

Appendix A: A Brief History of the U.S. Gridⁱ

Thomas Edison introduced the first electric power system in New York City in 1882. This direct current (dc) system initially served 59 customers in the Wall Street area at a price of about \$5 per kilowatt hour (kWh).ⁱⁱ It operated at 100 volts and mainly supplied electric lights. By the end of the 1880s, many cities had similar small central stations that each served only a few city blocks.

To the extent that the industry was regulated, city governments performed this function. City governments also became major customers—for street lighting and trolley services—and could extract various concessions in exchange for the right to string wires. Soon, they also became owners. By 1900, municipally owned utilities accounted for about 8% of total U.S. generation. Vigorous debates about the relative merits of government- and investor-owned utilities continued in the U.S. through the 1930s, when federal policies were established that today still favor government-owned and cooperative utilities.

A.1 BEYOND MUNICIPAL BOUNDARIES

The transformer was first demonstrated at scale in Germany in 1891. This innovation enabled the use of relatively high-voltage transmission capable

of carrying alternating current (ac) power over long distances with relatively low losses. In 1896, George Westinghouse began the hydroelectric development of Niagara Falls, transmitting significant power to Buffalo, New York, more than 20 miles away. This inaugurated the practice of locating generators at some distance from load centers and linking them by high-voltage transmission, then using transformers to lower the voltage delivered to ultimate customers.

Since then, engineering research and the development of new materials have enabled the use of ever-higher voltages. In the U.S., ac lines with voltages of up to 150 kilovolts (kV) were in place by 1910, and the first 245 kV line was commissioned in 1922. The invention of the transformer and high-voltage lines allowed private utilities to expand beyond municipal boundaries and take better advantage of economies of scale. Such expansion compounded problems with municipal regulation and led to state regulation of investor-owned electric utilities, generally with the utilities' active support. This trend began with the establishment of regulatory commissions in Wisconsin, Georgia, and New York in 1907. By 1914, 30 states had regulatory commissions, and today all states and the District of Columbia have them.ⁱⁱⁱ

ⁱ Significant portions of Appendix A are taken from U.S. Energy Information Administration, *The Changing Structure of the Electric Power Industry 2000: An Update* (Washington, DC: U.S. Department of Energy, 2000), http://www.eia.gov/cneaf/electricity/chg_stru_update/update2000.html; and Ignacio J. Perez-Arriaga, Hugh Rudnick, and Michel Rivier, "Electric Energy Systems—An Overview," in *Electric Energy Systems: Analysis and Operation*, ed. Antonio Gomez-Exposito, Antonio J. Conejo, and Claudio Canizares (Boca Raton: CRC Press, 2008), 1–50. See also David E. Nye, *Electrifying America* (Cambridge: MIT Press, 1990).

ⁱⁱ Except where otherwise noted, this price and others in Appendix A are expressed in 2010 dollars, using the Consumer Price Index from 1913 forward and the extension to earlier years available at <http://www.measuringworth.org/datasets/uscpir/result.php/>.

ⁱⁱⁱ Nebraska's regulatory commission does not oversee electricity rates because no investor-owned utilities sell electricity in that state.