Chapter **5**

Wood Pellets Business Model in Indonesia

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Referring to session 2.1, the amount of biomass especially wood chips or pellets will be estimated as 4.6 million tonnes to 34.8 million tonnes in 2040, for biomass co-firing coal power generation due to biomass mixing rate. In order to secure this remarkable volume of biomass, the supply chain must be maintained through applying some business model. Thus, in this chapter, appropriate business models are examined.

1.   Types of biomass supply chain business model

The biomass supply chain consists of following segments:
-        Cutting raw woods at a forest site and transporting to a fabrication factory
-        Fabricating wood chips and pellets
-        Transporting wood chips/pellets to coal plant sites

The biomass business model has the following three types of organization:
-        Pure private company (pure business basis)
-        Private company with government support such as subsidies and feed-in tariff (FIT)
-        Public company such as a national company

The best way for Indonesia is the pure private company because it can produce wood chips/pellets affordably, allowing it to compete with coal. However, if private companies cannot produce the chips/pellets at affordable prices, second- and third-generation options are considered. But the third option will fully depend on national budget, so that it is almost impossible. As a result, the second option is suggested in this report. The biomass supply chain will be implemented on business basis; however, in order to secure this business, Indonesia may provide financial incentives or formulate appropriate FIT system. In addition, Indonesia regulates lower biomass mixing ratio such as 5%–10%, so that the power generation cost could not increase highly.

Another point on the business model of biomass supply chain is the function of the private company, i.e.:

-        One company covers all the segments
-        One company covers each segment

The first option can minimise the total cost of the biomass supply chain, and the enterprise should be large. On the other hand, the second option can expect an economic rationale in each segment, but it should be a group of small enterprises. Therefore, the business configuration is vulnerable. Thus, the report recommends the first option.

2.   Economic study of the wood pellets business model

This section assesses the economics of the wood pellet supply chain business model based on several assumptions:

(1) Business configuration

A company engages the whole wood pellets supply chain, which comprises cutting raw woods, fabrication from raw woods to wood pellets and transportation of woods pellets from the fabrication site to coal power plants. In other words, this company consists of following departments:

a. Maintain woods including reforestation and cutting raw woods
b. Fabricate wood pellets based on the raw woods cut
c. Transportation of the wood pellets

(2) Basic assumption of the business model

a. Coal Power Plant
   - Capacity: 500 MW
   - Capacity factor: 80%
     = Generation amount: 3,504 GWh (500,000 kW x 24 x 365 x 80%) / year
   - 40% for thermal efficiency and 10% for biomass mixing ratio
     = Coal consumption: 3,504 GWh * 0.086 /40% = 753.36 ktoe (1toe = 10^7kcal) / year
     = Wood pellets consumption: 753.36 * 10% = 75 ktoe /year
     = Wood pellets consumption: 148.809 (75 / 5040 (kcal/kg)*10,000) ktoe /year = 150 ktoe /year and 407.696 = 408 tonne /day

b. Definition of biomass supply chain business model
   - Cutting raw woods by chainsaws
   - Fabrication from raw woods to pellets under assumed yield at 90%
   - Transportation: 100 km of distance between the fabrication site to a coal power plant

c. Others
   - Shared capital ratio: 30%
   - Interest rate of long-term borrowed money: 5%
   - Repayment years: 10 years after 3 years taxi holiday
   - Interest rate of short-term borrowed money: 7%
   - Interest rate of earning: 3%
   - Depreciation period: 10 years for all the equipment

(3) Cost assumptions

a. Cutting raw woods
   - Yield of fabrication factory: 90%
     = Cutting woods amount: 408 / 0.9 = 453 tonnes /day
   - Raw woods price: $35 / ton
   - Cutting equipment (chainsaw): $3,000 / unit
     = $3,000 x 70 units =$210,000
   - Number of labourers: 140 persons

b. Fabrication from raw woods to chips

- Fabricate 408 tonnes of pellets per day from 453 tonnes of raw woods
- Equipment: $1 million (21 tonnes of pellets production per day) and 20 units
- Number of labourers: 100 persons
- Electricity consumption per wood pellet: 0.1375 kWh / kg
- Electricity price: $0.07 /kWh

c. Transportation
- Number of trucks: $70,000 per truck (10-tonne capacity) and 15 trucks
- Number of drivers: 15 trucks x 2 = 20 persons
- Fuel economy of 10-tonne truck: 5 km/litre
  = Diesel consumption: 100km /5 km/litre x 2 (return) x 15 trucks =600 litre /day
- Diesel oil price: $0.050 /litre

(4) Forecasted income statement of A company

a. Annual revenue
- Price of wood pellets: $100 / tonne
  * Annual revenue: 150 (148.809) ktoe / year x $100/tonne = $ 15,000/ year

b. Operation cost
- Cutting raw woods
  * Raw wood cost: 165 ktoe x $35 /tonne = $5,775 /year
  * Labour cost: 70 team x 2 persons / team x $1,500 /person month x 12months   = $2,520,000 /year
  *Total operation cost: $5,775 + $2,520 = $8,295,000 / year
- Fabrication
  * Electricity cost: 150 ktoe x 0.1375 kWh/kg x 0.07 $/kWh x 1000 = $1,443.75 / year
  * Labour cost: 20 machines x 5 persons /machine x $1,500 /person month x 12 months / 1,000 = $1,800,000 /year
  * Total operation cost: $324,375,000/ year
- Transportation
  * Diesel oil cost: 600 litre/day x $0.5 / litre x 365 = $ 10,950,000 /year
  * Labour cost: 15 trucks x 2 persons /truck x $1,500 /person month x 12 = $ 540,000 / year
  * Total operation cost: $649,000 /year

c. Depreciation

- Cutting raw woods

  * Chainsaw: $3,000 /unit x 70 units / 1,000 / 10 years = $21,000 / year

- Fabrication

  * Wood pellets producer: $1 million /unit x 20 units x 1,000 / 10 years = $2,000,000 /year

- Transportation

  = 10-tonne truck: $70,000 / unit x 15 units / 1,000 / 10 years = $105,000 /year

d. Income statement

This business will start in 2024 and the forecasted income statement of A company is show below from 2024 to 2040 (refer to Table 5.1).

Table 5.1. Forecasted Income Statement of A company ($1,000)

|	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Revenue of wood pellets		15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Operation costs		12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188
Cutting raw woods		8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295
Fabrication		3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244
Transportation		650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
Depreciation		2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	0	0	0	0	0	0
Cutting raw woods		21	21	21	21	21	21	21	21	21	21						
Fabrication		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000						
Transportation		105	105	105	105	105	105	105	105	105	105						
Profit after Ope. & Dep.		686	686	686	686	686	686	686	686	686	686	2,812	2,812	2,812	2,812	2,812	2,812
Interrest payment		744	744	744	744	670	595	521	446	372	298	223	149	74	0	0	0
Long-term		744	744	744	744	670	595	521	446	372	298	223	149	74	0	0	0
Short-term																	
Interest received		0	62	126	191	213	236	262	289	319	350	384	397	412	429	492	556
Profit before tax		-58	4	68	133	229	327	427	529	632	738	2,972	3,060	3,149	3,241	3,304	3,368
Income tax			1	24	46	80	114	149	185	221	258	1,040	1,071	1,102	1,134	1,156	1,179
Profit after tax		-58	2	44	86	149	212	277	344	411	480	1,932	1,989	2,047	2,106	2,147	2,189

Source: Author.

Based on the income statement shown above, the following key findings are extracted:

i. A company will show a negative profit at the first year (2025) but after that will show a positive profit continuously until 2040.

ii. The department of cutting raw woods will mark highest cost share of a company at 60%, followed by the fabrication department at 35%, and the transportation department at 5% (refer to Figure 5.1).

iii. Looking at cost items, the cost of raw woods procurement will be highest share at 42%, followed by labour cost at 35%, electricity cost of the fabrication department at 10% (refer to figure 5-2). For this analysis, $35 per tonne is assumed for raw wood costs and this assumption will be crucial to maintain the economics of this business model.

iv. This business model will be operating cost-oriented not capital cost-oriented (refer to figure 5.1); thus, management of raw wood cost, labour cost, and electricity cost is essential. Few variations of capital cost will not affect this business seriously.

v. Assumed selling price of wood pellet is $100 per tonne and appropriate.

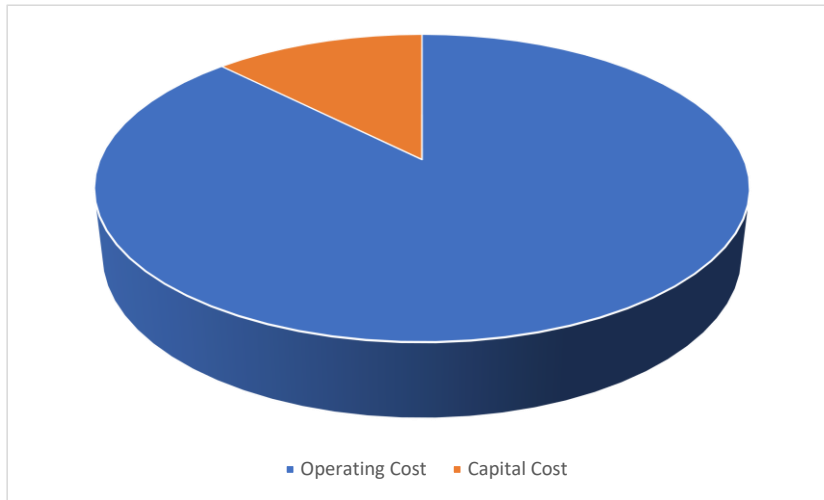**Figure 5.1. Operating Cost Structure by the Three Departments of A Company**
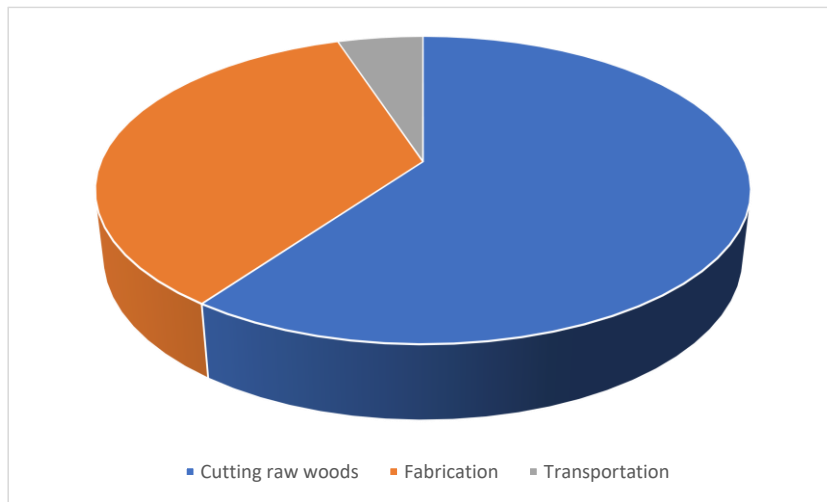
Source: Author.

Figure 5.2. Operating Cost Structure by the Cost Items of a Company
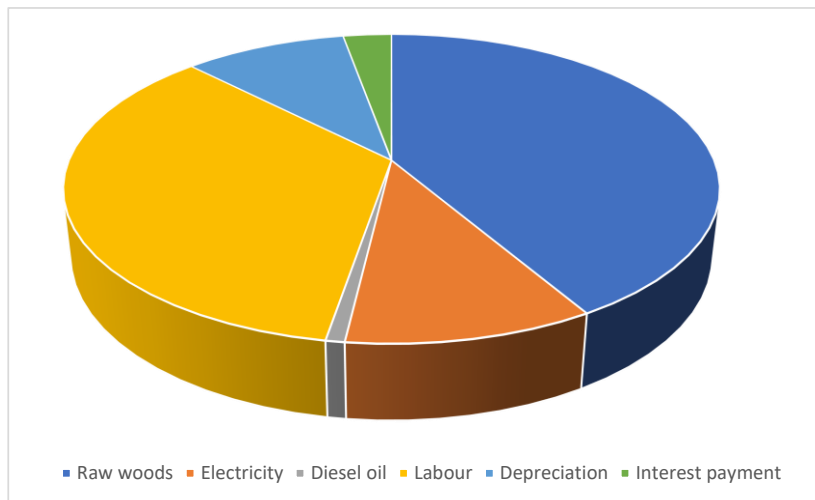
Source: Author.

Figure 5.3. Overall Cost Structure of a Company

- Operating Cost - Capital Cost

Source: Author.

(5)   Forecasted cash balance statement of a company

a. Capital cost

- Cutting raw woods: price of chainsaw $3,000 /unit and 70 units
  * $3,000 x 70 units = $210,000
- Fabrication: price of fabrication facility $1 million /unit and 20 units
  * $1 million x 20 = $20,000,000
- Transportation: price of truck $70,000 /unit and 15 units
  = $70,000 x 15 = $1,050,000
- Total capital cost
  =$210 + $20,000 + $1,050 = $21,260,000

b. Finance of capital cost

- Share of shared capital: 30%
  = $21,260 x 30% = $6,378,000
- Share of borrowed money (long-term): 70%
  = $21,260 x 70% = $14,882,000

c. Condition of borrowed money (long-term)

- Repayment period: 10 years with straight line method and 5% interest rate
- Repayment holiday; first 3 years

d. Cash balance statement

This business will start in 2024 and the forecasted cash balance statement of A company is shown below from 2024 to 2040 (refer to Table 5.2).

**Table 5.2. Forecasted Cash Balance Tables of a Company**

($1,000)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cash in Total	21,260	2,068	2,128	2,170	2,212	2,275	2,338	2,403	2,470	2,537	2,606	1,932	1,989	2,047	2,106	2,147	2,189
Profit after tax		-58	2	44	86	149	212	277	344	411	480	1,932	1,989	2,047	2,106	2,147	2,189
Depreciation		2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	0	0	0	0	0	0
Equity	6,378																
Long-term borrowed money	14,882																
Short-term borrowed money																	
Cash out Total	21,260	0	0	0	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	0	0	0
Repayment (long-term)					1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488			
Repayment (short-term)																	
Capital costs	21,260																
Cutting raw woods	210																
Fabrication	20,000																
Transportation	1,050																
Cash Balance	0	2,068	2,128	2,170	724	786	850	915	981	1,049	1,118	444	501	559	2,106	2,147	2,189
Accimulated cash balance	0	2,068	4,196	6,366	7,090	7,876	8,727	9,642	10,623	11,672	12,790	13,233	13,734	14,293	16,399	18,547	20,736

Source: Author.

Based on the cash balance statement mentioned above, the following key findings are extracted:

i. A company will never face a money shortage until 2040.

ii. In terms of share of capital cost, the fabrication department shows its largest at 94%, followed by transportation department at 5%. Thus, a wood pellets production facility becomes key regarding capital cost (refer to Figure 5.3).

iii. Total cash gain in 2025–40 will be $21,194,000 and it is almost same amount of total capital cost, $21,260,000.

Figure 5.3. Capital Cost Structure of the Three Departments

■ Cutting raw woods ■ Fabrication ■ Transportation
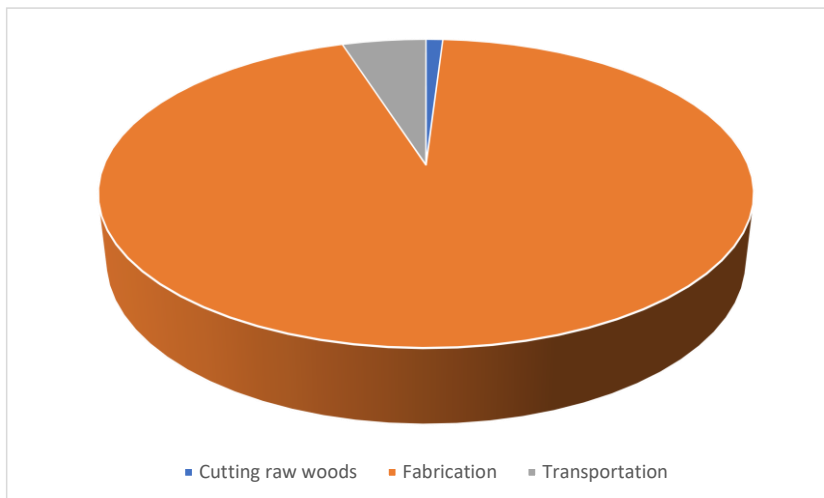
Source: Author.
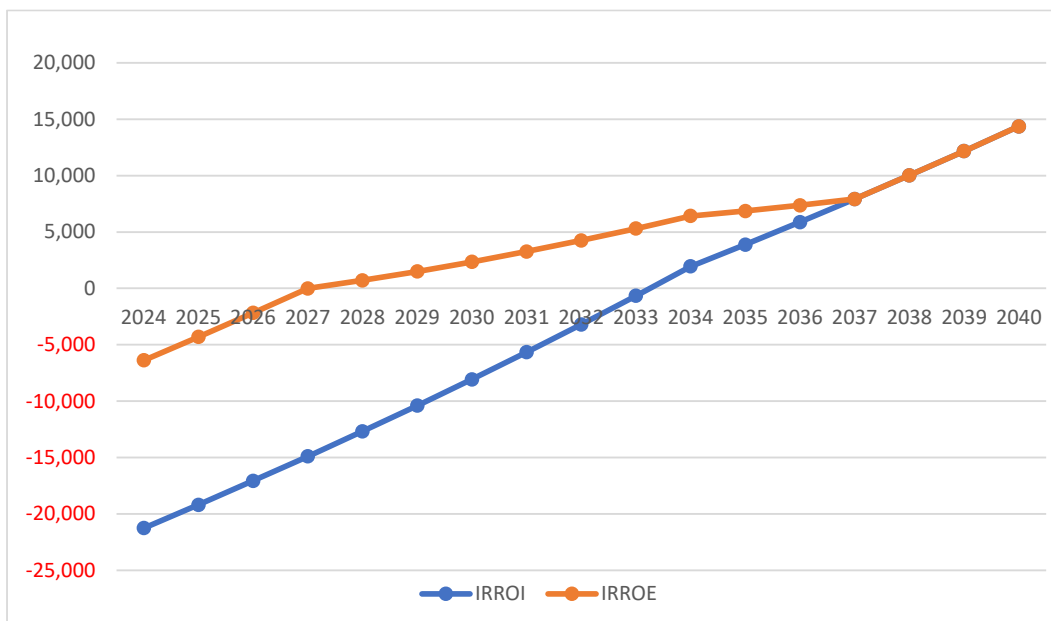
(6) Internal rate of return of A company

Next, the Internal Rate of Return (IRR) of A company is analysed. There are two types of IRR; one is Return on Investment, which is called Internal Rate of Return on Investment (IRROI) and other is Return on Equity, which is called Internal Rate of Return on Equity (IRROE). Definitions of both cash flows are:

- IRROI: cash flow = - total capital cost + profit after tax + depreciation
- IRROE: cash flow = - equity + profit after tax + depreciation – repayment (long term)

IRROI is meant to calculate rate of return on total investment. In other words, it shows real project economics. On the other hand, IRROE is meant to calculate just the economics of equity; in other words, shared capital or economics of shareholder.

Accumulated cash flows for Return on Investment and Return on Equity are shown in Figure 5.5.

Figure 5.5. Accumulated Cash Flows for Return on Investment and Return on Equity

IRROI = Internal Rate of Return on Investment; IRROE = Internal Rate of Return on Equity.
Source: Author.

Based on these cash flows, IRROI and IRROE are calculated using IRR function equipped in MS-Excel. The results are:
- IRROI: 7%
- IRROE: 22%

The economics of this wood pellets business model looks good and the return to shareholders also seems to be much better because the dividend ratio will be higher than 10%. If following important parameters could be secured, the following business model could be approved:

-   Price of wood pellets: $100 per tonne
-   Cost of raw woods: $35 per tonne
-   Cost of electricity: $0.07 per kWh
-   Capital costs of fabrication: $1 million per unit

(7)   Case study

We assume the first 3 years for a repayment grace period, but we analyse the economics if we cannot apply this grace period. This is a basic concept of the case study.

The income statement of the case study is shown at Table 5.3. One of important implications extracted from the income statement is a decrease of total interest payment compared to Table 5.1. Because repayment of the borrowed money (long term) will start from the first year, the outstanding borrowed money in 2025–35 is lower than Table 5.1. Thus, after-tax profit of the case study is improved.

Table 5.3. Income Statement of the Case Study

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Revenue of wood pellets		15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Operation costs		12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188	12,188
Cutting raw woods		8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295	8,295
Fabrication		3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244	3,244
Transportation		650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
Depreciation		2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	0	0	0	0	0	0
Cutting raw woods		21	21	21	21	21	21	21	21	21	21						
Fabrication		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000						
Transportation		105	105	105	105	105	105	105	105	105	105						
Profit after Ope. & Dep.		686	686	686	686	686	686	686	686	686	686	2,812	2,812	2,812	2,812	2,812	2,812
Interrest payment		744	670	595	521	446	372	298	223	149	74	-0	0	0	0	0	0
Long-term		744	670	595	521	446	372	298	223	149	74	-0	0	0	0	0	0
Short-term																	
Interest received		0	17	37	59	82	108	135	164	196	229	265	325	386	448	512	577
Profit before tax		-58	33	128	224	322	421	523	627	733	840	3,076	3,136	3,198	3,260	3,324	3,388
Income tax			12	45	78	113	147	183	219	256	294	1,077	1,098	1,119	1,141	1,163	1,186
Profit after tax		-58	22	83	145	209	274	340	407	476	546	2,000	2,039	2,078	2,119	2,160	2,202

Source: Author.

Next, we check the cash balance statement of the case study. Table 5.4 indicates that the cash balance in the first 3 years becomes worse; in other words, lower than Table 5.2 due to the starting repayment from the first year (2025). Fortunately, money shortage does not occur until 2040.

Table 5.4. Cash Balance Statement of the Case Study

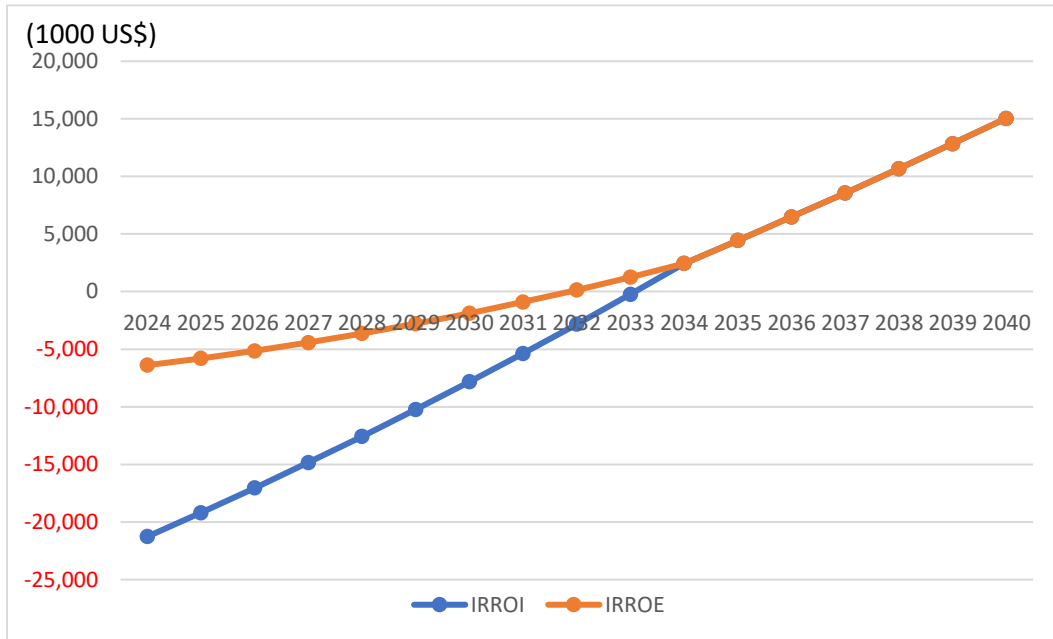|	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cash in Total	21,260	2,068	2,148	2,209	2,271	2,335	2,400	2,466	2,533	2,602	2,672	2,000	2,039	2,078	2,119	2,160	2,202
Profit after tax		-58	22	83	145	209	274	340	407	476	546	2,000	2,039	2,078	2,119	2,160	2,202
Depreciation		2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	2,126	0	0	0	0	0	0
Equity	6,378																
Long-term borrowed money	14,882																
Short-term borrowed money																	
Cash out Total	21,260	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	0	0	0	0	0	0
Repayment (long-term)		1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488	1,488						
Repayment (short-term)																	
Capital costs	21,260																
Cutting raw woods	210																
Fabrication	20,000																
Transportation	1,050																
Cash Balance	0	579	660	721	783	847	912	978	1,045	1,114	1,184	2,000	2,039	2,078	2,119	2,160	2,202
Accimulated cash balance	0	579	1,239	1,960	2,743	3,590	4,501	5,479	6,525	7,639	8,823	10,822	12,861	14,940	17,059	19,219	21,421

Source: Author.

Next, we analyse IRROI and IRROE based on both cash flows shown at Figure 5-6. The calculated results are:

- IRROI: 7%
- IRROE: 14%

Repayment of the borrowed money never affects the cash flow of IRROI, so that IRROI is the same as the base case. But the repayment does affect the cash flow of IRROE (refer to the formula mentioned before); as a result, IRROE becomes worse from 23% to 15%. However, 15% is still higher than 10% of a normal dividend ratio. As a conclusion, the grace period does not impact this wood pellets business model seriously. Again, the following parameters are key:

- Price of wood pellets: $100 per tonne
- Cost of raw woods: $35 per tonne
- Cost of electricity: $0.07 per kWh
- Capital costs of fabrication: $1 million per unit

Figure 5.5. Cash Flow of IRROI and IRROE of the Case Study

IRROI = Internal Rate of Return on Investment; IRROE = Internal Rate of Return on Equity. Source: Author.