FEASIBILITY REPORT

ANAEROBIC DIGESTION ON THE ISLAND OF ST. HELENA

Final report
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EXECUTIVE SUMMARY

One of the basic conditions for a stable biogas production is a continuous inflow of raw materials having a somewhat homogenous composition. It is the opinion of the expert that this could be realized at St. Helena.
Even though the island is small, the cost of transport is rather high (due to the geographical features of the island and the cost of fuel). This discourages transport and stimulates diverse decentralized initiatives. Therefore it might be a good option to implement several smaller biogas and composting projects on the island (instead of 1 -relatively- big project). Most probably, the two piggeries are the best places to start with anaerobic digestion.
Regarding diversion of household waste organic from Horse Point Landfill Site (HPLS), starting to implement a composting unit at HPLS would probablybe the best way to handle the issue of the biogenic waste on the island. There is actually no need to wait for a biogas plant in order to start diverting the organic fraction from the landfill. Therefore the expert advises to start with diverting this biodegradable fraction from the landfill in the first place and start to compost this material. Ideally this is the snowball that creates the avalanche of change.

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1 Introduction

The preparation and communication prior to and after the mission to St. Helena was rather extensive and difficult at some points[1]. Furthermore, the expert had the impression that some people had different interests, expectations and/or objectives of the mission (making biogas from any kind of feedstock / diversion from the landfill / finding a solution for the wastewater sludge, etc.). But nonetheless, the expert is glad for having had the opportunity to work in Saint Helena, offer his expertise and present this report to the client.

Besides Milan Jezic von Gesseneck & Anne-Gaëlle Julian from OCTA Innovation, the expert would like to thank all the people who took the time for meetings and discussing the possibilities, raising questions and giving food for thought. The discussions were open and very useful.
A special thanks goes out to Mike Durnford at EMD for all of his effort to make the mission to St. Helena as beneficial as possible.

As mentioned in the methodology presented in the application, anaerobic digestion cannot be compared to most other renewable energy technologies and/or waste treatment technologies. Anaerobic digestion is basically one of the oldest 'technologies' on earth. It is multi-faceted and can serve several purposes such as waste treatment (in a sustainable way), production of fertiliser, production of renewable energy, avoidance of BAU-emissions, etc.
But anaerobic digestion also requires a thorough preparation phase and a good follow-up and maintenance during operation. Furthermore, there are many different types of anaerobic digestion (wet vs dry digestion, batch vs. continuous digestion, etc.) and even more technologies and providers on the market. As can be noticed below, many aspects need to be considered in a biogas project. Therefore, it is very important to make an in-depth feasibility study and to implement a simple and sturdy technology in remote areas such as Saint Helena. In the context of the further development of the OCTs it would also be a critical mistake to rush things to implement a biogas plant too hastily.

Abbreviations:

- AD: Anaerobic Digestion
- ASP: Aerated Static Piles
- BAU: Business As Usual
- BPP: Biogas Production Potential
- CHP: Combined Heat & Power
- EMD: Environmental Management Division of the Saint Helena Government
- HPLS: Horse Point Landfill Site
- LEMP: Landscape & Ecology Mitigation Programme
- MSW: Municipal Solid Waste
- OCTs: Overseas countries and territories
- OFMSW: Organic Fraction of Municipal Solid Waste

SSO: Source Separated Organics (also referred to as bio-waste, kitchen waste, etc.). Green waste could be included in this fraction to a greater or lesser extent (different terminology is applied worldwide)

[1] Mainly because of the fact that the opening of the airport was delayed and different opinions on the scope of delivery between the expert and the beneficiary.

2 Short description of activities carried out

Project objective

The aim is to identify the optimal plant for St. Helena in order to produce energy from locally-produced waste.

Beneficiary

Overseas Countries and Territories (OCTs)

In accordance with the Methodology 07/03/2016 as presented by the expert, following activities were carried out:

- Preparation of the mission
  - Desk research
  - Preparation of a questionnaire
  - Contacting
  - Request for (preliminary) budgetary offers
  - Review of information received by EMD in advance
- Information gathering in St. Helena
  - Site visits and meetings with relevant people
- Consolidation of the information & writing of the report

Activities prior the mission in St. Helena:

17, 23 & 27/11/2017 *(Gent, Belgium)*

Preparation of the mission; communication, elaboration of questionnaires, contact with providers of small-scale biogas plants, research, etc.

Total: 3 days

Activities during the mission in St. Helena:

Day 1 – 04/12/2017 *(Saint Helena)*

- Visit to Horse Point Landfill Site; meet Patrick Crowie (Landfill Manager).
- Visit to Millennium Forest to assess the need for compost at that site
- Visit to Mulberry Gut Farm (vegetable farming); meeting with Colin Thomas (Owner).
- Visit to Solomon's Piggery; meeting with Mandy Peters (CEO), Cherie Dillon (Deputy CEO), Dean Okali (Production Division Manager) and Arthur Williams (Livestock Manager).
- Processing of data.

Day 2 – 05/12/2017 *(Saint Helena)*

- Visit to Environmental Management Division (EMD) of the Saint Helena Government. AD discussion with Mike Durnford at EMD.
- Guided tour of the Peaks with Lourens Malan to assess the possibilities of biomass from the forest for biogas and the need for compost
- AD discussion with Mike at EMD.
- Visit to St Helena Distillery; meet Paul Hickling (Owner) in order to discuss the possibilities of using waste from the distillery to produce biogas.
- Processing of data.

Day 3 – 06/12/2017 *(Saint Helena)*

- Meeting at Connect St Helena with Barry Hubbard (CEO) and Leon de Wet (Operations Director) to discuss the possibilities of electricity generation via biogas on the island.
- Meeting at Technical Services with Mark Plato (Project Manager) and Chris Peters (Civil Engineer) in order to discuss a possible location for a biogas plant on the island and the feasibility of construction such a plant.
- Meeting at St Helena National Trust with; Jeremy Harris (Director) in order to discuss the need for compost on the island.
- Processing of data.

Day 4 – 7/12/2017 *(Saint Helena)*

- Meeting at the Environmental Management Division (EMD) of Saint Helena with Isabel Peters (Chief Environmental Officer).
- Meeting at Agriculture & Natural Resources Division (ANRD) with Darren Duncan (Division Manager), Andy Timm (Agriculture Development Officer), Myra Young (Forestry Officer) Catherine Man (Senior Veterinary Officer) and Ludi Kern (Invasive Plants Specialist).
- Meeting at the Castle with Roy Burke (Chief Secretary)
- Processing of data.

Day 5 – 08/12/2017 *(Saint Helena)*

- Presentation of the task & the work to the Elected Members and OCTA AD Project Board Members/stakeholders - Council Chambers at the Castle.
- Processing of data.

Day 6 – 11/12/2017 *(Johannesburg, South Africa)*

- No travelling (there were no connecting flights). Writing of the report & preparing additional questions to technology providers.

Day 7 – 19/12/2017 *(Gent, Belgium)*

- Processing of data & writing of the report. Conversation with other consultant regarding biogas plants in remote areas.

Total: 7 days

Activities after the mission in St. Helena:

9, 16 & 23/01/2018 *(Gent, Belgium)*

- Consolidation of the information & preparation of the draft report
- Final contacts with technology providers
- Communication with EMD, OCTA Innovation & Eurecna

Total: 3 days

Another 2 days are foreseen in February for processing the feedback & finishing the final report.

3 Data collection & analysis

3.1 Feedstock

A variety of organic feedstock can be used for biogas production as long as they contain carbohydrates, proteins, fats and hemicelluloses as their main components. Possible substrates for anaerobic digestion available on the island are:

- Bio-waste/SSO: currently there is no source separate collection of household waste organics on the island of St. Helena.
- OFMSW: Every week, the EMD collects the mixed municipal solid waste that people put in their black wheelie bins. Glass and aluminium cans are collected separately in public places but not at household level. The waste is brought to HPLS by the two EMD collection vehicles. In 2013, the total amount of MSW sent to the landfill was calculated to be about 875 ton (for 4645 inhabitants) (see Picture 1). **According to EMD, the estimated amount of organic fraction in this waste (OFMSW) was 130 t.** The expert could not visually identify a lot of organic material in the MSW.

Picture 1: MSW in a landfill cell at HPLS

[There are nets above the landfill cells in order to avoid a sudden flight of a flock of birds (as a safety measure for the airport nearby).]

As a reference: the average amount of putrescible waste in Belgium and the Netherlands is about 150 kg/pp/y (sum of bio-waste collected separately & present in the mixed/residual waste). If that number would be applied to St. Helena we would obtain 675 ton. There are however a number of reasons why the amount of SSO on the island is (probably) lower:

- Disposable income is lower so people are not as wasteful.
- Many people have a small garden where they do home composting and/or keep some animals which they feed the kitchen waste.
- There are few restaurants, catering services & bars per inhabitants. These establishments usually create higher volumes of food waste.

The composition of this fraction is currently unknown. The expert has sent guidelines to EMD in order to select a representative sample of 2 kg of the fraction <40 mm to be sent to the lab of OWS in Belgium for an analysis. The results from this analysis would be of high importance to this report because the biogas production potential of waste is the starting point of any good feasibility study. The composition of waste is different in every country and region. There are biogas plants producing 45 Nl of biogas per kg of domestic waste, while other plants produce 165 Nl/kg. This means a difference in biogas (and revenues) of > 3.5 times. The results would, of course, also shed light on the possibilities of composting. Concerning the quantity & quality (composition) of the waste, the expert would like to add following considerations:

- As far as the expert could find out, there is no large difference in the quantity of the waste according to the period of the year (=seasonality).
- This is of course, a BAU-scenario. A change in policy (eg. introduction of differentiated rates in order to stimulate source separation of different fractions) is not taken into account. Furthermore, with the new airport,it is to be expected that the amount of tourists on the island will grow.
- This is only the biogenic waste that is currently contained in the black wheeler bin (biowaste that people are currently using for home-composting and/or sending to e.g. Millenium Forest or farmers for small-scale composting is not included). So the potential available quantity could be higher.
- The percentage of biogenic waste in the black bin wheeler seems to go up in the years after 2013 (see Annex 'Waste wheel annual data'), but it is not sure if this also means that there is a rise in absolute numbers (because it is not known how much waste was actually collected in the years after 2013).
- The amount of paper and cardboard in the black wheeler bin in 2013 is supposed to be about 30t. This fraction has a high biogas production potential, it's also collected via the black wheeler bin and therefore readily available at Horse Point Landfill Site. The share of this part has gone up in 2016 in 2017 (in relative numbers, it is not confirmed that this is also higher in absolute numbers). The (average) composition is unknown.
- There is a lot of green waste that is not included in the data/waste wheel analyses but that is also brought to the landfill (by the people themselves) and therefore readily available. The (average) composition is unknown.
- Sewage sludge is also available at the landfill site and could probably also be fed to the digester, at least in a certain amount. Several people raised the topic of the sludge and informed whether the biogas plant could also be a solution for this substrate. Unfortunately, the (average) composition of this substrate is currently unknown to the expert. Therefore it is difficult to assess the possibilities and potential of this feedstock. Either way, making biogas and/or compost from biosolids is possible. An analysis of this product should of course be done if St. Helena wishes to investigate valorization technologies for this substrate and if the production of biogas from sludge is to be considered.
- There are also other possible feedstocks available on the island:
  - **Pig manure** (solids and liquid) from the 2 piggeries on the island. Only the Solomon's piggery was visited (see Picture 2 & 3). This piggery has about 400 pigs but also has 2 other waste streams from the slaughterhouse (solids & liquid) which could also be used for biogas production (although those substrates are a bit more complicated then liquid pig manure to digest). Exact compositions and quantities of all these substrates are unknown.

Picture 2: pigs at Solomon's piggery

Picture 3: manure gutter at Solomon's piggery

There is also a second piggery on the island but this facility was not visited by the expert.

- **Fish waste** from the fish market. Average composition and quantities are unknown[2].
- **New Zealand flax cuttings**. Available in huge quantities on the island (in forests, along the roads & in gardens). The composition and the biogas potential are currently unknown. Due to the high fibre content, biogas production will probably be rather low. However, if flax is cut along the roadside, it could be a good idea to bring this to the future biogas plant and start experimenting with this substrate. Shredding of this product would be necessary before entering the digester.
- **Tungi spirit residues**. The Tungi distillery does not seem to produce a feedstock that contains enough energy in order to justify transporting this to the biogas plant, let alone taking this product into account while dimensioning the biogas plant. In need of a liquid substrate to add to an existing digester, this product could be reconsidered. But this product should not be taken into account in any design or feasibility studies.

Of course, not all technologies and systems can handle all these feedstock in all possible mixes and quantities; but that will be addressed later on.

[2] After reading the draft report, Derek Henry (Director ENRD) mentioned the following: Fish waste from the processing factory at Ruperts – quantities are possibly known as this waste is dumped at sea. Check with Elizabeth Clingham.

3.2 Energy

3.2.1 Valorisation of the biogas (general)

The harvested biogas can be used/valorized in different ways.

- Flaring
  The biogas is just burnt into the open sky (and therefore emitting mainly CO_2 instead of the more harmful CH_4). So there is a greenhouse gas saving, but the calorific value of the biogas is actually not valorized in this case.
- Use as a fuel for producing heat
  The produced biogas could be used to cook, dry or heat. As far as the expert can determine, there is no large (continuous) demand for heat on the island, except the hospital and the community care complex. However, that is quite far in distance from Horse Point Landfill Site or the 2 piggeries. Installing a waste treatment plant and/or biogas plant next to the hospital and nursing home, is most probably also not feasible.
- Use in a combined heat & power-plant (CHP)
  A CHP-plant produces electricity and heat. The electricity could be used on site or injected in the electricity grid. Valorizing the produced heat on the island would pose a challenge.
  This seems to be the best way to use the produced biogas on the island. If a biogas plant was to be installed at HPLS, the electricity produced could be used on site to power all current electrical equipment (which is limited at this moment) and possibly some future equipment (such as a conveyor belt and/or small shredder). Any excess electricity could be injected into the existing electricity grid (according to Mr. Hubbard & de Wet from Connect this should not pose a problem).
- Upgrading to bio-methane
  The CO_2 present in the biogas could be removed and the biogas is then 'upgraded' to bio-methane and could be injected into the gas grid or used as a vehicle fuel. The expert believes that the possible amount of biogas that could be produced on the island is so low that it would never justify an investment in such upgrading techniques. Furthermore, there is no gas grid available on the island and a vehicle on biogas would probably be too difficult (no knowledge on that topic is available on the island and probably not enough biogas/bio-methane will be produced for this).
  Notwithstanding the foregoing, the expert would like to mention that the company Bioeco Sarl offers an upgrading unit for producing biofuel starting from 1Nm³ biogas/hour (which could be possible for St. Helena).

There is a renewable energy program on the island and tenders in that regard were published. Not a single biogas technology provider showed interested in this. Probably because it would be too difficult to produce renewable electricity on the island with anaerobic digestion for under 12 pence/kWh (the threshold price Connect sets for buying the electricity). Therefore 'only' producing energy/electricity can not be the main driver for implementing a biogas plant (as mentioned before, AD serves multiple purposes – which is sometimes rather disadvantageous instead of advantageous).

3.2.2 Energy from OFMSW at HPLS

The expert advised EMD to collect a sample of <40mm and sent this over to OWS in Belgium to perform a BPP-test (this was also added as a free commercial gesture in the offer of the expert). However, the OCTA Innovation Project Board communicated on 5/01/2018 that it was agreed that collecting and sending a sample of organic waste for analysis would be 'too problematic and therefore discounted from further work'.
Therefore, at present, the exact amount and composition of the organic fraction in the municipal solid waste is unknown, but the expert assumes that there is *at least* 130 tpy of OFMSW and an additional 30 tpy of paper waste (easily) available on HPLS, resulting in a potential of 160 tpy of OFMSW (including paper & cardboard). Assuming an average biogas production of 125 Nm³ this could result in about 20.000 Nm³ biogas or 11.000 Nm³ CH_4

(assuming 55% methane) and an installed power of about 3-4 kWe (or 32.800 kWh of electricity)[3].
At this moment, there is a very low consumption of electricity at HPLS. However, surplus of electricity could be injected into the existing electricity grid.

Based on the contacts with the different providers the expert estimates the CAPEX for such a small-scale biogas plant at HPLS between € 100.000 and € 300.000. The large spread in price is due to the fact that many options are still open (production of hot water or electricity or Bio CNG?) and that the exact composition of the waste is still unknown. Prices from Tiguri & BioEco sarl (two providers who seem to have a lot of experience at first sight) lie between € 200.000 & 300.000 for a realistic concept for St. Helena. The expert does not have a good view on the OPEX but that should be low in this type of technology. The expert estimates the yearly OPEX between € 3.000 & € 5.000.
Of course, some additional CAPEX & OPEX is expected for the pretreatment of the waste (size reduction, removal of metals & inerts, etc.). But these expenditures depend on the composition of the feedstock and the configuration of the pretreatment (eg. highly automated or mainly manual selection).

Both systems look quite interesting but the expert would like to point out a few remarks:

- In general, (large-scale) wet digestion of household waste organics is not popular anymore (due to the many problems with sedimentation & flotation), so these problems should certainly be addressed as much as possible in advance whilst evaluating a (small-scale) 'wet' technology. Even paper could also pose problems in wet digesters.
- Some providers calculate with a biogas production of > 200m³/ton of food waste but as a general rule the expert considers this as very optimistic.
- For purpose of hygiene & regulations, pasteurization of the waste, digestate or compost would be required if the aim is to produce clean compost (5 hours at >57°C or 1 hour at >70°C uninterrupted are standard settings that comply with respectively UK and EU regulations, but other treatment methods could be accepted).

3.2.3 Energy from pig manure

In general, pig manure produces between 0,08 & 0,1 m³ CH_4 per day per pig. Solomon's piggery has about 400 pigs and is therefore able to produce at least about 32 m³ CH_4 per day (or about 11.200 m³ CH_4 per year). The manure from the pigs at Solomon's piggery could therefore also result in an installed power of about 3-4 kWe (or 33.000 kWh of electricity)[1]. The piggery at Solomon's does seem to have a high electricity demand (exact number is unknown to the expert). Auto-consumption of the produced electricity is usually to be preferred (instead of 100% injection in the electricity grid) because of financial and administrative-technical reasons. But of course, surplus electricity could also be injected into the existing electricity grid. For a slaughterhouse, it could also be very interesting to burn the biogas in a boiler for a couple of hours per day.
It goes without saying that the potential and the possibilities for a biogas plant at the other piggery should also be investigated.
Bringing manure up to (e.g. a digester at) Horse Point Landfill Site seems illogical because of their geographical location. The truck needs to climb a hill and cross a valley and that takes a lot of fuel and time.
Estimated CAPEX for a biogas plants (including valorization of the biogas) for these piggeries: between € 35.000 & 75.000. The expert does not have a good view on the OPEX but that should be very low in this type of technology.

[3] Based on an electrical efficiency of about 30% (small-CHP's have lower efficiencies then large-scale CHP's).

3.3 Digestate/compost

Besides the biogas, the anaerobic digester creates another product: 'digestate'. The composition of this products depends mainly on the ingoing feedstock but also on the applied technology. Digestate of a dry digester will have a total solids-content between 15 & 40% and digestate after a wet digestion will have a total solids-content <15%. Digestate from household waste organics is not used as such on the field. Most projects send this material to a composting plant in order to produce a compost that is 'stable' and safe to use. In order to do this, the digestate should be dewatered and/or dried, or 'mixed up' with dry material such as green waste in order to create a mixture that can be aerated/composted. There are no numbers available but the expert believes that there is (or could be) sufficient green waste available at HPLS to mix up a dry digestate to a total solids-content of 45% in order to pursue an efficient composting. In case a wet digestion would be installed, this could pose a problem and an additional dewatering (small press) or drying unit could be necessary.

Concerning the use of compost it seems that the use of compost is not widespread, not for individual families nor farmers. Of course, some people (or companies & institutions) on the island use imported compost (± 15 £/bag) but the exact amount of compost imported is not known to the expert. Furthermore, as a part of the St Helena Airport Project, the LEMP initiated a Community Compost Scheme in 2014 to reduce organic waste going to HPLS, and to assist with the production of compost to be able to grow endemic plants for habitat restoration works around the Airport construction. "*There are 10 JK400 compost units on Island spread throughout communities from Half Tree Hollow to Longwood. The units are being managed by individuals in these communities who have approached their neighbors to take part by collecting their kitchen waste. Each unit can accommodate 10 households. Anyone supporting the scheme can be provided with a kitchen caddy to store their organic waste in to make it easier to transport the waste to the composters. All kitchen organic waste can be put into these bins from tea bags to raw fish and cooked bones. In a matter of weeks the waste transforms into good quality compost, used to grow plants. An added benefit is that all waste composted does not go to the landfill, meaning there is less waste to attract pests. The scheme helps up to 100 households to divert their waste"*[4].
According to the expert, this initiative does not conflict with a potential biogas and composting plant. On the contrary; familiarizing people with organics and composting could only be beneficial for the island and its policy regarding organics and organics recycling.
Furthermore, the expert assumes that compost that would be produced at HPLS would be of better quality (due to a 'professional' follow-up) and that the quantities would be higher (and therefore easier to handle/spread).

So production and use of compost is not widespread but it seems as if there is certainly a potential market for good quality compost and furthermore it seems highly regrettable that this product is being imported (at a high cost) while it can perfectly be produced locally.

[4] http://www.sainthelena.gov.sh/lemp-community-compost-scheme/

4 Conclusion/opportunities:

One of the basic conditions for a stable biogas production is a continuous inflow of raw materials having a somewhat homogenous composition. It is the opinion of the expert that this could be realized at St. Helena in the long term.

Even though the island is small, the cost of transport is rather high (due to the geographical features of the island and the cost of fuel). This discourages transport and stimulates diverse decentralized initiatives. Therefore it might be a good option to implement several smaller biogas and composting projects on the island (instead of 1 -relatively- big project).

4.1 Domestic waste

In the long term, pursuing a biogas project on the organic fraction of household waste is something worth doing for St. Helena. First of all because it would extend the lifetime of HPLS to a great extent and furthermore, evolving towards a sustainable treatment of waste seems to be a necessity for the island now that it will be more connected, accessible and prone to accept more visitors and inhabitants. It is important to realize that '*we all make choices, but in the end our choices make us*'. The choices that are made now (or soon), will determine the look and image of the island in the near and far future.
That being said, it is clear that the provided data is not sufficient to draft a tender for a biogas plant treating the household waste organics of St Helena.

As a lack of renewable energy does not seem to be an acute problem and therefore the possible main driver for a biogas plant, **it is the opinion of the expert that a gradual evolution towards a biogas plants might be the best option** (instead of making a giant leap from a controlled landfill to a material recycling facility with a biogas plant included). After all, as for now, nobody really knows what the (average) composition of the biodegradable material/kitchen waste is, and how much tonnage this represents.

Starting to implement a composting unit would be the best way to handle the issue of the biogenic waste on the island. There is actually no need to wait for a biogas plant in order to start diverting the organic fraction from the landfill. Therefore the expert advises to start with diverting this biodegradable fraction from the landfill in the first place and start to compost this material. Ideally this is the snowball that creates the avalanche of change.

There are 2 scenario's for doing this:

- **BAU-scenario + post-separation at HPLS**
  In this scenario, the (mixed) waste is still collected in the black wheelie bins. In order to sort out the biodegradable fraction at HPLS, an investment should be made in some equipment such as a sieve, a shredder, a magnet. This could be accompanied/replaced by manual labor to a certain extent. Producing clean compost from the mixed waste would of course be more challenging than producing clean compost from SSO. But if the final compost would not be used for food production (but rather for landscaping), the demands for the produced compost could be lower.
- **Source separation**
  Implementation of a source separate collection of biogenic waste would make it easier to divert the organics from the landfill and to produce biogas and clean compost in the long term. This would of course result in an investment on the collection and logistic side. Furthermore, there would still need to be a shredder and a magnet and most probably a sieve before sending the organics to the digester, certainly if there is a desire to create clean compost for food production. But the CAPEX for the composting (and/or biogas) unit would be smaller compared to the case of mixed waste. Furthermore, all (future) biogas plants (and certainly low-tech solutions) would benefit from a feedstock with as little impurities as possible.

An additional collection service would most definitely be a disadvantage of this system, but, if the biogenic fraction would be left out of the black wheelie bins, there would probably be no need to collect this every week (but every fortnight instead). In order not to attract any vermin and cause inconvenience, the kitchen waste would likely have to be collected twice a week.

It is not the responsibility of the expert to decide on the type of collection scheme. But the expert is convinced that it would be good to build up some experience with the biogenic fraction before starting with an anaerobic digestion-unit. Once the biogenic fraction is separated (central or at source), this fraction can go to composting. The hangar at HPLS could be used to create a (professional or industrial) composting zone, either in windrows (that are turned every now and then) or in aerated static piles (ASP). An ideal mixture between kitchen waste and green waste will have to be made. A composting expert should probably be hired to bring in some knowledge on that topic but either way, local experience with the composting process will need to be built up. Of course, residues from invasive species (eg. New Zealand Flax) and solids from the piggeries could be added to a certain extent. The sewage sludge could also be used for producing biogas and/or compost, but given the fact that sewage sludge contains human excrements, some caution is required regarding the application of the digestate/compost on land for food production (this is mainly an issue if the composting process would be suboptimal and if pathogens would not be eliminated).
A professional (or industrial) composting unit will require energy and a future biogas plant could most probably be able to provide that energy. To dimension that biogas plant, data about the amount and the composition of the kitchen waste and the energy demand would be needed.

4.2 Pig manure

Actually, the pig manure from both piggeries could contain more energy than the OFMSW on the island (the energy content in the pig manure from Solomon's piggery alone is comparable to the assumed energy content in the OFMSW). And, most probably, the produced energy could be used on site to a great extent. Furthermore, installing a biogas plant on these farms could be less complicated because of the following facts:

- This would be a private project, no public money is involved and (probably) less 'red tape'.
- The technology for this kind of substrate is simple, cheap and proven. Furthermore, (no or) less problems are to be expected with impurities.

Bringing manure up to (e.g. a digester at) Horse Point Landfill Site seems illogical because of their geographical location. The truck needs to climb hills and cross vallies and that takes a lot of fuel and time.

The expert sees 3 possible technologies applicable:

- "balloon (sausage) bio-digesters" (**see Picture 4**): for small piggeries (10 to 500 pigs) & large piggeries (500 to 1000 pigs). This is a practical solution for remote sites like the island of St. Helena and this 1 or 2-ton package could easily be shipped to Saint Helena and both piggeries.
  This is a very simple technology, as well for installation as maintenance & operation. But the plastic balloon has a relatively short useful life-span (about 5 years) and is susceptible to mechanical damage and usually not available locally.

Picture 4: Balloon (sausage) biodigester

- anaerobic lagoons (**see Picture 5**): only for large piggeries

Picture 5: Anaerobic lagoon

Both technologies are provided by the company BioTec, but there are of course also other companies offering these technologies. Also the Combibag LP from Wiefferink (actually a type of an anaerobic lagoon) looks quite interesting for this purpose. However, the expert would like to emphasize that following matters deserve sufficient attention when selecting a technology:

- Manure washing needs to be controlled (amount of water)
- Pre-treatment could be necessary (presence of stones/litter/…)
- Antibiotic has to be monitored

5 Relevant technology providers

- Tiguri / SEaB Energy (Flexibuster), https://www.tiguri.swiss/anaerobic / https://seabenergy.com/
- Bio Eco sarl, http://www.bio-e-co.fr/index.php
- Erigène (Eribox), http://erigene.com/
- Qube Renewables Ltd, http://quberenewables.co.uk/
- Novatech GmbH, http://www.novatechgmbh.com/
- Bioplex Ltd, http://www.bioplex.co.uk/
- Biotec, http://www.bio-tec.net/ (mainly for the pig manure)
- Asia Biogas, http://www.asiabiogas.com/ (mainly for the pig manure)
- Green Heat International, http://www.greenheatinternational.com/biogas/ (mainly for the pig manure)
- Biolectric, https://www.biolectric.be/en/our-installation/ (mainly for the pig manure but not sure if they still offer the low-tech bag-digesters)
- FEW GmbH (Biogastiger), http://www.biogastiger.de/ (not sure if they are still active)

6 Useful articles & links

- Investigation on possibilities for biogas production from organic waste on the Croatian Island of Kirk,
- Solid waste management challenges in Pacific Island countries,
- Case study: Community participation in biogas production (Tuvalu)
- Towards the energy transition on Europe's islands.

7 Attachments

- ENRD Strategic Plan 2017-2020
- HPLS Management Manual
- Saint Helena Government Energy Strategy
- Waste Management and Recycling Options Assessment 2015
- Waste Management Strategy 2017
- Waste wheel annual data
- Presentation Biogas on St. Helena

8 Contact details

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