

Electric Transmission

Electricity cannot be stored, and must be generated and delivered the moment it is needed. The transmission network conveys electricity from generating facilities to homes and businesses. This network consists of the generating facilities, transmission lines, subtransmission lines, distribution lines, and substations.



Electricity is produced in **generators** at a generating facility. The generator typically consists of an electric conductor such as copper, which spins within a magnetic field to produce electricity. The energy used to spin the conductor can come from natural gas, coal, falling water, nuclear energy, and renewable resources such as wind and solar energy.

Voltage is analogous to pressure in a pipe. Electricity is transported over long distances at high voltages, which minimizes the loss of electricity to heat. At generating facilities, electricity is typically produced at less than 30,000 volts (30 kV). Before entering the transmission lines, the electricity is “stepped up” to high voltages by **transformers** (devices that increase or decrease the voltage on a circuit).

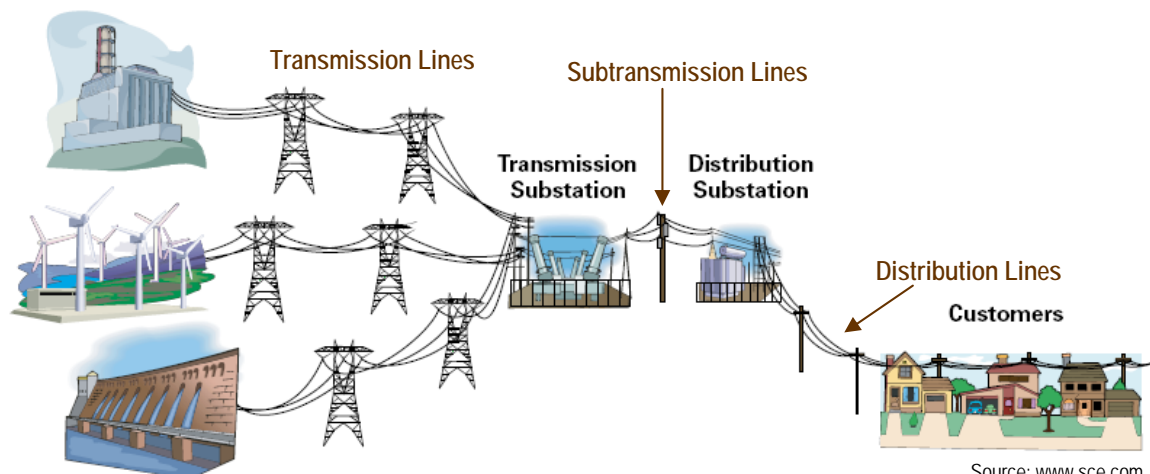
The **transmission lines** carry electricity over long distances, from the generating facility to areas of demand. The electricity in transmission lines is transported at over 200 kV to maximize efficiency. Voltages of 220 kV to 500 kV are typical. Transmission lines are usually attached to large metal frame towers or tubular steel poles.

Subtransmission lines carry electricity at voltages less than 200 kV; typically 66 kV or 115 kV. Subtransmission lines are usually suspended on tall wooden or metal poles. They can also be placed underground.



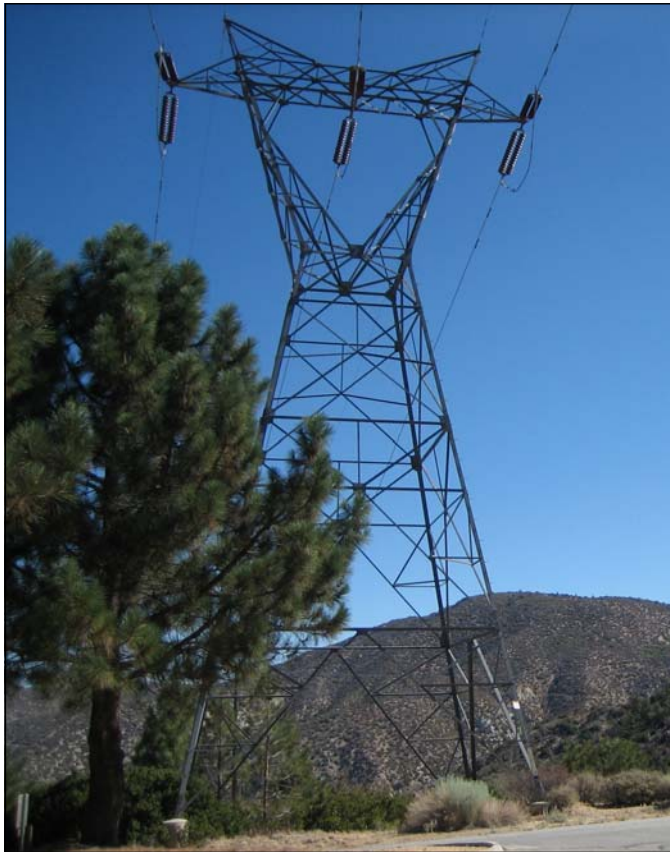
Once electricity reaches the area in which it will be used, it is transferred to **distribution lines**. These lines cover much shorter distances, and are typically energized at 16 kV, 12 kV, or 4 kV. Lower-voltage distribution lines carry electricity to neighborhoods on shorter wooden poles or underground. Transformers located on distribution poles, on a concrete pad on the ground, or underground further step down the voltage before it is ultimately delivered to homes and businesses.

Generating Stations



The electricity in homes is typically 120 volts ($1 \text{ kV} = 1,000 \text{ volts}$). When electricity moves from transmission lines to subtransmission lines to distribution lines, the voltage must be “stepped down” by transformers. This occurs at **substations**, like the one in the photo at right.

Power is most often distributed via **alternating current**, although **direct current** is sometimes used for long-distance, high-voltage transmission.



High voltage AC transmission tower

Direct current (DC): DC current flows in one direction and is rarely used in transmission systems because transformers cannot change the voltage of direct current. Therefore, to use DC transmission, the electricity at a generation facility must first be stepped up to high voltage, converted to direct current, transmitted, then changed back into alternating current to be stepped down for distribution. However, DC is useful over very large distances and between asynchronous grids (because DC electricity does not cycle, it can be used to connect two grids that are not in synch or at the same frequency).

Alternating current (AC): AC current changes direction periodically. A cycle is one full period, where current flows first in one direction and then in the other. In North America, the standard frequency of alternation is 60 cycles per second (60 hertz [Hz]). Most transmission lines transport ac power because electricity is generated and used as alternating current, and a transformer can be used to change the voltage where necessary.



High voltage DC (HVDC) transmission tower.