

Energy Systems Environmental Impacts

Biofuels: Biomass, Ethanol and Biodiesel

On the surface, biofuels look like an ideal energy solution. Since plants absorb carbon dioxide as they grow, crops could counteract the carbon dioxide released by cars. They are also renewable, and can be planted to replenish supplies.

Unfortunately, it's not that easy. It takes a tremendous amount of energy to grow crops, make fertilizers and pesticides and process plants into fuel. There is ongoing debate if ethanol from corn provides more energy than it uses for growing and processing the plants. Also, fossil fuels provide much of the energy in biofuels production, so biofuels may not replace as much oil as they use.

Biomass creates harmful emissions like carbon dioxide and sulfur when it is burned, but causes less pollution than fossil fuels. Even burning wood in a fireplace or stove can create pollutants like carbon monoxide. Burning municipal solid waste, or garbage that would otherwise go into a landfill, can also cause potentially dangerous emissions. Combustion of these materials must be carefully controlled. Disposing of the resulting ash can also pose a problem, as it may contain harmful metals like lead and cadmium.

Ethanol is often added to gasoline, and while these mixtures burn cleaner than pure gasoline, they also have higher “evaporative emissions” from dispensing equipment and fuel tanks. These emissions contribute to ozone problems and smog. Burning ethanol also creates carbon dioxide.

Biodiesel creates less sulfur oxides, particulate matter, carbon monoxide and hydrocarbons when burned than traditional petroleum diesel. But biodiesel creates more nitrogen oxide than petroleum diesel.

Coal

Coal mining has the potential to harm air, water and land quality if it is not done with proper care. Acidic water may drain from abandoned mines underground, and the burning of coal causes the emission of harmful materials including carbon dioxide, sulfur dioxide and mercury. “Clean coal” technology is being developed to remove harmful materials before they can affect the environment, and to make it more energy-efficient so less coal is burned.

The coal industry also restores mined land to or prepares it for more productive uses once surface mining is done.

Geothermal

Geothermal power plants have relatively little environmental impact—they burn no fuel to create electricity. These plants do create small amounts of carbon dioxide and sulfur compounds, but geothermal emissions are far smaller than those created by fossil fuel power plants.

Hydropower

While hydropower does not cause water or air pollution, it does have an environmental impact: Hydroelectric power plants may harm fish populations, change water temperature and flow (disturbing plants and animals) and force the relocation of people and animals who live near the dam site. Some fish, like salmon, may be prevented from swimming upstream to spawn. Technologies like fish ladders help salmon go up over dams and enter upstream spawning areas, but the presence of hydroelectric dams changes their migration patterns and hurts fish populations. Hydropower plants can also cause low dissolved oxygen levels in the water, which is harmful to river habitats. Reservoirs may also lead to the creation of methane, a harmful greenhouse gas.

Petroleum (Oil and Gas)

Great strides have been made to ensure that oil and gas producers make as little impact as possible on the natural environments in which they operate. These include drilling multiple wells from a single location to minimize damages to the surface, using environmentally sound chemicals to stimulate well production and restoring the surface as nearly as possible to pre-drilling conditions (as required by landowners and state or federal agencies, who often must approve the company's completion of restoration activities).

When many people think of oil and the environment, they think of oil spills. The reality is that the exploration and production of oil rarely create an oil spill. For decades the offshore oil and gas industry has had a strong safety and environmental record in operating in the Gulf of Mexico, with less than 0.001 percent of the oil produced in federal waters spilled since 1980. The Deepwater Horizon event is a stark reminder of the risks and challenges in offshore operations. The oil and gas industry takes safety and environmental stewardship very seriously. That is why when it is known how the Deepwater Horizon accident occurred, the industry will work together to ensure that that this kind of event never happens again anywhere in the world.

Most oil spills occur primarily during transportation, mostly involving the tankers that are used to move oil from where it is produced to where consumers need it. But oil spills from transportation have declined significantly during the past few years, and the growing use of double-hulled tankers provides extra protection. Another source of oil spills during transportation is pipelines. Unfortunately, a major reason for spills from pipelines in developing countries is civil unrest. Weather, such as hurricanes, is another factor in pipeline-related spills.

Urban runoff and natural seeps are large sources of oil pollution. Urban runoff comes from rain washing away oil drips from cars or machinery and people pouring used oil into the gutter and using other improper disposal methods. Natural seepage is actually the largest single source of petroleum inputs in marine environments totaling 47%.

When burned, petroleum products emit carbon dioxide, carbon monoxide and other air toxins, all of which have a negative effect on the environment.

Solar

Solar energy produces no air or water pollution or greenhouse gases. However, it has some indirect impacts on the environment. For example, the manufacturing of photovoltaic cells (PV) produces some toxic materials and chemicals.

Ecosystems can also be affected by solar systems. Water from underground wells may be required to clean concentrators and receivers, and to cool the generator, which may harm the ecosystem in dry climates.

Uranium (Nuclear Energy)

Nuclear power plants produce no air pollution or carbon dioxide, but they do produce byproducts like nuclear waste and spent fuels. Most nuclear waste is low level (for example, disposable items that have come into contact with small amounts of radioactive dust), and special regulations are in place to prevent them from harming the environment. But some spent fuel is highly radioactive and must be stored in specially designed facilities. In addition to the fuel waste, much of the equipment in the nuclear power plants becomes contaminated with radiation and will become radioactive waste after the plant is closed. These wastes will remain radioactive for many thousands of years, which may not allow re-use of the contaminated land.

Nuclear power plants use large quantities of water for steam production and for cooling, affecting fish and other aquatic life. Likewise, heavy metals and salts can build up in the water used in the nuclear power plant systems. When water is discharged from the power plant, these pollutants can negatively affect water quality and aquatic life.

Wind

Wind is a clean energy source. It produces no air or water pollution because no fuel is burned to generate electricity. The most serious environmental impact from wind energy may be its effect on bird and bat mortality. Wind turbine design has changed dramatically in the last couple of decades to reduce this impact. Turbine blades are now solid, so there are no lattice structures that entice birds to perch. Also, the blades' surface area is much larger, so they don't have to spin as fast to generate power. Slower-moving blades mean fewer bird collisions.