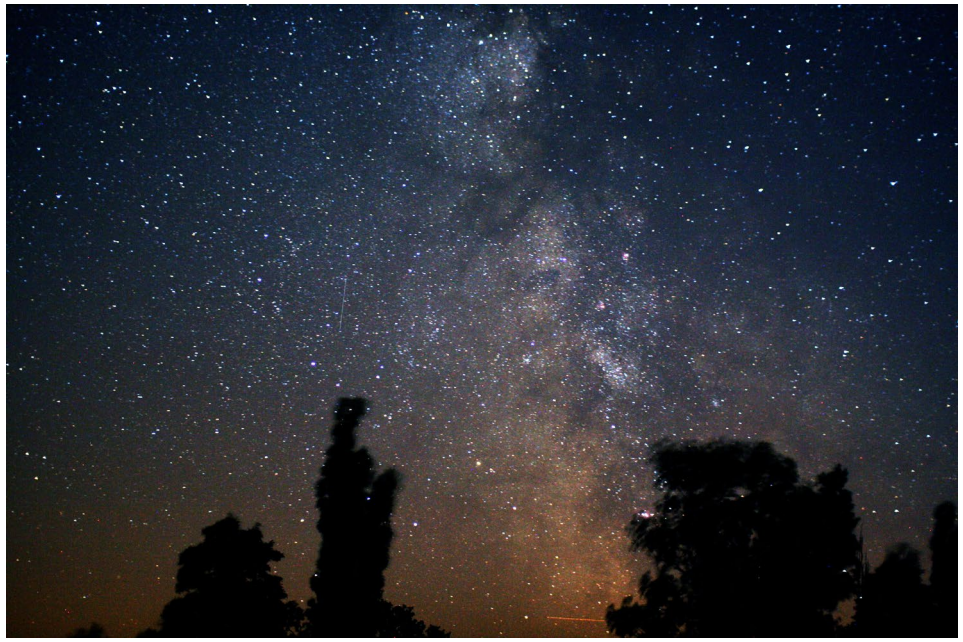
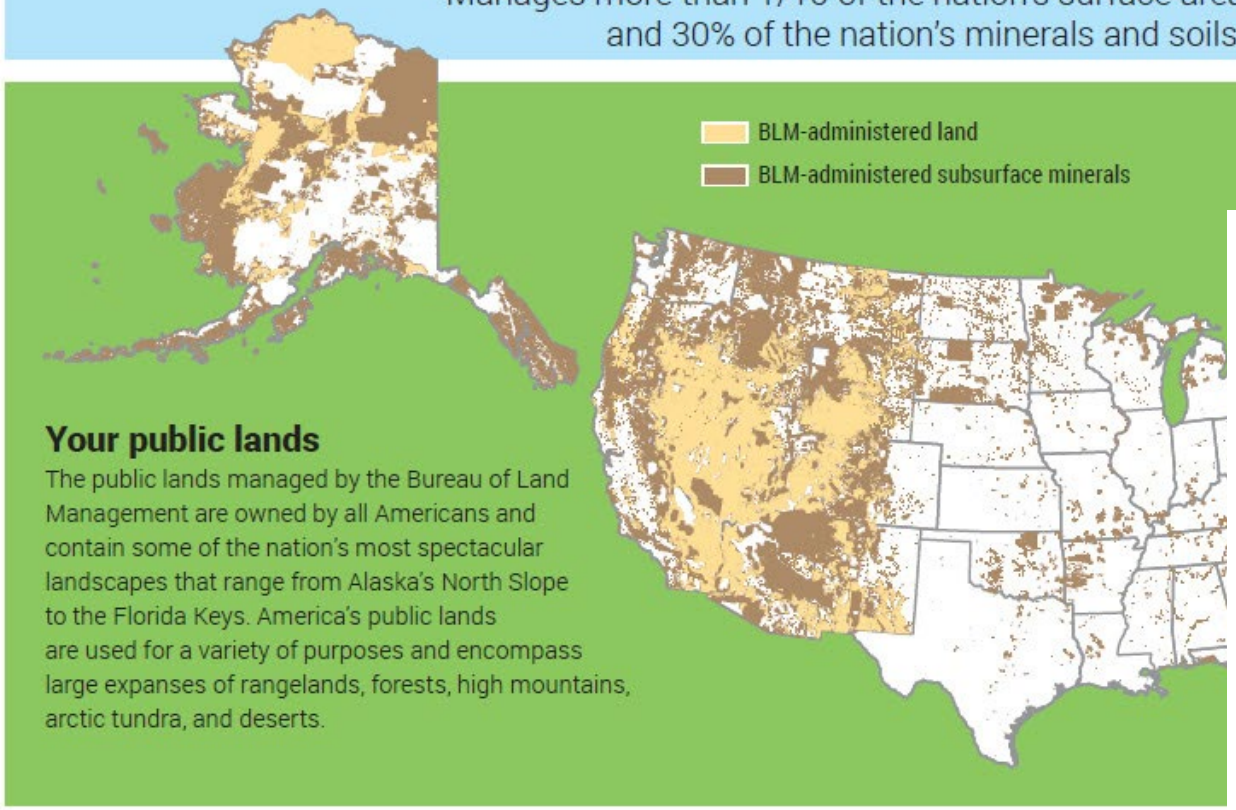




Current Federal Challenges for Clean Electricity Generation

The Bureau of Land Management

Manages more than 1/10 of the nation's surface area and 30% of the nation's minerals and soils.



Your public lands

The public lands managed by the Bureau of Land Management are owned by all Americans and contain some of the nation's most spectacular landscapes that range from Alaska's North Slope to the Florida Keys. America's public lands are used for a variety of purposes and encompass large expanses of rangelands, forests, high mountains, arctic tundra, and deserts.

Interior cancels largest solar project in North America

It's the Trump administration's latest move to slow or block major clean energy projects.

Top stories

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Senator Alex Padilla (.gov)

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2 weeks ago

National Fisherman

Trump administration pays $765 million to kill four more wind leases

2 weeks ago

Source: Trump's Interior Department cancels largest solar project in North America - POLITICO

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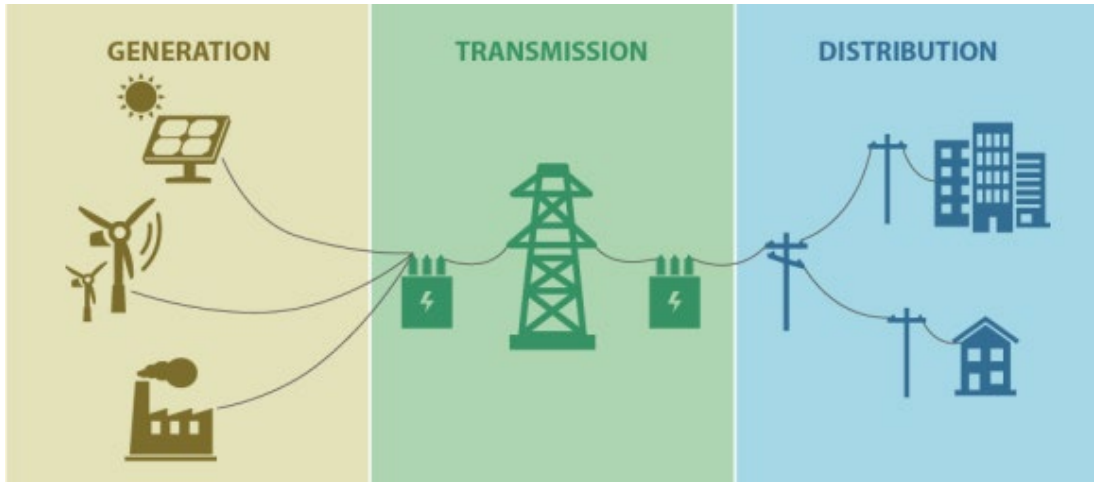
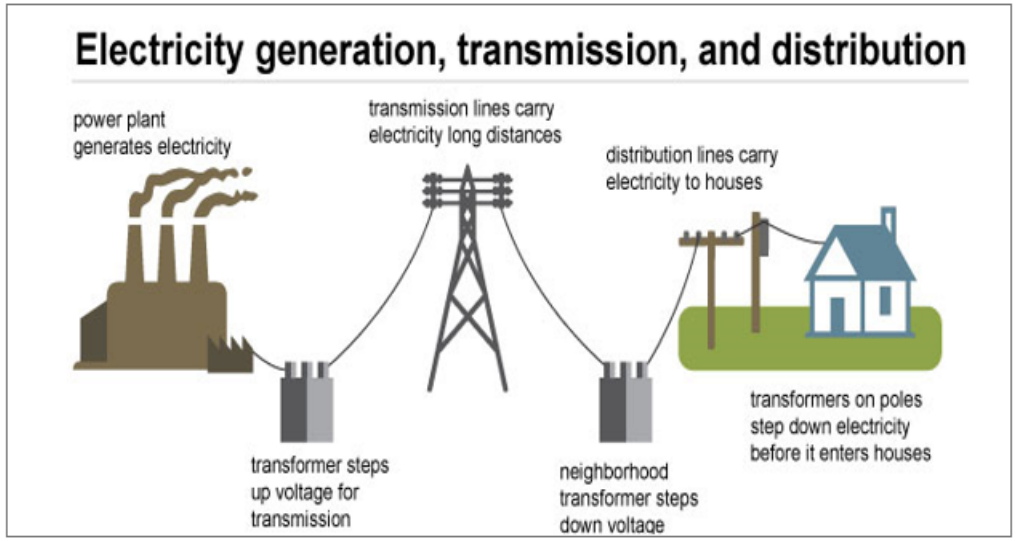
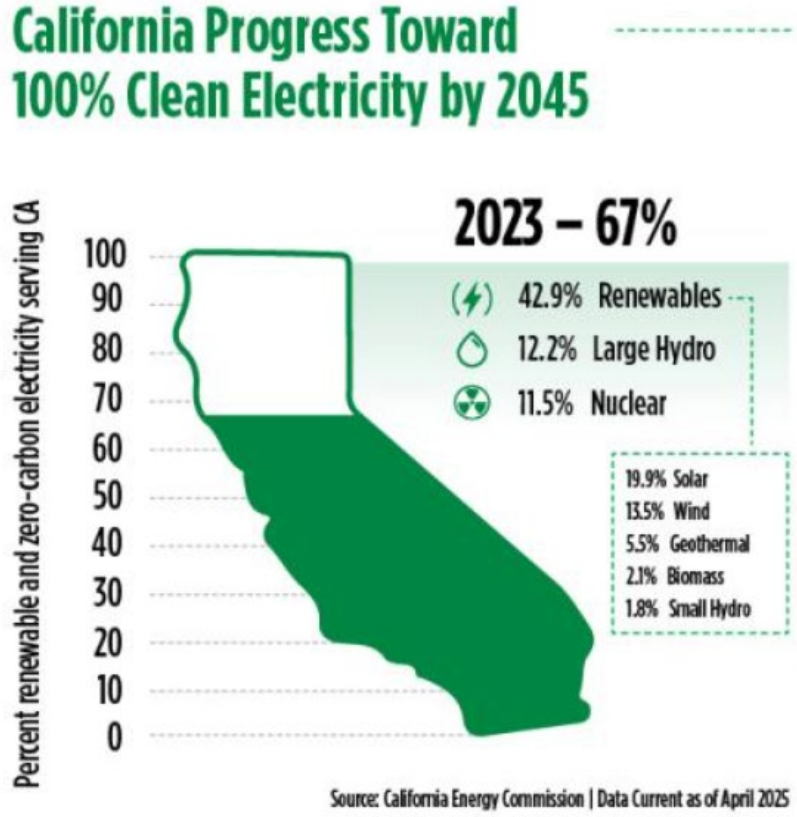
Transmission lines help deliver power from where it is generated to where it is used





California's Clean Electricity Goals



100% Clean Electricity by 2045 (SB 100)

- California law requires that 100% of retail electricity sales be supplied by renewable and zero-carbon resources by 2045.
- Interim targets include 60% by 2030, 90% by 2035, and 95% by 2040, guiding the pathway to full clean power.
- The law also requires that achieving this goal does not increase emissions elsewhere in the Western grid ("no resource shuffling").

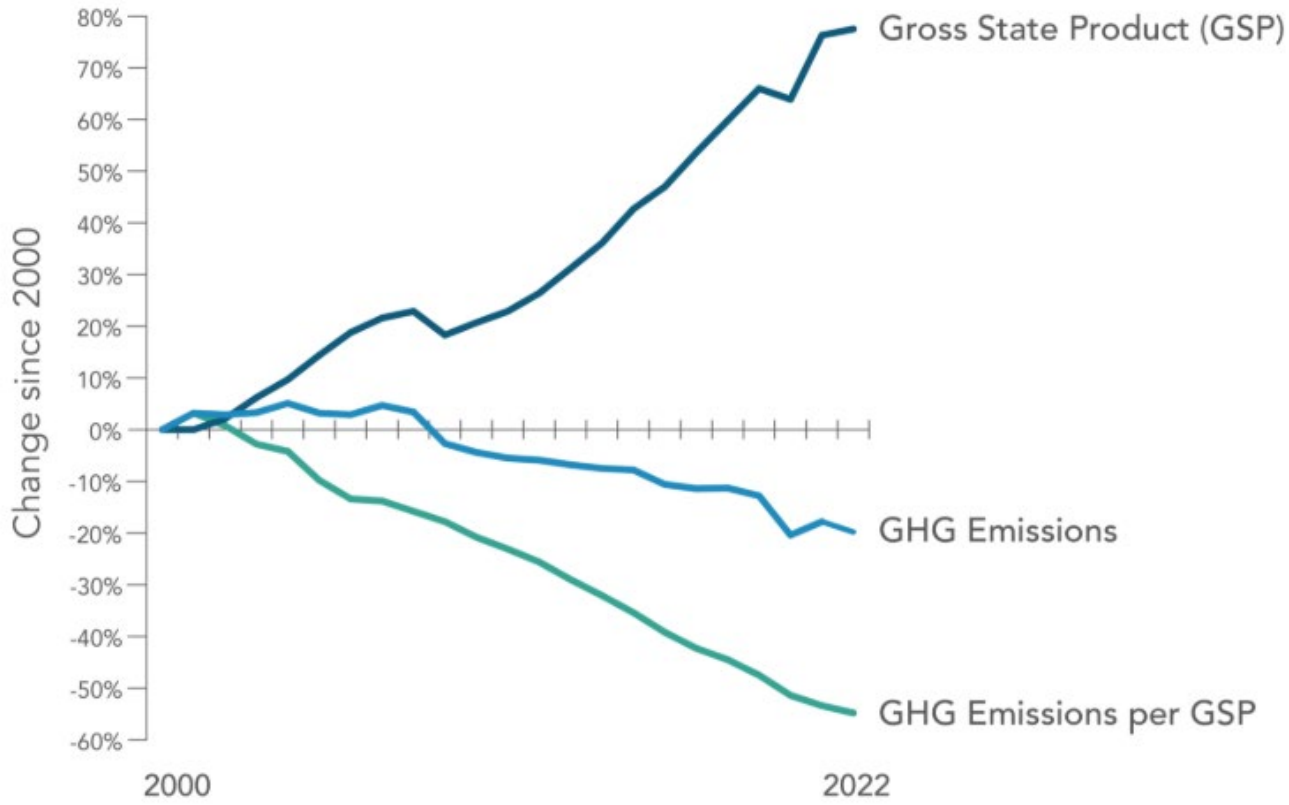
Why Is Transitioning to Clean Energy So Important?

- Mitigate or minimize air pollution, water pollution, and other environmental impacts of traditional energy
- Address global climate change
- Create new jobs and new industries
- Renewed focus on affordability and equity—lowering the energy burden and supporting vulnerable communities
- Increasing resiliency of our energy system

California's Climate Is Changing

http://www.climateassessment.ca.gov/state/docs/20190116-StatewideSummary.pdf

Reducing Pollution While Growing the Economy



Source: Climate Dashboard | CalEPA

A Snapshot of California's Energy Mix

Tuesday July 7, 2026

Current and forecasted demand AS OF 12:40 PT

About demand

Current capacity* 59,233 MW

- Current demand 30,269 MW
- Available next 1 – 4 hours 12,497 MW – 28,964 MW
  - Includes reserves 2,820 MW

59,233 MW Current capacity*

30,269 MW Current demand

2,820 MW Current reserves

35,158 MW Forecasted peak (19:00)

36,610 MW Tomorrow's forecasted peak

Supply and renewables AS OF 12:40 PT

About supply

30,269 MW Current demand

26,606 MW Current renewables

1,230 MW Current hybrids

22,530 MW Current solar

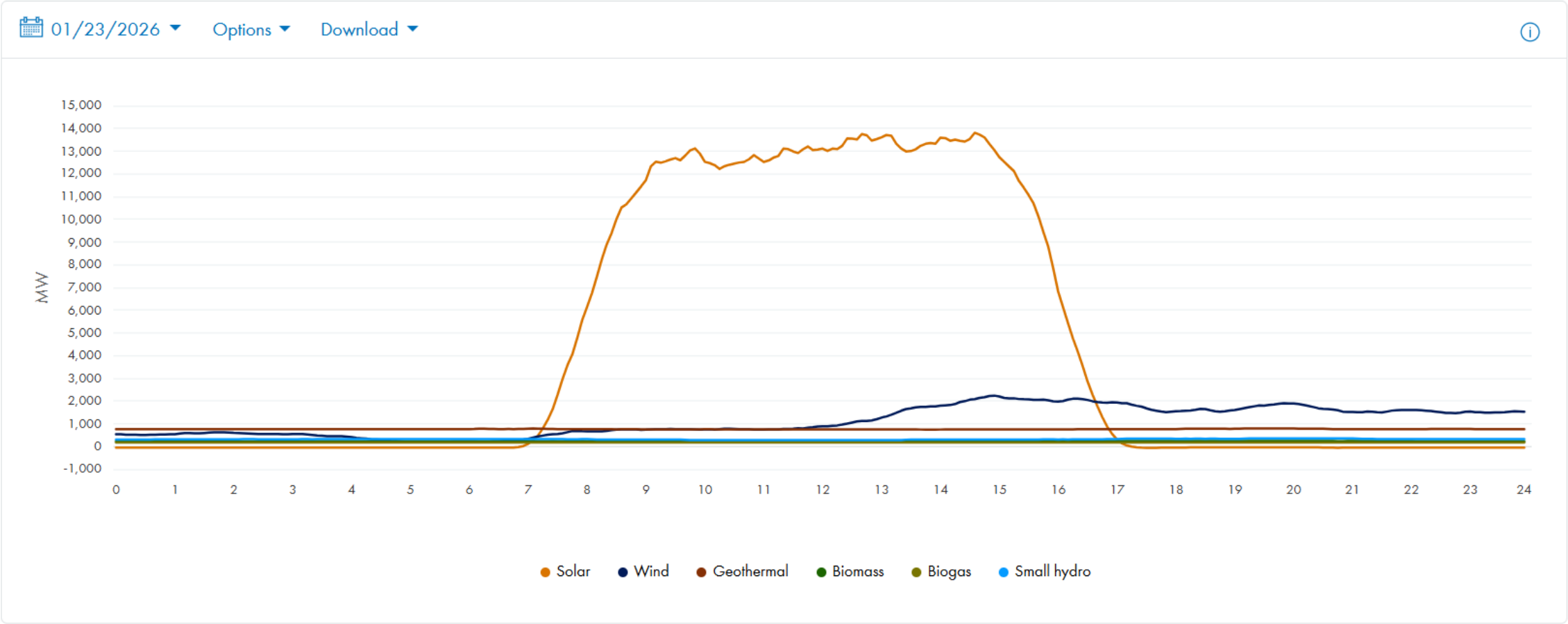
2,679 MW Current wind

Source: Today's Outlook | Supply | California ISO

A Snapshot of California's Energy Mix, Con't

Renewables trend

Power separated by renewable resource, on a 5-minute average.



Source: Today's Outlook | Supply | California ISO

A Just Transition

Barriers that crosscut all clean energy sectors

- Language
- Awareness
- Level of Expertise
- Time to participate
- Cost of, and access to, new technologies
- Need for trusted messengers
- Access to federal, state, or local government programs and proceedings

Resources

How electricity is generated - U.S. Energy Information Administration (EIA)

Advanced Small Modular Reactors - Idaho National Laboratory

How Hydropower Works | Department of Energy

Solar Data Cheat Sheet – SEIA

Thank you

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