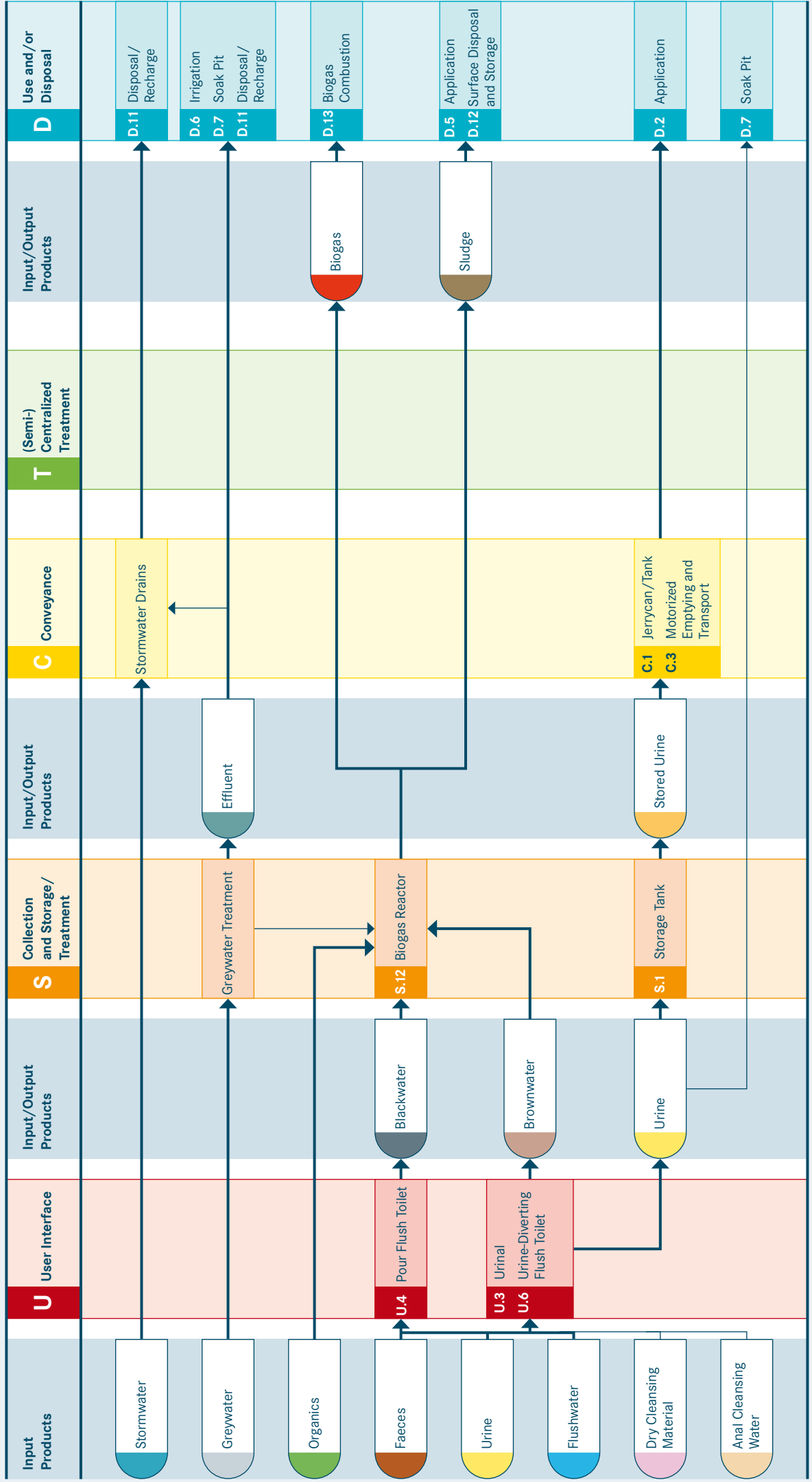
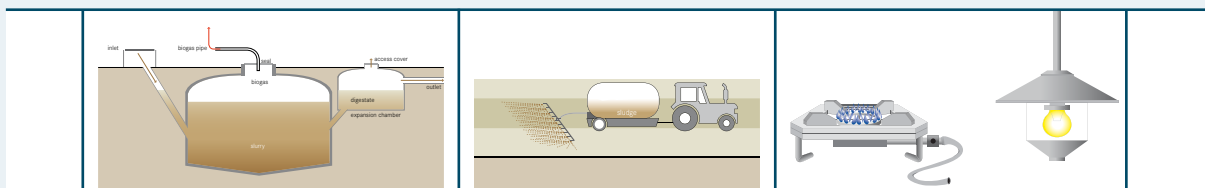


## Sanitation System 5: Biogas System



## System 5: Biogas System



This system is based on the use of a Biogas Reactor (S.12) to collect, store and treat the Excreta. Additionally, the Biogas Reactor produces Biogas which can be burned for cooking, lighting or electricity generation. Inputs to the system can include Urine, Faeces, Flush-water, Anal Cleansing Water, Dry Cleansing Materials, Organics (e.g., market or kitchen waste) and, if available, animal waste.

This system supports two different User Interface technologies: a Pour Flush Toilet (U.4) or, if there is a demand for the urine to be used in agriculture, a Urine-Diverting Flush Toilet (U.6). A Urinal (U.3) could additionally be used. The User Interface is directly connected to a Biogas Reactor (S.12, also known as an anaerobic digester) for Collection and Storage/Treatment. If a Urine-Diverting Flush Toilet is installed (and/or a Urinal), it will be connected to a Storage Tank (S.1) for Urine collection.

Depending on the loading and design of the Biogas Reactor, a thin or thick digestate (Sludge) will be continuously discharged. Because of the high volume and weight of the material generated, the Sludge should be used onsite. In some circumstances, a very thin digestate can be discharged to a sewer (though this is not shown on the system template here).

Although the Sludge has undergone anaerobic digestion, it is not pathogen free and should be used with caution, especially if there is no further treatment. Depending on how it is used, additional treatment (e.g., in Planted Drying Beds, T.15) may be required before application. It is nutrient-rich and a good fertilizer that can be applied in agriculture (D.5) or transported to a Surface Disposal or Storage site (D.12). The Biogas produced must be constantly used, for example as a clean fuel for cooking or for lighting (D.13). If the gas is not burned, it will accumulate in the tank and, with increasing pressure, will push out the digestate until the Biogas escapes to the atmosphere through the digestate outlet.

A Biogas Reactor can work with or without Urine. The advantage of diverting Urine from the reactor is that it can be used separately as a concentrated nutrient source without pathogen contamination. The Urine

collected in the Storage Tank is ideally applied on local fields (D.2). Stored Urine can be transported in Jerrycans or a Tank (C.1), or using a Motorized Emptying and Transport technology (C.3).

**Considerations** This system is best suited to rural and peri-urban areas where there is appropriate space, a regular source of organic substrate for the Biogas Reactor and a use for the digestate and Biogas. The reactor itself can be built underground (e.g., under agricultural land, and in some cases roads) and, therefore, does not require a lot of space. Although a reactor may be feasible in a dense urban area, proper Sludge management is crucial and needs specific attention. Because the digestate production is continuous, there must be provisions made for year-round use and/or transport away from the site.

The Biogas Reactor can function with a large range of inputs and is especially suitable where a constant source of animal manure is available, or where market and kitchen waste is abundant. On farms, for example, large quantities of Biogas can be produced if animal manure is co-digested with the Blackwater, whereas significant gas production would not be achieved from human Excreta alone. Wood material or straw are difficult to degrade and should be avoided in the substrate. Achieving a good balance between Excreta (both human and animal), Organics and water can take some time, though the system is generally forgiving. However, care should be taken not to overload the system with either too many solids or too much liquid (e.g., Greywater should not be added into the Biogas Reactor as it substantially reduces the hydraulic retention time).

Most types of Dry Cleansing Materials and Organics can be discharged into the Biogas Reactor, although to accelerate digestion and ensure even reactions within the tank, large items should be broken or cut into small pieces.

Guidelines for the safe use of Sludge have been published by the World Health Organization (WHO) and are referenced on the relevant technology information sheets.