



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

**T
www.**



Biogas Plants Proposal

**Project Location: St John's Schools (Nursery, Primary and Secondary)
(Mangochi)**

Prepared by: Clement Kandodo



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

Date: 22/02/2023

T

www.

Contents

1	The Executive Summary.....	3
2	EcoGen Technology Component.....	3
3	Description of the institution.....	3
4	Proposal.....	4
4.1	Biogas plant model for the school.....	4
4.2	Biodigester productivity.....	5
5	Key Equipment Specification.....	6
5.1	Digester Material-LLDPE Geomembrane advantage.....	6
5.2	Biogas Purification and conditioning equipment.....	6
5.3	Thermal Institution Appliances.....	6
6	Financial Plan.....	7
6.1	Optional Payment Plan.....	7
	More information on the financial plan.....	7
7	Notes.....	9
8	Terms and conditions.....	10



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

T

www.

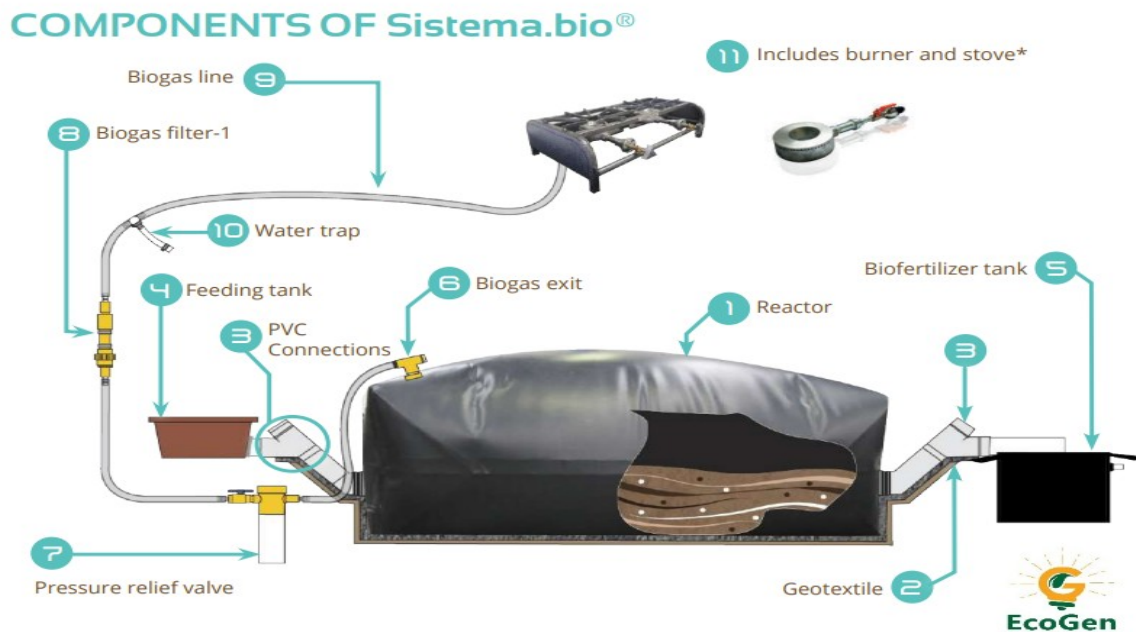
1 The Executive Summary

The EcoGen biogas plant proposal aims to provide a full digester, clean cooking, and fertilizer management system to St. John's Nursery, Primary and Secondary Schools. EcoGen will install their prefabricated hybrid reactors, which will convert cattle dung and organic food waste into methane-rich biogas that can be used for clean cooking and thermal processes. The output of the digester will also produce a powerful biofertilizer that can be used as a substitute for chemical fertilizers. The biogas system will help reduce the need for firewood and charcoal, making cooking more efficient and cost-effective.

2 EcoGen Technology Component

The EcoGen anaerobic digester package provides a full digester, clean cooking, and fertilizer management system. EcoGen biogas plant is a prefabricated hybrid reactor that can be installed easily. This waste manure breaks down anaerobically, producing methane-rich biogas that can be used for providing clean cooking and thermal processes for the farm and household. Biogas flows to different points of use like cooking stoves, burners, etc. with a simple, long-lasting gas line. The various components of the EcoGen reactor can be seen in the Figure below.

Figure 1: EcoGen Biogas system



3 Description of the institution

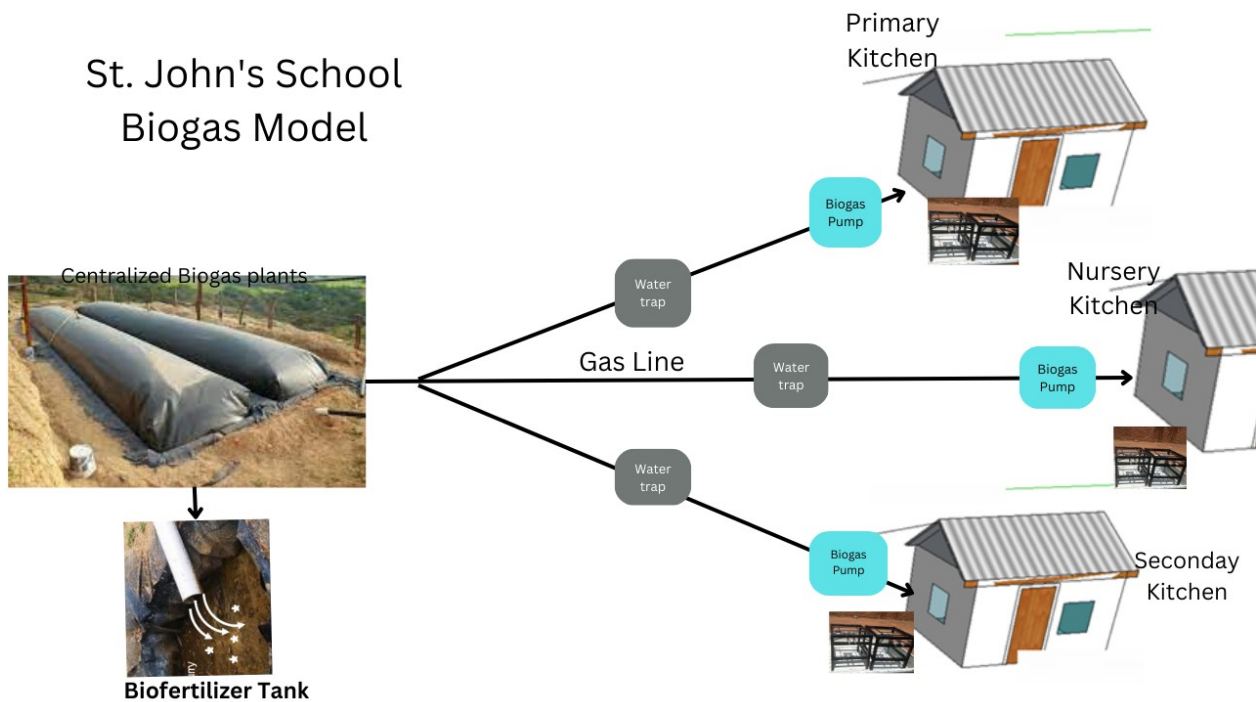
The school comprises three campuses, namely nursery, primary and secondary, which are close to one another. There are currently 800 learners enrolled in the school, with 250 in the nursery, 90 in the primary and 400 in the secondary. Each term, the nursery and secondary use MWK600,000 of firewood for cooking, while the primary uses MWK300,000. The institution also owns 73 cattle and 35 goats, which provide manure that can be used as a resource. Additionally, food waste such as kitchen leftovers and maize-bran are also accumulated at the school, offering potential for biogas production. The livestock shelter is located approximately 300 meters away from the schools. The school has an adequate water supply, with a 5,000-litre tank for the nursery, a 20,000-litre tank for the primary school, and a 20,000-litre tank for the secondary school. Additionally, the Father's house, which accommodates around 4 people, uses 19Kg of LPG each month and sometimes charcoal. The site also has a generator, which runs on diesel for 5-6 hours each day.

4 Proposal

EcoGen proposes to install biogas plants for the school to supply gas to each cooking positions (pots). EcoGen will be in charge of designing and installation of the biogas system as well as providing training on the operations and maintenance of the biogas system.

4.1 Biogas plant model for the school

St. John's schools will have a centralized biogas system from the livestock shelter to cooking positions. A centralized biogas system will consist of biogas source on same spot and a piping network with water traps to the kitchen. The biogas is then supplied to multiple cooking positions through the piping network. Each cooking position is equipped with a biogas pump that is connected to the digester and kitchen. The biogas pump ensures that each cooking position receives the same amount of biogas, allowing for a consistent cooking experience. The water traps in the piping network help to minimize the blockages in pipes due to water vapour accumulation, ensuring that the biogas flows efficiently. This system is ideal for large-scale applications just like the school. The secondary school, with its large student population, will have two Bio-Proburners connected to two pots that hold 200-250 litres each, as well as a set of bioburners for pots of no more than 120 litres. The nursery and primary school sections, on the other hand, will have two sets of bioburners connected to a stand in each kitchen, each supporting two pots. The diagram below gives an illustration (Model) on how the system will be connected;



4.2 Biodigester productivity

The table below details the input and output production of the site and designated system;

Table 1: Biodigester input and output using Cattle dung and other waste available on the school

Model	Maximum Loading of waste (Litres/day)			Biogas production	Biogas Equivalent		Biofertilizer
	Type of manure	Feeding (Litres/day)	Clean Water mixing (Litres/day)	m ³ /day	LPG (19kg/Month)	Firewood Kg/day	Litres/day
Sistema 120	Clean Cattle dung	1050	1400	57.3	38	1031	3150
	Food waste (Digestate)	345	450	96	65	1728	792
	Goat Manure	750	2120	37.5	25	675	3207

Note: Food waste should be crushed into pulp before being put into the digester plant.
Goat manure should always be moistened for 12 to 24 hours before being fed to the reactor.

The daily maximum loading of waste may as well be done in a waste combination mechanism. The table below gives an illustration for the mechanism with biogas produced for one Sistema 40;

Table 2: Daily feeding of Sistema 40 in a combination of food waste and cattle manure

Daily Inputs		Daily biogas output (m ³)	
Cattle dung (L)	Food waste (L)	Biogas	15
200	50		
150	65		
100	75		
50	90		
20	95		
-	115		

Note: Food waste daily feeding, Waste: Water dilution ratio 1:2 + one-part digestate



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

T

www.

- A practical demonstration of all waste addition will be done during the theoretical and practical training.
- The biogas production is based on standard biodigester use and institution's operating conditions.

5 Key Equipment Specification

5.1 Digester Material-LLDPE Geomembrane advantage

EcoGen uses Sistema.bio products as the exclusive distributor in Malawi which manufacture its product from LLDPE. Linear Low-Density Polyethylene (LLDPE) is the most flexible of the plastic sheeting films available in the world. Therefore, we consciously chose this membrane for our bio digesters. After the installation in the field, the membrane displays a tremendous amount of strength to absorb impacts while not tearing or puncturing during use.

5.2 Biogas Purification and conditioning equipment

Effectively decreases the levels of Hydrogen Sulfide in the biogas by up to 95%.

BioGasFilter-20 - significantly diminishes the smell of biogas and increases the lifespan of all metallic gas appliances by decreasing hydrogen sulfide concentration in the gas through a filtering media.

5.3 Thermal Institution Appliances

The Bio-Proburner-2 is a robust and reliable Institutional equipment capable of supporting daily institution cooking needs for up to 250L pots. Bio-burners will be provided for small pots of 100-120litres in case of the primary and nursery schools.

6 Financial Plan.

The proposed biogas system from EcoGen offers a sustainable and cost-effective solution for the institution's energy needs. Currently, the primary, nursery, and secondary schools spend a significant amount on firewood for food preparation, with annual expenses of MWK2,700,000. By adopting the biogas system, the school can reduce this expense and contribute to a sustainable future by reducing their carbon footprint. The system's 20-year plus lifespan ensures a long-term, reliable source of energy, which will continue to benefit the institution well beyond the initial investment.

The financial plan for the installation, commission, and after-sale services of the biogas system has been outlined in the proposal, with a total cost of **MWK15,942,800.00**. The system includes the Sistema 120 (three Sistema 40's biogas digesters), biogas pump-GF120, a set of bioproburner-2,



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

T

www.

additional burners, gas line, and other related expenses. By implementing the biogas system, the institution can not only save on operational costs but also significantly reduce their expenditures on firewood for food preparation, resulting in substantial cost savings in the long run. Furthermore, this investment aligns with the institution's values and long-term goals by promoting sustainable practices and cutting use of unsustainable energy sources.

If properly utilized, the biofertilizer (a by-product of the biogas system) will help the institution increase its earnings through selling of the biofertilizer to the community and further reduce its expenditures because it will grow its crops organically, eliminating the need for chemical fertilizer and pesticides, and sourcing all of its food from suppliers. With the current increase in the price of fertilizer, this solution will ensure the institution has access to affordable fertilizer and more potential customers interested in purchasing the affordable fertilizer for their fields.

6.1 Optional Payment Plan


The school has an option of a payment plan for a biogas system installation where you would pay 50% of the total cost upfront for installation, and then pay the remaining half of the cost in smaller payments over the next 8 months. We have included this flexible payment plan because the system will also be used for demonstration purposes.

An excel spreadsheet attached provides a comprehensive breakdown of the costs associated with the school system proposed.

More information on the financial plan

- The biogas line pole supports the gas line. A metal pole is recommended as it is resistant to termites and moisture.
- Biogas pump is included to increase pressure from the biogas system to the stoves. Each biogas pump will be installed to each of the institutions kitchen's namely primary, nursery and secondary schools.
- The Bio-Probuner-2 will be connected to the secondary school with big pots more than 200litres

Figure 2: Description of BioProburner-2



ThermalProductive

BioProBurner-2

- **Dimensions (burner only):** 8 x 19 x 72 cm (h x l x w)
- **Daily use:** 2 to 6 hours
- **Firepower:** Average of 30kW
- **Average biogas consumption:** 6 m³/h
- **Heated surface:** A minimum 60 x 60 cm surface should be considered
- **highest efficiency measured:** 45%
- **Water Boiling Test:** 80 L of water requires 1 hour to be heated up by 72 °C
- **Lifespan:** Average 2 years

Product description

The **BioProBurner-2** is our **medium productive** burner product. Ideal for heating large volumes of liquids (100 – 250L), the package contains all the components to enhance biogas (pressure and filtration).

Recommended with

SIS
40+

- ✓ Works with **biogas**
- ✗ Doesn't work with **LP gas**
- ✓ **Electricity** needed

Additional products recommended

- **BioGasPurifier-1**

Package contains

- (1) Medium productive burner
- (2) **BioGasPump-GF120**
- (3) **BioGasFilter-20**


Additional documentation

- **BioProBurners** dimensioning tables

www.ecogenmw.com

- Burners work best with pots of not more than 60 litres because the heat is distributed more evenly and the food can be cooked more quickly. In this model, two burners are to be combined for one cooking pot, as this will provide enough heat to cook the food evenly and quickly.

Figure 3: Description of Bio-burner and on a stand



About the BioBurner-1

- Product code: QUEMADOR-001
- Dimensions: 7 x 45 x 10 cm (h x l x w)
- Daily use: 2 to 5 hours
- Firepower: 3.4KW
- Average biogas consumption: 0.6 m³/h
- Maximal efficiency: of 42%, similar range to LP burners
- Time to boil 1 L of water: Approx. 5 minutes
- Lifespan: Average 3 years

Product description


The **BioBurner-1** is a household equipment that can be mounted on a **frame** and installed almost **anywhere** (i.e.: cooking on the ground, in existing water heater). One **BioBurner-1** is included in the standard digester kit from Sistema 8 and up (not included with Sistema 6).

Recommended with

■ Perfect fit	SIS 6	SIS 8	SIS 12	☑ Works with biogas
■ Needs to be combined with other appliances	SIS 16	SIS 20	SIS 30	☒ Doesn't work with LP gas
			SIS 40+	☑ No electricity needed

Additional products recommended

- BioGasFilter-20
- BioGasPurifier-1
- BioCounterweight



- Site preparation involves digging the trench where the biogas system will be installed. In this case, the trench will be 0.9 meters in depth, 2.30 meters in width, and 16.05 meters in length for each of the 3 systems. The system is going to have one biofertilizer tank of dimension 1.6 meters in depth, 3 meters in width, and 6 meters in length.
- Initial feeding in this case we will require cow dung (3500 litres) and water (28,000 litres) for each system. This is directed and supervised by our technicians. Also note that the initial feeding is a once-off thing, it happens only during the installation of the system.
- The system piping connections will pass underground as HDPE Pipe 50mm of large diameter will be used for efficient flow of gas.



HEADQUARTER

P.O.BOX 2004

Lilongwe, Malawi

el: +265 980 647 60

ecogenmw.com

T

www.

7 Notes

- **Warranty:** EcoGen will give a warranty of 10 years, prorated, starting on the date of installation, exclusively for the geomembrane.
- EcoGen will give a warranty of **1 year** on the thermal appliances and a 6-month warranty on the set of Bioproburner-2 and the Biogas Pump GF-120.
- The warranty does not cover any damage to the System Components described above caused by accidents, vandalism and non-compliance with the risk prevention form and user manual. The warranties include repairs, replacement, product change, and raw materials in general, including labor and transportation expenses derived from complying with this certificate.
- **Gas Commissioning:** 21-30 Days. It can be earlier or later due to environmental conditions. We will adjust the commissioning date according to digester inflation status.

8 Terms and conditions

- Prices are in Malawian Kwacha (MWK)
- Quote is valid for 30 days upon receipt
- Two free after-sale services.

Not included

- Fencing of the system
- Site preparation (Trench preparations)
- Initial feeding

We look forward to discussing this proposal further for adoption and Implementation.

For EcoGen Malawi Limited.

Clement Kandodo

Chief Technical Officer| EcoGen

www.ecogenmw.com
(www.sistema.bio.com)

(The official distributor of Sistema.bio)