THE DEVELOPMENT OF A COMMERCIAL BIOGAS PROJECT IN BRONKHORSTSPRUIT, SOUTH AFRICA

- A Review –

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1. Background & Objectives

The project reviewed here is one of the few, and the first commercial scale of this kind, that begins to tap into the immense South African bioenergy generation potential. Despite repeated reports considering both crop-based and waste-based resources, there is little activity on the ground. Around one hundred household scale installations and around ten projects at farm scale are known to be operational. Most of what exists at farm scale is around piggeries, seemingly inspired by the first medium biogas digester implemented at Humphries Piggery Farm in Bela Bela in. In most of these installations, biogas is used to generate electricity for private use and not exported onto the national grid. At the large scale (> 1 MW), some public entities (e.g. Joburg Water and PetroSA) have completed generating projects, whilst private enterprise (SAB) has operational biogas plants that supplement boiler fuel.

Bio2Watt, the company that it is developing the project under review, the Bronkhorstspruit Biogas Project (BBP), is a relatively new company founded only in 2007. The aim of Bio2Watt is to develop sustainable biomass chains for biogas generation from residual waste. BBP is the first project that Bio2Watt is developing; however the development of several others is underway, though not as advanced.

Since the project is the first of its kind in the country, it has been decided that learnings from its development will be well documented to inform and assist in the development of future projects.

The objective of this report is thus to document:

1) The development of the project from conceptualisation, via Environmental Impact Assessment (EIA) through to financial closure;
2) The interactions between the project developer Bio2Watt with various stakeholders that were instrumental in the development of the project, including (but not limited to) local and national government departments and business partners;
3) The processes of acquiring permits and authorizations from local and national authorities;
4) Processes and initiatives for acquiring project funding, and to some extent;
5) The experience with Clean Development Mechanism (CDM) funding for the project.

2. Theoretical framing

We draw from an 'innovation systems approach' in documenting the development of the biogas project. This type of approach has been found useful for gaining insights into how nations, regions and sectors position themselves innovate for economic/market benefits. It has also been used extensively to understand technology evolution and transitions in a more focused application viz. 'Technology Specific Innovation Systems'. A widely accepted definition is given by Carlsson and Stankiewcz (1991), who defined a technological system as a "Network of agents interacting in a specific economical/industrial area under a particular institutional infrastructure and involved in generation, diffusion and utlilisation of technology". This approach was found to be particularly useful in unpacking the development of the German Biogas Industry and other technologies in European industries (Hekkert et al, 2007).

There is a general consensus among technology specific innovation system scholars that for an industry to move from a place of experimentation to a full-fledged industry, activities that are undertaken by actors, networks and institutions should fulfil the so-called system functions. These include: entrepreneurial experimentation, knowledge development and diffusion, guidance of search, market formation, resource mobilisation and advocacy (Bergek et. al., 2008; Hekkert et al., 2007). These functions need to reinforce one another in virtuous cycles for an industry to mature. We are therefore interested to document which of these functions this early South African biogas project could draw on, which ones it stimulated to emerge, and which ones were lacking or so under-developed that they held back the execution of this project.

3. Results: Project documentation

3.1 The development of the project from conceptualisation, via Environmental Impact Assessment (EIA) through to financial closure

Overview

The Bronkshorstspruit Biogas Project (BBP) was conceptualised shortly after the company was established in 2007. The project is situated at the Beefcor Feedlot in Bronkhorstspruit, one of the largest in the country, housing in excess of 20 000 heads of cattle which produce over 40000 tonnes of manure per annum. The target capacity of BBP is 3 MWe to be generated from biogas produced from a variety of feedstocks. In addition to the cattle manure, the following substrates will be used; chicken abattoir waste, vegetable and fruit market waste, paper sludge and dairy waste. CPG-Waste Solutions, a New Zealand based company was initially identified as a technology provider for the Covered In Ground Anaerobic Digester (CIGAR), due to over 30 years experience in the construction and operations of biogas plants. Bio2Watt financed most activities during the concept design phase.

The Environmental Impact Assessment Process

Due to the size of the proposed development (a footprint of greater than 1 hectare of agricultural land), a full EIA had to be conducted according to the Environmental Impact Assessment (EIA) Regulation (2006). Bio2Watt contracted an EIA specialist consulting company, Core Earth Resources (CER) to conduct the EIA process.

The EIA process can be broadly categorised into two major phases, viz.

i) the scoping phase and

ii) the comprehensive EIA phase.

Scoping phase

In the first phase CER introduced the study to the public for initial participation, gathered relevant information and identified specialist studies for the subsequent phase. The outcome of this 4 month long phase was the submission of the scoping report to Interested and Affected Parties (I&APs) in Bronkhorstspruit for comment. The comments were then incorporated into the final scoping report which was sent to the designated provincial department for environmental authorisation. The responsible department for this project was the Gauteng Department of Agriculture, Conservation and Environment (GDACE). The department's decision for CER to proceed to the 2nd phase of the EIA process was made 7 weeks later.

Comprehensive EIA phase

Once the permission to go ahead with a comprehensive EIA was granted, CER outsourced specialist studies to other consulting companies (e.g. surface water impact, biodiversity assessments, etc.) and incorporated those study reports into the main EIA report and the Environmental Management Plan draft report. Once compiled, the reports were sent to I&APs in Bronkhorstspruit and a meeting hosted for additional comments. The comments and suggestions were incorporated into the final reports (the EIA report and the Environmental Management Plan reports) which were then lodged with GDACE for Record of Decision (RoD). The environmental authorisation was received 9 months later, and overall the entire EIA process for BBP took 1 year and 6 months.

Summary of funding initiatives

Bio2Watt had to invest its time and funds into an adequately researched desktop study that attracted a loan from E+Co in the initial stages of the project. The loan enabled Bio2Watt to commence with the EIA study for the BBP. At the same time Bio2Watt established an instrumental partnership with Partners for Innovation, a Dutch consulting entity which assisted in applying for funding from Agentschap NL's Global Sustainable Biomass Fund. Indeed, the application was successful and BBP received a big boost in August 2009 when they received a grant to develop sustainable biomass chains in South Africa for biogas projects from residual waste. This enabled development of other similar projects but also funded BBP pre-feasibility and feasibility studies as well as processes of acquiring permits and licences.

Summary of securing feedstock

Another instrumental aspect in the development of BBP was securing sufficient quantities of feedstock over and above cattle manure available at Beefcor; this has been on-going since 2008. Initially, chicken litter from the neighbouring Earlybird farm was secured as additional feedstock. It was established however that its use will evoke additional downstream effluent treatment and hence escalate capital and operations costs; it was thus abandoned and other material sourced. Additional feedstock materials that have been secured are chicken abattoir waste, yogurt and ice cream waste, liquid fat trap waste and most recently (2012) vegetable and fruit waste, as well as paper waste were secured. Bio2Watt has entered into a supply

agreement with a large waste companyto supply feedstock to BBP from the above mentioned locations. Their suitability for use as feedstock had to be tested.

Feedstock Bio-Methane Potential (BMP) tests

The suitability of a certain waste stream is usually determined by a Bio-methane Potential (BMP) test which gives its potential biogas yield. The BMP tests of various feedstocks was done in parallel with the process securing of additional feedstock summarised above. Through the NL Agency's grant Bio2Watt had hoped to set-up a pilot biogas plant in which BMP tests would be conducted. That component of the project was dropped due to extremely high set-up costs and lack of interest from potential users. Subsequent to that, a collaboration was established with the University of Witwatersrand (Wits) to set-up a similar laboratory facility based at Wits. Even though the collaboration was proposed under the Department of Trade and Industry's (Dti) Technology and Human Resources for Industrial Programme (THRIP) at a much lower cost to Bio2Watt, this initiative did not materialise due to internal matters within Wits University. The approved budget would have seen Bio2Watt contributing 1/3 and THRIP 2/3. The BMP tests were therefore outsourced to CPG-Waste Solutions in New Zealand. It was only in 2012 that two local laboratory facilities, one at the Stellenbosch University and another at FarmSecure Technologies were identified and used for BMP tests.

Summary of securing permits and licences

Another onerous process for BBP was acquiring permits and licences. The fact that the project was amongst the first of its kind in South Africa exacerbated matters. A list of licences and permissions required is listed in Section 3.3 below. The acquisition of licences and permits has essentially been ongoing since 2008 with varying requirements and time frames for each permit/licence.

Initiatives to secure debt for the construction phase

In addition to securing licences and permits for the project, the process of securing finance for the construction phase of the project commenced as early as 2009. Originally, the Development Bank of Southern Africa (DBSA) had agreed to provide 80% debt towards the construction of the project. DBSA was however unresponsive towards BioWatt's questions about banking requirements, which led them to approach and enter into an agreement with the Industrial Development Corporation instead, the loan agreement was signed on the 28th March 2013. IDC has provided a commercial loan of 70% of total project costs. Other equity investors include Bio2Watt, Norfund, EPC contractor and two impact funds. The project is estimated to be in operation in the second quarter of 2014.

Technology provision/partnership

The initial technology provider for the BBP was CPG-Waste Solutions, a New Zealand based company. Close to financial closure, however, its biogas unit was shut down prompting Bio2Watt to scout for another technology provider, additionally Basil Read Matomo who were the engineering group on the project at the time highlighted risks associated with the Inground digester systems because of South Africa's climatic conditions.. Bio2Watt approached a Canadian company, ADI, which unlike CPG-Waste Solution's CIGAR system employed a CSTR system. This has since proved to be too costly and Bio2Watt reviewed proposals from other

technology providers. In February 2013, Bosch Projects in partnership with the Danish company was awarded the contract to build the plant. For this reason, the project has been set back by a few months. In the past few months, outstanding licences viz. generation licence has been awarded and the water use licence was awarded in October 2013. The financial closure is expected to be not later than the end of November 2013.

3.2 The interactions between the project developer Bio2Watt with various stakeholders that were instrumental in the development of the project

Table 1 provides a list of stakeholders, including (but not limited to) local and national government departments and business partners and their interactions:

Table 1: Bio2Watt Stakeholder interactions

Type of stake-holder	Name	Summary of interaction
Academic institutions	University of Witwatersrand (Wits)	Collaborative work on setting up a lab/testing facility through the THRIP programme, this fell through. An additional agreement was to train personnel that would later be employed to run the Bio2Watt plant once it is up and running
	University of Cape Town (UCT)	UCT provides knowledge dissemination service to Bio2Watt by using various platforms to diffuse knowledge to various biogas actors with a primary focus on academic crowd
	University of Stellenbosch (US)	US provides Biomethane Potential (BMP) test services to Bio2Watt, it was only identified in 2012 after Bio2Watt had been outsourcing the services to a New Zealand based company
Financiers	NL Agency Global Sustainable Biomass Fund	NL Agency is the main funder Bio2Watt's development of biogas projects. It invested in excess of €600 000 over 4 years from August 2009.
	Industrial Development Cooperation (IDC)	IDC is the main financier of the construction of the BBP, it came on board as debt provider in the first half of 2011
	Development Bank of Southern Africa (DBSA)	DBSA funded the developmental phase of the project with an amount of R389 000 through the REMT funds they were also the initial debt provider for BPP project but it was later dropped due to bureaucratic related reasons

	E+Co	E&Co has been providing financial, legal and business expertise since November 2009. In 2010, E&Co provided a loan ofR2.7 million into the development of biogas projects in general
	Finnish Development organisation (Energy & Environment Partnership Programme in Southern and East Africa)	A grant to the amount of €50 000 was granted to Bio2Watt for the feasibility study of the BBP in 2011
Government entities	Department of Environmental Affairs (DEA) and Gauteng Department of Agriculture, Conservation and Environment (GDACE)	Interaction with DEA for EIA and Waste Management Licences were largely facilitated by CER on behalf of Bio2Watt.
	Department of Water Affairs and Forestry (DWAF)	The Water Use Licence Application (WULA) is being sourced by Bio2Watt from DWAF, the initial application was lost and had to be re-lodged
	Department of Energy (DoE)	DoE has been providing Bio2Watt with considerablesupport for the application of a Generation Licence from NERSA as the project is the first of its kind - the support extends to other government departments such as for the Water Use License
	Tshwane Municipality	It has been involved on various fronts; it had to issue Municipal Consent Use Licence for use of agricultural land. It was involved in permission for granting municipal solid waste for the project which hit bottlenecks because of various permissions that are required. It was also facilitating the off-take agreements and power purchase agreements (PPAs)
	Kwinguni Municipality	Bronkhorstspruit fell under the Kwungini municipality before Tshwane took over
	Eskom	Eskom is involved in authorisation of grid connections and transmission agreements, which Bosch Projectsis doing on behalf of Bio2Watt
Private Sector	BMW	Have signed a 10 year off-take agreement to purchase electricity generated from the BBP project

Service providers	Basil Read Matomo	Conducted a feasibility study for Bio2Watt (detailed design and costing) - Their proposal ended up too high given the PPA had already been signed based on a lower cost technology
	Bosch Projects and Danish's Combigas	Will be involved in the construction of the plant and the grid connection and transmission of power on Eskom's grid
	CPG- Waste Solutions	The initial technology provider who has being involved with the project from 2008 to 2012. They conducted the pre-feasibility study and did BMP tests. Initially they were going to construct and operate the BBP on behalf of Bio2Watt. Their biogas unit closed down in 2012
	Core Earth Resources (CER)	Environmental Consultants that were sub-contracted by Bio2Watt to conduct the EIA. This involved sub-contracting of other specialists whom they worked directly with.
	FarmSecure Technologies	They are providing BMP tests services as of 2012. Unfortunately due to delays in setting up a national framework to support biomass projects this company has now been liquidated and the laboratory with it.
	Edward Nathan Sonnenbergs (ENS) attorneys	Provides legal advice and assist in drafting commercial agreements and facilitating meetings that require legal expertise
	Partners for Innovation	They helped Bio2Watt to secure AgentschapNL funding to develop biogas projects in South Africa. They are also developing a framework that provides the methodology to be used to assess the sustainability of biogas from waste projects in South-Africa.

3.3 The processes of acquiring permits and authorizations from local and national authorities

Acquiring licences and permits from various government deparments was lengthy and tedious for the BBP. The first permit to be granted was the Environmental Authorisation. The details of the EIA process are detailed in Section 3.1 above. Below is a list of licences/permissions required for setting up a commercial biogas plant on agricultural land.

Name of a licence/permit	Responsible entities	Time frames	Additional requirements (if any)
Environmental Impact assessment (EIA)	Lodged at the designated provincial department as appointed by the National Department of Environmental Affairs	1.5 years	Specialist studies can include but are not limited to: ***Ground water impact study*** ***Surface water impact*** ***Heritage impact assessment*** ***Air emission impact*** ***Biodiversity assessment***
Land lease agreements	Department of Agriculture	6 months	Required if someone else besides the owner of the land plans to build and operate a plant, maximum duration of agricultural land lease is 10 years, in cases where more time is required, e.g. when the life of the plant is 20 years. An application has to be lodged with the Ministry of Agriculture for duration extension
Municipal Consent of Use Licence	Responsible municipality	2 years	This licence is granted by municipalities and allows plants to be built and operated on agricultural land
Waste Management Licence	Department of Environmental Affairs	Up to 6 months	Application is issued under the National Environmental Management Act, 2008 by the Department of Environmental Affairs. The licence authorises the storage and the processing of animal waste.
Water Use Licence Application (WULA)	Department of Water Affairs and Forestry (DWAF)	Up to 2 years	Application issued to the Ministry of Water Affairs and Forestry according to the National Water Act.
Power Purchase Agreements (PPAs) / Off take agreement licences	Private power users (e.g. BMW in case of Bio2Watt), municipalities etc.	Varies	The time this takes varies based on the length of negotiation process with an off taker
Generation Licence	NERSA	Up to 6 months	A generation licence from NERSA for projects outside the REIPPP have to get approval from the Department of Energy.

Grid Connection and Transmission Agreements	Eskom	Up to 12 months	Agreements obtained from Eskom if the connection is sub contracted
Wheeling agreement into the National Grid	Eskom	6 months	The procedure for this is well understood and requires that a power purchase agreement is concluded
Wheeling agreement with the involved municipality	Tshwane Municipality	2 years	The process of acquiring this was lengthy as there is no framework in place. This can also only be signed once a PPA has been signed

3.4 Processes and initiatives for acquiring project funding

The process followed to finance the development of the BBP can be broadly classified into 3 categories: i) own financing, ii) donor funding and iii) debt or equity financing.

In the initial phases of the project Bio2Watt financed its own activities, including the conceptualisation of the BBP. These activities were able to attract seed funding from E+Co in the form of a commercial loan, which kick-started the EIA process. This was able to get the project to a stage where they could attract funding from donor agencies.

a. Existing local channels

Bio2Watt's initial efforts to source funding locally were unsuccessful, for instance, their application the Central Energy Fund (CEF) was unfruitful. They used the project developers resources while looking for funding opportunities internationally. The outcome of the international funding endeavours are summarised in the next section. The local funders only came to the party once Bio2Watt had leveraged funding from international sources. The local funding of R389 000 came from Developmental Bank of South Africa (DBSA) and was specifically earmarked for the development of BBP.

b. International sources of funds

Following a comprehensive desk study on the potential of waste to energy projects, and a failed attempt to secure funding from local funders, Bio2Watt managed to secure a loan from a United States based organisation, E+Co. E+Co has since injected funds amounting to R2.7 million throughout the developmental phase of BBP. In addition, Bio2Watt collaborated with a leading Dutch consultancy for sustainable innovation, Partners for Innovation to source additional funds. Partners for Innovation helped Bio2Watt to secure funding from the Global Sustainable Biomass Fund of the Netherlands Development Organisation. The funding amounted to €627 000 and was received in August 2009 to develop several biogas projects in South Africa. Additional funding to the amount of €50 000 was granted by another international donor agency, the Finnish Development Organisation, specifically for the BBP.

c. Commercial banks

As noted in the summary above, the process of securing debt for the construction phase commenced early in the project development phase. Bio2Watt approached commercial and developmental banks to provide debt for the project; however were met with resistance from commercial banks due to the perceived risk. On the other hand, a developmental bank that Bio2Watt approached, the Developmental Bank Southern Africa (DBSA), agreed to provide up to 80% debt. Due to lack clarity with regards to banking requirements from DBSA, Bio2Watt sought and secured debt with another financier, the Industrial Development Corporation (IDC). Debt agreement between the IDC and Bio2Watt was signed on the 28th March 2013.

4. Analysis and Discussion

In the following section, a "technology innovation system functional analysis" is presented for this project. The analysis is based on a notion that for an emerging industry to develop, seven types of system functions, (also known as key activities), developed by Hekkert and his colleagues (2007) of Utrecht University, need to take place concurrently and reinforce each other. The analysis is meant at identifying key processes and activities that are currently evident in the industry. Firstly, an analysis is provided on how activities within the project (BBP) itself fulfilled functions that would be expected in the emergence of a South African biogas innovation system. Secondly, an investigation into which of the system functions were fulfilled or, not, by stakeholders with whom Bio2Watt interacted in the development of the BBP is also undertaken. It is also important to observe whether system functions fulfilled around this project reinforce one another into virtuous cycles, also referred to as motors of innovation.

Analysis of the BBP

Based on the narratives in previous sections, in particular, Section 3.1, the following functions have been fulfilled in the BBP:

1) The BBP is a typical example of the fulfilment of **entrepreneurial activities** function, whereby an entrepreneur takes a risk of investing his resources into a project without any grant promises. The main driver is the potential to generate energy from waste, despite the entrepreneur/company having no expertise in the technology itself, it has attempted to partner with experienced parties.

2) The initiative attracts donor funding for the company to do a thorough development of biogas projects in South Africa, a **resource mobilisation** activity.

3) **Knowledge diffusion** is another function that the BBP fulfils. Through the company's involvement in various government initiatives such as active participation in the waste to energy section of the Green Report, they have been able to diffuse knowledge about waste to energy technologies to others. In addition, the funders have requested that lessons learnt through the development of the project be disseminated to various stakeholders which will further fulfil the knowledge diffusion function.

4) To some extent this project has raised positive expectations (**guidance of search**) around energy from waste projects within government, which resulted in Bio2Watt being invited by

the Department of Environmental Affairs to COP17 to represent the country's energy from waste initiatives.

In summary, only four of the seven system functions were fulfilled by the project: entrepreneurial activity, resource mobilisation which has been able to unlock additional financing for BBP development, knowledge diffusion and to some extent guidance of search. There are no apparent reinforcing loops, thus no virtuous cycles can be observed in the development of the project.

Analysis of the broader landscape

Activities that can be observed in the broader biogas 'innovation system' (industry), which may have supported the BBP development, or their absence, which might have hindered it, are considered next. It was earlier mentioned that there were no national funding opportunities available when the development of BBP started, that changed later on in the project, as activities that contributed to the fulfilment of resource mobilisation were observed. For instance, DBSA provided some funding support in the third year of the development of BBP, and also that later the Industrial Development Corporation (IDC) agreed to finance the construction of the BBP. It can be observed therefore in the innovation system that entrepreneurial experimentation and risk-taking are important as they appear to precede the fulfilment of other functions, in this case resource mobilisation.

The 'guidance of search' function whose aim is to raise positive expectations about a particular technology, e.g. projects like the BBP seems to be limited in the larger industry. In addition, the 'market formation' function is weakly fulfilled, for instance, there is no information portal on the waste to energy market and the licensing requirements are usually not clearly articulated.

From the previous discussions and observations, it is clear that the institutional framework in which the biogas innovation system is to grow is generally not well defined. This can be observed by the non-fulfilment of system functions that are largely influenced and directed by government policy and regulations. These functions include guidance of search, resource mobilisation and market formation. Despite the announcement of a renewable energy policy in 2003 (SA Government, 2003) and follow-up strategy on biofuels in 2007, there was no clear regulatory renewable framework in place when the developmental process of BBP started. For instance, the REFIT programme which was aimed at giving direction to the industry was deemed unlawful in 2011, a huge drawback for most renewable energy projects and for biogas technology specifically. In addition, and to biogas technology's detriment, the renewable energy framework that was eventually put in place, the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) according to the biogas proponents, favoured the bigger renewable technologies projects such as wind and solar as opposed to the biogas technology.

As a result most, biogas initiatives continued in a weak, splintered or non-existing policy framework which proved to be problematic for BBP project. For instance, acquiring some permits and licences for a project that does not fall under the REIPPP was onerous and

additional permission and endorsements from other parties were essential. Therefore, although there was guidance of search for the renewable energy projects in general, that has not yet proved helpful or useful for the biogas industry at large. Also, equally requiring regulatory framework are the municipalities who need to support and provide permits and licences for projects similar to BBP.

The non-fulfilment of the resource mobilisation can be a hindrance to entrepreneurial experimentation and could dampen ambitions of a budding TIS. At the beginning of this project for instance, there was no clear direction regarding which government department or agency ought to drive and support energy from waste projects. It is clear that in the absence of international donor funding, the BBP would have struggled to get to the current state. There has since been other resource mobilisation initiatives: one such is Eskom's Standard Offer Programme (SOP) which although not relevant for projects that are less than 1 MW have been seen as a real alternative financing for renewable energy projects, especially the medium scale projects. Another is the recent establishment of the Green Fund.

Another important function that requires a regulatory framework is market formation, which talks to the importance to creating niche markets or incentives that protect emerging technologies against the incumbent ones. The current renewable energy framework appears to be more favourable for bigger renewable energy projects, e.g. solar and wind energy. Bio2Watt spent several years to reach a PPA with an industrial partner as such niches markets are not yet established for the biogas technology.

Also, the knowledge development function around biogas innovation is not widely fulfilled. There is relatively little biogas expertise in the country, especially in laboratory testing capabilities and locally available biogas technology. Here, the BPP might have found itself in a bit of 'chicken-and-egg' situation, in as much as the national innovation system does put emphasis on a linear model of technology invention to demonstration to market, but Bio2Watt not being a technology company nor able to devote resources to R&D to develop a local technology. As a result, Bio2Watt has had to leverage some of its activities in more mature biogas markets, which has also proven difficult. For instance, the first technology partner closed down operation at the late stages of project development. In addition, Bio2Watt might have to import some expertise to operate the plant, which points to a need for academic institution to equip graduates with some biogas knowledge if the industry is to reach the estimated potential growth.

Finally, whilst this development of a large-scale industrial biogas plant has been problematic and slow, surprisingly, there has been a lot more progress observed around medium scale biogas plants, esp. at piggeries. Although a commercial plant cannot be directly compared to medium scale units, increased entrepreneurial activity will hopefully influence a broader industry and provide platform for lobbying. Advocacy coalition function is beginning to be fulfilled following the formation of the Southern African Biogas Industrial Association (SABIA). Favouring the relatively faster rate of development of piggery projects is among other reasons the exemption from certain permits and licences. For instance, farmers implement and run the biogas systems, and thus do not require Municipal Land Use Consent Licence. Also, since the

generated biogas is often for farmers' use, they are exempt for several licences e.g. connection to grid agreements, generation licence, wheeling licences (Municipal and Eskom).

5. Summary of key learnings

Based on the previous analysis and discussions the following key learnings are extracted:

1) The development phase of a commercial biogas plant is lengthy, taking no less than 2 years even when all processes can be conflated and function ideally. For example, the EIA process alone took 1.5 years for BBP, which is normal for EIAs in South Africa. An approved EIA is a prerequisite for attaining some licences, viz. municipal consent of land use licence, generation licence, waste management licence and wheeling licences, and must thus be one of the earliest activities in the developmental phase of a project.
2) The process is not only lengthy but is also expensive: relative to the capital costs of developing the project (running in excess of R100 million), the share of approximately 5% on legal fees is sizeable.
3) The focus of the national innovation system on a linear technology driven process makes it difficult for early projects to adopt environmentally sensible technology developed elsewhere; in the case of the BBP no suitable biogas expertise and technology could be located in the country, which contributed to the slow progress of the project development. Bio2Watt had to leverage expertise from the more mature biogas markets. The switch of the initial technology provider then further delayed the project.
4) Thus far, there is an insufficient policy and esp. regulatory framework to guide the biogas industry, despite it having the potential to address some of the national challenges. For instance, whilst the National Waste Management Strategy developed under the NEM:Waste Act (2008) has the potential to ultimately ban the disposal of organic waste to landfills, which would present a real opportunity for biogas technology, it does not provide for a sufficiently consistent set of regulations to enable and streamline the deployment of this technology at this stage.
5) There exist inefficiencies in government departments in issuing permits. For instance, Bio2Watt had to re-apply for some permits as the response from government departments was not forthcoming.
6) Agricultural land as opposed to zoned industrial land evokes more permits: for instance the maximum agricultural land lease is 10 years; for 20 year projects, a lease extension has to be applied for from the Ministry of Land Affairs.
7) Power Purchase Agreements/ off-take agreements can take a long time and benefit from being pursued early in the project development.
8) The process of acquiring a wheeling agreement from a municipality is quite lengthy and in this case was unnecessarily expensive: for this project, it took 2 years and required extensive involvement of lawyers. The main reason is associated to the absence of the wheeling framework and lack of capacity for dealing with such issues within municipalities.
9) Obtaining generation licences for renewable energy projects that are not part of the REIPPPP is tedious, as NERSA requires motivation from the National Department of Energy before an application can be considered.

10) Lastly, there seems to be an increasing appetite by financiers for this type of 'green economy' venture – resource mobilisation is becoming easier as i) the country is translating a willingness to take action on climate change into concrete mechanisms and ii) successful demonstration projects start to provide guidance of search. .

6. Recommendations for future projects

6.1 Overall recommendations

The recommendations that were deduced from this review of the development of BBP can be broadly classified into 3 categories, viz. financial, implementation and technical, and are listed below:

Financial

Early stage funding from suitable government institutions (e.g. the Department of Environmental Affairs' Green Fund), or international funding, needs to be available for new projects. Funding support is needed early on in such a project as activities at the initial stage, e.g. Environmental Impact Assessment (EIA) and feedstock Bio-methane Potential (BMP) testing do take some time and need to be properly costed.

Commercial banks are becoming more mature in accessing concessionary funding instruments for such projects internationally; in line with this they should stream-line their stringent banking requirement for smaller renewable energy projects such as the biogas ones relative to larger ones e.g. solar and wind energy.

Implementation

Capacitating government agencies that issue various licences is crucial for speedy processing of applications, e.g. EIA. In a similar vein, a one stop shop with the capacity to offer advice and other related services regarding the development of renewable energy project e.g. licencing and permissions requirements can be beneficial for future projects.

The development of a framework that provides guidance for wheeling agreements within municipalities is crucial, as its absence results in lengthy licence processing times, up to 2 years and since it involves extensive involvement of legal support it can be an expensive process.

A process of acquiring generation licences for small renewable energy projects that are not part of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) should be simplified so that they can be granted by NERSA without the Department's of Energy's involvement.

Technical

There is a need to build capabilities to plan, design and construct biogas projects if the industry is to grow. Guiding industry technical standards are also needed, a matter which the newly formed 'Southern African Biogas Industrial Association' (SABIA) is planning to pursue. Lastly,

leveraging on the existing university capabilities e.g. for BMP tests instead outsourcing tests internationally could lower the costs of development.

Identifying several technology providers early on in such a project is beneficial, to give the developer options; a competitive bidding process by suitable technology providers can be initiated once the financial and regulatory aspects of the project are bedded down.

6.2 A guide for project developers: Setting up a commercial biogas digester in South Africa

1. Identify a suitable site to install a biogas plant. Here, close proximity to the feedstock and energy use/connection to power lines, if necessary, should ideally be prioritised. Also begin to apply for grants

2. Partner with experienced legal contract expert/s, their expertise will be invaluable throughout the project developmental phase. These include drawing and negotiating contracts with other stakeholders, clients and potential customers. It is however recommended that you negotiate a fixed fee contract with the legal team. Moreover if this is your fist project a financial adviser is highly recommended.

3. Once the site has been identified, contractual deliberations with relevant and affected parties should commence. For example, issues such feedstock acquisition, obtaining rights to use land etc.

4. Once relevant feedstock materials have been identified, their Biomethane Potential (BMP) tests need to be conducted, and checked against literature values.

5. The previous steps will inform a pre-feasibility desktop study; this is usually essential for assessing the viability of the project and can also be used as a proposal for funding applications to finance the rest of the project development. Additional funding is required for the rest of project development e.g. EIA and legal fees which can be extremely expensive. Developmental agencies locally and internationally are usually good starting points for this type of funding.

6. The next step is to select the exact site/land where the biogas digester will be erected and get the Environmental Impact Assessment (EIA) process as explained in Section 3 started.

7. As soon as the scoping phase of the EIA process has been completed, the developer may get the process of acquiring permits listed in Section 3.3 rolling as they can take extensive amounts of time. Although a positive RoD is a requirement for approval of some of the licences/permits, that is only required in the later stage.

8. Early negotiations with debt providers for the construction phase of the project should also start as soon as the scoping phase of the EIA process has been given a green light.

9. A concurrent activity is to identify and approach several technology providers. It is advisable to keep at least a couple until the very end of project development in case of any eventuality e.g. a company shutting down.

10. Once the EIA has been approved and a positive Record of Decision (RoD) granted, a process of identifying a potential off-taker can begin, especially if the project is not part of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP).

11. With a positive RoD is granted, a more aggressive process of acquiring debt from commercial and developmental banks can begin, in parallel to securing all the required permits besides the generation licence which is usually one of the last to be granted.

12. Once the bulk of the permits have been granted and the capital secured, a generation licence application can be lodged with National Regulator of South Africa (NERSA).

13. Reaching financial closure for MW sized project will take a minimum of 3 years, but can take up to 5 years.

Reference:

Hekkert, M.P. et al., 2007. Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74(4), pp.413–432.

APPENDIX:

Presentations made on the BPP during and as part of this documentation and knowledge dissemination project

1. Regional workshop on Emerging Technologies for Sustainable Biofuels and Added Value Bio-products from Agricultural Waste and Algae in SADC; Organised by **UNIDO and TIA**, Centurion, Pretoria; **26th July 2012**

2. Renewable Energy Video Discussion: Biogas technology: Operation and applications organised by **Centre for Renewable and Sustainable Energy Studies (CRSES)** at the University of Stellenbosch; **28th September 2012**.

3. Presentation lecture at Worldlife and Environment Society of South Africa **(WESSA); 10th October, 2012**

4. Presentation to the Climate Change Department at the City of Cape Town; **26th October, 2012**

5. Workshop on Sustainable Biomass in South East Africa, Maputo, Mozambique; **NL Agency** organised by: **19-21 March 2013**