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**REPIC**

Renewable Energy &  
Energy Efficiency  
Promotion in  
International  
Cooperation

## Final Report:

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# SUINERGIA

Reference plant for the  
ENERGETIC USE OF BIOGAS  
From anaerobic digestion plants in Brazil  
With the technology of the microturbine

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Report date: December 1<sup>st</sup> 2012  
 REPIC Contract number:  
 REPIC Project number:

Country: Brazil	Technology: Microturbine
Project Duration: Jan 2011 – Nov 2012	Category: Biogas

***Brazil***  
***the largest country of Latin America in population***  
***a country of superlatives, of contrasts and on the move***  
***... and in 2013: with Acrona***

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The author(s) of this report are alone responsible for its content and conclusions



## Contents

<b>0.</b>	<b>Summary</b> .....	<b>3</b>
<b>1.</b>	<b>Objectives</b> .....	<b>4</b>
<b>2.</b>	<b>Technical Solution / Applied Method</b> .....	<b>4</b>
<b>3.</b>	<b>Results</b> .....	<b>5</b>
<b>4.</b>	<b>Impacts</b> .....	<b>6</b>
<b>5.</b>	<b>Future Prospects</b> .....	<b>7</b>
<b>6.</b>	<b>Conclusions</b> .....	<b>7</b>
<b>7.</b>	<b>References</b> .....	<b>8</b>

### 0. Summary

Together with our Brazilian partner, the in São Paulo based company EcoGeo and with a co-financing of the Swiss Repic platform Acrona has realised a microturbine plant with one CR65 Microturbine on the Farm “Fazenda São Paulo” near Belo Horizonte, capital city of Minas Gerais. This plant commenced commercial operation in May 2012 and is working to the full satisfaction of the farm since then.

The target was to realise a reference project to demonstrate the reliability and technical capability of the microturbine technology fuelled with agricultural biogas. This target was completely achieved.

Acrona plans to realise three follow-up biogas projects in 2013, another six in 2014 and ten in 2015. As a result of the changed circumstances for co-generation projects in the last 24 months we also have commenced acquisition activities in this field. Our forecast includes two 1-MW-cogeneration projects for 2013.

The possibilities for financing of biogas projects have improved. With the Banco do Brasil, CEMIG and TPFL we have concrete programs and offers for financing of renewable energy projects with interest rates as low as five percent.

Subject to the approval of our board at the upcoming board meeting on December 14<sup>th</sup> 2012 we will create a subsidiary “Acrona Brasil” in São Paulo with a service hub in Belo Horizonte. A pre-contract for the purchase of an existing (silent) company is already signed. As a result the start of Acrona Brasil can be realised by a simple change of the company name. Also first interviews with potential employees have already been done recently.

The operational start of the reference site was delayed by almost eight months for various reasons. We also experienced a significant increase of hours needed to achieve our goals. I mention this in this summary because it would be naïve to assume that entering one of the biggest markets in the world can be done problem-free. There will be many hurdles to be taken. However, the prospects are excellent.

The most difficult part to enter a new market is always to realise a first project. Without the help of Repic this would not have been possible in our case. Many thanks.

## 1. Objectives

The Brazilian company AgCert had installed biogas digesters on almost 400 swine farms in Brazil under the CDM financing scheme of the Kyoto Protocol. The majority of these sites are flaring the gas. The Global Marshall Plan organization contacted us some three years ago and proposed to develop the concept of placing microturbines on these existing biogas plants in Brazil. The main objectives of the project have been to replace fossil fuel by renewable energy, to reduce the cost for electricity for the farmer and provide thermal energy for further use. The reference site demonstrates that these objectives are clearly met.

Several attempts have been made in Brazil to use biogas from anaerobic digestion of liquid manure in reciprocating gas engines in the past. Most of these attempts failed and an operation has often not been able for more than half a year. The main reason is seen in the fact that the biogas was used without pre-treatment, in particular without de-watering, but it is also assumed that the maintenance was not carried out frequently and by trained personnel. As a result, one of the major objectives of the pilot was to reduce existing prejudices by means of a successful demonstration of the operation of a microturbine plant with the biogas from an existing digester site over an extended period of time.

The concept has been to have a local content of the work as big as possible and feasible by a know-how transfer to Brazilian companies. For the reference project the objective was that the assembly of the plant shall take place at the factory of our partner EcoGeo in Sao Paulo. An engineer of EcoGeo has for this reason visited Acrona in Switzerland and did a two-week training session on the technology of the gas treatment and compressing plant. Whereas for the reference site the frame of the gas treatment plant was fabricated in Switzerland we intend also to carry out this work for future projects in Brazil.

The civil works on site and the interconnection (gas piping, process water, electrical) for the installation of a plant but also minor maintenance work such as oil change of the compressor or exchange of the activated carbon filter shall be carried out local manpower. The objective is to create work on farms in remote areas.

The successful demonstration plant is seen as the springboard for doing further projects and for creating an Acrona business hub in Brazil.

## 2. Technical Solution / Applied Method

The microturbine was sourced from the American company Capstone. The gas treatment plant is a development of Acrona, Switzerland. The main function of this component is to dry, filter, clean and compress the biogas. The unit was manufactured in a frame of two meter long, one meter wide and two meter height. This part also includes the programmable logic controller which controls and regulates the plant.

Both turbine and gas treatment plant has been shipped to the factory of our partner, the in São Paulo based company EcoGeo. The chiller, the activated carbon filter and heat exchangers were sourced locally by EcoGeo. All components were installed on a frame with the dimensions of approximately 6 x 2.5 meters. All piping and electrical wiring work was also carried out at the workshop of EcoGeo. The weather protection frame and roof was added at the end.

The entire plant was then transported by truck to the site and interconnected with help and support from the maintenance staff of the farm "Fazenda São Paulo". The advantage of the complete frame

installation at the factory of EcoGeo is that the work on site can be limited to a minimum. Also, the plant – for whatever reason – could to be transferred to another site with a minor effort.

The applied division of work worked out very well. The interfaces were clear and have not created problems. For the follow-up projects we intend to shift more work to Brazil. Only the concept and basic engineering as well as the software programming will be carried out in Switzerland. Also the material supply from Switzerland will be reduced: only the compressor will be pre-fabricated in Switzerland and shipped to Brazil whereas the sourcing of all other component and the assembly of the gas treatment plant will be done in Brazil.

The turbine will be bought from the United States since there is not Brazilian microturbine existing. For this reason it is not expected that the import of the microturbine will create difficulties. There is an existing custom tariff number in place for the importation of turbines.

### **3. Results**

With a delay of almost 8 months the microturbine plant finally commenced commercial operation in May 2012 and is working since then without any problems. The client is very satisfied.

The cooperation with the local partners EcoGeo from São Paulo and with Furtado & Associates from Belo Horizonte was excellent and we are convinced that the foundation for a fruitful and successful cooperation for future projects is set.

The only flaw from the point of view of the client is that he experiences frequently disturbances or shut down of the electrical grid. In such cases the turbine automatically shuts down and the farmer needs to restart the plant manually. During a visit to the site in November 2012 he asked us whether an automatic restart after a grid shutdown can be implemented. An investigation by the engineers at Acrona in Switzerland showed that with a minor correction in the wiring and with extended software this feature can be realised. Acrona will implement this modification through our local partner EcoGeo during the next site visit of EcoGeo.

## 4. Impacts

On the technical side the pilot project has successfully demonstrated that the microturbine is capable of running with agricultural biogas in Brazil. The problem is more seen on the biogas production. The company AgCert has been taken over by AES a few years ago. Due to the significant reduction of the prices for CO<sub>2</sub> certificates the business has not been profitable for years for AES. The attention to the maintenance of the biogas digesters was therefore insufficient. The consequences are sedimentation of biomass inside the digesters with the result of a reduced biogas production.

Our approach for the problem of a reduced biogas production is to offer a package to potential clients including the cleaning of the existing digesters and to retrofit them with combined heating and circulation system. This will increase the cost but is inevitable to secure a constant or even increased biogas production for an extended period of time. As a result of this price increase we will focus on projects with a minimum of three CR65 microturbines because the economics are better with larger projects. In parallel we will implement a cost reduction program to allow the realisation of projects with only two CR65 microturbines from middle of 2014 onwards. Whether it will be possible to realise projects with only one microturbine is not clear at this moment – it certainly is a target.

The financing side of the projects have clearly improved. The original concept was to finance the projects to 80 percent with money from the Brazilian development bank and realise the project under a Built-Operate-Transfer (BOT) concept. Recent discussions in Brazil showed that several institution offer 100% loans to the farmer with interest as low as 5 percent. We therefore have changed the concept and will include the organization of the financing of a projects into the package for the farmer.

The biggest change during the course of the project is that the activities of Acrona in Brazil have been extended: We now aim to enter Brazil on two tiers: agricultural biogas as foreseen but also co-generation projects as a new business segment. Co-generation means the simultaneous production of electricity and heat/cold at a client's industrial or commercial site. By doing this the overall efficiency can be increased to values as high as 90 percent whereas conventional centralised power plants do reach a maximum of 60 percent fuel efficiency. Co-generation is therefore seen as promising method of reducing CO<sub>2</sub> emissions. Subsequently follows some consideration on this subject.

With high gas prices and moderate electricity prices in most of the areas (only the São Paulo area and to a limited extend some other large cities have rather high electricity prices) the circumstances for co-generation projects running on natural gas or diesel have not been attractive. In addition it has to be considered that today 80 percent of the electricity in Brazil is renewable, i.e. mainly hydro power.

However, due to the rapidly increasing power demand and the fact that today Brazil suffers from the huge transportation distances between the production places of electricity and the large consumers at the east coast, mainly the São Paulo area, there are clear indications that distributed energy production in general and co-generation in particular may become a real alternative for the energy production. A new law has been introduced in February 2012 which allows the connection of decentralized power generation to the grid and gas and electricity utilities offers concrete programs for co-generation projects and last but not least: there are financing models for such projects available.

On the other hand, a recent declaration of the president Dilma Vana Rousseff that electricity prices must be reduced by 30 percent in February 2013 has created a lot of confusion in Brazil and would – if introduced in such a drastic manner – jeopardize many potential projects; not only for the electricity prices but also for the fact that it is difficult to find investors in a country with limited legal certainty where the president by his own decision can introduce such non market conformance steps.

## 5. Future Prospects

The key to follow-up projects is clearly the financing. The situation has changed since the time we started the project "Brazil". The global prices for CO<sub>2</sub> certificates have dropped significantly. A financing under the CDM regime is therefore very difficult – the same applies for an upgrade to the gold standard. Very positive is the fact that several key players have introduced programs for the financing of renewable energy projects:

The Banco do Brasil offers under the so called ABC line a financing at an interest rate of 5% with a required pay back time of 6 to 10 years. This model is available for projects of not more than 1'000'000 R\$ (less than half a million USD). Efficientia, a daughter company of the utility CEMIG applies an interest some 0.5% above the Brazilian "libor", i.e. a project financing can be done at an interest rate of 8 percent. Also the Sao Paulo based CPFL offers a program for financing of renewable energy projects.

On November 13<sup>th</sup> the result of the first half year of operation was presented to the porc producer association ASEMG at its headquarter in Belo Horizonte, Minas Gerais. It was agreed that an on-site-presentation for a limited number (12 -15) of selected farmers with a high potential shall be organized in the third week of January 2013 followed by a presentation and dinner at a suitable hotel.

Based on the positive operational result at the reference site and the now existing alternatives for project financing we assume that three follow-up projects can be realised in 2013, each with three microturbines CR65. The business plan foresees to realise 6 biogas projects in 2014 and from 2015 onwards 10 projects a year.

Even more optimistic is the situation in the field of natural gas driven microturbines plants. The target of such projects is to improve the energetic situation in an industrial or commercial (supermarket, hospital etc.) site by a so called co-generation plant, i.e. the simultaneous production of electricity and process heat. We plan to install two plants in 2013, each with 1 MW electrical power.

## 6. Conclusions

The most essential conclusion out of this pilot project is that the microturbine is perfectly capable of burning the biogas from the existing digestors in a most reliable manner.

The realisation of a pilot project has never been the ultimate goal but a means to an end to create a springboard for entering the Brazilian biogas market with the technology of the microturbine. One conclusion of this project is that everything takes longer than expected – this is also valid in Brazil. The foundation of Acrona Brasil will happen almost one year later than expected. The good news are that the perspectives are probably even better than anticipated.

We have been surprised by the high level of prices in Brazil which are in many areas comparable to the prices in Switzerland. To realise a microturbine plant in the city of Sao Paulo is as expensive as in Switzerland – if not even more expensive. In Minas Gerais the price level is a lower. On the other side the people in Minas Gerais are more conservative and it takes months if not years to build up a relationship of trust and mutual appreciation. The conclusion of this is that the different local characteristics need to be taken into consideration – the cooperation with local people is a must. And "local" is not equivalent to "Brazilian"; the difference between Manaus and Rio de Janeiro is probably bigger than the difference between Palermo and Helsinki. For the development of the Brazilian market

it will be essential to focus on geographical business clusters and not spread the projects all over the country.

In the last two years the possibilities for financing of renewable energy projects has been improved in Brazil and a positive environment to realise co-generation projects has been created. On the other hand we had expected big bureaucratic hurdles but we were wrong: they are not just big, they are immense. Brazil has a strongly growing economy and the upcoming world soccer championship and the Olympics have further pushed the economy. As a result it needs to be considered that changes in Brazil are not the exception but the norm. As a conclusion the circumstances for the realisation of microturbine projects are subject to a constant change of process. The review of the business concept and its adoption to a changed environment must be a continuous task.

## 7. References

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## Attachments

A) Photo report

Document is sent to the

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Attachment A) FOTO REPORT



Presentation of the biogas program by Acrona and Capstone in Belo Horizonte in October 2010 to the porc producer association ASEMG



Two years later: the pilot project commences commercial operation



The AGTP gas treatment plant. Designed and assembled in Switzerland, integrated into the plant at the EcoGeo factory in Sao Paulo, operated at the farm near Belo Horizonte.



The "heart" of the plant: a 65 kW microturbine from Capstone.



Capstone  
CR65 Microturbine

chiller

Activated carbon filter

Acrona gas treatment  
and compressing plant

Electrical cubicle  
with PLC