# FEASIBILITY STUDY OF THE FOUNDATION OF BIOETHANOL FACTORY IN LANGKAT, NORTH SUMATERA

Kamil Mustafa<sup>1</sup>, M. Banjarnahor<sup>2</sup>

<sup>1,2</sup>Department of Industrial Engineering, Universitas Medan Area, Medan, INDONESIA.

<sup>1</sup>kamilmustafa@gmail.com

### ABSTRACT

One of the potential alternative energy resources, in tackling the petroleum crisis, is the bioethanol. This paper reports the analysis of feasibility study of the construction of Bioethanol factory in Langkat Regency of North Sumatra Province. With an observation and analysis study it was found that currently, in North Sumatra there is no availability of bioethanol processing plants from molasses. The availability of molasses is much greater than that of the bioethanol manufacturing capacity. The availability of raw materials from PTPN II (State Plantation Company) and PTPN (State Plantation Company) VII averaged 53,000 tons of molasses, of which 64% of the molasses production of 36,000 tons to be diverted to produce bioethanol and 36% might be exported. Based on the factory installed capacity of 5 tons of molasses per hour, in one day the factory works normally for 24 hours, in a month 25 days and in a year work for 300 days, the production capacity planning. It concludes that the three sensitivity analysis tools show that the boietanol plant capacity of 5 ton / h molasses is feasible to build in North Sumatra.

Keywords: Feasibility study, Bioethanol, fuel oil, investment

### **INTRODUCTION**

The increasing number of vehicles and factories already resulted in the petroleum reserves of Indonesia running low. The petroleum reserves in Indonesia are predicted to be around 3.9 billion barrels. Therefore, the Indonesian Government is promoting various efforts to replace the use of petroleum with the utilization of biofuels. One of the government's efforts is the issuance of President's Instruction No.1 of 2006 on the supply and utilization of biofuel as fuel. Thus, the Director General of Oil and Gas Decree No.3674 / 24 / DJM / 2006 dated March 17<sup>th</sup>, 2006 which allowed the mixing of bioethanol into gasoline up to 10%. Ethanol possibility to be produced from plants containing starch, which so called bioethanol would be one of the potential alternative energy sources, in tackling the petroleum crisis. It is the utilization of molasses as a feedstock for bioethanol production. Additionally, Bioethanol in the future can be one of the supports of sugar industry income in the middle of price movement of sugar that often fluctuate. "Almost all sugar industries overseas, such as Thailand, India, and Brazil, have been working on bioethanol.

Feasibility studies are normally conducted to justify investments in infrastructure projects (Hyari and Kandil, 2009). The preparation of a feasibility study is an important element early in the life cycle of a resource development project (Mackenzie and Cusworth, 2007). Feasibility study is an in-depth study of a business or business idea of whether or not feasible business ideas to be implemented. Feasibility study has become a very valuable tool for the entrepreneurs, project sponsors, potential investors, industrialists, bankers, suppliers and others to ensuring that the business concept is technically, financially, socially, economically, legally and profitably sound before investing in it (Onyesom and Okolocha, 2014).Understanding of feasible in this assessment is the possibility of business ideas that

will be implemented to provide benefits, both in the sense of financial benefit and social benefits.

Strategic investment is the decisions on investments which have substantial effects on the long term financial and operational performance of companies (C. Carr and C. Tomkins in Atik, 2012). The strategic meaning of the location of the plant relates to the decision on capacity, ie where to expand in order to fit the distribution network effectively.

If all prices and charges are not dependent on location, then the selection will be determined by the proximity of potential customers or buyers, the existence of a similar and competitive organizations and by the center of business activities in general.

# Marketing Aspect Analysis

The purpose of marketing is to know the required product profile by doing both qualitative and quantitative approaches; knowing the level or volume of demands or needs within certain time. Qualitative method assigns two categories; exploratory and normative methods. The exploratory method generally assumes the origin at the moment and the mass and the projection of the future, while the normative method starts from the ideal condition and looks at the possibilities with the current conditions. Then, Quantitative approach uses the numerical analysis procedures in accordance with goals of the research. Thus, it predicts the trends, consisting of Linear, Quadrative and Growth methods:

### **Technins and Operations Aspects**

This part includes the planned production capacity plans expected by the company, appropriate technology selection, product design, plant location, optimal plant layout, area or planned production, availability of raw materials and finished goods inventory, and management.

### **Organizational Aspects and Management**

In the analysis of organizational and management aspects there are several plans that must be done, such as: Corporate organizational structure design; Manpower planning; Recruitment (procurement of labor), and Training of workers.

Organizational structure is a scheme that provides a general overview of the activities and prosese-processes that occur in an organization. There are 4 components that can give an understanding of organizational structure, namely: The organizational structure provides an overview of tasks and responsibilities to individuals and sections; The organizational structure establishes a system of relationships within the organization for communication, coordination, and horizontal and vertical integration. There are 3 Organizational structure plan, such as : The design of a functional organizational structure, such as an organizational structure in which groupings are performed on the basis of function so that activities of the same function are collected in one part; The design of hybrid and mixed organizational structures.

### Legal and Environmental Aspects

Legal aspect of investment covers all of activities related to investment in a country especially Indonesia must meet the aspects relating to the law and the conditions that have been established through applicable laws and regulations. Due to the existence of a legal, understanding of an activity can be a valid object of law. Then a legal body was formed. An environmental aspect analysis covers the ability to adapt to the nature of the environment itself. This limit is determined by the slip process for hundreds of millions of years in the evolution of human life.

# **Economic and Financial Aspects**

Economic feasibility is both a time and cost based method, which is primarily used for new system operation effectiveness and it is also called cost/benefit investigation (JIANG, 2011). Economic analysis covers two main issues: economic feasibility analysis and financial feasibility analysis. According to OEDC (Organization For Economic Co-Operation and Development) there are several items to determine an investment. Additionally, the Plant Investment Financing, namely ; Preliminary Expenditure Charges; Land Procurement Cost; Construction Cost; Cost of Equipment and Materials; Parts Replacement Cost, and Cost Supervisor. Thus, the Operational Costs such as; Purchases; Labor costs; Cost of Work; Supply and External Services; Travel expense and Management Expenses.

The revenue projection is the result of selling the product within a year at a set price.

R = Q x P

Where :

R = Income (in IDR) Q = Total of production Kg/Year P = Price/Kg

The increase of production cost needs to be calculated to estimate cost of goods sold in the coming period. The calculation of the increase of production cost is adjusted to the condition of the price of the materials concerned. In this case, it is necessary to examine the factors influencing it.

# **Cash Flow**

Cash flow statement is financial reprint which provides information to investors, creditors and others, useful in making rational decisions (Motlagh, 2013). It should be known that the new methods can be used if it is owned by a certain scenario will the cash flow pattern that will occur because of this investment. Here are the steps needed to determine cash flow

# **Investment Appraisal Criteria**

# Net Present Valeue (NPV)

Net Presen Value (NPV) is the difference between the present value of the entire annual net cash flow that the investor will receive during the plant's economic life. The Net Present Value (NPV) of an investment is the present value of the expected cash flows, less the cost of the investment (Ross in Nábrádi, 2007). In a factory feasibility study, what is meant by the current value is the value at the time the plant is completed.

$$NPV = \sum_{t=0}^{n} \frac{(NCF)t}{(1+i)^t}$$

Where :

NVP = Net Present Value

n = The age of investation

# Internal Rate Return

IRR is the average growth rate of money invested in which net cash flow from investment returns is reinvested for the business. IRR represents a discount rate which leads to a net present value of zero where the present value of the cash inflows equals to the cash outflows (Pauline in Bosri, 2002).

$$IRR = i_1 + \frac{NVP_1}{(NVP_1 + NVP_2)}(i_2 - i_1)$$

Where :

 $NVP_1$ : Net Present Valeu with interest rates  $i_1$  $NVP_2$ : Net Present Valeu with interest rates  $i_2$ : Interest rates (1) i1 i2 : Interest rates (2)

#### Payback Period

Payback is the most popular method applied by organizations to evaluate their capital investment proposals before embarking on them, especially in situations where future cash flow become very difficult to predict (Azeez, 2015). The period of return of capital is the time period required for the return of investment capital. Options fall on the project with the shortest return period.

### **RESEARCH METHOD**

This study applied an observation technique to collect the data of feasibility of Bioethanol factory. The framework of thinking in research is the rationale of research based on facts. Data obtained explain the interrelationship among these variables.

#### **RESULTS AND DISCUSSION**

#### **Market Analysis**

The by-product produced by the Sugar Factory is Molasses or also called Sugar Cane. Molasses containing about 50-60% of sugar and a number of amino acids and minerals are produced from various levels of processing from sugarcane to sugar which is a potential source of bioethanol production. Bioethanol is one of the alternative fuels that are constantly being developed for fossil fuel replacement products so that the use of such fossil fuels can be reduced. The Bioethanol product itself as determined by the government to date is as a maximum 10% mixture in premium fuel oil as stated in the Ministry of Energy and Mineral Resources Regulation of 2013 regarding the Provision, Utilization and Trading of Bio-fuel as Other Fuel Components require the mixing of fuel with biofuel, they are biodiesel and bioethanol. According to Pertamina (a state oil company of Indonesia), the Premium fuel consumption in Indonesia In 2010 reached 22,297,678 KL then estimated to increase to 25,500,879 KL in 2011. In 2012 premium consumption is estimated to reach 28,276,987KL and in 2013 increased to 29,289,769KL and later in the year 2014 premium consumption is estimated at 31,467,189 KL.

I ad	Table 1. Growth of Premium Fuel Consumption of Indonesia					
Year	Consumption	Year	Consumption			
2010	22.297.678	2017	34.385.047			
2011	25.500.879	2018	35.416.598			
2012	28.276.987	2019	36.479.096			
2013	29.289.769	2020	37.573.469			
2014	31.467.189	2021	38.700.673			
2015	32.411.205	2022	39.861.694			
2016	33.383.541	2023	41.057.544			
2017	34.385.047	2024	42.289.271			

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Table I	. Growth of Premium	i Fuel Consumptio	n of Indonesia

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• • • • •					
2018	35.416.598	2025	43.557.949		

With the mixing of bioethanol product of 10% into Premium type fuel can be calculated that the potential of Bioethanol uptake is as in the table below:

Year	Premium Fuel In Kilo Liter	Bio Mix In Percent	Potential Bioethanol In Kilo
1001	(KL)	(%)	Liter (KL)
2010	22.297.678	3%	668.930
2011	25.500.879	3%	765.026
2012	28.276.987	3%	848.310
2013	29.289.769	3%	878.693
2014	31.467.189	3%	944.016
2015	32.411.205	5%	1.620.560
2016	33.383.541	5%	1.669.177
2017	34.385.047	5%	1.719.252
2018	35.416.598	5%	1.770.830
2019	36.479.096	5%	1.823.955
2020	37.573.469	5%	1.878.673
2021	38.700.673	10%	3.870.067
2022	39.861.694	10%	3.986.169
2023	41.057.544	10%	4.105.754
2024	42.289.271	10%	4.228.927
2025	43.557.949	15%	6.533.692

 Table 2. Potential of Bioethanol Absorption in the Country as Premium Type Substitution of Fuel

This bioethanol production planning is in Sumatera especially in North Sumatera area, for which the production of molasses used is company located in Sumatera, i.e PTPN (State Plantation Company) II and PTPN (State Plantation Company) VII. The data of molases production for the last 10 years as following:

Year	Number Production	of Molases (Ton)	Total Production of PTPN II and PTPN VII	Average of Production	
	PTPN II	PTPN VII	(Ton)	(10n)	
2006	45.000	42.000	87.000	43.500	
2007	55.000	45.881	100.881	50.441	
2008	55.250	48.000	103.250	51.625	
2009	56.000	56.450	112.450	56.225	
2010	47.000	55.750	102.750	51.375	
2011	42.650	64.764	107.414	53.707	
2012	55.750	53.461	109.211	54.606	
2013	60.000	80.497	140.497	70.249	
2014	24.458	65.750	90.208	45.104	

Table 3. Molases Production PTPN II and PTPN VII

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2015	38 750	66 613	105 363	52 682

# Plant Site Planning

The location of bio-ethanol plant construction in Kwala Begumit, Stabat District, Langkat Regency of North Sumatra Province, with an area of 2.67 H. From downtown of Medan city it can be reached approximately 1 hour with a distance of about 36 Km. The Indonesia Government's plan to facilitate the Trans Sumatra Railway, makes the bioethanol plant integrated by the Cretaceous Line; it directly loads the bioethanol oil to the Belawan International Port. Basic selection of bioethanol plant location includes several factors such as, availability of water resource, drainage, soil bearing capacity, infrastructure, and close to the location of Kwala Madu Sugar Factory. Planned land acquisition for the construction of bioethanol plant around 26,700 m2 or 2,67 H.

### **Management Analysis**

### Form and Organizational Structure

The Limited Liability Company (PT) for Bioethanol needs the employees with various education backgrounds and levels such as follows.

No	Position	Total	Education	Nationality
1	Manager	1	Industrial Engineering (S1/S2)	Indonesia
2	Secretary manager	1	Management (S1)	Indonesia
3	Head of Administration	n 1	Accounting / Management (S1)	Indonesia
4	Head of Engineering	1	Engineering (S1)	Foreign
5	Head of Processing	1	Engineering (S1)	Foreign
6	Head of Laboratory	1	Chemical Engineering (S1)	Indonesia
7	Spv Processing	2	Engineering (S1/D3)	Indonesia
8	Spv Engineering	2	Engineering (S1/D3)	Indonesia
9	Administrative Staff	10	Accounting / Management (S1/D3)	Indonesia
10	Technical Staff	20	Engineering (S1/D3)	Indonesia
11	Employee Laboratory	8	Min.Vocational high School of Chemistry /D3	Indonesia
12	Processing Employees	55	Min.Vocational high School	Indonesia
13	Security officer	12	Vocation Senior High /armies	Indonesia
14	Janitor	10	Junior High School/ Senior High School	Indonesia
15	Driver	5	Junior High School/ Senior High School	Indonesia

### Table 4. Number of Employees and Employee Education Background

# Recruitment of Manpower and Training

The manpower planning for the bioethanol might be similar to PT. Malindo Raya which has a factory capacity which is relatively the same as factory planning capacity. For Manpower Training planned has an agreement with NEDO Inc. Japan (a Bioethanol technology company). Recruitment and labor training fees will be estimated IDR = 175.000.000 and IDR = 550,000,000.

# Legal and Environmental Analysis

# 1. Legal Analysis

### a. Legality Process

In Indonesia the establishment of a Limited Liability Company (PT) begins from a notary process in Langkat Regency. Following the Minister of Industry Decree, No. RI. 41 / M-IND / Per / 6/2008, all types of industries with total investment value of more than 200 million excluding land and building, it requires an Industrial Business License.

b. Capital and Share Ownership of the Company

The authorized capital of the Company is determined by the shareholders in front of the Notary for a legitimate legal force. The authorized capital makes the cash into the company's treasury by converting it to stock.

### c. Corporate Guarantee

Investment credit from the Bank in principle is guaranteed by all assets of the company either invested or to be invested while working capital loans will be guaranteed by the inventory.

### Environmental Analysis

### a. Negative Impact of Operation Activity on Bioethanol Plant

Possible impacts may include:

- a. The incidence of sound of the factory in the area around the factory.
- b. Activities of river water use and the incidence of waste disposal coming from the factory.
- c. Incidence of factory smoke exhaust.

The negative impact on the environment had been found (B), while others are only local and low intensity. The effect of the sound of the factory in the area around the factory will not interfere with residential areas and employee housing. While the influence of exhaust fumes is not affected by the air condition from the environment. So from the environmental damage caused by point B it will be made wastewater treatment station to soften bacteria decomposer into CH4 gas fuel for the purpose of energy enhancer.

### b. Positive Impact of Bio-ethanol Plant Development

The bioethanol plant construction project will have a positive impact by opening up new jobs for people of all levels and types of skills.

The opening of new employment field means additional income from the parties involved. Parties that directly earn income are residents around the parbik who will become factory employees. While the other party who will get revenue is the local government and the center. Additional revenue for the government in the form of taxes consisting of VAT, Income Tax, PBB and PE.

### c. Waste Treatment

Bioethanol plant waste processing implements COD wastewater treatment and waste water quality standards according to Environment Candidate 2014 for the Ethanol industry and the like.

# Economic and Financial Analysis

1. Investment Cost of Bioethanol Plant

The investment cost for the construction of a bioethanol processing plant consists of fixed asset investment cost and non-factory investment cost.

### a. Investment Cost Fix Asset Factory

According to the OECD (Organization For Economic Co-Operation and Development), all cost components directly related to the construction of bioethanol plant capacity of 5 Ton / hour molasses, ie preliminery expenditure or preliminary expenditures, the site & preparation or other land acquisition costs, construction, machine and equipment costs, replacement cost of spare parts, engginer fees, license fees and technology, cost of establishment, and working capital. This is estimated at IDR = 69.161.963.165, -.

b. Flower of Development Period (IDC)

During the construction of a bioethanol processing plant and its supporting facilities estimated to take approximately 6 (six) months or (18 months), the investment credit drawn is subject to interest in the development period (IDC). The interest rate of construction period is 6 (six) interest credit of 12% per annum is IDR = 8,229,435,580, -.

c. Working Capital Financing

In carrying out operational activities, this factory requires working capital for raw material procurement, salary / wages of employees, cost of sales and expenses of office / administration and other expenses. The initial working capital requirement in 3 Months of plant production / operation is estimated at IDR = 19.656.009.243, -

### 2. Project Budget Plan

Bioethanol plant construction cost budget 5 kg Molases / Hour capacity IDR= 97.117.497.988, - (Ninety Seven Billion One Hundred Seventeen Million Four Hundred Ninety Seven Thousand Nine Hundred Eighty Eight Rupiah) consists of:

- a. Fix Asset Investment Fee of IDR = 69.161.963.165, (sixty nine billion one hundred sixty one million nine hundred sixty three thousand one hundred sixty five rupiah).
- Interest during Construction (Interest during of Construction) =IDR.
   8.229.435.580, (eight billion two hundred twenty nine million four hundred thirty five thousand five hundred and eighty rupiah).
- c. Initial Working Capital of IDR = 19.656.099.243, (nineteen billion six hundred fifty six million ninety nine thousand two hundred forty three rupiah).

# 3. Sources of Investment Financing and Working Capital

To fund the construction of this project, both investment and working capital expenses are expected to be in the form of credit (loan) from the bank and part of the company's own financing (self financing).

# a. Loan Capital

The amount of loan capital expected from the Bank to finance the construction of the Bioethanol plant is 60% of the total investment, consisting of:

- 1) Investment Credit fixed assets amounting to IDR = 41.497.177.899, or 60% of the total investment cost.
- 2) The Development Capital Interest (IDC) is capitalized by the Bank of IDR = 4.979.661.348, or 60% of IDC.

3) Working Capital Loans of IDR = 11,793,659,546, or 60% of the initial working capital cost.

### b. Owner's equity

The Company's own capital stock for financing the Bioethanol plant development project is 40% of the total investment, consisting of:

- 1) Investment Cost of Rp27.664.785.266 or 40% of total investment cost.
- 2) Development Interest Rate (IDC) paid by the company amounting to IDR = 3.319.774.232, or 40% of IDC.
- 3) Initial Working Capital of IDR = 7,862,439,697, or 40% of the initial working capital cost.

The allocation of funds or credit from the Bank and the company's own funds is presented in the following table of the project financing structure.

# 4. Production and Operation Costs

Production and operating costs in question here are the costs incurred for plant operations consisting of direct costs and indirect costs. Direct costs consist of the cost of purchasing raw materials of molasses while the indirect costs consist of salaries and employee welfare, maintenance costs, administrative and general costs, marketing costs, interest on loans, taxes, insurance premium costs.

# a. Revenue Projection

Revenue is all income derived from production process activities at the plant. this revenue projection is the result of selling the product in units of years at a set price.

# b. Raw Material Costs

Costs incurred for the purchase of raw materials with 100% capacity realization. Molases raw materials come from companies that have declared to sell their Molases to this Plant. In the first year it is estimated that the need of raw materials of Molasses is 36,000 tons with an estimated price of IDR = 1.268, - / Kg. To determine the cost of raw materials must first be calculated the amount of raw materials needed in a year as follows.

# c. Salary / Wages and Employee Welfare

Number of employees of the Bioethanol factory 5 ton Molases / Hours of Work Capacity The total capacity of salt / wage and employee benefits in the first year is IDR = 6,506,400,000

# d. Operating Cost

Operating Cost covers any cost of processing used for the ongoing production process was predicted IDR =917.499.243. Operating costs are estimated to increase by 2% annually over the life of plant planning so that plant operating costs:

$$C_n = C x (1 + \pi)^{n-1}$$

 $C_n = \text{IDR} = 3.669.9700 \text{ x} (1 + 2\%)^{1-1}$ 

 $C_n = IDR = 5.505.000.000,$ -

So for the first year the operational cost of bioethanol plant capacity of 5 ton molases / hour is IDR = 5.505.000.000,-.

a. Total Production Cost

Total cost of bioethanol production is direct cost plus indirect cost. Here is the total cost of production

> *TC* = *Raw Materials Cost* + *Labor Cost* + *Operating Cost* TC = Rp.47.473.920.000 + Rp.6.506.400.000 + Rp.5.505.000.000TC = Rp.59.574.400.000, -

So for the first year the total production cost of bioethanol plant capacity of 5 ton molases / hour is IDR = 59,574,400,000, -

#### f. Pre-Tax Revenue (EBIT)

So for the first year total gross income of bioethanol plant capacity of 5 ton molasses / hour is

*EBIT* = *Total Revenue* - *Total Cost of Production* EBIT = Rp.89.088.480.000 - IDR = 59.574.400.000EBIT = Rp. 29.615.000.000

#### g. Depreciation Fees

Depreciation costs of fixed assets and construction period interest are computed using the straight-line method. Depreciation cost calculation is presented in the table below:

1 adie 5. Stakes Costs						
No	Description	Initial Value	%	Final score		
	Cost of depreciation					
1	Machinery and Equipment	45.385.777.500	7%	3.177.004.425		
2	Civil works	570.560.000	5%	28.528.000		
3	Piping, valve, fitting and insulation	721.360.000	5%	36.068.000		
4	Electrical	245.000.000	15%	36.750.000		
5	Construction	8.469.640.440	5%	423.482.022		
6	Machineries	6.322.345.500	7%	442.564.185		
Total		61.714.683.440		4.144.396.632		

Table 5. Stakes Costs
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Depreciation costs are estimated on the basis of a percentage of the acquisition value of assets and the classification of costs entered into production costs as well as incoming general and administrative costs can be seen in the calculation below

$$D = \frac{p - l}{n}$$
$$D = \frac{Rp.61.714.683.440 - Rp.4.144.396.632}{20}$$
$$D = Rp.2.878.514.340$$

### h. Tax

Taxation is the company's liability to the government for the profit from income / income less the total cost of the activity. the government regulation on the pouring in the Act of Income Tax Article 17 paragraph 1 states that taxpayer Income Tax is 25%.

*i. Cost of Production (HPP)* 

Cost of production is determined from the total production cost is distributed the production amount. Then the cost of bioethanol production in the first year is

$$HPP = \frac{TBP}{JP}$$

$$HPP = \frac{IDR.84.765.540.000}{9.000.000 \, Kg}$$

$$HPP = IDR.9.417$$

The cost of this production increased during the projection period of 20 years.

j. Evaluation of Economic and Financial Analyzes

1) Cash Flows

The cash flow for bioethanol plant capacity of 5 ton / hour molasses in the first year is as follows.

Table 6. Cash Flow						
Initial Cash Flow						
a. Initial Investment	69,161					
b. Working capital	19,656					
c. Total Initial Cash Flow	88,817					
Operating Cash Flow						
Total Production of Bioethanol / year (KL)		9360				
d. Results of BIOETANOL sales		89,088				
e. Total income		89,09				
f. Raw Material Cost (FFB) / year		47,474				
g. Labor costs		6,5				
h. Operation and Management Costs		5,505				
i. Total Production Cost		59,474				
EBITDA		29,615				
j. Depreciation		2,9				
k. Pre-Tax Revenue (EBIT)		26,74				
l. Tax		6,686				
m. Revenue After Tax (NIAT)		20,058				
n. Depreciation		2,9				
o. Total Operating Cash Flow		22,93				
Principal Production / kg		6.661				
Terminal Cash Flow						
p. Loan Return		9,000				
q. Other income / residual value						
r. Total Terial Cash Flow		-9,000				
Net Cash Flow (NCF) t	-89	13,928				

1) Net Present Value (NPV)

Net Present Value (NPV) is the difference between the present value of the entire annual net cash flow that the investor will receive during the plant's economic life. If NVP > 0, then the proposed investment is accepted, If NVP < 0, then the investment proposal is rejected and if NVP = 0, then the value of the firm remains even if the proposed investment is accepted or rejected.

$$NPV = \sum_{t=0}^{n} \frac{(NCF_0)}{(1+i)^0} + \frac{(NCF_1)}{(1+i)^1} \dots \frac{(NCF_{20})}{(1+i)^{20}}$$
$$NPV = \sum_{t=0}^{n} \frac{(-88,17)}{1} + \frac{(13,93)}{0,833} \dots \frac{(58,60)}{0,026}$$
$$NPV = 21.75$$

The NPV for the bioethanol plant is 21.75 so the plant is declared feasible.

#### 2) Internal Rate Return (IRR)

Internal Rate Return (IRR) is the average growth rate of money invested. IRR compares the interest rate already earned and the interest rate set (MARR). If IRR > MARR then the investment proposal is feasible, If IRR < MARR then the investment proposal is not feasible.

$$IRR = i_1 + \frac{NPV_1}{(NPV_1 + NPV_2)}(i_2 - i_1)$$

IRR = 30,56

#### 3) Benefit Cost Ratio (BCR)

Benefit Cost Ratio Is a comparison between income and expenses incurred during the investment age.

$$BCR = \sum_{i=1}^{n} \frac{BI\left(\frac{1}{1+r}\right)^{1}}{CI\left(\frac{1}{1+r}\right)^{1}} + \frac{BI\left(\frac{1}{1+r}\right)^{2}}{CI\left(\frac{1}{1+r}\right)^{2}} \dots \frac{BI\left(\frac{1}{1+r}\right)^{20}}{CI\left(\frac{1}{1+r}\right)^{20}}$$
$$BCR = \sum_{i=1}^{n} \frac{71,27}{57,08} + \frac{61,04}{48,32} \dots \frac{3,75}{2,89}$$

BCR = 1,0505

### CONCLUSION

The conclusions from the feasibility study are as following:

- 1. Based on the market, technical, organizational, management, environmental and financial aspects, the Bioetanol plant construction capacity of 5 ton molasses / hour was feasible in North Sumatra.
- 2. The result of sensitivity analysis for Bioethanol plant is as follows:
  - a. For molasses price = IDR. 1.268 and Bioethanol price =IDR. 9.518, Net Present Value of NPV 21.7> 0, Payback Period (PP) of 7.4 Years of Investment, Internal Rate Return (IRR) of 30.56> 25, Benefit Cost Ratio (BCR) of 1.0505 more than MARR which is set to 1, and Rate of Return (ROR) averaging 1.15. With this sensitivity analysis, it is stated that the Bioethanol plant capacity of 5 ton / h molasses was feasible to build.

- b. For molasses price around IDR. 1,840 and Bioethanol price IDR. 13,770, Net Present Value of NPV 106,75> 0, Payback Period (PP) of 9.1 years Investment, Internal Rate Return (IRR) of 49.79> 25, Benefit Cost Ratio (BCR) of 1.1827 more than MARR which is set to 1, and the Rate of Return (ROR) averages 1.86. With this sensitivity analysis, the Bioethanol plant capacity of 5 ton / h molasses was feasible to build
- c. It was found that the molasses price = IDR 845 and Bioethanol price = IDR 7.500, Net Present Value of NPV 9.24> 0, Payback Period (PP) of 6 years Investment, Internal Rate Return (IRR) of 25.01> 25, Benefit Cost Ratio (BCR) of 1.0132 more than the MARR applied i.e 1, and Rate of Return (ROR) averaging 1.06. With this sensitivity analysis, the Bioethanol plant capacity of 5 ton/h molasses was feasible to build.

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