

**63. PROFILE ON THE PRODUCTION OF LOW  
DENSITY POLYETHYLENE (LDPE)**

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## **I. SUMMARY**

This profile envisages the establishment of a plant for the production of low density polyethylene (LDPE) with a capacity of 40,000 tons per annum. LDPE is a thermoplastic material mostly used in the production of packaging materials.

The country's requirement of LDPE is met through import. The present (2012) demand for LDPE is estimated at 11,488 tons. The demand for the product is projected to reach 27,989 tons and 79,102 tons by the year 2018 and 2025, respectively.

The principal raw material required is ethylene gas which has to be imported.

The total investment cost of the project including working capital is estimated at Birr 1.31 billion. From the total investment cost, the highest share (Birr 995.28 million or 75.99%) is accounted by fixed investment cost followed by initial working capital (Birr 199.73 million or 15.25%) and pre operation cost (Birr 114.77 million or 8.76%). From the total investment cost Birr 754.34 million or 57.59% is required in foreign currency.

The project is financially viable with an internal rate of return (IRR) of 22.38% and a net present value (NPV) of Birr 833.15 million, discounted at 10%.

The project can create employment for 78 persons. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports. The project will also create forward linkage with the plastic products manufacturing sub sector and also generates income for the Government in terms of tax revenue and payroll tax.

## **II. PRODUCT DESCRIPTION AND APPLICATION**

Polyethylene (PE) is the most widely used plastic in the world, with an annual global production of approximately 80 million metric tons. Polyethylene is classified into several different categories based mostly on its density and branching. The mechanical properties of PE depend significantly on variables such as the extent and type of branching, the crystal structure and the molecular weight.

The most important polyethylene grades are HDPE and LDPE. LDPE is defined by a density range of 0.910–0.940 g/cm<sup>3</sup>. LDPE has a high degree of short and long chain branching, which means that the chains do not pack into the crystal structure as well. It has, therefore, less strong intermolecular forces. This results in a lower tensile strength.

LDPE is used in the production of food packaging materials for products such as baked goods, dairy products, frozen food, meat and poultry, candy and cookies and nonfood products such as industrial liners, heavy-duty sacks, multi-wall sack liners, pallet stretch- and shrink wrap, bundling and over-wrap, grocery sacks. Another application of LDPE is in the production of non packaging materials such as household wrap and bags, garbage bags, industrial sheeting and roll stock, agricultural film and disposable diaper backing.

LDPE is also used in coating of paper and paperboard products for packaging liquids such as milk and juices, the coating of foil to provide a heat-seal layer in multilayer film structures, and the coating of paper and woven cloth to provide a moisture barrier.

Low Density Poly Ethylene (LDPE) is obtained through the polymerization of ethylene gas. It is tough, is moisture resistant and is also resistant to chemical. It can be blow moulded or injection moulded. It is used in film and sheet manufacture, in wire and cable and in tube and pipe manufacture.

### **III. MARKET STUDY AND PLANT CAPACITY**

#### **A. MARKET STUDY**

##### **1. Past Supply And Present Demand**

At present the sources of supply to the local market for LDPE resins is import. The product is imported by the local plastic products manufacturers and processed in to various goods. The data source for import statistics i.e. Ethiopian Revenue and Customs Authority classifies import of PE resins under the following headings.

- Polyethylene having a specific gravity <0.94, in primary forms, and
- Polyethylene having a specific gravity >=0.94, in primary forms.

Therefore, since the available import data does not show import of PE by type, the trend in the aggregate import of PE is used as a base and then desegregated into HDPE and LDPE. Accordingly, the total import of PE during the period 2002 – 2011 is shown in Table 3.1.

**Table 3.1**  
**IMPORT OF PE RESINS (IN TONS)**

Year	Quantity
2002	13,491
2003	18,491
2004	19,533
2005	19,635
2006	22,383
2007	27,006
2008	27,839
2009	28,382
2010	25,648
2011	27,725

**Source:** - *Ethiopian Revenue & Customs Authority.*

As can be seen from Table 3.1, import of PE resins during the period under consideration have shown a noticeable increasing trend except a slight decline in the year 2010 compared to the previous three years i.e. year 2007—2009. During the first nine years of the data set i.e. 2002 – 2009 import of PE resins has shown a consistent increase. The imported quantity which was 13,491 tons during year 2002 has increased to 28,382 tons in 2009. During year 2010, the imported quantity of PE resins has declined to 25,648 tons, registering a decrease of about 9.63% compared to the previous year (2009). This could be due to the stock carry over from the year 2009 which has shown the highest level of import in the past 10 years. However, during 2011 import has increased to 27,725 tons. During the period under consideration (2002 – 2011) import of PE resin has registered an average annual growth rate of 9.04%.

Considering the nature of the import or apparent consumption trend for PE resin, it is assumed that the growth rate registered in the past will also continue in the near future. Accordingly, taking the apparent consumption for year 2011 as a base and applying a growth rate of 9.04% the present effective demand for PE resin is estimated at 30,231 tons.

According to a study conducted by IPS “ Feasibility Study for the Establishment of PE resin Manufacturing Plan, IPS, 2012” on average from the total amount of PE resin consumed by local manufacturers of PE products, the highest majority (58%) is accounted by HDPE and the remaining 38% by LDPE. The remaining 4% is accounted by other type of PE resins such as MDPE and VLDPE. Accordingly, the present effective demand for LDPE is estimated at 11,488 tons.

## **2. Demand Projection**

The demand for LDPE resins depend mainly on the performance of its end-user (i.e. the plastic products manufacturing sub - sector). Therefore, the demand for LDPE resins is a derived demand, which depends directly on the performance of its major end - user. On the other hand the performance of the LDPE products manufacturing sub - sector is dependant on the performance of the end users of LDPE products. LDPE is predominantly used for the production of packing materials in the manufacturing sector particularly the food manufacturing sub sector.

Consequently, the demand for LDPE resins depends on the growth of the manufacturing sector. On the other hand the performance of the manufacturing sector is dependent on a number of inter-related variables. Accordingly, the variables that are essential in determining the magnitude and trend of demand for LDPE resins are:

- Performance of the national economy;
- Performance of the manufacturing sector and plastic products manufacturing sub sector; and
- Rate of population growth and urbanization.

Accordingly, the following two scenarios are considered.

**Scenario 1:** GDP of the country is expected to grow at an average annual growth rate of 11.2% during the GTP period (2011 – 2015).

**Scenario 2:** The industrial sector, which includes the manufacturing sector, is expected to grow at an average annual growth rate of 20% during the GTP period (2011 – 2015).

Since the demand for LDPE resin is highly affected by both factors i.e. performance of GDP and the manufacturing sector, the assumptions are valid. Therefore, the average of the expected growth rate of GDP and the industrial sector which is 16% is used to project the local demand for LDPE resin. Accordingly, the projected demand for LDPE resin estimated on the basis of the above assumption and using the estimated present demand as a base is presented in Table 3.2.

**Table 3.2**  
**PROJECTED DEMAND FOR LDPE RESIN (TONS)**

<b>Year</b>	<b>Quantity</b>
2013	13,326
2014	15,458
2015	17,931
2016	20,800
2017	24,128
2018	27,989
2019	32,467
2020	37,662
2021	43,688
2022	50,678
2023	58,786
2024	68,192
2025	79,102

### **3. Pricing and Distribution**

The current FOB price of LDPE resins is USD 1,539 per ton or Birr 27,902. . Accordingly, allowing 35% for freight, insurance, inland transport, transit charges, bank charges and other costs the recommended factory gate price is Birr 37,668 per ton.

The product of the envisaged factory is an intermediate product used in the manufacturing other products and the end users are limited in number and their geographical distribution is limited and are mostly located in or around major cities and towns of the country. Accordingly, by taking the nature of the product and the characteristics of the end users direct distribution to end users is selected as the most appropriate distribution channel.

## **B. PLANT CAPACITY AND PRODUCTION PROGRAM**

### **1. PLANT CAPACITY**

The minimum available capacity which is 40,000 tons per annum is proposed which is the minimum technically feasible capacity. Similar to the most chemical plants, the LDPE plant has to operate continuously, i.e. 24 hours per day (three shifts per day of 8 hrs). Annual working days of 250 have been assumed. The hourly production capacity of the reaction (which is the core process machine) is approximately 7 tons.

Annual overhaul period of two months is assumed in estimating the net-annual working days.

### **2. PRODUCTION PROGRAM**

The production will start with a capacity of 60% of the plant full capacity production, then increases to 70%, 85% in second and third years and reach 100% at the fourth year of its operation.

## **III. MATERIALS AND INPUTS**

### **A. MATERIALS**

The basic raw material used is ethylene gas as a monomer. It is estimated that to produce 1 ton of LDPE, it requires 1.025 ton of ethylene gas. Thus, annual requirement of ethylene gas at full capacity production will be 41,000 tonnes. The unit cost of ethylene is estimated at about Birr 23,483.00 per tonnes. The annual cost of ethylene will therefore be Birr 962,803,000.00.



The cost of auxiliary materials required (catalysts & chemicals) will be Birr 6,000,800. The cost of packing materials will be Birr 1,600,000. Therefore, the cost of raw and auxiliary material required is Birr 970,403,800.

## B. UTILITIES

The utilities required for the envisaged plant are electricity, cooling water, fuel, inert gas, and process water. The total annual cost of utility is Birr 103.96 million. The annual consumption of utilities and the cost breakdown is shown in the Table 4.1.

**Table 4.1**  
**ANNUAL CONSUMPTION OF UTILITIES & COST**

Utilities	UOM	Qty.	Unit Cost	Total Cost
Power	kWh	21,000,000	0.65	27,300,000
Fuel Oil	tons	45,000	1,560.00	70,200,000
Cooling Water	m <sup>3</sup>	1,350	10.00	13,500
Nitrogen Gas	Nm3	2,580,000	2.50	6,450,000
<b>Total</b>				<b>103,963,500</b>

## IV. TECHNOLOGY AND ENGINEERING

### A. TECHNOLOGY

#### 1. Production Process

The polymerization process proposed is the tubular process polymerization. Ethylene is compressed from up to 3,500 bars and combined with the oxygen or air as initiator, then passed to a serpentine jacketed nickel/chromium tube, jacketed with carbon steel. Conversion of 20-25 % per pass is obtained. Plug flow gives a narrow molecular weight distribution of the polymer.

The polymer is separated from the ethylene at 340 bar where 90 percent of the ethylene is removed. The molten LPDE is extruded and palletized.

The free radical initiator is introduced at different zones to optimize productivity and performance optimization. Heat from the reaction is evacuated by cooling the reaction wall. The reaction temperature profile is controlled by the amount and nature of the initiators.

## 2. Environmental Impact

The envisaged plant produces LDPE resin using ethylene gas derived from ethanol obtained from sugar plant through tubular process. The plastic produced is called bio-plastic as compared from PE plastic produced from ethylene that is obtained from fossil fuel.

Strict emission control will be followed to reduce the emission of hazardous gases like ethylene, VOC etc from the polymerization process in to the atmosphere. The chosen technology is integrated with emission control systems.

## B. ENGINEERING

### 1. Machinery and Equipment

The total estimated cost of machinery and equipment of the envisaged plant is Birr 942,935,714 million, of which Birr 754,348,571 million is required in foreign currency. The machinery and equipment required and the cost estimates are shown in table 5.1.

**Table 5.1**

### **MACHINERY AND EQUIPMENTS**

<b>Sr. No</b>	<b>Machinery/Equipment</b>	<b>Quantity</b>
1	Tubular Reactor	1
2	High pressure separation Column	1
3	Low pressure Separation Column	1
4	Vessel tanks	5
5	Heat exchangers	5
6	Booster	1
7	Primary compressor	1
8	Secondary compressor	1
9	Extruder	1
10	Degasifier	1

<b>Sr. No</b>	<b>Machinery/Equipment</b>	<b>Quantity</b>
11	Drier	1
12	Storage silo	5
14	Water supply system	set
15	Cooling water system	set
16	Demineralized water system	set
17	Compressed air system	set
18	Steam system	set
19	Nitrogen system	set
21	Laboratory unit	set
22	Waste water treatment system	set
23	Workshop and Garage	set
24	Packing machine	2

## **2. Land, Building and Civil Works**

The total area of land required for the envisaged plant is 15,000 square meters, out of which 10,000 is building area and the rest is free space. The building comprises production hall, power house, water treatment plant, store for raw materials and products, offices, etc. The total cost of civil works is estimated at Birr 50 million with an assumption of construction rate of Birr 5,000/m<sup>2</sup>.

According to the Federal Legislation on the Lease Holding of Urban Land (Proclamation No 721/2004) 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 below 5,000 m<sup>2</sup>, 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<sup>2</sup>, 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.

Moreover, the Addis Ababa City Administration has recently adopted a new land lease floor price for plots in the city. The new prices will be used as a benchmark for plots that are going to be auctioned by the city government or transferred under the new "Urban Lands Lease Holding Proclamation."

The new regulation classified the city into three zones. The first Zone is Central Market District Zone, which is classified in five levels and the floor land lease price ranges from Birr 1,686 to Birr 894 per m<sup>2</sup>. The rate for Central Market District Zone will be applicable in most areas of the city that are considered to be main business areas that entertain high level of business activities.

The second zone, Transitional Zone, will also have five levels and the floor land lease price ranges from Birr 1,035 to Birr 555 per m<sup>2</sup>. This zone includes places that are surrounding the city and are occupied by mainly residential units and industries.

The last and the third zone, Expansion Zone, is classified into four levels and covers areas that are considered to be in the outskirts of the city, where the city is expected to expand in the future. The floor land lease price in the Expansion Zone ranges from Birr 355 to Birr 191 per m<sup>2</sup> (see Table 5.2).

**Table 5.2**

**NEW LAND LEASE FLOOR PRICE FOR PLOTS IN ADDIS ABABA**

<b>Zone</b>	<b>Level</b>	<b>Floor</b>
Central Market District	1 <sup>st</sup>	1686
	2 <sup>nd</sup>	1535
	3 <sup>rd</sup>	1323
	4 <sup>th</sup>	1085
	5 <sup>th</sup>	894
Transitional zone	1 <sup>st</sup>	1035
	2 <sup>nd</sup>	935
	3 <sup>rd</sup>	809
	4 <sup>th</sup>	685
	5 <sup>th</sup>	555
Expansion zone	1 <sup>st</sup>	355
	2 <sup>nd</sup>	299
	3 <sup>rd</sup>	217
	4 <sup>th</sup>	191

Accordingly, in order to estimate the land lease cost of the project profiles it is assumed that all new manufacturing projects will be located in industrial zones located in expansion zones. Therefore, for the profile a land lease rate of Birr 266 per m<sup>2</sup> which is equivalent to the average floor price of plots located in expansion zone 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 criteria are creation of job opportunity, foreign exchange saving, investment capital and land utilization tendency etc. Accordingly, Table 5.3 shows incentives for lease payment.

**Table 5.3****INCENTIVES FOR LEASE PAYMENT OF INDUSTRIAL PROJECTS**

<b>Scored Point</b>	<b>Grace Period</b>	<b>Payment Completion Period</b>	<b>Down Payment</b>
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 land lease period for industry is 60 years.

Accordingly, the total land lease cost at a rate of Birr 266 per m<sup>2</sup> is estimated at Birr 3,990,000 of which 10% or Birr 399,000 will be paid in advance. The remaining Birr 3,591,000 will be paid in equal installments with in 28 years i.e. Birr 128,250 annually.

## **VI. HUMAN RESOURCE AND TRAINING REQUIREMENT**

### **A. HUMAN RESOURCE REQUIREMENT**

The total human resource requirement of the plant is estimated at 78 persons. Details of human resource requirement and the estimated annual labor cost including the fringe benefits are shown in Table 6.1.

### **B. TRAINING REQUIREMENT**

Being a new technology to the country, foreign training is required for key technical personnel.

A minimum of three months' training is required for four technical personnel. The training cost is estimated at about Birr 600,000

**Table 6.1****HUMAN RESOURCE REQUIREMENT AND ESTIMATED COST**

<b>Sr. No.</b>	<b>Position Held</b>	<b>No. of Persons</b>	<b>Monthly Salary</b>	<b>Monthly Total Salary</b>	<b>Annual Salary</b>
1	G. Manager	1	10,000.00	10,000.00	120,000.00
2	Production Manager	1	8,000.00	8,000.00	96,000.00
3	Supervisors	4	5,000.00	20,000.00	240,000.00
4	Operators	20	3,000.00	60,000.00	720,000.00
5	Assistants	20	12,500.00	250,000.00	3,000,000.00
6	Laborers	8	1,500.00	12,000.00	144,000.00
7	Mechanics	4	2,500.00	10,000.00	120,000.00
8	Electricians	3	2,500.00	7,500.00	90,000.00
9	Chemists	5	3,000.00	15,000.00	180,000.00
10	Secretary	1	3,000	3,000.00	36,000.00
11	Accountant	1	4,000	4,000.00	48,000.00
12	Clerk	2	2,500	5,000.00	60,000.00
13	Cashier	1	2,000	2,000.00	24,000.00
14	Salesman	1	3,000	3,000.00	36,000.00
15	General Services	2	2,500	5,000.00	60,000.00
16	Guards	4	1,000	4,000.00	48,000.00
	<b>Total Cost</b>	<b>78</b>		<b>418,500.00</b>	<b>5,022,000.00</b>

**VII. FINANCIAL ANALYSIS**

The financial analysis of the LDPE 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	10%
Discount cash flow	10%
Accounts receivable	30 days
Raw material local	30 days
Raw material imported	120 days
Work in progress	1 day
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 1.31 billion (see Table 7.1). From the total investment cost, the highest share (Birr 995.28 million or 75.99%) is accounted by fixed investment cost followed by initial working capital (Birr 199.73 million or 15.25%) and pre operation cost (Birr 114.77 million or 8.76%). From the total investment cost Birr 754.34 million or 57.59% is required in foreign currency.

**Table 7.1**

### **INITIAL INVESTMENT COST ( '000 Birr)**

Sr.No	Cost Items	Local Cost	Foreign Cost	Total Cost	% Share
<b>1</b>	<b>Fixed investment</b>				
1.1	Land Lease	399.00		399.00	0.03
1.2	Building and civil work	50,000.00		50,000.00	3.82
1.3	Machinery and equipment	188,587.14	754,348.57	942,935.71	71.99
1.4	Vehicles	1,500.00		1,500.00	0.11
1.5	Office furniture and equipment	450.00		450.00	0.03
	<b>Sub total</b>	<b>240,936.14</b>	<b>754,348.57</b>	<b>995,284.71</b>	<b>75.99</b>
<b>2</b>	<b>Pre operating cost *</b>				
2.1	Pre operating cost	29,088.07		29,088.07	2.22
2.2	Interest during construction	85,687.03		85,687.03	6.54
	<b>Sub total</b>	<b>114,775.10</b>		<b>114,775.10</b>	<b>8.76</b>
<b>3</b>	<b>Working capital **</b>	<b>199,727.61</b>		<b>199,727.61</b>	<b>15.25</b>
	<b>Grand Total</b>	<b>555,438.85</b>	<b>754,348.57</b>	<b>1,309,787.42</b>	<b>100</b>

\* *N.B Pre operating cost include project implementation cost such as installation, startup, commissioning, project engineering, project management etc and capitalized interest during construction.*

\*\* *The total working capital required at full capacity operation is Birr 333.57 million. However, only the initial working capital of Birr 199.72 million during the first year of production is assumed to be funded through external sources. During the remaining years the working capital requirement will be financed by funds to be generated internally (for detail working capital requirement see Appendix 7.A.1).*



## B. PRODUCTION COST

The annual production cost at full operation capacity is estimated at Birr 1.37 billion (see Table 7.2). The cost of raw material account for 70.37% of the production cost. The other major components of the production cost are depreciation, utilities and financial cost, which account for 14.27%, 7.54% and 5.22%, respectively. The remaining 2.60 % is the share of utility, repair and maintenance, labor overhead and administration cost. For detail production cost see Appendix 7.A.2.

**Table 7.2**

**ANNUAL PRODUCTION COST AT FULL CAPACITY (YEAR THREE)**

<b>Items</b>	<b>Cost</b>	<b>%</b>
Raw Material and Inputs	776,323.04	66.49
Utilities	83,170.80	7.12
Maintenance and repair	22,630.46	1.94
Labour direct	4,017.60	0.34
Labour overheads	803.52	0.07
Administration Costs	400.00	0.03
Land lease cost	-	-
Cost of marketing and distribution	1,000.00	0.09
<b>Total Operating Costs</b>	<b>888,345.42</b>	<b>76.09</b>
Depreciation	196,749.76	16.85
Cost of Finance	82,473.76	7.06
<b>Total Production Cost</b>	<b>1,167,568.94</b>	<b>100</b>

## C. FINANCIAL EVALUATION

### 1. Profitability

Based on the projected profit and loss statement, the project will generate a profit throughout its operation life. Annual net profit after tax will grow from Birr 243.066 million to Birr 276.055 million during the life of the project. Moreover, at the end of the project life the accumulated net cash flow amounts to Birr 2.14 billion. For profit and loss statement and cash flow projection see Appendix 7.A.3 and 7.A.4, respectively.

### 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 for capacity utilization and sales value estimated by using income statement projection are computed as followed.

$$\text{Break -Even Sales Value} = \frac{\text{Fixed Cost} + \text{Financial Cost}}{\text{Variable Margin ratio (\%)}} = \text{Birr } 632,822,400$$

$$\text{Break -Even Capacity utilization} = \frac{\text{Break -even Sales Value}}{\text{Sales revenue}} \times 100 = 49.74\%$$

### 4. Pay-back Period

The pay-back period, also called pay – off period is defined as the period required for recovering 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 5 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 project is computed to be 22.38% indicating the viability 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 principle, a project is accepted if the NPV is non-negative. Accordingly, the net present value of the project at 10% discount rate is found to be Birr 833.15 million which is acceptable. For detail discounted cash flow see Appendix 7.A.5.

## **D. ECONOMIC AND SOCIAL BENEFITS**

The project can create employment for 78 persons. The project will generate Birr 556.20 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 also create forward linkage with the plastic products manufacturing sub sector and also generates income for the Government in terms of payroll tax.

**Appendix 7.A**  
**FINANCIAL ANALYSES SUPPORTING TABLES**



**Appendix 7.A.2**  
**PRODUCTION COST ( in 000 Birr)**

<b>Item</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Year 6</b>	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>	<b>Year 11</b>
Raw Material and Inputs	582,242	679,283	776,323	970,404	970,404	970,404	970,404	970,404	970,404	970,404
Utilities	62,378	72,774	83,171	103,964	103,964	103,964	103,964	103,964	103,964	103,964
Maintenance and repair	16,973	19,802	22,630	28,288	28,288	28,288	28,288	28,288	28,288	28,288
Labour direct	3,013	3,515	4,018	5,022	5,022	5,022	5,022	5,022	5,022	5,022
Labour overheads	603	703	804	1,004	1,004	1,004	1,004	1,004	1,004	1,004
Administration Costs	300	350	400	500	500	500	500	500	500	500
Land lease cost	0	0	0	0	128	128	128	128	128	128
Cost of marketing and distribution	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
<b>Total Operating Costs</b>	<b>666,509</b>	<b>777,427</b>	<b>888,345</b>	<b>1,110,182</b>	<b>1,110,310</b>	<b>1,110,310</b>	<b>1,110,310</b>	<b>1,110,310</b>	<b>1,110,310</b>	<b>1,110,310</b>
Depreciation	196,750	196,750	196,750	196,750	196,750	2,045	2,045	2,045	2,045	2,045
Cost of Finance	0	94,256	82,474	70,692	58,910	47,128	35,346	23,564	11,782	0
<b>Total Production Cost</b>	<b>863,259</b>	<b>1,068,433</b>	<b>1,167,569</b>	<b>1,377,623</b>	<b>1,365,970</b>	<b>1,159,483</b>	<b>1,147,701</b>	<b>1,135,919</b>	<b>1,124,137</b>	<b>1,112,355</b>

**Appendix 7.A.3**  
**INCOME STATEMENT ( in 000 Birr)**

Item	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Sales revenue	904,032	1,130,040	1,280,712	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720
Less variable costs	665,509	776,427	887,345	1,109,182	1,109,182	1,109,182	1,109,182	1,109,182	1,109,182	1,109,182
<b>VARIABLE MARGIN</b>	<b>238,523</b>	<b>353,613</b>	<b>393,367</b>	<b>397,538</b>	<b>397,538</b>	<b>397,538</b>	<b>397,538</b>	<b>397,538</b>	<b>397,538</b>	<b>397,538</b>
in % of sales revenue	26.38	31.29	30.71	26.38	26.38	26.38	26.38	26.38	26.38	26.38
Less fixed costs	197,750	197,750	197,750	197,750	197,878	3,173	3,173	3,173	3,173	3,173
<b>OPERATIONAL MARGIN</b>	<b>40,773</b>	<b>155,863</b>	<b>195,617</b>	<b>199,788</b>	<b>199,660</b>	<b>394,365</b>	<b>394,365</b>	<b>394,365</b>	<b>394,365</b>	<b>394,365</b>
in % of sales revenue	4.51	13.79	15.27	13.26	13.25	26.17	26.17	26.17	26.17	26.17
Financial costs		94,256	82,474	70,692	58,910	47,128	35,346	23,564	11,782	0
<b>GROSS PROFIT</b>	<b>40,773</b>	<b>61,607</b>	<b>113,143</b>	<b>129,097</b>	<b>140,750</b>	<b>347,237</b>	<b>359,019</b>	<b>370,801</b>	<b>382,583</b>	<b>394,365</b>
in % of sales revenue	4.51	5.45	8.83	8.57	9.34	23.05	23.83	24.61	25.39	26.17
Income (corporate) tax	0	0	0	0	0	104,171	107,706	111,240	114,775	118,309
<b>NET PROFIT</b>	<b>40,773</b>	<b>61,607</b>	<b>113,143</b>	<b>129,097</b>	<b>140,750</b>	<b>243,066</b>	<b>251,313</b>	<b>259,561</b>	<b>267,808</b>	<b>276,055</b>
in % of sales revenue	4.51	5.45	8.83	8.57	9.34	16.13	16.68	17.23	17.77	18.32

**Appendix 7.A.4**  
**CASH FLOW FOR FINANCIAL MANAGEMENT ( in 000 Birr)**

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Scrap
<b>TOTAL CASH INFLOW</b>	<b>1,024,373</b>	<b>1,191,112</b>	<b>1,130,318</b>	<b>1,280,990</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>448,922</b>
Inflow funds	1,024,373	287,080	278	278	0	0	0	0	0	0	0	0
Inflow operation	0	904,032	1,130,040	1,280,712	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	0
Other income	0	0	0	0	0	0	0	0	0	0	0	448,922
<b>TOTAL CASH OUTFLOW</b>	<b>1,024,373</b>	<b>953,589</b>	<b>1,023,054</b>	<b>1,122,190</b>	<b>1,365,796</b>	<b>1,287,052</b>	<b>1,379,429</b>	<b>1,371,181</b>	<b>1,362,934</b>	<b>1,354,687</b>	<b>1,228,620</b>	<b>0</b>
Increase in fixed assets	1,024,373	0	0	0	0	0	0	0	0	0	0	0
Increase in current assets	0	201,393	33,552	33,552	67,103	12	0	0	0	0	0	0
Operating costs	0	665,509	776,427	887,345	1,109,182	1,109,310	1,109,310	1,109,310	1,109,310	1,109,310	1,109,310	0
Marketing and Distribution cost	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0
Income tax	0	0	0	0	0	0	104,171	107,706	111,240	114,775	118,309	0
Financial costs	0	85,687	94,256	82,474	70,692	58,910	47,128	35,346	23,564	11,782	0	0
Loan repayment	0	0	117,820	117,820	117,820	117,820	117,820	117,820	117,820	117,820	0	0
<b>SURPLUS (DEFICIT)</b>	<b>0</b>	<b>237,523</b>	<b>107,263</b>	<b>158,799</b>	<b>140,924</b>	<b>219,668</b>	<b>127,291</b>	<b>135,539</b>	<b>143,786</b>	<b>152,033</b>	<b>278,100</b>	<b>448,922</b>
<b>CUMULATIVE CASH BALANCE</b>	<b>0</b>	<b>237,523</b>	<b>344,786</b>	<b>503,585</b>	<b>644,509</b>	<b>864,177</b>	<b>991,468</b>	<b>1,127,007</b>	<b>1,270,793</b>	<b>1,422,826</b>	<b>1,700,927</b>	<b>2,149,849</b>



**Appendix 7.A.5**  
**DISCOUNTED CASH FLOW ( in 000 Birr)**

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Scrap
<b>TOTAL CASH INFLOW</b>	<b>0</b>	<b>904,032</b>	<b>1,130,040</b>	<b>1,280,712</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>1,506,720</b>	<b>448,922</b>
Inflow operation	0	904,032	1,130,040	1,280,712	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	1,506,720	0
Other income	0	0	0	0	0	0	0	0	0	0	0	448,922
<b>TOTAL CASH OUTFLOW</b>	<b>1,224,100</b>	<b>699,783</b>	<b>810,701</b>	<b>954,894</b>	<b>1,110,194</b>	<b>1,110,310</b>	<b>1,214,481</b>	<b>1,218,016</b>	<b>1,221,550</b>	<b>1,225,085</b>	<b>1,228,620</b>	<b>0</b>
Increase in fixed assets	1,024,373	0	0	0	0	0	0	0	0	0	0	0
Increase in net working capital	199,728	33,274	33,274	66,548	12	0	0	0	0	0	0	0
Operating costs	0	665,509	776,427	887,345	1,109,182	1,109,310	1,109,310	1,109,310	1,109,310	1,109,310	1,109,310	0
Marketing and Distribution cost	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0
Income (corporate) tax		0	0	0	0	0	104,171	107,706	111,240	114,775	118,309	0
<b>NET CASH FLOW</b>	<b>-1,224,100</b>	<b>204,249</b>	<b>319,339</b>	<b>325,818</b>	<b>396,526</b>	<b>396,410</b>	<b>292,239</b>	<b>288,704</b>	<b>285,170</b>	<b>281,635</b>	<b>278,100</b>	<b>448,922</b>
<b>CUMULATIVE NET CASH FLOW</b>	<b>-1,224,100</b>	<b>-1,019,851</b>	<b>-700,513</b>	<b>-374,694</b>	<b>21,831</b>	<b>418,241</b>	<b>710,480</b>	<b>999,185</b>	<b>1,284,354</b>	<b>1,565,989</b>	<b>1,844,090</b>	<b>2,293,012</b>
Net present value	-1,224,100	185,681	263,916	244,792	270,832	246,139	164,961	148,151	133,034	119,441	107,220	173,079
Cumulative net present value	-1,224,100	-1,038,420	-774,503	-529,711	-258,879	-12,740	152,222	300,373	433,406	552,847	660,067	833,146

NET PRESENT  
VALUE 833,146  
INTERNAL RATE OF  
RETURN 22.38%  
NORMAL PAYBACK 5 years