The Importance of Credit Program Scheme on Waste to Energy Program in Indonesia: Case Study on Tofu Industry

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Abstract. This study aimed to provide a basis for future policy making in supporting the waste to energy from tofu in Indonesia. The policy studied was the credit program scheme for tofu industry. The financial feasibility, as well as cost and benefit analysis, were conducted to meet the objectives. Tofu industries are mostly small-sized industry which supports people with middle-to-low incomes. On the other hand, tofu industry also contributes significant amounts of emissions. Thus this calls for government intervention to encourage tofu industries to convert their wastes to energy. The result of the study shows that the developments of biogas reactors are feasible for size 84 m^3 and 94 m^3. The study also found that for both sizes, the benefits are higher than the costs.

Key words: Tofu industry, waste to energy, credit program, feasibility study

1 Introduction

The steadily increasing price of energy has resulted in higher energy costs to industry for production and simultaneously a larger portion of household expenditures on energy. The growing energy demand and prices also affect the State Budget contributing to ever higher energy subsidies. Further, the high dependency on fossil fuel energy contributes to slowing down efforts to reduce greenhouse gas (GHG) emissions. Thus, biomass utilization by conversion from Waste to Energy (WtE) is an alternative energy source that allows reductions in GHG emissions.

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Utilization of agricultural and other wastes as an energy alternative provides advantages. Firstly, there is scope for overall improvement in energy efficiency because agricultural/other wastes contain large energy potential and are wasteful if not utilized. Secondly, the use of agricultural/other wastes can be very cost efficient because waste disposal is sometimes more costly than using the waste itself. Thirdly, utilization of wastes reduces needs for landfilling/piling which can generate significant costs in waste management.

A number of existing credit promotion programs have been supported by the Ministry of Finance (MoF) including the e Credit for Food and Energy Security which to date in the energy area has mainly targeted on biofuel raw materials [1–3]. Such interest subsidy programs may provide useful model for the development of WtE credit support programs but are likely to require adaptation.

Financing WtE investment through credit programs, besides of having potential benefits, has a logical consequence on the cost side. By providing the supports to the financing in the WtE, it is expected that the benefits are expected to be greater than the costs incurred. Thus, this study purposed (i) to elaborate the industry and the possibility of the financing, (ii) to provide a basis for future policy making, and (iii) provide the necessary analysis of the costs and benefits of a WtE investment financing through a credit program.

2 Objectives

This study aims to identify and to analyze the costs and benefits associated with the proposed scheme of investment financing credit program to support the development of WtE for tofu industry. The study was also supported with the financial feasibility analysis to measure the viability of the program from the financial perspective. It is expected that the results of these analysis can be used for setting policies related to WtE investment financing through credit program.

3 Methodology

The study was conducted mainly based on the financial analysis (FA), cost and benefit analysis (CBA) and literature review. The assumptions in the FA and CBA of development projects in the WtE were based on a primary survey and secondary data from the Ministry of Energy and Mineral Resources (MEMR) and the MoF. The secondary data was captured from various programs of WtE investment that has been undertaken by the MoF and the MEMR.

3.1 Financial feasibility analysis

To find the proper indicators for the study, there are several criteria to be fulfilled. The criteria were including net present value (NPV) and internal rate of return (IRR). NPV is the different between the present value from the positive cash flows and negative cash flows. On the other hand, the IRR describes the rate of return on net investment. In the project evaluation, the project is feasible when the NPV level is equal to or greater than the IRR and bigger than the discount rate.

Other financial indicators are Profitability Index (PI) and Return on Investment (ROI). PI is the comparison between net cash flow in the future with present cash flow. ROI is the ratio of net income to expenses. Investment is feasible to run when PI is greater than 1. A positive ROI shows that the investment is feasible to run.

Moreover, FA is already known and commonly used in several studies. The application of FA can be used either as a single method or combined with the other method such as technical analysis [4] as well as regional and sectoral economic approach [5]. FA was also employed in measuring the feasibility of the introduction of new energy sources including waste cooking oil [6], solar energy [4] and also for the feasibility of mass production [7].

3.2 Cost and benefit analysis

The Cost and Benefit Analysis is the process to identify, calculate, and compare the costs and the social benefits that are produced by project/investment activities. The justification for cost and benefit analysis is the limited utility of narrow financial analysis that cannot capture all the benefits and losses that have an impact on the society as a consequence of investment project. Indicators that focus only on financial analysis can be wrong if used as an indicator of social welfare because some projects/investments result in goods that cannot be sold freely in the market, such as garbage management, emission reductions, or health facility repairs.

One method of cost and benefit analysis that is commonly used are benefit-cost ratios (BCR). Benefit-cost ratios (BCR) basically are the comparison between the present values of benefit values that are being received by society to the cost that society must pay as a result of the project. Projects are judged as feasible to run if the BCR is larger than 1. Therefore the value of benefits over time are larger than estimated cost values.

$$BCR = \frac{\sum_{i=1}^{n} \frac{Bn}{(1+i)^n}}{\sum_{i=1}^{n} \frac{Cn}{(1+i)^n}} \quad (1)$$

Where
BCR = Benefit and cost ratio
Bn = benefit at the end of period
Cn = cost at the end of period
n = period of investment

There is a wide range use of BCR in measuring the feasibility of the project or program including health [8–10], natural resources management [11, 12], and renewable energy from wind power [13]. Thus, it is expected that the combination of the application FA and CBA in this study may provide comprehensive analysis and may also provide broad policy recommendation.

4 Development of biogas reactors from tofu industry waste

The tofu industry plays an important role in Indonesia. The industry is a small-sized industry which supports people with middle-to-low incomes. In Indonesia, there are 177 tofu and tempeh cooperatives in 18 provinces. There are 115 000 units of tofu makers with 1×10^6 workers being absorbed by the industry. The tofu industry depends a lot on the availability of soybean. Approximately, the tofu industry needs 132 t of soybeans per month.

The tofu industry contributes significant amounts of emissions. There are 84 000 business entities in Indonesian tofu industry. With production capacity exceeding 2 560 000 t per year, the tofu industry produces 20×10^6 m^3 of liquid emissions per year, which is equivalent to 1×10^6 t of carbon dioxide. With 80 % of the tofu industry concentrated on

Java Island, the liquid emissions from the tofu industry on Java Island may be around 800 × 10^9 t of carbon dioxide.

The tofu industry waste contains a high concentration of organic materials in general, such as protein, carbohydrate, fat, and oil. That high concentration of organic materials potentially emits methane. Similar to cattle farm waste, tofu industry waste can also be processed with a biogas reactor.

One type of tofu industry waste processing technology is the use of a Fix Bed Reactor which is constructed with an anaerobic system. This system needs large tracts of land and does not need energy for aeration. The advantage of this system is its good output. This system will result in a form of biogas and dregs and also water for feeding fish. Besides that, the process is more stable and creates less mud. Tofu liquid waste processing units consist of the main unit of the digester, sewage collection pipe network, gas container, trickling, filter, processed residual waste network, and processed residual water pool.

5 Existing credit programs

Among fiscal facilities that are provided by the government, there are some that are relevant to the credit programs, among others:

5.1 Interest subsidy pattern

This scheme will allow the government to provide fiscal facilities to the beneficiaries by providing a fund from the budget to pay the interest as the result of the implementation of the program. There several interest subsidy pattern and among others are: first, Credit for Food and Energy Security (Kredit Ketahanan Pangan dan Energi/KKP-E) [1] that supports the food security program and the biofuels raw materials development program and emphasizes the role of funding through the involvement of national banks with interest subsidies from the government. In addition, to ensure supply, distribution and funding accountability of the KKP-E the scheme needed to be created with an integrated credit mechanism.

Second, Credit for Bio Energy Development and Plantation Revitalization [14]. In order to accelerate the development smallholdings plantation, the Minister of Agriculture has issued Regulation of the Ministry of Agriculture [15] about Estate Development through a Plantation Revitalization Program. This program was purposed to enhance the development of estate crop plantations through expansion, regeneration and rehabilitation. This is related to the implementation of development programs for feedstock crops especially biofuels and plantation revitalization funding support which involves the national banks. Third, Credit for Businesses Program [16]. This scheme is purposed to accelerate the development of economic activities in the real sector to alleviate poverty and expand work opportunities. Four, Credit for Cattle Breeding (KUPS) [17, 18]. Under this scheme, the government committed to develop one million cows over five years period. To smooth the program, the business community were provided with adequate rate in terms of subsidized interest loans executed via an executing bank.

5.2 Assurance services pattern

The empowerment of Micro, Small, Medium Enterprises and Cooperatives (MSME) to support job creation, and poverty reduction was pursued through the issuance of a government policy package in 2007. To improve MSME access to financing sources, it was

considered necessary to provide credit/bank financing with soft and affordable requirements backed by a guarantee facility from the Government.

5.3 Combination pattern program (Indonesia regional water companies)

In order to speed up the drinking water supply, the Central Government with regard to the financial capacity of the State has guaranteed the repayment of bank loans and subsidies on the interest charged by banks [19]. The guarantee is for the debt of regional (local) water (supply) companies while providing interest subsidies on loans by the banks to local water companies. This step is expected to improve the company's financial condition and ultimately facilitate the supply of clean water in the area. Credit support is given only for investment, based on the agreement between the regional water companies and the bank.

6. Credit for Food and Energy Security (KKP-E)

Below is a further description of KKP-E as the potential incentive for the WtE from tofu program.

Table 1. Description of KKP-E.

Definition	Financing Object	Financing Subject	Credit Size	Interest Rate	Participant Interest Expense	Interest Subsidy
Credit in order to improve food security and energy	Business activities that can be funded: development of food crops, horticultural crops development, plantation development, procurement of food (rice, corn, soybean and fisheries), livestock, arrests and fish farming, procurement/ rejuvenation equipment, machinery and other means to support other business activities.	Farmers/ ranchers/ growers/ fishermen and fish farmers who are members of groups and/or cooperatives	•Maximum IDR 100 million per person •Maximum IDR 500 million per farmer groups and cooperatives	• KKP-E Plantation: LPS + 5 % • KKP-E Non-Plantation: LPS + 6 %	•KKP-E Plantation: 7 % •KKP-E Non-Plantation: 6 %	•KKP-E Plantation: 5 % •KKP-E Non-Plantation: 7 %

KKP-E is purposed to improve food and energy security. The coverage is quite wide from the development of crops to the rejuvenation of equipment. This means that in the WtE from tofu program, it may be used to improve the quality of the tofu as well as increasing the machinery capacity of the conversion. The subject also covers the low-level farmers either as an individual or as a group. With the low-interest rate caused by the interest subsidy, it is expected that farmers will be interested in joining the program.

7 Result and analysis

Prior to further analysis with the feasibility of the financial support mechanism, the general assumptions were set. This was purposed to provide the basic scheme for the government to support with the financial intervention from the budget. It was also aimed to set the minimum requirement for the scheme to be financially feasible. The general assumptions were then provided in Table 2 as follows.

Table 2. General assumptions.

No	Item	Amount
1.	Loan term	5 yr
2.	Economical period	20 yr
3.	LPS interest rate/ Lending rate	7.5 %/6 % = total 13.5 %
4.	Exchange rate 1 USD	IDR 11 500
5.	SME income tax rate	1 % of the turnover
6.	Big industry income tax rate	35 % of taxable profits
7.	Substituted Gas	Subsidized LPG
8.	Diesel	Non-Subsidized Diesel
9.	No Carbon Trade	0
10.	Financial Feasibility	NPV > 0, IRR > market interest rate (12 %), ROI > 0, Profitability Index > 1
11.	Various size of biogas reactors	MEMR = 90 m^3 (without cleaner production development) MoE = 94 m^3 and 84 m^3 (with cleaner production development)

7.2 Financial feasibility analysis

In this study, the financial feasibility was determined by four categories i.e. Net Present Value, Interest Rate of Return, Return on Investment and Profitability Index. The analysis will measure whether NPV > 0, IRR > market interest rate (12 %), ROI > 0, and Profitability Index > 1, which therefore the scheme is considered to be financially feasible.

Table 3. Financial feasibility calculation.

Debtor Interest Rate	NPV (IDR million)			IRR (%)			ROI (%)			PI		
	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3
0 %	103.65	193.7	-49.38	19.13 %	30.28 %	7.50 %	20.10 %	390.29 %	80.68 %	1.70	2.83	0.59

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Table 3. Financial feasibility calculation (continue)

Debtor Interest Rate	NPV (IDR million)			IRR (%)			ROI (%)			PI		
	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3	94 m^3	84 m^3	90 m^3
1 %	100.21	191.24	-52.18	18.83 %	29.88 %	7.29 %	19.95 %	383.05 %	78.01 %	1.68	2.81	0.57
2 %	96.77	188.79	-54.97	18.53 %	29.49 %	7.09 %	19.79 %	376.01 %	75.42 %	1.65	2.79	0.54
3 %	93.32	186.33	-57.76	18.24 %	29.11 %	6.89 %	19.64 %	369.18 %	72.90 %	1.63	2.76	0.52
4 %	89.88	183.87	-60.55	17.96 %	28.73 %	6.69 %	19.49 %	362.54 %	70.45 %	1.61	2.74	0.5
5 %	86.44	181.41	-63.34	17.67 %	28.36 %	6.50 %	19.33 %	356.09 %	68.08 %	1.58	2.72	0.47
6 %	83.00	178.95	-66.13	17.40 %	27.99 %	6.31 %	19.18 %	349.81 %	65.76 %	1.56	2.69	0.45
7 %	79.56	176.49	-68.92	17.13 %	27.63 %	6.12 %	19.03 %	343.70 %	63.51 %	1.54	2.67	0.43
8 %	76.12	174.04	-71.71	16.86 %	27.28 %	5.94 %	18.88 %	337.76 %	61.32 %	1.51	2.65	0.4
9 %	72.68	171.58	-74.50	16.60 %	26.93 %	5.76 %	18.73 %	331.97 %	59.19 %	1.49	2.62	0.38
10 %	69.23	169.12	-77.29	16.30 %	26.58 %	5.58 %	18.58 %	326.34 %	57.11 %	1.47	2.60	0.36
11 %	65.79	166.66	-80.08	16.10 %	26.25 %	5.41 %	18.43 %	320.85 %	55.09 %	1.44	2.58	0.33
12 %	62.35	164.2	-82.87	15.80 %	25.91 %	5.24 %	18.28 %	315.50 %	53.12 %	1.42	2.55	0.31
13 %	58.91	161.74	-85.66	15.60 %	25.59 %	5.07 %	18.13 %	310.29 %	51.20 %	1.40	2.53	0.29
13.5 %	57.19	160.51	-87.06	15.50 %	25.43 %	4.99 %	18.05 %	307.73 %	50.26 %	1.39	2.52	0.27

The financial feasibility analysis is in-line with the notion to support the provision of interest subsidy to the farmers. The higher burdens of the debtor results smaller level of the financial indicators means less feasible the program. Further, according to the result, bio digester with size 94 m^3 and 84 m^3 are financially feasible, whilst the 90 m^3 is not feasible.

7.3 Cost and Benefit Analysis

The cost and benefit analysis was employed by measuring the cost, the benefit and then comparing both to find the result. The project is feasible if the ratio is above 1.

Table 4. Cost and benefit analysis.

No.	Indicator	94 m^3	84 m^3	90 m^3
1	Initial Cost (IDR)	148 000 000	105 720 000	120 000 000
2	Loan Tenure (Year)	5 yr	5 yr	5 yr
3	Lended Interest Rate	13.5 %	13.5 %	13.5 %
4	Interest Rate Borne by Beneficiaries (Scenarios)			
A.	Scenario 1: Interest Rate Borne by Beneficiaries	0.0 %	0.0 %	0.0 %
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Table 4. Cost and benefit analysis (continue)				
No.	**Indicator**	**94 m^3**	**84 m^3**	**90 m^3**
	Interest Subsidy	13.5 %	13.5 %	13.5 %
	Cost (C) (IDR)	302 109 086	215 127 576	244 185 671
	Benefit (B) (IDR)	753 439 700	547 826 431	462 564 344
	Net Benefit (IDR)	451 330 614	332 698 855	218 378 672
	B per C Ratio (BCR)	2.49	2.55	1.89
	Feasibility (If BCR > 1)	Feasible	Feasible	Feasible
	CO2 Emission Reduction (t)	1 557	321	862
B.	Scenario 2: Interest Rate Borne by Beneficiaries	1.0 %	1.0 %	1.0 %
	Interest Subsidy	12.5 %	12.5 %	12.5 %
	Cost (C) (IDR)	302 109 086	215 127 576	244 185 671
	Benefit (B) (IDR)	753 439 700	547 826 431	462 564 344
	Net Benefit (IDR)	451 330 614	332 698 855	218 378 672
	B per C Ratio (BCR)	2.49	2.55	1.89
	Feasibility (If BCR > 1)	Feasible	Feasible	Feasible
	CO_2 Emission Reduction (t)	1 557	321	862

The above table shows that the CBA results all sizes are feasible. The ratios of BCR are more than 1 for all of the investments. The highest level comes from size 84 m^3 at 2.55, followed by 94 m^3 with 2.49 and 1.89 for 90 m^3.

Even though the financial feasibility analysis and cost and benefit analysis give a positive result to the support of the WtE program, there are several key success factors that may give impact to the success of the program i.e.:

- Fossil energy and electricity prices are high and not subsidized,
- Conducted to substitute fossil energy types,
- Sustainable availability of waste,
- Limited land for waste disposal,
- High tipping fee for disposal of garbage/waste,
- Policies for better WTE support,
- Public support.

9 Conclusion and recommendation

The result of the study shows that financially, not all development of WtE for Tofu Industry types are feasible to develop. It is only for 84 m^3, and 94 m^3 investments are financially feasible. While on the other hand, economically, all kinds development of WTE Tofu industry as a focus in this study deserves to be developed.

To make it more financially feasible, interest subsidies are needed to finance the development of WTE Tofu Industry. When using existing credit scheme, KKP-E (with revision in the regulation), WtE for biogas from tofu industry are potential, where the primary concern is the large investment required can be up to IDR 100 000 000 for individual and IDR 500 000 000 for the group (communal).

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