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Mobilising Renewable Energy Investments

Uganda: Captive Power

Model Business Case: Biomass Power Systems at Large Rice Mills

INTRODUCTION

This Model Business Case analyses the financial viability of a medium-size biomass combustion plant investment at a larger rice mill in Uganda. Captive power[1] — or the self-generation of electricity from renewable energy for internal consumption — may help reduce operating costs and improve power reliability. The analysis considers the potential benefits of on-site generation, reduced power outages leading to increased production and possibilities to sell excess electricity to neighbours for a typical larger rice mill.[2]

TARGET AUDIENCE

— **Owners and operators of rice and other grain mills** with larger scale operations (10,000+ tonnes/year) and with processing residues available on site who might consider a biomass plant for own power generation now or in the future

— **Owners of other agro-processing facilities and potential project developers** who may be interested in understanding the economics of and considerations around biomass captive plant implementation in Uganda

1) For a comprehensive definition and overview of captive power in Uganda, please consult the accompanying Developer Guide; accessible at www.get-invest.eu
2) The scenario is hypothetical as direct sale to an electricity buyer other than Uganda Electricity Transmission Company Limited is only currently allowed in specific circumstances that do not apply to this case (More details can be found in the accompanying Developer Guide). The scenario is nevertheless included for comparison purposes

TECHNOLOGY OVERVIEW

Annex A provides more details.

ASSUMPTIONS AND MAIN PARAMETERS

The generation from a biomass captive plant – using rice husk (and possibly maize and other grains) already available onsite as a feedstock[3] — will meet some of the load requirements at a rice factory, thereby reducing the amount of electricity consumed from the grid. If the cost of self-generation is less than the cost of electricity, the captive plant leads to energy savings and lower electricity

3) After milling, 20-30% of the processed rice remains as rice husk residue. Currently, most rice husk is sold by millers to farmers, traders and industry

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bills. Each facility must be assessed over a sufficient timeframe to adequately identify the savings and investment opportunities.

In addition, a biomass power plant can help avoid downtime caused by power outages. While air drying of rice is a common practice in Uganda, for the Model Business Case it is assumed that the rice mill already has mechanical drying equipment installed to increase the quantity and quality of rice available for processing. However, power outages are still a limiting factor for the maximum capacity utilisation of existing machinery. By reducing outages, a captive system might allow the rice mill to increase its production and thereby rice sales and revenue.

To illustrate the potential of an investment in a captive biomass system, the Model Business Case presents hypothetical yet realistic economic benefits for a larger-scale rice mill in the medium industrial code 20 tariff category.[4] Two plant sizes and three scenarios are assessed:

— Case 1 — 440 kW plant for electric power

— Case 2 — 440 kW combined heat and power system

— Case 3 — 780 kW plant with electricity sales to neighbouring rice mills

The technology proposed is classical combustion combined with a water-steam cycle with a steam turbine. Given the relatively small capacity, a single or double stage turbine, which are simple and robust, are considered. Their electrical efficiency is comparatively low, but the market price for the fuel is comparatively low as well.

Only case 2 assesses the possibility of co-generation with utilisation of process heat for rice drying to test the cost-benefits of replacing the existing rice husk burners for drying. In the other two cases, electricity is the only useable output of the plant.

The power plant is connected to the grid and is operated continuously in parallel to the processing facilities, with a minimum of downtime. The plant is sized to cover the rice factory's base load, with demand exceeding the net capacity of the plant being met by the grid. The plant is designed to operate off-grid (i.e. in island mode) during grid power outages. During short periods of low power demand, it is assumed that either an agreement can be made with the regulator and utility to spill any surplus electricity into the grid or that it will be fed into a load bank. In both cases, it means that an estimated 5% of the biomass plant generation is not used by the rice mill.

Model parameters

The main captive biomass system parameters are shown in **Table 1** and **Table 2**. The net electrical capacity of the system was set to match the assumed base load of the rice factory. The 7,920 nominal load hours (90.4% capacity factor) are based on 330 factory operating days and the assumption that production will be increased due to fewer power outages. Power outages and fluctuations can affect businesses between 1.6% to 35% of the year in Uganda.[5] An annual average grid outage time of 4% was assumed for the model.

TABLE 1. Site characteristics – common to all cases

PARAMETER	UNIT	VALUE
Fuel: rice husk, LHV	MJ/kg	14.0
Annual use (at nominal load)	hours	7,920
Annual grid outage time	%	4
Rice mill base load	kW	400
Rice mill mean load	kW	450
Rice mill maximum demand*	kW	750
Rice processed at factory	tonnes/year	67,810
Available rice husk	tonnes/year	14,876

*Note: code 20 customers have a maximum demand allowance of 500 kVA. In practice this bound is not strictly applied and the illustrative maximum demand is therefore not unrealistic

4) The Model Business Case analyses the potential return on investment from a biomass captive power system based on projected cost savings, increased production and possible electricity sales

5) Derived from:
- World Bank (2014) Enterprise Survey Uganda 2013. Link: http://www.enterprisesurveys.org/data/exploreeconomies/2013/uganda#infrastructure – accessed April 2019
- CDC (2016) What is the Link Between Power and Jobs in Uganda? Final Report by Steward Redqueen, p. 23. Link: https://www.cdcgroup.com/en/news-insight/insight/articles/what-is-the-link-between-power-and-jobs-in-uganda/ – accessed April 2019
- Interviews with and data from existing and potential captive power projects in Uganda. The wide range is due to geographical differences in grid reliability.

TABLE 2. Biomass plant characteristics – specific to each case

PARAMETER	UNIT	CASE 1	CASE 2	CASE 3
Rated thermal input	kWth	3,960	3,960	6,550
Biomass quantity required for plant	tonnes/ year	8,065	8,065	13,333
Biomass quantity required for dryers	tonnes/ year	1,543	0	1,543
Plant electrical efficiency	%	11.2	11.2	11.9
Gross electrical capacity	kW	440	440	780
Captive system own consumption	%	10	10	10
Net electrical capacity	kW	400	400	700
Expected annual production	MWh/ year	3,168	2,534	5,544
Electricity sold to neighbours	MWh/ year	0	0	2,376

A major requirement is a high availability (reliability) of the plant to limit the impacts of grid power outages on rice production. It is assumed that only the outages that occur during the 330 days of production are reduced, and that 317 hours/ year of grid outage (4% of 330 days) correspond to 13.2 days of production that will no longer be interrupted. This is a major but conservative assumption with regard to the benefits. In reality, especially if there are many short outages, the avoided interruption in production due to the captive plant will be much more important.

Modelled scenarios

The three scenarios for the biomass power plant project are described, next.

440 kW plant for electric power: In the first case, the bioenergy system is used for captive power generation only. The main benefits are that grid electricity can be replaced and that rice and maize processing can be increased as the system enables the factory to continue to operate even during grid outages.

440 kW combined heat and power system: The proposed system is not only used for electricity generation but in addition supplies steam to heat the grain dryers (combined heat and power — CHP). Steam is extracted from the turbine at 90°C and 0.7 bar absolute. The hot water from the condenser is pumped to the dryers to provide hot air at approximately 85°C. The CHP system slightly increases investment costs but the heat replaces the rice husk that would otherwise have been used to fuel the mechanical dryers and therefore can instead be sold. For the analysis, the steam supply is considered as a fuel saver only. The rice husk burners of the dryers are not operated while steam is supplied, but they are still in place as a backup: since rice and maize processing is the core business, a problem with the power plant should not affect processing. Steam extraction reduces electricity generation, so less grid electricity is replaced. The power losses are calculated based on thermodynamic data.

780 kW plant with electricity sales to neighbouring rice mills: This scenario shows the situation where the excess electricity is sold to neighbours under a take-or-pay arrangement. The same rice mill, base load and consumption are assumed, but the plant capacity is increased and all of the additional electricity is sold. The selling price is an average of the code 20 tariff in Q4 2017 plus a 20% margin (EUR 0.16/kWh or UGX 682/kWh[6]), because the customer of the electricity also benefits from reduced outage hours and increased reliability, resulting in higher revenues from increased rice sales. The scenario is hypothetical as direct sale to an electricity buyer other than UETCL[7] is only currently allowed in specific circumstances that do not apply to this case. The scenario is nevertheless included for comparison purposes.

Investment and operating costs

Capital expenditure (CAPEX) includes the costs for engineering, purchase, construction and commissioning of the plant. The estimation is based on the product of the cost per kW thermal installed (EUR 500/UGX 2.1 million) and the thermal firing rate plus the product of the cost per kW electric installed (EUR 2000/ UGX 8.5 million) and the gross capacity of the turbine including the generator. The amounts reflect international/European costs with some equipment from Asia. For transport and import (e.g. from Europe to Uganda via Mombasa, Kenya), an additional 10% is included in the costs. Development costs included in the CAPEX are for feasibility, permits and other costs.

6) An UGX-EUR exchange rate of 0.000234769 from October 2017 is used throughout the analysis
7) Uganda Electricity Transmission Company Limited

TABLE 3. Biomass plant CAPEX & OPEX

COMPONENT		UNIT	CASE 1			CASE 2			CASE 3		
			Unit cost	Project cost		Unit cost	Project cost		Unit cost	Project cost	
				EUR	Mio UGX		EUR	Mio UGX		EUR	Mio UGX
CAPEX	Power plant	EUR/kW	7,100	3,156,000	13,400	7,150	3,176,000	13,500	6,830	5,312,000	22,600
	Development costs	—	—	125,000	532	—	125,000	532	—	155,000	660
OPEX	Fuel cost	UGX/kg	25	47,000	202	25	47,000	202	25	78,000	333
	Maintenance	%	1.8	57,000	242	1.8	57,000	244	1.8	96,000	407
	Personnel	—	—	57,000	245	—	57,000	245	—	57,000	245
	Insurance	%	0.8	25,000	108	0.8	25,000	108	0.8	43,000	181
	Raw material	—	—	29,000	122	—	29,000	122	—	47,000	201

For annual maintenance and insurance costs (OPEX), a percentage of the plant CAPEX is applied. The staff costs are based on three shifts per day with three operators, a local technical manager and a plant manager familiar with rice husk power. Fuel "costs" account for lost revenue from rice husk that is currently sold and transported off-site (because the rice husk is instead used to generate power). Raw material stands for raw materials, consumables and supplies, including for water treatment.

Electricity costs

Electricity tariffs for industrial consumers in Uganda are comprised of 5 main components as described in the accompanying GET.invest Developer Guide: a) monthly service charge, b) time-of-use energy charge, c) maximum demand charge, d) reactive power penalty and reward and e) Value Added Tax at 18%.

The time-of-use energy charge has the most influence on project viability. While the maximum demand charge can also be reduced with a power plant that consistently meets part of the facility load, the economic benefit is not large. Demand charge reduction is nevertheless considered in the analysis. The monthly fixed charge is not considered as it is not a cost that can be avoided and the potential reactive power benefits are not included for simplicity. Code 20 tariffs are shown in **Table 4** for Q4 2017.

Value Added Tax

Value Added Tax (VAT) at 18% is not considered in the analysis. Although VAT is applicable on bioenergy and related equipment it is not capitalised in the CAPEX in the financial model because as a throughput tax it may be recoverable from rice factory sales. Furthermore, other tax incentives (e.g. investment deduction allowance) that may be available for the project are not included in the assessment, which could bring benefits that offset the application of VAT. Similarly, VAT on the end-user electricity tariffs is not considered as an avoided cost for the calculation of the benefits.

Nevertheless, some facility owners who cannot completely offset VAT on purchases against VAT on sales and who cannot recover VAT from the revenue authority may consider VAT as a cost or cash flow item to factor into investment decision-making.

The Umeme tariff and the biomass system O&M costs are assumed to increase by 4% annually from 2020 based on inflation projections for Uganda.

TABLE 4. Umeme time-of-use energy tariffs for code 20 (medium industrial) in Uganda, Q4 2017

TARIFF CODE	TARIFF CLASS	TIME OF USE		ENERGY CHARGE/kWh		ENERGY CHARGE +VAT	
	Voltage level & demand	Period	Hours	UGX	EUR	UGX	EUR
20	Medium industrial 415 V Max 500 kVA	Peak	18:00-00:00	738.0	0.1733	870.84	0.2044
		Shoulder	06:00-18:00	565.9	0.1329	667.76	0.1568
		Off-peak	00:00-06:00	345.7	0.0812	407.93	0.0958

Financing scenarios

The two financing scenarios — a) commercial bank loan and b) Green green credit line — are assessed for the three different model business cases. The following financing assumptions have been made:

Commercial bank loan
- 70% debt, 30% equity
- 20% interest rate
- 17% required return on equity
- 5 year loan tenor
- No grace period

Green credit line
- 70% debt, 30% equity
- 7% interest rate
- 17% required return on equity
- 10 year loan tenor
- 2 year grace period

The commercial bank loan is considered for comparison purposes even though the shorter loan tenor does not allow for the loan to be repaid from the project cash flows.

The green credit line option is considered a realistic financing scenario considering existing options for concessional loans such as SUNREF[8] and that usually biomass equipment for captive-sized plants is often purchased in USD or EUR and a number of facility owners/long-term lessors have foreign currency revenue streams via export. Any exchange rate risk is not considered in the analysis.

The Model Business Case is based on an investment in Euro. In all cases, a two-year preparation, development and construction period has been assumed (2018 and 2019) and 20 years of operation, which corresponds to the expected lifetime of the bioenergy plant. The division of the present value of costs by the present value of electricity production results in a levelised cost of electricity (LCOE) for the system. The net present value (NPV) is calculated comparing the system costs with the expected benefits in terms of grid electricity savings, increased rice (and maize) processing due to reduced outages as well other benefits as applicable (electricity and rice husk sales) for each year separately using a discount rate of 17% on equity cash flows, which reflects the assumed required return on equity.[9]

Income tax of 30% is considered on revenues from increased rice production and electricity sales to third parties as these would be taxable. Avoided grid electricity benefits from captive power come from cost savings rather than revenue generation and therefore income tax is not considered.

Financial Analysis Results

The results of the financial analysis for the three model cases are presented in Table 5 and Table 6 for the two financing scenarios. The tables illustrate the return on equity invested (equity IRR or EIRR) and other project indicators taking into account the investment, operating and financing expenses mentioned previously. The minimum debt service coverage ratio (DSCR) is also shown.

8) The Agence Française de Développement (AFD) funds a green credit line in Uganda under the SUNREF (Sustainable Use of Natural Resources and Energy Finance) programme, which finances renewable energy investments via local commercial banks by means of on lending. Credit was available in USD with an interest rate of 6-7% as of late 2017. A tenor of up to 12 years and a grace period of three years may be available

9) The assumed rate of return on equity is based on the relatively risk-free 14.98% coupon on a 15-year Bank of Uganda treasury bond as of June 2018 and, because some risk is priced into the bond, a modest equity risk premium of 2%

TABLE 5. Biomass project indicators with commercial bank loan

CASE	PLANT SIZE & SCENARIO – ALL TARIFF CODE 20	LCOE		EQUITY IRR	EQUITY NPV		MIN. DSCR
		EUR/kWh	UGX/kWh		EUR	Mio UGX	
1	440 kW	0.303	1,292.2	19.6%	279,000	1,187	0.78
2	440 kW + CHP	0.378	1,608.6	15.6%	–155,000	–660	0.67
3	780 kW + electricity sales	0.282	1,202.9	16.3%	–115,000	–491	0.70

TABLE 6. Biomass project indicators with green credit line

CASE	PLANT SIZE & SCENARIO – ALL TARIFF CODE 20	LCOE		EQUITY IRR	EQUITY NPV		MIN. DSCR
		EUR/kWh	UGX/kWh		EUR	Mio UGX	
1	440 kW	0.233	991.8	40.1%	1,197,000	5,099	1.86
2	440 kW + CHP	0.289	1,229.4	32.1%	773,000	3,291	1.58
3	780 kW + electricity sales	0.217	922.8	33.4%	1,383,000	5,893	1.63

With commercial financing at 20% interest, the indicators show that only the first case is economically attractive based on the input assumptions. Case 1 has the highest return on investment because the relative share of captive generation that is used to increase rice production and sales is the highest of the three cases. Case 2 has a higher levelised cost and lower return as the reduced power generation (due to steam extraction for drying) means not as much grid electricity costs are avoided as in case 1 and the benefit of having more rice husk left over for sale (because rice husk burners are not used for drying) is low.

The LCOE for case 3 is the lowest due to minor economies of scale. Although the sale of electricity to neighbours is at a price that is 20% higher than the avoided cost of grid electricity, the return on investment is not as good as case 1 because the proportion of generation that increases rice production is lower and the greater upfront cost takes longer to pay back.

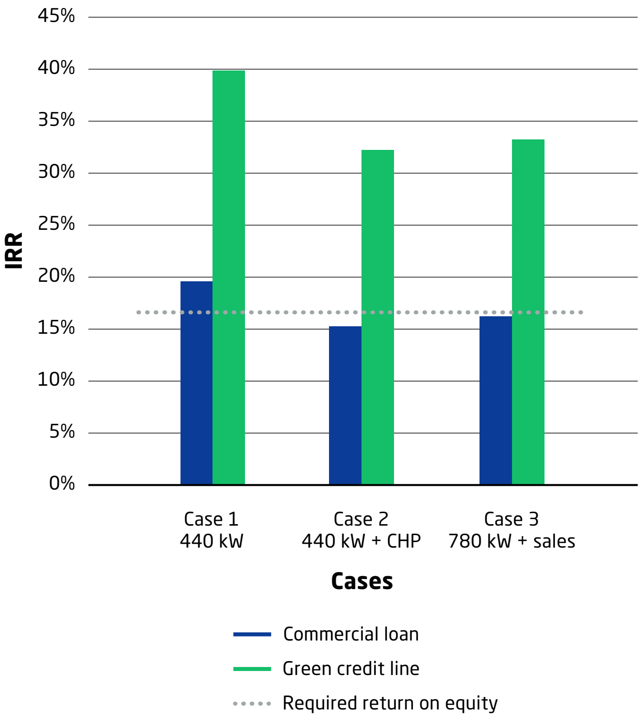
In the three cases, the reduced power outages and the associated increase in rice milling and sales revenues accounts for 30–50% of the economic benefit of the project. This highlights the value of a captive biomass plant in areas with higher grid outages — in some areas of Uganda the outage time can be much more than 4%.

Lenders financing a project usually require a debt service coverage ratio of at least 1.2 to provide assurances. This condition is not met for any of the three cases in any year of the loan, meaning that the projects do not generate enough cash to pay back the loan over the 5-year loan tenor, and therefore that the bank would not finance the project.

With green credit line financing, the return on equity increases and is very favourable for all case. And importantly, due to the improved financing terms, the minimum DSCR is sufficient to provide assurances to lenders.

An overview of the results of the analysis in terms of return on equity for the cases and two financing scenarios is found in **Figure 1**.

FIGURE 1. Overview of the financial analysis results



Sensitivity analysis

A sensitivity analysis was performed on key parameters to test the result of a change in the variables on the economic performance of the project for the two financing scenarios. The parameters are:

- The energy yield — to account for uncertainties in projections and plant performance
- The investment costs — to account for cost overruns or delays
- The rice husk feedstock cost — to account for seasonal and geographic price differences
- The discount rate — to account for different expectations for return on equity

For energy yield (see **Figure 2**), in the commercial loan scenario, an increase of 3–4% in energy generation would be sufficient to bring the 440 kW + CHP and 780 kW + electricity sales cases (case 2 and case 3, respectively) above the 17% return on equity benchmark. For the 440 kW case (case 1), a decrease in energy yield of about 7% would no longer deliver the required returns.

With the green credit line, a reduction of 22.5% or more in energy yield would result in returns below the benchmark for case 2 and case 3.

The sensitivity test on investment costs shows that with a commercial loan a reduction of about 5% in costs would mean that case 2 and case 3 would provide a return on equity of 17%. At the same time, investment costs would need to be more than 10% higher than expected before case 1 falls below the threshold. In the green credit line scenario, all cases remain above the threshold even when investment costs increase by 25%, as shown in **Figure 3**.

The rice mill sells husk that is not burned in the power plant or used for drying at UGX 25/kg (EUR 0.0059). Rice husk prices in Uganda can, however, reach UGX 130/kg (EUR 0.0305) depending on the location and season. A higher price negatively affects the project economics as the foregone revenue from rice husk sales (now used for captive power) increases. If the rice husk sale prices would reach the upper end of the range, even projects financed under the green credit line may no longer deliver the required return, although case 1 remains above the benchmark (**Figure 4**).

It can be seen that CHP (where fuel is used at a higher overall efficiency) project economics improve relative to non-CHP scenarios at a higher fuel price. However, the price is not yet high enough that the fuel savings surpass the benefits of greater electricity generation for own use.

In the case of the discount rate, with a commercial loan case 2 and case 3 only become a worthwhile investment if the expected return on equity is lowered by about 5–10% (to 16.3% and 15.6% respectively). For case 1, the NPV enters negative territory when the return expectation is about 15% higher (at 19.6%). In the green credit line scenario, the NPV remains positive even if the expected return on equity was 50% more than assumed (i.e. a return of 25.5). **Figure 5** shows the results.

FIGURE 2. IRR test against variation in energy yield[10]

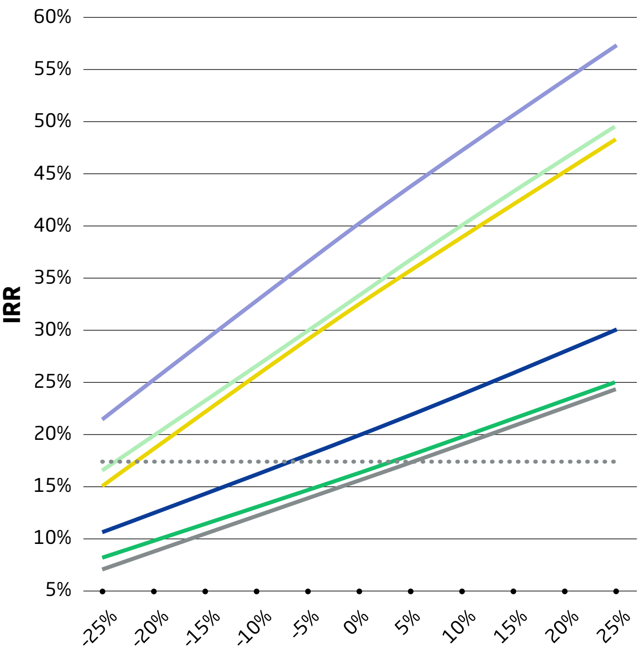


FIGURE 3. IRR test against variation in investment costs

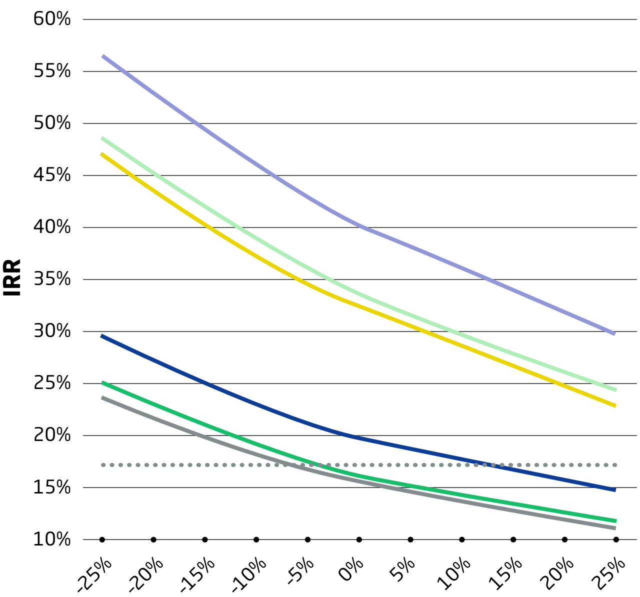


FIGURE 4. IRR test against increase in rice husk sale price (UGX/kg)

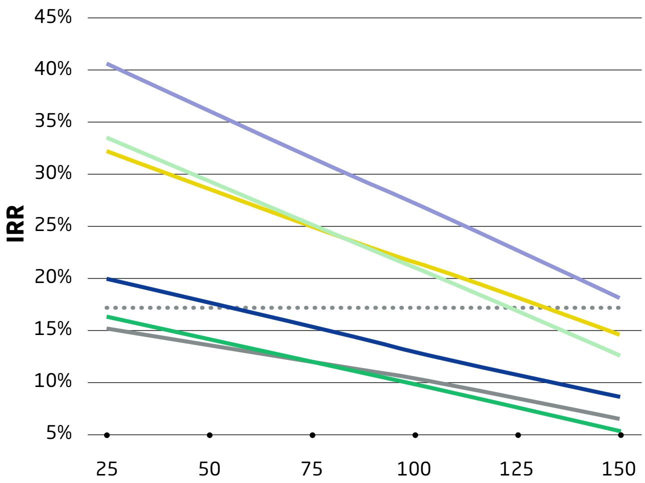
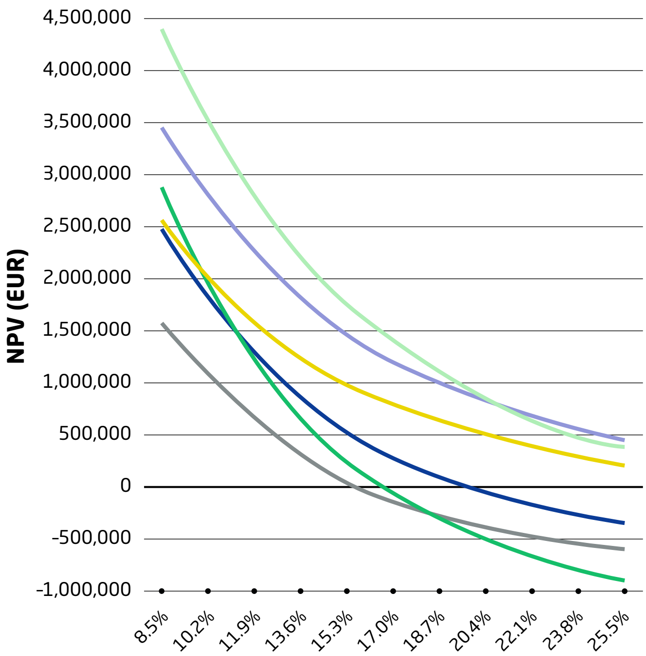
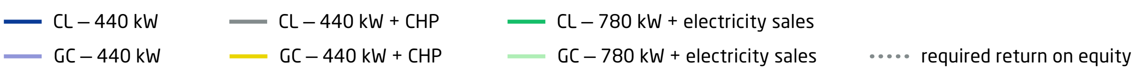


FIGURE 5. NPV test against variations of the discount rate (-50% to +50%)





10) Note: CL = commercial loan, GC = green credit line

KEY TAKEAWAYS

— An investment in a biomass captive plant is highly site specific and should only be made after a detailed assessment that also considers possible alternatives and is ideally part of a comprehensive energy management plan.

— The cost of electricity at a facility — i.e. the retail tariff or cost of diesel generation — is a significant factor in the potential viability of biomass captive power, the economics of which are based on avoided costs. Due to economies of scale, relatively higher levelised costs at smaller sizes and operational considerations, biomass combustion captive plants may be best suited for larger facilities. However, larger users are likely to fall into customer categories with lower electricity tariffs, with a negative impact on economic viability. Nevertheless, due to the potential for a biomass plant to run continuously and the possibility to produce heat as well as power, other factors enter into consideration. For example, where a rice mill faces power outages that affect production; a biomass plant is an option to address the situation, resulting in increased revenue.

— Apart from **a)** technical, feedstock and operational considerations, which are key risks for biomass plants, other potential risks for captive power investments in Uganda include: **b)** the future direction of the electricity tariff, **c)** lower than expected inflation, **d)** currency exchange rates, and **e)** issues around the need to import most equipment.

ANNEX A

Technology Overview

Biomass direct combustion is a thermochemical process where fuel is burned with an excess of oxygen (air) to release heat. In the most common type of biomass power plant, the heat fires a boiler to produce steam, which is converted into electricity. The main system components are:

— **Fuel feeding** system to deliver the feedstock to the firing system in the boiler

— **Boiler** where the fuel is combusted to produce steam

— **Turbine** where the energy from the steam propels a rotating shaft

— **Generator** that is driven by the rotating shaft to produce electricity

— **Condenser, air or water cooled,** where the steam is condensed and then pumped to the

— **Feed water treatment unit** and back to the boiler

— **Flue gas treatment (cyclones, filter) and stack**

A typical configuration of a biomass plant is found in **Figure 6**.

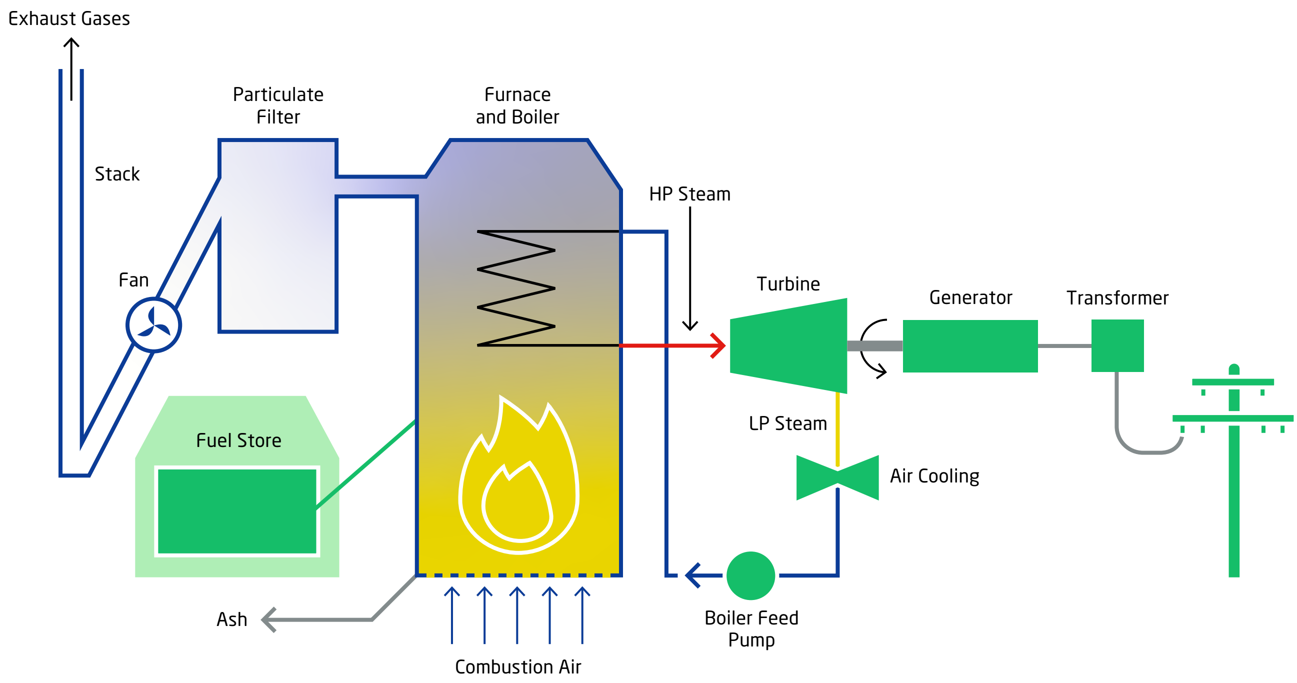
A biomass captive plant can be set up to provide electricity to a facility that is either on or off-grid and also where appropriate displace or completely replace diesel back-up generators. Many biomass plants for grid-connected facilities operate in parallel to the mains power. Those that can also run in “island” (or off-grid) mode and continue to supply electricity during outages require additional equipment: mains power failure detection, automatic switch, power and frequency control to match load, possibly a load bank if the demand of the mill fluctuates faster than the power generation can be adapted and possibly a black start diesel generator.

While biomass plants of 5 MWel capacity have electrical efficiencies of around 25%, the efficiency drops significantly at capacities below 2 MWel (0.5–1 MWel: 10–13%). This means that for smaller plants a relatively large firing system, boiler, turbine and other components produce a relatively small power output. This results in high specific investment costs per kWel and high biomass fuel consumption, making smaller plants attractive only in some circumstances.

Generally, solid fuel plants should run at high load hours for economics and plant efficiency reasons. Therefore, a facility planning to install a biomass captive plant should have consistent operations (even if the load varies, base load should differ as little as possible from mean load).

Co-generation of heat and power (CHP) is an interesting option for certain biomass plants: the heat of steam extracted from the water/steam cycle or heat recovered from the main condenser could be used for facility processes. Tri-generation (+generating cold through absorption or adsorption heat pumps) or quad-generation (+generation and utilisation of CO_2) could be considered where there is demand, e.g. for a diary or greenhouse agriculture.

FIGURE 6. Biomass plant system diagram[11]



It should be noted that bioenergy plants are very site specific — plant requirements, including type of fuel and availability, logistics, load requirements of the facility, characteristics of possible heat consumers — and therefore a detailed assessment is always needed and the system must be designed for the specific site conditions.

Performance considerations

For a biomass plant, key considerations to take into account in Uganda include:

— **Feedstock.** Biomass availability (including seasonality, access and consideration of other uses), suitability (quality/ properties, in particular of agro-industrial residues such as rice husk and cocoa pod husk), collection and storage costs, among others, are important factors for feasibility. Seasonal availability could be compensated for by using other types of biomass, otherwise significant storage space is required.

— **Economies of scale.** On the one hand, there are significant economies of scale with larger steam turbine power plants. On the other hand, two factors hinder scalability in Uganda: a) the amount of centralised biomass resources are relatively small and b) a larger facility with higher electricity demand often falls in the code 30 tariff category, which makes captive power more uneconomical except in a few cases (e.g. the sugar sector or where there are significant grid outages).

— **Technical staff.** A company should have and/or be able to train and retain technical staff for plant operations and maintenance

— **Insufficient maintenance and lack of spare parts.** The generally low density of infrastructure for solid fuel fired heating plants and power plants in Uganda means that specialised contractors and spare parts are not readily available.

11) Source: Lapping, Daniel (2018) Top 9 Biomass Generators to Know in 2018. Disruptor Daily website, 1 February 2018, link: https://www.disruptordaily.com/top-9-biomass-generators-to-know-in-2018/ – accessed April 2019

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The first series of GET.invest Market Insights are published in early 2019 covering four renewable energy market segments in three countries, namely: renewable energy applications in the agricultural value-chain (Senegal), captive power (behind the meter) generation (Uganda), mini-grids (Zambia) and stand-alone solar systems (Zambia).

Each Market Insight package includes **a)** a 'how to' Developer Guide, **b)** Model Business Cases and **c)** Case Studies. The Developer Guide enables the reader to navigate the market and its actors, to understand the current regulatory framework and lays down the step-by-step process of starting a new project/business. The Model Business Case analyses project economics and presents hypothetical, yet realistic, investment scenarios. It hence indicates the criteria for a viable project/business to enable the reader to identify the most cost-effective project/business opportunities. The Case Study analyses the viability of operational or high-potential projects/businesses to highlight lessons learnt and industry trends.

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GET.invest is a European programme which supports investment in decentralised renewable energy projects. The programme targets private sector business and project developers, financiers and regulators to build sustainable energy markets.

Services include project and business development support, information and matchmaking, and assistance in implementing regulatory processes. They are delivered globally and across different market segments.

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