Asia-Pacific Economic Cooperation

Bureau of Energy, Ministry of Economic Affairs

APEC Workshop on Bio-pellet Production, Handling and Energy Utilization

Economic Feasibility Study of Utilizing White-leadtree Pellet Instead of Fossil Fuel for Boiler Application

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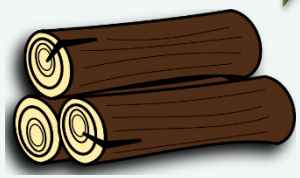
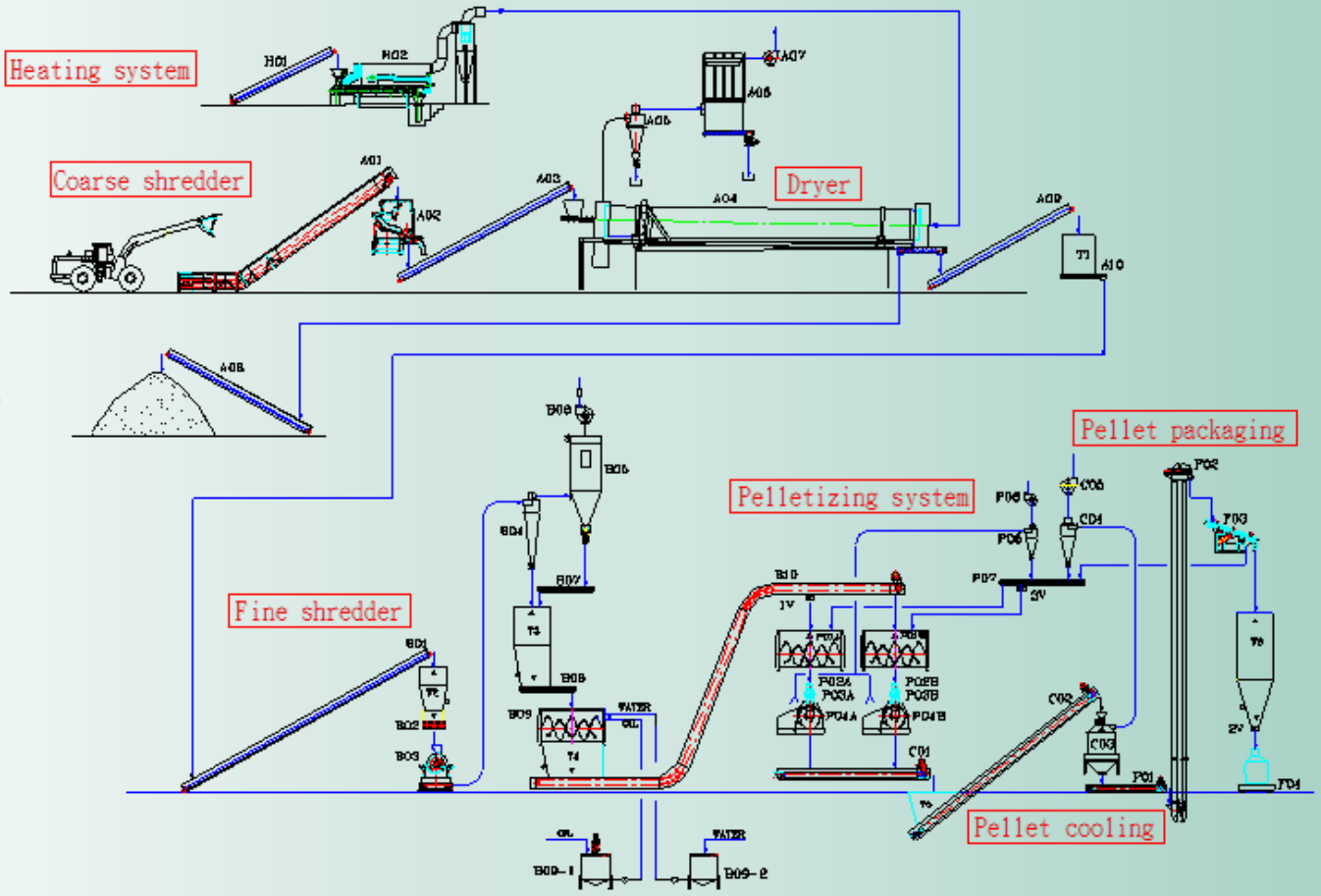
Bio-pellet manufacturing plant

- A production line of bio-pellet is composed of coarse shredder, dryer with heating system, fine shredder, pelletizing system, pellet cooling and pellet packaging.





Bio-pellet Packaged Boiler

- Substitute natural gas for bio-pellet on boiler application

- To reduce cost: Natural-gas burner is replaced by a pellet feeder and pellet burner, without replacing the boiler main body.
- The cost of pellet feeder and burner is included in the cost of bio-pellet production.

To expand the market:

Bio-pellet supplier replaces pellet feeder and burner for free if SMEs can sign a long contract (>3 years).

Cost of Plant and labor

- Assume: Production Capacity- 3 tons/hr (15,840 ton/year; 16 hr/day, 330 day/year) on one bio-pellet production line.

Cost of facility, plant and others

	Item	Cost (USD)	Note
1	Facility	1,000,000	Equipment for a production line
2	Plant	133,893	Plant area 15m x 45m，construction fee NTD 6,050/m^2
3	Pellet Feeder/burner	78,479	Plant pellet production provides 1.87 set of boiler pellet consumption annually
4	Interest	14,548	Items (1+2+3) x loan 60% x 2% interest rate
5	Feedstock	457,020	Moisture content 30 wt%
6	Fuel	17,052	Chain stocker, wood fuel 743 ton/year, NTD 700/ton
7	Electricity	242,361	Electricity consumption 400 kW，NTD 3.5/kWh
8	Water	0	No water consumption

Labor Cost

	Item	Labor Cost (USD/year)	Labor Cost (NTD/year)	Note
1	Plant manager	22,951	700,000	(1 employee * NTD700,000)
2	Operators	82,623	2,520,000	(6 employees *NTD420,000)

Total Cost	105,574 (USD / Year)

Note: 1 USD= 30.5 NTD

Equivalent bio-pellet selling price

- Assume:
  1) Natural gas is replaced by white-leadtree pellet as the fuel for packaged boiler.
  2) 1 USD can buy the same heating value of natural gas or bio-pellet fuel.

- Based on natural gas heating value of 37.8 MJ/m^3 and its price is 0.37 USD/m^3 in Chinese Taipei. ⇨ 102.2 MJ/USD
- The equivalent bio-pellet selling price is calculated at 159.41 USD/ton with heating value of 16.05 MJ/kg.

1. If white-leadtree pellet selling price is less than 159.41 USD/ton , then white-leadtree pellet is more competitive than natural gas for packaged boiler fuel.

2. Natural gas is cheaper than heavy fuel oil and diesel in Chinese Taipei. If bio-pellet can replace natural gas in boiler application then bio-pellet can replace heavy fuel oil or diesel, too.

3 cases

Case 1

- The white lead-tree is an invasive plant, invading the native forestry.
- Assume feedstock cost of white leadtree only calculates the **transportation fee** of 23 USD/ton (700 NTD/ton).

Case 2

- Feedstock cost of white leadtree calculates logging and transportation fees of 75.4 USD/ton (2,300 NTD/ton).

Case 3

- A win-win strategy

Case 1

Production Cost

◆ The cost of white-leadtree pellet is 59.54 USD/ton (1,816 NTD/ton).

Item	Consumption	Unit cost (NTD)	Consumption of pellet per kg	Cost per year (NTD/year)	Cost of pellet per ton (NTD/ton)
Raw material	3,771.4 kg/h	700/ton	1.257 kg/kg	13,939,094	880
Utility	◆ wood fuel for heating ◆ electricity ◆ waste water			7,912101	500
Variable operating cost				21,851,196	1,380
Labor				3,220,000	203
Maintenance	2% of cost of facility, plant, pellet feeder/burner			739,545	47
Insurance & tax	1.5% of cost of facility, plant, pellet feeder/burner			554,660	35
Overhead	20% of labor cost			644,000	41
Fixed operating cost				5,158,207	326
Total operating cost				**27,009,403**	**1,705**
Annual plant cost	Plant operation 20 years			**1,760,826**	**111**
Total investment				**28,770,229**	**1,816**

Case 1 (cont'd)

Bio-pellet Selling Price

The selling price of white-leadtree pellet is based on the discounted cash flow method, including:

- IRR=15%, loan of 60% of total factory cost from bank
- Interest rate = 2%
- Plant operation time 20 years and 10-year factory accelerated depreciation
- VAT =17%.

The selling price of white-leadtree pellet is 77.38 USD / ton which is competitive with natural gas.

Case 2

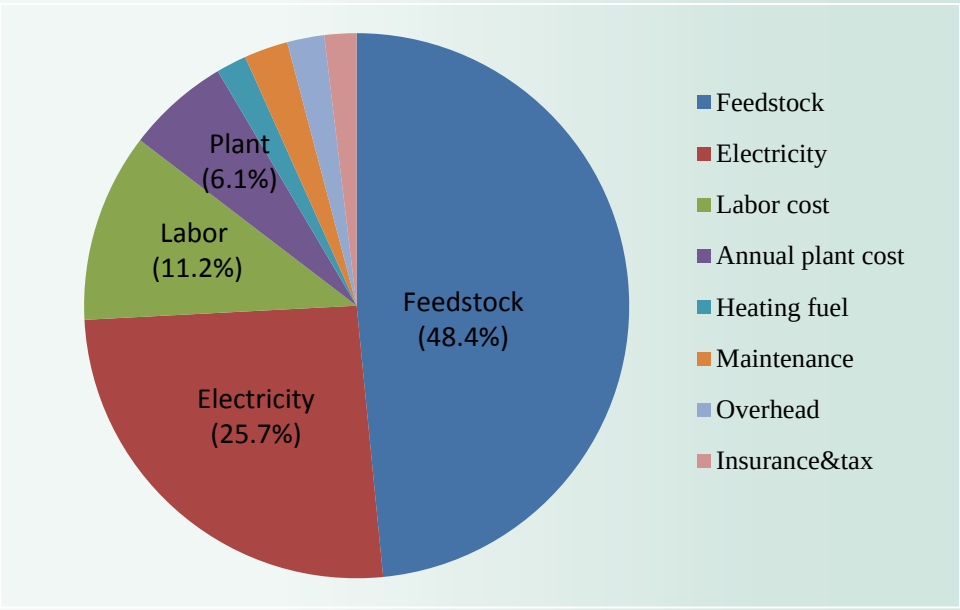
Bio-pellet Production Cost and Selling Price

- The white-leadtree pellet production cost is 127.97 USD/ton (3,903 NTD/ton) and selling price is 145.8 USD/ton.
- Competitive to selling price of natural gas.

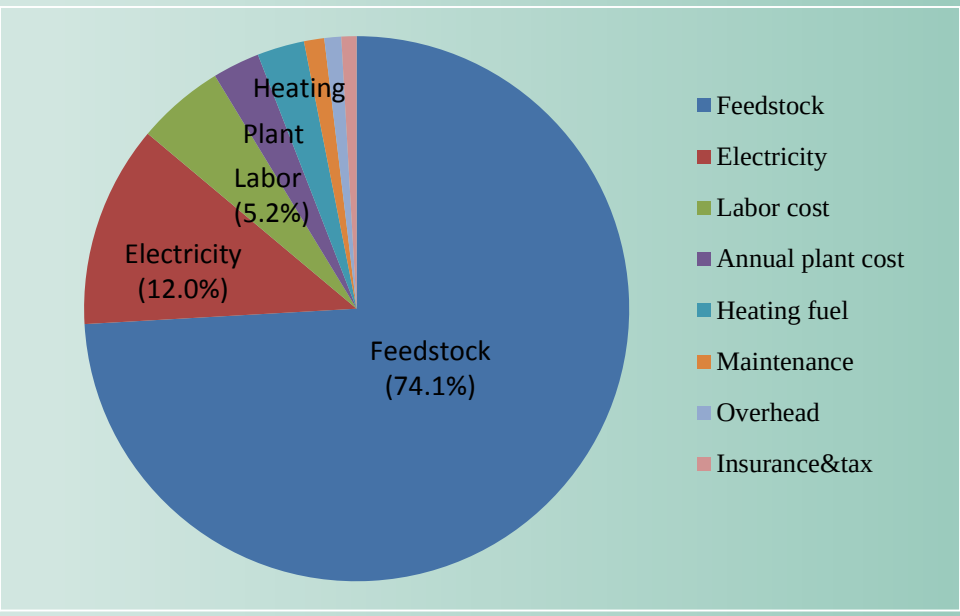
Item	Consumption	Unit cost (NT$)	Consumption of pellet per kg	Cost per year (NT$/year)	Cost of pellet per ton (NT$/ton)
Raw material	3,771.4 kg/h	Feedstock (transport fee + logging fee) 2,300/ton	1.257 kg/kg	45,799,882	2,891
Utility	◆ water & chemicals			0	0
	◆ wood fuel for heating			1,708,904	108
	◆ electricity			7,392,000	467
	◆ waste water			0	0
	◆ solid waste			0	0
Subtotal				54,900,785	
Labor				3,220,000	203
Maintenance	2% of cost of facility, plant, pellet feeder/burner			739,547	47
Insurance & tax	1.5% of cost of facility, plant, pellet feeder/burner			554,660	35
Overhead	20% of labor cost			644,000	41
Fixed operating cost				5,158,207	
Total operating cost				**60,058,993**	3,792
Annual plant cost	Plant operation 20 years			**1,760,826**	111
Total investment				**61,819,819**	3,903

The Cost Ratio of white-leadtree pellet

Case 1



Case 2



Case 3

A Win-Win Strategy

- The selling price of bio-pellet is based on 90% of equivalent bio-pellet selling price (159.41 USD/ton).
- Based on feedstock cost of 75.4 USD/ton (Case 2) and bio-pellet selling price of 90% of equivalent bio-pellet selling price,

➡ The IRR of bio-pellet supplier is 12.4%.

Conclusion

- Assume 1 USD can buy the same heating value of natural gas or bio-pellet fuel, the equivalent bio-pellet selling price is 159.41 USD/ton, as the highest selling price to compete with the natural gas.
- The selling price of white-leadtree pellet is based on the discounted cash flow method. Results show that both the selling prices of bio-pellet of Case 1 and Case 2 are competitive with selling price of natural gas.
- A win-win strategy is proposed. The selling price of white-leadtree pellet is 90% of equivalent natural gas price, enhancing SMEs competition. The bio-pellet supplier gets IRR=12.4% with augmentation of market share in return.

Thank You