CLASS 3 OUTLINE

Coal Fired Power Plants And Demonstration Of An Electrostatic Precipitator (With PEPCO Representative)

I. Review of Classes One and Two

- Briefly discuss home energy audits prepared by the students following the first class.
- Briefly discuss what the kids learned last week about air pollution. Note that much of our electricity is generated by burning coal and briefly discuss the types of pollution generated by coal fired power plants, including sulfur dioxide (SO2), nitrous oxides (NOx), carbon dioxide (CO2), and particulate matter.
- Briefly review the cap and trade program to remind the students of what they are working towards. Point out that the cap and trade program currently just deals with the SO2 problem.
- Key Point: Many sources of pollution, such as power generation, are necessary parts of human life. Therefore, we need to figure out how to minimize pollution even if we cannot totally eliminate it.
- Introduce Colin Danville, a senior engineer at PEPCO

II. Presentation by Colin Danville

- Twenty to thirty minute presentation on how power is generated, the various types of pollution generated by power production, and how power plants try to reduce pollution.

III. Pollution Control Devices Using Sulfur Dioxide and Particulate Matter as Examples

A. Particulate Matter Control Options
- electrostatic precipitator
- cyclones
- filters or baghouses
- capitalize on reduced demand due to conservation to allow for decreased production

B. Sulfur Dioxide Control Options
- use low sulfur coal
- scrubbers/flue gas desulfurization (wet or dry):

-use chemical reactions to absorb SO2 from the flue gas, producing either a wet or dry sulfur-containing byproduct. If the byproduct is dry it can be removed with an electrostatic precipitator or filter just like particulate matter.

- capitalize on reduced demand due to conservation to allow for decreased production

- cap and trade:
  -in order to meet a government-imposed pollution limit, use any of the above options to reduce the amount of pollution emitted by the power plant so that the plant can sell excess pollution allowances. Alternatively, buy pollution allowances from another plant that already has reduced the amount of sulfur dioxide it emits.

IV. Demonstration of an Electrostatic Precipitator

A. Introduction to Static Electricity

- Demonstrate the principle of static electricity using balloons and pepper flakes. When the kids rub the balloons on their clothes, the balloons build up an electrical charge so that when they are held over the pepper, the pepper flakes stick to them.

- Discuss with the kids what types of air pollution they think static electricity might be able to control (*e.g.*, particulate matter or SO2 that has been absorbed into a dry byproduct after use of a dry scrubber)

B. Building an Electrostatic Precipitator.

- Demonstrate at the front of the class how particulate matter (represented by paper punch holes) spews out the top of a smokestack (represented by a clear plastic tube used for protecting fluorescent lights), when a hair dryer blows air over the top of the tube. As an aside, discuss the Bernoulli effect that causes the punch holes to rise in the first place.

- Discuss the effect of static electricity and how we might use static electricity to prevent air pollution from coming out of the "smoke stack."

- Create an electrostatic precipitator by building up a charge of static electricity inside the plastic tube by rubbing a plastic bag attached to a coat hanger along the inside of the tube.

- Demonstrate how the paper punch holes stick to the inside of the charged plastic tube instead of spewing out the top when the hair dryer is turned on. Although some pollution still escapes, much of it is retained in the tube due to static electricity.

V. Conclusion

- Revisit how companies can use pollution control devices as one of many methods of complying with air pollution limits imposed by the Clean Air Act. For example, if the Clean Air Act only allows a company to emit 10,000 tons of SO2 per year, the company

can comply with the law by encouraging conservation to reduce the amount of power that needs to be produced (and hence the number of tons of SO2 emitted), using materials that emit less pollution such as low sulfur coal, installing pollution control devices, or trading pollution allowances with other companies.