

Activity 5.1: Group B Transportation Handout

How do we get around?

People in the United States get around in many different ways – buses, cars, trucks, bikes, trains, planes, skateboards, roller skates, skis, boats, and foot (to name a few). Many of these forms of transportation lead to carbon dioxide emissions. In fact, transportation emits about one third of greenhouse gas emissions in the United States (second only to electricity generation in power plants). Most of these emissions are related to personal cars, trucks, and plane rides, and some of these emissions are from commercial trucks and planes.

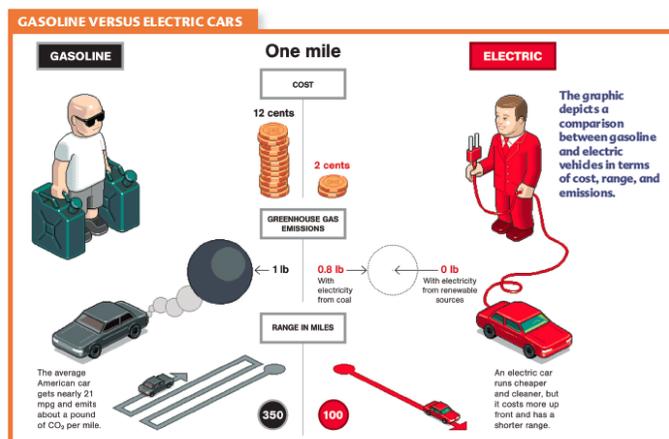
Transportation in vehicles with combustion engines

Most emissions from transportation come from our use of cars, trucks, trains, and airplanes with combustion engines. Most of these vehicles use non-renewable fossil fuels like gasoline (which comes from petroleum) or natural gas, and some use renewable resources like biofuels. Combustion engines work by burning gasoline. Gasoline molecules have energy rich C-C and C-H bonds that contain stored potential chemical energy. When the gasoline burns, the atoms from the gasoline molecules are rearranged into new water and carbon dioxide molecules. When this oxidation happens, the stored chemical energy is transformed to motion and heat energy, which make the car run. Some engines burn biofuels or natural gas instead of gasoline, but the basic mechanism is the same, because all of these fuels contain energy-rich C-C and C-H bonds: these materials are burned to make the vehicles run.

Transportation in electric vehicles or hybrid vehicles

Some vehicles' engines are powered using electricity instead of burning fossil fuels. Most of these cars store chemical energy in batteries that can be used and then recharged. The chemical energy in the battery is extracted, transformed into electrical energy, which is then transformed into motion energy that makes the motor run. When these batteries run out of energy, they can be recharged.

Electric engines can still contribute to carbon dioxide emissions. Even though there are no fossil fuels (like gasoline) burning inside the engine, the electricity that charged the battery was generated at a power plant, and then transported to the charging location through cables



and wires in the “grid.” Because most power plants in the United States use coal and natural gas to generate electricity, it is likely that the energy used to power electric cars causes carbon emissions indirectly.

Hybrid vehicles used both combustion and electric engines. They also have an internal generator that converts motion energy from the car (when the brake is applied) into chemical energy that is stored in the battery.

Transportation on foot or bike (or anything human-powered).

Walking, running, riding bikes, skiing, skateboarding, or roller skating are all forms of transportation that are powered by the chemical energy stored in our bodies. This chemical energy is stored in the C-C and C-H bonds of high-energy molecules, like fats and carbohydrates. When we move, cellular respiration in our bodies deconstructs these large macromolecules and rearranges the atoms into new molecules, like carbon dioxide and water. When the carbon atoms from the fat molecules recombine with oxygen to form carbon dioxide, energy is released in the form of motion and heat, which is how we move our bodies. This energy can then be used to pedal a bicycle or push a skateboard. When we move, the carbon dioxide and water vapor that result from cellular respiration are exhaled through our lungs, and go into the atmosphere pool. Even though there are carbon emissions associated with these forms of transportation, the emissions are much less than using combustion or hybrid vehicle engines.

How much carbon dioxide do we emit when we move one mile?

When we travel one mile using different forms of transportation, we emit different amounts of carbon dioxide. The most efficient form of transportation in terms of carbon dioxide emissions are walking or biking. Some forms of public transportation like buses and subways that transport many people at once are also relatively low in carbon emissions. The types of transportation that emit the most carbon dioxide are engines that require a lot of energy to power the vehicles, like airplanes and solo-driver cars.

