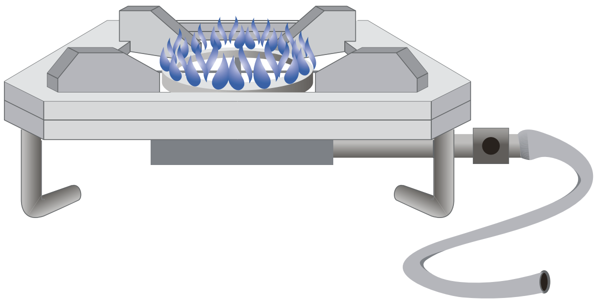
Use of Biogas

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation * Recovery	** Household * Neighbourhood City	** Household ** Shared ** Public	Productive use of energy
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
* Little	** Medium	Biogas	



Anaerobic digestion of sludge and other organic matter produces biogas (a mix of methane and other gases). Biogas can be used like other fuel gas for cooking, heating, lighting and electricity production.

When produced in household-level Biogas Reactors **(S.16)**, biogas is most suitable for cooking or lighting. Where biogas is produced in large anaerobic digesters **(T.4)**, electricity generation is an alternative.

Design Considerations: Gas demand can be defined on the basis of energy previously consumed. For example, 1 kg of dried cow dung corresponds to 100 L of biogas, 1 kg of firewood corresponds to around 200 L of biogas, and 1 kg of charcoal corresponds to 500 L of biogas. Gas consumption for cooking per person and per meal is between 150 and 300 L biogas. Approximately 30–40 L biogas is required to boil one litre of water, 120–140 L for 0.5 kg rice and 160–190 L for 0.5 kg vegetables. Tests have shown that the biogas consumption rate of a household biogas stove is between 300 to 400 L per hour. However, this depends on the stove design and methane content of the biogas. Compared to other gases, biogas needs less air for combustion. Therefore, conventional gas appliances need to be modified when they are used for biogas combustion (e.g. larger gas jets and burner holes). The distance through which the gas must travel should be minimised as leaks may occur. Drip valves should be installed for the drainage of condensed water, which accumulates at the lowest points of the gas pipe.

Materials: Appliances required depend on how the biogas will be used. Many appliances have to be designed specifically for use with biogas and these are not always widely available. However, conventional gas burning stoves can be easily modified for use with biogas by widening the jets and burner holes and reducing the primary air intake. When biogas is used for cooking, a simple pressure indicator should be installed to inform the user of the amount of gas available.

Applicability: Biogas Reactors **(S.16, T.4)** can be considered as a treatment option during the stabilisation and recovery phase and the production of useable energy (biogas) can partially reduce dependence on other fuels and contribute to a community's self-reliance. When considering the use of biogas, it is important to consider the calorific efficiency of biogas in different applications; it is 55 % in stoves, 24 % in engines, but only 3 % in lamps. A biogas lamp is only half as efficient as a kerosene lamp. For common household or community level installations, the most efficient use of biogas is in stoves for cooking. For larger installations, the most efficient use of biogas is electricity generation with a heat-power combination. In this case, 88 % efficiency can be reached.

Operation and Maintenance: Biogas is usually fully saturated with water vapour, which leads to condensation. To prevent blocking and corrosion, the accumulated water should be periodically emptied from the system's water traps. Trained personnel must regularly check gas pipelines, fittings and appliances. Cooking stoves should be kept clean and the burner ring should be checked for blockages. When using biogas for an engine, it is necessary to first reduce the hydrogen sulphide content as it forms corrosive acids when combined with condensing water.

Health and Safety: When faecal matter and organic material is anaerobically digested as it is in a Biogas Reactor, the biogas produced is primarily composed of methane and carbon dioxide, with lesser amounts of hydrogen sulphide, ammonia, and other gases, depending on the material being digested. Each of these gases has safety issues. Overall, biogas risks include explosion, asphyxiation, disease, and hydrogen sulphide poisoning.

Costs: The costs depend on the chosen application for the biogas and the appliance required. Piping is required and generally available in local markets. Gas cooking stoves are cheap and widely available. With proper instructions and simple tools the modifications can be done by a local handyperson.

Social Considerations: In general, users find cooking with biogas acceptable as it can immediately be switched on and off (unlike wood and coal). Also, it burns without smoke, and, does not contribute to indoor air pollution. Biogas generated from faeces may not be appropriate in all cultural contexts. Training and orientation on biogas production, safety, and piping should be given to support user acceptance, to ensure efficient use and maintenance of the stove, to facilitate rapid identification of leakages and other potential issues. In some cases, users will need to learn how to cook with gas. It should also be demonstrated to users that biogas is not dangerous (due to its low concentration of methane).

Strengths and Weaknesses:

(+) Free energy source
(+) Can substitute fuel wood and other sources for cooking
(+) Comparably few operation skills and little maintenance required

(−) May not meet energy requirements and cannot replace all energy types
(−) Biogas can only be stored for several days (low energy density) and needs to be used daily
(−) Biogas lamps have lower efficiency compared to kerosene lamps
(−) Biogas production below 15 °C is not economically feasible

→ **References and further reading material for this technology can be found on page 195**