

The Electric Utility Industry in 1965: At the Pinnacle of Success before the Blackout

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Had it not been for the November blackout in the northeastern United States, 1965 would have been a banner year for the American electric utility industry. Power companies produced a record amount of electricity—at declining unit prices—using the technologically most advanced equipment ever. Wall Street also seemed pleased with the industry, as the prices of bellwether utility companies soared to heights not seen since before the end of the great bull market in 1929. Managers of power companies felt comfortable in the knowledge that they were stewards of a technological system that benefited society. All in all, the industry looked like it was in wonderful shape—that is, before the blackout struck.

Creation of the Industry

When Thomas Edison “invented” the electric utility industry in 1882 by opening the first power station in New York City, he used fairly conventional generating equipment of the day: Large reciprocating steam engines turned dynamos that yielded direct-current (DC) electricity at about 110 volts. The electricity streamed out of the power plant through copper wires and illuminated Edison’s marvelous electric lights in businesses and wealthy homes within a mile radius of the plant. Beyond that range, the electric current deteriorated due to resistance in the wires. Nevertheless, Edison foresaw a city being served by several of his power plants as well as businesses that bought his equipment for self-generation.

But Edison’s paradigm for the power industry did not prevail. Edison’s direct-current system lost out to alternating-current (AC) competitors such as those offered by the Thomson-Houston and Westinghouse companies. By the 1890s, these firms introduced appliances (especially motors) that could use AC, and they demonstrated that

by transforming AC to high voltages, the power could be produced at large power plants and transmitted great distances without severe losses of power. The Westinghouse company, for example, demonstrated the merit of AC by producing electricity from the power provided by Niagara Falls, which was then transmitted at 11,000 volts twenty miles to Buffalo in 1896. Soon thereafter, AC became the norm, and DC systems faded into history.

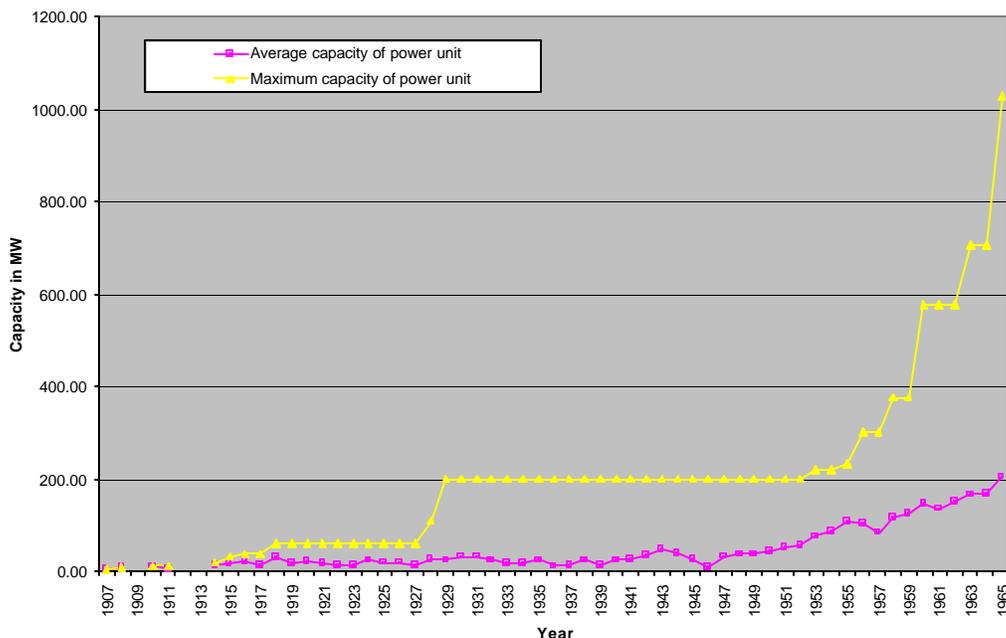
As electric utilities began offering service in cities, some entrepreneurs realized they could exploit AC technology to consolidate several small firms into larger ones. Perhaps the greatest exponent of such consolidation was Samuel Insull, once a secretary to Thomas Edison. Taking over the small Chicago Edison company in 1892, he bought out competitors and introduced AC technologies so he could produce power from larger power plants for sale to more customers in a larger geographical region. By the first decade of the twentieth century, Insull ran a virtual monopoly in Chicago.

Technological and Managerial Principles

Economies of Scale in Generation of Power

Perhaps most significantly, Insull took advantage of economies of scale that he saw in a new form of prime-mover—the steam turbine. Designed in England for powering ships, the steam turbine produced rotary motion directly by having steam pass across wind-vane shaped blades attached to a shaft. Connected to a dynamo (also called a generator), the turbine had many advantages over the traditional reciprocating steam engine: it took up less space, it produced rotary motion directly, it was quieter and vibrated less, and it could be enlarged upon without any apparent limit. In 1903, Insull convinced a reluctant General Electric Company to manufacture a steam turbine that produced 5 megawatts (MW) of power. After a few years of modest success with that machine, Insull installed a 12 MW machine in 1912. Perhaps most attractive was the turbines' ability to produce large amounts of power using disproportionately less material and at lower unit costs. Because the turbines exhibited this so-called economy of scale effect, they could be installed in ever-larger increments and at ever-lower costs per megawatt. Indeed, Insull exploited scale economies in his power company empire, such that by 1929, the largest steam-turbine generator cranked out 208 MW. Other utility

Average and Maximum Capacities of Power Units, 1903-1965

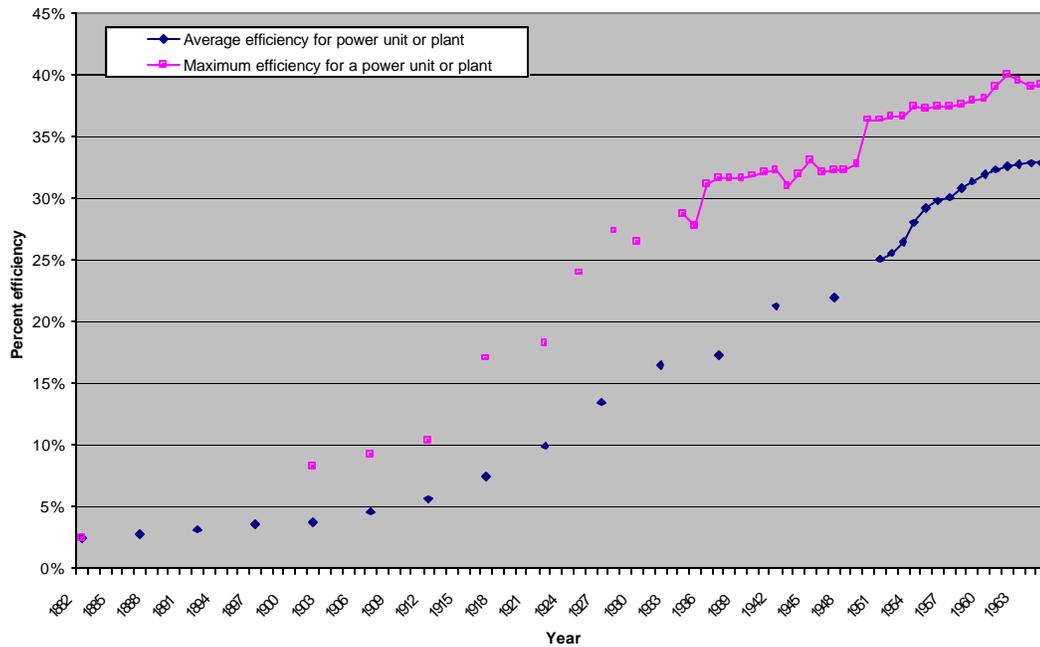


managers followed the example set by Insull, and they ordered power units that reached the “magic” number of 1,000 MW by 1965.

Increased Thermal Efficiencies Too

Beyond exploiting economies of scale in turbine-generator equipment, utility managers in the twentieth century took advantage of boilers and other equipment that could more efficiently convert raw energy (such as coal) into electricity. The key here was to increase the temperatures used in boilers and to build turbines so their metal parts could withstand high-temperature steam. Realizing a market for such machines, manufacturers such as General Electric and Westinghouse employed new metal alloys for boilers and turbines that resisted the corrosion-causing effects of the hot steam. Consequently, thermal efficiencies rose during the next decades. Edison’s New York City plant, for example, converted about 2.5% of the energy from fossil fuel into electricity. That number rose to 4% in 1900 and 10% in 1913 in Insull’s advanced power plants. The trend continued into the 1960s, when the industry’s best power unit converted about 40% of the raw energy into electricity; the average plant demonstrated an efficiency of a few percent less—33%.

Thermal Efficiency for Power Plants or Power Units, 1882-1965



Value of Regulation

Finally, Insull understood the value of regulation as an important management principle that allowed his firm to become huge and successful. While some of his contemporaries viewed government oversight of the electric utility industry with anathema, Insull realized (as early as 1897) that state regulation would allow power companies to win designation as “natural monopolies.” Defined as monopolies that could deliver goods and services more efficiently rather than could a host of competing entities, natural monopoly utility companies would win state sanction to operate in an environment that allowed expansion and use of ever-larger generation technologies. Though regulators would have the final say about the price of power charged by utilities, ensuring that the companies did not exploit their monopoly position, they also would secure the legitimacy and security of power companies as monopolies within specified geographical regions. Moreover, Insull realized that state oversight meant that utilities would be able to gain investment funds more easily than in a competitive environment, because regulators had an obligation to ensure that power companies earned enough money to pay the interest and principle on the bonds. This last feature especially made investors happy with utility promissory notes.

Combination Yields Major Benefits

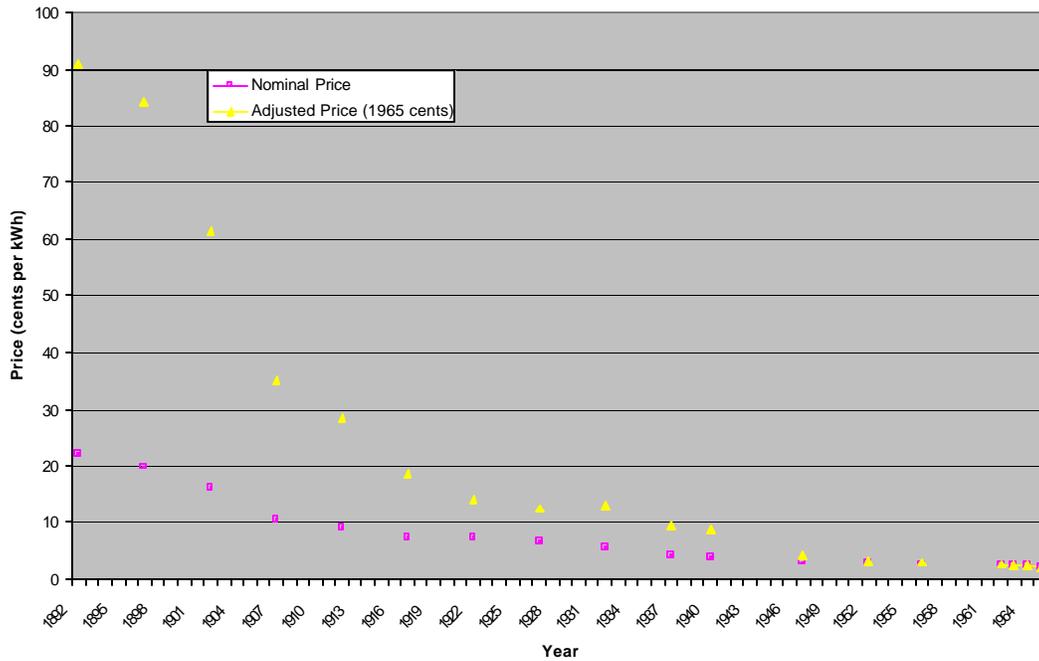
Price of power declines; Consumption increases

The combination of scale economies, increased thermal efficiency (along with other advances in transmission and control technologies), and regulation allowed power companies to produce more power at lower unit costs. Insull realized the value of these factors earlier than most other managers. He also realized that if he could sell large amounts of power to customers who would consume it at times of the day when his firm had plenty of spare capacity, he could increase his profit, even if he decreased the price. (This approach is known as improving the “load factor”--the ratio of the average amount of power produced over a designated amount of time to the peak load occurring during that period.) In 1898, his company earned about 9 cents per kilowatt-hour (kWh) of electricity sold. In 1912, the firm’s average income dropped to a bit more than 2 cents per kWh, yet the company remained profitable because of the increased consumption brought about by the lower prices.

Utility managers around the country emulated Insull, using what is sometimes referred to as the “grow-and-build strategy.” As demand for electricity increased, utilities built new, technologically advanced, and larger power units. Because the unit cost for power declined with these new plants, the companies could decrease the price of power. Lower prices stimulated new and expanded use of power, so the demand for power increased again, creating the need to build more, further advanced power plants in an unending cycle.

By 1965, the strategy yielded an amazing set of statistics: Consumption of power grew at a 12% annual rate from 1900 to 1920; from 1920 to 1965, it leaped ahead at about 7% per year. Such rapid rates of electricity consumption exceeded the growth rate for all energy sources together by a factor of 4 to 5.5 times. As consumption increased, the price of power declined: in 1965 cents, power used by residential customers dropped from about 90 cents per kWh in 1892 to a little more than 2 cents in 1965.

Price of Residential Electricity: 1892-1965



The Human Value of Electricity

Statistics do not tell the entire story, however. The major reason for the rapid escalation of consumption was simply that electricity proved to be a highly versatile source of energy that was highly valued in American society. When factories switched from steam engines to small electric motors for powering machinery, productivity soared, allowing more products to be made at lower cost. On the home front, electricity powered an increasing number of appliances that improved the material standard of living. Despite the effects of the Great Depression, for example, a growing number of people could afford electric refrigerators. Electric radios, ranges and stoves, washing machines, and scores of other appliances that initially were viewed as novelties quickly became necessities in the wired homes of the vast majority of Americans. (Even rural customers began enjoying these appliances after the federal government encouraged electrification of farms and areas outside big cities.) In the 1950s, the number of appliances continued to proliferate in the home, as air conditioners and televisions became popular with the postwar masses. In general, electricity became viewed by most people to be a

commodity that made life more pleasant and more productive. “Live better electrically”—an advertising slogan employed by the utility industry in the late 1950s—should not be viewed cynically as an advertising pitch from selfish hucksters. Rather, it reflected a generally accepted truth about the value of electricity. In this light, one can understand why most utility managers took special pleasure in their work. Not only did they help their companies produce more power at lower rates; they also helped improve the lives of their customers.

1965—A Banner Year

Not unexpectedly, utility companies in the postwar period became favorites of investors. As sales of power increased, so did profits (even as unit prices declined) and dividends to stockholders. Of course, utility company shares had become favorite tools of speculation and exploitation by utility managers of the 1920s; in August 1929, Moody’s average of electric utility stocks peaked at 169.80 (monthly average). The Great Depression and the reorganization of the utility industry in 1935 (with passage of the Public Utility Holding Company Act and the Securities and Exchange Act) caused investors to spurn utility stocks, and Moody’s average for power company securities plummeted to 11.41 in April 1942. But the postwar success of power companies to exploit new generation and transmission technologies gave investors cheer: in 1958, the Moody average stood at 57.96 (an average for the year); in April 1965, it had reached a post-Depression high of 119.57.

To the casual observer, then, the utility industry in mid-1965 appeared to be the picture of success. Manufacturers produced continuously improving technology for generating electricity, and utility companies employed it to benefit their companies, their stockholders, and their customers. What could have been better than this smoothly running electric utility system that provided universal benefits?

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Also see essays written by the author (and by B. Finn) on the history of the electric utility industry, at the Smithsonian Institution's site, Powering a Generation of Change, at <http://www.si.edu/organiza/museums/nmah/csr/powering/>