E-TAntsoroka ho an'ny Fampandrosoana ny maha Olona
In the Regional Network for Equity in Health in East and Southern Africa (EQUINET)

A Biodigester for clean energy at ENSOA, Antsirabe, Vakinakaratra, Madagascar

Building a pit for the biodigester J.E. Heriniaina, May 2025

Domestic investment in technology research and development (R&D) and a supportive technology ecosystem builds locally appropriate, climate-sensitive technologies for healthy urban ecosystems. This case study illustrates a promising practice in the construction of a biodigester at the Ecole Nationale des Sous-Officiers d'Active (ENSOA) in Antsirabe Madagascar.

'BUILDING' urban health through clean energy technology

EQUINET's recommendations on integrated urban health in 2024 in Eastern and Southern Africa include measures to BUILD health promoting integrated improvements for urban health, including supporting the locally produced technologies for this (EQUINET, 2024). This case study exemplifies the 'BUILD' agenda in its domestic investment in technology R&D, and in a supportive technology ecosystem for locally appropriate, climate-sensitive technologies and infrastructures that build links between food, waste and energy systems.It is based on key informant interviews after consent and review of published documents collected in May 2025.

The National School for Non-Commissioned Officers of the Army (ENSOA), founded in 1963 in Antsirabe, is a leading military institution training non-commissioned officers in the Malagasy Army and Gendarmerie. Hosting between 700 and 1,000 boarders each year, ENSOA has established an agricultural club and an environmental site in a strategy for sustainable development. ENSOA's decision to install a biodigester was taken within the context of the New Energy Policy 2015–2030 promoting renewable energy (MEH, 2015); and rules that cover biodigesters, including the Mise en Compatibilité Des Investissements avec l'Environnement (MECIE) Decree No. 2025-080 requiring environmental and social impact assessments to integrate ecological considerations into relevant projects (MECIE, 2025); and the oversight and guidance by the Directorate for the Promotion of Ethanol and Bioenergy of compliance with national energy and environmental goals (MEH, 2022).

School environmental site, including fish farming, J.Heriniaina, May 2025

The decision to install a biodigester for clean energy

In February 2025, ENSOA commissioned a biodigester to produce biogas from organic waste generated by its communal kitchens and livestock facilities, aligning with energy transition, sustainable waste management, and youth capacity goals. The biodigester is part of a broader ecosystem in ENSOA that combines agriculture, livestock farming (cattle, goats, sheep), fish farming, and insect farming (black soldier flies), to enhance the school's food self-sufficiency. It provides an accessible learning hub for local communities, students, non-government and civil society organizations, particularly in the Vakinankaratra region. In this way, it prepares future non-commissioned officers to become agents of change for agro-ecological best practices and sustainable energy innovations in their communities.

Animal waste used as organic input material for the biodigester, J.Heriniaina, May 2025

The installation of a biodigester was seen to significantly reduce the use of firewood, still widely employed for cooking, replacing it with renewable energy from locally produced organic waste, and reducing the environmental impact of waste. By promoting clean and sustainable biogas energy it would reduce greenhouse gas emissions, and reduce deforestation and pollution caused by wood combustion. At the same time it would build students' skills in ecological agriculture and sustainable technologies by integrating these practices into their training.

The installation was motivated and supported internally by skills and resources available within the ENSOA school, within their training programme. The school proposed the project, a technician identified the construction requirements and Bank of Africa Madagascar (BOA) approached and provided financial support to bring the project to life, with policy support from Ministry of Agriculture and Livestock, the Green Energy and Materials Company, and Colonel RAZAFITOMBO Leva Niaina, the project's initiator from ENSOA.

Building and using the biodigester for local energy needs

A structured process to ensure sustainability and efficiency began with an in-depth site study and environmental assessment by a private company specialized in biogas, Energie et Matériaux Verts (EMV) in June 2024 to determine the best location for the biodigester, taking into account the sources and quantity of organic matter and waste. EMV developed a customized design of the biodigester in June 2024 to align to capacities and operational conditions, the availability of components, noted below) and applicable safety standards. EMV provided school personnel with hands-on training to build understanding of the operation and daily maintenance requirements, such as cleaning the biodigester's filters and established a monitoring system of the system's performance and identify necessary technical support from EMV. The project started in December 2024, was completed by end January 2025 and has operated since February 2025.

Capacities, materials and resources

The materials and cost to build and install the biodigester (USd3108) are shown below:

Description	Details	USd amount
Construction materials	Iron, cement, bricks, planks, roundwood, culverts, nails, gravel, rope, stones, sand, tar.	1 006
Biodigester kit materials	Gas stove, purifier, gas pump, water trap, hose, shut-off valve, piping, dome cover.	740
Construction costs	Masonry, supply, accommodation, transportation, labor, kit installation.	822
Study and monitoring		540

Main fermentation pit with its gas dome and the pipe transporting the produced gas to the school's kitchen

Operating and using the biodigester

Three pits were constructed to form the biodigester:

- the first for the input of organic matter;
- the second, the main chamber (18 m^3), for fermentation, equipped with a flexible membrane that serves as a gas dome; and
- the third for the outlet of the digestate, which is used as fertilizer.

The gas produced is transported directly to the school's kitchen through a pipe and used in gas cookers. (See adjacent photographs).

The biodigester is fed daily with two to three wheelbarrows of organic waste. The biogas produced is used for cooking for about 8 hours per day.

In the second pit, the main fermentation chamber, two carts of raw materials are introduced via the first pit. Water is poured around the gas dome to prevent any gas leakage.

The raw materials ferment for approximately five days. After this period, gas begins to form and can be used for around twenty-eight days, provided that raw materials are regularly added.

Gas produced being used in the school's kitchen

Third pit collecting the digestate used as fertilizer and manually removed with shovels All photos J.Heriniaina, May 2025

The daily input of two to three wheelbarrows of waste ensures continuous gas production, sufficient for 8 to 10 hours of cooking per day for around 700 people, including trainees, instructors, and other school staff.

The daily input of waste is carried out by the students themselves. Two staff members at the school have been assigned to monitor and manage the system.

Challenges, solutions and learning

One of the main challenges encountered during the implementation of the project was the insufficiency of organic raw materials required for the optimal functioning of the biodigester. The household and animal waste generated on-site was not enough to ensure continuous feeding of the digester, which led to additional expenses for the purchase of external organic matter.

To address this constraint, the school adopted a sustainable solution. They progressively increased their livestock population and intensified their agricultural activities on-site, to generate more organic waste internally.

Despite the initial challenges, the biodigester at ENSOA has yielded notable results. The use of firewood has decreased by 30%, reducing pressure on forest resources and lowering greenhouse gas emissions. Organic waste now has effective value, strengthening the environmental sustainability of ENSOA. The biogas produced enables the school to partially meet its energy needs, providing around eight hours of cooking time per day for approximately 700 people.

Moreover, the site has enhanced its demonstration and educational role. It has become a local model of environmental innovation, regularly welcoming visits from regional stakeholders, civil society organizations, and students seeking inspiration to develop similar initiatives.

The success of this first biodigester has led to the planning of a second project, this time with the support of Baobab Bank Madagascar. Additionally, a broader site development project is underway, in partnership with the Ministry of Agriculture and Livestock, aiming to transform ENSOA into a regional flagship site for the Vakinankaratra region.

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