Module 6.1

Simplified Financial Models

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1 Introduction to simplified financial models

The simplified financial model is a tool that enables to understand the economic fundamentals of a project and how to structure its financing. The minimum knowledge required to use that tool is related to the technical characteristics of the project (for example, production factor, life duration of components, duration of construction), the economic characteristics of the project (for example cost of investment, cost of maintenance, price of electricity generated) and the financial characteristics of the project (structure of equity, debt and grant; cost of debt; expected return on equity). A simplified financed model has been developed for each technology based on their specific characteristics.

2 Economic analysis

All simplified financial models are built on the same structure:

Fixed Cost assessment of the project consists of the capital expenditure cost (CAPEX) and fixed operating and maintenance cost (OPEX). For power generation projects with renewable energy:

- The **CAPEX** is a one off cost that occurs during the construction of the project before its commissioning and is expressed in monetary unit (Euro, US dollar or whatever currency is selected) per kW of installed or nominal capacity[1]. CAPEX must be broken down by components with various technical life durations (see technical life duration below) or components with various equity investors (e.g. utility company, private equity holder, consumer).

Range of CAPEX for mid-scale generation projects

		Run-of-river Hydro	On shore wind	Solar PV	Biomass combustion electricity plant	Biogas digester and electricity generator	Diesel generator
Range in KW							
CAPEX ($/kW)	from	2000	2200	1300	2500	3000	1000
	to	5000	2600	2000	4500	6500	1300

- The **OPEX** is a cash expenditure that occurs every year and is expressed in monetary unit per annum for one kW of installed or nominal capacity for fixed OPEX and per kWh for variable OPEX.

[1] Or per connexion for electricity access project

Range of OPEX for mid-scale projects

		Run-of-river Hydro	On shore wind	Solar PV	Biomass	Biogas	Diesel
Fixed OPEX (% capex)	from	3,0%	4,4%	1,5%	4,0%	5,0%	2,0%
	to	7,0%	6,0%	2,5%	6,0%	8,0%	4,0%
variable non fuel OPEX ($/kWh)	from	0,000	0,002	0,000	0,002	0,020	0,014
	to	0,000	0,005	0,000	0,004	0,030	0,028
Variable fuel OPEX ($/kWh)	from	0,000	0,000	0,000	0,005	0,014	0,300
	to	0,000	0,000	0,000	0,022	0,058	0,500

Note 1: Part of the OPEX cost is variable (per kWh output) as it is linked to the consumption of basic commodities such as cooling water, chemicals, lubricant, replacement of wearing parts and fossil fuel. The latter one mostly for conventional fuel technologies such as diesel gen-set but also for biomass supply. In the case of a fixed operating cost and a generation output lower than expected, the project owner / operator is exposed to the risk of a higher average cost per kWh that may exceed the revenue from the power purchase agreement that is usually strictly proportional to the kWh output.

Note 2: For a new project, the OPEX is the full operational cost of the project. For a rehabilitation/strengthening or an expansion/extension[2] project, the OPEX is the marginal operational cost incurred by the project.

Technical Life Duration of equipment components

For some technologies the Capital Expenditure (CAPEX) cost may be a recurrent expense as reinvestment has to be factored periodically such as every 5 or 10 years in order to replace specific components that have a shorter life than the useful life of the project. For example, DC/AC inverters used with solar PV systems have a technical life of 5 to 10 years and must be replaced periodically.

This is the reason why the CAPEX is broken down by components with shorter technical life duration than the useful life of the project. It may also be useful to separate components that receive a performance guarantee from the manufacturer over a shorter period than the useful life of the project. In this latter case, it is assumed that the component must be replaced at the extinction of the guarantee period. For example, modules manufacturers estimate the life duration of solar PV modules over 25 years, while the useful life of the balance of plant may exceed 30 or 40 years.

[2] Expansion of the capacity of a generator or extension of the geographical coverage of a grid

Range of technical life duration of project components

		Run-of-river Hydro	On shore wind	Solar PV	Biomass combustion electricity plant	Biogas	Diesel
Electromechanical equip. (year)	from	10	10		10		
	to	15	15		15		
Solar module (year)	from			20			
	to			25			
Inverter (year)	from			5			
	to			10			
Battery (year)	from			2			
	to			5			
Thermal engine (year)	from					5	5
	to					15	10

Production and incomes

This section is factoring the revenue generated by the project and that will offset the project costs. The revenue is calculated on an annual basis and starts at the commercial commissioning of the project. The revenue is usually calculated as a **physical quantity** of energy generated by the project (or off-taken by a paying consumer) multiplied by a **unit price**.

For a power generation project with renewable energy:

- The **quantity of energy** generated is calculated from a **capacity factor** that expresses the fraction of annual hours where energy is generated at the full available capacity of the plant. The production factor is specific to each project. For example, a hydro project may have a production factor that may vary between 0.5 and 0.9 depending on the flow duration of the river. Assuming a production factor of 0.6, the amount of energy generated on average in a year equals the available capacity expressed in kW x 8760 hours/year x 0.6. This yields a quantity of energy generated in kWh per year. The **available capacity is** a fraction of the installed capacity.

  Range of capacity factor for mid-scale generation projects

		Run-of-river Hydro	On shore wind	Solar PV	Biomass combustion electricity plant	Biogas digester + electrity generator	Diesel generator
Capacity factor (%)	from	55,0%	20,0%	15,0%			
	to	80,0%	35,0%	20,0%	85,0%	90,0%	95,0%

- **The unit price of energy** is the agreed price in the power purchase agreement[3] or the price determined in the feed-in tariff policy, if there is such a policy. The price per kWh is usually expressed in foreign currency (in most cases in US dollar) in order to remove the foreign

[3] In absence of power purchase agreement, a unit price aligned with industry benchmarks may be used; for example a distribution price for a grid strengthening and extension project

exchange risk. In the UEMOA[4] or CEMAC[5] economic zone, a unit price determined in FCFA[6] is equivalent to a price in EURO, considering the fix parity of 655 FCFA per Euro. For prices determined in local currency that do not have a fix parity with a hard currency, an averaged conversion rate over the duration of the power purchase agreement must be forecasted that introduces a foreign exchange risk. Usually the feed-in tariff policies that express the unit price in local currency consider an adjustment of the price of electricity at the same pace as the public electricity tariff schedule for sale of electricity to the consumer. When this price adjustment is made on a monthly basis (foreign exchange pass through cost component in the electricity public tariff schedule), then a great part of the foreign exchange risk is mitigated.

The **duration of the power purchase agreement** provides the time horizon for the revenue certainty. It is usually 15 to 20 years. Beyond this time horizon, there is no formal contractual commitment that guarantees an income to the project. Therefore, for the purpose of the financial analysis, the worst scenario must be considered with a revenue down to zero and the operation of the project must be stopped or transferred to the public domain at zero value with no liability for the project owner.

Revenue upsides (e.g., carbon emission credit or sale of by-products of the project) that come on top of the guaranteed revenue are normally not considered in the simplified financial analysis[7].

Basic economic indicators

The **pay-back period** calculates how many years are necessary to cover the CAPEX with the net annual revenue that consists of the annual income minus the annual OPEX charges. The economic sustainability of a project is subject to the pay-back period being shorter than the project economic life.

The **internal rate of return**[8] calculates the interest rate that makes equal to zero the net present value of all cash flows both negative (costs) and positive (revenue) over the period of revenue certainty. In the first year, the cash flow consists of the CAPEX and is negative. From the second year until the end of the time series, the cash flow consists of the revenue minus the OPEX (minus the reinvestment cost if applicable). To be financially viable, the investment should have an internal rate of return exceeding the weighted average cost of capital (WACC).

3 Financial analysis

The next section of the simplified financial model is the **financial analysis**.

The total amount to be financed includes the capital investment cost as described in the economic analysis section plus the specific financing cost that occurs during the construction period that is called **interest during construction** (IDC). During the construction period, the project cannot service financial charges from revenue. Therefore, this cost has to be factored in the project cost used to calculate the source of funds.

There are three types of source of fund

[4] UEMOA: Union Economique et Monétaire Ouest Africaine

[5] CEMAC: Communauté Economique et Monétaire de l'Afrique Centrale

[6] FCFA: Franc de la Communauté Financière Africaine, Monetary unit of UEMOA and CEMAC economic zone

[7] Upside revenues are considered for biogas project

[8] Here, in absence of financing consideration, it is the "economic" internal rate of return

Equity is the money committed by the owners of the project from their own source or through an equity partner. Equity investors expect a return on their investment during the course of the project that is much higher than the riskless money market or yield of riskless businesses. As a result of higher risky business environment in certain sub-Saharan countries, the equity investors will increase the expected return with a risk premium. The usual expected return on equity in sub-Sahara Africa varies in the range of 15% to 25% after tax[9]. However, this return is not guaranteed to the owner and is at risk. The return on equity investment corresponds to their share of the benefits remaining after all project financial obligations have been met (such as repayment of loan annuity and taxes). Equity investors recover their initial investment plus an expected profit when they sell their shares to other investors, or when the assets of the project are liquidated and proceeds distributed among them after all financial obligations have been satisfied. Equity partners usually have a short term exit clause (usually after 5 to 7 years of project operation that is much shorter than the loan duration), where they intend to recover their initial investment, plus the expected return, plus their share of the benefit over the project life.

Loan is the money committed by banks against a predetermined repayment schedule in order to finance the project. Lenders recover their initial investment plus an agreed interest rate during the loan duration. It is expected that the project will generate sufficient revenue to cover all charges. Should the revenue be tighter than expected, the equity partner will squeeze their own return to be able to repay the loan. This is the reason why the lender requires a minimum equity participation as a security for financing a project (30% to 40%). The equity investors will support the project risks. In case of temporary revenue disruption, and consumption of all available cash to repay the term of the loan, liquidity guarantees will be called in order to be able to repay the loan timely and avoid to default. These liquidity guarantees take the form of risk insurance that are subscribed with the loan and which premium are paid for with the interest rate.

In the case of a public investment, the loan is usually a loan to the government on lent to the public asset manager. The government provides its sovereign guarantee to the loan which means that the government is bound to repay the loan independently of the ability of the underlying investment to generate sufficient revenue for the asset owner to repay the investment. Such sovereign loans are strictly monitored by the IMF that states that heavily indebted countries are not eligible to sovereign debt.

Grant is an optional source of fund that is provided by a donor with no obligation of repayment. A grant will alleviate the annual repayment charges in order to make them match project revenue. A grant may also finance development costs at a time where the financing of the project (agreement with equity partners and lenders) is not yet closed.

Quasi Equity is the money committed by a third party that has some traits of equity, such as having flexible repayment options or being non-secured by any collateral. Examples of quasi-equity include mezzanine debt (preference equity, perpetual loan, junior debt) and subordinated debt.

Quasi equity investors bear the risk of the project and are refunded if the project shows a positive net margin after repayment of the senior debt.

The **financing leverage on grant** is calculated as the amount of investment divided by the amount of grant. This is a performance indicator in the developing world that indicates how much USD of investment has been mobilised for one USD of grant.

[9] In the simplified financial model, it is assumed that there is not income tax. Should there be an income tax, the project will have to yield a return on equity that is a multiplier of the expected return on equity after tax.

The **Weighted Average Cost of Capital (WACC)** intends to calculate the equivalent interest rate applicable to the project cost that will be sufficient to service the loan and serve the expected return on equity. The WACC is calculated over the loan duration as follows:

- Share of loan x loan interest rate +
- Share of equity x duration of loan / duration of financial analysis x expected return on equity +
- Share of grant x 0

In the above formula, the higher is the share of grant, the lower will be the WACC (as a result of a lower share of Loan + equity)

The longer is the duration of financial analysis compared to the loan duration, the lower will be the WACC. This is because the share of equity is normalised to the duration of loan which is lower than the duration of the financial analysis.

The **annuitized capital cost over the loan period** is calculated using a Payment (PMT) function of Excel that gives the annual payment for the normalized investment (Loan + Equity over the loan period, ignoring the grant amount) over the loan period at the interest rate equalled to the WACC.

The **Levelized Cost Of Electricity (LCOE)** is calculated by adding the annuitized capital cost and the annual operating expense and dividing by the quantity of electricity generated. The LCOE should be inferior to the feed-in tariff.

The last financial ratio calculates the **Net Present value (NPV)** of the project over the financial analysis period. The cash flow schedule is the same as for the calculation of the internal rate of return from year 2 onward. The only difference is on year 1 that indicates the negative value of the investment (same as for IRR) minus the IDC (Interest During Construction) that adds up to the investment cost) plus the grant amount (that is to be deducted from the investment cost).

The discount factor for the NPV is the WACC which reflects the cost of money for the project. However, in some cases the WACC can be extremely low (combination of high grant value, concessional interest rate for the loan, and low equity share with low return on equity). The simplified financial model considers a minimum discount rate of 5% (or the WACC, if its value is above 5%) to calculate the NPV. The NPV is the adjustment criterion for the grant and calculate the **"blending optimum"**. NPV must be positive and close to zero:

- A **negative NPV** indicates that the project does not generate enough income to offset the financial burden; therefore, the grant should be increased and the loan decreased.
- A **largely positive NPV** indicates that the project produces a financial surplus, which is incompatible with the initial grant to the project; accordingly, the grant can be reduced and the loan increased towards a "blending" optimum.

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4 What are the key questions?

From the Donor's point of view

- What is the minimum level of grant that makes the project attractive for the private sector?
- Is the financing leverage within an acceptable range for similar projects?
- What is the cost of the KWh produced? Is it sustainable for the local economy?
- Is the return on equity claimed by the private investors acceptable and reasonable?

From the Lender's point of view

<u>For a power generation project with renewable energy</u>

- How certain will the project deliver the expected revenue?
- Will the expected income be sufficient to support the repayment of the loan and the payment of a reasonable / expected return on equity?
- Is the investment cost estimate credible?
  - What if the project investment cost is much higher than initially expected (CAPEX risk)?
  - Are the shareholders committed to increase the equity in order to finance the gap?
- Is the revenue secured during the loan period?
  - What if the physical output of the power plant is lower than expected (volume risk)?
  - What if the price of generated electricity plummets (price risk)?
  - What if the off-taker does not pay the purchased electricity in time (risk of creditworthiness of off-taker)?
- Will the technology deliver the expected power generation output (technology risk)?
- Will the off-taker take the delivery of all electricity generated by the power plant (grid operational risk)?

<u>For an energy efficiency project</u>

- Will the project deliver the expected savings?
- Are those savings sufficient to support
  - the repayment of the loan +
  - a reasonable / expected return on equity +
  - an immediate expected and attractive reduction of the operation budget (cash benefit) during the loan period?
- Is the investment cost estimate credible?
  - What if the project investment is much higher than initially expected (CAPEX risk)?
  - Are the savings secured during the loan period?
  - What if the underlying physical quantity of energy savings is lower than expected (volume risk)?
  - What if the price of the underlying physical quantity plummets (price risk)?
- Will the technology deliver the expected savings (technology risk)?

Annexes

Annex 1 Run-of-river hydro power plant

SIMPLIFIED FINANCIAL MODEL FOR HYDRO PROJECT (1 kW)				
	Items	**unit**	**value**	**comments**
	COST			
1	Cost of civil work per kW installed	USD	2500	data input
2	cost of mechanical/electrical equipment per KW installed	USD	2500	data input
1+2	total cost per KW installed (CAPEX)	USD	5000	calculated
3	running/maintenance cost per year per KW (OPEX)	USD	100	data input
	LIFE DURATION			
4	civil work in years	year	50	data input
5	electrical/mechanical equipment in years	year	15	data input
%4+%5	weighted life duration in years	year	32,5	calculated
	PRODUCTION AND INCOMES			
6	Average production factor		0,6	data input
7	Feed in tariff (per kWh)	USD	0,15	data input
8	Duration of PPA (year)	year	20	data input
	BASIC ECONOMIC INDICATORS			
9	Pay back period in years	year	7,3	calculated
10	Internal rate of return		10,9%	calculated
	FINANCING			
11	IDC	USD	300	data input
12	TOTAL AMOUNT OF GRANT (per kW)	USD	1500	data input
13	TOTAL AMOUNT OF EQUITY (per KW)	USD	1500	data input
14	TOTAL AMOUNT OF LOAN (per KW)	USD	2300	calculated
12/(11+13	Total CAPEX + IDC (per KW)	USD	5300	calculated
	check		OK	test sum of financing sources equal to CAPEX +IDC
	FINANCING LEVERAGE ON GRANT		3,53	calculated
	WEIGHTED RATE OF RETURN OF EQUITY IN %		22%	data input
	WEIGHTED INTEREST RATE of LOANS IN %		10,0%	data input
	WEIGHTED LOAN DURATION		15	data input
	check		OK	test loan duration less than financial analysis period
	WACC - Weighted Average Cost of Capital in %		9,01%	calculated
	Financial analysis duration (year)		20	data input; up to 30 years
	Annuitized Capital Cost over loan period (per kW-year)	USD	425	calculated using WACC
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	USD	0,10	calculated over loan period
	Discount rate %		9,01%	WACC by default or data input; minimum discount rate is 5
	NPV (per kW)	USD	1 646	calculated using discount rate
	other financial ratios			

Annex 2 Solar PV power plant

SIMPLIFIED FINANCIAL MODEL FOR SOLAR PV PROJECT (Peak Capacity 1 kW)				
	Items	**unit**	**value**	**comments**
	COST			
1	cost of balance of plant per kW installed	USD	1600	data input
2	cost of PV cells per KW installed	USD	1000	data input
3	cost of inverters per KW installed	USD	400	data input
1+2+3	total cost per KW installed	USD	3000	calculated
4	running/maintenance cost per year per KW	USD	43	data input
	LIFE DURATION			
5	balance of plant in years	year	50	data input
6	PV cells in years	year	25	data input
7	inverters in years	year	10	data input
%5+%6+%	weighted life duration in years	year	36,3	calculated
	PRODUCTION AND INCOMES			
8	Net Available Capacity over loan period	kW	0,86	data input
9	Equivalent hours per day at full capacity	hours	5	data input
10	Average production factor		0,21	calculated
11	Feed in tariff (per kWh)	USD	0,1773	data input
12	Duration of PPA (year)	year	20	data input
	BASIC ECONOMIC INDICATORS			
13	Pay back period in years	year	14,4	calculated
14	Internal rate of return		2,7%	calculated
	FINANCING			
	IDC	USD	138	data input
11	TOTAL AMOUNT OF GRANT (per kW)	USD	1020	data input
12	TOTAL AMOUNT OF EQUITY (per KW)	USD	0	data input
13	TOTAL AMOUNT OF LOAN (per KW)	USD	2118	calculated
11+12+13	Total CAPEX (per KW)	USD	3138	calculated
	check		OK	test sum of financing sources equal to CAPEX + IDC
	FINANCING LEVERAGE ON GRANT		3,08	calculated
	WEIGHTED RATE OF RETURN OF EQUITY IN %		22%	data input
	WEIGHTED INTEREST RATE of LOANS IN %		7,0%	data input
	WEIGHTED LOAN DURATION		15	data input
	check		OK	test loan duration less than financial analysis period
	WACC - Weighted Average Cost of Capital in %		4,72%	calculated
	Financial analysis duration (year)		20	data input; up to 30 years
	Annuitized Capital Cost over loan period (per kW-year)	USD	200,27	calculated using WACC
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	USD	0,1555	calculated over loan period
	Discount rate %		5,00%	WACC by default or data input; minimum discount rat
	NPV (per kW)	USD	367	calculated using discount rate
	other financial ratios			

Annex 3 Wind power plant

	Items	unit	value	comments
	COST			
1	cost of balance of plant per kW installed	EUR	592	calculated
2	cost of mechanical equipment per kW installed	EUR	1000	data input source TAF
3	cost of transport erection electrical work per KW installed	EUR	208	data input source TAF
1+2+3	total cost per KW installed	EUR	1800	
4	running/maintenance cost per year per KW	EUR	79	data input source TAF
	LIFE DURATION			
5	balance of plant in years	year	50	data input source TAF
6	mechanical equipment in years	year	25	data input source TAF
7	electrical equipment	year	25	data input source TAF
%5+%6+%	weighted life duration in years	year	33,2	calculated
	PRODUCTION AND INCOMES			
8	Net Available Capacity over loan period	kW	1,00	data input source TAF
9	Average wind speed at hub height 100 m	m/s	6,5	
10	Average production factor		0,25	
11	Feed in tariff year 1 (per kWh)	EUR	0,12	
	Annual increase of feed-in tariff year 1 - 10	%	0,0%	
12	Duration of PPA (year)	year	20	data input source TAF
	BASIC INDICATORS			
13	Pay back period in years	year	9,8	calculated
14	Internal rate of return	%	6,2%	calculated
	FINANCING			
11	IDC	EUR	83	data input source TAF
12	TOTAL AMOUNT OF GRANT (per kW)	EUR	76	
13	TOTAL AMOUNT OF EQUITY (per KW)	EUR	464	calculated
14	TOTAL AMOUNT OF LOAN (per KW)	EUR	1343	
12+13+14	Total CAPEX with IDC (per KW)	EUR	1883	
	check		OK	test sum of financing sources equal to CAPEX + IDC
	FINANCING LEVERAGE ON GRANT		25	calculated
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	EUR	0,1262	calculated over loan period; must be below feed-in tariff
	Discount rate %		7,98%	WACC by default or data input; minimum discount rate is 5%
	NPV (per kW)	EUR	-1	calculated using discount rate; reduce grant to target NPV=0
	other financial ratios			

Annex 4 Biomass combustion electricity plant

	Items	unit	value	comments
	FIXED COST			
1	Cost of civil work per kW installed	EUR	400	data input
2	cost of mechanical/electrical equipment per KW installed	EUR	1600	data input
1+2	total cost per KW installed (CAPEX)	EUR	2000	calculated
3	running/maintenance cost per year per kW (FIXED OPEX)	EUR	100	data input
	LIFE DURATION			
4	civil work in years	year	50	data input
5	electrical/mechanical equipment in years	year	15	data input
%4+%5	weighted life duration in years	year	22,0	calculated
	PRODUCTION AND INCOMES			
6	Average production factor		0,85	data input
7	Feed in tariff (per kWh)	EUR	0,065	data input
8	Duration of PPA (year)	year	20	data input
	VARIABLE COST			
	Biomass cost per kg	EUR	0,008	
	Water content of biomass	%	30	
	Boiler steam capacity	kg/h	4,7	
	Boiler efficiency	%	75	
	Biomass supply capacity	kg/h	1,12	
	Auxiliary capacity	kW	0,12	
	Variable non fuel O&M per kWh	EUR	0,0021	
	Total variable cost per kWh	EUR	0,011	
			0,009	
	BASIC ECONOMIC INDICATORS			
9	Pay back period in years	year	8,2	calculated
10	Internal rate of return		7,0%	calculated
	FINANCING			
11	IDC	EUR	80	data input
12	TOTAL AMOUNT OF GRANT (per kW)	EUR	250	data input
13	TOTAL AMOUNT OF EQUITY (per KW)	EUR	350	data input
14	TOTAL AMOUNT OF LOAN (per KW)	EUR	1400	calculated
12/(11+13	Total CAPEX + IDC (per KW)	EUR	2080	calculated
	check		OK	test sum of financing sources equal to CAPEX +IDC
	FINANCING LEVERAGE ON GRANT		8	calculated
	WEIGHTED RATE OF RETURN OF EQUITY IN %		22%	data input
	WEIGHTED INTEREST RATE of LOANS IN %		10,0%	data input
	WEIGHTED LOAN DURATION		10	data input
	check		OK	test loan duration less than financial analysis period
	WACC - Weighted Average Cost of Capital in %		8,58%	calculated
	Financial analysis duration (year)		20	data input; up to 30 years
	Annuitized Capital Cost over loan period (per kW-year)	EUR	241	calculated using WACC
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	EUR	0,057	calculated over loan period
	Discount rate %		8,58%	WACC by default or data input; minimum discount rate is 5
	NPV (per kW)	EUR	-2	calculated using discount rate
	other financial ratios			

Annex 5 Biogas digester and electricity generator

SIMPLIFIED FINANCIAL MODEL FOR BIOGAS POWER PLANT PROJECT (1 kW)				
	Items	**unit**	**value**	**comments**
	FIXED COST			
1	Cost of civil work per kW installed	EUR	928	data input
2	cost of mechanical/electrical equipment per KW installed	EUR	2428	data input
1+2	total cost per KW installed (CAPEX)	EUR	3356	calculated
3	running/maintenance cost per year per kW (FIXED OPEX)	EUR	242	data input
	LIFE DURATION			
4	civil work in years	year	30	data input
5	electrical/mechanical equipment in years	year	15	data input
%4+%5	weighted life duration in years	year	19,1	calculated
	PRODUCTION AND INCOMES			
6	Average production factor		0,41	data input
7	marginal electricity price (per kWh)	EUR	0,21	data input
8	Duration of PPA (year)	year	20	data input
	UPSIDE REVENUE			
	solid biofertiliser price per tonne dry	EUR	1,7	
	solid biofertiliser production per year	t dry	6,7	
	liquid biofertiliser price per m3	EUR	0,92	
	liquid biofertiliser production per year	m3	18,0	
	C02 emission abatement credit per tonne CO2	EUR	2,5	
	CO2 emission abatement per year	t	5,5	
	VARIABLE COST			
	Waste value per kg	EUR	0,008	data input
	Dry matter content of waste	%	27	data input
	Biogas generation per tonne dry matter	m3	659	data input
	Methane content in biogas	%	55	data input
	Engine efficiency	%	39	data input
	Waste supply capacity	kg/h	2,8	data input
	Auxiliary capacity	kW	0,06	data input
	Variable non fuel O&M per kWh	EUR	0,019	data input
	Total variable cost per kWh	EUR	0,043	calculated
			0,024	
	BASIC ECONOMIC INDICATORS			
9	Pay back period in years	year	25,1	calculated
10	Internal rate of return		-7,0%	calculated
	FINANCING			
11	IDC	EUR	74	data input
12	TOTAL AMOUNT OF GRANT (per kW)	EUR	2148	data input
13	TOTAL AMOUNT OF EQUITY (per KW)	EUR	0	data input
14	TOTAL AMOUNT OF LOAN (per KW)	EUR	1208	calculated
12/(11+13	Total CAPEX + IDC (per KW)	EUR	3430	calculated
	check		OK	test sum of financing sources equal to CAPEX +IDC
	FINANCING LEVERAGE ON GRANT		2	calculated
	WEIGHTED RATE OF RETURN OF EQUITY IN %		22%	data input
	WEIGHTED INTEREST RATE of LOANS IN %		6,0%	data input
	WEIGHTED LOAN DURATION		15	data input
	check		OK	test loan duration less than financial analysis period
	WACC - Weighted Average Cost of Capital in %		2,11%	calculated
	Financial analysis duration (year)		20	data input; up to 30 years
	Annuitized Capital Cost over loan period (per kW-year)	EUR	95	calculated using WACC
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	EUR	0,137	calculated over loan period
	Discount rate %		5,00%	WACC by default or data input; minimum discount rate is 5
	NPV (per kW)	EUR	-7	calculated using discount rate
	other financial ratios			

Annex 6 Diesel electricity generator

SIMPLIFIED FINANCIAL MODEL FOR DIESEL PROJECT (1 kW capacity)				
	Items	**unit**	**value**	**comments**
	FIXED COST			
1	Cost of balance of plant per kW installed	USD	700	data input
2	Cost of mechanical/electrical equipment per KW installed	USD	400	data input
3	Cost of thermal equipment per KW installed	USD	200	data input
1+2+3	total cost per KW installed	USD	1300	calculated
3	non fuel fixed maintenance cost per year per KW	USD	35	data input
	VARIABLE COST			
	Fuel price (per tonne)	USD	1400	data input
	Fuel density	kg/litre	0,84	data input
	Fuel to power heat rate	litre/kWh	0,26	data input
	Full load efficiency on LHV	%	38%	calculated
	Lube oil	g/kWh	1,5	data input
	Fuel & lube oil cost (per kWh)	USD	0,3142	calculated
	variable non fuel O&M (per kWh)	USD	0,014	data input
	Total variable cost (per kWh)	USD	0,3282	calculated
	LIFE DURATION			
4	balance of plant in years	year	50	data input
5	electrical/mechanical equipment in years	year	15	data input
6	thermal equipment in years	year	5	data input
%4+%5+%	weighted life duration in years	year	31,5	calculated
	PRODUCTION AND INCOMES			
7	Hours of operation per week at full load	hours	36	data input
8	Average production factor		0,21	calculated
9	Feed in tariff (per kWh)	USD	0,4300	data input
10	Duration of PPA (year)	year	20	data input
	BASIC INDICATORS			
11	Pay back period in years	year	14,5	calculated
12	Internal rate of return		0,6%	calculated
	FINANCING			
	IDC	USD	20	data input
13	TOTAL AMOUNT OF GRANT (per kW)	USD	0	data input
14	TOTAL AMOUNT OF EQUITY (per KW)	USD	390	data input
15	TOTAL AMOUNT OF LOAN (per KW)	USD	930	calculated
13+14+15	Total CAPEX (per KW)	USD	1320	calculated
	check		OK	test sum of financing sources equal to CAPEX
	FINANCING LEVERAGE ON GRANT		#DIV/0!	calculated
	WEIGHTED RATE OF RETURN OF EQUITY IN %		20%	data input
	WEIGHTED INTEREST RATE of LOANS IN %		5,0%	data input
	WEIGHTED LOAN DURATION		15	data input
	check		OK	test loan duration less than financial analysis period
	WACC - Weighted Average Cost of Capital in %		9,43%	calculated
	Financial analysis duration (year)		15	data input; up to 30 years
	Annuitized Capital Cost over loan period (per kW-year)	USD	167,91	calculated using WACC
	CAPEX cost per kWh	USD	0,0894	
	Fixed Maintenance cost per kWh	USD	0,0186	calculated
	Variable cost per kWh	USD	0,3282	calculated
	FINANCIAL RATIOS			
	LCOE Levelized Cost of Electricity per kWh produced	USD	0,4363	calculated over loan period
	Discount rate %		9,43%	WACC by default or data input; minimum discount rate is 5%
	NPV (per kW)	USD	-399	calculated using discount rate
	other financial ratios			

Annex 7 Grid reinforcement and extension

SIMPLIFIED FINANCIAL MODEL FOR GRID REINFORCEMENT AND EXTENSION (per connection)				
	Items	**unit**	**Value**	**Comment**
	CAPEX			
1	MV grid cost	EUR	574	Design
2	LV grid cost	EUR	328	Design
3	Street lighting cost	EUR	164	Design
4	Connection cost	EUR	164	Design
1+2+3+4	Total grid cost	EUR	1230	Calculated
4	**OPEX (per year)**	EUR	9,84	Design
	TECHNICAL LIFE			
5	MV grid (years)	year	60	Data
6	LV grid (years)	year	60	Data
7	Street lighting (years)	year	10	Data
8	Connection (years)	year	30	Data
%5+%6+%	weighted technical life		49,3	Calculated
	ELECTRICTY CONSUMPTION AND REVENUE			
	max capacity per household W	W	350	Design
	No of households	N°	1	Design
	Annual electricity use per new household per year	kWh	305	Design
	Total consumption new customers per year	kWh	305	Calculated
	Cumulated installed capacity	kW	0,35	Calculated
9	Load factor of new clients		0,099	Calculated
	Incremental supply to existing customers per year	kWh	500	Design
	Global Load factor		0,263	Calculated
10	Distribution tariff per kWh	EUR	0,0580	Data
	Average revenue per new customer per year)	EUR	47	
	BASIC ECONOMIC INDICATORS			
11	Pay back period in years	year	33,35	Calculated
12	Internal rate of return	%	-1,1%	Calculated
	FINANCING			
	IDC	EUR	98	
13	EU GRANT	EUR	574	Data
14	PRIVATE EQUITY (000 EUR)	EUR	164	Data, Connection fee
15	LOAN (000 EUR)	EUR	590	Data
13+14+15	Total CAPEX + IDC	EUR	1328	Calculated
	check		OK	test sum of financing sources equal to CAPEX + ID
	TECHNICAL ASSISTANCE	EUR	82	Data
	TOTAL BUDGET	EUR	1410	Calculated
	FINANCING LEVERAGE ON GRANT		1,15	Calculated
	Return on equity %		0%	Data
	Loan interest rate %		3,0%	Data
	Loan duration (years)		25	Data
	check		OK	test loan duration less than financial analysis peri
	WACC - Weighted Average Cost of Capital in %		1,33%	Calculated
	Financial analysis duration	year	30	Data
	Annuitized Capital Cost over loan period per year	EUR	28	Calculated witjout connection
	FINANCIAL RATIOS			
	Levelized cost of Electricity per kWh supplied	EUR	0,0469	calculated over the loan period
	Discount rate		5,00%	WACC by default or data
	NPV	EUR	-0	calculated using discount rate
	other financial ratios			