The first electric power plant capable of bringing electricity into people’s homes, Edison’s Pearl Street Station in New York, served 85 customers within a square mile. His design quickly took off and was duplicated around the country. In 1895 another huge milestone came when George Westinghouse opened the first major power plant that used the newly developed alternating current power systems, which could transport electricity more than 200 miles—a huge improvement from Edison’s one mile radius! Fast forward to 1927 and establishment of the PJW Interconnection, which provided for large-scale distribution of power among three separate companies in Pennsylvania and New Jersey over hundreds of miles, forming the first power pool of its kind in North America.

By 1930 roughly 90 percent of people living in cities and big towns had electricity in their homes. It was easy for power companies to get electricity to groups living close to each other. It wasn’t easy or economical to supply power to rural areas. Only about 10 percent of Americans living on farms or in other rural areas had electricity at that time. The privately owned power companies argued that it would cost them too much money to bring electric lines to farms that were miles and miles apart. They also felt that the farmers would be too poor to pay for the services. President Roosevelt did not agree with this logic, and in 1935 the Rural Electric Administration was established to bring electricity to rural areas. Within four years electricity in rural areas rose 25 percent.54
At the same time utility companies saw the home market as a way to increase demand for electricity. As early as the 1890s, utility companies realized that home use of electricity was an important factor in the distribution of power demand. For centralized plants to be effective in the generation and distribution of electricity, the periods of peak demand (the times of the day when the greatest amount of electricity is used) needed to be distributed throughout the day.

Industry, a major electricity consumer, had their peak periods during the day, conversely, the peak demand for domestic customers fell at the end of the work day and during the evening. So this meant that all of the power produced by a handful of key generating stations capable of making electricity at the lowest cost would be utilized. During periods of the highest demand, secondary and generally less efficient plants would be brought online to provide the additional power needed.

This untapped home market was a catalyst for greater revenues for the utility companies and a much needed means to balance the large capital improvements being made to generation facilities and expansion of transmission lines. But how to reach the residential customer?

The homemaker was the person whom the utilities needed to reach. In 1917 Public Service of New Jersey hired their first home economist, Ada Bessie Swann, to develop a program to educate the homemaker on the benefits and uses of electricity and gas in the home. The concept evolved from simple cooking instructions to a full Home Economics Department by 1924.

Public Service took on a staff of home economists and brought on their first female engineer, a graduate of the Massachusetts Institute of Technology (MIT), to reach the person of greatest influence in the home—the woman. These experts in home economics gave instruction on the improvement of household standards through demonstrations and lectures at clubs and organizations, and radio broadcasts. The intent was to promote home appliances. Over the course of the next two decades, the home economics department created a shift in the use of new appliances from the affluent customer to the growing middle class. They became instrumental in the popularization of the use of electricity, which was previously viewed as expensive and unsafe.

In the 1920s and 1930s, contests and model houses were used to demonstrate the ease and benefits of electricity. Public Service arranged for model homes to be lit with electricity as part of the National Electric Light Association Home Light Contest. Displays at company offices included model kitchens. In 1936 a model house was exhibited in a building on Park Place next to Public Service’s Newark terminal. The exhibit, called The House Practical, was a completely furnished modern home outfitted with electric lighting, cooking, heating, and ventilation equipment. The home was built to demonstrate that use of electricity made a home more attractive and reduced the amount of domestic labor. An advertisement claimed that the house had 80 different uses for electricity and gas. The House Practical had seven rooms, a basement, and a garage with a fully electric utility room, laundry, and kitchen, against a charming painted suburban backdrop. The rooms of the Georgian-inspired

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Public Service kept abreast with the development of new products for the home and improvements to existing products. The company tested, sold, and installed electrical and gas appliances to its customers, leading the market in sales of home appliances. Many homemakers were introduced to the widening array of appliances through classes and demonstrations on cooking and homemaking offered by the utility’s Home Economics Department. In this way the homemaker could learn about the time-saving modern appliances available, domestic science, and household improvements. Commercial offices and advertisements featured company-endorsed products and services.

In addition to sales, electrical companies focused on public relations. They produced publications and brochures, and participated in public events. Reddy Kilowatt, a cartoon mascot with distinctive light bulb nose, lightning bolt limbs and body, and electrical outlet ears, was developed at the Alabama Power Company by Ashton Collins and first used in 1926. He was subsequently licensed and used to promote electricity for more than 30 years by 200 utilities, including PSE&G. In 1940 Public Service used Reddy Kilowatt in a 16-page booklet that showed the homeowner how to plan “Reddy Boxes” (wall outlet) in different parts of the house. PSE&G would continue to publish literature promoting the use of electricity until the energy crisis of 1973-1974. Their efforts were not limited to promotion of gas and electric services, but included promotion of commerce, industry, and agriculture across the State of New Jersey. After all, public relations were as important as promotion and sales. It also encouraged general economic growth in the state, which in turn created new customers.

**ELECTRICAL USE**

Even with all of the promotion surrounding electricity, it didn’t truly take off for use in the domestic market until the 1920s. In areas where electricity was available, many homes were wired and used electricity for light by the end of the decade. By 1940, electrical service was available in 79 percent of homes. As the companies expanded their markets, gas and electric utilities competed for customers and the consumer was faced with choice between the two power sources. Where available, gas became the preferred cooking method by 1930, replacing wood and coal stoves. One development during the Depression years helped the utility companies. In the 1920s middle income families were more likely to invest in automobiles instead of other major goods like home appliances. By contrast, when automobile purchase became more difficult during the slow economic years of the 1930s, households increased spending on appliances.

It is hard to imagine that new houses were generally not built to accept a wide range of electrical appliances until the 1930s; many houses were wired for lighting only. Even with the new homes constructed during the boom years of the 1920s, homes lacked adequate electrical systems capable of handling the variety of new electrical appliances available. To make homes safe for motorized appliances, the National Electrical Code, established in 1897, was revised in 1923 with requirements for new types of wiring and distribution circuits. In 1922, 80 percent of the dwellings in the country had either no electricity or substandard wiring. Two-thirds of the nation’s dwellings were not technologically able to be modernized by the installation of basic wiring for lights and appliances in the 1920s, but by the end of the 1930s, two-thirds of homes had this capability and could be modernized with appliances.
Electricity transformed the home into a refuge of comfort and convenience. No longer did activity stop at night because of lack of light; families stopped congregating at the hearth or by the cookstove to stay warm, and without open flames requiring supervision, children could pursue activities throughout the house. The home reflected the increased leisure time available. Basements were utilized as living space; fathers and sons set up model electric trains, a popular pastime during the interwar years; and families listened to the radio. Even during the lean years of the Depression, use of electric lights, appliances, and motorized toys and tools intensified. The modern electric home emerged as a source of identity for the American family, made possible by larger pools of power.

**GROWTH OF THE INTERCONNECTION**

The cooperative arrangement and technological advancements that made power pooling among PSE&G, Philadelphia Electric Company, and PP&L in the 1920s and 1930s possible set the standard for high-voltage transmission, and exchange of energy between companies and states. It established many of the standards that would continue to be used for the nation’s electrical grid.

Certainly, planning for the demands faced by the utilities was daunting. In 1929 a PSE&G engineer summed up the forecaster’s nightmare by imagining the load requirements if every light in every home were suddenly turned on, if every household appliance were plugged in at the same time, if every factory started up all together, if every elevator in every office and store were running at the same time, and if every electric streetcar started at once, the result would be a load demand three and a half times the amount that all of the generators could supply at full capacity! Of course, this did not happen, but the summary provided an early understanding of the benefits and importance of interconnection with neighboring utility companies.

At the same time Public Service expanded its network of high-tension lines. Between 1923 and 1929, Public Service invested $118 million in transmission improvements. The company constructed a 132,000-volt inner ring through its northern territory, completed in 1928, and formed a connection with the transmission systems of Jersey Central Power & Light, New Jersey Power and Light, Rockland Light and Power (Rockland Electric), and Staten Island Edison. The company’s Transmission Construction Department linked its southern territory with its northern zone in 1929 with completion of a line between the Metuchen and Trenton switching stations. The line from Trenton to Metuchen was completed in a little over six months and provided for “continuity of service and amply protects the entire territory, north and south.”

In the decades between 1930 and 1950, the demand for electricity increased exponentially. During World War II the increase in electrical demand strained supply because of manufacturing for the war effort. This was followed by the postwar boom years and higher private consumer demand. Postwar growth and expansion overwhelmed the electric power industry; construction of new capacity could not keep up with the increasing demand.
The members of the PNJ were also overwhelmed despite the access to the power pool. It was clear that the original PNJ agreement needed to be revised and additional members brought into the Interconnection. By 1952, when the original 25-year agreement was to expire, additional satellite companies had negotiated with the members of the power pool and were reaping the benefits of the pool without investing in its operations. The Operating Committee explored changes to the agreement to improve operating conditions and benefits for all members.

On September 26, 1956, a five-party agreement was signed that added the Baltimore Gas & Electric Co. and the General Public Utilities (four companies operating in the Mid-Atlantic region) to the original three partners of the PNJ. This revision resulted in a new name for the interconnection—the Pennsylvania-New Jersey (PNJ) Interconnection became the Pennsylvania-New Jersey-Maryland (PJM) transmission network. The new arrangement provided customers with further assurance that their power supply would be more efficient and more reliable. It also resulted in a more unified approach and more cooperation among the member utilities for system planning.

Technological advancements, such as automated system controls, also created challenges for the PJM operating and management committees. Sharing the cost of implementing these controls had to be carefully considered and established network-wide if they were to be beneficial for the power pool as a whole. Individual controls on systems might not allow the needed flexibility.
to provide capacity and reserve for the fluctuating needs of the other systems in the pool. As load requirements to supply greater quantities of electricity grew, the PJM responded by increasing its high-voltage transmission, and the Roseland to Bushkill line was increased from 220kV to 230kV transmission. In 1962 the utilities announced plans for an 18-member power interconnection, construction of 600 miles of 500kV transmission lines, and building two new mine-mouth power plants in western Pennsylvania and West Virginia. The plan included the immediate construction of a 500kV East-West interconnection between New Jersey and Pennsylvania and investment in the first of the two power plants, the Keystone Generating Station. The project was described as one of the largest undertaken in the industry.

The PJM expanded during the mid-twentieth century to include utilities located in Pennsylvania, New Jersey, Maryland, Delaware, Virginia, and the District of Columbia, eventually expanding from New Jersey to West Virginia and northern Illinois. As North America’s largest central energy dispatcher, the PJM became an RTO, a regional transmission organization, governed by an independent board that oversees and creates the rules and markets for electricity exchanges.

Across the nation, the electrical system or network of power as we know it had developed into today’s basic form by 1940. Utility-controlled organizations like PNJ, and later PJM, handled every part of the generation, transmission, and distribution of electricity with few technical industry regulations or requirements. Although the utilities were regulated monopolies, they operated independently of other power pools throughout the nation, which meant that system controls were established at will by the utility companies. Within this complicated framework, private companies account for nearly 80 percent of the all of the power sold, through centralized power generation and distribution within regional transmission networks.

We have all heard of blackouts and brownouts and are aware of those appeals, generally made on hot summer days, to reduce electricity usage because of higher than normal demands on the power system. Newscasters and radio announcers ask us to turn down the air conditioning and save electricity so that the system won’t be overloaded and fail, causing a reduction in available power, or brownout, or a total loss of power, known as a blackout.

Regional systems of pooling power and centralized generation have many advantages, such as economy, ability to provide greater quantities of electricity, and shared costs for plant and transmission, but the system is not without the occasional flare. There have been chain reactions where one thing goes wrong, which sets off the next failure that trips another, so that within seconds one small incident creates a much larger series of failures that can shut down power to whole regions.

The first such event, known as the Great Northeast Blackout, happened on November 9, 1965. Although few PJM customers were affected, this was the first large-scale blackout in the United States and would have an impact on trying to prevent such events in the future. The blackout affected the Northeastern states and two provinces in Canada. According to The New York Times, the power outage spanned an area of 80,000 square miles where more than as 25 million people lived and worked. Later estimates would increase the number of people affected to more than 30 million.

A series of power failures that began at 5:27 p.m. Eastern Standard Time, at the height of rush hour, turned into a blackout that lasted for about 13 hours. The greatest impact was to New York, New England, and Ontario, Canada. About 800,000 riders were stuck on New York City subways; trains came to a halt; airplanes were left circling, unable to land; and traffic became jammed. Off-duty policemen, National Guard, and other militiamen were called to duty or put on alert.

The blackout started with a faulty relay at the Sir Adam Beck Station on the Ontario side of Niagara Falls. This failure caused a surge of power south, which overloaded the systems, and automatic shutdowns ensued throughout the electrical grid, causing a massive blackout within a matter of minutes. Staten Island and those portions of Brooklyn interconnected with PSE&G did not lose power.
This was the first major power outage experienced in modern times, and it caused regulators and utilities alike to reassess the power supplies and systems throughout the United States. The PJM power pool provided a useful model of a successful interconnection of independent utilities and systems. The PJM had been designed to allow each member system to remain isolated in case of a major failure of a generator, and therefore few parts of its service area were affected by the 1965 blackout. This was in contrast to the interconnection of the rest of the Northeast, in which the failure of one generator could result in interconnection-wide collapse.

Because of the Great Northeast Blackout in 1965, the PJM took steps to prevent a similar blackout in the PJM region. However, in 1967, less than two years later, the PJM had its first major blackout. At the time three large system improvements—the Oyster Creek nuclear station, Keystone Unit 1, and the Keystone 500kV transmission line—planned to be operational before the beginning of the summer period of high demand, were delayed. The interconnection was entering the summer season with low, if not inadequate reserves. On June 5 an overload of the lines about 17 miles from the Plymouth Meeting substation caused cascading failures that resulted in system shutdowns and a separation of the eastern area from the rest of the interconnection. The event began shortly after 10 o’clock in the morning, and by 3 o’clock in the afternoon 80 percent of the load to the affected area had been restored.

In 1969 and 1970, a different pattern would emerge when demand escalated well beyond load requirement estimates and new capacity lagged behind service dates. One of the most notable events happened on Thursday, July 17, and Friday, July 18, 1969, when exceptionally hot weather and high humidity caused a 40 percent increase in the electrical base load over the requirements of the previous week of cool weather. The first day, to stabilize demand, all nonessential station use was cut and customers voluntarily reduced power usage. Friday began with a 10 percent reduction in available power because of equipment failures. The curtailment measures of the previous day were repeated, however, and radio and television appeals went out to customers asking them to reduce their electricity usage further. By the start of the afternoon, the interconnection lost power from two units, followed by loss of one its 230kV tie lines. Restoration took between 10 and 30 minutes and curtailment was canceled later that day.

On August 14, 2003, the country experienced its largest blackout. Power was interrupted across parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont, and the Canadian provinces of Ontario and Quebec. It was estimated that some 50 million people were affected by the blackout. Most had power restored within hours, but it took two days to restore power in some areas of the United States, and parts of Ontario continued to have rotating blackouts for as long as two weeks. As with the Great Northeast Blackout of 1965, most of the PJM transmission operations area remained operational and was not affected by the blackout. The outages did cause grid separation, and a small portion of the PSE&G New Jersey zone electrically separated from the Eastern Interconnection.