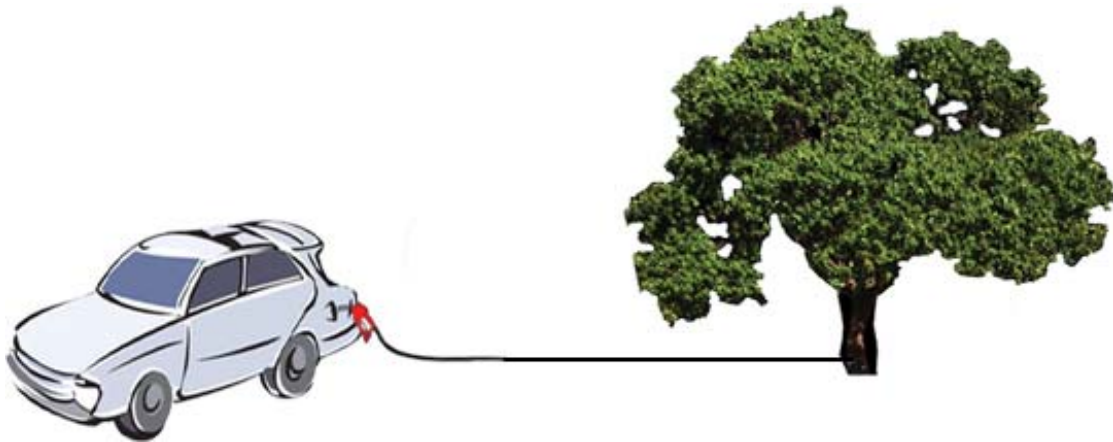




Clean
POWER 

The logo for "Clean POWER" features the word "Clean" in a grey, sans-serif font and "POWER" in a bold, black, sans-serif font. To the right of the text is a stylized graphic of a flame or arrow pointing upwards, colored with a gradient from blue at the bottom to red at the top.

Commercial Production of Bio Diesel Setting up 400 Lit per Day Refinery



0001-100000-052-001

ISSUE: 01

December, 2006

APPROVAL SHEET

SYNOPSIS :

TITLE : Commercial Production of Bio Diesel by setting up 400 lit per day refinery

DOCUMENT NUMBER : 0001-100000-052-001 Issue: 01

PREPARED BY : _____
(M. Asif Iqbal)
Director Product Development

: _____
(Dr. Mushtaq Ahmad)
Consultant Bio-Fuels

: _____
(M. Ammad Riaz)
Director Systems Engineering

ENDORSED BY : _____
(xxxxxxx)
Alternative Energy Development board

DATE : **December, 2006**

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 2 of 15

TABLE OF CONTENTS

Page No

TABLE OF CONTENTS.....	3
LIST OF ABBREVIATIONS	4
SECTION 1.....	5
EXECUTIVE SUMMARY	5
SECTION 2.....	6
SCOPE AND OBJECTIVES	6
2.1 SCOPE OF THE PROPOSAL	6
2.2 OBJECTIVES OF THE PROPOSAL	6
SECTION 3.....	7
PROJECT DESCRIPTION.....	7
3.1 SUPPLY CHAIN DESIGN	7
3.2 SUPPLY CHAIN DESCRIPTION	8
3.1.1 Crop Seed	8
3.1.2 Plantation of Pongam and Jatropha.....	8
3.1.3 Waste Vegetable Oil	10
3.1.4 Chemicals.....	10
3.2 CALCULATION OF YIELDS	11
3.3 BIO DIESEL PRODUCTION PLANT (400 LIT PER DAY)	11
SECTION 4.....	12
PROJECT SCHEDULE.....	12
THE COST PARAMETERS.....	13
5.1 THE COST OF PRODUCTION PLANT.....	13
5.2 THE COST OF RAW MATERIAL	13
5.1.1 Crop Seed	13
5.1.2 Plantation of Pongam and Jatropha.....	14
5.1.3 Waste Vegetable Oil	14
5.2 THE COST OF PROCESSING.....	14
5.3 THE COST OF BIO DIESEL	15

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 3 of 15

LIST OF ABBREVIATIONS

AEDB	Alternative Energy Development Board
CPL	Clean Power (Pvt.) Ltd.
SVO	Straight Vegetable Oil
WVO	Waste Vegetable Oil

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 4 of 15

SECTION 1

EXECUTIVE SUMMARY

Bio-diesel is a bio-degradeable and non-hazardous diesel fuel substitute. In addition to being good for the engine, Bio-diesel has positive environmental impacts. The biggest advantage of Bio-diesel for Pakistan is that it is produced from local, renewable resources, and substitution of petroleum diesel with Bio-diesel will bring about significant reductions in the crude oil import bill of the Government of Pakistan, and reduce our energy dependence on foreign sources.

This document is feasibility for commercial production of bio diesel in Pakistan. The document covers production of 400 lit per day of pure bio diesel. The foremost element of supply chain has been considered to keep the cost of product within limits.

The project utilizes multiple options, in phases, including growing of crops on waste lands, plantation of pongame ~ jatropha trees and use of waste vegetable oils. At present, there can be several attributes that might raise the cost of bio diesel at the beginning but with the passage of time, the cost comes down. Therefore, such temporary factors may be taken as development cost.

Such a pilot project can be enhanced to millions of gallons production per year through self operative automated production plants / refineries, which have their own economies and scales.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 5 of 15

SECTION 2

SCOPE AND OBJECTIVES

2.1 SCOPE OF THE PROPOSAL

Scope of this project is to initiate commercial production of bio diesel in Pakistan. This is a pilot project, a part of vision to launch bio diesel on a country wide scale.

2.2 OBJECTIVES OF THE PROPOSAL

The objectives of this pilot project are as below:

- ❖ 01 model B10 filling station
- ❖ Acceptance qualification at user level
- ❖ Hands on grip and awareness over technology
- ❖ Set up an efficient supply chain for bio diesel production

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 6 of 15

SECTION 3

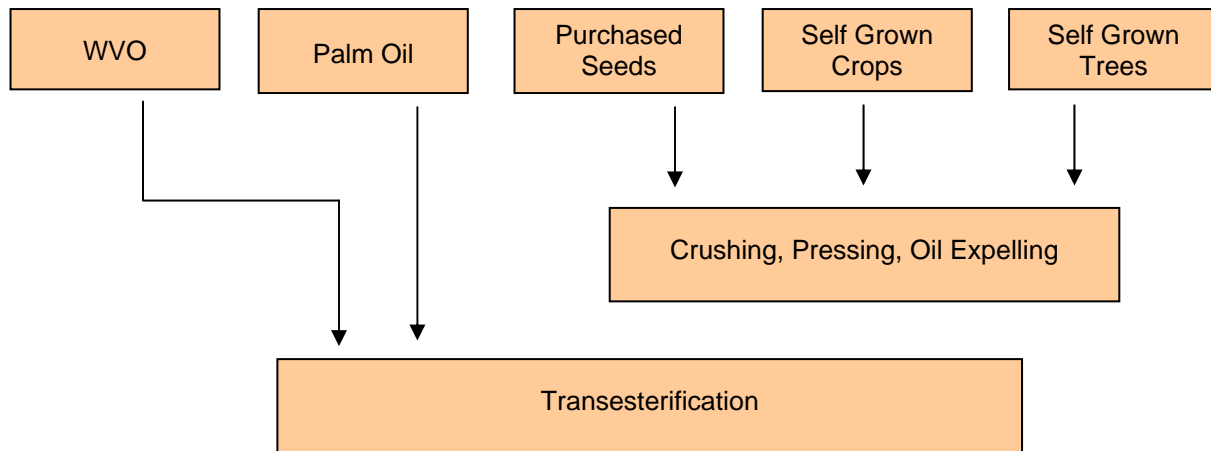
PROJECT DESCRIPTION

3.1 SUPPLY CHAIN DESIGN

There are more than one option for selecting players of supply chain which have their own features and cost affects. Growing of crops is a seasonal activity which gives desired yields every season. On the other hand, growing of pongame and jatropha is a one time exercise but a long term activity. Once the trees start yielding, then it is only the supervision and seed collection. In parallel, WVO can supplement at any point in time,

The quantities projected herein are seasonal. The end requirement in terms of total oil produced over the year when divided on daily basis meets the demand rate. However, the importance of avoiding shortfall during any part of the year is understood so that production of oil and supply of fuel to sale point remains continuous. For that, a sufficient and economical inventory level will also be maintained.

The supply chain design is diagrammatically shown below:



Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 7 of 15

The detailed description of supply chain is as follows:

3.2 SUPPLY CHAIN DESCRIPTION

3.1.1 Crop Seed

A combination of white mustard, canola and sunflower is selected to use available land round the year. Thus there will be three yielding seasons which will collectively pool the seed for the whole year. The estimated yield round the year is calculated to give a supply of *491.9 Lit per day*. The total land for planting these combinations for said yields is calculated to be *75 hectares*.

Description	White Mustard	Canola	Sunflower
Seeds (kg per ha) per year	2200 kg	2200	3200
Oil Content (%)	35%	35%	35%
Oil Recovery after Transesterification	90%	90%	90%

The cost of crop seeds including seeds, sowing, watering and harvesting becomes Rs 18.2 per lit.

The requirements of tools, agricultural machinery, labor; water system etc has been calculated on sub contract basis. Land will be dedicated by GoP

3.1.2 Plantation of Pongam and Jatropha

Reliance on pongame and jatropha is more sustainable option on long term. Pongame start yielding in 3 years and the yield continues to increase as the years pass. Jatropha starts yielding within 6 months. As trees need not to be cultivated every season, thus they only require supervision and seed collection, once fully grown. Moreover, the oil yield from trees is more than crops on a particular piece of land. Thus land requirement will gradually reduce as project will shift its reliance from crops to trees.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 8 of 15

A total of 15 hectares is calculated for plantation of pongame and jatropha to give 514 lit of bio diesel per day. Land will be dedicated by GoP. The plantation design and yield is obtained as below:

Description	Pongame	Jatropha
Configuration	15 x 15 Ft Block	8 x 8 Ft Block
Number of trees per ha	483 trees	1700 trees
Total number of trees in 15 ha	7245 trees	25,500 trees
Time to full growth (years)	4 years	1 year
Seeds (kg per tree) per year	40 kg	12 kg
Oil Content (%)	35%	35%
Oil Recovery after Transesterification	90%	90%

For plantation, saplings can be produced by developing a nursery or by outsourcing. It is proposed to involve a nursery for producing saplings. Seeds of pongame are locally available for germination. Seeds of jatropha will be obtained from Indian collaboration of CPL. *The estimated price for pongame is Rs 5 per sapling and jatropha is Rs 10 per sapling.*

The manpower for supervision and seed collection is estimated to be a total of (1 person per 8 ha) at Rs 4000 per month. One plant taxonomy expert at Rs 25000 per month is required for management of overall plantation and growth monitoring.

The cost of pongame and jatropha seeds are calculated to be Rs 2.88 per lit of bio diesel produced.

The cost of agricultural tools, machinery, water connection etc has not been considered as it varies from case to case and is sometimes negligible when these resources are already available with the project owner.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 9 of 15

3.1.3 Waste Vegetable Oil

WVO is an alternate option to meet any shortfall in supplies and to maintain the chain functional. WVO is presently available at approx Rs 40 per lit of bio diesel produced. However, this is not the permanent option to rely on production and the prices are expected to decrease as the scales increase.

3.1.4 Chemicals

The chemicals include methanol, caustic soda and vinegar. Methanol is used for in transesterification equal to 20% by volume of straight oil. That means 20 lit of methanol is required for every 90 lit of bio diesel produced at a 90% recovery rate. Oil refineries working at par, are the best source for supply of methanol. The ex refinery price of methanol is estimated to be Rs 25 per lit, which makes it to cost Rs 5.55 per lit of produced bio diesel.

Item	Quantity	Rate (Rs)	Cost share per lit of produced bio diesel (Rs)
Methanol	20% by vol of SVO/WVO	Rs 25 per lit	<i>Rs 5.5 per lit</i>
Caustic Soda	3.5 / 6.5 gm per lit of SVO/WVO	Rs 700 per kg	<i>Rs 2.72 / 5.0 per lit</i>
Vinegar	6% by vol of SVO/WVO	Rs 67 per lit	<i>Rs 4.46 per lit</i>

Caustic soda is used at 3.5 gm per lit of SVO and 6.5 gm per lit of WVO and is available at Rs 700 per kg.

Vinegar is used at 6% of SVO / WVO and cooking grade vinegar is available at Rs 67 per lit.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 10 of 15

3.2 CALCULATION OF YIELDS

Source	Season	Land (ha)	Seed (kg or lit)	Oil / season (lit)	Oil / year (lit)	Oil / day (lit)
White mustard	Sep-Nov	75	165,000	57,750	179,550	491.9
Canola	Dec-Mar		165,000	57,750		
Sunflower	April-Aug		240,000	84,000		
WVO	Jan-Dec	--	--	164,250	147,825	405
Pongame	Mar-Aug	15	289,800	101,430	187,677	514.2
Jatropha	Mar-Sep		306,000	107,100		

3.3 BIO DIESEL PRODUCTION PLANT (400 LIT PER DAY)



Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 11 of 15

SECTION 4

PROJECT SCHEDULE

Once agreed upon a project, CPL will arrange production plant from abroad. Parallel to this, crop cultivation can begin simultaneously so that seeds are available at the end of season. After plant commissioning till beginning of crop yields, WVO will be used. The trees will start contributing with time.

Plant can be commissioned and made operative with in 02 months.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 12 of 15

SECTION 5

THE COST PARAMETERS

The costing in this section includes direct costs only and does not take into account the custom duties, sales taxes, excise duties etc.

5.1 THE COST OF PRODUCTION PLANT

Item	Cost (PKR Million)
Seed Press	1.5
Transesterification	1.0
Civil Works and Commissioning	0.5
TOTAL	3.0

5.2 THE COST OF RAW MATERIAL

5.1.1 Crop Seed

Type	Cost per kanal (PKR)				Total 75 ha (PKR)	Supervision (PKR)	Cost/kg (PKR)	Cost/lit (PKR)
	Seeds (PKR)	Sowing (PKR)	Watering (PKR)	Harvesting (PKR)				
Wt Must	20	100	200	200	780,000	225,000	6.4	18.2
Canola	20	100	200	200	780,000	300,000		
Sunflower	90	100	500	100	11,85,000	375,000		
WVO								40

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001		ECP No -	
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01		Page 13 of 15	

5.1.2 Plantation of Pongam and Jatropha

Type	Cost of Sapling (PKR)	Labor	Cost per kg (PKR)	Cost per lit (PKR)
Pongame	5	300,000	1.0	2.88
Jatropha	10			

5.1.3 Waste Vegetable Oil

Cost of WVO per : Rs 40 per lit

5.2 THE COST OF PROCESSING

Type	Raw material (Rs / Lit)	Extraction (Rs / Lit)	Methanol (Rs /lit)	Caustic soda (Rs / Lit)	Vinegar (Rs / lit)	Labor (Rs / Lit)	Total (Rs / Lit)
Wt Must	17.4		5.5	2.7	4.46	4.54	35.5
Canola	18.7						
Sunflower	18.5						
Pongame	2.95					4.34	17.8
Jatropha	2.8						
WVO	40.0		5.0	5.52	60.6		

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 14 of 15

5.3 THE COST OF BIO DIESEL

The total cost of bio diesel can be computed by determining the depreciation factor of plant machinery against total production and adding that into the cost of production. After that, the profit margins can be fixed and sale price can be calculated.

Title Commercial Production of Bio Diesel by Setting up 400 Lit per Day Refinery			Document No 0001-100000-052-001	ECP No -
Originator Ammad	Approval Ammad	Date Dec, 2006	Document Issue No 01	Page 15 of 15