Report on Technical Concepts for Demo Case Biogas Projects

Selection process, criteria and preliminary technical assessments

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DiBiCoo – Digital Global Biogas Cooperation
Grant Agreement N°857804

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Executive Summary

The objective of the DiBiCoo Project is to support the development of a healthy biogas sector in developing and emerging countries. To achieve this, DiBiCoo has identified promising project opportunities, from which demo projects and follower projects have been selected. These projects will serve as examples on how to set up reliable biogas projects in cooperation with European technology providers. In order to select these demo projects and follower projects, possible project opportunities were collected in a first step.

The selection of demo projects from the identified project opportunities was conducted in several stages. First, the eligibility of the applications was checked. Second, a preliminary technical design and financial analysis was conducted and follow-up questions to applicants were sent to gain more detailed information on the proposed projects. Third, a selection process and matrix were prepared and approved by the Steering Committee. Fourth, the evaluation matrix was completed by the respective target country partner and the Austrian Energy Agency independently, in order to generate first evaluation scores for all applications. Fifth, the shortlisted project applications were presented in country specific Steering Committee meeting sessions together with these first evaluation scores, which were used to compare the projects within one country to each other and to discuss all shortlisted potential projects with all consortium partners. Lastly, based on these presentations and the discussion, the Steering Committee voted to select one demo case per country.

Until end of August 2020, 52 project applications were submitted in total in the five DiBiCoo target countries. These applications are distributed over all target sectors / feedstocks as organic fraction of municipal solid waste, sludge from wastewater treatment, agricultural residues, residues from animal husbandry and agro-industrial residues. From these 52 project applications, 21 have been deemed eligible to become a demo case and provided sufficient information for a technical and financial assessment. From these shortlisted applications, one demo case per country has been selected, leading to five demo cases in total, as shown in Table 1.

Country	Company	Feedstock	Utilization	Connection	Size	Annual production
Argentina	Biolectrica Dos SA	Thin stillage Organic municipal waste	CHP	Grid	2,100 kWe	17.000 MWhe/a
Ghana	Beta Construction Engineers Ltd.	Organic municipal waste Wastewater (primary sludge)	CHP	Grid	1,400 kWe	12.000 MWhe/a
Indonesia	PT Ecody Agro Energi	Palm Oil Mill Residues	CHP	Island / Self consumption	3,100 kWe	23.000 MWhe/a
South Africa	New Auto Energy & Crosspoint	OFMSW Market waste Wastewater	Methane injection	Local mini-grid	150 m³/h CH4	1.150.000 m³ CH/a
Ethiopia	Bahir Dar University and Lake Tana and other water bodies' protection and development Agency	Water Hyacinth Manure	CHP	Grid	1,600 kWe	13.000 MWhe/a

Table 1: Overview of the selected demo projects with preliminary results about size and production.

The focus of this report is a detailed description of the evaluation and selection process and a first presentation of the selected demo projects.

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Summary of the DiBiCoo Project

The *Digital Global Biogas Cooperation (DiBiCoo)* project is part of the EU's Horizon 2020 Societal Challenge 'Secure, clean and efficient energy', under the call 'Market Uptake Support'.

The target importing emerging and developing countries are Argentina, Ethiopia, Ghana, South Africa and Indonesia. Additionally, the project involves partners from Germany, Austria, Belgium and Latvia. The project started in October 2019 with a 33 months-timeline and a budget of 3 Million Euros. It is implemented by the consortium and coordinated by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

The overall objective of the project is to prepare markets in developing and emerging countries for the import of sustainable biogas/biomethane technologies from Europe. DiBiCoo aims to mutually benefit importing and exporting countries through facilitating dialogue between European biogas industries and biogas stakeholders or developers from emerging and developing markets. The consortium works to advance knowledge transfer and experience sharing to improve local policies that allow increased market uptake by target countries. This will be facilitated through a digital matchmaking platform and classical capacity development mechanisms for improved networking, information sharing, and technical/financial competences. Furthermore, DiBiCoo will identify five demo cases up to investment stages in the 5 importing countries. Thus, the project will help mitigate GHG emissions and increase the share of global renewable energy generation. The project also contributes to the UN Sustainable Development Goals (SDG 7) for 'Affordable and clean energy", among others.

Further information can be found on the DiBiCoo website: www.dibicoo.org.

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Contents

Executive Summary 2
Summary of the DiBiCoo Project 3
Contents 4
List of Tables 5
List of Abbreviations 6
1 Introduction 7
2 Demo case selection process 8
2.1 Eligibility check 8
2.2 Preparation efforts 8
2.3 Evaluation process 9
2.4 Evaluation matrix 10
2.5 Benefit packages for demo projects 13
3 Description of selected demo projects 14
3.1 Argentina 14
3.2 Ghana 14
3.3 Ethiopia 15
3.4 Indonesia 15
3.5 South Africa 16
Annex I – Info Sheets of the demo projects 17

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List of Tables

Table 1: Overview of the selected demo projects with preliminary results about size and production. 2
Table 2: Overview of eligibility of project application 8
Table 3: Evaluation category, criteria and sub-criteria 10
Table 4: Evaluation matrix excerpt 12
Table 5: Demo case – Argentina 14
Table 6: Demo case – Ghana 14
Table 7: Demo case – Ethiopia 15
Table 8: Demo case – Indonesia 15
Table 9: Demo case – South Africa 16

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List of Abbreviations

AEA	Austrian Energy Agency
CHP	Combined Heat Power
CNG	Compressed Natural (or Bio) Gas
D	Deliverable
DiBiCoo	Digital Global Biogas Cooperation
DM	Dry Matter
EBA	European Biogas Association
FvB	Fachverband Biogas e.V. (German Biogas Association)
GDPR	General Data Protection Regulation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
ICEADDIS	ICEADDIS IT Consultancy PLC
INTA	Instituto Nacional de Tecnología Agropecuaria
ISEES	Institute for Sustainable Energy and Environmental Solutions
MSW	Municipal Solid Waste
OFMSW	Organic Fraction of MSW
RDI	Inisiasi Pengkajian Resiliensi - Resilience Development Initiative (RDI)
SC	Steering Committee
T	Task
WTP	Waste Treatment Plant
WWTP	Waste Water treatment plant

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1 Introduction

The aim of DiBiCoo is to support the development of healthy and technologically reliable biogas sectors in developing and emerging countries. To achieve this, the project has already analysed the biogas markets as well as the economic and social environments in the five target countries: Argentina, Ethiopia, Indonesia, Ghana and South Africa (see: D3.3 Report on Biogas Markets and Frameworks in Argentina, Ethiopia, Indonesia, Ghana and South Africa). By doing so, networks related to the biogas-sector in each of these countries were identified. Additionally, promising feedstocks for biogas in these countries, such as organic fractions of municipal solid waste, wastewater treatment sludge, agricultural residues, animal husbandry residues and agro-industrial residues, were identified.

In a previous task (T3.6), potential biogas project ideas were collected in the 5 target countries, from which at least one project in each country was then selected as a DiBiCoo demo project (T6.1). A detailed description of the process for the demo case selection is described in chapter 2. A brief description of each of the demo projects is presented in chapter 3 and Annex I.

The selected demo projects will from now on receive support within the DiBiCoo Market Uptake Programme in WP 6 through the joint elaboration of technical concepts and development of business models, access to capacity building trainings and knowledge transfer and will be supported to establish connections with European technology providers.

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2 Demo case selection process

The aim of the demo case selection process was to identify the most suitable projects from all received applications in each importing country to become the DiBiCoo demo projects in a transparent and fair process. The remaining eligible projects that were not selected as demo cases have become so called DiBiCoo follower projects.

2.1 Eligibility check

The first step of the selection process was an eligibility check of the submitted project applications by the respective importing country partner and the Austrian Energy Agency. The basis for the eligibility check was to validate the information provided in the first questionnaire related to the application process for business opportunities. The information provided included the overall concept, feedstock types, -amounts and -availability.

The eligibility criteria applied were based on the requirements from the Grant Agreement and were predefined as follows:

Ineligible projects are those:

1. with an estimated size of the biogas-plant below 75 kW_e or 40m^3 biogas per hour,
2. with very poor-quality application, and/or
3. which are not clearly biogas projects, such as standard wastewater-, or waste treatment plants. If a project in this field of application was deemed eligible (in case it included biogas equipment in its plans), the system boundaries of the project needed to clearly focus on the biogas part of the plant.

An overview of the total number of applications, the number of eligible and the number of ineligible projects for each country is shown below in Table 2.

	Argentina	Ethiopia	Ghana	Indonesia	South Africa	Total
Eligible	13	7	7	3	6	36
Not eligible	5	1	2	3	5	16
Total	18	8	9	6	11	52

Table 2: Overview of eligibility of project application

2.2 Preparation efforts

After 36 projects have been deemed eligible, a second questionnaire with more detailed questions was sent to each of the applicants. The answers to these questions mainly supported a preliminary assessment of technical design and financial analysis based on a standardized biogas design tool. In case any inputs provided were questionable, the AEA together with the importing country partner adjusted the inputs to more realistic values based on publicly available information in order to avoid random errors. These adjusted values were applied for all

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projects evaluated in a country equally when necessary, thus changing potentially random errors to potentially systemic errors. As these systemic errors influenced the scores of the projects in a country equally, they were neglected for the selection process and actually led to a fairer selection of the demo case (as the influence of random errors was limited). Questionable inputs were discussed with demo and follower projects to consolidate the inputs used for the analysis in the future.

The results of the preliminary assessment of technical design and financial analysis were used for the evaluation of technical and financial criteria in the evaluation matrix.

2.3 Evaluation process

The evaluation process was defined in advance collaboratively by the DiBiCoo consortium. A standardized evaluation matrix including criteria, criteria description, evaluation requirements, scoring, and weighting were developed and confirmed by the Steering Committee before the project opportunities were evaluated. It was agreed that the importing country partner and the AEA prepare a first evaluation for each project separately based on the defined criteria in order to ensure a fair and independent assessment. The preliminary average score and average weighted score was calculated automatically. The projects were subsequently ranked according to the average weighted score.

The results of this preliminary evaluation were made available to each DiBiCoo consortium partner before the selection meeting together with the filled questionnaires, other project documents submitted, as well as the outcomes of the preliminary assessment of technical design and financial analysis.

In separate selection meetings for each country, the top-ranked projects were introduced to the SC by the importing country partner. If the difference in score of the top-ranked applications was less than 15%, the relevant criteria scores were discussed. After the presentation of the top ranked projects and their scores and after clarifying questions from the Steering Committee members, the Steering Committee voted on the demo case.

The top-ranked projects in one country had similar scores and were all deemed suitable to become the demo case, so a unanimous decision could not be reached. Hence, the selected demo projects in other countries were considered and taken into account to ensure that there is a wide variety of supported demo projects.

After the selection process was finalized for all five target countries, demo projects and follower projects were informed that they have been selected either as demo project or follower project. They were also again briefed on what benefits this selection will include (e.g. support in the joint development of a suitable technical concept for their project application) and were asked to confirm, if they still want to cooperate with DiBiCoo.

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2.4 Evaluation matrix

The standardized evaluation matrix for the demo project selection was developed and approved by the Steering Committee before the projects were evaluated. It included criteria, criteria description, evaluation requirements, scoring, and weighting. The evaluation matrix was structured along three main evaluation categories, namely Compliance and Suitability, Technical Aspects, and Financial Aspects. Each evaluation category had the following sub-criteria;

Evaluation category	Evaluation criteria	Evaluation sub-criteria
Compliance and Suitability	Applicant participation	Document completeness
		Detail level of information
		Participation of applicant
	Applicant qualifications	CVs available - experience
		Track record in general
		Track record in the country
		Track record regarding biogas
		Professionalism of applicant
Technical Aspect	Feedstock	Quality of feedstock
		Distribution of production over time
		Source of feedstock
	Utilization of biogas / Sustainability	Biogas focus
		Viability of biogas utilization
		Size of the Project
		Environmental impact of the project (in CO_2 eq.)
Financial Aspects	Financial viability	Net present value
		Project-Internal rate of return
		Levelized cost of electricity / Levelized cost of gas

Table 3: Evaluation category, criteria and sub-criteria

2.4.1 Evaluation scoring and weighting

The basis for scores was given by the evaluation matrix to facilitate equal treatment of the applications (see the basis in the table below in row “Evaluation requirements”). The scores ranged between 0 and 10. A preliminary score was assessed separately by the importing country partners and the AEA. An average of the two scores was then calculated and used for the preliminary ranking. However, in the selection meetings of the Steering Committee the differences between the score given by the importing country partner and the AEA were also discussed. The sub criteria *Participation of applicant* and *Professionalism of applicant* were evaluated solely by the importing country partners, since the AEA was not in contact with the applicants at that time.

Every criterion features a weighting factor that was agreed upon by the Steering Committee (SC) in advance. The weighting factor was a percentage and all weighting factors together sum up to 100%. Each score for each criterion (0-10) was multiplied with the respective

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weighting factor. The weighted scores were summed up to the total weighted score. The total weighted score lied between 0 – 100.

2.4.2 Evaluation matrix

The table below is an excerpt of the evaluation matrix, including the sub-criteria, the description, the evaluation requirement and the weighting factor is shown.

Evaluation sub-criteria	Description	Evaluation requirements (points can be between steps!)	Weighting factor
Document completeness	All requested documents and information are provided	All information provided: 10 points Almost complete: 8 Most important information provided: 4 Information provided insufficient for assessment: 0	2,0%
Detail level of information	The detail level of the provided information is sufficient for a reliable assessment	The detail level of the provided is very detailed: 10 The detail level meets the minimum standard for having a viable assessment: 5 The detail level is poor and does not give sufficient information for assessment: 0	6,0%
Participation of applicant	The applicant provided the requested information in time and is available for follow ups, etc.	The applicant provided the information independently after the first request: 10 The applicant needed little support to provide the information: 8 The applicant needed several contacts to provide the information: 4 The applicant was not participating properly at all: 0	6,0%
CVs available - experience	The applicant has sufficient knowledge of biogas technology / project management	The applicant has expertise in biogas-technology and project management: 10 The applicant has sufficient knowledge in biogas-technology and project management: 5 The applicant has insufficient knowledge in biogas-technology and project management: 0	2,0%
Track record in general	How many general projects are finished by the applicant	The applicant has a broad track record in general: 10 The applicant has a limited track record in general: 4 The applicant has no track record in general: 0	2,0%
Track record in the country	How relevant are the projects/activities in the country	The applicant has a broad track record in the country: 10 The applicant has a limited track in the country: 4 The applicant has no track record in the country: 0	2,0%
Track record regarding biogas	How many biogas projects are finished by the applicant	The applicant has a broad track record regarding biogas: 10 The applicant has a limited track regarding biogas: 4 The applicant has no track record regarding biogas: 0	2,0%
Professionalism of Applicant	The applicant makes a professional personal impression in personnel contact	(only to be evaluated by importing country partner)	8,0%

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Quality of feedstock	The quality of feedstock meets the requirements for a reliable process (Dry matter and volatile solids, gas yield, impurities)	The feedstock meets all of the necessary standards: 10 The feedstock meets the standards of impurities but has little gas yield: 6 The feedstock has high gas yield but does not meet the standards for impurities: 4 The feedstock has low gas yield and doesn't meet the standards for impurities: 2 The feedstock is not suitable for fermentation: 0	10,0%
Distribution of production over time	The production of biogas is steady	The potential biogas production is steady all-year round: 10 The production falls under 80% of the maximum at some point: 8 The production falls under 60% of the maximum at some point: 6 The production falls under 40% of the maximum at some point: 4 The production goes to zero at some point: 2 The production goes to zero for several months: 0	7,0%
Source of feedstock	The number of feedstock sources and reliability	The feedstock is steadily produced on-site: 10 The feedstock comes from few reliable sources(< 6 sources): 8 The feedstock comes from a high number of reliable sources (> 6 sources): 6 The feedstock comes from questionable sources: 4 The source of feedstock is not specified: 0	5,0%
Biogas focus	Is the project focused at biogas-technology	The project is a classical biogas-plant for agricultural residues or equivalent: 10 The project is a classical biogas plant with industrial wastes: 8 The project is for wastewater treatment / utilizes Organic Fraction of Municipal Solid Waste: 6 The project uses Municipal Solid Waste: 2	5,0%
Viability of biogas utilization	The proposed utilization of biogas corresponds to local conditions	The proposed utilization fits the local conditions:10 The proposed utilization would need significant local adaptations (e.g. long grid connections): 5 The proposed utilization does not fit the local conditions at all: 0	4,0%
Size of the Project	The impact of the project regarding energy output is high	The project has a peak production of higher than 1 MWe or 500 m³Biogas/h: 10 For every 100 kWe less: -1 The project has a peak production of lower than 100 kWe or 50 m³Biogas/h: 0	5,0%
Environmental impact of the project (in CO_2 eq.)	Comparing greenhouse gas (in CO_2 eq.) reduction potential of applications in one country	Ranking of applications in one country The highest ranked applications get 10 points Any application with negative greenhouse gas reduction potential (= increase of greenhouse gases) gets a score of 0	9,0%
Net present value	The net present value is as high as possible	The Net Present Value is positive: 10 The Net Present Value is negative: 0	9,0%
Project-Internal rate of return	The Project-Investment rate of return is as high as possible	The Internal Rate of Return is above 15%: 10 The Internal Rate of Return is above 12%: 8 The Internal Rate of Return is above 10%: 4 The Internal Rate of Return is below 10%: 0	9,0%
Levelized cost of electricity / Levelized cost of gas	LCOE, LCOG relative to sales prices of electricity or gas	If LCOE / LCOG smaller than price for selling or substituting: 10 If higher: 0	7,0%

Table 4: Evaluation matrix excerpt

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2.5 Benefit packages for demo projects

The benefit package that demo projects might receive by participating in the DiBiCoo Market Uptake Programme is listed below. The DiBiCoo consortium communicated those to demo projects and plans to implement these activities for the selected demo projects:

1. Development of a suitable technical concept (up to pre-feasibility level)
    - Combined heat and power (CHP) or
    - Biogas-upgrading: grid-injection / Compressed Natural or Bio-Gas (CNG)-station / gas cylinders
2. Preparation of an investment case and model (up to pre-feasibility level)
    - Revenues and financing analysis
    - Cash-flow analysis
    - Key performance indicators
3. Analysis of key environmental and socio-economic impacts
4. Establishing contact with relevant professional European biogas partners and components technology suppliers or project developers
5. Trainings, know-how transfer, study tours, tools and matchmaking event
6. Joint business model development including financing concept and risk analysis
7. Adaptations of the technical concept and economic analysis considering feedback on equipment performance and prices from European suppliers
8. Support in conducting of a pre-feasibility study and writing of a pre-feasibility report under joint responsibility.

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3 Description of selected demo projects

A brief description of the five selected demo projects is given in the following sub-chapters. The respective info sheets are presented in the annex. DiBiCoo received the permission of the following demo cases to publish the Information presented here. The respective demo projects also filled in and signed a data consent form.

3.1 Argentina

Country	Argentina
Company	bg²
Project Name	Let your waste enlighten you
Feedstock (%FM)	Thin stillage Organic municipal waste
Utilization	CHP
Connection	Grid
Size (preliminary calculation)	2 100 kW_e
Annual production (preliminary calculation)	17 000 MWh_e/a
Info	Uses residues from bio-ethanol production together with organic fraction of municipal solid waste (OFMSW)

Table 5: Demo case – Argentina

3.2 Ghana

Country	Ghana
Company	Beta Construction Engineers Ltd.
Project Name	Beta Biogas Integrated System
Feedstock (%FM)	Organic municipal waste Wastewater (primary sludge)
Utilization	CHP
Connection	Grid
Size (preliminary calculation)	1 400 kW_e
Annual production (preliminary calculation)	12 000 MWh_e/a
Info	Waste treatment plant

Table 6: Demo case – Ghana

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3.3 Ethiopia

Country	Ethiopia
Company	Lake Tana and other water bodies' development and protection agency and Bahirdar University
Project Name	Biogas production using water hyacinth (Echiornea crassippus) and other organic wastes
Feedstock	Water hyacinth Manure Agricultural residues
Utilization	CHP
Connection	Grid
Size (preliminary calculation)	1 600 kW_e
Annual production (preliminary calculation)	13 000 MWh_e/a
Info	Water hyacinth will be collected from the water body of Lake Tana and utilized, together with agricultural residues - producing electricity paired with environmental protection measures. The project developer wants to save Lake Tana with collaborative efforts and sustainably use this Majestic renewable resource from Generation to Generation.

Table 7: Demo case – Ethiopia

3.4 Indonesia

Country	Indonesia
Company	PT Ecody Agro Energi
Project Name	anonymous
Feedstock (%FM)	Palm Oil Mill residues
Utilization	CHP
Connection	Island / Self consumption
Size (preliminary calculation)	3 100 kW_e
Annual production (preliminary calculation)	23 000 MWh_e/a
Info	Residue utilization from palm oil mill in island operation with substitution of diesel

Table 8: Demo case – Indonesia

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3.5 South Africa

Country	South Africa
Company	New Auto Energy & Crosspoint
Project Name	Lanseria Biogas Project
Feedstock (%FM)	Wastewater OFMSW Market waste
Utilization	Methane injection to micro gas grid
Connection	Mini-grid
Size (preliminary calculation)	150 m^3/h CH_4
Annual production (preliminary calculation)	1 150 000 m^3/a CH_4
Info	Treatment of municipal waste-streams for a new residential district with micro gas grid and substitution of fossil fuels for heating and cooking

Table 9: Demo case – South Africa

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Annex I – Info Sheets of the demo projects

Argentina

Demo project

supported by

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Let your waste enlighten you

This biogas project utilizes the organic fraction of municipal solid waste in co-digestion with thin stillage from a neighbouring bio-ethanol production

Country: Argentina

Developing Company: bg2

Biogas Utilization
Combined Heat-Power

Feedstock
Thin stillage
Organic fraction of municipal solid waste

Electricity production (est.)
17 GWh per year

Operation
Public grid injection

DiBiCoo is an international project supported by the Horizon 2020 programme of the European Commission and implemented by GIZ in cooperation with 12 experienced organizations across four continents with the overall objective to establish closer cooperation between European technology suppliers and biogas stakeholders in the partner countries Argentina, Ethiopia, Ghana, Indonesia, and South Africa. The activities focus on capacity building, support to establish favourable for cooperation in the biogas sector as well as the development of promising biogas projects. These biogas projects will lead to increased energy security, local added value, job creation and the share of renewable energy at local level while reducing greenhouse gas emissions. In each partner country one project idea was selected as demo case to be a show case about development in the biogas sector in it's country.

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Ethiopia

Demo project

supported by

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Digital global Biogas Cooperation

Biogas production using water hyacinth (Echiornea crassippus) and other organic wastes

Water hyacinth will be collected from the water body of Lake Tana and utilized, together with agricultural residues - producing electricity paired with environmental protection measures. The project developer wants to save Lake Tana with collaborative efforts and sustainably use this Majestic renewable resource from Generation to Generation.

Country: Ethiopia

Developing Company: Bahir Dar University and Lake Tana and other water bodies' protection and development Agency (PIs: Dr Nega Tassie and Dr Ayalew Wondie).
Project Team members: Dr Solomon Libsu; Dr Dessalegn Ejigu; Mr. Getu Alemayehu; Mr. Hailemaryam Zewdu; Mr. Tewekel Mohammed and Mr. Ato Solomon Girmay

Biogas Utilization
Combined Heat-Power

Feedstock
Water hyacinth
Manure

Electricity production (est.)
13 GWh per year

Operation
Grid injection

Photo taken by Nega Tassie

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Ghana

Demo project

supported by

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BetaBiogasIntegratedSystem Project

The biogas plant will utilize the organic fraction of municipal solid waste together with municipal sludge. It helps to sustainably dispose municipal residues and produce renewable electricity.

Country: Ghana

Developing Company: BETA CONSTRUCTION ENGINEERS LTD

Biogas Utilization
Combined Heat-Power

Feedstock
Organic household waste
Faecal sludge and septage

2Electricity production (est.)
24 GWh per year

Operation
Public grid injection

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Indonesia

Demo project

supported by

DiBiCoo
Digital global Biogas Cooperation

The biogas plant will utilize residues of palm oil production to substitute fossil fuel for electricity production in a remote area while reducing the environmental impact of the residues.

Country: Indonesia

Developing Company: ecody

Biogas Utilization
Combined Heat-Power

Feedstock
Palm oil mill residues

2Electricity production (est.)
24 GWh per year

Operation
Self Consumption

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South Africa

Demo project

supported by

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Lanseria BioGas Project

The biogas plant will utilize organic municipal waste and wastewater to produce biomethane and inject it into a local micro gas grid supplying sustainable, green gas to the sourrounding areas.

Country: South Africa

Developing Company: NewAutoEnergy

CROSSPOINT PROPERTY INVESTMENTS

Biogas Utilization
Gas upgrading

Feedstock
Wastewater
Organic municipal waste

Electricity production (est.)
1.1 mio. m^3 bio-methane per year

Operation
Local micro gas grid injection

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