# ELECTRICITY

## WHAT IS IT?

On June 10, 1752 Benjamin Franklin flew a kite in an electrical storm and got himself a shock. But it wasn't until New Year's Eve of 1879 when Thomas Edison put it to replicable use. He demonstrated how to channel electrical energy and move it along a wire to fire up a light bulb. Things haven't been the same since.

Now electricity runs much of the modern world. As copper electrons are pulled or pushed out of orbit they flow to the closest atom that will accept them, which in turn pushes out other electrons to do the same thing. Copper is a particularly good conductor, but not the only one. This flow of electrons is electricity – which is the power used to run our homes, offices, world economy, and increasingly our transportation systems.

We often hear the message to "conserve energy" from our electricity providers. But we must remember that electricity is only one kind of energy. Thermal energy is another type of energy that is discussed in a companion article. Conserving thermal energy is often overlooked when it can be an important strategy to conserve electricity, too.

## HOW IS IT MADE?

- Hydropower generates electricity from falling water that spins generators that get electrons to leave their stable orbits and flow along conductors.
- Combustion of fossil fuels such as coal, natural gas, or diesel is another way to create electricity as the high temperatures of combustion are used to make steam or hot gasses that drive generators to spin electrons into a current.
- Fuel cells create electricity through combustion or chemical processes that create both electrical and thermal energy.
- Photovoltaic (PV) panels use sunlight to create electricity. Solar cells in the panel use positive and negatively charged silicon layers to create an electric field. Photons of sunlight nudge electrons free such that they push electrons creating a flow into metal conductors. Each panel has many of these cells – enough to create electricity that can be driven by sunlight.
- Wind turbines use flowing air through propeller blades to drive generators.
- Wave energy is another type of wind energy. Winds cause waves that create an up and down motion that can drive pistons to spin generators.
- Tidal energy generators use the flow of waters back and forth as the moon shifts ocean mass back and forth. These flows can also be used to spin turbines to create electricity.
- Electricity can be stored by shifting it to other forms of energy
  - Batteries use chemical processes to hold and re-release electrical charges.
  - Renewable electricity generation sources such as wind and solar can store excess energy by pumping water above hydroelectric dams where it can be tapped when electrical demand outstrips supply.
  - Excess electrical energy can be stored as hot water or ice to pre-heat or pre-cool thermal demands.
- Creative use of different forms of energy whether electrical, thermal, or chemical are key to maximizing the potential for energy efficient systems to use in industrial symbiosis projects. For example, carbon dioxide emissions from combustion can be redirected to greenhouses, where extra carbon increases plant growth. Or thermal energy in wastewater that results from domestic hot water going down the drain, can be recaptured and used to pre–heat tomorrow's showers, thus reducing demand for electricity from other sources.

## OPPORTUNITES FOR INTEGRATION

- Combine renewable energy generation with heating and energy conservation.
- Support decentralized renewable energy generation to strengthen local economies.
- Use biomass power generation to reduce hazardous forest fuels.

## DESTINATION/FATE

- When electricity is created it needs to be delivered to be useful. We typically use an electrical grid of tall towers and large wires to guide the flow of electrons throughout the regional grid. This method is widespread but inefficiencies of this approach causes losses of about half of the electricity generated. Thus if electricity is created miles away from where it is used, there are substantial loss of potential supply.
- Alternating current, where the polarity of the electrical flow is constantly cycling, (AC) is also less efficient than direct current (DC).
- These two characteristics of the electricity delivery are important when considering industrial symbiosis.
  - Electricity generated and used on site can be much more efficient than electricity delivered by the grid.
  - And if that on-site generation is kept as direct current (DC) then even more additional efficiencies can be achieved.

## CONCERNS

- Each of these methods of electrical generation have different advantages and disadvantages that need to be considered when selecting which option to use.
- Non-renewable energy sources such as fossil fuels, are finite (meaning we can run out) but even more alarming, they can emit pollutants that rock the world.
- Renewable electrical sources should be preferred if possible, although PV panels may have end of life disposal costs