Financial and economic aspects

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Sources: renewables global status report 2009 update;
FACT data

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Introduction

- Biofuels and bioenergy should be competitive with other options:
  - with other renewables like e.g. wind, water, solar;
  - with grid connection to central grid
- Decision making depends on feasibility in financial aspects, but also on other aspects like
  - Reliability (functioing over time),
  - Ease of operation,
  - Storage features

Financial = part of wider appraisal

- Demand of target group for a activity/project
- Why there is such demand:
  - Is priority of target group;
  - Hear-say of success;
  - Real need for energy, expressed as impediment for further progress;
  - Obtaining side benefits (belong to..)
- Rapid Rural appraisal to find out?

Appraisal

Appraisal methods can be various:

- When evaluating: judging and ranking on first set criteria by the target group;
- Straight voting of the target group;
- Discussing and shaping to consensus;
- More scientific approach of setting criteria, indicators and finally valueing criteria/indicators with different weights
- Others

How to determine financial and economic feasibility

- Simple pay-back:
- Cash flow analysis: value future costs and income over the economic life of the project and see the
- Internal Rate of return: this is the interest rate at which the total of income of the project equals the costs of the project over the lifetime
- Return on Equity: If the costs of the loan part

Practical Cash flow approach focus

Cashflow approach with spreadsheet and sensitivity can be used to cover all needs:

- Return on equity for investors,
- Economic viability,
- For taxation purposes,
- For special requirements of funders (PSO,ORET, etc..),
- Part of Due dilligence,

Cashflow = ordering income and costs

- Ranking costs: Investment and operational costs over the years if costs are expected to grow faster than the that of the general economy, adaptation can be made
- Ranking income streams over the years: if income e.g. due to price rise is expected that is higher than the regular, adaptation can be made for this.
- Income and cost streams are substracted;
- Normally this leads to a negative in the first year due to investment ballast;

continued

- With the operating costs being less as the yearly revenues, this can be paid back: by adding a penalty year over year (interest because future values do not have the same as today's values), a Internal rate of return is calculated: this is an iterative process, today as a excel function.
- The internal rate is the value at which the project over the years is zero sum.
- That means e.g. that a project with 20 % IRR would in fact generate an interest of 20 % if the investment would not have a interest on it. Or differently said: such project would with a 10 % interest on capital, be able to cover that interest and still have 12 % additional.

Example cash flow or a grass biogas electricity project

Table 12	Cash flow analysis										
Financial Cash flow		year	1	2	3	4	5	6	7	8	9	10
Activity	Description											
Incoming	Sales of electricity		3529	3529	3529	3529	3529	3529	3529	3529	3529	3529
	Others											
	Subtotal		3529	3529	3529	3529	3529	3529	3529	3529	3529	3529
Investment												
	Land, preparation and sowing	1293										
	Irrigation pump and lines	885										
	Chipper and mixer	740										
	Biodigestor complete with cleaning and tubing and control	6212										
	Electric Generator complete with control	8476										
	Minigrid	3021										
	Sutotal	20628										
Operating costs												
	Operation of the energy grass land		300	300	300	300	300	300	300	300	300	300
	Chipper and mixer		8	8	8	8	8	8	8	8	8	8
	Biodigester		211	211	211	211	211	211	211	211	211	211
	Generador		437	437	437	437	437	437	437	437	437	437
	Minigrid		273	273	273	273	273	273	273	273	273	273
	Subtotal		1229	1229	1229	1229	1229	1229	1229	1229	1229	1229
Subtotal costs		20628	1229	1229	1229	1229	1229	1229	1229	1229	1229	1229
Benefits - costs		-20628	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300

Internal Rate of Return (IRR)

- IRR of 2 % with E price of 15 USDcents/kWh

- This is for small system, and likely reduced to 7 USDcents/kWh for systems of 100 ha

Some notes on income streams

Income streams:

- volume/ probability of price/probability of existence
- Own target group use or markets
- Examples of revenue streams
  - Sales of energy commodity
  - Sales of eg. carbon credits
  - Sales of residues avoid double counting or unsustainable systems (e.g. take out biomass and do not include nutrients recycling)
  - Sales of other by products

Some notes on cost streams

Cost streams:

- Conservative estimates on efficiencies or performances of technology is wise!
- Investment costs: capital what costs are in the project, which outside : project boundary definition is important!
- Investment costs: also the setting up (scan, prefeasibility, feasibility, design, financial engineering, etc..)
- Capital costs: % equity % loans, conditions and terms

- Operating costs expectations
- Operating costs: depending on what is to be delivered
  - Feedstock costs;
  - Storage costs ;
  - Transport and handling costs;
  - Personnel costs;
  - Management costs;
  - Energy and water input costs;
  - Administrative fee collection costs;
  - Office costs;
  - Land costs;
  - Building rental costs;

FACT examples

- FACT sheets internal use:
  - Jatropha full utilization from Jatropha planting to Jatropha PPO, biodiesel, electricity generation (from PPO and biogas from cake). organic manure from digestate
  - Gasification/steam/biogas for electricity
  - Biogas Grass system
  - Renewables for village power and industries

Jatropha full utilization

Table 1 General input data

Type of oil crop	Name	Jatropha
Size of Farm	ha	500
Financial data		
Interest rate of loan	%/yrs	6%
Duration of loan	yrs	10
Return on equity		25%
Investment		100%
Loan		70%
Equity		30%
Labor data		
Non Skilled labor	USD/manday	1.00
Skilled labor (30% above non skilled)		1.30
Staff labor (30% above skilled)		1.69
Fuel costs		
Diesel	USD/l	1.16
	USD/kWh	0.25
Harvest and distribution of seed		
kg oil	%	20%
kg cake	%	80%
Seed value at farm gate	USD/kg	0.14

Table 5 **Fertilzer efficiency: of the fertilizer only % is used by the plant, rest is lost**

Type of	Type of	Efficiency
	N	50%
	P2O5	22%
	K2O	65%
	Ca	10%
	Mg	10%
	S	22%

Table 6 **Soil fertility and contribution to nutrient supply of Jatropha**

Parameter	Units	Value	Observation
			Observation of fertility for all nutrients
Contribution of soil to the plant development year 1 to 4 in %		70%	low 10% / mediu m 40% / high 70%

Table 5 Financial cashflow oil pressing

Financial Cashflow Activity	Year Description		0	1	2	3	4	5	6	7	8	9
Benefits	Oil sales			340000	340000	340000	340000	340000	340000	340000	340000	340000
	Cake sales			17600	17600	17600	17600	17600	17600	17600	17600	17600
	Others											
	Subtotal			357600	357600	357600	357600	357600	357600	357600	357600	357600
Investment												
	Buildings incl storage		389083									
	Land		1744									
	Presses		208333									
	Oil storage		1750									
	Filters		7292									
	Pumps valves and piping		5490									
	Sutotal	1227385	613693									
Operational												
	Seeds			294000	294000	294000	294000	294000	294000	294000	294000	294000
	Electricity consumption			274	274	274	274	274	274	274	274	274
	Parts and filters			6686	6686	6686	6686	6686	6686	6686	6686	6686
	Labor &management			6043	6043	6043	6043	6043	6043	6043	6043	6043
	Stationary			1000	1000	1000	1000	1000	1000	1000	1000	1000
	Permits			100	100	100	100	100	100	100	100	100
	Sutotal			308104	308104	308104	308104	308104	308104	308104	308104	308104
Subtotal costs			613693	308104	308104	308104	308104	308104	308104	308104	308104	308104
Benefits- Costs			-613693	49496	49496	49496	49496	49496	49496	49496	49496	49496

IRR (10 Yrs)	-6%
IRR (15 Yrs)	2%

Example Gasification/steam/

Table 1 — Inverse calculation of biomass residue needs for output

Parameter	Unit	Value
Required Electricty Output	kW	50
Required hours of functioning/day	no/day	8
Required days functioning/week	no/week	6
Required weeks functioning/year	no/year	50
Total hours of functioning per year	no/year	2400
Load factor as compared to rated capacity	%	30%
Total in production requirement	kWh/yr	36000
Efficiency of conversion		
engine	%	25%
generator	%	92%
control system	%	98%
transmission	%	95%
distribution	%	95%
total efficiency	%	20%
Required brut energy for system	kWh/yr	176971
	MJ/yr	637095
Lower Heating value of		
Producer gas (CH4 H2 CO CO)	MJ/m3	5.2
Requirement for producer gas	m3 producergas/yr	122518

Gasification

Parameter	Unit		Case 1 Rice husk	Case 2 Wood
	Year			
Investment		0	-119500	-119500
Electricity sales -Operating costs		1	12281	11440
		2	12281	11440
		3	12281	11440
		4	12281	11440
		5	12281	11440
		6	12281	11440
		7	12281	11440
		8	12281	11440
		9	12281	11440
		10	12281	11440
		11	12281	11440
		12	12281	11440
		13	12281	11440
		14	12281	11440
		15	12281	11440
		16	12281	11440
		17	12281	11440
		18	12281	11440
		19	12281	11440
		20	12281	11440
IRR (10 yrs)			0%	-1%
IRR (20 yrs)			8%	7%

Tabla 12 Cash flow analysis

Financial Cashflow		year		1	2	3	4	5	6	7	8	9
Activity	Description											
Incoming	Sales of electricity			10587	10587	10587	10587	10587	10587	10587	10587	10587
	Others											
	Subtotal			10587	10587	10587	10587	10587	10587	10587	10587	10587
Investment												
	Land, preparation and sowing		7760									
	Irrigation pump and lines		5311									
	Chipper and mixer		4438									
	Biodigestor complete with cleaning and tubing and control		24033									
	Electric Generator complete with control		15257									
	Minigrid		5439									
	Sutotal		62238									
Operating costs												
	Operation of the energy grass land			2347	2347	2347	2347	2347	2347	2347	2347	2347
	Chipper and mixer			20	20	20	20	20	20	20	20	20
	Biodigestor			746	746	746	746	746	746	746	746	746
	Generador			640	640	640	640	640	640	640	640	640
	Mini grid			346	346	346	346	346	346	346	346	346
	Sutotal			4098	4098	4098	4098	4098	4098	4098	4098	4098
Subtotal costs			62238	4098	4098	4098	4098	4098	4098	4098	4098	4098
Benefits - costs			-62238	6489	6489	6489	6489	6489	6489	6489	6489	6489
IRR (10 Yrs)			1%									
IRR (15												

Exercise

- Work with the FACT or other models to adapt those for Indonesia in hypothetical case

Further study

- Basics on cashflow analysis in Wiki;
- Handbooks on business economics;
- Models of FACT in cashflow.

Thank you for your attention.

Questions?

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