PROFILE ON ACETYLENE PLANT

TABLE OF CONTENTS

I. SUMMARY

This profile envisages the establishment of a plant for the production of acetylene with a capacity of 210 tones per annum. The project will also produce 600 tonnes of slaked lime annually as a by product.

Acetylene (C_2H_2) is an organic gas of the alkynes group, which has a very high calorific value. It is, hence, principally used in oxy-acetylene welding in metal workshops, garages and industries.

The major raw material needed to produce acetylene is calcium carbide, which have to be imported.

The present unsatisfied demand for the proposed product is estimated at 88.78 tones per annum. The unsatisfied demand is expected to reach at 469 tones by the year 2018.

The total investment requirement is estimated at about Birr 5.97 million, out of which Birr 525 thousand is required for plant and machinery. The plant will create employment opportunities for 14 persons.

The project is financially viable with an internal rate of return (IRR) of 23.20 % and a net present value (NPV) of Birr 3.47 million discounted at 8.5%.

The project will have forward linkage with the manufacturing and construction sector. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.

II. PRODUCT DESCRIPTION AND APPLICATION

Acetylene is an organic compound produced from the exothermic reaction of calcium carbide and water. Either as liquid or gas, it is highly explosive since it is an endothermic compound and decomposes into the elements carbon and hydrogen.

Acetylene is used as raw material to produce different chemicals such as vinyl chloride (a chemical used to produce PVC), 1, 4-Butanediol, vinyl acetate, etc.

In addition, it is used as fuel in gas welding. Acetylene with oxygen produces high temperature flame (3500 ^{o}C) which is used to cut and weld different metallic products.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Acetylene is an organic gas of the alkaline group and has a very high calorific value. It is, hence principally used in Oxy-Acetylene welding.

The demand for acetylene is met through local production. One medium and a few small scale plants produce acetylene for sale; while lots of automotive repairs and metal/mechanical workshops often generate acetylene with improvised equipment and containers for instantaneous uses. Generating acetylene gas is a simple process; pressure-filling it into metallic cylinders for storage and prolonged use requires some capital investment.

Review of the Annual External Trade Statistics reveals that from 1997 to 2006, an average of 52,175 kg of acetylene gas generating apparatus worth Birr 4,587,674.40 were imported annually. The lion's share of these imports are attributed to small

metal/mechanical and auto workshops which use them for improvised production of acetylene since the quantity produced for the market by “Chora Gas and Chemicals Factory” and the other small firms does not address the demand by these workshops.

To illustrate the demand volume for acetylene gas from another perspective, another approach is applied here. The basic raw material for the production of acetylene gas is Calcium Carbide, {locally known by it Italian name “Carburro.”} From 1997 to 2006, an average of 536,465 kg of calcium carbide worth Birr 2,347,580.80 was being imported annually.

The underlying reason for presenting the data regarding the importation of calcium carbide is not merely to show the magnitude but to relate the fact that in the case of the improvised production of acetylene gas by workshops for own use, all that is generated is not put to use and that most of it is wasted since they do not have the facility to store and preserve acetylene gas generated as such. Calcium carbide is probably the most important calcium compound; and is produced in electric furnaces. Acetylene is produced from the C_a C_2 by reaction with water, from which other organic compounds {e.g. ethanol, acetaldehyde} may be obtained.

Calcium carbide may also be converted to Calcium Cyanamid (lime nitrogen) which is used as fertilizer. Since there is no fertilizer manufacturing factory in the country to convert calcium carbide into lime nitrogen, it can be argued that the total imported calcium carbide is destined for the production of acetylene. For detail information on import of Calcium Carbide, see Table 3.1.

Table 3.1

IMPORT OF CALCIUM CARBIDE FOR ACETYLENE PRODUCTION {Kg}

Year	Import	Value
1997	617,010	3,068,423
1998	320,315	1,340,293
1999	497,760	1,812,722
2000	762,206	2,357,166
2001	461,300	1,879,180
20002	315,827	1,279,920
2003	697,400	2,695,438
2004	257,400	1,189,142
2005	838,798	4,839,714
2006	596,609	3,013,510
Total	**5,364,645**	**23,475,508**
Average	***536,465***	***2,347,551***

Source: *Ethiopian Customs Authority annual external trade statistics, unpublished*

Another reason for the presentation of the import data for calcium carbide is to estimate supply volume of acetylene gas by computing raw material-output ratio in the absence of any information regarding the supply-demand scenario. Average import of calcium carbide for the years 1997-2006 was 536,465 kg.

To pressure-fill a single, 32kg holding capacity acetylene gas cylinder, it requires the oxidation of 48 kilograms of calcium carbide. The average import of calcium carbide from 1997-2006 could have been utilized to produce 357,647 kg of acetylene gas which could be filled into 11,176 cylinders of 32kg capacity.

The import quantity for 2006 is almost equivalent to the 10-year average. To estimate present demand therefore, the 10% rate of economic growth recorded is applied in this connection. Present demand for Acetylene gas stands at 393,214 kg.; or 12,288 cylinders of 32kg holding capacity.

Supply volume of acetylene from local sources is not specifically reported anywhere. Even the Annual Statistical Abstract of CSA on manufacturing industries has no entry for acetylene production. Inquiries have brought to light, however, that there are in the country, one medium-scale and four small-scale acetylene plants with the technical apparatus to pressure-fill 304,430 kg of acetylene gas into 9,513 cylinders of 32kg holding capacity.

Present supply demand gap for acetylene is, therefore, 88,784 kg of acetylene, pressure-filled into 2,775 cylinders of 32kg capacity.

2. Projected Demand

To establish forecasted demand for acetylene gas, identification of consumers of the product is vital. Mechanical, metallurgical and auto mechanical workshops are the major consumers of acetylene gas. The level of demand is expected to steadily increase with increased activity in these workshops as a result of economic growth. The demand increase by these institutions for the coming 10 years is conservatively estimated to be 7.0% / year.

Future local output of existing acetylene producing plants is assumed to remain constant at its present level of production of 304,430kg/annum. In Table 3.2 is presented forecasted demand and supply-demand gap for acetylene for the next 10 years.

Table 3.2

DEMAND FORECAST FOR ACETYLENE GAS {Kg}

Year	Forecast Demand	Domestic Supply	Supply-Demand Gap
2009	420,739	304,430	116,309
2010	450,191	304,430	145,761
2011	481,704	304,430	177,274
2012	515,423	304,430	210,993
2013	551,503	304,430	247,073
2014	590,108	304,430	285,678
2015	631,416	304,430	326,986
2016	675,615	304,430	371,185
2017	722,908	304,430	418,478
2018	773,511	304,430	469,081

3. Pricing & Distribution

Currently acetylene sales at Birr 10.65/ kilogram. The average unit CIF value of a kilogram of calcium carbide is Birr 5.05. It requires 1.5 kg of calcium carbide to produce a kilogram of acetylene gas. It means that raw material bought at Birr 7.57 CIF is utilized to produce gas that sells for Birr 10.65.

At Birr 10.65 per kg, sale of acetylene filled in a 32kg cylinder at Birr 340.80 factory gate is recommended for future local production.

The current price of slaked lime ranges from about Birr 3,500 to Birr 4,500 per tonnes. This price range could, therefore, be used as a reference for the financial evaluation of the project.

Distribution can best take place by setting up own distribution centers at selected locations, preferably where mechanical and auto mechanical workshops abound. One may also sale through the agency of businessmen already established in existing distribution channels for access to the regions.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The production capacity of the envisaged project is 210 tons per annum based on 300 working days per year and single shift per day.

2. Production Programme

Table 3.3 shows the production programme of the project. At the initial stage of production, the project may require some years to penetrate the market. Therefore, in the first and second year of production, the capacity utilization rate will be 75% and 90%, respectively. In the third year and onwards, full capacity production shall be attained.

Table 3.3

PRODUCTION PROGRAMME

S/N	Product	Production Year		
		1	2	3
1	Capacity Utilization Rate %	75	90	100
2	Acetylene(Ton)	158	189	210
3	Byproduct Slaked lime(ton)	450	540	600

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

The major raw materials of the production of acetylene are calcium carbide and water. Other auxiliary materials are nitrogen, iron oxide and silica gel. All the raw materials are imported except nitrogen which can be generated from atmospheric air by fractional distillation. The total cost of annual raw materials and auxiliary materials is estimated Birr 1,803,000, out of which Birr 1,338,633 is in foreign currency.

Table 4.1

ANNUAL CONSUMPTION OF RAW- MATERIALS AND UTILITIES

Description	Unit of meas.	Qty.	Cost in '000 Birr		
			F.C	L.C	T.C
Calcium Carbide	ton	570	1,026.0	342.0	1,368.0
Nitrogen gas	Cylinder	120	-	18.0	18.0
Iron oxide	Kg	473	38.31	12.77	51.08
Silica gel	Kg	120	4.32	1.44.0	5.76
Packaging*	Cylinder	200	270.0	90.0	360.0
Total			**1338.633**	**464.211**	**1,803**

* the cylinder considered in the raw material is by assuming the replacement of 5% loss or damage annually other wise it is recycled.

B. UTILITIES

The major utility requirements of the project are electricity and water supply. The required quantity of these utilities is shown on Table 4.2 below.

Table 4.2

ANNUAL UTILITY REQUIREMENT AND COST

Sr. No.	Utility	Unit of Measure	Qty	Cost (Birr)
1	Electricity	kWh	47275	22,389
2	Water	m^3	10,000	32,500
	Total			**54,889**

IV. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Process Description

The size of calcium carbide shall first be reduced to fine powder by pulverizer. The pulverized carbide is then added though a gas tight hopper-valve arrangement to the acetylene gas generator in which the quantity of water used is sufficient to discharge the calcium hydroxide as lime slurry containing 85-90% water. The temperature is kept below 90^oc and 2 atm. the gas generator.

The impure acetylene (C2H2) from the generator is scrubbed with water. The continuous supply of cooling water in to the scrubber is also used as a source of water for the reaction with carbide. After the scrubber, the gas is purified and dried with iron-oxide and silica gel.

The production process is environmental friendly. The by product slaked lime is used for construction purpose and PH adjustment in industry.

2. Source of Technology

The following Chinese company may supply the complete set of machinery and equipment.

China Machinery & Equipment (CME)
No. 178, Guanganmenwai Street, Xuanwu Distrit, Beijing
Tel. (86-10) 63451188
Fax. (86-10) 63261865

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 at Birr 525,000 of which Birr 437,435 is required in foreign currency.

Table 5.1

MACHINERY & EQUIPMENT REQUIREMENT

S/N	Description	Qty	Cost '000 Birr		
1	Water tank	2	44.65	-	44.65
2	Carbide feed mechanism	1	-	113.73	113.73
3	Carbide buffer	1	-	61.24	61.24
4	Acetylene generator	2	-	91.86	91.86
5	Pulverizer	2	-	52.49	52.49
6	Scrubber	1	-	56.86	56.86
7	Purifier	1	-	34.99	34.99
8	Nitrogen cylinders	15	-	26.24	26.24
9	Pumps	3	42.90	-	42.90
	Total		**87.56**	**437.43**	**525.0**

1. Land, Building and Civil Works

The total land requirement for the envisaged plant is estimated at 1,500 m^2out of this 450 m^2 is built-up area. A building covering 350 m^2 containing underground to accommodate the store in the underground and the production facility on the ground floor. The office will occupy 100m^2 area. Cost of building construction with at rate of Birr 2,400 per m^2 amounts to Birr 1,080,000.

According to the Federal Legislation on the Lease Holding of Urban Land (Proclamation No 272/2002) in principle, urban land permit by lease is on auction or negotiation basis, however, the time and condition of applying the proclamation shall be determined by the concerned regional or city government depending on the level of development.

The legislation has also set the maximum on lease period and the payment of lease prices. The lease period ranges from 99 years for education, cultural research health, sport, NGO , religious and residential area to 80 years for industry and 70 years for trade while the lease payment period ranges from 10 years to 60 years based on the towns grade and type of investment.

Moreover, advance payment of lease based on the type of investment ranges from 5% to 10%.The lease price is payable after the grace period annually. For those that pay the entire amount of the lease will receive 0.5% discount from the total lease value and those that pay in installments will be charged interest based on the prevailing interest rate of banks. Moreover, based on the type of investment, two to seven years grace period shall also be provided.

However, the Federal Legislation on the Lease Holding of Urban Land apart from setting the maximum has conferred on regional and city governments the power to issue regulations on the exact terms based on the development level of each region.

In Addis Ababa the City's Land Administration and Development Authority is directly responsible in dealing with matters concerning land. However, regarding the manufacturing sector, industrial zone preparation is one of the strategic intervention measures adopted by the City Administration for the promotion of the sector and all manufacturing projects are assumed to be located in the developed industrial zones.

Regarding land allocation of industrial zones if the land requirement of the project is blow 5000 m^2 the land lease request is evaluated and decided upon by the Industrial Zone Development and Coordination Committee of the City's Investment Authority. However, if the land request is above 5,000 m^2 the request is evaluated by the City's Investment Authority and passed with recommendation to the Land Development and Administration Authority for decision, while the lease price is the same for both cases.

The land lease price in the industrial zones varies from one place to the other. For example, a land was allocated with a lease price of Birr 284 /m^2 in Akakai-Kalti and Birr 341/ m^2 in Lebu and recently the city's Investment Agency has proposed a lease price of Birr 346 per m^2 for all industrial zones.

Accordingly, in order to estimate the land lease cost of the project profiles it is assumed that all manufacturing projects will be located in the industrial zones. Therefore, for this profile, which is a manufacturing project a land lease rate of Birr 346 per m^2 is adopted.

On the other hand, some of the investment incentives arranged by the Addis Ababa City Administration on lease payment for industrial projects are granting longer grace period and extending the lease payment period. The criterions are creation of job opportunity, foreign exchange saving, investment capital and land utilization tendency etc. Accordingly, Table 5.2 shows incentives for lease payment.

Table 5.2

INCENTIVES FOR LEASE PAYMENT OF INDUSTRIAL PROJECTS

Scored point	Grace period	Payment Completion Period	Down Payment
Above 75%	5 Years	30 Years	10%
From 50 - 75%	5 Years	28 Years	10%
From 25 - 49%	4 Years	25 Years	10%

For the purpose of this project profile the average i.e. five years grace period, 28 years payment completion period and 10% down payment is used. The period of lease for industry is 60 years.

Accordingly, the total lease cost, for a period of 60 years with cost of Birr 346 per m^2, is estimated at Birr 31.14 million of which 10% or Birr 3,114,000 will be paid in advance. The remaining Birr 28.03 million will be paid in equal installments with in 28 years i.e. Birr 1,000,929 annually.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

In order to run the envisaged plant efficiently, it needs 14 employees. The estimated annual cost of manpower is Birr 208,500. The detail of which is shown in Table 6.1

Table 6.1

MANPOWER REQUIREMENT AND ESTIMATED ANNUAL COST

S/No	Manpower	Qty	Monthly salary (Birr)	Annual salary (Birr)
1	General Manager	1	3,500	42,000
2	Secretary	1	900	10,800
3	Sales /purchase man	1	1,200	14,400
4	Accountant	1	1,200	14,400
5	Production head	1	2,500	30,000
6	Operators	2	1,200	14,400
7	Laborers	4	1,400	16,800
8	Mechanic	1	600	7,200
9	Laboratory technician	1	900	10,800
10	Driver	1	500	6,000
	Sub total	**14**		**166,800**
	Benefit (25% of BS)			41,700
	Total			**208,500**

B. TRAINING REQUIREMENT

On-the-job training shall be carried out during plant erection and commissioning by expert of machinery supplier. The training cost is estimated at Birr 30,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the acetylene 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	2 years
Bank interest	8.5%
Discount cash flow	8.5%
Accounts receivable	30 days
Raw material local	30 days
Raw material import	90 days
Work in progress	1 days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days
Repair and maintenance	3% of machinery cost

A. TOTAL INITIAL INVESTMENT COST

The total investment cost of the project including working capital is estimated at Birr 5.97 million, of which 7 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 ('000 Birr)

Sr. No.	Cost Items	Local Cost	Foreign Cost	Total Cost
1	Land lease value	3,114.00	-	3,114.00
2	Building and Civil Work	1,080.00	-	1,080.00
3	Plant Machinery and Equipment	87.6	437.44	525.00
4	Office Furniture and Equipment	100.00	-	100.00
5	Vehicle	450.00	-	450.00
6	Pre-production Expenditure*	382.85	-	382.85
7	Working Capital	325.95	-	325.95
	Total Investment cost	**5,540.36**	**437.44**	**5,977.80**

* *N.B Pre-production expenditure includes interest during construction (Birr 252.85 thousand), training (Birr 30 thousand) and Birr 100 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 2.51 million (see Table 7.2). The material and utility cost accounts for 71.69 cent of the production cost. The other major components of the production cost are cost deprecation, financial cost and direct labour which account for 9.40%, 7.39% and 3.98% respectively. The remaining 7.54 % is the share of utility, maintenance and repair, labour overhead and other administration cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	1,803.00	71.69
Utilities	54.89	2.18
Maintenance and repair	26.25	1.04
Labour direct	100.08	3.98
Labour overheads	41.70	1.66
Administration Costs	66.72	2.65
Land lease cost	-	-
Total Operating Costs	**2,092.64**	83.21
Depreciation	236.50	9.40
Cost of Finance	185.77	7.39
Total Production Cost	**2,514.91**	**100**

C. FINANCIAL EVALUATION

1. Profitability

Based on the projected profit and loss statement, the project will generate a profit through out its operation life. Annual net profit after tax will grow from Birr 974.05 thousand to Birr 1.49 million during the life of the project. Moreover, at the end of the project life the accumulated cash flow amounts to Birr 11.29 million.

2. Ratios

In financial analysis financial ratios and efficiency ratios are used as an index or yardstick for evaluating the financial position of a firm. It is also an indicator for the strength and weakness of the firm or a project. Using the year-end balance sheet figures and other

relevant data, the most important ratios such as return on sales which is computed by dividing net income by revenue, return on assets (operating income divided by assets), return on equity (net profit divided by equity) and return on total investment (net profit plus interest divided by total investment) has been carried out over the period of the project life and all the results are found to be satisfactory.

3. Break-even Analysis

The break-even analysis establishes a relationship between operation costs and revenues. It indicates the level at which costs and revenue are in equilibrium. To this end, the break-even point of the project including cost of finance when it starts to operate at full capacity (year 3) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 22\ \%$$

4. Payback Period

The pay back period, also called pay – off period is defined as the period required to recover the original investment outlay through the accumulated net cash flows earned by the project. Accordingly, based on the projected cash flow it is estimated that the project's initial investment will be fully recovered within 4 years.

5. Internal Rate of Return

The internal rate of return (IRR) is the annualized effective compounded return rate that can be earned on the invested capital, i.e., the yield on the investment. Put another way, the internal rate of return for an investment is the discount rate that makes the net present value of the investment's income stream total to zero. It is an indicator of the efficiency or quality of an investment. A project is a good investment proposition if its IRR is greater

than the rate of return that could be earned by alternate investments or putting the money in a bank account. Accordingly, the IRR of this porject is computed to be 23.20 % indicating the vaiability of the project.

6. Net Present Value

Net present value (NPV) is defined as the total present (discounted) value of a time series of cash flows. NPV aggregates cash flows that occur during different periods of time during the life of a project in to a common measuring unit i.e. present value. It is a standard method for using the time value of money to appraise long-term projects. NPV is an indicator of how much value an investment or project adds to the capital invested. In principal a project is accepted if the NPV is non-negative.

Accordingly, the net present value of the project at 8.5% discount rate is found to be Birr 3.47 million which is acceptable.

D. ECONOMIC BENEFITS

The project can create employment for 14 persons. In addition to supply of the domestic needs, the project will generate Birr 2.06 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. The project will have forward linkage with the manufacturing and construction sector.