

## Biogas, Biofuels, Biodiesel

### Biogas

Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. It is a renewable energy source and in many cases exerts a very small carbon footprint. Biogas can be produced by anaerobic digestion with anaerobic bacteria, which digest material inside a closed system, or fermentation of biodegradable materials. Biogas is primarily methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) and may have small amounts of hydrogen sulphide (H<sub>2</sub>S), moisture and siloxanes. Biogas is produced as landfill gas (LFG), which is produced by the breakdown of biodegradable waste inside a landfill due to chemical reactions and microbes, or as digested gas, produced inside an anaerobic digester. By converting cow manure into methane biogas via anaerobic digestion, the millions of cattle in the United States would be able to produce 100 billion kilowatt hours of electricity, enough to power millions of homes across the United States. In fact, one cow can produce enough manure in one day to generate 3 kilowatt hours of electricity; the dangers of biogas are mostly similar to those of natural gas, but with an additional risk from the toxicity of its hydrogen sulfide fraction. Biogas can be explosive when mixed one part biogas to 8-20 parts air.

### Biodiesel

Biodiesel is a renewable, clean-burning diesel replacement that is reducing U.S. dependence on foreign petroleum, creating jobs and improving the environment. Made from a diverse mix of feedstocks including recycled cooking oil, soybean oil, and animal fats, it is the first and only EPA-designated Advanced Biofuel in commercial-scale production across the country and the first to reach 1 billion gallons of annual production. Meeting strict technical fuel quality and engine performance specifications, it can be used in existing diesel engines without modification and is covered by all major engine manufacturers' warranties, most often in blends of up to 5 percent or 20 percent biodiesel. It is produced at plants in nearly every state in the country.

### Biofuels

Biofuels are fuels that can be processed from numerous types of biomass. First generation biofuels are processed from the sugars and vegetable oils formed in arable crops, which can be smoothly extracted applying conventional technology. In comparison, advanced biofuels are made from lignocellulosic biomass or woody crops, agricultural residues or waste, which makes it tougher to extract the requisite fuel. Advanced biofuel technologies have been devised because first generation biofuels manufacture has major limitations. First generation biofuel processes are convenient but restrained in most cases: there is a limit above which they cannot yield enough biofuel without forbidding food supplies and biodiversity. Many first generation biofuels rely on subsidies and are not cost competitive with prevailing fossil fuels such as oil, and some of them yield only limited greenhouse gas emissions savings. When considering emissions from production and transport, life-cycle assessment from first generation biofuels usually approach those of traditional fossil fuels. Advanced biofuels can aid resolving these complications and can impart a greater proportion of global fuel supply affordably, sustainably and with larger environmental interests.