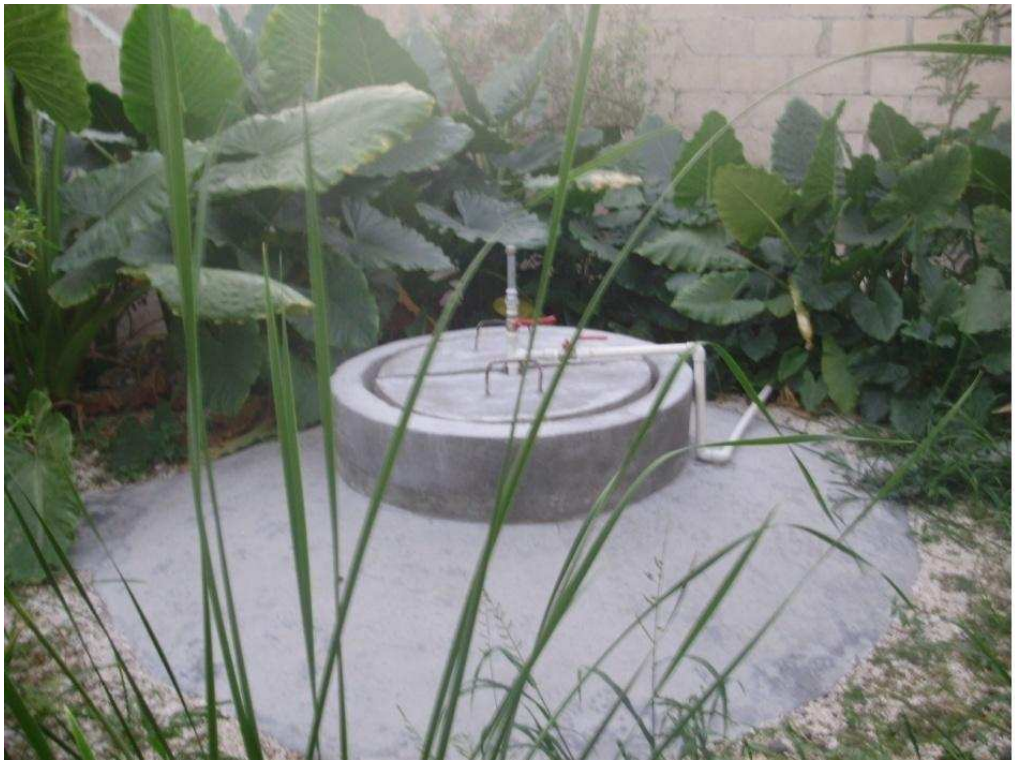
RÉPUBLIQUE D'HAÏTI
DINEPA
Direction Nationale
de l'Eau Potable
et de l'Assainissement

HAITI BIOGAS PROGRAMME STRATEGY 2010-2012



Prepared by the
Haiti Biogas Technical Working Group
Through the support of
United Nations Environment Programme

Developped in Q3 2010 - Latest revision in Q4 2010

1. INTRODUCTION

1.1 Purpose of the Strategy

This strategy is designed for two purposes:

- To formalize and guide the activities of the Haiti Biogas Technical Working group;
- To inform other potential actors and investors in the field of biogas in Haiti of the government approved strategy and scope of work for activities within this field.

This guiding document is first designed to be valid until the end of 2012, and then it will be readapted by the partners in order to have a more long term strategy for biogas in Haiti. It will be reviewed at regular interval (end of year) and may be adjusted accordingly.

1.2 Relief and Recovery background

Activities in the biogas field within Haiti for 2010 – 2012 will take place in a complex background of disaster relief, recovery and development.

For relief, as of June 2010, over 1.5 million remain displaced from the earthquake and over 1 million are dependent on food aid. About 1 million of the displaced people are located in over 1340 camps of variable size and formality. A large scale humanitarian program is addressing basic needs; however securing adequate shelter and sanitation remains very difficult.

For recovery, as of June 2010, the general direction of the recovery has been laid out in the Haitian government Plan D'Action de Relevement and Development National (PARDN) (PARDN). Of direct relevance to biogas, the PARDN makes clear reference to the need for investments in sanitation (Section 4.3.6) with an estimated budget of US$160 million (Table 4.5). Other relevant sections include agriculture (4.3.1) and access to electricity (4.2.4).

For long term development, the needs are possibly best expressed in terms of access to clean water and sanitation. Before the earthquake, only 24% of Haitians had access to improved sanitation in urban area and only 71% had improved water sources (2008 figures WHO/UNICEF JMP). Hence there is an enormous unmet need for improved sanitation (which is closely linked to the potable water needs due to water pollution issues).

2. BACKGROUND AND RATIONALE

2.1 Biogas background

Biogas is the shorthand label for the process of controlled anaerobic digestion of organic matter combined with methane gas capture. The process converts organic waste such as human and animal excreta and food wastes into methane, nutrient rich effluent (supernatant) and solid sludge suitable for soil conditioning. The technology has been established for over 30 years and several million units are apparently in operation worldwide. The technology is simple, highly economic and scalable: the smallest units serve individual households whilst the largest built process waste from thousands of livestock. However lessons learned in many countries indicate that the technology needs to be introduced with care – technical problems do occur and adapting the designs and operating systems to the local context is critical for its acceptance. Economic marginality is also an issue for many designs and settings.

General background on biogas can be found at http://www.iea-biogas.net/ , http://www.ashdenawards.org/biogas and several other commercial websites and sources such as http://www.completebiogas.com/toc.html

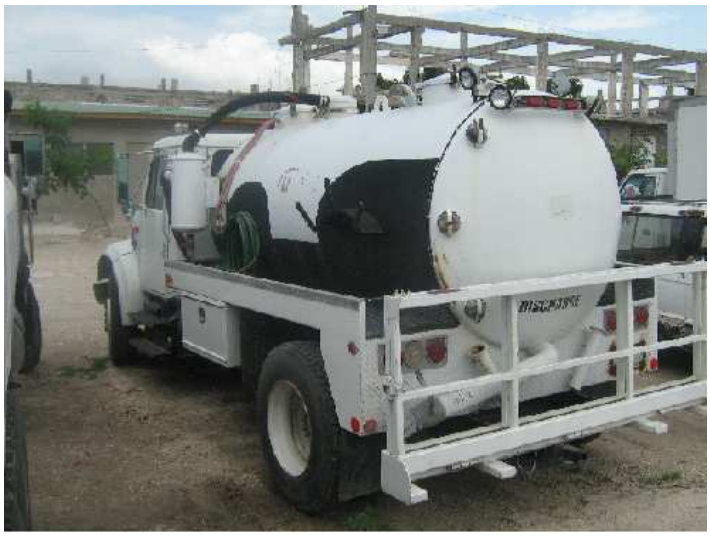
Family size Biodigestor in Petrópolis-RJ, Brazil.

2.2 Existing needs and potential applications

Biogas is a multi-thematic solution to multiple problems or needs. In the Haitian context, the technology has the theoretical potential to partly address the following needs:

Human waste/sewage treatment: At present very little human waste is properly treated in Haiti. Most toilets are simple pit latrines or emptied either directly into storm water drains or into basic septic or holding tanks. Some tanks are emptied by trucks however the resultant highly polluting waste is typically dumped directly into watercourses or into gullies which are flooded seasonally. Since the earthquake, a fleet of desludging trucks has been mobilized to transport human waste from collection points in the temporary camps. Most of this waste is going to dumpsites or again

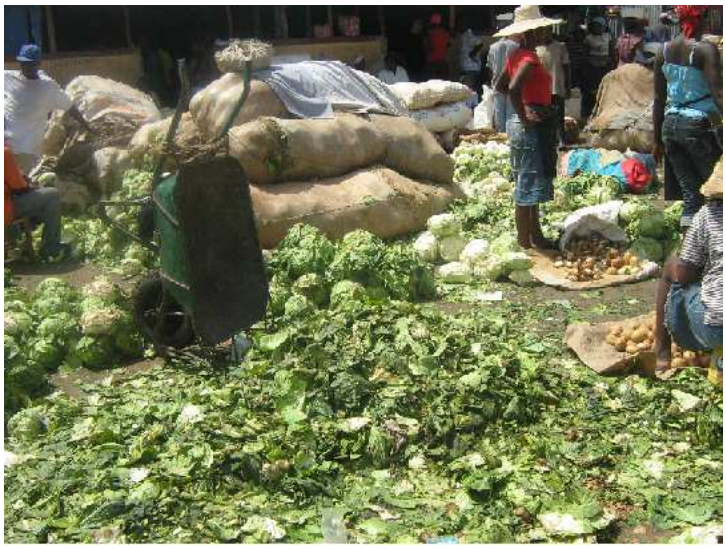
to watercourses. This can cause serious human health problems as this is currently (Q4 2010) the case with the cholera outbreaks affecting the country (as of October 29th, the Ministry of Health has confirmed 4,714 hospitalized cases and 330 deaths from cholera and the WHO affirms that the peak has not been reached yet). The root causes of this epidemic disease demonstrate that long-term solutions to the disposal and sustainable treatment of human waste are more needed than ever. In practical terms, there is a need to address human waste treatment for practically all of the near 10 million population of Haiti with the needs possibly most urgent in the 3 million urban populations in the regions affected by the earthquake. Human waste can be simply treated by biogas units and indirectly produce 100.000 m3 biogas, equivalent to 225.000 kWh (energy) per day. [1]



A sludge tanker

Organic waste management: At present organic wastes (mainly discarded fruit and vegetable matter) are not properly managed. Large quantities of material are dumped on streets, channels, and gullies or at best transported to the local landfill. Landfills are generally uncontrolled and are a major source of pollution, adding to the health hazards. Mixed organic waste can be treated by biogas units to become a source of clean energy. Some of the waste coming from butcheries can be used in biogas units too.

[1] One adult person can generate 50 liter of biogas per day. Average with child is estimated to 33 l/day. One m^3 biogas contains 2.6 MJ or 7.2 kWh energy. 25% to 35% can be converted to electricity, rest is heat losses.



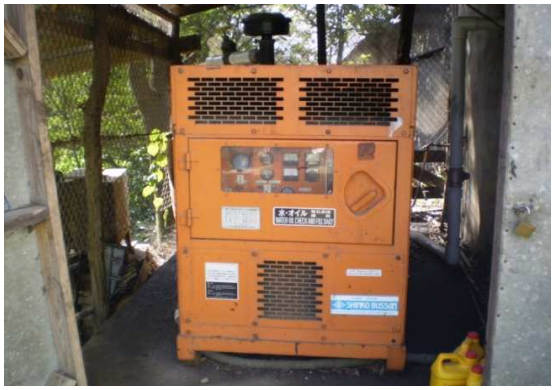
Port au Prince marked vegetable waste.

Access to energy: Haiti is extremely energy poor. Essentially modern forms of energy-specifically electricity and gas – are only available to a minority of households. The main part of Haiti energy demand is covered with overexploited natural resources in the form of firewood and charcoal. This situation is aggravating the chronic wood fuel resources deficit.

Biogas units increase access to energy through the use of human waste for the supply of methane, which can be used for cooking or industrial heating. [2]Large scale biogas units can generate methane to supply cities with electricity from fuel gas engines or turbines. In fact, human excreta from 1 million people can generate cooking gas for up to 100.000 households or fuel 75.000 kWh/day gas powered electricity generator units. [3] Taking into account cultural acceptance, relatively easiness to store and transport the gas as well as linkages with national or local electricity grids, biogas has the potential to provide a small but locally useful percentage of Haitian energy need.

[2] VivaRio experience from Brazil says 50 liters biogas/day with 74% methane from an adult person. It gives 37 liter methane corresponding 23 grams with a calorific value of 1312 kJ or 314 kcal or 364 Wh (the amount of energy 4,5 liter of water absorbs when heated from 30 to 100 degree Celsius)

[3] Source: www.embrapa.gov.br.



Biogas powered generator

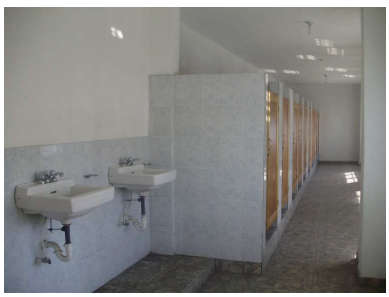
Biogas based gas cooker

Fertilizer: The outputs of a fully operational biogas plant include liquid effluent (supernatant) and solid residue (sludge). Both the liquids and the solids, though not sterile, contain high levels of organic and inorganic matters, particularly nitrogen, and are very suitable for use as fertilizers and soil conditioners. The viability of the use of these outputs is principally linked to materials handling and transport costs – the materials need to be transported to the agricultural sites or such activities need to come to the biogas unit. As an agricultural and developing country, Haiti has a clear need for such outputs. The potential for use and associated economics needs to be reviewed on a case by case basis.

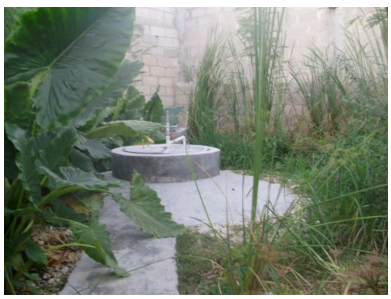
2.3 Existing biogas units and approach used

There are two operating biogas units in the neighborhood of Bel-Air in Port-au-Prince, built by Viva Rio as pilot models to benefit the community. Based on their success and, in partnership with Norwegian Church Aid (NCA), Viva Rio is working to implement 18 additional bio systems in the Haitian municipalities of Port au Prince and Cite Soleil until December 2010.

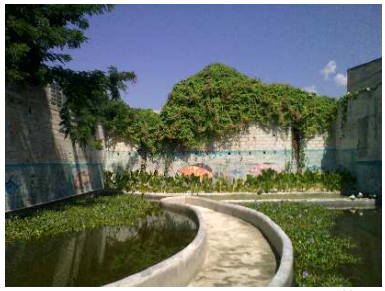
Viva Rio has been using a successful approach, which has been proven to work. It consists in integrating the local community in the whole biogas implementation process: design, construction and management. Viva Rio trains local workers to become experts in building and managing the bio-system. It also promotes hygiene and the use of local materials and local institutional resources.



Public Toilets in the Biogas Unit



Biogas Unit or Biodigestor



Lake zone or Biodigestor Liquid Effluent

2.4 Review of alternatives and limitations

This brief review of alternatives is based upon the simplification that the principal driver of biogas for Haiti is improved sanitation, with energy and fertilizer aspects considered to be important but secondary benefits. We also bear in mind that for DINEPA, the alternatives should be based on individual or semi-collective treatment systems.

- The "do nothing' or baseline alternative is inexpensive in investment cost however it is highly damaging to human health (e.g. cholera outbreaks, etc.) and the environment. Hence it is not considered a viable long term alternative.
- The basic alternative in use now consists in collecting the sludge in pits or portable toilets to be emptied by desludging trucks. This alternative can be associated with a treatment process on the final destination of the sludge. However it might be highly damaging to human health and to the environment. Hence it is not considered a viable long term alternative.

- One viable but only partial alternative is an increase in the use of deep pit toilets and composting toilets. The pit toilets are relatively inexpensive but their long term application is largely limited to rural and peri-urban areas. The composting toilets can be used anywhere, but the compost needs to be brought to an area where farming is being done. This still leaves an estimated 3 million or more urban dwellers without an adequate solution.

- Another potentially viable alternative is the increased use of holding tanks and septic tanks with outfalls and infiltration systems. This would be a major improvement on the existing situation but would still result in large scale use of desludging trucks and disposal of human waste from the full tanks.

- Construction of decentralized waste water treatment systems (DEWATS). Those can include the use anaerobic baffled reactors, septic tanks with several compartments… This solution is interesting but not yet in use in Haïti. The out coming effluent can be used in fish ponds.

- The fourth major alternative is the construction and operation of sewage treatment works for the human waste transported by trucks. The principal obstacle in this case is the cost – both for construction and for operations. All other things being equal, industrial biogas should have an economic advantage over conventional systems due to the simpler construction and lower capital cost and the economic returns from gas production. This comparison however depends upon moderate liquid effluent discharge standards or a beneficial use of the effluent – biogas plants cannot achieve very strict discharge standards.

Whilst in theory, biogas has potentially a very broad application in Haiti, in practice, limitations and operational issues noted in other countries might similarly constrain its potential here. These issues include cultural issues, construction costs, space constraints, limited gas storage and feedstock limitations (for example Haitian animal rearing practices are unlikely to yield enough manure in most places). All of these issues will be addressed at the feasibility and design stage to avoid sustainability problems and deliver real benefits.

2.5. Summary of rationale

In summary, there is a clear and major need for improved sanitation and environmental solutions for Haiti. The cholera outbreak affecting the country urges the need to find sustainable and long-term solutions to human waste treatment. Biogas can provide part of the solution to this challenge, particularly in urban areas. The gas and fertilizer outputs are considered to be co-benefits and would assist principally in reducing the overall operating costs - potentially to the stage of generating a marginal profit for some operations. If successful and fully rolled out across Haiti, it could provide sustainable benefits to 2 - 4 million people at a lower cost than the noted alternatives.

3. BIOGAS PROGRAM 2010 – 2012

3.1 Goal and Objectives

Goal 2020: Provide economically sustainable improved sanitation to at least 2 million Haitians.

Goal - December 2012: Provide a low cost, environmentally acceptable sanitation solution to 1 million Haitians.

Objectives - December 2012:
- Develop an environmentally acceptable permanent solution for 50% of the human waste collected in tanks in the Port au Prince region.
- Improve the access to clean toilets to 200,000 residents of transitional camps and marginal areas (bidonvilles).

Outline Scope 2010 – 2012

The program scope for 2010 – 2012 will depend largely upon: a) funding for construction and b) securing land for biogas units. At its full scale the scope of work would include:

1. **Program coordination and development** Coordination, development of government awareness and policies as well as local technical capacity for construction and operation.

2. **Small scale sub-program: expansion** phase of small scale units to provide coverage for 200,000 residents of the Port au Prince region with a later expansion of pioneer sites into 10 other Haitian cities and major towns.

3. **Industrial sub-program** Design, construction and startup of an industrial biogas site with power generation using human waste, waste from the butchery and vegetable waste in the Port-au-Prince region.

Each of these major components is described in turn below.

3.2 Program coordination and development

Biogas is a completely new technology for Haiti and as such it presents both risks and opportunities. To provide real benefits on a large scale it needs to grow very quickly from a very limited base but also to develop locally applicable designs and social models. Finally it needs to evolve into a self financing and self sustaining process within 5 years or less to enable it to continue in the complete absence of foreign aid. Combined these present a major challenge.

In this context, the proposed scope of program coordination and development is as follows:

- Continuous coordination – provided initially by the Biogas Technical Working Group but delegated at a later stage to a full time professional working within DINEPA.
- Awareness raising on biogas issues with the government, international partners and local partners
- Support to the development of government policies regarding biogas.
- Capacity building linked to the technology - in addition to the working level capacity building occurring with the urban and industrial sub-programs.
- Resource mobilization for the program.

3.3 Small-scale sub-program

The working model for the urban sub-program is the construction of up to 20 communal toilets clustered around a small to medium scale biogas unit. The gas generated is normally used for communal cooking or powering generators. The supernatant flows through a biological filter system of water plants and trees and the solids are extracted yearly and used as soil conditioner.

This model is technically well proven and has a low unit construction cost. However, if we want to promote this system in order to serve the sanitation needs of the low-income towns of Haiti, we will need to build thousands of units across the country. Those units must be operationally self-sufficient through cost recovery via toilet fees and the use of the gas. The challenge in this case is to continually improve the social and economic model in order to gain the acceptance of the communities and to drive down the costs of construction and operation.

Between 2010 and 2012, the number of units to be built may range from 40 to over 500 dependent upon funding and feedback from the early efforts.

3.4 Industrial Sub-program

At present, the sludge coming from the camps is desluged on the national landfill of Truitier. The total amount of human waste discharged daily represents approximately 500 m^3. As the number of sanitation facilities will increase, this volume will grow.
These volumes are appropriate for treatment in one or several industrial scale biogas units. Such units have large digestion chambers and operate at high efficiency. Normally the gas produced is used onsite to fuel a gas engine for electricity generation. They require full time staff, a moderate amount of space (2000m^2 or more) and sustainable solutions for effluent use or disposal. Capital costs and power outputs are completely dependent on the unit scale, type and site layout but start at US$ 1 million or more. Running costs can be partly, if not completely, recovered if the generated electricity is sold into the grid at commercial rates.

The site selection, design, approvals and construction process for industrial biogas units can take well over a year in other countries and is anticipated to take at least one year in Haiti. Specialist engineering expertise is required for this work. A substantive feasibility and design process is required given the high uncertainties linked to the introduction of industrial biogas in general and in Haiti in particular. The logical first steps therefore in launching an industrial biogas program are a) to undertake a rigorous feasibility study and b) secure a suitable site.

The construction of an industrial biogas unit by end 2011 or earlier is proposed. This will be dependent upon funding, a positive result from the feasibility study and the government of Haiti securing an appropriate site.

3.5 Budget

The budget for the 2010 – 2012 program cannot be accurately predicted at this stage and is expressed as a range in the table below.

Component	Min	Optimum	Maximum	Comments
Program coordination and development	100,000	500,000	700,000	Coordination costs increase with program size
Small scale subprogram	1.000,000	2,000,000	6,000,000	Capacity constrained by space availability in high-density urban areas.
Industrial subprogram	2,000,000	5,000,000	10,000,000	Costs highly unpredictable at this stage
Totals	3,100,000	7, 500,000	16,700,000	Range indicates uncertainty prior to feasibility study

3.6 Financing

In Q3 and Q4 2010 the biogas program has secured and allocated approximately US$80,000 provided by Norwegian Church Aid and UNEP for the small-scale sub-programme and secured US$130,000 through OCHA and UNEP for the industrial scale sub-programme. Overall, those funding are being used to carry out in-depth feasibility study that will be translated into technically sound and costed proposal for the installation and operation of small scale and industrial biogas units in the Metropolitan Area of Port au Prince in 2011.

This implies the need for additional financing in Q1 2011 for the implementation of the project proposals developed. At this point in time (October 2010), the budget needed is highly uncertain but expected to be in the order of US$ 5 – 10 million. The proposal, in particular for the industrial unit, will target the Haiti Recovery Fund and bilateral donors. The small-scale subprogram will continue to target smaller donors such as NGOs but do not exclude the HRI.

3.7 Work plan 2010 - 2012

The 2010 – 2012 detailed work plan for the Haiti Biogas Program will change regularly as early results are reviewed and financing secured. Hence it will be a living document and will be developed and updated by the Biogas Technical Working Group at regular intervals.

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