

Chapter 11 Review

- Steam engines harnessed stored chemical energy to produce mechanical energy but had two defects.
 - Mechanical energy only available locally.
 - Steam engines were big, hot and caused much air pollution.
- Being able to generate energy in a central location and easily transport it to where it could be used, helped mitigate the second problem.
- Faraday began his investigation during a review of earlier experiments (an important step in the scientific method).
- In a demonstration of the circular lines of force around a current-carrying wire, Faraday constructed a primitive electric motor.
- Faraday conducted many experiments trying to find a way to produce a current with a magnet.
- He first discovered (around the same time as Joseph Henry) that a changing current in one wire can induce a current in a nearby wire.
- He then discovered that moving a magnet near a coil of wire induced a current in the wire.
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- He first discovered (around the same time as Joseph Henry) that a changing current in one wire can induce a current in a nearby wire.
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- Faraday combined his experimental results into a theory of electromagnetic induction.
- Faradays theory started by imagining magnetic lines of force in space.
- The theory of electromagnetic induction can be stated as changing lines of magnetic force can induce a current in a wire.
- Faradays experiments showed that an electric current is produced when a conducting wire is moved relative to a magnetic field. This phenomenon was used to develop the dynamo, now called the electric generator.
- Hippolyte Pixii invented the commutator which produced a pulsating direct current instead of the usual alternating current.
- Widespread use of electricity was stalled for decades due to the need for large quantities of affordable electricity.
- Efficient electric generators were finally developed in the last quarter of the 1800s.
- The steam turbine still provides most of our electricity.

- While the electric motor turns electrical energy into mechanical energy, the electric generator does the reverse, it turns mechanical energy into electrical energy. The Hyperphysics site has some examples of AC and DC motors and an AC generator (a DC generator would have a commutator similar to the one in the DC motor picture). If you did not see the back-to-back generator demonstration, check out this video.
- The mechanical-energy source for the steam turbine is the steam. The energy for the steam comes from many sources (e.g., coal, oil, uranium).
- Although the electric light bulb was essentially invented earlier, Edison is widely credited with the first practical version.
- By creating a low-current light bulb that could be used in parallel (so that one could be switched off at a time), Edisons light bulb became a practical success.
- The light bulb, along with Edisons power distribution system led to the electric age.
- Initial electric generation and distribution was DC
- AC power generation was easier because no commutator is required.
- AC power transmission is more efficient because high voltage / low current results in less power loss during transmission and it is easier to change the voltage of AC for the journey.
- Energy consumption has exploded over the last 100 years. The average US resident is responsible for 3.7106 times as much energy as is required for subsistence.
- Two-thirds of the energy consumed is wasted:
 - Much is wasted because of the 2nd law of thermodynamics.
 - Much waste is due to inefficient vehicles and appliances.
- Most of our energy comes from stored chemical energy (fossil fuels) which are becoming scarce and cause pollution and global warming.
- Nuclear energy is one option, however, no solution exists to the problem of long-term storage of waste.
- Conservation is one way to save energy resources.
- A fossil-fuel power plant tops out at 38% - 40% due to mostly unavoidable problems such as the second law and the need to transmit power and fuel long distances.
- Nuclear power tops out at around 30% efficiency.
- Solar energy may be able to replace much fossil-fuel derived energy used today.
- Wind energy is also a viable alternative energy source.
- Hydroelectric power is attractive because it does not cause pollution and is not limited by the second law. It is also somewhat renewable as rain continues to fall.