Pros and Cons of Primary Energy Sources

Energy Source	How Obtained	Pros	Cons
Renewable Sources			
Biofuels (ethanol biodiesel, and biogas)	Crops such as corn, soy, sugarcane, and wheat (and related crop wastes) or animal waste are converted to a concentrated fuel	• Abundant supply • Can be used in internal combustion engines for transportation	• Requires water and land to grow crops, competing with valuable food crops • Emits air pollution • May require pesticides to grow certain crops • Uses fossil fuels in conversion
Geothermal	Natural heat found deep below the Earth's surface is used to generate electricity or heat or cool buildings	• Low carbon emissions • Non-polluting • Minimal environmental impact • Low cost to maintain	• Accessible geothermal fields (areas with high heat flow) are found in limited locations around the world • High initial cost and high operating costs • May require expensive transmission
Hydropower	Flowing water turns a turbine to generate electricity.	• Low carbon emissions • Non-polluting • Can generate large quantities of power • Output can be adjusted to meet demand	• Dams are costly to build • Dams can cause habitat loss and other environmental impacts • Can be affected by drought • Can be the source of controversy over land use and water rights
Solar	Solar-powered photovoltaic (PV) panels convert the sun's rays into electricity. Solar can also be used to create steam used to generate electricity.	• Most abundant energy source available • No carbon emissions • Non-polluting • Is well-suited for local rooftop installations	• Depends on sunny weather • Can only be generated during the day • Requires large spaces for panels • May have high initial cost
Wind	Wind turbines convert the wind's	• Currently the least expensive and fastest	• Depends on windy locations

Energy Source	How Obtained	Pros	Cons
	energy into electricity or to be used for tasks like pumping or desalinizing water	growing source of renewable electricity • No carbon emissions • Non-polluting	• Windy locations tend to be remote or offshore, which requires expensive transmission lines • Requires extensive land areas, which can be disruptive to ecosystems. • Wind turbines can be dangerous to certain bird populations.
Wood (biomass)	Comes from forests and wooded lands, or as co-product from wood processing	• Often made from forest residues, sawdust, and other sources that might otherwise go to waste • Important emergency back-up fuel • Generated from forests, which are a renewable resource	• Emits carbon when burned • If the forest is not managed sustainably then the use of biomass can increase carbon emissions when burned. • Contributes to air pollution
Nonrenewable Sources			
Coal	Mined from underground seams, then burned to generate electricity	• Abundant supply • Relatively cheap • Easily transported to power stations • Can generate large amounts of power	• Emits the most carbon per unit of energy of any commercially available fuel • Major source of toxic emissions (mercury, arsenic) and other air pollutants • High environmental impact from mining and burning •
Natural Gas (methane)	Tapped from natural deposits within the earth, then burned to generate electricity	• Widely available • Cleanest-burning fossil fuel	• High transportation and distribution costs • Unavailable in some areas due to infrastructure

Energy Source	How Obtained	Pros	Cons
		• Carbon emission are half of coal per unit of thermal energy • Natural gas is often used in combination with renewable resources and as a "peaking" resource	• Production and transportation of methane can result in leakage, contributing to greenhouse gases • Pipelines and production impact local environment (water usage, groundwater pollution, wildlife and habitats) • Fracking (a process for extracting natural gas) can contaminate groundwater and may trigger human-caused earthquakes
Nuclear Power (uranium fission)	Originates from splitting uranium atoms in a process called fission that generates heat, which can be used to form steam and generate electricity	• No carbon emissions • Little air pollution • A very small amount of uranium is needed to make a lot of energy • Uranium reserves are abundant	• Involves radioactive materials and radioactive waste that are extremely dangerous to living things • Recycled fuel (e.g. plutonium) is an extremely toxic and long-lived substance • No safe long-term solution for storage of radioactive waste currently exists in the U.S. • Very expense building costs due to safety, emergency, containment, radioactive waste, and storage systems • Requires large quantities of cooling water; heated

Energy Source	How Obtained	Pros	Cons
			wastewater may harm some aquatic life
Petroleum (Oil)	Pumped up by wells from vast underground reservoirs, then burned to generate electricity	• Relatively inexpensive to produce • Easy to transport • Suitable for fueling cars, trucks, and other transportation • Used in many products – from plastics to prescription drugs	• Carbon emissions per unit of energy is higher than natural gas but lower than coal, contributing to greenhouse gases • Only found in limited areas, some of which are environmentally sensitive • Pipelines and production impact local environment (water, wildlife, and habitats)
Waste (refuse-derived fuel)	Solid waste is burned at waste-to-energy plants, using the heat to make steam for generating electricity or to heat buildings	• Provides cheap source of energy • Reduces need for landfills • Saves trash-hauling expenses	• Emits carbon • Creates air pollution • Can harm human health • Requires expensive technology to reduce negative impacts