The Techno-Financial Model to Determine the Financial Viability of Biomass Power Plants

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1.0 INTRODUCTION

Renewable Energy has been endorsed as the 5th fuel component in the 8th Malaysia Plan (2001-2005) [1]. An initial target of 500MW by the year 2005 was set. However, planting up has been sluggish. To date all, with the exception of a 2MW Landfill Gas Power Plant and a 10MW Biomass Power Plants, have failed to take off, indicating the failure of the 5th fuel policy [2]. The primary reason, it seems, was the (marginal) viability of the project due to low electricity tariff purchased by the Utilities and the failure of techno-preneurs to understand the technical and financial complexities of planting up a biomass power plant.

The need to amalgamate both the technical and financial data whilst constructing the financial model in determining the viability of projects is often neglected. This is primarily due to the lack of in-depth understanding, rather than lack of planning, of the importance of inter-reactive interplay of engineering and financial parameters by the project planners. This paper employs engineering finance methodology in constructing a Techno-Financial Model (TFM) [3] to demonstrate the importance of recognising the interplay between the "financial" and "technical" parameters so that projects could be structured in such a way that will ensure its long-term viability.

2.0 OBJECTIVES OF TECHNO-FINANCIAL MODEL

The primary objective of the Techno-Financial Model is to construct a model that could "inter-react" with critical technical and financial components that are crucial in determining the viability of the project. This would effectively determine the technology (process and design) that could be utilised to make the project viable.

3.0 TECHNO-FINANCIAL MODEL: DEFINITION, METHODOLOGY, FRAMEWORK AND STRUCTURE

3.1 Definition of TFM: Engineering Finance

The International Association of Financial Engineers defined financial engineering as finance using engineering methodologies such as linear equation, and time series analysis. It is used in the design, analysis and construction of financial contracts in portfolios analysis and stock option. In this paper the concept advocated by the author is referred to as "Engineering Finance". It is defined as engineering using financial techniques in implementing projects (project design and project financing) to produce a cost effective and cost efficient engineering design.

3.2 Methodology

The TFM model amalgamate certain features of both the Landfill Gas (financial) model (constructed in 1999) and the Genting Sanyen Power Plant IPP (financial) model constructed in 1995. Both are proven models. The models were updated, adapted and simplified to suit the Islamic Funding requirements[4]. This model could be used for both Landfill Gas and biomass plants. The validity and reliability of the model was anchored using primary data (actual data from the LFG power project in Puchong), and reliable and valid secondary data (obtained from a Research Survey) derived from credible LFG power generators (Britain), palm oil millers (Malaysia) and biomass power developers from India and Thailand.

3.3 Framework of the Techno-Financial Model.

The framework of the Techno-Financial Model lies in the two major components of engineering and finance as schematically shown in Figure 1 below:

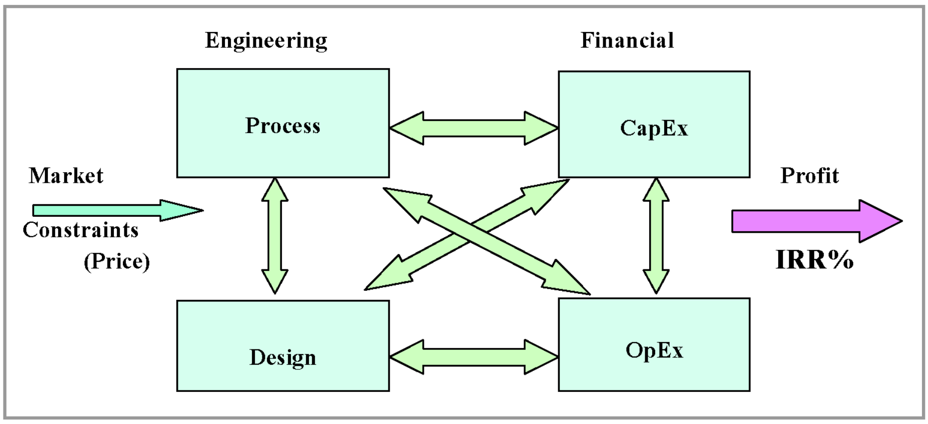

Figure 1: Engineering Finance Model Inter-Reactive Process

Note: Iterative action normally refers to a one-on-one reaction; whereas Inter-Reactive action refers to a multiple reaction one-on-many.

The figure above shows the inter-reactive interplay of the major techno-financial components. The Critical Technical Component (CTC) is the (i) Engineering Process and the (ii) Engineering Design (of equipment) whereas the Critical Financial Component (CFC) are the (i) Capital Equipment (CapEx) cost and the (ii) Operating Cost (OpEx). The "Equipment

Design" is functional to the "Process" component that in turn influences the "CapEx" of the equipment. This in turn will influence the "OpEx" of the equipments. Similarly, the "OpEx" will also influence the "Process" and the "CapEx" will influence the "Engineering Design". These critical components are also subjected to exogenous (controllable and uncontrollable) market forces such as supply and demand of produce, availability and prices of raw materials, manpower availability and level of skill. All these are influencing factors in determining the suitable processes to be employed in the project. This, in turn, will influence the design of the equipment/technology to be used in the production process. These equipment designs will also dictate its (capital) cost and, this, in turn, will determine its cost of production (OpEx). All these interplay will eventually be reflected in the yield of the investment, namely, the Internal Rate of Return (IRR) and the Return on Equity (ROE). The resultant would be a (financially) lean engineering design and process that yield a lucrative return on the investments.

3.4 Structure of the Techno-Financial Model

For the Biomass Power Plant, data were obtained from palm oil mill operations in Malaysia and major equipment suppliers. The model and sub-models in the Techno-Financial Model are all interlinked in a circular manner giving it the inter-reactive features that is essential in achieving an integrated scenario. The Technical–Financial Link Flow Chart in Figure 2 shows the flow of the computation including the sub-routines to compute taxation, Interest During Construction, depreciation etc.

The Input–Output Model (I-O model) shown in Figure 3 below comprises three parts: the Input Model, the TFM Engine and the Output Model. The Input Model and Output Models can be easily customised to suit client requirements and the nature of the project. This is the articulateness build-in into the model. The report generation capability of the TFM model is limited only by imagination. It will be able to serve many masters for a myriad of purposes.

The Input Model comprises two sub-models: the technical sub-model; and the financial sub-models. The technical sub-model in turn could be intelligently linked to the (proprietary) Engineering Softwares that design the power plant. Thus any change in technical parameters, would be reflected instantaneously at the IRR.

3.5 Techno-Financial Models and Sub-Models

The TFM comprises six models and seven sub-models as follows:

(i) Executive Summary
1. Technical and Financial Assumption model
2. Revenue model
3. Variable and Fixed Cost (OpEx) model
4. Cash Flow model
5. Profit and Loss model
6. Return on Investment model

This is supplemented by seven sub-models as follows:

1. Construction Drawdown/IDC Computation
2. Debt Schedule and Reserves
3. Depreciation and Capital Allowance
4. Taxation Schedule
5. Dividends
6. Salaries and Wages
7. Asset Classifications

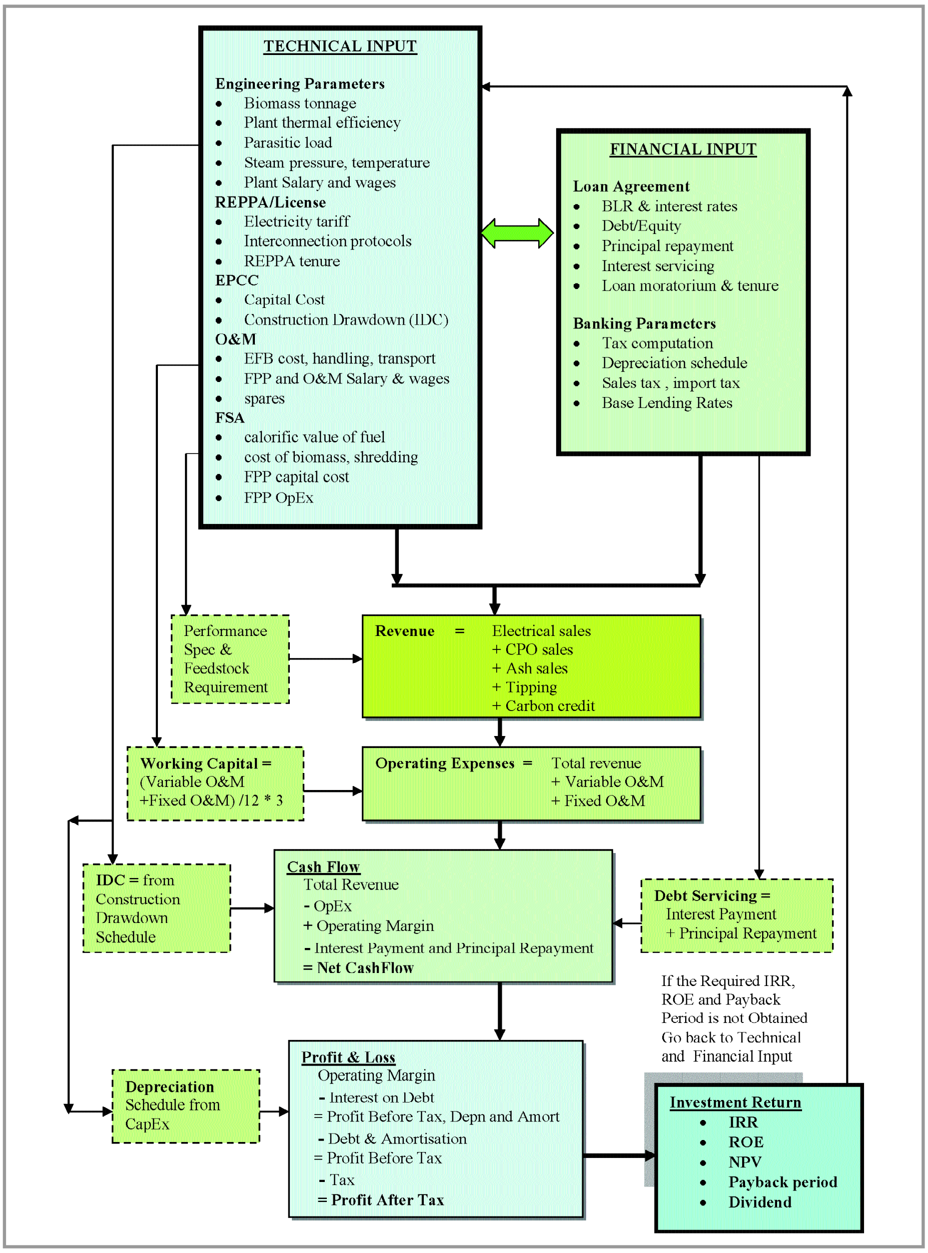

Figure 2: Technical – Financial Link Flow Chart

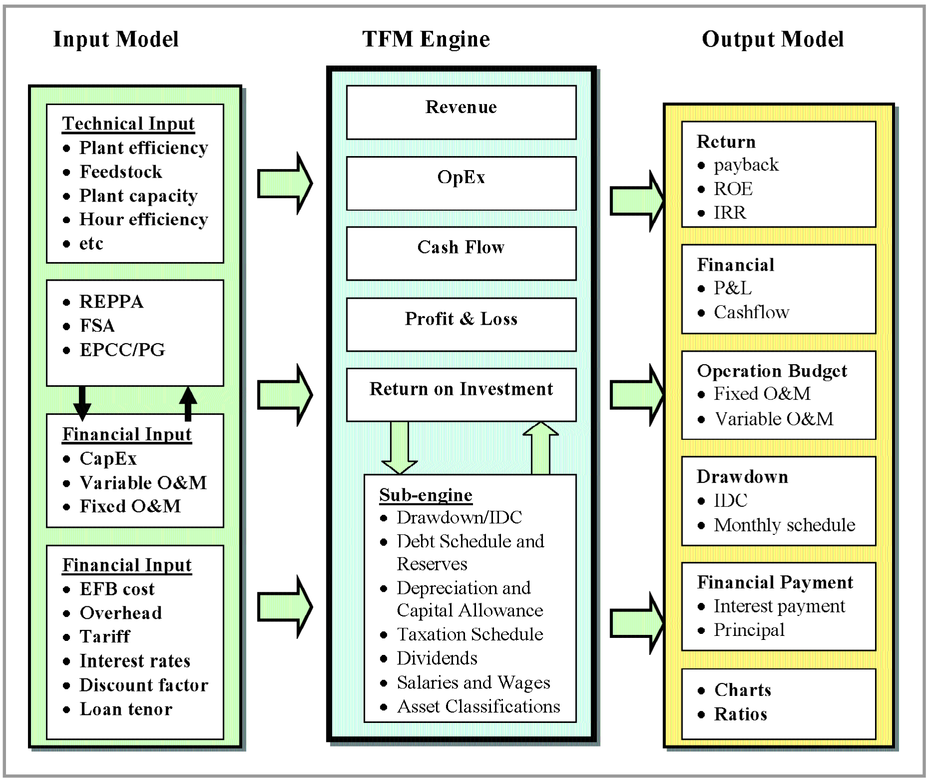

Figure 3: Input – Output Model

Executive Summary

The executive summary shown in Chart 1 below presents the main technical and financial parameters such as:

- ***Capital Structure*** - shows the capital equipment such as fuel preparation plant, power plant and interconnection cost. The softcost would include consultancy fee, Interest During Construction (IDC) and working capital.

- ***Financial Structure*** - shows the equity and debt structure in percentage and Ringgit Malaysia and the project cost per MW in RM and USD.

- ***Financial Highlights*** - shows the annual revenue from the sales of electricity, CPO, ash, carbon credit and tipping fee. Also shown are the OpEx, Operating Margin and Profit

STRICTLY CONFIDENTIAL
Biomass Power Plant
Executive Summary

location: Semenanjung
fund type: conventional

Capital Structure

		RM	
Fuel Prep Plant		2,626,500	
Power Plant		24,538,720	
Interconnection Cost		625,000	
	Total Hardcost		27,790,220
Total Softcost		1,132,156	
Interest During Construction (IDC)		1,759,723	
	Project Cost		30,782,100
working capital			417,581
	TOTAL PROJECT COST		31,199,681

Financial Structure

			RMmillion
	Equity	32.05%	10.00
	Debt	67.95%	21.20
	Grant	0.00%	-
TOTAL			31.20
		RM	USD
per MW Total Project Cost		5.00	1.32
per MW Hardware cost		4.45	1.17

Financial Highlights

Annual Revenue (yr1)	RM		sen per kWh
electricity	6,850,320	Fuel Cost	2.06
CPO	1,232,153	Variable Cost	1.22
ash	483,653	Fixed Cost	1.90
Carbon credit	-	Total Cost	5.18
tipping fee	-		
Total Annual Revenue	8,566,126		
			averages (21yrs)
Operation Cost (OpEx)	1,670,324		2,029,362
Operating Margin	6,834,194		6,683,899
Profit After Tax	4,013,434		4,652,349
Returns			maintainable annual profit per year
ROE	23.30%		
Payback Period (yrs)	4.00	Yr1-5	4,319,920
NPV@10%	15,411,166	Yr6-10	4,961,261
Project IRR	12.13%	Yr11-15	5,169,657
Payback Period (yrs)	7.01	Yr16-21	4,940,856

Technical Configuration

			MW
Installed Capacity			6.2
Export Capacity		Primary	4.0
		Secondary	1.0
EFB cost		RM per ton	5.50
Tipping Fee		RM per ton	0.00
Sensitivity Analysis			
Primary tariff		sen per kWh	17.00
Secondary Tariff		sen per kWh	17.00
Average tariff		sen per kWh	17.00
Plant degradation			100.00%
OpEx			100.00%
Forex	USD/RM		3.8
Interest spread			1.50%
Equity contribution (RMmillion)			10.00

Qualification Statement:
In compliance to Section 368 of the Company Act 1965 the author of this forecast hereby declares that this forecast and all its associated information data assumptions were made on a "Best Endeavour" basis and deem to be accurate reliable and valid at the point in time these data and assumptions were made. These assumptions were not intended to be misleading false misrepresentative or deceptive. To the best knowledge of the author there is no dishonest concealment of material facts.

Chart 1: Executive Summary

After Tax. It also provides the ROE and IRR and its corresponding payback period and the Net Present Value (NPV).

- ***Technical Configuration*** - shows the installed capacity, export capacity and the EFB cost and Tipping Fee.

Technical and Financial Assumptions Input Model

The Technical and Financial Assumption model is the input model that allows all the technical and financial assumptions to be inputted. Technical assumptions such as the Installed and Exported Capacity, plant efficiency, feedstock consumption etc., are computed at the Technical Worksheet (please refer to s3.6). The Financial input includes the Capital Cost, Operational Expenses etc, to be input here. The Input models also enable the Foreign Exchange to be considered.

Revenue Model

The Revenue model is where the total revenue is computed. The basic input comes from the Technical and Financial Input model. The revenue would be from sales of electricity, sale of crude palm oil, sale of ash, tipping fee and carbon credit. This model also computes the total amount of electricity generated, CPO extracted and Total Revenue per kWh etc. This model also incorporates a sensitivity analysis capability for degradation of plant capacity.

OpEx Model (Fixed and Variable Cost)

The Variable and Fixed Cost model computes the variable and fixed cost of the operation. The major component of the variable cost is the EFB cost. The current market price of Empty Fruit Bunches (EFBs) is between RM0-5 per ton. Transportation and handling would cost between RM4-7 per ton. This model enables the computation of unit cost for Variable and Fixed O&M.

CashFlow Model

The Cash Flow model generates the cash flow that is a resultant of the revenue and the operating cost. It also incorporate the cashflow due to the working capital input as well as the debt interest and principal repayment. This model shows the liquidity of the plant to meet all its current obligations. The model computes the following: Operating Revenue, Operating Expenses, Operating Margin, Cash Available for Debt and Reserves and After Tax Cash Flow.

Profit and Loss Model

The Profit and Loss model computes the profitability of the project at various levels: operational, before tax and depreciation, and after tax. This model would also determine the return of the investments and the maintainable profit after tax in 5-year periods for the whole REPPA tenure of 21 years.

Return on Investment Model

The Return on Investment Model computes the return on the venture at both the equity (ROE) and after tax level (IRR), the payback period and the Net Present Value. In addition the model also shows the profit sharing structure and Islamic Funding return. The Islamic Funding [4] is when the profit after tax is distributed in the agreed portion dictated by the equity contribution between the mudarib (promoter) and rrab al-mal (investor). For the Lukut case, with a tariff of RMsen17 per kWh the project yield a return of 12.13%. In comparison, the Islamic Funding computes an IRR and ROE of 15.24% and 29.31% respectively. This is significantly higher than the conventional funding since the interest element e.g. IDC was eliminated.

3.6 Technical Worksheets

This Technical Worksheet computes the total plant load requirement with the different performance specifications and feedstock requirements. The critical technical components, namely the performance specification was extracted manually and inputted into this model. The final results being the total plant power consumption were transferred automatically to the Feedstock Requirement Computation and the Technical and Financial Assumptions Model.

4.0 Conclusions

The inter-reactive integration of the technical parameters with the financial drivers in the TFM has paved the way to a more intelligent inter-reactive integration with proprietary engineering design softwares in the future. It has made (engineering) decision-makers more aware of “alternative design” from the perspective of both the process and equipment design. The financial savings from these “cost efficient design” in the long-term would be phenomenal. Therefore, the intelligent use of the TFM is imperative to ensure that projects implemented would give the expected yield for the effort and satisfy shareholders’ and banker’s expectations. ■

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