

Name:

Date:

Class:

## Connecting to the Big Picture Handout **Answer Key**

### **Topic: Air Quality and Energy Use/Development**

Follow the instructions below; then answer the *Reflection Question*.

In this activity, we looked specifically at emissions from vehicles, but the extraction\* and use of fossil fuels can lead to many other air quality impacts as well. Describe a potential impact on air quality related to either the extraction or use of each of the three fuels below and explain how that impact could occur.

Hints are provided to help you reach an answer, but many correct answers exist for each fuel and you do not have to respond to the questions posed in the hints.

\*Essentially, extraction means how we get the raw material out of the ground, such as mining in the case of coal.

### **Example** (using today's activity)

*Oil is refined to make gasoline that is combusted in vehicle engines, which generates pollutants that can affect the environment (such as carbon dioxide and climate change) and human health (such as nitrogen oxides).*

**Natural gas** (Hint: Natural gas is mostly made of methane, which is a powerful greenhouse gas. In addition to burning natural gas, what if it were to leak from a pipeline, for example?)

*Example 1: Leaking methane from pipelines or wells increases the total methane in the atmosphere, and because it is a powerful greenhouse gas that enhances the warming occurring as part of climate change.*

*Example 2: Sometimes on oil/gas pads you see "flaring," which is when companies burn off excess gas instead of just venting it. The idea is that the emissions will be less harmful if they are completely combusted to CO<sub>2</sub>, rather than the mix of methane and hydrocarbons they began as. However, the combustion at these flares is not always perfect and sometimes incomplete combustion still occurs, resulting in VOCs and carbon monoxide being added to the atmosphere.*

**Oil** (Hint: What do you think causes that "gasoline smell" when you pump gas for your car? Could it be harmful to humans at high levels? Does it include any "ingredients" of ozone?)

*Example 1: That gasoline smell is VOCs (specifically BTEX compounds: benzene, toluene, ethylene and xylene), which can be harmful at high concentrations or if with low-level exposure over an extended period of time; they are also considered carcinogens. In addition to the effects on humans, the VOCs in gasoline can contribute to ground level ozone formation.*

*Example 2: Oil refineries tend to be a concern to surrounding communities because the activities required to refine oil into gasoline release many VOCs (hydrocarbons) that are harmful to human health.*

**Coal** (Hint: Think about the shipping of coal around the world. Sometimes coal mined in the U.S. is shipped to China for power plants. Might air quality impacts be associated with shipping activities?)

*Example 1: Shipping coal great distances adds to its greenhouse gas footprint. Not only does the burning of the coal generate CO<sub>2</sub> emissions, but its transport also results in more greenhouse gas emissions.*

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*Example 2:* The use of coal in power plants results in emissions and was the primary cause of acid rain issues in the U.S. in the 1970s and 1980s. Coal with sulfur was being burned, which resulted in sulfur oxide emissions (such as  $\text{SO}_2$ ). The sulfur oxide dissolved into water droplets in the air, acidifying them and resulting in acidic rain. The implementation of control technologies to remove the sulfur oxides from the emissions was very successful, and acid rain is no longer a big problem.

### Reflection Question

In a brief paragraph, explain one way in which fossil fuels have a positive impact on your daily life and one way in which they have a negative impact on your daily life. (Write on the back of this sheet.)

#### Positive examples:

- Combusted to generate electricity
- Enables transportation of goods and people
- Enables the creation of petroleum products (plastics)
- Modern civilization was built on fossil fuels

#### Negative examples:

- Poor air quality in high-density cities due to traffic
- Power plant emissions into the atmosphere
- VOCs contribute to ground-level ozone formation
- Odors from refineries and oil and gas extraction impact quality of life
- Politics of energy development (for example, political fights in the U.S. about whether or not to develop certain regions)