

lebih dari MARR yang ditetapkan yaitu 1, dan Rate of Return (ROR) rata – rata 1,06. Dengan analisis sensitivitas ini dinyatakan pabrik bioetanol kapasitas olah molases 5 ton/jam layak dibangun

## 5.2 Saran

1. Pembangunan pabrik bioetanol ini sangat penting untuk dilaksanakan agar menjadi nilai tambah pendapatan pabrik gula mengingat harga gula yang sering terjadi fluktuatif.
2. Berdasarkan perencanaan pemerintah untuk mengurangi pertambahan gas emisi buang idealnya pemerintah indonesia harus memiliki beberapa pabrik bioetanol

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LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM

VI-1

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
<b>A JUICE CONCENTRATION OFF STORAGE STATION</b>						
1	Vapour liquid separator	Cylindrical vertical type, 4 m3 capacity, SS 304	set	1	121.500.000	121.500.000
2	Recirculation cum transfer pump	Centrifugal type, with 150 m3/hr	Ea	1	95.500.000	95.500.000

		capacity				
3	Final condenser	Sheel & tube type, with 300 m3 heat transfer area, SS 304	Ea	1	105.000.000	105.000.000
4	Syrup intermediate storage tank	Cylindrical vertical type, with 20 m3 capacity, SS 304	Ea	1	295.000.000	295.000.000
5	Syrup Transfer Pump	Centrifugal type, with 35 TPH capacity	Ea	1	95.000.000	95.000.000
6	Condensate collection tank	Cylindrical vertical type, with 2 m3 capacity	Ea	1	60.750.000	60.750.000
7	Condensate transfer pump	centrifugal type, with 10 m3/hr capacity, CL	Ea	1	12.000.000	12.000.000
8	Vacuum pump	Waterring type, with 350 m3/hr capacity	Ea	1	112.000.000	112.000.000
						<b>896.750.000</b>
<b>B</b>	<b>MOLASSES STORAGE STATION</b>					
1	Molasses tank with accessories	Vertical Cylindrical Type, with 1000 Ton capacity	Ea	2	1.521.500.000	3.043.000.000
2	Molasses pit	Rectangular Underground type, with 100 Ton capacity	Ea	1	160.000.000	160.000.000
3	Molasses pump	Gear/Lobe type, with 35 TPH capacity	Ea	1	95.000.000	95.000.000
4	Molasses filter	Basket Strainer Type, SS 304	Ea	1		88.457.000
						<b>3.386.457.000</b>
<b>C</b>	<b>UTILITY &amp; CHEMICAL REACTOR STATION</b>					
1	Air blowers	Water ring type, with 350 Am3/Hr capacity	Ea	2	46.332.000	92.664.000

2	Air filter	HEPA type	Ea	1	12.000.000	12.000.000
3	CO2 scrubber	Sieve trays type, with 800 mm dia having 6 nos, trays	Ea	1		34.500.000

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN VI-2

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
4	Acid doasing tank	Cylindrical, vertical type, with 1 m3 capacity	Ea	1	30.375.000	30.375.000
5	Acid doasing pump	Centrifugal type, with 1 m3/hr capacity	Ea	1	6.630.000	6.630.000
6	Antifoam doasing tank	Cylindrical, vertical type, with 1 m3 capacity	Ea	1	30.375.000	30.375.000
7	Antifoam doasing pump	Gear type, with 1 m3/hr capacity	Ea	1	8.250.000	8.250.000
8	Nutrient doasing tank with agitator	Cylindrical, vertical type, with 2 m3 capacity	Ea	1	60.750.000	60.750.000
9	Nutrient doasing pump	Centrifugal type, with 12 m3/hr capacity, wetted parts SS	Ea	1	18.500.000	18.500.000
10	PF & Fermenter cleaning nozzels	SS 304	Ea	6		12.450.000
11	CIP tank	Cylindrical, vertical type, with 10 m3 capacity, SS 304	Ea	1	303.750.000	303.750.000
12	CIP Pump	Centrifugal type, with 15 m3/hr capacity	Ea	1	25.000.000	25.000.000
						<b>635.244.000</b>

#### D FERMENTATION STATION

1	Syrup receiving tank	Cylindrical/vertical, conical bottom type, with 3 m3 capacity	Ea	1	91.125.000	91.125.000
2	Weighed syrup tank	Cylindrical/vertical, flat slopping bottom type, with 60 m3 capacity	Ea	1	853.500.000	853.500.000

3	Syrup weighing system	Load cell type, with 3 Ton capacity	Ea	1	98.756.000	98.756.000
4	Weighed syrup pump	Gear type, with 15 TPH capacity	Ea	1	31.660.000	31.660.000
5	Culture Vessels-I	Cylindrical, Vertical & Jacket type 0,2 m3 capacity	Set	1	15.187.500	15.187.500
6	Culture Vessels-II	Cylindrical, Vertical & Jacket type 1 m3 capacity	Set	1	30.375.000	30.375.000
7	Culture Vessels-III	Cylindrical, Vertical & Jacket type 5,5 m3 capacity	Set	1	151.875.000	151.875.000
8	Culture vessel transfer pump	Trolley mounted type, with 5 m3/hr capacity	Ea	1	7.500.000	7.500.000

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN

VI-3

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
9	Pre fermenter along	Cylindrical/vertical, conical bottom type, with 50 m3 capacity	Ea	2	89.000.000	178.000.000
10	Pre Fermentor recirculation pump	Centrifugal type, with 25 m3/hr capacity	Ea	2	34.000.000	68.000.000
11	Fermenter with spanger	Cylindrical, vertical, conical bottom type, with 350 m3 capacity	Ea	4	250.000.000	1.000.000.000
12	Fermenter wash Cooler	PHE type	Ea	4	12.500.000	50.000.000
13	Fermenter re circulation pump	Centrifugal type, with 250 m3/hr capacity	Ea	4	124.000.000	496.000.000
						<b>3.071.978.500</b>

**WASH  
E CLARIFICATION  
STATION**

1	Wash sttling tank	Cylindrical, vertical, conical bottom type, with 225 m3 capacity	Ea	1	675.045.000	675.045.000
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2	Sludge settling tank	Cylindrical, vertical, conical bottom type, with 60 m3 capacity	Ea	1	688.500.000	688.500.000
3	Sludge Trough	Cylindrical, vertical type, with 0,5 m3 capacity	Ea	2	15.375.000	30.750.000
4	Sludge transfer Pump	2 m3/hr capacity	Ea	2	2.750.000	5.500.000
5	Wash holding tank	Cylindrical, vertical, conical bottom type, with 350 m3 capacity	Ea	1	950.673.000	950.673.000
6	Fermented wash feed pumps	Centrifugal type, with 30 m3/hr capacity	Ea	1	3.500.000	3.500.000
						<b>2.353.968.000</b>
<b>F</b>	<b>DESTILATIONSTATION STATION</b>					
1	Analyzer column	Rh Grid trays type, with 2000 mm dia. 20 no, of trays and 750 mm tray spacing	Ea	1	281.250.000	281.250.000
2	Degasifying Column	Sieve trays type, with 1250 mm dia, 6 no. Of trays and 750 mm tray spacing	Ea	1	190.576.000	190.576.000

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN

VI-4

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
3	Rectifier Column	Bubble cap trays type, with 1500 mm dia, 72 no. Of trays and 250 mm tray spacing	Ea	1	250.700.000	250.700.000
4	Aldehyde Column	Bubble cap trays type, with 1600 mm dia, 30 no. Of trays and 300 mm tray spacing	Ea	1	255.750.000	255.750.000

5	Analyser Condenser-I	Shell & tube, horizontal type, with 75 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	120.000.000	120.000.000
6	Analyser Condenser-II	Shell & tube, horizontal type, with 75 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	120.000.000	120.000.000
7	Analyser Condenser-III	Shell & tube, horizontal type, with 75 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	120.000.000	120.000.000
8	Analyser Reboiler	Shell & tube, vertical type, with 230 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	2	375.000.000	750.000.000
9	Aldehyde Condenser-I	Shell & tube, horizontal type, with 35 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	90.000.000	90.000.000
10	Aldehyde Condenser-II	Shell & tube, horizontal type, with 7 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	56.000.000	56.000.000
11	Analyser reboiler vent condenser	Shell & tube, horizontal type, with 10 m2 heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	64.000.000	64.000.000

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
12	Rectifier PVC condenser	Shell & tube, horizontal type, with 3 m <sup>2</sup> heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	12.000.000	12.000.000
13	Rectifier reboiler	Shell & tube, horizontal type, with 180 m <sup>2</sup> heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	230.000.000	230.000.000
14	Analyzer condenser tank	Cylindrical, vertical type with 1 m <sup>3</sup> capacity	Ea	1	30.375.000	30.375.000
15	Rectifier reflux tank	Cylindrical, vertical type with 1 m <sup>3</sup> capacity	Ea	1	30.375.000	30.375.000
16	RS Intermediate tank	Cylindrical, vertical type with 1 m <sup>3</sup> capacity	Ea	1	30.375.000	30.375.000
17	Steam condense tank	Cylindrical, vertical type with 2 m <sup>3</sup> capacity	Ea	1	60.750.000	60.750.000
18	FW preheater	PHE type	Ea	1		9.000.000
19	Rectifier feed preheater	PHE type	Ea	1		13.500.000
20	RS Cooler	Shell & tube, horizontal type, with 35 m <sup>2</sup> heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	45.000.000	45.000.000
21	IS Cooler	Shell & tube, horizontal type, with 3 m <sup>2</sup> heat transfer area having 25,4 mm OD tube, 3000 mm long	Ea	1	29.000.000	29.000.000



22	FO Cooler	Double pipe type	Ea	2		7.500.000
23	FO decanter	Cylindrical, vertical type, SS 304	Ea	1		14.000.000
24	Analyser bottom pump	Centrifugal type with 30 m3/Hr	Ea	1	50.000.000	50.000.000
25	Analyser condensate pump	Centrifugal type with 7 m3/Hr	Ea	1	9.500.000	9.500.000
26	Rectifier bottom pump	Centrifugal type with 5 m3/Hr	Ea	1	5.500.000	5.500.000

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN

VI-6

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
27	Rectifier reflux pump	Centrifugal type with 18 m3/Hr	Ea	1	27.500.000	27.500.000
28	Steam condensate pump	Centrifugal type with 7 m3/Hr	Ea	1	9.500.000	9.500.000
29	RS transfer pump	Centrifugal type with 3 m3/Hr	Ea	1	3.500.000	3.500.000
30	Vacum pump	Centrifugal type, with 350 Nm3/hr capacity	Ea	1	195.000.000	195.000.000
31	Cold water overhead tank	Cylindrical type, with 40 m3 capacity	Ea	1	121.500.000	121.500.000
32	Hot water tank	Cylindrical type, with 2 m3 capacity	Ea	1	60.750.000	60.750.000
						<b>8.000.837.000</b>

**G DEHYDARTION STATION**

1	Molecular sieve bed with desiccant- 3A and internals	4.25 m3 Capacity 127 m2 heat transfer area	Ea	2		24.000.000
2	Regeneration Condenser	having 25.4 mm OD tube, 3000 mm long	Ea	1	567.000.000	567.000.000

3	Feed preheater	14 m2 heat transfer area having 25.4 mm OD tube, 3000 mm long	Ea	1	73.332.000	73.332.000
4	Product Condenser	40 m2 heat transfer area having 25.4 mm OD tube, 3000 mm long	Ea	1	209.520.000	209.520.000
5	Regeneration preheater	6 m2 heat transfer area having 25.4 mm OD tube, 3000 mm long	Ea	1	31.428.000	31.428.000
6	Regeneration Cooler	PHE type	Ea	1		12.000.000
7	Superheater	11 m2 heat transfer area having 25.4 mm OD tube, 3000 mm long	Ea	1	57.618.000	57.618.000
8	Dry bioetanol product drum	0.8 m3 capacity	Ea	1	24.000.000	24.000.000
9	Regeneration drum	0.8 m3 capacity	Ea	1	22.000.000	22.000.000

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN VI-7

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
10	Vacuum eductor/vacuum pump	Standart	Ea	1	12.500.000	12.500.000
11	Regeneration Pump	45 m3/Hr capacity	Ea	1	65.000.000	65.000.000
12	Product pump	3 m3/Hr capacity	Ea	1	3.500.000	3.500.000
						<b>1.101.898.000</b>
<b>H</b>	<b>BIOETANOL STORAGE STATION</b>					
1	Bioetanol storage tank	Vertical Cylindrical type of 3000 m3/Ton Capacity	Ea	3	3.521.500.000	10.564.500.000

2	Rectified spirit storage tank	Vertical Cylindrical type of 700 m3/Ton Capacity	Ea	1	2.375.000.000	2.375.000.000
3	Impure spirit storage tank	Vertical Cylindrical type of 100 m3/Ton Capacity	Ea	1	1.475.000.000	1.475.000.000
4	Fusel oil storage tank	Vertical Cylindrical type of 10 m3/Ton Capacity	Ea	1	147.500.000	147.500.000
5	Bioetanol day receiver	Vertical Cylindrical type of 75m3/Ton Capacity	Ea	3	1.106.250.000	3.318.750.000
6	SDS tank	Vertical Cylindrical type of 100m3/Ton Capacity	Ea	1	147.500.000	147.500.000
7	Vent condenser	Sheel & tube heat exchanger type, with heat transfer area of 3 m2	Ea	4	19.200.000	76.800.000
8	Fire arrester	Standart type	Ea	9	8.700.000	78.300.000
9	BioEthanol transfer pump	Centrifugal type of 40 m3/Hr capacity	Ea	2	62.000.000	124.000.000
10	RS transfer pump	Centrifugal type of 20 m3/Hr capacity	Ea	1	31.000.000	31.000.000
11	IS transfer Pump	Centrifugal type of 20 m3/Hr capacity	Ea	1	31.000.000	31.000.000
12	FO transfer pump	Centrifugal type of 10 m3/Hr capacity	Ea	1	15.000.000	15.000.000
13	SDS tank transfer pump	Centrifugal type of 15 m3/Hr capacity	Ea	1	23.575.000	23.575.000
14	Bioethanol flow meter	Positive displacement type flow meter of 40 m3/hr capacity	Ea	1	123.450.000	123.450.000
15	IS Flow meter	Positive displacement type flow meter of 20 m3/hr capacity	Ea	1	61.725.000	61.725.000
						<b>18.593.100.000</b>

LAMPIRAN 1 MESIN DAN PERALATAN PABRIK BIOETANOL CAP 5 TON OLAH MLASES/JAM LANJUTAN

VI-8

No	Uraian	Spesifikasi	Satuan	Jumlah	Harga (Rp)	Total (Rp)
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<b>I WATER TREATMENT STATION</b>						
1	Water intake & pump	Standart	Ea	2	8.400.000	16.800.000
2	Pump hose	Standart	Ea	1	36.300.000	36.300.000
3	Reciver pump	Standart	Ea	2	4.300.000	8.600.000
4	Chemical pump & accesories	Standart	Ea	2	6.600.000	13.200.000
5	Claffier tank	Cap 90 m3/hr	Ea	1	205.000.000	205.000.000
6	Claffier water basin	Cap 200 m3	Ea	1	290.000.000	290.000.000
7	Send filter Pump & hose pump	Standart	Ea	2	39.800.000	79.600.000
8	Pressure sand filter	Standart	Ea	2	475.000.000	950.000.000
9	Water tower tank	Capacity 90 m3 and 40 m3	Ea	1	450.000.000	450.000.000
10	Chlorone pump	Standart	Ea	2	4.200.000	8.400.000
11	Interconnecting piping	Standart	Ea	1	14.100.000	14.100.000
12	Booster pump for cation tank	Standart	Ea	2	4.300.000	8.600.000
13	Cation Exchange	Cap. 25 m3/Hr	Ea	1	175.000.000	175.000.000
14	Anion Exchange	Cap. 25 m3/Hr	Ea	1	175.000.000	175.000.000
15	Boiler feed tank	Cap. 100 m3	Ea	1	275.000.000	275.000.000
16	Dearetor feed pump	Standart	Ea	2	4.200.000	8.400.000
17	dearetor unit	Cap. 20 m3/hr	Ea	1	167.500.000	167.500.000
18	Chemical pump & accesories	Standart	Ea	2	3.200.000	6.400.000
						<b>2.887.900.000</b>
<b>J PIPING WORKS</b>						
1	Piping works	Standart	Lot	1	1.475.000.000	1.475.000.000
2	Valves	Standart	Lot	1	1.005.000.000	1.005.000.000
3	Fittings	Standart	Lot	1		

					125.000.000	125.000.000
4	Instrumentation	Standart	Lot	1	236.345.000	236.345.000
5	Insulation Work for all tanks & pipim	Standart	Lot	1	674.300.000	674.300.000
6	Sludgepipe HDPE to effluent pond	Standart	Lot	1	686.000.000	686.000.000
						<b>4.201.645.000</b>
<b>K</b>	<b>FIRE FIGHTING EQUIPMENT</b>					
1	Fire hydrant c/w box	Standart	Lot	1	250.000.000	250.000.000
2	Fire fighting diesel c/w pump	Standart	Ea	1	6.000.000	6.000.000
						<b>256.000.000</b>
<b>TOTAL</b>						<b>45.385.777.500</b>

LAMPIRAN 2 PIPING INSULATION, MACHENARIES DAN ELECTRICAL PABRIK BIOETANOL CAP 5 TON OLAH MOLASES/JAM  
VI-9

NO	URAIAN	SATUAN	JUMLAH	SATUAN HARGA (Rp)	TOTAL (Rp)
A	PIPING, VALVE, FITTING & INSULATION				
1	External Piping	Lot	1	555.000.000	555.000.000

2	Valve, Fitting & Insulation	Lot	1	105.750.000	105.750.000
3	Pipe Track	Lot	1	60.610.000	60.610.000
<b>TOTAL</b>					<b>721.360.000</b>

**MACHINERIES**

<b>NO</b>	<b>URAIAN</b>	<b>SATUAN</b>	<b>JUMLAH</b>	<b>SATUAN HARGA (Rp)</b>	<b>TOTAL (Rp)</b>
<b>A</b>	<b>JUICE CONCENTRATION FOR OFF-SEASON STORAGE STATION</b>				
1	Electro motor 75 Kw/100 Hp-Electrim	Ea	1	38.500.000	38.500.000
2	Helical gear box 15 kw/26	Ea	1	73.150.000	73.150.000
3	Panel star delta 1x75 Kw thersing drum	Ea	1	21.000.000	21.000.000
4	Gear motor for vacum pump 18,5 kw/25 Hp	Ea	1	72.150.000	72.150.000
5	Gear motor for centrifugal pum 18,5 kw/25	Ea	1	73.150.000	73.150.000
<b>B</b>	<b>FERMENTATION STATION</b>				
6	Pressure gauges	Ea	28	11.837.500	331.450.000
7	Temperature sensors	Unit	35	8.650.000	302.750.000
8	Foam sensors	Ea	4	18.700.000	74.800.000
9	Glass tube rotameters	Ea	6	15.152.000	90.912.000
10	Magnetic flow meter with totalizer	Unit	3	26.125.000	78.375.000
11	Peneumatic controlled On-Off valve	Ea	12	34.250.000	411.000.000
12	Process water flow control loop	Unit	4	26.125.000	104.500.000
13	Colling water flow control loop in	Ea	4	20.000.000	80.000.000
14	Fermented mas flow control loop	Ea	1	24.560.000	24.560.000
15	Flow control valve molases feed 24 k	Ea	4	45.765.000	183.060.000
16	Total control loops	Ea	13	23.826.000	309.738.000
<b>C</b>	<b>DESTILATION STATION</b>				
17	Pressure Gauges	Ea	26	17.837.500	463.775.000

18	Vacuum gauges	Ea	6	21.000.000	126.000.000
19	Temperature indicator (RTD) type	Ea	48	11.250.000	540.000.000
20	Metal tuberotameters	Ea	8	8.000.000	64.000.000
21	Magnetic flow meter with totalizer	Ea	1	42.350.000	42.350.000
22	Pressure trasnmitter	Ea	6	6.450.000	38.700.000
23	Control loops	Ea	1	12.000.000	12.000.000
24	Steam flow control loops	Ea	1	4.500.000	4.500.000
25	Exhaust steam flow control	Ea	1	6.000.000	6.000.000
26	Mash steam flow control	Ea	1	12.560.000	12.560.000
27	Fodraw control loop	Ea	1	24.560.000	24.560.000
28	Rectified spirit to storage	Ea	1	45.000.000	45.000.000
29	Cooling water flow control loop	Ea	2	40.250.000	80.500.000

LAMPIRAN 2 PIPING INSULATION, MACHENARIES DAN ELECTRICAL PABRIK BIOETANOL CAP 5 TON OLAH MOLASES/JAM LANJUTAN

VI-

10

NO	URAIAN	SATUAN	JUMLAH	SATUAN HARGA (Rp)	TOTAL (Rp)
30	Mash column bottomlevel control loop	Ea	1	12.450.000	12.450.000
31	Exhaust column bottom level controlloop	Ea	1	15.000.000	15.000.000
32	Rectifier reflux tank level control loop	Ea	1	21.000.000	21.000.000
33	F.O. Draw tank level control loop	Ea	1	24.253.000	24.253.000
34	F.O. Washing tank level control loops	Ea	1	25.000.000	25.000.000
35	Pressure control loop	Ea	1	12.350.000	12.350.000
36	Rectifier vacuum control loop	Ea	1	45.640.000	45.640.000
37	Total control loops	Ea	14	23.000.000	322.000.000
38	Safe testers	Ea	1	2.250.000	2.250.000
<b>D DEHYDRATION STATION</b>					
39	Pressure gauges	Ea	15		

				17.837.500	267.562.500
40	Temperature indicators (RTD) type	Ea	18	24.000.000	432.000.000
41	Metal tube rotameters	Ea	1	16.450.000	16.450.000
42	Glass tube rotameters	Ea	2	13.000.000	26.000.000
43	Feed flow control valve	Ea	5	36.500.000	182.500.000
44	steam to the vaporizer reboiler	Ea	1	15.450.000	15.450.000
45	Pressure control valves for the seive beds	Ea	2	45.650.000	91.300.000
46	Vacuum control valve for the sievie beds	Ea	2	40.000.000	80.000.000
47	Pessure contro valve- Shaw valve	Ea	2	35.000.000	70.000.000
48	Automated control valve	Ea	1	75.000.000	75.000.000
49	Flash tank	Ea	1	40.000.000	40.000.000
50	Level transmitter	Ea	1	12.450.000	12.450.000
51	Level control valve for regeneration	Ea	1	23.750.000	23.750.000
52	Flow control valve	Ea	13	23.000.000	299.000.000
53	Fortex Flowmeter	Ea	1	30.000.000	30.000.000

**TOTAL**

**5.870.445.500**

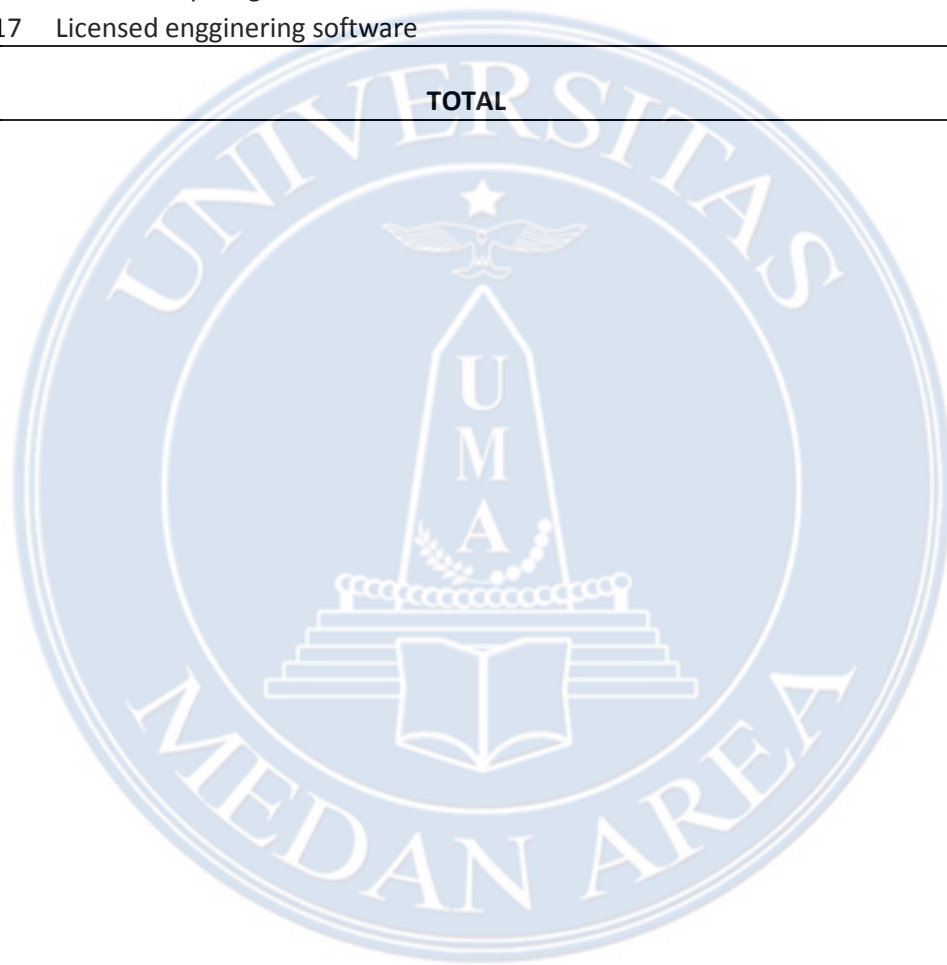
**ELECTRICAL**

NO	URAIAN	SATUAN	JUMLAH	SATUAN HARGA (Rp)	TOTAL (Rp)
<b>E</b>	<b>PLC CONTROL AUTOMATION</b>				
1	Control panel for PLC consisting				
2	Marshalling Panel				
3	CPU cards with redundancy				
4	Power supply with redundancy				
5	Analog input module				
6	Analog output module	LOT	1	245.000.000	245.000.000
7	Digital input module				
8	24 VDC filed power supply				
9	I/O installation racks				
10	Interposing redy board				
11	Deskjet color Printer (Canon)				



LAMPIRAN 2 PIPING INSULATION, MACHENARIES DAN ELECTRICAL PABRIK BIOETANOL CAP 5 TON OLAH  
MLASES/JAM LANJUTAN  
VI-11

NO	URAIAN	SATUAN	JUMLAH	SATUAN HARGA (Rp)	TOTAL (Rp)
	Operator station with 19 IN monitor				
12	2 Nos				
13	with destop Mounted PC (Dell)				
14	Windows 10 Operating System				
15	Licensed system software				
16	Licensed report genertation software				
17	Licensed engginering software				
<b>TOTAL</b>					<b>245.000.000</b>



LAMPIRAN 3 BANGUNAN DAN SARANA PABRIK BIOETANOL

VI-12

NO	URAIAN	SATUAN	JUMLAH	SATUAN HARGA (Rp)	TOTAL (Rp)
<b>A</b>	<b>CIVIL WORKS</b>				
	<b><u>Juice concentration off storage station</u></b>				
1	Juice concentration off storage fondation and slab	Ls	1	37.750.000	37.750.000
2	<b><u>Molasses storage station</u></b>	Unit	1		

	Oil storage foundation and Pump hose			69.700.000	69.700.000
3	<b>Reactor station</b> Reactor found and slab	Ls	1	105.000.000	105.000.000
4	<b>Fermentation station</b> Fermentation found and slab	Ls	1	56.750.000	56.750.000
5	<b>Wash Clarification Station</b> wash found and slab	Ls	1	42.570.000	42.570.000
6	<b>Destillation station</b> Destillation found and slab	Ls	1	79.200.000	79.200.000
7	<b>Dehydration station</b> dehydration found	Ls	1	40.000.000	40.000.000
8	<b>Bioetanol storage station</b> Bioetanol storage tank foundation	Unit	1	20.790.000	20.790.000
9	<b>Water treatment station</b> Water treatment plan	Ls	1	52.470.000	52.470.000
10	<b>Power house</b>	Ls	1	21.780.000	21.780.000
11	<b>Incinerator</b>	Ls	1	44.550.000	44.550.000
<b>TOTAL</b>					<b>570.560.000</b>

NO	URAIAN BANGUNAN	KAPASITAS 5 TON MOLASES/JAM			
		JENIS BANGUNAN	LUAS (M2)	JUMLAH UNIT	HARGA (Rp)
<b>B</b>	<b>PERUMAHAN</b>				
	Bangunan rumah type 1	Permanen	1.620	15	841.540.000
	Bangunan rumah type 2	Permanen	700	10	600.600.000
	Bangunan rumah type 3	Permanen	200	2	171.600.000
	Bangunan mess	Permanen	310	1	265.980.000
	Bangunan pos jaga	Permanen	16	1	7.392.000
<b>C</b>	<b>KANTOR</b>				
	Bangunan pos jaga	Permanen	30	1	14.748.000
	Bangunan kantor	Permanen	301	1	303.517.500
	Bangunan laboratorium	Permanen	100	1	54.054.000
	Bangunan kantin	Permanen	112	1	66.528.000
	Bangunan mushollah	Permanen			

		80	1	9.504.000
Bangunan toilet	Permanen	22	1	13.186.800
Bangunan Poliklinik	Permanen	60	1	6.754.000

LAMPIRAN 3 BANGUNAN DAN SARANA PABRIK BIOETANOL LANJUTAN

VI-13

NO	URAIAN BANGUNAN	KAPASITAS 5 TON MOLASES/JAM			HARGA (Rp)
		JENIS BANGUNAN	LUAS (M2)	JUMLAH UNIT	
	Taman		200	1	43.657.000
	Bangunan Aula		80	1	9.504.000
	Parkir	Permanen	157	1	36.390.000
<b>TOTAL</b>					<b>2.444.955.300</b>
<b>D</b>	<b>LOKASI PABRIK</b>				
	<b>Bangunan jembatan timbang</b>	Permanen	93	1	55.004.000
	<b>Bangunan molases storage tank</b> Molasses tank with accesories Found	Permanen	325	2	115.768.920
	<b>Bangunan Proses Utama</b> Reactor Found & Slab Fermentation Found & Slab Wash Clarification Found & Slab Destilation Found & Slab Dehydration Found & Slab	Permanen	7.045	1	3.285.519.920
	<b>Bangunan bioetanol storage tank</b> Bioetanol Storage Tank with Accesories Found	Permanen		1	123.437.000
<b>TOTAL</b>					<b>8.469.640.440</b>

LAMPIRAN 4 BIAYA PENGELUARAN PENDAHULUAN, PENGADAAN LAHAN DAN REPLECMENT PART  
VI-14

**A PRELIMINERIS**

NO	URAIAN	SATUAN	JUMLAH	HARGA SATUAN (Rp)	TOTAL (Rp)
<b>A PREMILINARY EXPENDITURE</b>					
1	Engginering design, studi kelayakan, legal advance, Design Study, Initial Investigation	Ls	1	233.750.000	233.750.000
2	Transfortation, site office, site facillities, test ru & commisioning	Ls	1	245.750.000	245.750.000
<b>TOTAL</b>					<b>479.500.000</b>

**B PENGADAAN LAHAN**

NO	URAIAN	SATUAN	JUMLAH	HARGA SATUAN (Rp)	TOTAL (Rp)
<b>A PENGADAAN LAHAN DAN PEMBUATAN JALAN</b>					
1	Harga Tanah	M	26700	75.000	2.002.500.000
2	Biaya Notaris,BPN, Biaya Balik Nama (10 % dari total transaksi)	Lot	1	200.225.000	200.225.000
3	Drainase, Jalan, Rel Kreta	Lot	1	525.000.000	525.000.000
<b>TOTAL</b>					<b>2.727.725.000</b>

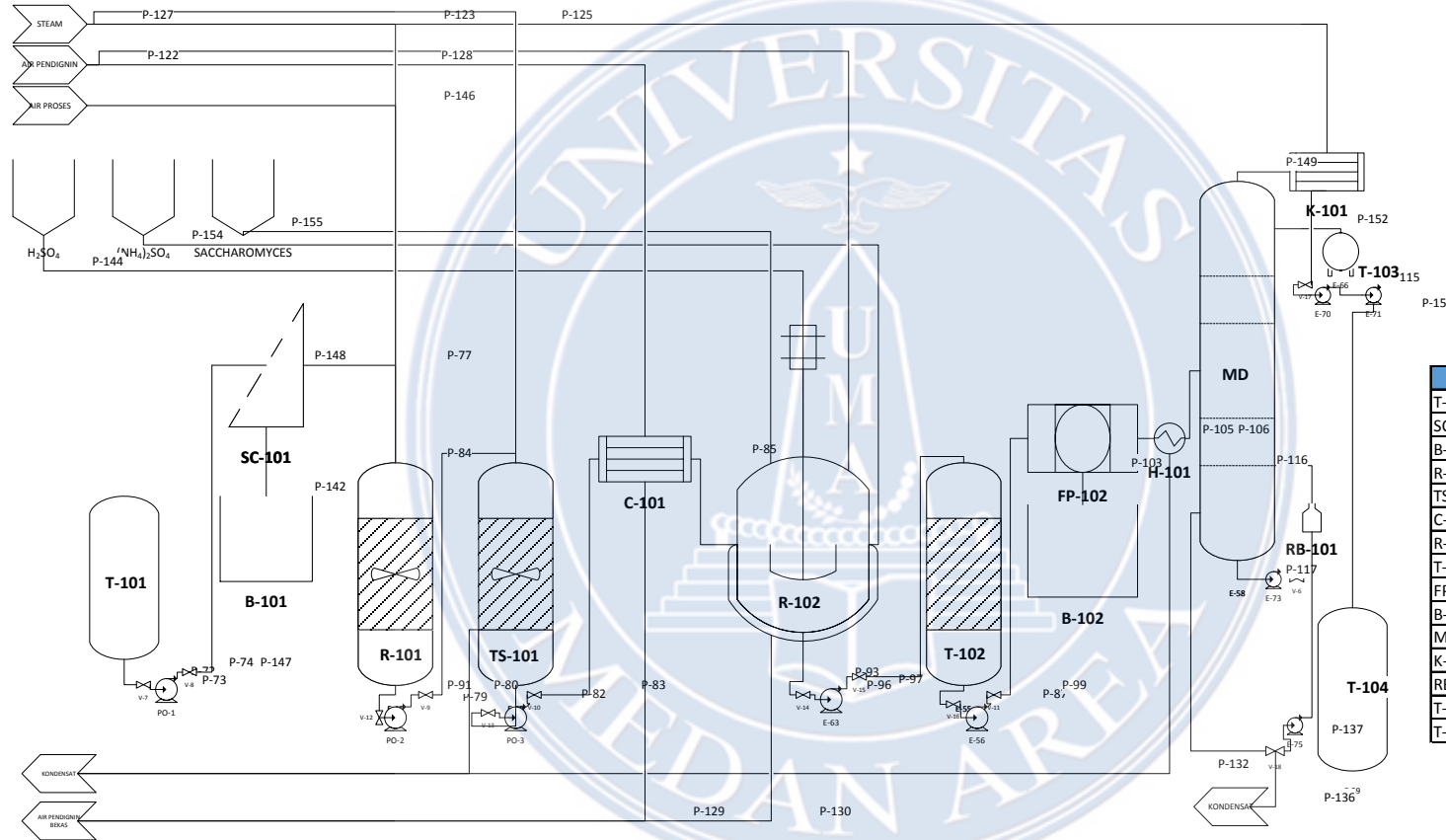
**C BIAYA PENGGANTIAN SUKU CADANG**

NO	URAIAN	SATUAN	PRESENTASE	HARGA	TOTAL
1	Biaya penggantian suku cadang	Lot	20%	5.870.445.500	1.174.089.100
<b>TOTAL</b>					<b>1.174.089.100</b>

**D BIAYA PENGAWASAN**

NO	URAIAN	SATUAN	JUMLAH	HARGA SATUAN (Rp)	TOTAL (Rp)
1	Biaya pengawas	Lot	250.000.000	250.000.000	250.000.000
<b>TOTAL</b>					<b>250.000.000</b>

## FLOW DIAGRAM PROSES PEMBUATAN BIOETANOL



KODE	KETERANGAN
T-101	Tangki Penyimpan Molases
SC-101	Screening
B-101	Bak Penampung-1
R-101	Reaktor
TS-101	Tangki Sterilisasi
C-101	Cooler
R-102	Fermentor
T-102	Tangki Penampung Fermentor
FP-102	Filter Press
B-102	Bak Penampung-2
MD	Menara Destilasi
K-101	Kondenser
RB-101	Reboiler
T-103	Tangki Penyimpan Destilat
T-104	Tangki Penyimpan Biletanol

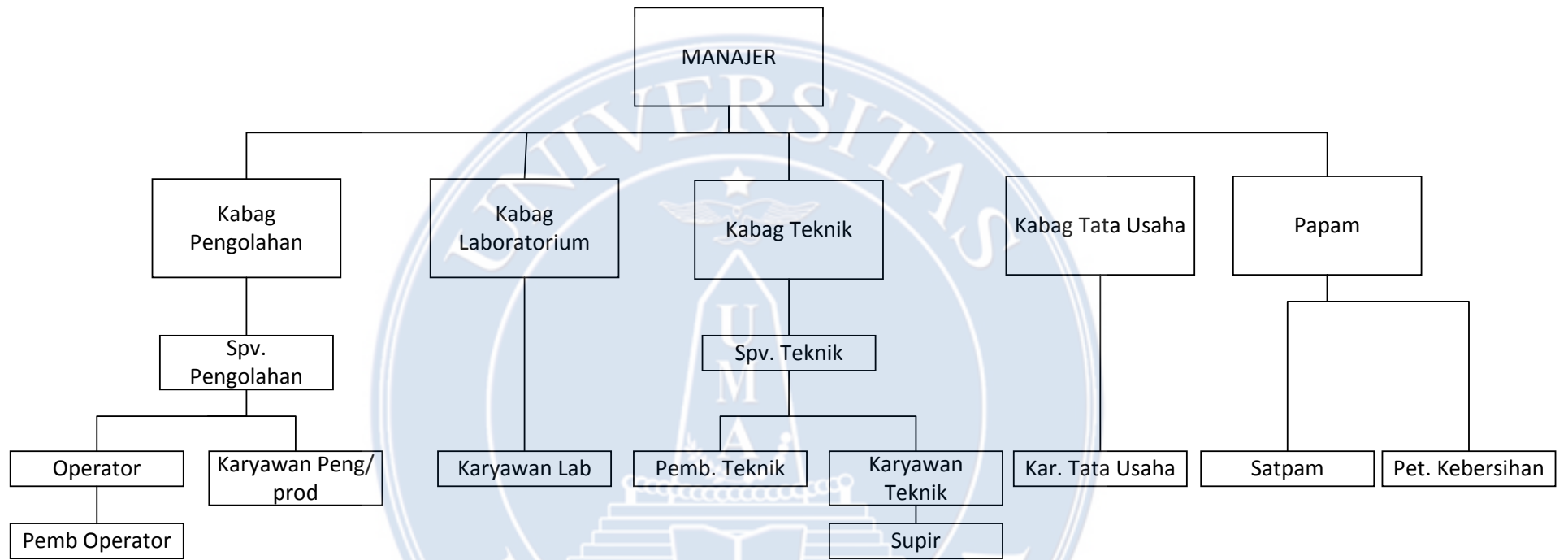
**LABORATORIUM SISTEM PRODUKSI**  
**PROGRAM STUDI TEKNIK INDUSTRI**  
**FAKULTAS TEKNIK**  
**UNIVERSITAS MEDAN AREA**

FLOW PROSES CHART PEMBUATAN CRUDE PALM OIL DAN INTI SAWIT PTPN II PAGAR MERBAU

OPERATION PROCESS CHART

SKALA	NAMA	TANGGAL	T. TANGAN
DIGAMBAR	Teguh Prasetya	20-07-2016	
DIPERIKSA	Ir.M.Banjarnahor.M.sc	20-07-2016	
DISETUJUI	Ir.M.Banjarnahor.M.sc	20-07-2016	









Tabel 4.19 Proems Cash Flow Untuk Harga Molases Rp.1.268 dan Harga Bioetanol Rp.9.518

IV-50

PROEMS CASH FLOW PERENCANAAN PABRIK BIOETANOL ( Milyar Rupiah)																						
Tot.Inves	Harga Jual Produk BIOETANOL /Kg	9518	7%	Cap.Pabrik /jam/kg	5.000	A Upah	10%	bunga	10,0%	CAPEX	60	Biaya t.Kerja 104 oang/thn /1 shift	4,33	Jumlah SHIFT/hari	3	Hari efectif/Bulan	26					
89	Harga Bahan Baku MOLASE /Kg	1268	7,8%	OER	0,25	B.Operasi	2%	umur/tn	20	Pajak	25%	Biaya B.bakar/energi/Perawatan	3,67	Jumlah Jam/Shift	8	prod.efectif	100%	100%				
No	Uraian	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I	<b>Aliran Kas Awal</b>																					
	a. Investasi Awal	69,161																				
	b. Modal Kerja	19,656																				
	c. Total Aliran Kas Awal	88,817																				
II	<b>Aliran Kas Operasi</b>																					
	<b>Total Produksi Bioetanol/tahun (KL)</b>		9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360
	d. Hasil penjualan BIOETANOL		89,088	95,378	102,112	109,321	117,039	125,302	134,148	143,619	153,759	164,614	176,236	188,678	201,999	216,260	231,528	247,874	265,373	284,109	304,167	325,641
	f. Total Pendapatan		89,09	95,38	102,112	109,321	117,039	125,302	134,148	143,619	153,759	164,614	176,236	188,678	201,999	216,260	231,528	247,874	265,373	284,109	304,167	325,641
	g. Biaya Bahan Baku (TBS)/tahun		47,474	51,163	55,138	59,422	64,039	69,015	74,378	80,157	86,385	93,097	100,331	108,126	116,528	125,582	135,340	145,856	157,189	169,402	182,565	196,750
	h. Biaya Tenaga Kerja		6,5	7,1	7,9	8,6	9,5	10,5	11,5	12,7	13,9	15,3	16,8	18,5	20,4	22,4	24,7	27,1	29,8	32,8	36,1	39,7
	i. Biaya Operasi dan Manajemn		5,505	5,615	5,725	5,835	5,945	6,056	6,166	6,276	6,386	6,496	6,606	6,716	6,826	6,936	7,046	7,157	7,267	7,377	7,487	7,597
	j. Total Biaya Produksi		59,474	63,922	68,722	73,902	79,494	85,531	92,050	99,089	106,693	114,908	123,783	133,374	143,738	154,941	167,051	180,143	194,300	209,608	226,163	244,070
	EBITDA		29,615	31,456	33,390	35,419	37,545	39,771	42,099	44,530	47,065	49,706	52,453	55,304	58,260	61,319	64,477	67,730	71,074	74,501	78,004	81,571
	k. Penyusutan		2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9
	l. Pendapatan Sebelum Pajak (EBIT)		26,74	28,59	30,52	32,55	34,67	36,90	39,23	41,66	44,20	46,84	49,58	52,43	55,39	58,45	61,61	64,86	68,20	71,63	75,13	78,70
	m. Pajak		6,686	7,146	7,630	8,137	8,669	9,225	9,807	10,415	11,049	11,709	12,396	13,109	13,848	14,612	15,402	16,215	17,051	17,908	18,783	19,675
	n. Pendapatan Setelah Pajak (NIAT)		20,058	21,439	22,890	24,411	26,006	27,676	29,422	31,245	33,146	35,127	37,187	39,326	41,543	43,837	46,205	48,645	51,153	53,723	56,350	59,026
	o. Penyusutan		2,9	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
	p. Total Aliran Kas Operasi		22,93	24,31	25,76	27,28	28,88	30,55	32,29	34,11	36,02	38,00	40,06	42,20	44,41	46,71	49,08	51,52	54,02	56,59	59,22	61,90
	<b>Pokok Produksi/kg</b>		6,661	7,136	7,649	8,202	8,800	9,445	10,141	10,893	11,705	12,583	13,531	14,556	15,663	16,860	18,154	19,553	21,065	22,701	24,469	26,382
III	<b>Aliran Kas Terminal</b>																					
	q. Pengembalian Pinjaman		9,000	8,700	8,400	8,100	7,800	7,500	7,200	6,900	6,600	6,300	6,000	5,700	5,400	5,100	4,800	4,500	4,200	3,900	3,600	3,300
	r. Pemasukan lain/NILAI sisa						0,000															
	s. Total Aliran Kas Terial		-9,000	-8,700	-8,400	-8,100	-7,800	-7,500	-7,200	-6,900	-6,600	-6,300	-6,000	-5,700	-5,400	-5,100	-4,800	-4,500	-4,200	-3,900	-3,600	-3,300
IV	<b>Aliran Kas Bersih (NCF) t</b>	-89	13,928	15,609	17,360	19,181	21,076	23,046	25,092	27,215	29,416	31,697	34,057	36,496	39,013	41,607	44,275	47,015	49,823	52,693	55,620	58,596

Tabel 4.20 NPV analisis dan Analisis Sensitivitas Untuk Harga Molases Rp.1.268 dan Harga Bioetanol Rp.9.518

MENGHITUNG NPV						ANALISIS SENSITIVITAS				
Diketahui :										
X1 =	0,2									
X2 =	0,6									
MARR =	0,25									
Menghitung NPV i = 20 %										
Tahun (i)	NET CASH FLOW	Factor Disconto 0,2	Present Value(PV) 0,2	Factor Disconto 0,6	Present Value(PV) 0,6					
						Input	FAKTOR CASH-FLOW	Satuan	Base	remark
0	-88,82	1	-88,817	1	-88,817	1	Total Investasi	M	83,845	
1	13,93	0,83333	11,60702	0,62500	8,70526	2	CAP.PABRIK (MOLASES/JAM)	Kg	5000	
2	15,61	0,69444	10,83987	0,39063	6,09743	3	Material Balance ( O E R )		0,25	
3	17,36	0,57870	10,04616	0,24414	4,23822	4	Biaya Tenaga Kerja/tahun/ 1 shift	M	4,33	
4	19,18	0,48225	9,25030	0,15259	2,92685	5	Biaya Operasi/B.Bakar/maintenance	M	3,67	
5	21,08	0,40188	8,47005	0,09537	2,00998	6	Ratio antara Modal sendiri/Pinjaman		2:3	
6	23,05	0,33490	7,71798	0,05960	1,37363	7	Lama Pinjaman/thn	th	20	
7	25,09	0,27908	7,00259	0,03725	0,93473	8	Bunga Pnjaman		0,1	
8	27,21	0,23257	6,32929	0,02328	0,63364	9	Pajak		0,25	
9	29,42	0,19381	5,70110	0,01455	0,42807	10	Jumlah Shiff /hari		3	
10	31,70	0,16151	5,11926	0,00909	0,28828	11	Harga BIOETANOL/L (RP)	Rp	9518	
11	34,06	0,13459	4,58366	0,00568	0,19359	13	Harga Bahan Baku/Kg (rp)	Rp	1268	
12	36,50	0,11216	4,09325	0,00355	0,12966	14	Efisiensi Produksi		1	
13	39,01	0,09346	3,64629	0,00222	0,08663	Result	1 NPV		21,74133	TRUE
14	41,61	0,07789	3,24060	0,00139	0,05774		2 IRR		30,56039	TRUE
15	44,28	0,06491	2,87369	0,00087	0,03840		3 BCR		1,039948	TRUE
16	47,02	0,05409	2,54295	0,00054	0,02549		4 R O R		1,145074	TRUE
17	49,82	0,04507	2,24568	0,00034	0,01688		5 P-BP		0,738577	TRUE
18	52,69	0,03756	1,97921	0,00021	0,01116					
19	55,62	0,03130	1,74096	0,00013	0,00736					
20	58,60	0,02608	1,52842	0,00008	0,00485					
NPV			21,7413		-60,6091				TRUE	
MAKA										
NPV , (i=20%) 21,74133181										
Dari Tabel diatas diperoleh bahwa : NPV > 0 berarti Studi Layak										
Untuk Menentukan Internal Rate Return (IRR) adalah :										
IRR by formula	7%									
IRR	30,56039257 >25 Sehingga Usulan Layak									

TAHUN	FAKTOR DISKOSTO	PV ( Benefit )	PV ( Cost )																						
0	0,0000	-	88,8170																						
1	0,8000	71,2708	57,0751																						
2	0,6400	61,0420	48,3150																						
3	0,5120	52,2813	40,9560																						
4	0,4096	44,7778	34,7637																						
5	0,3277	38,3513	29,5450																						
6	0,2621	32,8471	25,1399																						
7	0,2097	28,1329	21,4160																						
8	0,1678	24,0953	18,2636																						
9	0,1342	20,6371	15,5912																						
10	0,1074	17,6753	13,3228																						
11	0,0859	15,1385	11,3948																						
12	0,0687	12,9659	9,7543																						
13	0,0550	11,1050	8,3567																						
14	0,0440	9,5112	7,1649																						
15	0,0352	8,1462	6,1474																						
16	0,0281	6,9770	5,2780																						
17	0,0225	5,9757	4,5344																						
18	0,0180	5,1180	3,8979																						
19	0,0144	4,3835	3,3526																						
20	0,0115	3,7544	2,8851																						
Jumlah		474,1864	455,9714																						
BCR	1,03994757			Bila BCR > 1 berarti Usulan Investasi Pabrik Layak																					
MENENTUKAN RATE OF RETURN (ROR)																									
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
ROI RATE OF RETURN	(1) GROSS PROFIT / INVESMENT				0,333433	0,354165	0,375938	0,398781	0,422722	0,447786	0,473994	0,501365	0,529913	0,559647	0,59057	0,622679	0,655961	0,690396	0,72595	0,762581	0,800227	0,838815	0,878251	0,918419	
	(2) PROFIT AFTER DEPREC/ INVESMENT				0,30112	0,321851	0,343624	0,366468	0,390409	0,415472	0,44168	0,469051	0,497599	0,527333	0,558256	0,590365	0,623647	0,658082	0,693637	0,730267	0,767914	0,806502	0,845937	0,886105	
	(3) NET PROFIT AFTE TAX / INVESMENT				0,22584	0,241389	0,257718	0,274851	0,292807	0,311604	0,33126	0,351788	0,373199	0,3955	0,418692	0,442774	0,467736	0,493562	0,520228	0,5477	0,575935	0,604876	0,634453	0,664579	
PI	(4) PROFITAFTER TAX BEFORE DEP/INVEST				0,30112	0,321851	0,343624	0,366468	0,390409	0,415472	0,44168	0,469051	0,497599	0,527333	0,558256	0,590365	0,623647	0,658082	0,693637	0,730267	0,767914	0,806502	0,845937	0,886105	
ROR	RataRata																							1,145074	
MENENTUKAN PAY BACK PERIODE (TINGKAT PENGEMBALIAN MODAL)																									
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
P-BP	Total Investasi / Annual Gross Profit =				22,28713	23,82157	21,19423	18,83598	16,7221	14,82968	13,13762	11,62646	10,2784	9,077155	8,007874	7,057048	6,212413	5,462859	4,798337	4,209776	3,688999	3,228644	2,822096	448,6837	
	P-BP =				0,738577	TAHUN																		0,738577	
PI	INDEKS PROFITABILITAS				0,130685	0,122047	0,113111	0,10415	0,095365	0,086898	0,078843	0,071262	0,064189	0,057638	0,051608	0,046086	0,041054	0,036486	0,032355	0,028631	0,025284	0,022284	0,019602	0,092419	

PROEMS CASH FLOW PERENCANAAN PABRIK BIOETANOL ( Milyar Rupiah)																						
Tot.Inves	Harga Jual Produk BIOETANOL /Kg	13770	7%	Cap.Pabrik /jam/kg	5.000	Δ Upah	10%	bunga	10,0%	CAPEX	60	Biaya t.Kerja 104 oang/thn /1 shift	4,33	Jumlah SHIFT/hari	3	Hari efektif/Bulan	26					
89	Harga Bahan Baku MOLASE /Kg	1870	7,8%	OER		0,25	B.Operasi	2%	umur/tn	20	Pajak	25%	Biaya B.bakar/energi/Perawatan	3,67	Jumlah Jam/Shift	8	prod.efectif	100%	100%			
No	Uraian	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I	<b>Aliran Kas Awal</b>																					
	a. Investasi Awal	69,161																				
	b. Modal Kerja	19,656																				
	c. Total Aliran Kas Awal	88,817																				
II	<b>Aliran Kas Operasi</b>																					
	<b>Total Produksi Margarine/tahun (TON)</b>		9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360
	d. Hasil penjualan BIOETANOL		128,887	137,987	147,728	158,158	169,324	181,278	194,077	207,778	222,448	238,152	254,966	272,967	292,238	312,870	334,959	358,607	383,924	411,029	440,048	471,115
	f. Total Pendapatan		128,89	137,99	147,728	158,158	169,324	181,278	194,077	207,778	222,448	238,152	254,966	272,967	292,238	312,870	334,959	358,607	383,924	411,029	440,048	471,115
	g. Biaya Bahan Baku /tahun		70,013	75,453	81,315	87,634	94,443	101,781	109,689	118,212	127,397	137,296	147,964	159,461	171,851	185,204	199,594	215,103	231,816	249,828	269,240	290,160
	h. Biaya Tenaga Kerja		6,5	7,1	7,9	8,6	9,5	10,5	11,5	12,7	13,9	15,3	16,8	18,5	20,4	22,4	24,7	27,1	29,8	32,8	36,1	39,7
	i. Biaya Operasi dan Manajemn		5,505	5,615	5,725	5,835	5,945	6,056	6,166	6,276	6,386	6,496	6,606	6,716	6,826	6,936	7,046	7,157	7,267	7,377	7,487	7,597
	j. Total Biaya Produksi		82,013	88,212	94,900	102,114	109,898	118,297	127,361	137,145	147,706	159,107	171,416	184,708	199,061	214,563	231,305	249,390	268,927	290,034	312,838	337,480
	EBITDA		46,874	49,774	52,829	56,044	59,427	62,982	66,715	70,634	74,742	79,045	83,550	88,259	93,177	98,307	103,653	109,216	114,997	120,996	127,210	133,636
	k. Penyusutan		2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9
	l. Pendapatan Sebelum Pajak (EBIT)		44,00	46,90	49,96	53,17	56,56	60,11	63,85	67,76	71,87	76,18	80,68	85,39	90,31	95,44	100,78	106,35	112,13	118,13	124,34	130,77
	m. Pajak		11,001	11,726	12,490	13,294	14,139	15,028	15,961	16,941	17,968	19,044	20,170	21,347	22,577	23,859	25,196	26,587	28,032	29,531	31,085	32,691
	n. Pendapatan Setelah Pajak (NIAT)		33,003	35,178	37,469	39,881	42,417	45,084	47,884	50,823	53,904	57,132	60,510	64,041	67,730	71,578	75,587	79,760	84,095	88,594	93,255	98,074
	o. Penyusutan		2,9	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
	p. Total Aliran Kas Operasi		35,87	38,05	40,34	42,75	45,29	47,95	50,75	53,69	56,77	60,00	63,38	66,91	70,60	74,45	78,46	82,63	86,97	91,46	96,12	100,94
	Pokok Produksi/kg		9,069	9,731	10,445	11,216	12,048	12,945	13,914	14,959	16,087	17,305	18,620	20,040	21,574	23,230	25,019	26,951	29,038	31,293	33,730	36,362
III	<b>Aliran Kas Terminal</b>																					
	q. Pengembalian Pinjaman		9,000	8,700	8,400	8,100	7,800	7,500	7,200	6,900	6,600	6,300	6,000	5,700	5,400	5,100	4,800	4,500	4,200	3,900	3,600	3,300
	r. Pemasukan lain/NILAI sisa						0,000															
	s. Total Aliran Kas Terial		-9,000	-8,700	-8,400	-8,100	-7,800	-7,500	-7,200	-6,900	-6,600	-6,300	-6,000	-5,700	-5,400	-5,100	-4,800	-4,500	-4,200	-3,900	-3,600	-3,300
IV	<b>Aliran Kas Bersih (NCF) t</b>	-89	26,873	29,348	31,939	34,651	37,487	40,454	43,554	46,793	50,174	53,702	57,380	61,211	65,200	69,348	73,657	78,130	82,765	87,564	92,525	97,644

Lampiran Lanjutan Untuk Harga Molases Rp.1.870dan Harga Bioetanol Rp.13770

**MENGHITUNG NPV**

Diketahui :

$X_1 = 0,2$

$X_2 = 0,6$

MARR = 25%

Menghitung NPV  $i = 20 \%$

Tahun ( t )	NET CASH FLOW	Factor Disconto		Present Value(PV)		ANALISIS SENSITIVITAS					
		20%	60%	20%	60%	FAKTOR CASH-FLOW		Satuan	Base	remark	
0	-88,817	1,00000		-88,82		Input	1	Total Invetasi	M	83,845	
1	26,87	0,83333		22,39			2	CAP.PABRIK (MOLASES/JAM)	Kg	5000	
2	29,35	0,69444		20,38			3	Material Balance ( O E R )		0,25	
3	31,94	0,57870		18,48			4	Biaya Tenaga Kerja/tahun/ 1 shift	M	4,33	
4	34,65	0,48225		16,71			5	Biaya Operas/B.Bakar/maintenance	M	3,67	
5	37,49	0,40188		15,07			6	Ratio antara Modal sendiri/Pinjaman		2:3	
6	40,45	0,33490		13,55			7	Lama Pinjaman/thn	th	20	
7	43,55	0,27908		12,16			8	Bunga Pnjaman		10%	
8	46,79	0,23257		10,88			9	Pajak		25%	
9	50,17	0,19381		9,72			10	Jumlah Shift /hari		3	
10	53,70	0,16151		8,67			11	Harga BIOETANOL/L (RP)	Rp	13770	
11	57,38	0,13459		7,72							
12	61,21	0,11216		6,87			13	Harga Bahan Baku/Kg (rp)	Rp	1870	
13	65,20	0,09346		6,09			14	Efisiensi Produksi		100%	
14	69,35	0,07789		5,40		Result	1	NPV		106,75	TRUE
15	73,66	0,06491		4,78			2	IRR		49,79	TRUE
16	78,13	0,05409		4,23			3	BCR		1,1827	TRUE
17	82,77	0,04507		3,73			4	R O R		1,86	TRUE
18	87,56	0,03756		3,29			5	P-BP		1,8	TRUE
19	92,52	0,03130		2,90							
20	97,64	0,02608		2,55							

NPV 106,75 -36,60

FEASIBEL TRUE

MAKA NPV , (i=20%) ADALAH 106,8

Dari Tabel diatas diperoleh bahwa : NPV > 0 berarti Studi Layak

Untuk Menentukan Internal Rate Return (IRR) adalah :

IRR by formula 13%

IRR 49,79 >25 Sehingga Usulan Layak

MENENTUKAN BCR																					
I=	25%	FAKTOR DISKOSTO		PV ( Benefit )		PV ( Cost )															
0		0		-																	89
1		0,8000		103,11		75,11															
2		0,6400		88,31		63,86															
3		0,5120		75,64		54,36															
4		0,4096		64,78		46,32															
5		0,3277		55,48		39,51															
6		0,2621		47,52		33,73															
7		0,2097		40,70		28,82															
8		0,1678		34,86		24,65															
9		0,1342		29,86		21,10															
10		0,1074		25,57		18,07															
11		0,0859		21,90		15,49															
12		0,0687		18,76		13,28															
13		0,0550		16,07		11,40															
14		0,0440		13,76		9,79															
15		0,0352		11,79		8,41															
16		0,0281		10,09		7,23															
17		0,0225		8,65		6,21															
18		0,0180		7,40		5,35															
19		0,0144		6,34		4,60															
20		0,0115		5,43		3,96															
		Jumlah		686,02		580,05															
BCR	1,1827	Bila BCR> 1 berarti Usulan Investasi Pabrik Layak																			
MENENTUKAN RATE OF RETURN (ROR)																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ROI	(1) GROSS PROFIT / INVESMENT	0,527764	0,560413	0,59	0,6310086	0,6690896	0,709116	0,751155	0,79527	0,841526	0,889981	0,9406929	0,993713	1,049086	1,10685305	1,167043	1,2296783	1,294766	1,3623032	1,4322678	1,5046209
RATE																					1,905
OF	(2) PROFIT AFTER DEPREC/ INVESMENT	0,49545	0,5281	0,56249216	0,598695	0,636776	0,676803	0,718841	0,762957	0,809212	0,857668	0,9083792	0,961399	1,016773	1,07453941	1,13473	1,1973647	1,262453	1,3299896	1,3999542	1,4723073
RETURN																					1,840
	(3) NET PROFIT AFTE TAX/ INVESMENT	0,37	0,396075	0,42186912	0,4490212	0,477582	0,507602	0,539131	0,572218	0,606909	0,643251	0,6812844	0,721049	0,762579	0,80590456	0,851047	0,8980235	0,94684	0,9974922	1,0499656	1,1042305
																					1,840
ROR	RataRata																				1,862
MENENTUKAN PAY BACK PERIODE (TINGKAT PENGEMBALIAN MODAL)																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P-BP	Total Investasi / Annual Gross Profit =	36,67033	39,08687	34,693657	30,772159	27,274562	24,15749	21,38167	18,91156	16,71508	14,76331	13,030192	11,49228	10,1285	8,91994652	7,849665	6,9024592	6,064728	5,3243078	4,6703291	1271,5714
																					1,813
	P-BP =	1,81 TAHUN																			
PI	INDEKS PROFITABILITAS	0,2521	0,2295	0,2081	0,1881	0,1696	0,1525	0,1369	0,1225	0,1095	0,0977	0,0869	0,0773	0,0686	0,0608	0,0538	0,0476	0,0420	0,0370	0,0326	0,1667

PROEMS CASH FLOW PERENCANAAN PABRIK BIOETANOL ( Milyar Rupiah)																						
Tot.Inves	Harga Jual Produk BIOETANOL /Kg	7500	7%	Cap.Pabrik /jam/kg	5.000 Δ	Upah	10%	bunga	10,0%	CAPEX	60	Biaya t.Kerja 104 oang/thn /1 shift	4,33	Jumlah SHIFT/hari	3	Hari efectif/Bulan	26					
89	Harga Bahan Baku MOLASE /Kg	845	7,8%	OER	0,25	B.Operasi	2%	umur/tn	20	Pajak	25%	Biaya B.bakar/energi/Perawatan	3,67	Jumlah Jam/Shift	8	prod.efectif	100%	100%				
No	Uraian	TAHUN																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<b>I</b>	<b>Aliran Kas Awal</b>																					
	a.Investasi Awal	69,161																				
	b.Modal Kerja	19,656																				
	c. Total Aliran Kas Awal	88,817																				
<b>II</b>	<b>Aliran Kas Operasi</b>																					
	<b>Total Produksi Margarine/tahun (TON)</b>		9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360	9360
	d. Hasil penjualan BIOETANOL		70,200	75,156	80,462	86,143	92,224	98,735	105,706	113,169	121,159	129,713	138,870	148,675	159,171	170,408	182,439	195,320	209,109	223,872	239,678	256,599
	f. Total Pendapatan		70,20	75,16	80,462	86,143	92,224	98,735	105,706	113,169	121,159	129,713	138,870	148,675	159,171	170,408	182,439	195,320	209,109	223,872	239,678	256,599
	g.Biaya Bahan Baku /tahun		31,637	34,095	36,744	39,599	42,676	45,992	49,566	53,417	57,567	62,040	66,861	72,056	77,655	83,688	90,191	97,199	104,751	112,890	121,662	131,115
	h. Biaya Tenaga Kerja		6,5	7,1	7,9	8,6	9,5	10,5	11,5	12,7	13,9	15,3	16,8	18,5	20,4	22,4	24,7	27,1	29,8	32,8	36,1	39,7
	i. Biaya Operasi dan Manajemn		5,505	5,615	5,725	5,835	5,945	6,056	6,166	6,276	6,386	6,496	6,606	6,716	6,826	6,936	7,046	7,157	7,267	7,377	7,487	7,597
	j. Total Biaya Produksi		43,637	46,855	50,328	54,079	58,131	62,508	67,237	72,349	77,876	83,851	90,313	97,303	104,865	113,047	121,902	131,487	141,862	153,096	165,260	178,435
	EBITDA		26,563	28,302	30,134	32,063	34,094	36,228	38,469	40,820	43,283	45,862	48,557	51,372	54,306	57,361	60,537	63,833	67,247	70,776	74,417	78,164
	k. Penyusutan		2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9
	l. Pendapatan Sebelum Pajak (EBIT)		23,69	25,43	27,26	29,19	31,22	33,36	35,60	37,95	40,41	42,99	45,69	48,50	51,44	54,49	57,67	60,96	64,38	67,91	71,55	75,29
	m. Pajak		5,923	6,358	6,816	7,298	7,806	8,339	8,900	9,487	10,103	10,748	11,422	12,125	12,859	13,623	14,417	15,241	16,094	16,977	17,887	18,824
	n. Pendapatan Setelah Pajak (NIAT)		17,770	19,074	20,448	21,895	23,418	25,018	26,699	28,462	30,310	32,244	34,265	36,376	38,577	40,868	43,250	45,722	48,283	50,930	53,660	56,471
	o. Penyusutan		2,9	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
	p.Total Aliran Kas Operasi		20,64	21,94	23,32	24,77	26,29	27,89	29,57	31,33	33,18	35,11	37,14	39,25	41,45	43,74	46,12	48,59	51,15	53,80	56,53	59,34
	Pokok Produksi/kg		4.969	5.312	5.684	6.084	6.517	6.985	7.490	8.036	8.627	9.265	9.955	10.702	11.510	12.384	13.330	14.354	15.463	16.663	17.963	19.370
<b>III</b>	<b>Aliran Kas Terminal</b>																					
	q. Pengembalian Pinjaman		9,000	8,700	8,400	8,100	7,800	7,500	7,200	6,900	6,600	6,300	6,000	5,700	5,400	5,100	4,800	4,500	4,200	3,900	3,600	3,300
	r. Pemasukan lain/NILAI sisa						0,000															
	s. Total Aliran Kas Terial		-9,000	-8,700	-8,400	-8,100	-7,800	-7,500	-7,200	-6,900	-6,600	-6,300	-6,000	-5,700	-5,400	-5,100	-4,800	-4,500	-4,200	-3,900	-3,600	-3,300
<b>IV</b>	<b>Aliran Kas Bersih (NCF) t</b>	-89	11,640	13,244	14,918	16,665	18,488	20,388	22,369	24,432	26,580	28,814	31,135	33,546	36,047	38,638	41,320	44,092	46,953	49,900	52,930	56,041

Lampiran Lanjutan Untuk Harga Molases Rp.845 dan Harga Bioetanol Rp.7.500

VI-20

**MENGHITUNG NPV**

Diketahui :

$X_1 = 0,2$

$X_2 = 0,6$

MARR = 25%

Menghitung NPV  $i = 20\%$

Tahun (i)	NET CASH FLOW	Factor Disconto		Present Value(PV)		ANALISIS SENSITIVITAS					
		20%	20%	60%	60%	FAKTOR CASH-FLOW			Satuan Base	remark	
0	-88,817	1,00000	-88,82	1,00000	-88,82	Input	1	Total Invetasi	M	83,845	
1	11,64	0,83333	9,70	0,62500	7,27		2	CAP.PABRIK (MOLASES/JAM)	Kg	5000	
2	13,24	0,69444	9,20	0,39063	5,17		3	Material Balance ( O E R )		0,25	
3	14,92	0,57870	8,63	0,24414	3,64		4	Biaya Tenaga Kerja/tahun/ 1 shift	M	4,33	
4	16,67	0,48225	8,04	0,15259	2,54		5	Biaya Operas/B.Bakar/maintenance	M	3,67	
5	18,49	0,40188	7,43	0,09537	1,76		6	Ratio antara Modal sendiri/Pinjaman		2,3	
6	20,39	0,33490	6,83	0,05960	1,22		7	Lama Pinjaman/thn	th	20	
7	22,37	0,27908	6,24	0,03725	0,83		8	Bunga Pnjaman		10%	
8	24,43	0,23257	5,68	0,02328	0,57		9	Pajak		25%	
9	26,58	0,19381	5,15	0,01455	0,39		10	Jumlah Shift /hari		3	
10	28,81	0,16151	4,65	0,00909	0,26		11	Harga BIOETANOL/L (RP)	Rp	7500	
11	31,14	0,13459	4,19	0,00568	0,18						
12	33,55	0,11216	3,76	0,00355	0,12		13	Harga Bahan Baku/Kg (rp)	Rp	845	
13	36,05	0,09346	3,37	0,00222	0,08		14	Efisiensi Produksi		100%	
14	38,64	0,07789	3,01	0,00139	0,05	Result	1	NPV		9,24	TRUE
15	41,32	0,06491	2,68	0,00087	0,04		2	IRR		25,01	TRUE
16	44,09	0,05409	2,38	0,00054	0,02		3	BCR		1,0132	TRUE
17	46,95	0,04507	2,12	0,00034	0,02		4	R O R		1,06	TRUE
18	49,90	0,03756	1,87	0,00021	0,01		5	P-BP		0,6	TRUE
19	52,93	0,03130	1,66	0,00013	0,01						
20	56,04	0,02608	1,46	0,00008	0,00						
NPV			9,24		-64,63			FEASIBEL		TRUE	

MAKA NPV , (i=20%) ADALAH 9,2

Dari Tabel diatas diperoleh bahwa : NPV > 0 berarti Studi Layak

Untuk Menentukan Internal Rate Return (IRR) adalah :

IRR by formula 8%

IRR 25,01 25,01 >25 Sehingga Usulan Layak



Lampiran Lanjutan Untuk Harga Molases Rp.845 dan Harga Bioetanol Rp.7.500

VI-21

MENENTUKAN BCR																					
I=	25%	FAKTOR DISKOSTO																			
		PV ( Benefit )		PV ( Cost )																	
0		0	-	89																	
1		0,8000	56,16	44,41																	
2		0,6400	48,10	37,39																	
3		0,5120	41,20	31,54																	
4		0,4096	35,28	26,64																	
5		0,3277	30,22	22,54																	
6		0,2621	25,88	19,10																	
7		0,2097	22,17	16,21																	
8		0,1678	18,99	13,78																	
9		0,1342	16,26	11,72																	
10		0,1074	13,93	9,99																	
11		0,0859	11,93	8,52																	
12		0,0687	10,22	7,28																	
13		0,0550	8,75	6,22																	
14		0,0440	7,49	5,32																	
15		0,0352	6,42	4,56																	
16		0,0281	5,50	3,91																	
17		0,0225	4,71	3,35																	
18		0,0180	4,03	2,88																	
19		0,0144	3,45	2,47																	
20		0,0115	2,96	2,13																	
		Jumlah	373,65	368,79																	
BCR	1,0132	Bila BCR> 1 berarti Usulan Investasi Pabrik Layak																			
MENENTUKAN RATE OF RETURN (ROR)																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ROI	(1) GROSS PROFIT / INVESMENT	0,299078	0,31865	0,34	0,3610057	0,3838644	0,407892	0,433124	0,459593	0,487329	0,516361	0,5467108	0,578399	0,611438	0,6458373	0,681595	0,718703	0,757141	0,7968794	0,8378718	0,880058
RATE		1,106																			
OF	(2) PROFIT AFTER DEPRECI/ INVESMENT	0,266764	0,286336	0,30696638	0,3286921	0,3515507	0,375579	0,400811	0,427279	0,455016	0,484047	0,5143972	0,546085	0,579125	0,61352366	0,649282	0,6863893	0,724828	0,7645658	0,8055582	0,8477443
RETURN		1,041																			
	(3) NET PROFIT AFTE TAX / INVESMENT	0,20	0,214752	0,23022478	0,2465191	0,2636631	0,281684	0,300608	0,32046	0,341262	0,363035	0,3857979	0,409564	0,434344	0,46014275	0,486961	0,514792	0,543621	0,5734243	0,6041686	0,6358082
		1,041																			
ROR	RataRata	1,063																			
MENENTUKAN PAY BACK PERIODE (TINGKAT PENGEMBALIAN MODAL)																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P-BP	Total Investasi / Annual Gross Profit =	19,74433	21,19295	18,9332172	16,894354	15,057717	13,40574	11,92196	10,59106	9,398805	8,332063	7,37874	6,527738	5,768904	5,09297118	4,491503	3,9568349	3,482018	3,0607635	2,6873894	387,86661
		0,648																			
	P-BP =	0,65 TAHUN																			
PI	INDEKS PROFITABILITAS	0,1092	0,1035	0,0972	0,0905	0,0837	0,0769	0,0703	0,0640	0,0580	0,0524	0,0472	0,0424	0,0379	0,0339	0,0302	0,0269	0,0238	0,0211	0,0187	0,0806











