

# Energy to Burn

## Understanding Waste to Energy

### Objectives

Students will be able to understand that some waste material can be burned to generate electricity.

### Web-Directed Research

These activities correlate with the Keep America Beautiful “Clean Sweep U.S.A.” web site targeted to grades 6-8, and are designed to expand on the objectives in this lesson. The web site can be found at [www.kab.org/cleansweepusa](http://www.kab.org/cleansweepusa).

1. Define the difference between “**incineration**” and “**waste to energy**”. Describe the processes in a waste to energy facility.
2. Find out how much energy is generated nationally. What percent of our energy comes from waste to energy? What are two other specific facts about this form of solid waste management (statistics, regulations, costs savings, impact on recycling, etc.)? Identify two career paths that might involve energy production. Have students report back.
3. Find out if there is a waste to energy facility nearby. If not, where is the closest one? Does any of the community’s waste go there? Find out how air emissions are handled and how and where ash is disposed. Who regulates and who monitors the facility? Why might a community chose waste to energy?

#### Web sites to consult:

- U.S. Environmental Protection Agency “Terms of Environment” (<http://www.epa.gov/OCEPAt/terms/>) and state municipal solid waste data (<http://www.epa.gov/epaoswer/non-hw/muncpl/states.htm>)
- Onondaga County Resource Recovery Association (<http://www.ocrra.org/WTEtour1.html>)
- Integrated Waste Services Association ([www.wte.org](http://www.wte.org))
- The Solid Waste Association of North America (<http://swana.org/>)
- Environmental Career Organization ([www.eco.org](http://www.eco.org))
- Environmental Jobs and Careers ([www.ejobs.org](http://www.ejobs.org))
- Web site of the City or County government that handles solid waste

### In-Class Activities

#### Method

Students will observe a demonstration of how a turbine is turned by steam. They will then calculate how much energy could be produced by burning municipal solid waste.

#### Materials

a coffee can, water, hot plate, pinwheel (toy wind mill), safety goggles, pot holder

#### Vocabulary

combustible, energy recovery, incinerate, non-combustible, refuse derived fuel (RDF), solid waste management, waste-to-energy

#### Procedure

1. Refer to the "Teacher Backgrounders" on the Keep America Beautiful web site ([www.kab.org/cleansweepusa](http://www.kab.org/cleansweepusa)) for more information and a diagram on the waste-to-energy process.
2. Explain that solid waste management addresses the question, "What do we do with our trash?" There are five primary management options. Depending on the particular waste item, it can be reused, recycled, composted, burned, or landfilled. Burning solid waste, called waste-to-energy, reduces its volume and creates energy in the process.

Energy has many forms, such as heat, light, and movement. Energy can be stored, and it can change from one form to another. In this demonstration, heat energy will be converted into energy which creates motion.

Most of the electricity we use is produced by burning fossil fuels, natural gas, or heat produced in nuclear reactions. The heat produced in electric power plants is used to heat water and create steam. The steam then causes a turbine to turn, which generates electricity. In waste-to-energy facilities, waste material is burned instead of fossil fuels to produce electricity.

3. Explain that you are going to demonstrate how heat energy can be used to produce steam which can then turn a turbine to generate electricity. Make sure you are wearing safety goggles and follow all safety procedures required.
4. Put approximately one cup of water in the coffee can.
5. Punch a small hole in the lid.
6. Tape a windmill toy (pinwheel) to the side of the can so that it will catch the escaping steam and spin.
7. Place the coffee can on the hot plate.
8. Watch the windmill spin. Be sure that the students understand that in a waste-to-energy facility waste material would be burned to generate the heat and that the turbine would be connected to an electrical generator.

### **Assessment**

Students will define waste-to-energy. Students will research to determine if waste-to-energy is being used in their community and/or state.

### **A Waste-to-Energy Challenge**

Every year, each of us is responsible for about 1 ton of garbage. One person's yearly garbage fills about 27 large garbage cans. When 1 ton of garbage is combusted in a waste-to-energy facility, we recover 550 kilowatt hours of energy. If electricity costs 7 cents per kilowatt hour, how much is the energy contained in 1 ton of garbage worth? [Answer: \$35.00]

NOTE: This lesson is adapted from materials published by the North Carolina Cooperative Extension Service. Used with permission.

### **Standards of Learning**

The North American Association for Environmental Education (NAAEE) Guidelines for Excellence in Environmental Education can be found at <http://naaee.org/npeee/learnerguidelines/8th.html>. The Guidelines for Learning which correlate to this lesson are: Strand 1 A, C, F, G; Strand 3 A, B, C; Strand 4 A, B, C, D.