Answer Key

* The **grid system** coordinates several sources of energy production so that a particular home may actually receive electricity that came from a

1. List FIVE possible sources of energy production: nuclear, hydroelectric, fossil fuels, wind, solar.

* **US Grid System**
* **AC Grid System**: what does “AC” stand for? Alternating current
* **Neighborhood** 🡪 What type of power plant is used in this neighborhood? nuclear
* **European Grid** 🡪 List the SIX sources of energy production: solar, thermal, photovoltaics, wind, hydroelectric, biomass, geothermal
* **Peakload vs. Baseload**

Demands for power vary greatly during the day and night. These demands vary considerably from season to season, as well.

For example, the highest peaks are usually found during the summer daylight hours when air conditioners are running.

* **Nuclear & Fossil Fuel Plants**

Nuclear and fossil fuel plants are not efficient for producing power for the short periods of increased demand during peak periods. Their operational requirements and their long startup times make them more efficient for meeting baseload needs.

* **Hydro, Wind & Solar Power**

Since hydroelectric generators can be started or stopped almost instantly, hydropower is more responsive than most other energy sources for meeting peakload demands. Water can be stored overnight in a reservoir until needed during the day, and then released through turbines to generate power to help supply the peakload demand. What TWO other power sources work well as PEAKload? Wind, solar

* **Why the Grid?**

Mixing of power sources offers a utility company the flexibility to operate steam plants most efficiently as baseload plants while meeting peak needs with the help of hydropower. This technique can help ensure reliable supplies and may help eliminate brownouts and blackouts caused by partial or total power failures.

* **DEFINE “dropout” 🡪 *momentary loss of power***

“brownout” 🡪 *drop in voltage that doesn’t run appliances (burns them out)*

“Blackout” 🡪 *total loss of power (most severe power outage)*

* **2003 Blackout**

In August, 2003, a series of mis-steps led to a catastrophic blackout in a large portion of the eastern and mid-western United States. That it occurred on a very hot day meant maximum discomfort for many who lived through the experience, and was in part responsible for the problem itself.

The American continent was electrified, but in electric utility “islands.” EXPLAIN:

Cleveland got its electricity from the Cleveland Electric Illuminating Company,

Columbus from Columbus-Southern Ohio Electric Company,

Pittsburgh from Duquesne Power,

Newark, New Jersey from the Public Service Electric and Gas Company,

New York from Consolidated Edison (known as Con Ed), and so forth. Most utilities were self-contained monopolies.

Gradually, inter-connections were extended. By the nineteen-sixties, there were many more high-tension transmission lines, and so many more interconnections. The utilities were still monopolies, but even in the East, electricity could be sent long distances.

Interconnections are good, because they bring stability to the system.

An interconnected system can reroute energy where it is needed, protecting against problems when a generator is lost. However, the larger system also brings complexity**.** The added complexity makes it difficult to respond to catastrophic failures, especially in the times before computers were widely used.

In many developing countries, electricity may fail catastrophically in specific areas because demand exceeds supply or because of trouble with the distribution system (these troubles may even be due to sabotage in some cases).

The 2003 East-Midwest blackout affected about 50 million people in the northeast, the midwest, and Canada.

* **Populations Affected** 🡪 according to the table, which blackout has affected the most people? Northeast Ontario Midwest Electricity is not easily stored and is used essentially as it is generated. This implies that there is a constant dance of supply and demand
* **Note** that the August, 2003 blackout was an unprecedented event both in terms of the population affected and the loss of load. The grid was built over a long period of time, and many of the parts of the grid are quite antiquated. Restructuring the grid is needed.
* **So What Happened?**

The prolonged heat wave was taking its toll. The Task Force examined FirstEnergy records and found that actual measured voltage levels on the transmission system on August 14 were below 100% starting early in the day.”

* The **loss** of the transmission lines as the afternoon progressed led to more and more difficulty in maintenance of reactive power demand. Load reserves were gone by 4 o’clock, and the overextended system soon crashed, dragging the rest of the region along with it.
* **Relays** (transfer electricity)

Relays sense even small power surges and shut down automatically in “cascades,” carrying large swaths of the grid along. This is both good and bad; good because it isolates the systems’ generators, transmission lines, and substations in small failures;

bad because it exacerbates the crash, shutting down even if the relay is far removed from the actual problem, in large ones.