Thomas Edison

At the end of the nineteenth century, electrical power was still in its infancy. By 1880, the primary uses for electricity were to drive the growing telegraph system around the world and some public arc lighting projects for streetlights. Telephones were new and slowly being adopted.

The electrical technology needed to mature a bit more. The leading force in bringing electricity to market was Thomas Edison, one of our greatest inventors. He also invented motion pictures, sound recording and dozens of other useful items.

Edison's style of inventing was to figure out something the world needed, then go into his lab and try things until he had a solution. In one case, he tried more than one thousand experiments before he solved the problem. Edison was not a believer in mathematics or systematic science, instead he believed in hiring legions of smart people to try lots of solutions.

Edison was the first person with a vision for how electricity might be deployed. He wanted to bring electricity into people's homes where they could replace open flames with safe electric lights. He also realized that other uses for electricity would quickly follow. He set about creating each component required starting at the light bulb and working back towards the steam engine turning the dynamo. When he was done, he had a way to generate and distribute power to homes, then to meter usage for billing and finally to turn lights on and off at will. He is the person who specified 110 volts for consumer electricity – that was 100 volts plus 10% for voltage loss.

Edison was a great inventor but he was not highly skilled with electricity. He filled in the components in his vision with ideas he understood. Edison had learned using batteries that produce direct current. Direct current is when the voltage in the circuit stays constant and the current flows in the same direction. We still use DC today in cars, cell phones and flashlights – anywhere you use a battery.

Unfortunately, DC power does not travel well. Long runs from the generator to the consumer resulted in substantial losses of energy as the voltage drops with distance. For example, if the power leaves the generating station at 100 volts and drops 50 volts in transit, only half of the power is available for use at the other end.

The Edison system simply could not send power very far and would require a generating plant roughly every mile. Furthermore, the amount of power it could deliver would be quite limited which meant that it would not be possible to have large-scale electrical machinery in factories.

There is another way to generate power called Alternating Current or AC. Here the voltage constantly changes direction many times each second. AC current does a funny thing when it powers an electromagnet: it causes the North and South poles to change places at the same frequency as the AC current's voltage changes.

This varying magnetic field is very useful. If you place a second electromagnet next to the AC connected one, the changing magnetic field induces electricity in the second electromagnet. Depending upon the way the magnets are designed and connected, the voltage coming out of the second magnet could either be much high or lower than the original AC voltage. This resulting device is called a transformer because it transforms voltages. And it is very important.

Let us re-visit the power distribution problem where the DC system lost half of its power. If an AC system is used, instead of transporting the electricity at 100 volts, we can use a transformer to turn it into a much higher voltage such as 10,000 volts. The loss of 50 volts is now almost unnoticeable. At the consumer's end, a second transformer can step the voltage back down to the standard levels.

Using AC, power can be generated in one location and consumed hundreds of miles away with very little loss. It is also possible to create a huge grid where many power plants contribute power and many consumers use power. In fact, some large bits of machinery can consume huge amounts of power from the grid. If this sounds familiar, it is. It is the way our electrical grid works today.

So our story is about the inventor of the modern electrical grid.