265. PROFILE ON THE PRODUCTION OF BIO-DIESEL

TABLE OF CONTENTS

		PAGE
I.	SUMMARY	265-3
II.	PRODUCT DESCRIPTION & APPLICATION	265-3
III.	MARKET STUDY AND PLANT CAPACITY	265-4
	A. MARKET STUDY	265-4
	B. PLANT CAPACITY & PRODUCTION PROGRAMME	265-7
IV.	RAW MATERIALS AND INPUTS	265-8
	A. RAW & AUXILIARY MATERIALS	265-8
	B. UTILITIES	265-9
V.	TECHNOLOGY & ENGINEERING	265-9
	A. TECHNOLOGY	265-9
	B. ENGINEERING	265-10
VI.	MANPOWER & TRAINING REQUIREMENT	265-12
	A. MANPOWER REQUIREMENT	265-12
	B. TRAINING REQUIREMENT	265-12
VII.	FINANCIAL ANLYSIS	265-13
	A. TOTAL INITIAL INVESTMENT COST	265-13
	B. PRODUCTION COST	265-14
	C. FINANCIAL EVALUATION	265-15
	D. ECONOMIC BENEFITS	265-16

I. SUMMARY

This profile envisages the establishment of a plant for the production of bio diesel with a capacity of 300 m^3 per annum.

The present demand for the proposed product is estimated at 38.12 million litters per annum. The demand is expected to reach at 79.26 million litters by the year 2022 .

The plant will create employment opportunities for 40 persons.

The total investment requirement is estimated at Birr 5.90 million, out of which Birr 3.22 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 32 % and a net present value (NPV) of Birr 7.01 million, discounted at 8.5 %.

II. PRODUCT DESCRIPTION & APPLICATION

Biodiesel is an alternative fuel from agricultural products that can be used directly in any existing unmodified diesel engine. It is a variety of ester-based oxygenated fuels deried from natural, renewable biological sources such as vegetable oils. Unlike fossil diesel, pure bio-diesel is bio-degradable, nontoxic and essentially free of sulfur and aromatics

Advantages of bio-diesel are:

- Production from sustainable / renewable biological sources,
- Ecofriendly and oxygenated fuel,
- Sulfur free, less CO, HC, particulate matter and aromatic compounds emissions,
- Source of income to rural community,
- Full properties similar to the conventional fuel,
- Used in existing unmodified diesel engines,

- Reduce expenditure on oil imports, and
- Non-toxic, biodegradable and safety to handle.

The by-products of the project are expeller cake and glycerol. Expeller cake can be used as manure or after detoxification for animal feed. The crude glycerol can be sold for refineries which can further process it for soap and candle making.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Bio-diesel is a clean burning alternative fuel, produced from domestic, renewable resources. Bio diesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a bio-diesel blend. It can be used in compression-ignition (diesel) engines with little or no modifications. Bio-diesel is better for the environment because it is made from renewable resources and has lower emissions compared to petroleum diesel. Its use decreases dependence on imported oil and contributes to the country's economy.

Bio diesel can be used in its pure form (100% bio diesel) or blended with diesel fuel. Therefore, the consumption of diesel fuel is considered in estimating the demand for bio-diesel. The consumption of petroleum fuels during 1995-2004 is shown in Table 3.1. The consumption of diesel fuel has increased over the years from 460,584 tonnes in 1995 to 796,044 tonnes in 2003. On the average, 632,918 tonnes of diesel fuel is consumed annual in the country during the reference period. Accounting, on the average, for about 51.4% of all the petroleum fuels consumed, diesel fuel constitutes the major petroleum fuel consumed in the country.

Table 3.1

CONSUMPTION OF PETROLEUM FUELS (TONNES), 1995-2004

Year	Diesel Fuel	Petroleum Fuels
1995	460,584	1,004,927
1996	495,141	1,060,162
1997	539,998	1,109,062
1998	561,309	1,122,450
1999	631,133	1,204,025
2000	687,041	1,301,144
2001	682,749	1,294,104
2002	754,260	1,411,159
2003	796,044	1,405,643
2004	720,918	1,405,249
Average	**632,918**	**1,2317,93**

A bio diesel project was started in Ethiopia by National Bio-diesel Company (NBC), which acquired land in Benishangul-Gumuz Regional State for planting jatropha. Other national and foreign companies are also in the process of starting similar venture.

SNNPRS has a large resource base for the production of bio diesel fuel. Some foreign companies have applied for investment licenses from the region investment bureaus for the production of bio diesel feedstock. A SUN bio fuel, a London based company, has received 5000ha from the SNNP and has already planted 70 ha with *Jatropha curcas.* Another company, BECCO Bio fuels, an American company, has received 3,000 ha from the SNNP Investment Bureau in September 2006 for *Jatropha curcas* production which is going to operate in Sidama zone. The company plans to expand its plantation to 30,000 ha. At the same time *Beta* – local company has received 100ha to grow *jatropha* in Guraghe zone. The trend for bio fuel development program has received local and global attention for better use of clean energy. Developing countries like Ethiopia can benefit by substituting imported petroleum diesel with bio-diesel fuel.

As stated above, bio-diesel can be blended at any level with petroleum diesel to create a bio diesel blend. According to knowledgeable people, in the context of developing countries like Ethiopia, about 10% bio diesel could be blended with petroleum diesel. However, the demand for bio-diesel is conservatively estimated at 10% of the average consumption of petroleum diesel in the country. Thus, the present demand for bio-diesel is set at 38,128 thousand liters.

2. Projected Demand

The average annual rate of growth of the consumption of petroleum diesel in the country during 1995–2004 is computed to be 5%. This rate of growth is adopted in projecting the demand for bio diesel. The projected demand for the product is shown in Table 3.2.

Table 3.2

PROJECTED DEMAND FOR BIO DIESEL ('000 LITERS)

Year	Projected Demand
2007	38,128
2008	40,034
2009	42,036
2010	44,138
2011	46,345
2012	48,662
2013	51,095
2014	53,650
2015	56,332
2016	59,149
2017	62,106
2018	65,212
2019	68,472
2020	71,896
2021	75,491
2022	79,265

3. Pricing and Distribution

The factory gate price of bio-diesel for the envisaged plant is set at Birr 4.62 per liter, considering the current selling price of Birr 5.44 per liter of diesel fuel at fuel stations in Addis Ababa.

The envisaged plant can use its own and/or existing fuel distribution network to distribute its product.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The annual production capacity of the project is 300 m3 of bio-diesel oil based on 300 working days per annum and 24 hours per day.

2. Production Programme

Table 3.3 indicates the production programme of the plant. At the initial stage of the project, full capacity production may not be attained. In the first and second year of production the capacity utilization rate of the plant will be 70% and 90%, respectively. In the third year and then after full capacity production shall be attained.

Table 3.3

PRODUCTION PROGRAMME

Sr. No.	Product	Production Year		
		1	2	3-10
1	Biodiesel oil (m^3)	210	270	300
2	Expeller cake (tonnes)	523	673	747.5
3	Glycerol	133	171	190
4	Capacity utilization rate(%)	70	90	100

IV. MATERIAL AND INPUTS

A. RAW AND AUXILIARY MATERIALS

The raw and auxiliary materials of the project are jatropha seed, ethanol (or methanol) & caustic soda (catalyst).

In fact, bio-diesel can be produced from soyabean, rapeseed, sunflower, peanut, castor, etc. However, its production cost and the benefits gained from the sales of the product should be investigated. Therefore, non-edible oil sources are usually preferred for bio-diesel production. For example jatrophe curcas is identified as potentially attractive as non-edible oil source for bio-diesele production. In addition, jatropha has other added advantages high seed productivity and suitability for tropical and sub-tropical agriculture.

Furthermore, jatropha is a multipurpose and drought resistant shrub. Its seed yield ranges from 7.5 to 12 tonnes per hectare per year. Therefore, to feed the envisaged project with jatropha seed, about 120 hectares of jatropha plant will be required.

Other raw materials, ethanol and caustic soda, are also available locally.

Table 4.1 shows the annual raw and auxiliary material requirement and its cost.

Table 4.1

ANNUAL RAW AND AUXILIARY MATERIALS REQUIREMENT & COST

Sr. No.	Raw Material	Unit	Qty	Cost (‘000 Birr)
1	Jatropha seed	Tonnes	1,200	480
2	Ethanol (96%)	‘000 lt	150	750
3	Caustic soda (100% basis)	Tonnes	34	68
4	Barrels (200 lt) (Replacement cost)	pcs	100	15
	Total			**1313**

B. UTILITIES

The principal utilities of the project are electricity and water. The annual utility requirement and cost of the project is indicated in Table 4.2.

Table 4.2

ANNUAL UTILITIES REQUIREMENT & COST

Sr. No.	Utility	Unit	Qty	Cost ('000 Birr)
1	Electricity	kWh	753,200	357.02
2	Water	m^3	6,000	60
	Total			**417.02**

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Process Description

The jatropha seed shall first be cleaned using seed cleaners, vibratory or rotary screens. The cleaned seeds then enter into the press, in which the crude oil and expeller cake will be produced. The crude oil will be settled and filtered. The cleared crude oil passes to esterification reactor in which the crude biodiesel and glycerol will be produced. Crude glycerol and crude biodiesel shall be separated by settling or centrifugation. The crude biodiesel then shall be washed with water and pure biodiesel will be produced.

2. Source of Technology

The following company may supply the plant machinery on turnkey basis.

Muez-Hest Process Technologies Plc
231-Blue Rose Industrial Estate
Mumabai 400066,India
Tel. 91-22-28701752
Fax. 91-22-28544826

B. ENGINEERING

1. Machinery and Equipment

The list of machinery and equipment is indicated in Table 5.1. The total cost of machinery is estimated to be Birr 3,220,000 of which Birr 2,683,000 is in foreign currency.

Table 5.1

LIST OF MACHINERY & EQUIPMENT

Sr. No.	Description	Qty. No.
1	Seed cleaning unit	1
2	Seed milling and conditioning unit	1
3	Press (including oil screening)	1 unit
4	Filter press	1
5	Esterification reactor (with heater, stirrer etc.)	1
6	Storage tanks	6
7	Glycerol settling tanks	3
8	Biodiesel washing tank	2
9	Miscellaneous equipments such as pump and conveying equipment	lumpsum

2. Land, Building and Civil Works

The total land requirement of the project is 3,000 m^2 of which the built-up area is 850 m^2. The cost of building is, thus, estimated at Birr 1,275,000. The lease value of land is Birr 240,000 at a rate of 1 Birr/m^2/year for 80 years.

3. Proposed Location

Location of a plant is determined on the basis of proximity to raw material, availability of developed infrastructure and nearness to market out lets. Accordingly, Yem Special Woreda and Dunna Woreda are identified of these Yem special woreda is selected. It is therefore decided that the envisaged plant will be established in Fofa town.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

List of manpower and its labour cost is indicated in Table 6.1. The total annual cost of labour is estimated at Birr 481,500.

Table 6.1

MANPOWER REQUIREMENT AND LABOUR COST

Sr. No.	Manpower	Req. No.	Monthly Salary (Birr)	Annual Salary (Birr)
1	General manager	1	3,000	36,000
2	Secretary	1	800	9,600
3	Sales officers	2	2,000	24,000
4	Accountant	1	2,000	24,000
5	Production head	1	2,000	24,000
6	Chemist	3	4,500	54,000
7	Maintenance crew (mechanical)	3	3,000	36,000
8	Operators	12	8,400	100,800
9	Labourers	10	4,000	48,000
10	General service	6	2,400	28,800
	Sub-total	**40**	**32,100**	**385,200**
	Benefits (25% BS)		8,025	96,300
	Total	**40**	**40,125**	**481,500**

B. TRAINING REQUIREMENT

Training of labour force shall be carried out by the experts of plant machinery suppliers. The total cost of training is estimated at Birr 40,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the bio-diesel project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 year
Source of finance	30% equity
	70% loan
Tax holidays	3 years
Bank interest	8.5 %
Discount cash flow	8.5%
Accounts receivable	30 days
Raw material local	30 days
Work in progress	2 days
Finished products	30 days
Cash in hand	10 days
Accounts payable	30 days

A. TOTAL INITIAL INVESTMENT COST

The total investment cost of the project including working capital is estimated at Birr 5.90 million, of which 17 per cent will be required in foreign currency.

The major breakdown of the total initial investment cost is shown in Table 7.1.

Table 7.1

INITIAL INVESTMENT COST

Sr. No.	Cost Items	Total Cost ('000 Birr)
1	Land lease value	240
2	Building and Civil Work	1,275.00
3	Plant Machinery and Equipment	3,220.00
4	Office Furniture and Equipment	100
5	Vehicle	250
6	Pre-production Expenditure*	497.49
7	Working Capital	321.1
	Total Investment Cost	**5,903.6**
	Foreign Share	17

** N.B Pre-production expenditure includes interest during construction (Birr 347.49 thousand) training (Birr 40 thousand) and Birr 130 thousand costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

B. PRODUCTION COST

The annual production cost at full operation capacity is estimated at Birr 3.23 million (see Table 7.2). The material and utility cost accounts for 53.44 per cent, while repair and maintenance take 3.55 per cent of the production cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	1,313.00	40.56
Utilities	417.02	12.88
Maintenance and repair	115	3.55
Labour direct	288.9	8.92
Factory overheads	96.3	2.97
Administration Costs	192.6	5.95
Total Operating Costs	2,422.82	74.84
Depreciation	487.75	15.07
Cost of Finance	326.86	10.10
Total Production Cost	**3,237.43**	**100**

C. FINANCIAL EVALUATION

1. Profitability

According to the projected income statement, the project will start generating profit in the first year of operation. Important ratios such as profit to total sales, net profit to equity (Return on equity) and net profit plus interest on total investment (return on total investment) show an increasing trend during the life-time of the project.

The income statement and the other indicators of profitability show that the project is viable.

2. Break-even Analysis

The break-even point of the project including cost of finance when it starts to operate at full capacity (year) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 28\ \%$$

3. Pay Back Period

The investment cost and income statement projection are used to project the pay-back period. The project's initial investment will be fully recovered within 4 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 32 % and the net present value at 8.5 % discount rate is Birr 7.01 million.

D. ECONOMIC BENEFITS

The project can create employment for 40 persons. In addition to supply of the domestic needs, the project will generate Birr 3.22 million in terms of tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.