LAMPIRAN

Lampiran 1

FFB *processed per year* = $30 \times 24 \times 345 = 248{,}400$

POME generated per year = 78,057.8

CH_4 *Produced* =

1. Biogas = $78{,}057.8 \times 28.82 = 2{,}249{,}625.45$ m^3
2. CH_4 yang diproduksi (m^3)= $2{,}249{,}625.45 \times 65\% = 1{,}462{,}256.543$ m^3
3. 1 m^3 CH_4 sama dengan 0.717 kg CH_4 = $1{,}462{,}256.543 \times 0.717 = 1{,}048{,}437.941$ kg
4. CH_4 *Produced* = $\frac{1{,}048{,}437.941}{1000} = 1{,}048.4379\ ton/tahun$

Energy rate = $CH_4(m^3) \times 50 = 1{,}048{,}437.9 \times 50 = 52{,}421{,}897.05$ MJ/tahun

$$= \frac{52421897.05 \frac{\text{MJ}}{\text{tahun}}}{3600} = 14{,}561.63807 \text{ MWh/tahun}$$

Power plant capacity (*gas engine*)

$$= \frac{(Energy\ rate \times 40\%)}{8000}$$

$$= \frac{(14{,}561.63807 \text{ MWh/tahun} \times 40\%)}{8000} = 0.728081904\ MW$$

Electricity generated per year

$= Power\ plant\ capacity \times 8000 \times 1000$

$= 0.728081904\ MW \times 8000 \times 1000 =$ 5,824,655.228 kWh/tahun

Availability factor 90% = $Electricity\ generated\ per\ year \times 90\%$

= 5,824,655.228 kWh/tahun × 90% = 5,242,189.705

Lampiran 2

CAPEX Tipe Tangki CSTR

Project development cost = 3% × 24,669,599,136.46 = Rp 740,087,974.09

Site preparation and civil work = 5% × 24,669,599,136.46 = Rp 1,233,479,956.82

Digester system, piping and flaring $= 34\% \times$ 24,669,599,136.46 = Rp 8,387,663,706.4

Gas cleaning and pumps systems$= 11\% \times$ 24,669,599,136.46 = Rp 2,713,655,905.01

Gas engine and generator $= 17\% \times$ 24,669,599,136.46 = Rp 4,193,831,853.2

Controller and electrical system $= 10\%$ 24,669,599,136.46 = Rp 2,446,959,913.65

Balance of plants $= 11\% \times$ 24,669,599,136.46 = Rp 2,713,655,905.01

Grid interconnection system $= 4\% \times$ 24,669,599,136.46 = Rp 986,783,965.46

Other cost (IDC & *insurance*) = $5\% \times$ 24,669,599,136.46 = Rp 1,233,479,956.82

Lampiran 3

OPEX Tipe Tangki CSTR

Operating labors $= 25 \times 986{,}783{,}965.46 =$ Rp 246,695,991.36

General administration & other $= 14 \times 986{,}783{,}965.46 =$ Rp 138,149,755.26

Insurance $= 5 \times 986{,}783{,}965.46 =$ Rp 49,339,198.27

Digester service and maintenance $= 17 \times 986{,}783{,}965.46 =$ Rp 167,753,274.13

Gas engine service and maintenance $= 39 \times 986{,}783{,}965.46$

$=$ Rp 384,845,746.53

Lampiran 4

Depresiasi Tipe Tangki CSTR

Harga perolehan mesin

= *Digester system, piping and flaring + Gas cleaning and pumps systems + Gas engine and generator + Controller and electrical system +Balance of plants +Grid interconnection system*

= Rp 8,387,663,706.40 + Rp 2,713,655,905.01 + Rp 4,193,831,853.20

+ Rp 2,466,959,913.65 + Rp 2,713,655,905.01 + Rp 986,783,965.46

= Rp 21,462,551,248.72

Depresiasi = $\frac{15}{120} \times Rp$ 21,462,551,248.72 $=$ Rp 2,682,818,906.09

Lampiran 5

Keuntungan Tipe Tangki CSTR

Penjualan listrik per tahun = 5,242,189.705 kWh per tahun × Rp 1,610

= Rp 8,439,925,425.43

$Keuntungan = Penjualan - Biaya\ Operasional - Depresiasi$

= Rp 8,439,925,425.43 - Rp 986,783,965.46 - Rp 2,682,818,906.09

= Rp 4,770,322,553.88

Keuntungan setelah Pajak 10% = Rp 4,770,322,553.88 × 90%

= Rp 4,293,290,298.49

Lampiran 6

Arus Kas (*Net Cash Flow*) Tipe Tangki CSTR

$Aliran\ kas\ Netto\ (arus\ kas) = laba\ bersih + depresiasi + bunga *$

= Rp 4,293,290,298.49 + Rp 2,682,818,906.09 $= Rp$ 6,976,109,204.58

Lampiran 7

Break Even Point Tipe Tangki CSTR

$$BEP = \frac{\text{BT}}{\text{h} - \text{bv}} \times 100\% = \frac{Rp\ 986{,}783{,}965.46}{Rp\ 8{,}439{,}925{,}425.43 - \text{Rp } 246{,}695{,}991.36}$$

$$= 0.12 \times 100\% = 12\%$$

$$BEP = \frac{total\ biaya\ tetap}{1 - (\text{harga jual atau biaya variabel })}$$

$$= \frac{Rp\ 986{,}783{,}956.46 + \text{Rp } 246{,}695{,}991.36}{1 - \text{Rp } 8{,}439{,}783{,}965.43} = Rp\ 986{,}783{,}956.46$$

Lampiran 8 *Net Present Value dengan Discount Factor* 15% Tipe Tangki CSTR

year	***Net cash flow***	***Discount factor 15%***	***Present value***
0	- Rp 25,656,383,101.92	0	-Rp 25,656,383,101.92

year	*Net cash flow*	*Discount factor 15%*	*Present value*
1	Rp 6,976,109,204.58	0.869565217	Rp 6,066,181,917.03
2	Rp 6,958,223,745.21	0.756143667	Rp 5,261,416,820.57
3	Rp 6,940,338,285.83	0.657516232	Rp 4,563,385,081.51
4	Rp 6,922,452,826.46	0.571753246	Rp 3,957,934,870.99
5	Rp 6,904,567,367.09	0.497176735	Rp 3,432,790,262.22
6	Rp 6,886,681,907.71	0.432327596	Rp 2,977,302,632.97
7	Rp 6,868,796,448.34	0.37593704	Rp 2,582,235,004.62
8	Rp 6,850,910,988.97	0.326901774	Rp 2,239,574,954.75
9	Rp 6,833,025,529.59	0.284262412	Rp 1,942,372,318.57
10	Rp 6,815,140,070.22	0.247184706	Rp 1,684,598,395.44
11	Rp 6,797,254,610.84	0.214943223	Rp 1,461,023,811.67
12	Rp 6,779,369,151.47	0.18690715	Rp 1,267,112,568.16
13	Rp 6,761,483,692.10	0.162527957	Rp 1,098,930,128.63
14	Rp 6,743,598,232.72	0.141328658	Rp 953,063,688.23
15	Rp 6,725,712,773.35	0.122894485	Rp 826,553,008.92
	Net Present Value		**Rp 14,658,092,362.37**

Contoh perhitungan:

Discount Factor = $\frac{1}{(1+0.15)^1}$ = 0.869565217

NPV Tipe Tangki CSTR

Pada tahun awal hanya ada total investasi awal jadi hasilnya minus total investasi (tidak ada pemasukan)

Pada tahun pertama $= arus\ kas \times Discount\ factor$

$=$ Rp 6,976,109,204.58 $\times$ 0.869565217

= Rp 6,066,181,917.03

Total perhitungan dijumlahkan (-Rp 25,656,383,101.92 + Rp 6,066,181,917.03 +…..+…..= Rp 14,658,092,362.37) sehingga menghasilkan NPV sebesar Rp 14,658,092,362.37

Lampiran 9

Perhitungan IRR Tipe Tangki CSTR

Contoh perhitungan IRR

$$IRR = 15 + \frac{Rp\ 14{,}658{,}092{,}362.37}{Rp\ 14{,}658{,}092{,}362.37\ -(-Rp\ 1{,}544{,}788{,}335.81)}(28-15)$$

= 26.75%

Lampiran 10

Perhitungan PP Tipe Tangki CSTR

Tahun	***Net cash flow***	***Cumulative NCF***	***Index cash flow positive***
0	-Rp 25,656,383,101.92		
1	Rp 6,976,109,204.58	-Rp 18,680,273,897.33	0
2	Rp 6,958,223,745.21	-Rp 11,722,050,152.12	0
3	Rp 6,940,338,285.83	-Rp 4,781,711,866.29	0
4	Rp 6,922,452,826.46	Rp 2,140,740,960.17	0.690753984
5	Rp 6,904,567,367.09	Rp 9,045,308,327.26	0.310047081
6	Rp 6,886,681,907.71	Rp 15,931,990,234.97	1.313449416
7	Rp 6,868,796,448.34	Rp 22,800,786,683.31	2.319473339
8	Rp 6,850,910,988.97	Rp 29,651,697,672.28	3.328139385
9	Rp 6,833,025,529.59	Rp 36,484,723,201.87	4.339468299
10	Rp 6,815,140,070.22	Rp 43,299,863,272.08	5.353481047
11	Rp 6,797,254,610.84	Rp 50,097,117,882.93	6.370198816
12	Rp 6,779,369,151.47	Rp 56,876,487,034.40	7.389643013
13	Rp 6,761,483,692.10	Rp 63,637,970,726.49	8.411835275
14	Rp 6,743,598,232.72	Rp 70,381,568,959.21	9.436797468
15	Rp 6,725,712,773.35	Rp 77,107,281,732.56	10.46455169

Contoh perhitungan PP

$$PP = (\mathrm{n}-1) + \left[Cf - \sum_{1}^{n-1} An\right]\left(\frac{1}{An}\right)$$

$$\sum_{1}^{n-1} An = aliran\ kas\ pada\ tahun\ n\ sebelum\ periode\ pengembalian$$

$$\sum_{1}^{n-1} An = \text{Rp } 6{,}976{,}109{,}204.58 + \text{Rp } 6{,}958{,}223{,}745.21 + \text{Rp } 6{,}940{,}338{,}285.83$$

= Rp 20,874,671,235.63

$$periode\ pengembalian = 3 + \frac{Rp\ 25{,}656{,}383{,}101.92 - \text{Rp } 20{,}874{,}671{,}235.63}{\text{Rp } 6{,}922{,}452{,}826.46}$$

=3.69 tahun = 44 bulan

Lampiran 11

CAPEX Tipe *Covered Lagoon*

Project development cost $= 3\% \times$ Rp 19,000,000,000 = Rp 570,000,000.00

Site preparation and civil work $= 5\% \times$ Rp 19,000,000,000 = 950,000,000.00

Digester system, piping and flaring $= 34\% \times$ Rp 19,000,000,000

= Rp 6,460,000,000.00

Gas cleaning and pumps systems

$= 11\% \times$ Rp 19,000,000,000 $=$ Rp 2,090,000,000.00

Gas engine and generator $= 17\% \times$ Rp 19,000,000,000= Rp 3,230,000,000.00

Controller and electrical system $= 10\% \times$ Rp 19,000,000,000

= Rp 2,446,959,913.65

Balance of plants $= 11\% \times$ Rp 19,000,000,000 = 1,900,000,000.00

Grid interconnection system $= 4\% \times$ Rp 19,000,000,000 = Rp 2,090,000,000.00

Other cost (IDC & *insurance*) = $5\% \times$ Rp 19,000,000,000 = Rp 760,000,000.00

Lampiran 12

OPEX Tipe *Covered Lagoon*

Operating labors $= 25\% \times$ Rp760,000,000.00 $=$ Rp 190,000,000.00

General administration & other

$= 14\% \times$ Rp760,000,000.00 $=$ Rp 106,400,000.00

Insurance $= 5\% \times$ Rp760,000,000.00 $=$ Rp 38,000,000.00

Digester service and maintenance

$= 17\% \times$ Rp760,000,000.00 $=$ Rp 129,200,000.00

Gas engine service and maintenance $= 39\% \times$ Rp760,000,000.00

$$= \text{Rp } 296{,}400{,}000.00$$

Lampiran 13

Depresiasi Tipe *Covered Lagoon*

Harga perolehan mesin

= Digester system, piping and flaring + Gas cleaning and pumps systems + Gas engine and generator + Controller and electrical system +Balance of plants +Grid interconnection system

= Rp 6,460,000,000.00 + Rp 2,090,000,000.00 + Rp 3,230,000,000.00

+ Rp 1,900,000,000.00 + Rp 2,090,000,000.00 + Rp 760,000,000.00

= Rp 16,530,000,000.00

Contoh perhitungan depresiasi

Depresiasi = $\frac{15}{120} \times \text{Rp } 16{,}530{,}000{,}000.00 = \text{Rp } 2{,}066{,}250{,}000.00$

Lampiran 14

Keuntungan Tipe *Covered Lagoon*

Penjualan listrik per tahun = 5,242,189.705 kWh per tahun × Rp 1,610

= Rp 8,439,925,425.43

$$Keuntungan = Penjualan - Biaya\ Operasional - Depresiasi$$

$= \text{Rp } 8{,}439{,}925{,}425.43 - \text{Rp}760{,}000{,}000.00 - Rp2{,}066{,}250{,}000.00$

= Rp 5,613,675,425.43

Keuntungan setelah Pajak 10% = Rp 5,613,675,425.43× 90%

= Rp 5,052,307,882.89

Lampiran 15

Arus Kas (*Net Cash Flow*) Tipe *Covered Lagoon*

$$Aliran\ kas\ Netto\ (arus\ kas) = laba\ bersih + depresiasi + bunga *$$

$= \text{Rp } 5{,}052{,}307{,}882.89 + \text{Rp } 2{,}066{,}250{,}000.00 = Rp\ 7{,}118{,}557{,}882.89$

Lampiran 16

Break Even Point Tipe *Covered Lagoon*

$$BEP = \frac{\text{BT}}{\text{h} - \text{bv}} = \frac{\text{Rp } 760{,}000{,}000.00}{Rp\ 8{,}439{,}925{,}425.43 - \text{Rp } 190{,}000{,}000.00} = 0.9 \times 100\%$$

$$= 9\%$$

$$BEP = \frac{total\ biaya\ tetap}{1 - (\text{harga jual atau biaya variabel })}$$

$$= \frac{Rp\ 760{,}000{,}000 + \text{Rp } 190{,}000{,}000.00}{1 - \text{Rp } 760{,}000{,}000} = \text{Rp}760{,}000{,}000.09$$

Lampiran 17 *Net Present Value* dengan *Discount Factor* 15% Tipe *Covered Lagoon*

year	***Net cash flow***	***Discount factor 15%***	***Present value***
0	-Rp 19,760,000,000.00	0	Rp 19,760,000,000.00
1	Rp 7,118,557,882.89	0.869565217	Rp 6,190,050,332.94
2	Rp 7,104,782,882.89	0.756143667	Rp 5,372,236,584.41
3	Rp 7,091,007,882.89	0.657516232	Rp 4,662,452,787.30
4	Rp 7,077,232,882.89	0.571753246	Rp 4,046,430,870.61
5	Rp 7,063,457,882.89	0.497176735	Rp 3,511,786,930.13
6	Rp 7,049,682,882.89	0.432327596	Rp 3,047,772,452.70
7	Rp 7,035,907,882.89	0.37593704	Rp 2,645,058,382.66
8	Rp 7,022,132,882.89	0.326901774	Rp 2,295,547,695.60
9	Rp 7,008,357,882.89	0.284262412	Rp 1,992,212,716.23
10	Rp 6,994,582,882.89	0.247184706	Rp 1,728,953,914.35
11	Rp 6,980,807,882.89	0.214943223	Rp 1,500,477,343.50
12	Rp 6,967,032,882.89	0.18690715	Rp 1,302,188,261.40
13	Rp 6,953,257,882.89	0.162527957	Rp 1,130,098,796.00
14	Rp 6,939,482,882.89	0.141328658	Rp 980,747,802.96
15	Rp 6,925,707,882.89	0.122894485	Rp 851,131,304.95
	Net Present Value		**Rp 61,017,146,175.74**

Contoh perhitungan:

Discount Factor = $\frac{1}{(1+0.15)^1}$ = 0.869565217

NPV

Pada tahun awal hanya ada total investasi awal jadi hasilnya minus total investasi (tidak ada pemasukan)

Pada tahun pertama $= arus\ kas \times Discount\ factor$

$= \text{Rp } 7{,}118{,}557{,}882.89 \times 0.869565217$

= Rp 6,190,050,332.94

Total perhitungan dijumlahkan (+Rp 19,760,000,000.00 + Rp 6,190,050,332.94

+ Rp 5,372,236,584.41 +…..+…..= Rp 61,017,146,175.74) sehingga menghasilkan NPV sebesar Rp 61,017,146,175.74

Lampiran 18

Perhitungan IRR Tipe *Covered Lagoon*

Contoh perhitungan IRR

$$IRR = 15 + \frac{Rp\ 61{,}017{,}146{,}175.74}{Rp\ 61{,}017{,}146{,}175.74 - (-Rp\ 243{,}328{,}933.48)}(36 - 15)$$

= 35.92%

Lampiran 19

Perhitungan PP Tipe *Covered Lagoon*

Tahun	***Net cash flow***	***Cumulative NCF***	***Index cash flow positive***
0	-Rp 19,760,000,000.00		
1	Rp 7,118,557,882.89	-Rp 12,641,442,117.11	0
2	Rp 7,104,782,882.89	-Rp 5,536,659,234.23	0
3	Rp 7,091,007,882.89	Rp 1,554,348,648.66	0.780800039
4	Rp 7,077,232,882.89	Rp 8,631,581,531.54	0.219626608
5	Rp 7,063,457,882.89	Rp 15,695,039,414.43	1.222005096
6	Rp 7,049,682,882.89	Rp 22,744,722,297.32	2.226346869
7	Rp 7,035,907,882.89	Rp 29,780,630,180.20	3.232663457
8	Rp 7,022,132,882.89	Rp 36,802,763,063.09	4.240966481
9	Rp 7,008,357,882.89	Rp 43,811,120,945.97	5.251267655

Tahun	***Net cash flow***	***Cumulative NCF***	***Index cash flow positive***
10	Rp 6,994,582,882.89	Rp 50,805,703,828.86	6.263578784
11	Rp 6,980,807,882.89	Rp 57,786,511,711.75	7.277911766
12	Rp 6,967,032,882.89	Rp 64,753,544,594.63	8.294278595
13	Rp 6,953,257,882.89	Rp 71,706,802,477.52	9.312691358
14	Rp 6,939,482,882.89	Rp 78,646,285,360.40	10.33316224
15	Rp 6,925,707,882.89	Rp 85,571,993,243.29	11.35570352

Contoh perhitungan PP

$$= (\mathrm{n} - 1) + \left[Cf - \sum_{1}^{n-1} An\right]\left(\frac{1}{An}\right)$$

$$\sum_{1}^{n-1} An = aliran\ kas\ pada\ tahun\ n\ sebelum\ periode\ pengembalian$$

$$\sum_{1}^{n-1} An = \text{Rp } 7{,}118{,}557{,}882.89 + \text{Rp } 7{,}104{,}782{,}882.89$$

= Rp 14,223,340,765.77

$$periode\ pengembalian = 2 + \frac{Rp\ 19{,}760{,}000{,}000.00 - \text{Rp } 14{,}223{,}340{,}765.77}{\text{Rp } 7{,}091{,}007{,}882.89}$$

= 2.78 tahun = 33.37 bulan

Lmapiran 16

Dokumentasi Peneltian