# Bio gas is a renewable source of energy

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Biogas is a mixture of methane, CO2 and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment. The precise composition of biogas depends on the type of feedstock and the production pathway; these include the following main technologies:

The methane content of biogas typically ranges from 45% to 75% by volume, with most of the remainder being CO2. This variation means that the energy content of biogas can vary; the lower heating value (LHV) is between 16megajoules per cubic metre (MJ/m3) and 28MJ/m3. Biogas can be used directly to produce electricity and heat or as an energy source for cooking.

Biomethane (also known as "renewable natural gas") is a near-pure source of methane produced either by "upgrading" biogas (a process that removes any CO2 and other contaminants present in the biogas) or through the gasification of solid biomass followed by methanation:

Biomethane has an LHV of around 36MJ/m3. It is indistinguishable from natural gas and so can be used without the need for any changes in transmission and distribution infrastructure or end-user equipment, and is fully compatible for use in natural gas vehicles.

A wide variety of feedstocks can be used to produce biogas. For this report, the different individual types of residue or waste were grouped into four broad feedstock categories: crop residues; animal manure; the organic fraction of MSW, including industrial waste; and wastewater sludge.

Specific energy crops, i.e.low-cost and low-maintenance crops grown solely for energy production rather than food, have played an important part in the rise of biogas production in some parts of the world, notably in Germany. However, they have also generated a vigorous debate about potential land-use impacts, so they are not considered in this report"s assessment of the sustainable supply potential.

Using waste and residues as feedstocks avoids the land-use issues associated with energy crops. Energy crops also require fertiliser (typically produced from fossil fuels), which needs to be taken into account when assessing the life-cycle emissions from different biogas production pathways. Using waste and residues as feedstocks can capture methane that could otherwise escape to the atmosphere as they decompose.

Most biomethane production comes from upgrading biogas, so the feedstocks are the same as those described above. However, the gasification route to biomethane can use woody biomass (in addition to MSW and agricultural residues) as a feedstock, which consists of residues from forest management and wood processing.

The feedstocks described above were considered in this report"s assessment of the sustainable biogas and biomethane supply potential, and are further discussed in Section 3 below.

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The development of biogas has been uneven across the world, as it depends not only on the availability of feedstocks but also on policies that encourage its production and use. Europe, the People"s Republic of China (hereafter, "China") and the United States account for 90% of global production.

Europe is the largest producer of biogas today. Germany is by far the largest market, and home to two-thirds of Europe"s biogas plant capacity. Energy crops were the primary choice of feedstock that underpinned the growth of Germany"s biogas industry, but policy has recently shifted more towards the use of crop residues, sequential crops, livestock waste and the capture of methane from landfill sites. Other countries such as Denmark, France, Italy and the Netherlands have actively promoted biogas production.

In the United States, the primary pathway for biogas has been through landfill gas collection, which today accounts for nearly 90% of its biogas production. There is also growing interest in biogas production from agricultural waste, since domestic livestock markets are responsible for almost one-third of methane emissions in the United States (USDA, 2016). The United States is also leading the way globally in the use of biomethane in the transport sector, as a result of both state and federal support.